Offshore finance and corporate tax avoidance

García-Bernardo, J.

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Corporate tax avoidance deprives governments of tax revenues, privileges large MNCs over small and medium-sized enterprises, and contributes to rising inequality. This dissertation employs an antidisciplinary approach to open the black box of corporate tax avoidance. Using novel datasets and algorithms, it uncovers the emergence of coordination centers—developed jurisdictions that play a key and increasingly important role in the orchestration of global value chains and corporate tax avoidance. Amongst these, six jurisdictions stand out: the Netherlands, Switzerland, Luxembourg, Ireland, the United Kingdom and Singapore. By uncovering the rise of coordination centers, I expose new potential avenues for regulation.
OFFSHORE FINANCE AND CORPORATE TAX AVOIDANCE

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Promotor: Dr. Eelke M. Heemskerk Universiteit van Amsterdam
Copromotor: Prof. dr. Brian M. Burgoon Universiteit van Amsterdam
Overige leden: Prof. dr. Brooke Harrington Dartmouth College
               Prof. dr. Daniel K. Mügge Universiteit van Amsterdam
               Dr. Ursula Daxecker Universiteit van Amsterdam
               Prof. dr. Ewald R. Engelen Universiteit van Amsterdam
               Prof. dr. Cees G. H. Diks Universiteit van Amsterdam

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Corporate tax avoidance by multinational corporations (MNCs) is not too different from alchemy. The latter claims to transmute base metals into gold. The former aims to transform operating profits made in one country—e.g. by selling coffee—into (financial) profits in an offshore financial center—such as royalties received for the right to use the image of a mermaid on a coffee cup. These financial profits are then taxed at an extremely low rate. The alchemists of today are tax professionals, who advise governments on the creation of tax legislation, and at the same time advise MNCs on how to organize their structure and operations to take advantage of such legislation. And they are highly successful. Nowadays 40% of all foreign profits of MNCs ($600–$1,000 billion) follow this transmutation and are shifted towards offshore financial centers.

The strategy to shift profits towards offshore financial centers is relatively simple. A slightly simplified explanation follows, omitting the technical details—that in turn constrain small corporations in their ability to use these strategies. Imagine that a chain of coffeehouses named GreenMermaid Corporation sets up a subsidiary in an offshore financial center and transfers to it the trademark “GreenMermaid”. Subsidiaries of GreenMermaid in other countries acquire the licence to use the trademark and, similarly to what would happen if they would receive that licence from a different corporation, need to pay a royalty—e.g. 8% of total sales—to the subsidiary in the offshore financial center. This reduces the operating profits in the first country (and with them the taxes due) and increases the financial profits in the offshore financial center, where they will be taxed at a low rate. For example, the average tax rate in one of the largest offshore financial centers, Luxembourg, is below 1% for US MNCs. Moreover, the specific royalty fee (8% of total sales in our example) is often agreed in secret between GreenMermaid and the offshore financial center. A higher royalty fee allows the corporation to transfer more profits towards the offshore financial center. Similar profit shifting strategies revolve providing loans, management or technical services, or goods with a markup.
Corporate tax avoidance deprives governments of tax revenues, privileges large MNCs over small and medium-sized enterprises, and contributes to the increase in within-country inequality experienced in recent decades. While the relevance of tax avoidance has been recognized since the late 20th century, quantitative research on tax avoidance has been hampered by a lack of data. This dissertation employs an antidisciplinary approach to open the black box of corporate tax avoidance, combining theories and methods from political science, economics, international business and management, and computer science. This antidisciplinary approach uncovers the emergence and relevance of “coordination centers”—jurisdictions from where both tax avoidance and global value chain are organized.

This dissertation analyzes which jurisdictions can be considered offshore financial centers and the extent to which they contribute to corporate tax avoidance. Identifying offshore financial centers is key to understanding the dynamics of and policy responses to tax avoidance. However, this has become a politicized and contested issue. This dissertation systematically analyzes this issue from four different perspectives and reveals a clear pattern of specialization. There are two main types of offshore financial centers. The first, the profit center, resembles the conventional idea of the tax haven—a small island state with no taxation and high secrecy that attracts large amounts of profit. Profit centers play a role in the organization of MNCs through intermediary and top holding companies. The profit per employee in these jurisdictions is usually above $500,000/employee, which reflects the lack of real activity in these jurisdictions. Among these, Bermuda, the British Virgin Islands, and the Cayman Islands are the largest profit centers.

The second type of offshore financial center, the coordination center, is a jurisdiction that provides the regulatory underpinning necessary for corporate tax avoidance. They serve as the point of access to large markets, have a highly skilled workforce and good infrastructure, a stable political climate, and tax features specifically created to attract intermediary holding companies. They are important not only for profit shifting through holding companies, but also for regional management, financing operations, and high value-adding activities such as procurement, marketing, sales and distribution. The main such examples are the Netherlands, Switzerland, Luxembourg, Ireland, the United Kingdom, and Singapore. I find that coordination centers play an
increasingly large role in relation to corporate tax avoidance in two ways. Firstly, I show that these are the places where tax professionals (and with them the orchestration of tax avoidance) are situated. Secondly, I show that an increasing amount of profits are shifted to these jurisdictions. In the last decade, 14.2% of all profits from US MNCs have been shifted to four coordination centers: the Netherlands, Switzerland, Ireland and Luxembourg. This is because they offer very low tax rates on financial profits—e.g. those arising from trademarks, intellectual property, or loans. MNCs in these jurisdictions pay a similar effective tax rate to the one in Bermuda.

The principles of international tax set up in the 1930s created opportunities for corporate tax avoidance which were realized through the expansion of offshore finance and the financialization of MNCs. This process has contributed to rising inequality in the power relationships between and within firms and states. Within firms, large MNCs have been gaining power vis-à-vis small and medium enterprises, since profit shifting through the transformation of operating profits into financial profits is only available to large companies. Moreover, governments have increasingly been offering tax incentives to large firms. Within states, the emergence of coordination centers has reduced the tax sovereignty of all other countries. While countries could prevent profit shifting to profit centers via withholding taxes, countries have failed to prevent profit shifting to coordination centers. Partially because of this increased ability of MNCs to escape taxation, and fostered by discourses around “national competitiveness,” governments around the world have been urged to reduce corporate income tax.

This dissertation provides new insights into the debates around wealth inequality, specifically by showing how the wealth-equalizing institutions have been eroded by the actions of offshore financial centers—directly through tax avoidance, and indirectly through tax competition. It also provides avenues for regulation. Instead of shaming small-island jurisdictions into compliance, a radical transformation of the international tax system, limiting the potential harmful effects of coordination centers, should be the focus for policy efforts towards stopping corporate tax avoidance.
SAMENVATTING

Belastingontwikkeling door Multinationale ondernemingen (MNO’s) verschilt niet heel veel van alchemie. Waar alchemie beweert onedele metalen in goud om te zetten, proberen belastingontwijkers bedrijfswinsten gemaakt in het ene land – door bijv. koffie te verkopen – om te zetten in (financiële) winst op een offshore financial center (OFC) – bijvoorbeeld als royalty’s die verdiend zouden zijn met het gebruik van een beeld van een zeemeermin op een koffiekop. Deze financiële winsten worden dan tegen een extreem laag tarief belast. De alchemisten van tegenwoordig zijn de belastingprofessionals die regeringen adviseren bij de totstandkoming van de belastingwetgeving, en tegelijkertijd MNO’s adviseren over hoe ze hun structuur en activiteiten moeten organiseren om van een dergelijke wetgeving te kunnen profiteren. En met succes: tegenwoordig volgt 40% van alle buitenlandse winsten van MNO’s (600–1.000 miljard dollar) deze transmutatie door de winsten naar OFCs te verschuiven.

De strategie waarmee winst naar OFCs wordt verschoven, is relatief eenvoudig. Er volgt een enigszins vereenvoudigde uitleg, zonder technische details – die op hun beurt voorkomen dat ook kleine bedrijven deze strategieën te kunnen gebruiken. Stel een keten van koffiehuizen genaamd de GreenMermaid Corporation, zet een dochteronderneming in een OFC op en draagt het handelsmerk ‘GreenMermaid’ over. De dochterondernemingen van GreenMermaid in andere landen verwerven de licentie om het handelsmerk te mogen gebruiken en moeten, op dezelfde manier als ze die licentie van een ander bedrijf zouden krijgen, een royalty als vergoeding voor die rechten betalen – bijv. 8% van de opbrengst – aan de dochteronderneming in het OFC. Dit vermindert de bedrijfswinst in het eerste land en verhoogt de financiële winst in het OFC waar deze winst tegen een lager tarief belast wordt. Het gemiddelde belastingtarief dat MNO’s uit de verenigde staten betalen in Luxemburg, één van de grootste OFCs, ligt bijvoorbeeld lager dan 1%. Bovendien worden afspraken over de hoogte van de royalty (bijvoorbeeld 8% van de totale opbrengst) vaak in het geheim gemaakt tussen GreenMermaid en het OFC. Een hogere royalty maakt het mogelijk om een groter deel naar het OFC over te brengen. Soortgelijke
winstverschuivingsstrategieën bestaan door te voorzien in leningen, technische
dienstverlening of goederen met een bepaalde opmaak.

Door belastingontwikkeling lopen regeringen belastinginkomsten mis, worden
grote multinations bevoordeeld ten opzichte van het midden- en kleinbedrijf
en vergroot het binnenlandse ongelijkheid zoals de afgelopen decennia te zien
was. Hoewel de relevantie van belastingontwikkeling sinds het einde van de 20e
eeuw wordt erkend, werd kwantitatief onderzoek naar belastingontwikkeling vaak
belemmerd door een gebrek aan gegevens. Dit proefschrift gebruikt een anti-
disciplinaire aanpak om de black box van de belastingontwikkeling van bedrijven
te openen, door theorieën en methoden uit de politieke wetenschappen, de
economie, het internationale bedrijfsleven en management en informatica
te combineren. Deze anti-disciplinaire benadering onthult de opkomst en
de relevantie van ‘coördinatiecentra’ – rechtsgebieden van waaruit zowel de
belastingontwikkeling als de mondiale waardeketen worden georganiseerd.

In dit proefschrift wordt geanalyseerd welke jurisdicties als OFCs kunnen
worden beschouwd en in hoeverre zij bijdragen aan belastingontwikkeling. Het
identificeren van OFCs is essentieel om de dynamiek van en de beleidsreacties
op de belastingontwikkeling te begrijpen. Echter, belastingontwikkeling is een
sterk gepolitiseerde en omstreden kwestie geworden. In dit proefschrift
wordt het onderwerp systematisch geanalyseerd vanuit vier verschillende
perspectieven en het laat een duidelijk patroon van specialisatie zien. Er zijn
twee hoofdtype OFCs. De eerste, het winstcentrum, lijkt op het conventionele
idee van het belastingparadijs – een kleine eilandstaat zonder belastingen
met hoge geheimhouding die grote winsten aantrekt. Winstcentra spelen via
intermediairbedrijven en aan de top staande holdings een rol bij de organisatie
van MNO’s. De winst per werknemer in deze rechtsgebieden is gewoonlijk
hoger dan $500.000 per werknemer, wat het gebrek aan echte activiteit in
deze rechtsgebieden weerspiegelt. In deze groep zijn Bermuda, de Britse
Maagdeneilanden en de Kaaimaneilanden de grootste winstcentra.

Het tweede type OFC, het coördinatiecentrum, is een rechtsgebied dat de
wettelijke onderbouwing biedt, die nodig is voor belastingontwikkeling. Ze dienen
als toegangspunt tot de grotere markten, beschikken over hooggekwalificeerd
personeel, een goede infrastructuur, een stabiel politiek klimaat en belasting-
ingenmerken die speciaal zijn gecreëerd om intermediaire holdings aan te
trekken. Ze zijn niet alleen belangrijk voor de winstverschuivingen via de holdings, maar ook voor het regionaal beheer, de financieringsactiviteiten en de activiteiten met een hoge toegevoegde waarde zoals de inkoop, de marketing, de verkoop en de distributie. De belangrijkste voorbeelden hiervan zijn Nederland, Zwitserland, Luxemburg, Ierland, het Verenigd Koninkrijk en Singapore. Ik toon aan dat coördinatiecentra op twee manieren een steeds grotere rol spelen bij het vermijden van vennootschapsbelasting. Ten eerste zal ik laten zien dat dit de plaatsen zijn waar de belastingprofessionals (en daarmee dus ook de orkestratie voor de belastingontwikkeling) zich bevinden. Ten tweede laat ik zien dat steeds meer winsten naar deze jurisdicties worden verschoven. In het afgelopen decennium is 14,2% van alle winst van de Amerikaanse MNO’s naar vier coördinatiecentra verschoven: Nederland, Zwitserland, Ierland en Luxemburg. Dit komt omdat ze zeer lage of minimale belastingtarieven bieden op financiële winst die bijvoorbeeld voortvloeit uit handelsmerken, intellectuele eigendom of leningen. MNO’s in deze rechtsgebieden betalen een vergelijkbaar effectief belastingtarief als dat in Bermuda.

De principes van de internationale belasting, die in de jaren dertig van de vorige eeuw zijn ingevoerd, creëerden mogelijkheden voor het vermijden van vennootschapsbelasting die werden gerealiseerd door de uitbreiding van offshore financiering en de financialisering van MNO’s. Dit proces heeft bijgedragen aan toegenomen ongelijkheid in de machtsverhoudingen tussen en binnen de bedrijven en de staten. Tussen bedrijven onderling winnen grote Multinationals aan macht ten opzichte van het midden- en kleinbedrijf, aangezien de winstverschuivingen door de omzetting van bedrijfswinsten naar financiële winsten alleen beschikbaar is voor de grote bedrijven. Bovendien bieden overheden steeds vaker grote bedrijven belastingvoordelen aan. Tussen staten onderling heeft de opkomst van coördinatiecentra de fiscale soevereiniteit van alle andere landen verminderd. Terwijl landen via bronbelasting winstverschuiving naar winstcentra konden voorkomen, hebben ze de winstverschuiving naar coördinatiecentra niet kunnen voorkomen. Mede dankzij de toegenomen mogelijkheden van multinationals om belasting te ontkomen en gestimuleerd door vertogen over ‘nationaal concurrentievermo- gen’, wordt er bij de regeringen over de hele wereld op aangedrongen om de vennootschapsbelasting te verlagen. Dit proefschrift biedt nieuwe inzichten in de debatten rondom de vermogensongelijkheid en dan met name door te laten zien hoe het vermogen van nivellerende instituties is uitgehold door de
acties van de OFCs – direct door de belastingontwijking en indirect door de belasting concurrentie. Maar het biedt ook mogelijkheden voor regulering. In plaats van de jurisdicties van de kleine eilanden met beschijmen tot naleving te dwingen, moet een radicale transformatie van het internationale belastingstelsel, die de mogelijke schadelijke effecten van de coördinatiecentra beperkt, de focus voor beleidsinspanningen zijn om de belastingontwijking door bedrijven te stoppen.
I have been lucky to meet and be supported by extraordinary human beings during my PhD. Writing the acknowledgment section may even be the hardest part of it (if you are reading this and are a member of my committee, please do not take this as a challenge when coming up with questions for the defense).

I would first like to thank my supervisor, Eelke Heemskerk, who was pivotal in my development as a social scientist. I appreciate that he has always supported, nurtured and shared my desire to maintain an antidisciplinary approach, giving me the freedom to develop as an independent researcher while supporting me every step of the way. Thank you for finding an incredible group of people that is the CORPNET family, for inspiring me with your passion to understand corporate power and bluetooth, and for encouraging me to sail further into offshore finance. Eelke’s support would have not been possible without the funding from the European Research Council (ERC). Spoiler alert, the scale of tax avoidance in the EU corresponds to roughly 100 times the budget of the ERC (or the cost of hiring four million researchers). I would also like to thank my co-supervisor Brian Burgoon, because I don’t know anybody who gives more constructive feedback. I am also grateful to all the professors that have marked my career, especially Mary Dunlop, Carmen Marín, Maggie Eppstein and Peter Dodds.

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Lastly, I appreciate the Netherlands becoming an offshore financial center so I can write this thesis. You can stop now.
LIST OF PUBLICATIONS

Chapter 2

Chapter 3

Chapter 4
Garcia-Bernardo J. and Stausholm S.N. (Forthcoming) “Geography of tax professionals on LinkedIn: Coordination centers are the nexus between onshore production and offshore finance”.

Chapter 5

Chapter 6

Chapter 7

Chapter 8
CHAPTER 1

Introduction

Multinational corporations (MNCs) are a key actor in contemporary capitalism. Since the 1960s, increases in capital mobility and technological development have allowed for the meteoric growth of MNCs. Today, MNCs are responsible for 33% of global output, 49% of world exports, and 23% of global employment (Casestin et al., 2018). MNCs use highly complex corporate structures of parents and subsidiaries to organize their global operations and ownership structure (Fig. 1.1). For example, the British-based banking and financial services company HSBC is composed of at least 1632 legal corporate entities in 65 countries. The largest brewing company in the world, Anheuser-Busch InBev, consists of at least 907 corporate entities involving 73 countries. These complex corporate structures purposefully span countries and jurisdictions in order to increase competitive advantage by minimizing costs and accountability (Seabrooke & Wigan, 2017).

Figure 1.1. Geographical distribution of a large food and drink processing corporation. Nodes represent subsidiaries. Arrows represent ownership relations. The size of the node is proportional to the revenue reported by the subsidiary. The data was collected from Orbis in September 2018.
Chapter 1. Introduction

One of the ways to reduce costs for MNCs is by placing important assets (e.g. intellectual property or interest-bearing loans) or distributor intermediaries in offshore financial centers (OFCs), and charging subsidiaries in high-tax jurisdictions for their use. This allows corporations to avoid taxation by reducing the profits in the high-tax jurisdiction and increasing the profits in OFCs.

Nowadays, MNCs shift 40% ($600 billion–$1.1 trillion) of their foreign profits to OFCs such as the Netherlands, Switzerland or Bermuda (OECD, 2015; Clausing, 2016; Tørslov, Wier, & Zucman, 2018; Janský & Palanský, 2019; Cobham & Janský, 2018).

Corporate tax avoidance is problematic because it affects the efficiency and equity of financial markets and societies (Slemrod & Yitzhaki, 2002). With regards to economic efficiency, large MNCs are the only firms with the resources necessary to create and maintain the financial structures required to avoid taxation. This distorts the market by giving large MNCs a de facto tax subsidy that domestic firms and small MNCs cannot receive. The OFCs involved in tax avoidance also affect economic efficiency by hiding potential market risks (Rixen, 2013). As an example, the financial products that contributed to the crisis in 2007 were mainly located in offshore financial centers (Wójcik, 2013; Haberly & Wójcik, 2015). Furthermore, the confidentiality that some OFCs provide to MNCs are also used by organized crime to carry out illegal activities such as money laundering and financing terrorism (McCann, 2006; Asatryan et al., 2017).

With regards to economic equity, the ability of large MNCs to reduce their tax bill eliminates the moral principle that all firms should be treated equally (also known as horizontal equity) as well as the progressivity of the tax system (also

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1The goal of both tax evasion and avoidance is tax minimization. The difference is that tax evasion uses illegal methods (e.g. not declaring income) and tax avoidance uses legal methods (e.g. relocating to Ireland). The distinction is, however, not clear for the sophisticated mechanisms used by some MNCs.

2Zorome (2007, p. 7) defines OFCs as jurisdictions that “provide financial services to nonresidents on a scale that is incommensurate with the size and the financing of their domestic economies.” While early offshore financial centers were mainly small (offshore) islands, offshore denotes a regulatory space outside the home jurisdiction of the individual or corporation, and as such can be located anywhere (Palan, 1998). Tax havens are jurisdictions that typically have no income tax, no withholding taxes, no capital gain taxes and no taxes on inheritances/gifts. Since tax is the major factor affecting financial transactions in OFCs (Hampton, 1996), all OFCs can be considered tax havens, but not all tax havens are able to attract large influxes of foreign capital. In this sense, the term “tax haven” refers to a feature of the jurisdiction (low taxation) that may lead to the attraction of foreign capital, while the term OFC refers to an outcome of the jurisdiction (the successful attraction of foreign capital). Through this thesis and chapter, the term “offshore financial center” will be used.
known as vertical equity). This ability has only been accentuated with the rise of the digital economy and the financialization of the firm, which has increased the ability of large MNCs to shift their profits to low-tax jurisdictions. The increase in the footlooseness and economic importance of MNCs constrains the autonomy of governments (Palan, 2002; Arel-Bundock, 2017; Rixen, 2011b) and pressures them to reduce corporate income tax rates in an attempt to maintain and attract the mobile capital of MNCs (Keen et al., 2014). Partially as a result of tax avoidance and the decrease in corporate income tax rates, jurisdictions have increasingly shifted the tax burden from capital to consumption (Fig. 1.2) (Loretz, 2008; Schwarz, 2007; Saez & Zucman, 2016), which has contributed to an increase in inequality (Saez & Zucman, 2016). Finally, the reduction of corporate tax rates also allows individuals to book their income into corporations, and as such increases pressure on governments to also reduce personal income taxation (Anheier & Daly, 2006).

While the relevance of corporate tax avoidance is widely recognized, we still know very little about the extent to which MNCs avoid taxes, how this has changed over time, and exactly what role is played by offshore financial centers in the process. This lack of knowledge is directly attributable to the lack of data, as recognized by the IMF in their influential report “Offshore Financial Centers”: “All examinations of the role of OFCs in the international financial system have been hampered by a lack of adequate data” (IMF, 2000). The lack of adequate data is, in turn, a consequence of the confidentiality provided by OFCs, which allows MNCs to hide the location of their activities from governmental and public scrutiny. Confidentiality, together with low taxation, is
Chapter 1. Introduction

the main reason for MNCs to use OFCs (Hampton, 1996). This is evidenced for example in the Paradise Papers leaks, which contained the following excerpts from the consultation of Apple's law firm, Baker MacKenzie, with the offices of the offshore law firm Appleby in the Cayman Islands, the British Virgin Islands, Bermuda, the Isle of Man, Guernsey and Jersey: “What information is publicly visible (e.g. through the companies registry or equivalent) when a company is registered in your jurisdiction?” and “Confirm that an Irish company can conduct management activities […] without being subject to taxation in your jurisdiction” (Price, 2017).

The last decade has seen the development of novel datasets and methodologies that have for the first time allowed researchers to estimate the global scale of tax avoidance. This estimation has shown that tax avoidance deprives governments of hundreds of billions of dollars in tax revenue, and that the majority of corporate profits accumulate in a handful of jurisdictions (OECD, 2015; Clausing, 2016; Torslov et al., 2018; Janský & Palanský, 2019; Cobham & Janský, 2018). While these insights are undoubtedly crucial to understanding corporate tax avoidance, the specific mechanisms employed in corporate tax avoidance remain underexplored. This dissertation employs an interdisciplinary approach to open the black box of corporate tax avoidance, combining insights from political science, economics, international business and management, and computer science. This interdisciplinary approach allows me to answer four important and interrelated questions: Which jurisdictions are offshore financial centers? How are offshore financial centers used by MNCs? To what extent do offshore financial centers affect corporate taxation? In which offshore financial centers is tax avoidance orchestrated? The answers to these questions help to explain the emergence of “coordination centers” as places that play a key and increasingly important role in orchestrating corporate tax avoidance. The emergence of such jurisdictions has increased the inequality in the power relationships between and within firms and states. Increasingly, very large MNCs and coordination centers have gained power vis-à-vis other firms and jurisdictions.

Before analyzing the effect of offshore financial centers in corporate tax avoidance, it is necessary to understand how the international tax system works, and the structural changes that enabled corporate tax avoidance. The next three sections provide a historical background. Section 1.1.1 details how
the principles of international tax created the opportunities for tax avoidance; Section \[1.1.2\] explains the creation and expansion of OFCs; Section \[1.1.3\] summarizes how financialization provided the conditions necessary for the development of corporate tax avoidance; Section \[1.1.4\] subsequently builds on the historical background to show how tax avoidance works in the present. I then explore how tax avoidance provides challenges and opportunities for the three main players involved in tax avoidance: the MNCs (Section \[1.2.2\]), the OFCs (Section \[1.2.1\]), and the business service providers (Section \[1.2.3\]). For each actor, I summarize the literature and identify the research questions investigated in this dissertation.

1.1 Historical background

1.1.1 Origins and principles of international tax

Taxation is the main source of finance for governments, and one of the main drivers of state-building (Schwartz, 2000). Until the First World War, taxes were collected primarily on property and goods, and accounted for 5–10% of national incomes (Fig. 1.3A). During the First World War, personal income taxes were increased to fund the war efforts, from 0–8% in 1913 to 40–70% in 1921 (Fig. 1.3B). At this time corporate income tax was also introduced, partially to prevent individuals from moving their income to corporations and avoid paying tax altogether (Picciotto, 1992).

![Figure 1.3](image)

Figure 1.3. (A) Taxes collected as a percentage of national income (B) Marginal tax rate on personal income. Source: Piketty (2015)

The creation of corporate taxation in the 1920s brought the problem of *double taxation*. Companies from country A (home or source country) selling products
in country B (host or residence country) would face taxes on the profits made in both the home and host countries. Governments had different incentives in their decision to tax profits either in the home or host country. Countries whose companies sold more products abroad (net capital exporter) preferred the residence principle, where all profits are only taxed in the home country. Conversely, net capital importer countries preferred the source principle, where profits are only taxed in the host country. In order to find a solution for those competing interests, the League of Nations established the governing principles of international business taxation (Picciotto, 1992; Cohen, 1990). These principles can be summarized in five points: (I) Taxes on passive income, corresponding to returns on investment (e.g. interest on loans or royalties), should be paid in the home country (source principle). (II) Taxes on active income (e.g. profits made by selling products or services) should be paid in the host countries (residence principle). If the home country decides to tax worldwide income (net capital exporters have an incentive to do this), the country should provide tax relief on the taxes paid abroad. (III) National sovereignty principle: Countries remain fully sovereign with respect to taxation, and issues between countries should be resolved through bilateral tax treaties. (IV) The amount of taxes due should be calculated according to the location of the profits—in contrast with possible alternatives such as the location of revenue, assets and employees. (V) Arm’s length principle: Trade between affiliated entities (subsidiaries of a multinational corporation) should take place at arm’s length—i.e., using a price similar to the one that would be set by independent entities trading in the market.

The establishment of the arm’s length principle (Principle V) was an attempt to curtail tax avoidance via profit shifting. Profit shifting involves the inflation of prices when selling a product or providing a service internally within a MNC from a subsidiary in a low-tax jurisdiction to a subsidiary in a high-tax jurisdiction (Picciotto, 1992). As stated in the Carroll Report for the League of Nations (Carroll, 1933):

> Tax collectors complain that sometimes enterprises take the rate of tax in various countries into consideration, and fix the transfer price from the factory to the selling establishment at so high a figure as to show little or no profit in the books of the sales branch. Through the arbitrary fixation of

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3Selling products is mainly done through subsidiaries in the host country.
4The League of Nations was an intergovernmental organization created after the First World War with the goal of maintaining world peace. It was replaced in 1946 by the United Nations.
inter-establishment billing prices or charges for interest, royalties, services, etc., profits can be shifted from place to place, the purpose frequently being to transfer them to the country with a low rate of tax or no income-tax at all.

Governments can ensure that transactions are carried out at arm's length by finding comparable, market-priced goods and services sold by competitors. This principle works relatively well for manufactured products, for which comparable products are easy to find. However, comparable, market-priced products are often hard to find for intangibles (Luja, 2016). After all, how would you value the design of a mermaid on a cup of coffee? By “placing the mermaid” in a subsidiary of a low-tax jurisdiction, Starbucks can charge for its use to subsidiaries in high-tax jurisdictions. Since royalties are taxed in the jurisdiction where the mermaid is located (Principle I), Starbucks can in this way erode the profits earned by selling coffee and that would otherwise be taxed in the high-tax jurisdiction (Principle II). Since taxes are paid on the profits (Principle IV), corporations can relatively easily and, moreover, legally reduce their tax bill. As we will see in Section 1.2.1, this has created important challenges to the system and has prompted the initiation of radical reforms by the Organisation for Economic Co-operation and Development (OECD) and the European Commission in the last five years.

The establishment of the principle of sovereignty (Principle III) produced insulated national laws. From the perspective of the state, some jurisdictions (especially small states) have large incentives to craft regulatory regimes tailored to MNCs in an attempt to attract their mobile capital (Bucovetsky, 1991). By reducing tax rates and offering other beneficial legislation, some offshore centers are able to attract the profits of MNCs from the places where “real activity” takes place—i.e., where the employees, customers and assets are located. From the perspective of the firm, the principle of national sovereignty implies that MNCs can reside in different locations and shop around for the best regulation (Palan, 2002). For instance, an MNC can set up a manufacturing plant in Poland, a headquarters in Bermuda and a holding company in the Netherlands to take advantage of low labor costs, no corporate taxation, and no withholding taxes and investor protection, respectively. Indeed, the ability to use a network of subsidiaries to shop for legislation is considered a key factor in the dominance of modern MNCs (Picciotto, 1999). Multinational corporations can thus, as Palan (2002, p. 172) argues, “take advantage of the fiction of their fragmentation” to shift profits to low-tax jurisdictions. Today, the 500 largest
U.S. corporations (Fortune 500) keep $2.56 trillion stashed, untaxed, offshore (ITEP, 2017).

The combination of the five principles, which are still held today, have been successful in preventing double taxation. However, they have also created the conditions that enable tax avoidance (Rixen, 2011a). Under the principles, coordination problems related to double taxation needed to be solved through bilateral tax treaties. Bilateral treaties coordinate the legislation of two countries to ensure that the same income is not taxed twice, and reduce or eliminate international withholding taxes. Withholding taxes are taxes levied when money enters or leaves a country, and are a mechanism to prevent tax avoidance and evasion. The basic idea is that even if a jurisdiction offers a low tax rate, shifting the profits there would trigger a withholding tax, which would eliminate the advantages associated with such profit shifting. Taxing financial transactions, however, also reduces investment in the country, which pressures states into signing bilateral tax treaties (Weyzig, 2013; Arel-Bundock, 2017). By the end of the 20th century, countries had signed over 1500 such treaties, which has increased to over 3300 treaties in 2019 (Fig. 1.4). The choice to coordinate tax policy via bilateral tax treaties created opportunities for treaty shopping. By signing a tax treaty with a low-tax jurisdiction and another with a high-tax jurisdiction, OFCs could allow MNCs to use the OFC’s network of tax treaties to indirectly invest in the high-tax jurisdiction from the low-tax jurisdiction and avoid withholding taxes (Arel-Bundock, 2017; Rixen, 2011a; Riet & Lejour, 2014). While the tax avoidance problems associated with the international tax principles were foreseen, they were considered secondary to the problem of double taxation.\footnote{See Rixen (2011a) for a good overview of such deliberations in the League of Nations.}

1.1.2 The creation of offshore finance

Early stages of offshore financial centers

The increase in taxation during the First World War provided the incentives for tax avoidance by individuals and corporations alike. Early offshore centers, such as Switzerland, the Bahamas and the Channel Islands, were jurisdictions exempting foreign-sourced income and providing strict banking secrecy (Picciotto, 1999; Hampton, 1996). Tax could then be evaded by not declaring the income in the home country. An alternative way to minimize tax cost was to transfer the assets to a trust (Harrington, 2017). A trust is a contract
which defines the ownership of assets. It takes place between three parties: a settler who is the original owner, a trustee who accepts the legal ownership of the assets, and a beneficiary (who can be the same person as the settler) who receives the benefits of the assets. The trust splits the legal ownership, which now lies with the trustee, from the beneficiary ownership. Trusts contributed greatly to the development of offshore financial centers. As long as the trustee (the legal owner) was located in a location without tax, revenue arising from the ownership of those assets would remain untaxed (Harrington, 2017). One of the earlier examples of corporate tax avoidance can be traced back to 1921. The Vestey brothers, owners of the world’s largest meat and food processing corporation, moved from the United Kingdom (U.K.) to Buenos Aires and transferred their global assets to a trust in France. This trust then lent large amounts of money to another British company that they controlled, allowing them to enjoy the profits of their business without facing either corporate or personal income tax (Picciotto, 1999). Another example of early regulatory avoidance using offshore financial centers is the use of flags of convenience by shipping companies. Ships are required to follow the legislation of the flag they fly. During the prohibition of liquor in the United States (1920–1933), U.S. shipping companies started to use the Panamanian flag, first to circumvent the prohibition, and then to avoid taxes and other important legislation (Picciotto, 1999).

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6Trusts originated in the 13th century in Common Law, and were later recognized by Civil Law regimes. Trusts are not separate legal entities, and as such they do not have to be registered, and cannot be sued (Harrington, 2017).
While the establishment of income tax created the incentives for tax avoidance, it remained a limited phenomenon given the predominantly domestic nature of the corporation, and the lack of both digital and physical infrastructure. The Second World War brought new budgetary stress challenges to states. In preparation for the war efforts, governments created new taxes and increased income tax rates from 25–66% in 1931 to 60–97.5% in 1944 (Fig. 1.3B). The increased tax rates were then kept in place until the deregulation wave of the 1980s (Section 1.1.3). Modern offshore financial centers (OFCs) also emerged around the 1930s, as explained by Palan (2002, p. 159):

Modern tax havens did not originate as part of a conscious state or firm strategy. Rather, they evolved slowly and haphazardly; states appear to have stumbled upon the various attributes of tax havens, such as bank secrecy laws, low taxation, and “liberal” corporation laws. Furthermore, each of these attributes appears to have originated in different places and at different times. Only by the 1930s had a select number of tax havens—including Switzerland, Liechtenstein, the Bahamas, and Bermuda—begun to integrate the diverse elements into a core component of their development strategies.

The Second World War strengthened the main two incentives to relocate assets offshore: regulatory avoidance and asset protection. The high tax rates established to fund the war efforts increased the incentives for individuals and corporations to relocate offshore. Moving offshore also allowed those in German-occupied territories to avoid having their assets confiscated. This is for example the case of money from both Nazi elites and victims of Nazi persecution in Swiss banks (Ramasasty, 1998), or the relocation of Dutch transnational corporations to Curaçao (Boise & Morriss, 2012). The increase in the use of offshore financial centers created the demand for the last part of a modern OFC: business service professionals. Such professionals played a pivotal role in the shaping of the modern OFC (Palan, 2002), which we explore in Section 1.2.3.

The Bretton Woods Agreement

The end of the Second World War brought countries together again in an attempt to stabilize markets and hedge against another Great Depression, which had de-stabilized international politics in the 1930s (Milner & Helleiner, 1995). The United Kingdom (through John Maynard Keynes) and United States (through Harry Dexter White) negotiated a new set of principles to rule
commercial and financial relationships (Milner & Helleiner, 1995; Boughton, 2002). These negotiations resulted in the Bretton Woods Agreement. In it, international free trade was combined with strict capital controls at the national level and intergovernmental cooperation to maintain fixed exchange rates, where all currencies were indirectly pegged to gold through the U.S. dollar (Milner & Helleiner, 1995; Neal, 2015). The agreement created an “embedded liberalism” (Ruggie, 1982), where capital restrictions were seen as necessary to stop speculative capital and ensure stable exchange rates (Milner & Helleiner, 1995). In the words of John Maynard Keynes:

[capital controls were considered] not merely as a feature of the transition, but as a permanent arrangement, the plan accords to every member government the explicit right to control all capital movements. What used to be a heresy is now endorsed as orthodox. (quoted in Milner and Helleiner, 1995)

The United Kingdom chose to control short-term movement of capital out of the sterling area (Burn, 2006). The United States chose not to impose capital controls, but implemented strict legislation to prevent speculative banking. This included the establishment of a maximum interest rate, the requirement of minimum reserves, and the division between commercial and investment banking (McCann, 2006; Burn, 1999). Such strict regulations restricted investment in foreign currency and bond markets, and with it they also limited tax avoidance. However, as we explore in Section 1.1.2, they also created large incentives to avoid them (IMF, 2000). The third part of the equation, together with free trade and national capital controls, was intergovernmental cooperation, in the form of exchange of information between countries and the creation of a strong International Monetary Fund (IMF) with power to enforce capital controls (Milner & Helleiner, 1995). However, the final scope of international cooperation fell short of that which was envisaged by Keynes and White, which previous authors have attributed to lobbying by the New York banking sector (Burn, 2006). The limited scope of the cooperation gave room for jurisdictions to avoid cooperation, and was a key factor leading to the eventual re-emergence of free movement of capital (Burn, 2006).

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7Capital controls were enacted by the Defence (Finance) Regulation of 1939 and the 1947 Exchange Control Act.
8The strict legislation was enacted by the Interest Equalization Tax of 1963, the Foreign Credit and Exchange Act of 1965, the Regulation Q 1933, and the Glass-Steagall Act of 1933.
The Eurodollar and Eurobond markets

The Bretton Woods Agreement provided the institutional underpinning to the “Golden Age of Capitalism” (1950–1970), delivering unprecedented growth and low levels of inequality. However, it faced a critical challenge, which was presaged by Triffin and Kaynes (Maes, 2013). Since the U.S. dollar was linked to gold, foreign countries had strong incentives to accumulate the dollars spent by the U.S. state and firms abroad. The demand for dollars would create a current account deficit in the U.S., and at some point the dollars in foreign hands would eventually be greater than U.S. gold reserves, bringing the interconvertability of gold to dollar to a halt. This, however, did not happen until a decade after the invention of the Eurodollar market, an invention that punctured a hole in the Bretton Woods system even before it fully came into operation in 1958 (Burn, 2006; Green, 2016). The creation of the Eurodollar market led to the restoration of the City as the center of international finance, and also to the partial decoupling of finance from trade and the re-emergence of international finance (Burn, 2006).

The creation of the Eurodollar market dates back to the 1950s. Soviet and Chinese communist governments, fearing confiscation from the U.S., deposited some of their dollars in Paris and London. In London, such dollars did not need to (and could not, until 1958) be converted into pounds. The Bank of England, eager to see foreign dollars entering the City of London, chose to levy stamp and withholding taxes only to sterling accounts, while leaving Eurodollars unregulated. (Picciotto, 1999; Burn, 2006; Green, 2016; Neal, 2015). But equally importantly, they did not come under the U.S. regulations either, since those deposits were not located within its territory (Burn, 1999). Such double avoidance of regulation created a new jurisdictional space: the offshore system. Nowadays, the practical totality of international lending takes place offshore. The Eurodollar market is the distinctive feature of modern international finance (Lewis, 1999).

Initially and until the late 1950s, the Eurodollar deposits were used back in the United States or in the inter-bank market (Burn, 1999). In 1955 a new use of

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9Eurodollars are deposits denominated in U.S. dollars outside of the United States—and therefore not subject to U.S. legislation. However, the term is typically used (including in this dissertation) to denote all currencies deposited outside their home country. The prefix “Euro-” is not related to the European Area or the euro and it is only a historical accident. Eurobonds are bonds denominated in a currency different from that of the country where they are issued. The Euromarket in this context is the market of Eurodollar and Eurobonds.
Eurodollar was created. Since U.S. interest rates were capped by “Regulation Q” and the requirement to maintain minimum reserves, banks using Eurodollars could offer higher interest rates for U.S. deposits. This opportunity was realized by the Midland Bank (now part of HSBC), and was quickly followed by other British merchant banks (Burn, 2006). Soon after Eurodollars started to be used to finance international business. The sterling crisis of 1957 prompted the U.K. government to increase interest rates and restricted the use of sterling for financing, which caused U.K. merchant banks to look for new sources of finance for their international business, of which Eurodollars proved to be a lucrative example (Milner & Helleiner, 1995; Burn, 1999). The growth of the U.S. MNCs in Europe began supplying and demanding Eurodollars. This, together with the restoration of widespread currency convertibility in 1958 and the relaxation of exchange controls resulted in the phenomenal expansion in the 1960s and 1970s of the Eurocurrency market (Walter, 2011; Picciotto, 1999).

The advantage of U.K. banks, which could offer higher interest rates than U.S. banks, did not last long. By the 1960s, most U.S. banks had already established branches in the City of London (Burn, 2006; Green, 2016). Exemption from reserve requirements and interest rate caps enabled banks to offer low-cost loans and high interest rates (Picciotto, 1999; Hampton, 1996). That provoked U.S. legislators to attempt to regulate the offshore market and prevent outflows from the U.S. economy. However, they encountered resistance from the Bank of England. In the word of James Keogh, a senior official at the Bank of England:

> It doesn't matter to me whether Citibank is evading American regulations in London. I wouldn't particularly want to know. (quoted in Burn, 1999)

The response of the United States to the unwillingness of the U.K. to cooperate was to deregulate the financial market, create new financial products and further foster the development of the Eurodollar market. The Eurodollar market grew from basically no operations in 1958 to $1 billion in 1960, $19 billion in 1967, $57 billion in 1970, $215 billion in 1975 and $1.05 trillion in 1983 (Burn, 2006). Since 1977, the Bank for International Settlement has collected statistics on banking claims denominated in foreign currency, and they show the continuous growth of the market (Fig. 1.5) until 1990, and then again from 2000 to 2008. The expansion of the Eurodollar market contributed to the development of banking, business service professionals, legislation and other infrastructure both in London and in U.K. territories. This development of
The creation of offshore finance

The offshore infrastructure was later crucial for the expansion of corporate tax avoidance.

A second crucial invention in the development of corporate tax avoidance was the Eurobond market. The issuing of bearer bonds, prohibited since 1939, was reintroduced in Britain in 1963, as long as they were not denominated in sterling (Burn, 2006). Corporations started using them to raise money and provide loans to other companies. Bearer bonds are anonymous and transferable bonds which have physically attached coupons that entitle the owner to the payment of interest at the maturity date printed on the coupon. They were attractive for MNCs since Eurobonds faced lower regulations and supposedly gave access to lower interest rates (Kidwell, Marr, & Thompson, 1985). They were attractive to investors since they could be issued in a country without stamp duty, transferred physically without paying withholding taxes, and could be cashed anywhere, avoiding local taxes on interest (Picciotto, 1999; Neal, 2015). The first Eurobond was cashed in Luxembourg to avoid the 42.5% British income tax, issued in Schipol airport (the Netherlands) to avoid the 3% British stamp duty, and listed on the London Stock Exchange (Burn, 2006). The development of the Eurobond market was also marked by legislation in the United States. Pressured by the outflow of U.S. dollars driven by the Eurodollar market, President Kennedy implemented the Interest Equalization Tax of 1963, and the Foreign Credit and Exchange Act of 1965 to discourage investors from
buying foreign securities on the U.S. capital market (Burn, 2006). This in turn fostered the development of the Eurobond as MNCs sought finance outside the United States. During the period 1963–1973 $33.3 billion in Eurobonds were issued, which grew to an annual rate of $58 billion by 1984 (Burn, 2006). By 1997, 88% of international lending already took place offshore. As we explore subsequently, the creation of the Eurobond market was a main reason for MNCs to set up subsidiaries offshore, which further contributed to the development of offshore legislation and offshore business provider services. Their presence in offshore financial centers, together with a developed offshore infrastructure, would later allow MNCs to create corporate tax avoidance structures.

The expansion of offshore financial centers
The Eurodollar and Eurobond market fostered the expansion of early offshore centers, since MNCs and individuals could use them to escape regulation (Johns & Le Marchant, 1983). In the 1960s U.K. fund managers started to establish collective investment schemes in Hong Kong, Bermuda and the Channel Islands to protect against high tax rates in the U.K. on unearned (non-labor) income (Hampton, 1996). As firms started to internationalize in the 1960s, small states, often advised by tax professionals, started enacting legislation with the intention to attract foreign branches of banks and subsidiaries of MNCs (Picciotto, 1999; Palan, 2002). By setting up subsidiaries in OFCs without relocating productive activity, MNCs could take advantage of such custom-made legislation. (Palan, 2002) One of the main reason why MNCs first moved offshore was to issue Eurobonds and raise capital for the parent company (Hampton, 1996). The advantage of doing so for investors was that interest received in Eurobonds was tax-free, and that the investor would remain anonymous thanks to the strict secrecy of offshore financial centers. By the early 1970s many U.S. banks had branches in Caribbean tax havens as Eurocurrency booking offices (Hampton, 1996), in large part to cater to their corporate clients. A second related reason for corporations to use offshore financial centers was the avoidance of withholding taxes. MNCs looking to invest in foreign countries—mainly U.S. MNCs investing in Europe—faced withholding taxes on the dividend, royalty and interest payments. By routing the investments using a subsidiary in Curaçao (then part of the Netherlands Antilles), they could take advantage of the double tax treaty between the Netherlands and the United States (signed in 1948 and extended to include the Netherlands Antilles in 1955), by virtue of which withholding taxes were removed. Moreover, the profits in
Shareholder value and the rise of tax avoidance

Curaçao would not face taxation until the profits were repatriated to the United States. (Boise & Morriss, 2012; Picciotto, 1999). This *treaty shopping* was a key ingredient in the expansion of offshore financial centers and corporate tax avoidance. Jurisdictions such as the Netherlands, with its extensive network of bilateral tax treaties, have consistently been used to route investment and enable MNCs to avoid taxes (Weyzig, 2013). Nowadays, 60% of all royalty payments that enter the Netherlands go directly to the low-tax jurisdiction of Bermuda (Lejour, Möhlmann, & van ’t Riet, 2019).

1.1.3 Shareholder value and the rise of tax avoidance

The collapse of the Bretton Woods system

As predicted by Triffin and Keynes, the U.S. started to face an increasingly large balance of payments deficit in the 1950s. The U.S. attempted to control the deficit by establishing capital controls and increasing interest rates in the 1960s. The controls moved lending from U.S. banks to the Eurodollar market, which in theory would help to equalize the national accounts of the U.S. (D’Arista, 2009). On the other hand, the increase in interest rates would move from U.S. branches offshore to the U.S. (D’Arista, 2009). However, the U.S. efforts were in vain given the two continuous outflows of U.S. dollars. Firstly, dollars spent during the Vietnam war (1955–1975) ended up in the central banks of France (because of Vietnamese repatriates) and Japan (for its role in the supply chain) (Neal, 2015). Secondly, low-inflation countries were building up export surpluses. With fixed exchange rates, this implied that the surpluses could not be used to expand domestic money supply, and were instead accumulated (Neal, 2015). When countries with large reserves of dollars (mainly France and Germany) started to ask for gold in exchange for their dollar reserves, the gold outflux became unsustainable for the U.S., and they responded by temporarily ending the dollar-gold interconvertibility in 1971 (Neal, 2015). After some efforts to devaluate the dollar and save the gold standard, speculative runs against the dollar in 1973 caused the U.S. to let its currency float, effectively ending the

For transactions within the European Union, withholding taxes were abolished in 2003 via the Interest and Royalties Directive and the EU Parent-Subsidiary Directive (European Commission on Taxation and Customs, 2014, 2015). This increased the incentives of European jurisdictions to reduce withholding taxes. By signing a tax treaty with a low-tax jurisdiction or unilaterally eliminating all withholding taxes, OFCs could offer MNCs the possibility to route investment from a low-tax jurisdiction to the entire European Union, avoiding withholding taxes in all EU member states. In order to reduce the opportunities for tax avoidance, over 100 jurisdictions in 2016 signed the “Multilateral Instrument,” which replaces thousands of bilateral tax treaties with a multilateral instrument intended to eliminate gaps and mismatches in international tax rules, and with it the opportunities for treaty abuse (OECD, 2018).
Bretton Woods Agreement. Capital controls in the U.S. would disappear one year later, in 1974 (D’Arista, 2009).

**Deregulation and financialization**

The equilibrium of the Bretton Woods Agreement relied on international cooperation to control capital flows. But rather than cooperate, it was in the interest of some jurisdictions to defect in order to attract foreign capital. In the case of the Eurodollar market, this defection was realized by the U.K.’s decision to leave the market unregulated. Once this happened, competition for the international offshore market via liberalization was inevitable. Competition for the market only grew more fierce after the collapse of the Bretton Woods system in 1971 and the failed initiatives to reverse the globalization of finance in the 1970s. The stagnation of the economy in the late 1960s and 1970s brought new challenges to governments. In this context, deregulation and liberalization were seen by governments across the world as a way to increase growth and handle the social, fiscal and legitimization crisis (Harvey, 2010; Milner & Helleiner, 1995; Krippner, 2019). The reforms started in the U.S. and quickly transferred to the U.K. through a “transatlantic regulatory feedback loop” that stimulated processes of continuous financial deregulation in order to maintain competitive status (Green, 2016; Auernheimer, 2013; Hansen, 2002). The U.S. had already abolished capital controls in 1974. The international trend continued with the Thatcher government abolishing sterling capital controls in 1979, which was followed by Australia, New Zealand, continental Europe, and Japan. Competition for the Eurodollar and Eurobond market intensified again in 1981, when the U.S. created its own offshore financial system located in New York, the New York International Banking Facilities (IBFs). These IBFs lowered reserve requirement and removed the interest rate ceiling for non-U.S. residents and corporations, which attracted bank operations back to the United States (Hampton, 1996). The IBFs were quickly replicated in Tokyo, Singapore, and other jurisdictions (Milner & Helleiner, 1995; Palan, 2002), and by the mid-1990s, all capital controls had been abolished (Milner & Helleiner, 1995). The deregulation trend was also accompanied by the signing of an increasing

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11 The interest often relied on specific groups within the State. See Burn (1999) for a description of the British case.
12 The reintroduction of controls on capital was considered four times (in 1976 in the U.K., in 1978–79 and 1979–80 in the U.S., and in 1983 in France). The lack of international cooperation, required for example to set minimum capital requirements in the Euromarket, together with the spread of neoliberal ideology, scotched all attempts to re-regulate the Euromarket (Milner & Helleiner, 1995).
number of tax and investment treaties to further increase capital mobility and international investment (Fig. 1.4).

The systematic deregulation of the economy set up the requirements for financialization (Krippner, 2019). Financialization is defined by Krippner (2019, p. 4) as “The tendency for profit making in the economy to occur increasingly through financial channels rather than through productive activities.” Financialization has been explored in several ways in the literature (see for example van der Zwan 2014, Horn 2017, Krippner 2019 for reviews). I see three relevant strands for the study of corporate tax avoidance: the financialization of households, the shift from productive to financial operation of the corporation, and the emergence of the shareholder value ideology. The first strand describes how the development of IT technologies and new investment products connected individual households to financial markets (van der Zwan, 2014). Linking the wealth of the average person to the growth of the economy partially aligned the goals of capital and labor, and facilitated discourses of risk-taking and self-fulfillment (van der Zwan, 2014).

The second strand identifies the shift of non-financial corporations towards financial products. In this aspect, the Marxist literature offers a useful perspective. This literature locates the origins of financialization within the response of government to the crisis of 1970s (Krippner, 2019). As the returns from productive investment decreased in the stagnation of the 1970s due to external competition from foreign firms (Arrighi, 1994), the monopolization of the corporation (Magdoff & Sweezy, 1987) and the oil crisis (Barsky & Kilian, 2004), firms started to increase financial operations, which provided higher rates of return (Aguilera, 2002). Importantly, a key ingredient in the shift towards financialization was the availability of low-cost finance from the Eurodollar and Eurobond markets (Picciotto, 2017). Today, the automobile industry in the U.S. generates 23% of its profits from loans to purchase cars and other financial products, a trend that is similar for other nonfinancial firms (Aguilera, 2002; Davis, 2009). The increase in finance did not imply that higher capital was made available to invest in productive activities. On the contrary, investment in financial assets reduced investment in productive assets and hindered corporate growth (Stockhammer, 2004). Investment in financial

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13Source: Orbis, using the ratio of financial to total profits for all U.S. automobile manufacturers for the years 2010–2019.
assets, as we will explore in Section 1.1.4, allowed corporations to easily transfer those assets to low-tax jurisdictions, and to transform operating profits (taxed at the general tax rate) into financial profits (taxed generally at lower levels, for example through patent boxes).

This strand of literature also explains the increasing reliance of corporations on income from intellectual property rights (Schwartz, 2017). Intellectual property rights allow knowledge to be treated as property, and give their owner monopoly rights to exploit an intangible asset (usually a patent, copyright, or trademark). They encourage firms to invest in intangible assets by ensuring a monopoly rent during an extended period of time. Over the last fifty years, MNCs have come to rely more on revenue streams from intellectual property rights, since these streams provided higher returns (Daum, 2002). This has deeply affected the strategies for corporate tax avoidance. MNCs can now locate the intellectual property (or the rights to use it) in a low-tax jurisdiction. They can then charge subsidiaries in high-tax jurisdictions for its use, effectively transforming the operating profits in the high-tax jurisdiction to financial profits in the low-tax jurisdictions.

Finally, the last strand of literature deals with the *shareholder value* paradigm (Mizruchi & Kimeldorf, 2005; van der Zwan, 2014; Horn, 2017). Before the 1980s, corporations would share their profits between all stakeholders (e.g. employees, managers, communities, or shareholders) (Davis, 2009; Froud, Johal, & Williams, 2002). This is exemplified by the generous wages and pension funds offered to all employees of large corporations. In this paradigm, the shareholders received a return consisting of their investment plus a risk premium. However, increased foreign competition in the United States, the creation of the Eurodollar market, and the 1973 oil crisis produced a “Copernican Revolution” in the 1980s and 1990s resulting in the shareholder value paradigm (Davis, 2009). In this paradigm, the only goal of corporation became to “increase its profits so long as it stays within the rules of the game” (Friedman, 2007). The literature on financialization has investigated the ways in which this paradigm change pushed nonfinancial firms into financial markets. Krippner (2019) summarizes the two main transformations discussed in the literature. The first was the emergence of a corporate takeover market in the 1980s, where the rising inflation and the policy changes by the Reagan administration resulted in the breaking up of large conglomerates into
leaner firms more focused on the stock price (see also Davis, Diekmann, and Tinsley (1994)). The second transformation was the emergence of powerful institutional investors with the power to demand increased returns. These institutional investors were also able to align the objectives of management and shareholders by offering executive compensation in the form of stock options. The results of both transformations was the financialized firm, where unprofitable divisions would be sold, employees would be laid off to increase financial indicators, tax would be minimized, and financial accounts would be “engineered” in order to reach analysts’ forecasts (Froud et al., 2002).

In the shareholder value paradigm, tax is generally a cost that should be minimized. In this context, concerns about the effects of tax avoidance are typically dismissed with the argument that morality is subjective, and that we should only allow the law to guide what is right and what is wrong. This use of the law as a moral compass can partially be traced to a series of court cases regarding tax avoidance (Picciotto, 1992). We can see this as early as 1929, where the British judge Lord Clyde (Ayrshire Pullman Motor Services vs. Inland Revenue [1929] 14 Tax Case 754) stated that:

No man in the country is under the smallest obligation, moral or other, so to arrange his legal relations to his business or property as to enable the Inland Revenue to put the largest possible shovel in his stores. The Inland Revenue is not slow, and quite rightly, to take every advantage which is open to it under the Taxing Statutes for the purposes of depleting the taxpayer's pocket. And the taxpayer is in like manner entitled to be astute to prevent, so far as he honestly can, the depletion of his means by the Inland Revenue

These statements proliferated in court cases and established the legality of tax avoidance structures (Picciotto, 1992). The best example of using the law as a moral compass is perhaps the response of MNCs to controversies about their tax minimization strategies, which has been dubbed as the “tax mantra”: “We pay all tax that is due in all of the countries in which we operate.” Since the financial crisis, however, there has been a change. Governments and international organizations have started to coordinate in an attempt to radically change the international tax system (see Section 1.2.1). Public opinion, once oblivious to tax avoidance, has been shaken by leaks coming from OFC. The Paradise and Panama papers have shown how politicians, wealthy individuals and MNCs connive to reduce their tax bill. Even the shareholder value paradigm

14https://phdskat.org/taxmantra/
has started to be challenged. The CEO of Unilever, one of the largest consumer goods MNCs, stated that focus solely on shareholder value was “distracting many companies from doing what they should be doing” to innovate, invest, renew their strategies and take care of all their stakeholders. He asked: “Why should the citizens of this world keep companies around whose sole purpose is the enrichment of a few people?” (Edgecliff-Johnson, 2019; Edgecliffe-Johnson, 2018).

1.1.4 Tax avoidance in the 21st century

The principles of international tax created the opportunities for corporate tax avoidance, which were realized through the expansion of offshore finance and the financialization of the MNC. Before focusing on the contribution of this dissertation, this section explains how MNCs avoid taxes using financial products and offshore financial centers.

Territorial and worldwide tax systems

Imagine a corporation that earns $10 million in the home country (where the headquarters are located) and $10 million abroad. The home country can decide to tax either only the earnings in the home country or the worldwide earnings. The first system corresponds to a territorial system, where foreign profits are exempt. This is the most common system. The second system was used by United Kingdom and Japan until 2009, and by the United States until the Tax Cuts and Jobs Act of 2017. In order to avoid the problem of double taxation, the United States offers a credit on the taxes paid abroad. For instance if the United States taxed 30% of the $10 millions earned abroad, but foreign governments had already taxed $2 million, the United States would end up taxing only $1 million. In practise, most tax systems are a hybrid of the two systems (see e.g. Clausing (2015) for a complete description). For example, a common feature of the worldwide tax systems is the deferral, whereby taxes on reinvested profits (i.e., non-distributed to shareholders) are deferred to the next year, when they can again be reinvested. Since MNCs can always defer taxation on foreign profits, this makes the worldwide tax system similar to a territorial tax system. The advantage of reinvesting profits is that the unpaid taxes will generate returns. While this may seem a modest advantage,

15The new system still has a new worldwide tax named “Global Intangible Low-Taxed Income” (GILTI). The calculation of the tax is complicated and dependent on many factors, but in general GILTI is supposed to reduce profit shifting by taxing foreign subsidiaries if their profit far exceeds their tangible assets.
Tax avoidance in the 21st century

A company reinvesting 100 million would have an extra 100–150 million after 10 years (assuming an annual return of 10%). Nowadays, approximately one third of all foreign direct investment by U.S. MNCs corresponds to reinvested profits (Lundan, 2006).

Profit shifting and corporate tax avoidance

In order to avoid taxes, corporations need to move their profits to a low-tax jurisdiction. As explained in Section 1.1.1, passive incomes (royalties, interest, management fees, leased equipment) are considered costs in the host country and as such are taxed only by the home country, while active income (production) is taxed directly by the host country. There are three main ways for multinationals to shift profits to low-tax jurisdictions. Firstly, profit shifting can happen simply by placing (via intra-group transactions and cost-contribution agreements) an important asset (or the rights to income streams generated by them) in a low-tax jurisdiction, and then charging subsidiaries in high-tax jurisdictions for its use (UNCTAD, 2015; Palan, Murphy, & Chavagneux, 2013). The asset can range from intangibles such as intellectual property or know-how, to interest-bearing loans, consultancy services, or expensive machinery. However, in most cases it is an intangible or an interest-bearing loan, since financial products are relatively easy to move across borders.

A second option, used frequently by retailers such as Inditex (the biggest fashion group in the world) or Starbucks, is to establish a distribution center in a low-tax jurisdiction. The subsidiary buys products across the world at a low price, and sells them with a mark-up to the other subsidiaries. While this mark-up needs to be market priced (similar to the mark-up that an independent entity would charge), substantial amounts of profit can be moved in this way to low-tax jurisdictions, eroding the taxable bases of both the country of the producer and the country of the consumer, and increasing the profits in the location of the distribution center.

A third option is to exploit mismatches between national legislation. This is for example the case of Apple Operations International (AOI), a subsidiary of Apple in Ireland which makes up the majority of Apple’s foreign profits, and who pay an effective tax rate of under 2% (Seabrooke & Wigan, 2014). Irish law establishes that the tax residency of a company is determined by the place of management and control. U.S. law, on the other hand, establishes that
1.2. The three actors involved in corporate tax avoidance

The tax residency of a company is determined by its place of incorporation. Since AOI was incorporated in Ireland but controlled from the United States, AOI was tax resident nowhere. Importantly, this affects only the foreign profits of Apple, and does not negatively affect the tax base in the United States. A similar mismatch between two national regulatory systems can be found in financial products (Bryan, Rafferty, & Wigan, 2017). MNCs can use financial instruments that are considered equity in the home country and debt in the host country. Since equity payments (dividends) are taxable in the host country, and debt payments (interest) are taxable in the home country, these financial instruments pay tax nowhere. These three methods of profit shifting are responsible for the bulk of modern-day tax avoidance. As we will see in Section 1.2.3, tax professionals play a key role in this process, both by advising governments on the creation of tax legislation, and by advising MNCs on how to organize their structure and operations to take advantage of such legislation.

1.2 The three actors involved in corporate tax avoidance

This section motivates the four research questions from this dissertation: Which jurisdictions are offshore financial centers? How are offshore financial centers used by MNCs? To what extent do offshore financial centers affect corporate taxation? In which offshore financial centers is tax avoidance orchestrated? In order to motivate the research questions in a structured manner, I analyze the three actors involved in corporate tax avoidance: the state (Section 1.2.1), the MNC (Section 1.2.2), and the tax professionals that make tax avoidance possible (Section 1.2.3).

1.2.1 Actor 1: The state

Opportunities from deregulation and bilateralism

The elimination of capital controls and the financialization of the economy brought opportunities for governments. By reducing taxation, some jurisdictions could attract significant influxes of foreign profit. The capability to attract significant influxes of foreign profit depends at the core on differences in country size. The tax revenue collected throughout the world would be

\[ \text{The profits would only be taxed if repatriated to the United States. The Tax Cuts and Jobs Act of 2017 created a tax holiday, whereby profits could be repatriated paying a tax rate of 8% (instead of 35%). For more information see United States Senate (2013).} \]
maximized if all countries would agree on a tax rate. However, some small countries can maximize their revenue flows by attracting the profits of MNCs through low taxation (Bucovetsky, 1991). On the other hand, large countries cannot attract enough multinationals to compensate for the tax revenue lost from the domestic sector, and are also generally more subject to national political constraints (Genschel, Lierse, & Seelkopf, 2016; Genschel & Seelkopf, 2016). This creates an asymmetric prisoner dilemma, since only one of the actors (small countries) can improve their position by choosing not to cooperate. The Netherlands, Ireland, Switzerland, Bermuda and Singapore attract $200 billion of the profits made abroad by U.S. corporations, 50% of all their foreign profits (Tørslov et al., 2018). This figure represents around 10% of the GDP of those countries.

It is important to note that a tax decrease does not automatically imply that a country will attract the mobile profits of corporations. Among the most important non-tax factors are stability, access to international financial markets, the appearance of cleanness (i.e., not tainted by scandals), and agreements with major countries (Palan, 2002; McCann, 2006). Those factors are essential to the ability of attracting significant flows of foreign capital. This combination of factors is best achieved in former and current U.K. colonies and territories. They are extremely stable politically. The political elites in these jurisdictions are considered to be captured by corporate and tax professional elites, which ensures a “business friendly” environment (Palan et al., 2013; Christensen & Hampton, 1999; Harrington, 2016). The confidential relationship between banker and client is implicit in colonies with a tradition of British Common Law (Hampton, 1996). Moreover, the United Kingdom is in charge of the foreign policy and defense of current territories such as the Cayman Islands or the British Virgin Islands. Finally, the connection with the City of London ensures their access to finance, and serves as a link to clients worldwide. However, similar conditions are also found in Caribbean French colonies that did not become large offshore financial centers, such as St. Kitts or Antigua. According to Hampton (1996, p. 56), the main reason why U.K. territories (and London) became so successful at attracting offshore finance is that corporations believed that the United Kingdom would not regulate the offshore financial system.
The presence of low-tax jurisdictions allows MNCs to avoid taxes by shifting profits to those jurisdictions. This begs the question of why onshore states tolerate (or even encourage) corporate tax avoidance. Cohen (1990) and Rixen (2011a) give three interrelated reasons. First, the principles of international tax set in place to eliminate double taxation created a coordination game, and countries are wary of endangering the equilibrium since they have an interest in facilitating investment flows. For this reason, reforms to reduce corporate tax avoidance have mainly been unilateral and incremental for a problem that requires radical reforms (see Keen and Konrad (2013), Genschel and Schwarz (2011) for an overview of the attempted reforms). Any reform that could address corporate tax avoidance requires a radical challenge to the principle of “national tax sovereignty,” whereby each country has the exclusive right to tax the profits booked in their jurisdiction. Second, offshore financial centers can successfully block the efforts of international organizations such as the OECD to reduce corporate tax avoidance. This is especially the case for developed countries that benefit from the current equilibrium in the international tax system (Genschel & Rixen, 2015). Probably the best example of this takes place within the European Union, where tax reforms require unanimity. In the European Union, countries such as the Netherlands or Luxembourg consistently oppose legislation aimed at curbing tax avoidance. Third, corporate lobbying has undermined efforts to reform the tax system. An example here is the reaction of the United States to the “Guidelines on Harmful Preferential Tax Regimes,” developed by the OECD in 1998 in an attempt to discourage the spread of harmful tax incentives (OECD, 1998). In 2001, the new Bush administration declared that “the United States does not support efforts to dictate to any country what its own tax rates or tax system should be, and will not participate in any initiative to harmonize world tax systems” (O’Neill, 2001, as cited by Rixen (2011a)). Similar examples include the limitation of CFC legislation (Picciotto, 2018) and the elimination of the withholding tax on dividends in the Netherlands (Babic, Garcia-Bernardo, Huijzer, & Valeeva, forthcoming). A fourth reason pointed out by Latulippe (2016) is the “competitive discourse” (Porter, 1996; Cerny, 1990; Stopford, Strange, & Henley, 1991; Elkins, Guzman, & Simmons, 2006; Jensen, 2008).

17One of the reforms challenging this principle is the Controlled Foreign Corporation (CFC) legislation. These rules limit the deferral of tax in low-tax jurisdictions by including passive income earned by controlled entities in low-tax jurisdictions to the tax base of the corporation. However the definition of passive income leaves enough space for tax avoidance (Picciotto, 2018).

18See for example the countries opposing reforms during the “Special Committee on Tax Rulings and Other Measures Similar in Nature or Effect” (Kofod & Theurer, 2019).
Thomas, 2010). According to the competitive discourse, reforms affecting the ability of MNCs to avoid taxes hurt the reputation of the host country and its ability to compete for FDI vis-à-vis other states. The pervasiveness of the competitive discourse overrides other taxation goals. “Neutrality, efficiency and equity are set aside or seen as secondary to competitiveness” (Latulippe, 2016, p. 95).

The opportunities for some jurisdictions to attract the mobile profits of MNCs created tax competition between countries. The literature on tax competition is vast, but there are two strands I would like to stress. The first strand deals with the strategic interaction between countries, where scholars have looked at the extent to which tax competition may lead to races to the bottom or top, or give rise to other forms of competitive (or cooperative) dynamics (Genschel & Schwarz, 2011; Keen & Konrad, 2013; Wilson, 1999; Brueckner, 2003; Swank, 2016a; Devereux, Griffith, & Klemm, 2002; Devereux, Lockwood, & Redoano, 2008). This strand of literature confirms that strategic interaction between countries exists, that it negatively affects the ability of government to tax MNCs (Keen et al., 2014; Swank, 2016b; Palan, 2002; Beer, Klemm, & Matheson, 2018), and that it is subject to national political constraints (Genschel et al., 2016; Jensen, 2008; Blonigen, 2005; Li, 2006). The second strand deals with the effect of corporate taxes on attracting foreign investment. Research in this strand shows that increasing corporate income tax by 1 point decreases FDI by 3.9% on average (De Mooij & Ederveen, 2003). However, as we will see in Section 1.2.2, FDI is highly affected by intermediate holding companies, and the semi-elasticity of tax for investment in the real economy (measured typically using employment or fixed assets) is contested (Clausing, 2014).

Tax competition in a financialized era

The picture of tax competition becomes more clear if we take the financialization of the firm into consideration. Modern MNCs use holding companies to place important value-creating assets in offshore financial centers, and shift profits to those states. By charging foreign subsidiaries for the use of those (financial) assets, MNCs are able to transform operating income in the subsidiary to financial income in the offshore financial center. For example, a Starbucks subsidiary in Germany may pay a royalty of $1 per coffee sold to a Starbucks subsidiary in the Netherlands for the use of the brand. Without that payment, the profits of the German subsidiary would increase by $1 per coffee,
from which it would pay approximately 30 cents in tax. With that payment, the profits of the Dutch subsidiary increase by $1 per coffee. There, only 7% tax would be paid on the royalties since it falls under the scope of the patent box, whereby revenues arising from intellectual property (such as branding) are taxed at a lower rate.

This transformation of operating to financial income is key to understanding how middle-sized countries such as the Netherlands are able to compete for foreign capital. Competition (antitrust) law prevents jurisdictions from giving tax advantages solely to MNCs. As previously mentioned, this is the main reason that prevents medium and large-sized countries from competing for the profits of MNCs, since tax revenue losses from widespread tax incentives in the domestic sector would not offset the gains from attracting foreign capital. However, jurisdictions can provide different tax treatment to financial profits. For instance, they can offer low tax rates to the interest income received from owning loans, or royalty income received from owning intellectual property. By lowering taxes on financial income, OFCs can attract the subsidiaries of corporations that hold those financial products, without hurting the tax revenue from domestic firms. The transformation of operating to financial income requires financial products to be valued according to the arm's length principle. This implies that MNCs and governments need to agree on what the fair price of a patent or a brand is, which determines how much they can charge a foreign subsidiary for it. This price can be agreed case by case between the MNCs and the governments through secret Advanced Tax Rulings (ATRs) and Advanced Pricing Agreements (APAs). Nowadays, thousands of these rulings are in force in the E.U. (European Commission on Taxation and Customs, 2019). While these rulings were conceived to avoid double taxation and give security to MNCs, they play an important role in tax avoidance. The sheer amount of financial profits of MNCs provides huge incentives to OFCs to misvalue some products and attempt to lure those profits into the jurisdiction (Eden & Byrnes, 2018). This has been the case in the Netherlands with Starbucks; in Luxembourg with Fiat, McDonalds or Amazon; and in Ireland with Apple (Gunn & Luts, 2015; Luja, 2016). In all those cases, the European Union has ruled that those countries were providing an unfair tax incentive to individual companies (state aid), which goes against competition law (Gunn & Luts, 2015).

19 see Kofod and Theurer (2015) for a list of current cases.
The breakdown of the system
The increased ability of MNCs to reduce taxes on financial profits has allowed corporations such as Apple, Google, Microsoft and Facebook to enjoy tax rates below 5% on their foreign profits, putting pressure on governments to control tax avoidance. The financial crisis of 2007 destabilized the system (Christensen & Hearson, 2019). Public outrage arising from corporate tax avoidance and the new estimates of wealth inequality (e.g. the World Inequality Database), together with budgetary deficits experienced by governments, have produced a dramatic scaling in reforms. Governments have started to cooperate by automatic sharing of information (Hakelberg, 2016) and by harmonizing the treatment of corporations and financial products in tax treaties (OECD, 2018). Countries have also started to unilaterally challenge the principle of “national sovereignty.” This is for example the case of the Foreign Account Tax Compliance Act (FATCA) of 2010, which requires non-U.S. institutions to provide information about the operations of U.S. citizens abroad. Another example is the recent efforts of the governments of France, Italy, Spain, Austria, India and the United Kingdom to tax digital corporations according to the revenue arising from customers within their countries (Asen, 2019). Digital corporations earn their profits mainly from activities such as advertisement or intellectual property, which are sold or serviced to customers all around the globe. Since profits are recorded in the place where the products and services are sold, digital corporations can place those advertisement services or intellectual property in a low-tax jurisdiction and record profits only in that jurisdiction. European readers can check the address of their payments to Google, Netflix or Apple, which will undoubtedly be located in Ireland. The unilateral decision to tax corporations on the revenue arising from the customers of corporations is a key step to avoid corporate profit shifting.

Which jurisdictions are offshore financial centers?
It is clear that OFCs play a key role in tax avoidance, and identifying the countries that can be considered OFCs is key to understanding the dynamics of and policy responses to tax avoidance. The identification of OFCs has, however, become a politicized and contested issue. In general, OFCs are identified and measured through two approaches: measuring the misalignment between the location of financial activity and “real” activity, and analyzing the institutional framework. The misalignment approach identifies OFCs as the countries where profit accumulates (e.g. Hines and Rice (1994), Tørslov et al. (2018), Cobham
and Janský (2019) or by the size of the financial sector (e.g. Fichtner (2018)). The institutional approach identifies OFCs as the countries exhibiting certain legal features, such as low corporate tax or secrecy. The two main examples of the latter approach are the Financial Secrecy Index and the Corporate Tax Haven Index by the Tax Justice Network (Cobham, Janský, & Meinzer, 2015) and the highly controversial and politicized black lists of “tax havens” or “uncooperative jurisdictions.”

Both the misalignment and institutional approaches hold enormous value when it comes to understanding offshore financial centers. The misalignment approach allows us to estimate the relevance of a set of countries according to a specific variable (e.g. the location of profits); however it is not able to identify different types of OFCs. For example, profits do not tend to accumulate in the United Kingdom, although the U.K. may be considered the largest OFC with regards to corporate tax avoidance given the role of its territories. Conversely, the institutional approach is able to identify different types of OFCs, but it is not able to show the actual relevance of those OFCs. In order to clarify both the types and relevance of OFCs, I raised the first research question:

RQ1: “Which jurisdictions are offshore financial centers?”

1.2.2 Actor 2: The multinational corporation

The great fragmentation of the firm

The abolition of capital controls allowed for a rapid expansion of international trade and investment. Firms started to unbundle their production in global value chains to expand operations and reduce production costs (Gereffi, Humphrey, & Sturgeon, 2005; Thomsen, 1994). The number of MNCs grew from 7,000 in 1970 to 35,000 in 1990, and to 53,000 in 1998 (Rixen, 2011a). By 2006, there were at least 78,000 MNCs with more than 780,000 subsidiaries worldwide (Rixen, 2011a). The erosion of financial barriers and the financialization of the firm not only allowed MNCs to expand, but also brought new opportunities for tax planning. “Exit” by moving increasingly financialized assets and operations to OFCs became a viable option for tax payers (Genschel & Schwarz, 2011; Hirschman, 1978). We refer to this process of fragmentation and dispersion of both the operational activities and legal-financial structure as “the great fragmentation of the firm.”
Corporate tax avoidance takes place through the fragmentation and restructuring of the legal-financial structure of the firm (Seabrooke & Wigan, 2017; Bryan et al., 2017; Wójcik, 2013; Reurink, 2020). By strategically placing distributor intermediaries, financial products that aim to exploit mismatches between national legislations, or important value-creating assets in low-tax jurisdictions, MNCs can shift profits towards offshore financial centers and reduce their tax bill. Similarly, corporations can take advantage of the most beneficial tax treaties using OFCs. To do so, interest, royalty and dividend payments are not made directly to the parent company, but indirectly through an OFC.

All these tax planning strategies have something in common: they all use holding companies in OFCs. Holding companies appear in different forms and may be used for a number of purposes, many of which are related to profit shifting. Nowadays, a typical large MNC contains dozens of holding companies (Fig. 1.1). The importance of holding companies should not be underestimated. In 2015, after some MNCs relocated intellectual property to Ireland, the GDP of Ireland grew by 26%. Globally, 40% of all foreign investment is made through intermediate holding companies with no real business activities, and frequently with the goal of reducing tax payments (Casella, 2019; Damgaard, Elkjaer, & Johannesen, 2019; Haberly & Wójcik, 2015).

In order to understand how holding companies, which are located predominantly in OFCs, are used by MNCs, I raised the second research question:

**RQ2:** “How are offshore financial centers used by MNCs?”

Answering this question requires an understanding of how corporations have fragmented (both operationally and legal-financially), and necessitates an exploration of the role that OFCs play in this process.

**Scale of tax avoidance**

*Tax advantages are generally perceived as the single biggest reason for the use of offshore financial centers.* (IMF, 2000)

The fragmentation of the firm, especially the relocation of important value-creating assets, allows corporations to shift profits to OFCs. However, the extent to which MNCs avoid taxes through profit shifting is unclear. This is mainly due to the lack of data. MNCs are only required to publish their aggregated
accounts. These financial reports reflect the global amount of MNC profits, employees, assets and other financial variables. Not disaggregating by country has hindered research on the extent of profit shifting. One exception to this is the United States. The United States had a worldwide tax system in which the worldwide profits of MNCs were taxed. In order to avoid double taxation, the U.S. offered a tax credit on the tax paid to foreign countries. Calculating the tax credit and the tax due required the U.S. to collect country-level information on the location of the profits and taxes of MNCs, which they then aggregated and made publicly available. These data allowed research on profit shifting as early as 1994, where Hines and Rice found that 38% of the profits of U.S. MNCs were shifted to subsidiaries in low-tax jurisdictions. The latest studies, using different methods, calculate the global profit shifted to be $600–$1100 billion a year (see e.g. OECD, Clausing, Tørsløv et al., Janský and Palanský, Cobham and Janský). That corresponds to around 40% of the profits made abroad by MNCs.

While these studies have been able to show the scale of profit shifting and the revenue losses for governments, they provide little information about the contribution of profit shifting to the decline of the tax rates paid by MNCs in the last decades (Fig. 1.6). There are several ways to measure the tax rates that

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20 Unlisted companies do not need to make aggregated (consolidated) accounts public, although they often do.

21 Country by country reporting (CBCR) is becoming a popular legislation. In the European Union, banks and extractive industries are already required to disclose disaggregated information. In the United States, all MNCs are required to fill CBCR. However, this information is not public except at aggregated level, which we use in Chapter 6.
MNCs pay (De Mooij & Ederveen, 2008; Fullerton, 1983)—see Garcia-Bernardo, Jansky, and Tørsløv (2019) for a summary of the recent literature. In general, effective tax rates can be divided into law-based rates, which are based on hypothetical tax rates that a future investment project would face, and data-based rates, which are based on taxes actually paid by firms to governments. Law-based rates measure the general tax rate of the country (statutory tax rate), the theoretical tax cost of new investments (average tax rate) or increased investments (marginal tax rate). Data-based rates are calculated using the ratio of corporate income tax to gross income (profits). They can however differ depending on the measure of taxation—e.g. cash taxes (actually paid to governments) or accountancy taxes (recorded in the financial reports). More importantly, they often differ due to the definition of profits. For instance, the commonly-used database from the Bureau of Economic Analysis (a U.S. governmental body) reports either “profit-type returns” or “net income,” both partially reflecting gross profits, but missing either non-operating income (in the case of profit-type returns), or double-counting part of the profits (in the case of net income).

Independently of the definition used, the effective tax rates paid by MNCs have been continuously decreasing since the 1960s. While understanding the effective tax rates paid by MNCs in different countries is important to show the scale of tax avoidance, this tells us little about the causes of the decline. For instance, it could be that statutory tax rates are declining worldwide, that the number of tax deductions is increasing, that there has been a change towards industrial sectors with higher tax deductions (e.g. real estate or finance), or that there has been an increase in profit shifting through OFCs. This raises our third research question:

**RQ3: “To what extent do offshore financial centers affect corporate taxation?”**

### 1.2.3 Actor 3: The enablers

Finally, the third actors involved in corporate tax avoidance are professional business service providers—e.g. law firms, trust agencies and accountants. They play a key role in connecting firms, governments, financial centers and offshore jurisdictions (Wójcik, 2013; OECD, 2008; Russell & Brock, 2016; Beaverstock, Taylor, & Smith, 1999). At the state level they advise governments...
on the design of tax policy (Seabrooke & Wigan, 2017), and small jurisdictions on how to become offshore financial centers (Dörry, 2016; McCann, 2006). Even as early as the late 19th century they played a key role in the liberalization of corporate regulation. This was the case for example in the regulation of New Jersey and Delaware, which led to the development of Delaware as the preferred place of incorporation for U.S. firms. Today, more than 50% of U.S. corporations, including more than two thirds of the Fortune 500 companies, are incorporated in Delaware (Delaware Division of Corporations, 2019). In contrast, only 0.3% of the U.S. population live in Delaware.

At the corporate level they advise firms in the design of their tax structures (Sikka & Willmott, 2013; Jones, Temouri, & Cobham, 2018; Ajdacic, Heemskerk, & Garcia-Bernardo, 2019), create the financial reports of corporations (where the valuation of intangibles and the classification of assets is established), and audit the financial reports. The market of professional services is highly dominated by four firms: EY, PWC, Deloitte and KPMG. The so-called Big 4 are involved at all levels of the tax system and play a key role in the creation of tax avoidance (Sikka & Willmott, 2013; McKee, Garner, & McKee, 2000; Ajdacic et al., 2019). For example, Jones et al. (2018) show that corporations that use the services of the Big 4 have a larger presence in offshore jurisdictions. In a recent paper, we show that not only do they have a larger presence in offshore jurisdictions, but also use more intermediate holding companies and exhibit more complex corporate structures (Ajdacic et al., 2019). Moreover, we find that this effect is only present for large MNCs.

Finally, tax professionals connect MNCs to governments. The Luxembourg Leaks (ICIJ, 2014) revealed the 548 tax rulings set up by PriceWaterHouseCooopers (on behalf of their MNC clients) with the Luxembourgian government. These leaks led the European Commission to investigate McDonalds, Amazon and GDF-Suez (Kofod & Theurer, 2015) and allowed those companies to avoid over $1 billion in European taxes Young, 2015. Given the fact that tax professionals design and maintain the financial products required for tax avoidance, it is perhaps not surprising that they are linked to most tax scandals—see McCann (2006, p. 158) for other examples.

Given their role in connecting firms to offshore financial centers, understanding their geographical location can give us insight into the places where tax
avoidance is orchestrated. This would allow us to assess whether current
regulation efforts focused on tax professionals can be successful. Previous
research on the geography of tax professionals has suffered from a lack of
comprehensive empirical data (Wójcik, 2013). In general, Clark and Monk
(2014), Wainwright (2011), Beaverstock et al. (1999) emphasize the importance
of London orchestrating tax minimization strategies. Poon, Tan, and Hamilton
(2019), using the (highly biased) data from the Panama Papers, find that many
intermediaries in tax avoidance are placed in small offshore financial centers.
In order to understand whether tax avoidance is orchestrated from developed
offshore financial centers such as London, or in small offshore financial centers,
I raise the fourth research question:

RQ4: “In which offshore financial centers is tax avoidance orchestrated?”

1.3 Summary of the dissertation

The following section details how the contributions of each chapter not only
answer the questions raised in the preceding sections, but also uncover and
characterize the emergence of “coordination centers” as the physical places
from which tax avoidance is orchestrated.

Chapter 2 introduces a novel data-driven approach for identifying OFCs based
on the position of countries within the global corporate ownership network.
The global corporate ownership network is a directed graph where the nodes are
subsidiaries of MNCs as well as independent firms and the links are ownership
relations. At the time of data collection, the network was composed of 97
million nodes and 71 million links. Since we know the jurisdiction in which
the subsidiaries are located, and since returns of capital flow through the
ownership network, we can analyze the importance of jurisdictions in relation
to financial flows. By splitting this network in chains of lengths two and
three subsidiaries long—similar to modeling the network as first- and second-
order Markov Chains—we are able to uncover higher-order dependencies in
the network. In particular, I found that OFCs can be divided into two groups.
The first group is sink-OFCs, which are jurisdictions appearing at the top of
corporate structures. Sink-OFCs attract and retain foreign capital. The second

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23 e.g. lawyers, accountants, financial advisors, banks and other service providers are required to
report to tax authorities on any structures created on behalf of their clients that could be used to
hide the ownership of assets (OECD, 2017).
group is conduit-OFCs, which are jurisdictions appearing in the middle of corporate structures. Conduit-OFCs are attractive intermediate destinations in the routing of international investments. We identify 24 sink-OFCs, mostly former and current British colonies and territories. In addition, a small set of five countries—the Netherlands, the United Kingdom, Ireland, Singapore and Switzerland—canalize the majority of corporate investment from and towards sink-OFCs, and as such play a key role in the coordination of the operations of MNCs.

In Chapter 3 we expand on the distinction between sink-OFCs and conduit-OFCs and further characterize profit centers and coordination centers. Instead of looking only at corporate ownership structures, we explicitly detail the process of the operational and legal-financial unbundling of the firm, a process that we call “the great fragmentation of the firm.” We argue that holding companies are a key component in the conceptualization of MNCs. Furthermore, we disaggregate the structure of the firm in its basic functions: manufacturing affiliates, shared service centers, R&D facilities, intermediate holding companies and top holding companies. We show that in the European Union the location of different types of subsidiaries is associated with different macro-institutional and tax indicators. Furthermore, we use cluster analysis to find complementarities between the types of subsidiaries that countries are able to attract, which allows us to identify five different FDI attraction profiles. The countries corresponding to each FDI attraction profile are highly successful at attracting specific combinations of subsidiaries. Two of these FDI attraction profiles are successful at attracting holding companies and as such can be considered offshore financial centers; we name them profit centers and coordination centers. Profit centers are jurisdictions that attract both top and intermediate holdings of MNCs and a disproportionate amount of their profits. They do so through extremely low tax rates and lenient regulation. Coordination centers are jurisdictions that attract intermediate holdings of MNCs and high value-adding shared service centers, and as such play a central role in the coordination of the different functions of MNCs. They do so via a highly skilled workforce, good infrastructure, a stable political climate, and tax features specifically created to attract holding companies. These tax features include low withholding taxes, a large network of double tax treaties, and the presence of patent boxes and special treatment of group interest income. Interestingly, we find that all European conduit-OFCs are, in fact, coordination centers. They are
not only important in relation to financial flows, but also attract managerial and other high value-adding activities, pointing to a wider role of these conduits not only as empty conduits of financial flows, but as orchestrators of tax avoidance. While our analysis is restricted to E.U. data, I argue that Singapore, the only non-European conduit-OFC, should also be considered a coordination center. Among E.U. sink-OFCs, we find that Malta and Cyprus correspond to profit centers, and Luxembourg can be considered both a profit and a coordination center—a double role that I also expect from Hong Kong.

In Chapter 4, we show that coordination centers play a key role in corporate tax avoidance. We do this by mapping the geographical dispersion of tax professionals, who are responsible for tax planning for MNCs. Accessing data on this profession is challenging, however. To obtain a representative sample of their location, we develop a novel data-collection method based on the advertisement tool of LinkedIn: the LinkedIn Campaign Manager. The LinkedIn Campaign Manager facilitates the targeting of advertisements to specific audiences, defined based on location, job title and company size, among other criteria. This allows us to target advertisements to tax professionals and obtain the potential total number of tax professionals that are theoretically able to see the advertisement. We then analyze this dataset to show that tax professionals are indeed located in coordination centers. However, we show that while their location correlates with the location of financial and managerial activity, it correlates neither with the location of productive economic activity, nor with measures of financial secrecy or profit shifting. Given that coordination centers play a key role in the coordination of MNCs, it is not surprising that tax avoidance is also orchestrated from their midst in conjunction with finance and management. Finally, we did not find a significant relationship between tax professionals and measures of secrecy or profit shifting. This strengthens the view that profit centers (or sinks) are just empty shells where profits are booked.

Chapter 5 looks into the incentives of MNCs to internationalize, a crucial topic in the strategic management and international business fields. The literature on internationalization exposes four basic motivations to internationalize: access to resources, access to markets, efficiency gains, and acquisition of strategic assets (Thomsen, 1994; Blonigen, 2005). In this chapter, we analyze the efficiency gains hypothesis, which postulates that firms internationalize in order to increase performance. Measuring the pre-tax efficiency gains
of MNCs, we find no support for this hypothesis at the within-firm level. However, it has been hypothesized that gaining access to the offshore system is an important motivation for the firm to internationalize (Picciotto, [1999]; Palan, [1998]). This would likely be reflected in higher after-tax efficiency gains, which paves the way for new studies looking at the after-tax efficiency gains of internationalization, and the role of profit and coordination centers in the process.

Chapters 6 and 7 analyze the location of the profits, taxes, and real activity of MNCs. Chapter 6 analyzes offshore financial centers in relation to misaligned profits—that is, profits found in a jurisdiction without corresponding real activity. Using six different datasets on U.S. MNCs, we find a similar and small set of jurisdictions accounting for the majority of misaligned profits. Among such profit centers we find Bermuda, the Cayman Islands, the British Virgin Islands and Puerto Rico. Importantly, we find that coordination centers—in particular the Netherlands, Ireland, Switzerland and Luxembourg—are able to attract a large share of the profits of U.S. MNCs, which was not so much the case a decade ago (Fig. 1.7). We also find that the location of misaligned profits correlates extremely well with the effective tax rate paid by MNCs in the jurisdiction, but not with the statutory tax rate. Coordination centers such as the Netherlands and Luxembourg, with relatively high statutory corporate tax rates, are able to attract a large fraction of U.S. profits through low effective tax rates. This, as we explored before, is due to their ability to offer lower tax rates to financial profits. The low effective tax rates and high profits in coordination centers reflect the challenges of regulating corporate tax avoidance. Introducing withholding taxes and economic sanctions is a feasible policy in the case of far-flung Caribbean islands. Coordination centers, however, are strong, developed countries, and are used by MNCs as bases from which to invest in other countries. Introducing capital barriers to those countries is politically and economically difficult. This limitation of policy options is likely to intensify tax competition.

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24 We use data on U.S. MNCs for three reasons. Firstly, U.S. MNCs account for the largest share of foreign investment. Secondly, high-quality data is only available for U.S. MNCs. Thirdly, Chapter 7 compares U.S. and E.U. MNCs.

25 Within the European Union, where most coordination centers are located, introducing withholding taxes is not allowed. Introducing withholding taxes to, for example, Singapore, would be a feasible tax policy. However, as long as one European country chooses not to do so, MNCs could avoid those taxes by investing through that jurisdiction.
Chapter 7 builds on the previous analysis of profit shifting and develops a framework to decompose the decline of effective tax rates for both E.U. and U.S. MNCs. We find that effective tax rates have decreased in the last decade by 9.7% and 7.1% respectively, and that both the tax rates on profits made domestically and abroad have declined similarly. We show that the majority of the decline in tax rates is explained by falling statutory tax rates and tax bases, and increased profit shifting only accounts for between 5% (E.U. MNCs) and 30% (U.S. MNCs) of the decline in effective tax rates. Importantly, profit shifting has increased the most to Switzerland (4.2 percentage points), the Netherlands (4.0 percentage points), Ireland (3.3 percentage points) and Singapore (2.7 percentage points). Compared with 2005, an extra 14.2% of the global profits of U.S. MNCs are booked in those four coordination centers, which highlights the growing importance of those jurisdictions. As mentioned in the previous paragraph, the growing importance of coordination centers may intensify tax competition. While increased profit shifting explains only up to one third of the decline in effective tax rates, the reduction in statutory tax rates and tax bases can be seen as a response to profit-shifting-promoted tax competition. In this sense, our analysis coincides with the implications of Keen et al. (2014), which shows that the revenue losses to governments from tax competition are potentially four to six times larger than that from profit shifting itself.

Chapter 8 analyzes the completeness of the main dataset used in this dissertation: Orbis. The Orbis dataset contains information from over...
300 million companies, compiled from country registers and other country collection agencies. Moreover, it presents a novel method to increase the accuracy of the dataset. Apart from Chapter 8, this dissertation provides a number of additional methodological contributions to the analysis of corporate tax avoidance and offshore finance. Chapter 2 provides a new method of analyzing corporate ownership networks, which enables the identification and measurement of both conduit-OFCs and sink-OFCs. Chapter 4 provides a novel method of exploring the geographical dispersion of hard-to-study professions, which can be further used to analyze the composition of any given profession—e.g. age, sex, industrial sectors. Chapters 2, 3, 6 and 7 all combine databases, clean them and make them available to other researchers’ databases.

Finally, Chapter 9 concludes and connects the findings from this dissertation to larger debates on corporate power, tax reform, macroeconomic statistics and inequality.

The emergence of coordination centers

RQ1: Which jurisdictions are offshore financial centers?

This dissertation tackles this question from four different angles. First, looking at financial flows in the global corporate ownership network, I find that OFCs are divided into two classes: sink-OFCs and conduit-OFCs. Sink-OFCs are located at the top of corporate structures and are composed of 24 jurisdictions, mostly current and former U.K. colonies and territories. Conduit-OFCs are located in the middle of corporate structures and comprise six main jurisdictions: Switzerland, the Netherlands, Ireland, the United Kingdom, Belgium and Singapore. Two sink-OFCs, Hong Kong and Luxembourg, play a double role and could also be considered conduit-OFCs. Second, looking at the fragmentation of the firm in the context of the European Union, I again find two different types of OFCs: profit centers and coordination centers. Unsurprisingly, since holding companies play a key role in the fragmentation of the firm, the list of profit and coordination centers greatly overlap with the list of sink and conduit OFCs. The two profit centers in the E.U., Malta and Cyprus, are also sink-OFCs. The six coordination centers—Switzerland, the Netherlands, Ireland, the United Kingdom, Belgium and Luxembourg—are also conduit-OFCs. Luxembourg plays a double role in-between profit and coordination centers. Third, looking at the location of tax professionals, I identify a strong link between offshore financial centers and the places from which tax avoidance
is orchestrated. I find that while the tax industry is relatively important in profit centers (or sink-OFCs), the majority of the activity happens within coordination centers. Here, I again find that the Netherlands, Luxembourg, Singapore, Switzerland and the United Kingdom could be considered OFCs. Interestingly, I find that the United States and Canada also have high ratios of tax professionals. Finally, looking at the location of the profits of U.S. MNCs, I identify OFCs as the places that disproportionally accumulate (at least on paper) the profits of MNCs. With this analysis I confirm the importance of three profit centers (Bermuda, the Cayman Islands and the British Virgin Islands) and four coordination centers (Switzerland, the Netherlands, Luxembourg and Ireland). While the different chapters provide slightly different lists, a clear pattern of specialization emerges. We need, therefore, to think of two types of OFC. The first, the profit center, resembles the conventional idea of the tax haven—a small island state with no taxation and high secrecy that attracts a large amount of profit. Among these, Bermuda, the British Virgin Islands and the Cayman Islands are the largest profit centers. The second, the coordination center, is a place from which corporate tax avoidance is orchestrated and increasingly used to book profits. The main such examples are the Netherlands, Switzerland, Luxembourg, Ireland, the United Kingdom and Singapore, with Hong Kong and Belgium playing a secondary but relevant role.

RQ2: How are offshore financial centers used by MNCs?
The use of OFCs by MNCs depends on the type of OFC. Profit centers play a role in the organization of MNCs through intermediary and top holding companies. The profit per employee in those jurisdictions is usually above $500,000/employee, which reflects the lack of real activity in those jurisdictions. Coordination centers play a key role in the organization of MNCs. They are important not only for profit shifting through holding companies, but also for regional management, financing operations and high value-adding activities such as procurement, marketing, sales and distribution. Moreover, they serve as the point of contact between tax professionals and corporate management.

RQ3: To what extent do offshore financial centers affect corporate taxation?
Offshore financial centers affect corporate taxation in three ways. The first way is by being the location where tax strategies are designed and implemented, which we explore in RQ4 below. The second way is by hosting the profits of
MNCs and offering low effective tax rates. I find that 5–30% of the decline in effective tax rates in the last decade is due to an increase in profit shifting to offshore financial centers. Profit centers have historically played a key role as the places where MNCs stashed their profits. This is still the case today. Bermuda, the Cayman Islands and the British Virgin Islands are among the jurisdictions with the highest amount of profits booked by U.S. MNCs. However, I find that coordination centers play an increasingly larger role in relation to profit shifting. In the last decade, 14.2% of all profits from U.S. MNCs have been shifted to four coordination centers: the Netherlands, Switzerland, Ireland and Luxembourg. MNCs in those jurisdictions pay a 10.8% points lower tax rate than the average—a similar tax rate to the one in Bermuda. The last way in which offshore financial centers affect corporate taxation is indirectly, through tax competition. By increasing the ability of MNCs to escape taxation, offshore financial centers may be contributing to a “race to the bottom” in corporate taxation, whereby jurisdictions reduce corporate income tax rates in order to retain or attract subsidiaries of MNCs. This is especially relevant in the case of coordination centers. Regulation (e.g. through the introduction of withholding taxes) of profit centers is politically and economically feasible. This is not the case for developed countries in the heart of the European Union. Future research should investigate the role of these countries in potentiating tax competition.

RQ4: In which offshore financial centers is tax avoidance orchestrated?

This dissertation reveals the importance of coordination centers in the orchestration of corporate tax avoidance. These are the jurisdictions that provide the regulatory underpinning necessary for corporate tax avoidance. They are developed countries whose economy is not only based on attracting the profits of MNCs, which make them politically difficult to regulate. They have wide networks of treaties with other countries, and serve as the point of access to large markets (the European Union, China and other Asian economies), which makes them perfect locations for holding companies. They have a highly skilled workforce and good infrastructure, which makes them equally perfect locations for regional headquarters and high value-adding activities. They have a business-friendly mentality, where governments are willing to give tax advantages to MNCs. Likely because of this combination of factors, tax
professionals, in conjunction with the assent of the governments and regional management, orchestrate tax planning from those jurisdictions.

Corporate tax avoidance deprives governments of tax revenues, privileges large MNCs over small and medium-sized enterprises, and contributes to the increase in within-country inequality experienced in recent decades. This dissertation employs an interdisciplinary approach to open the black box of corporate tax avoidance, combining theories and methods from political science, economics, international business and management, and computer science. This interdisciplinary approach allows me to reveal the role that offshore financial centers, and especially coordination centers, play in corporate tax avoidance. By doing so, this dissertation shows potential avenues for regulation. A radical transformation of the international tax system, limiting the potential harmful effects of coordination centers, should be the focus for policy efforts towards stopping corporate tax avoidance.

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REFERENCES


Actors 3: The enablers


CHAPTER 2

Typology of Offshore Financial Centers: Conduits and Sinks

This chapter introduces a novel data-driven approach for identifying OFCs based on the position of countries within the global corporate ownership network. The global corporate ownership network is a directed graph where the nodes are subsidiaries of an MNC and the links are ownership relations. At the time of data collection, the network was composed of 97 million nodes and 71 million links. Since we know the jurisdiction in which the subsidiaries are located, and since returns of capital flow through the ownership network, we can analyze the importance of jurisdictions in relation to financial flows. By splitting this network in chains of lengths two and three subsidiaries long—similar to modeling the network as first- and second-order Markov Chains—we are able to uncover higher-order dependencies in the network. In particular, I found that OFCs can be divided into two groups. The first group is sink-OFCs, which are jurisdictions appearing at the top of corporate structures. Sink-OFCs attract and retain foreign capital. The second group is conduit-OFCs, which are jurisdictions appearing in the middle of corporate structures. Conduit-OFCs are attractive intermediate destinations in the routing of international investments. We identify 24 sink-OFCs, mostly former and current British colonies and territories. In addition, a small set of five countries—the Netherlands, the United Kingdom, Ireland, Singapore and Switzerland—canalize the majority of corporate investment from and towards sink-OFCs, and as such play a key role in the coordination of the operations of MNCs.
Abstract

Multinational corporations use highly complex structures of parents and subsidiaries to organize their operations and ownership. Offshore Financial Centers (OFCs) facilitate these structures through low taxation and lenient regulation, but are increasingly under scrutiny, for instance for enabling tax avoidance. Therefore, the identification of OFC jurisdictions has become a politicized and contested issue. We introduce a novel data-driven approach for identifying OFCs based on the global corporate ownership network, in which over 98 million firms (nodes) are connected through 71 million ownership relations. This granular firm-level network data uniquely allows identifying both sink-OFCs and conduit-OFCs. Sink-OFCs attract and retain foreign capital while conduit-OFCs are attractive intermediate destinations in the routing of international investments and enable the transfer of capital without taxation. We identify 24 sink-OFCs. In addition, a small set of five countries—the Netherlands, the United Kingdom, Ireland, Singapore and Switzerland—canalize the majority of corporate offshore investment as conduit-OFCs. Each conduit jurisdiction is specialized in a geographical area and there is significant specialization based on industrial sectors. Against the idea of OFCs as exotic small islands that cannot be regulated, we show that many sink and conduit-OFCs are highly developed countries.

2.1 Introduction

Multinational corporations use highly complex corporate structures of parents and subsidiaries to organize their global operations and ownership structure. For example, the Britain-based banking and financial services company HSBC is composed of at least 828 legal corporate entities in 71 countries. The largest brewing company in the world, Anheuser-Busch InBev, consists of at least 680 corporate entities involving 60 countries. These complex corporate structures purposefully span across countries and jurisdictions in order to increase competitive advantage by minimizing costs and accountability (Seabrooke & Wigan, 2017). Some jurisdictions are particularly popular, such as Bermuda, the British Virgin Islands, and the Cayman Islands (Fichtner, 2016). Often referred to as Offshore Financial Centers (OFCs), these jurisdictions attract financial activities from abroad through low taxation and lenient regulation. With an estimated 50% of the world's cross-border assets and liabilities (US$21-US$32
trillion) passing through OFCs (Henry, 2012; Palan, Murphy, & Chavagneux, 2013) they have become dominant nodes in the transnational financial-economic network in which capital is stored and redistributed. The largest OFCs generally have well-developed regulatory institutions and comply with international laws on trade and money laundering (Rixen, 2013). At the same time, the services that OFCs offer are increasingly under scrutiny for, amongst others, facilitating corporate tax avoidance. We consider that OFCs are not only places where capital is ‘stored’, but act as nodes in a complex network of international capital flows. We suggest a novel approach for identifying and classifying offshore financial centers based on the underlying large-scale granular firm level ownership data.

Corporations create complex corporate ownership structures for at least three reasons. First, corporations seek to increase legal protection. By organizing parts of their corporate structure in certain trusted territories with favorable legal conditions they can increase legal certainty for their operations or for joint-ventures. And by setting up subsidiaries in specific jurisdictions and using such subsidiaries to invest in other countries, multinationals can hedge their investment against decisions of governments. Second, favorable regulatory regimes in OFCs can be used by companies to avoid corporate accountability and public scrutiny of their operations, i.e. regulatory arbitrage. For instance, many of the opaque structured financial products that aggravated the global financial crisis since 2008 were created in OFCs (Lysandrou & Nesvetailova, 2015; Fernandez & Wigger, 2016). Third, complex corporate ownership structures help to minimize tax payments—especially for corporations that have many intangible assets, such as intellectual property rights (Bryan, Rafferty, & Wigan, 2017). For instance, between 2007 and 2009 Google moved the majority of its profits generated outside the United States (US$12.5 billion) to Bermuda through corporate entities in the Netherlands. As a result Google paid an effective tax rate of 2.4% on all operations (Drucker, 2010). Similarly, Apple used Ireland to avoid US$14.5 billion in taxes since 2003 (European Commission, 2016), and Starbucks UK voluntarily payed £20 million after it came to light that it had paid virtually no taxes since establishing in the UK (Houlder, Pickard, Lucas, & Jopson, 2012). In total, every year multinationals avoid paying US$50-200 billion in taxes in the European Union using OFCs (Dover, Ferret, Gravino, Jones, & Merler, 2015). In the United States, tax evasion by multinational corporations via offshore jurisdictions is estimated
to be at least US$130 billion per year (Zucman, 2014). While reducing costs is in general a valid concern for corporations, these practices significantly diminish tax revenues and as such may inhibit the capacity of states. Moreover, tax avoidance provides a competitive advantage to multinationals over small and middle sized companies, which are taxed at national rates—ranging between 25 and 35% for most developed countries.

Given the policy-concerns caused by the use of OFCs in recent years, the identification of OFC jurisdictions has become a politicized and contested issue. The International Monetary Fund (IMF) and the Organization for Economic Co-operation and Development (OECD) have published lists of OFCs based on a qualitative assessment of the jurisdictional regulations and taxation frameworks. However, this approach says little about the real-world relevance of specific jurisdictions as OFCs and is also vulnerable to political influence. In contrast to these qualitative approaches, Zoromé has defined OFCs as jurisdictions that ‘provide financial services to nonresidents on a scale that is incommensurate with the size and the financing of their domestic economies’ (Zorome, 2007). Zorome (2007) as well as Cobham, Janský, and Meinzer (2015) used flow data on the export of financial services to calculate ratios that indicate how significantly a jurisdiction acts as an OFC. Fichtner further expanded this approach by using stock data on international banking assets, portfolio investment, and foreign direct investment (FDI) in relation to the gross domestic product (GDP) of a jurisdiction to calculate an ‘offshore-intensity ratio’ (Fichtner, 2018). While the offshore-intensity ratio approach identifies which countries have a disproportionate value of inward foreign investment, it is limited in at least two ways. First, aggregated national statistics such as FDI are subject to political preferences and influence (Mügge & Stellinga, 2015). For instance, inward FDI is systematically underreported (International Monetary Fund, 1992). Second, the existing methods cannot shed light on the position of a jurisdiction in the broader network of capital flows since they are not able to differentiate if the inward foreign investment reported by Bermuda originates in the Netherlands, or if in contrast it originates in Germany and is routed through the Netherlands.

We propose a novel network analytic approach to identify OFCs based on a country’s position in the network of global corporate ownership. In contrast to prior work, our approach characterizes countries based on a distinction
between sink-OFCs and conduit-OFCs. Sink-OFCs are countries that attract and retain foreign capital—territories in this category are usually characterized as tax havens, such as the British Virgin Islands, the Cayman Islands and Bermuda. Most sink-OFCs have small domestic economies and large values of foreign assets, which are attracted through low or zero corporate taxes. Because of this disparity between the local economy and external assets, the aforementioned offshore-intensity ratio approach is well suited for identifying these sink-OFCs (Fichtner, 2018). Conduit-OFCs on the other hand are ‘countries that are widely perceived as attractive intermediate destinations in the routing of investments’ (Keen et al., 2014). Conduit-OFCs typically have low or zero taxes imposed on the transfer of capital to other countries, either via interest payments, royalties, dividends or profit repatriation. In addition, such jurisdictions have highly developed legal systems that are able to cater to the needs of multinational corporations. Conduits play a key role in the global corporate ownership network by allowing the transfer of capital without taxation. In this way, profit from one country can be re-invested in another part of the world paying no or little taxes. Countries such as the Netherlands and Ireland have been criticized for these types of activities (Oxfam, 2016).

The building blocks of our method for identifying OFCs are what we call global ownership chains (GOCs), in which a series of companies are connected in a chain if for each two directly subsequent entities $A$ and $B$, it holds that firm $A$ is owned by firm $B$, i.e., there is a link between them in the ownership network. Under European Union regulations (Council Directive 2003/123/EC), transfers of capital without taxation are typically only allowed through ownership links from subsidiaries to parents, meaning that value can flow from $A$ to $B$. These EU regulations are expanded to other countries via tax treaties, allowing companies to transfer capital outside the EU through corporate structures. Based on the value going through these international ownership chains, we propose two new centrality measures specifically aimed at measuring the extent to which a jurisdiction is a sink-OFC or conduit-OFC. We furthermore introduce an entropy-based metric that can characterize the specialization of an OFC in terms of which countries it services.

The proposed network analytic approach to identifying OFCs has a number of advantages. First, it makes no $a$ priori assumptions about the global economy and the countries involved; the possible identification of a country
2.2. Methods

2.2.1 Data extraction and quality assessment

We sourced company ownership data from the Orbis database (http://orbis.bvdinfo.com) in November 2015. Orbis is a unique and frequently used information provider that covers about 200 million public and private firms worldwide (Glattfelder, 2010; Heemskerk, Takes, Garcia-Bernardo, & Huijzer, 2016) compiled from official country registrars and other country collection agencies. For each available company, we extracted its operating revenue, country, city, sector, global ultimate owner (the parent firm who owns at least 50% of the company directly or indirectly and is not itself owned by any other firm) and all ownership relationships, with the direct and total ownership percentage. Moreover, since companies located in Isle of Man (IM), Jersey (JE) and Guernsey (GG) use the country code of the United Kingdom, every company located in IM, JE or GG cities was given the country code of the territories (see Supplementary Methods). The resulting dataset contains as an OFC is purely data-driven. Second, it does not rely solely on aggregated macroeconomic indicators that may introduce significant noise and deviations, but on fine-grained data of firm-level corporate ownership. Third, this firm-level data allows us for the first time to quantitatively identify and distinguish between both sink-OFCs and conduit-OFCs. Fourth, our approach is also suitable to classify and characterize the specialization of OFCs across geographic regions and industrial sectors. OFC specialization is a key issue from a policy and regulatory perspective, but cannot be answered by existing quantitative methods. If OFCs are not specialized and occupy structural and functional equivalent positions in the network of global corporate ownership, we can assume that firms can easily re-organize their corporate structures to other OFCs in the wake of regulation (Weyzig, 2013). On the other hand, if OFCs are specialized then there is likely more room for tailored policy interventions and regulation. Our research demonstrates that—contrary to the still prevalent conjecture that offshore finance resembles an ‘atomized’ marketplace in which a multitude of approximately equal jurisdictions compete and where regulation is therefore unfeasible—the corporate use of OFCs is in fact concentrated in a small number of key jurisdictions, most of which are highly-developed OECD countries.
71,201,304 distinct ownership relationships between 98,255,206 companies. Note that our data selection method does not include private wealth, only corporate structures are considered.

Data quality of Orbis differs across regions. Firm coverage is better for high-income countries than for low-income countries (Cobham & Loretz, 2015; Garcia-Bernardo & Takes, 2018). In the United States, a significant number of companies registered in the state of Delaware are not covered because they are not required to file information—a problem shared between all corporate information providers. In general, poor data quality is associated with fiscal secrecy since these jurisdictions do not consistently report the companies registered in their territories. So, if we are missing data, then this data is more likely to be missing in an OFC than in a non-OFC. Therefore, the findings that we report likely represent a lower bound on the position of offshore financial centers in the corporate ownership network.

Two extra steps were done to ensure a correct analysis of the data. First, we deconsolidated financial accounts. Generally, only consolidated financial information is available for large companies—i.e., the revenue of all the subsidiaries is reported in both the subsidiaries and the parent company. We corrected this by recursively subtracting the operating revenue of all subsidiaries of companies with consolidated accounts along all paths of ownership relations (see Supplementary Methods). Second, since the information is collected by different country-level agencies and merged by Orbis, the sum of the ownership stakes was normalized as in Vitali, Glattfelder, and Battiston (2011) to account for missing shareholders (see Supplementary Methods).

2.2.2 From company data to global corporate ownership chains

In this section we outline our approach that from the ownership data constructs country chains which can ultimately be used to detect OFCs. For theoretical definitions of the the different concepts in each of these construction steps, the reader is referred to the Supplementary Methods.

Ownership network

We considered the network of ownership relations as a directed graph with the firms as nodes and the links as ownership relations, where value flows from
corporate entities to their owners. The structure of this network itself has been extensively studied and exhibits common properties of complex networks such as a power-law degree distribution and weight (strength) distribution. We can furthermore observe the emergence of a giant weakly connected component capturing the majority of corporations in the network, as well as a bow-tie structure featuring a smaller strongly connected component in the center. The remainder of this paper considers the derivation of chains from the ownership links, and is not directly concerned with further exploration of the network’s macro level structure. As such, for more details the reader is referred to the excellent study of the global ownership network by Vitali et al. [2011].

Company level chains
From the set of over 71 million ownership relations we identified the global corporate ownership chains (GCOCs) as follows. For each node, we applied a depth-first search algorithm, exploring the resulting network as far as possible along each branch before backtracking, forming chains from the starting node. We continued adding nodes to a chain until the multiplicative ownership fell below 0.001 (for instance, four companies in a chain owning 10% of the next). Chains reaching the origin node (i.e., loops) or a node previously visited in the considered chain were ignored to avoid infinite loops. The results are robust to variations of the multiplicative ownership threshold (Supplementary Information). Our approach still reflects country round-tripping (where value flows from country A to B and to A again) since this strategy requires two different companies in country A. We repeated this process for all nodes in the network, which resulted in a set of 11,404,819 ownership chains.

Multiplicative ownership
For each ownership chain we determined its value using the weighting method by Vitali et al. [2011]. It weighs the value $V_p$ of a chain $p$ in terms of the revenue of the initial company in the chain: $V_{C_1|C_2|C_3} = R_{C_1} \cdot MO_{C_1|C_2|C_3}$. Here $C_1|C_2|C_3$ corresponds to a chain of three companies in which $C_2$ owns $C_1$ and $C_3$ owns $C_2$, $R_{C_1}$ is the operating revenue of company $C_1$ and $MO$ is the multiplicative ownership, i.e., the product of the weights of the links between the subsequent firms in the chain.
Aggregating at the country level

Next we determined the country of domicile for each corporate node in a GCOC. Given our goal of studying transnational links, we merged together adjacent nodes in a chain that are located in the same country. Finally, we divided each chain into chunks of length 2, 3, …, |chain|, which resulted into 108,159,506 chunks. In order to avoid double counting revenue, we kept the maximum revenue for each group of chunks matching to the same country level chain, the same owner and the same upstream companies. For instance, we can have a chain \( A_1 | A_2 | B_1 | B_2 \), where companies \( A_1 \) and \( A_2 \) are located in country \( A \), and companies \( B_1 \) and \( B_2 \) are in country \( B \). From this chain, we can create all chunks in Figure 2.1A, matching to the same country chain \( (A | B) \). Since the value originates in the same company \( (A_1) \), it has the same owner in country \( B \) \((B_1)\), and the flow happens through the same companies \( (A_1 | A_2) \), we only keep the chunk with the largest value. In this way we obtained 16,448,469 chains.

After grouping all chains going through the same countries we obtained 377,098 different country-level ownership chains (e.g. \( ES | NL | LU \)). In these chains value flows from a company in the source (ES) to an owner in the sink (LU) (the sink owns the source either directly or through conduit countries). Next, we identify OFCs based on particular motifs in the ownership chains.

2.2.3 Finding Sink and Conduit Offshore Financial Centers

Avoiding double counting of sinks and conduits

In order to identify sinks and conduits we focus on two subsets of country chains. The first subset contains 52,655 chains of size three and is used for the conduit-OFC analysis. This selection strategy ensures that conduits (countries
in the middle of an ownership chain) are not double counted (Fig. 2.1B–C). For instance, using chains of length four would result in double counting country C in Fig. 2.1C. The second subset contains 7,172 chains of size two and is used for the sink-OFC analysis. This selection strategy ensures that sources and sinks are not counted twice.

**Sink Offshore Financial Centers (sink-OFCs)**

Sink-OFCs are jurisdictions that attract and retain foreign capital, i.e., jurisdictions in which GCOCs end. Thus, we define the sink centrality \( S_c \) of a country as the difference of value entering and leaving the country, divided by the sum of all value in the network. Moreover, since this difference is proportional to the size of the country, we normalized the centrality by the gross domestic product (GDP) of the country.

\[
S_c = \frac{\sum_{g \in G^2: g[1]=c} V_g - \sum_{g \in G^2: g[0]=c} V_g}{\sum_{g \in G^2} V_g} \cdot \frac{\sum_i GDP_i}{GDP_c},
\]

Here, \( G^2 \) is the set of country chains of size two and \( g[i] = c \) means that the \( i \)-th country in country chain \( g \) is country \( c \). Furthermore, \( GDP_c \) is the GDP of country \( c \). Using the measure in Equation 2.1 we define as sink offshore financial centers (sink-OFCs) those countries that have a disproportional amount of value staying in the country, where a disproportional amount is set to 10—i.e., the value staying in the country is 10 times higher than the value that would correspond to the country in terms of its GDP. The results are robust to variations of this threshold (Supplementary Information).

**Conduit Offshore Financial Centers (conduit-OFCs)**

We define conduits as *jurisdictions that act as intermediate destinations to sink-OFCs*. The conduit centrality \( C_c \) of a country \( c \) is defined in two axes. The first axis, inward conduit centrality \( (C_{cin}) \), measures the value of chains flowing from a sink-OFC, into the conduit, out to another country. The second axis, outward conduit centrality \( C_{cout} \), measures the value of chains flowing from any country, into the conduit, out to a sink-OFC. Since this flow is proportional to the size of the country, we normalized the centrality by the gross domestic product (GDP) of the country.
Here, $G^3$ are chains of length three, $G^3_{s1}$ is the subset of $G^3$ in which the first country in the chain is a sink-OFC. Analogously, $G^3_{s3}$ is the subset of $G^3$ in which the third and last country in the chain is a sink-OFC. Countries with a $C_c$ larger than 1 in both axes ($C_{cin}$ and $C_{cout}$) were considered conduit-OFCs. We empirically found that the division between conduit-OFCs and other countries occur naturally around $C_{c(in/out)} = 1$ (Supplementary Information).

In order to understand if a country $c$ serves as a conduit for many other countries or only a few, we calculate the Shannon entropy of the distribution of values leaving ($EC_{cout}$) or entering ($EC_{cin}$) the country in chains of size three. Shannon entropy is lower for conduits catering to few countries and more skewed value distributions—i.e., most of the value coming from the same country; and higher for conduits catering to many countries and with more even distributions.

$$EC_{cin} = - \sum_i (V_{i|c|s} \log (V_{i|c|s})),$$

$$EC_{cout} = - \sum_i (V_{s|c|i} \log (V_{s|c|i})),$$

Where $V_{i|c|w}$ denotes the sum of value in all $G^3$ where the source is country $i$, the conduit is country $c$ and $s$ is any sink-OFC, normalized such that $\sum_i (V_{i|c|s}) = 1$. 

### 2.3 Results

#### 2.3.1 Identifying Sink Offshore Financial Centers

We first identified sink and conduit Offshore Financial Centers. Figure 2.2A shows the sink-OFC centrality for every country, with the absolute value of the
metric on the horizontal axis and the proper GDP-normalized value on the vertical axis (see Methods). Node size reflects the sum of all value entering or leaving the country. Orange colored countries receive more value than they send and are thus net sinks. Green countries cannot be sink-OFCs because they are net senders.

Figure 2.2. Sink and conduit centralities (A) Absolute value of the sink-OFC centrality versus absolute value of the sink-OFC centrality without the GDP normalization. The color of the node indicates the sign of the sink-OFC centrality (green are negative, orange are positive). The size of the node is proportional to the sum of the value entering and leaving the country. (B) Inward vs outward conduit centrality. (C) Average conduit centrality (in and out) versus average entropy of the distribution of value (in and out). (D) Value flowing through the conduit to non-sink-OFC countries versus non-normalized conduit centrality (value flowing through the conduit to sink-OFC countries). Color in plots B–D indicates function; sink-OFCs are colored in red, conduit-OFCs are colored in green, and all other countries are colored in blue.

We denoted the 24 orange colored countries above the factor 10 threshold in Fig. 2.2A as sink OFCs (Tables S1 and S2). The sink-OFC centrality is proportional to FDI and as such mirrors the offshore intensity ratio approach (Fichtner, 2018) for identifying sink-OFCs (Supplementary Fig. S1). Our list of sink-OFCs is indeed associated with territories with low or zero corporate taxes, where capital accumulates. While Panama is well known as a tax haven, our approach does not identify it as a sink-OFC. Panama is mainly a tax haven for individuals and with relatively high corporate taxes (25%) is less attractive for corporate groups. In the notorious Panama Papers (https://panamapapers.icij.org) the large majority of the involved shell companies were actually domiciled in the British Virgin Islands (VG).
Identifying Conduit Offshore Financial Centers

Table 2.1. List of sink-OFCs, ordered by sink centrality value.

<table>
<thead>
<tr>
<th>ISO2</th>
<th>Country name</th>
<th>$S_c$</th>
<th>ISO2</th>
<th>Country name</th>
<th>$S_c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG</td>
<td>British Virgin Islands</td>
<td>5235</td>
<td>NR</td>
<td>Nauru</td>
<td>67</td>
</tr>
<tr>
<td>TW</td>
<td>Taiwan</td>
<td>2278</td>
<td>CY</td>
<td>Cyprus</td>
<td>62</td>
</tr>
<tr>
<td>JE</td>
<td>Jersey</td>
<td>397</td>
<td>SC</td>
<td>Seychelles</td>
<td>60</td>
</tr>
<tr>
<td>BM</td>
<td>Bermuda</td>
<td>374</td>
<td>BS</td>
<td>Bahamas</td>
<td>40</td>
</tr>
<tr>
<td>KY</td>
<td>Cayman Islands</td>
<td>331</td>
<td>BZ</td>
<td>Belize</td>
<td>38</td>
</tr>
<tr>
<td>WS</td>
<td>Samoa</td>
<td>277</td>
<td>GI</td>
<td>Gibraltar</td>
<td>34</td>
</tr>
<tr>
<td>LI</td>
<td>Lichtenstein</td>
<td>225</td>
<td>AI</td>
<td>Anguilla</td>
<td>27</td>
</tr>
<tr>
<td>CW</td>
<td>Curacao</td>
<td>115</td>
<td>LR</td>
<td>Liberia</td>
<td>17</td>
</tr>
<tr>
<td>MH</td>
<td>Marshall Islands</td>
<td>100</td>
<td>VC</td>
<td>St. Vincent&amp;Gren.</td>
<td>14</td>
</tr>
<tr>
<td>MT</td>
<td>Malta</td>
<td>100</td>
<td>GY</td>
<td>Guyana</td>
<td>14</td>
</tr>
<tr>
<td>MU</td>
<td>Mauritius</td>
<td>75</td>
<td>HK</td>
<td>Hong Kong</td>
<td>14</td>
</tr>
<tr>
<td>LU</td>
<td>Luxembourg</td>
<td>71</td>
<td>MC</td>
<td>Monaco</td>
<td>11</td>
</tr>
</tbody>
</table>

In contrast to the results from the offshore-intensity ratio approach, our method identifies Taiwan (TW) as a very prominent sink-OFC. In-depth studies by tax specialists have suggested that Taiwan is an ‘unnoticed tax haven’ (Tax Justice Network, 2016), since it has not signed the OECD Common Reporting Standard for the automatic exchange of financial information and maintains bank confidentiality. The prominence of Taiwan is driven by Taiwanese technological companies, which often own Chinese firms through Hong Kong (33%) and Caribbean Islands (20%), or own Hong Kong firms through Caribbean Islands (12%). Due to pressure by China, Taiwan does not participate in FDI statistics collected by the IMF and therefore was not detected by studies relying on aggregated international FDI data.

Our approach replicates the outcomes of the offshore-intensity ratio method, but is also able to identify hitherto ‘unnoticed’ sink-OFCs. In addition, our approach enables us to quantify the weight of each territory in corporate offshore finance. In conclusion, the five largest sink-OFCs in terms of non-normalized sink-OFC centrality are: Luxembourg, Hong Kong, the British Virgin Islands, Bermuda and Jersey (Supplementary Table S2).

2.3.2 Identifying Conduit Offshore Financial Centers

While sink-OFCs store capital, conduit-OFCs facilitate the movement of capital between sink-OFCs and other countries. Figure 2.2B shows the inward versus outward conduit-OFC centrality (see Methods). We marked in red countries identified as sink-OFCs in Fig. 2.2A. Blue countries are not OFCs since they are not sink-OFCs and only a moderate sum of value in chains ending (or starting)
in sink-OFCs goes through them. We denote all the jurisdictions in the upper right quadrant as conduit OFCs. As expected, the sink-OFCs (in red) are also important conduits.

Green countries are distinct conduit-OFCs (Table 2.2). Our approach identifies five large conduit-OFCs that do not act as sink-OFCs: The Netherlands, the United Kingdom, Switzerland, Singapore and Ireland. These countries facilitate the transfer of value from and to sink-OFCs, and are used by a wide range of countries (Figure 2.2C). Importantly, these countries are also used extensively as conduits to non-OFCs (Figure 2.2D), indicating that conduit-OFCs are not used exclusively for the transfer of value to sink-OFCs. This contrasts with countries such as Russia, China or most sink-OFCs, which are used by companies as conduits to sink-OFCs more frequently than as conduits to non-OFCs (Figure 2.2D). Finally, our approach also identifies three small conduit-OFCs that do not act as sink-OFCs: Belgium, Panama and Guernsey. For a comparison of our approach with other rankings of OFCs, see Supplementary Information and Supplementary Table S5.

Table 2.2. List of conduit-OFCs, ordered by value flowing through the conduit toward sink-OFCs. Non-norm. = Non-normalized.

<table>
<thead>
<tr>
<th>ISO2</th>
<th>Country name</th>
<th>Non-norm. ( C_{c_{out}} )</th>
<th>Non-norm. ( C_{c_{in}} )</th>
<th>( C_{c_{out}} )</th>
<th>( C_{c_{in}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL</td>
<td>The Netherlands</td>
<td>7.4 ( \cdot ) 10^{11}</td>
<td>3.8 ( \cdot ) 10^{11}</td>
<td>18.6</td>
<td>22.5</td>
</tr>
<tr>
<td>GB</td>
<td>United Kingdom</td>
<td>3.8 ( \cdot ) 10^{11}</td>
<td>1.3 ( \cdot ) 10^{11}</td>
<td>3.1</td>
<td>2.4</td>
</tr>
<tr>
<td>CH</td>
<td>Switzerland</td>
<td>2.2 ( \cdot ) 10^{11}</td>
<td>2.7 ( \cdot ) 10^{10}</td>
<td>6.9</td>
<td>2.0</td>
</tr>
<tr>
<td>SG</td>
<td>Singapore</td>
<td>7.2 ( \cdot ) 10^{10}</td>
<td>2.2 ( \cdot ) 10^{10}</td>
<td>5.1</td>
<td>3.8</td>
</tr>
<tr>
<td>IE</td>
<td>Ireland</td>
<td>6.4 ( \cdot ) 10^{10}</td>
<td>3.3 ( \cdot ) 10^{10}</td>
<td>5.9</td>
<td>7.2</td>
</tr>
</tbody>
</table>

2.3.3 Geographical specialization

Next, we investigated if there exists geographical specialization in the ownership network. Figure 2.3 shows the network of value flow between countries, where the color indicates the relative importance of the link in relation to a simple null model where the weights are set to the product of the GDP of each pair of countries (see Supplementary Methods). The size of the nodes is proportional to the fraction of chains where that country appears, and the color shows the sink-OFC centrality. The position of a country in the network is set through a force-directed layout, where well connected countries are close in space. This is reflected by European countries placed close to the Netherlands (NL) and Luxembourg (LU), while Asian countries are placed close
to Hong Kong (HK) and other sink-OFCs, and United Kingdom (GB) acts as an integrator between Europe and Asia.

The geographical specialization observed at the country-by-country ownership network (Fig. 2.3) can be further dissected at the global corporate ownership chain level. Figure 2.4 shows the countries that appear in the source and sink position of the chain. Since we are interested in conduit-OFCs, we restricted the analysis to those chains ending in a sink-OFC. For each country in the horizontal axis we visualized two columns. The leftmost column represents the value associated to the source countries, while the rightmost column shows the distribution of the value associated to sink-OFCs. The Netherlands and the United Kingdom are the largest conduits, with values going through them twice the value of the next largest country (Luxembourg). Each country is specialized in a geographical area: the United Kingdom serves as a conduit between European countries and LU, BM, JE, VG and KY. The Netherlands is the principal conduit between European companies and LU, CW, CY and BM. Importantly, the majority of investments from LU or HK do not require a conduit, and thus LU and HK companies invest directly in European countries and China (Fig. 2.4 inset). In contrast, investments from countries typically identified as tax havens (e.g., BM, VG or KY) do, and thus companies located in these jurisdictions invest in other OFCs (Fig. 2.4 inset).

Other countries are also specialized. Switzerland is used as a conduit to Jersey. Ireland is the route for Japanese and American companies to Luxembourg (note that since the US is not considered a sink-OFC, companies with the structure \( EU_{country} \rightarrow IE \rightarrow US \) (such as Apple) do not contribute to the conduit-OFC centrality of Ireland). Cyprus is primarily used by Russian companies owned from the British Virgin Islands. Belgium is used as a conduit for the company Euroclear (see Supplementary Information).

British Virgin Islands (VG), Cayman Islands (KY) and Bermuda (BM) are strongly interlinked, with many chains starting and ending in the three jurisdictions under British sovereignty (as evidenced in Fig. 2.3). However they are used by different countries. VG is used for chains starting in China (CN) and Hong Kong (HK) and ending in Taiwan (TW) or HK. BM is used for European companies owned from the VG or LU. Cayman Islands (KY) chains start in TW, HK and China and end in TW and HK. Finally, HK and Singapore (SG) are
Figure 2.3. Network of ownership flows between countries Node size is proportional to the unnormalized conduit-OFC (value flowing through the conduit towards sink-OFCs). Node color is sink centrality (value entering minus value leaving the country, divided by the GDP). Edge size is proportional to the value flowing through countries. Edge color is proportional to the significance of the flow in relation to a null model. See Supplementary Methods for an explanation of the null model.
Figure 2.4. Geographical specialization The value going through each conduit in chains of size three ending in sink-OFCs is depicted. The first column visualizes the source countries, the second column represents the sink countries, and the horizontal axis shows the conduit countries. Sink-OFCs are marked red and conduit-OFCs are marked green, all countries representing less than US$10^{10}$ are combined together in gray. Dark gray corresponds to companies with unknown location. (inset) Value invested from companies located in sink-OFCs (horizontal axis) into other countries.

small territories connecting Asia, Europe and sink-OFCs: HK acts as the conduit between China and TW, VG, KY; SG has an important role joining many different countries (mainly South-East Asia, CN, GB and NL) to HK, VG, KY and BM.

2.3.4 Sector specialization

Next, we looked at whether specialization was also present at the sectoral level. We first converted each global corporate ownership chain in terms of the sectors involved by using the statistical classification of economic activities in the European community (NACE Rev. 2). For instance the chain 291 → 642 → 829 indicates that a company in sector 291 (manufacture of motor vehicles) is owned by a company in sector 642 (holding company), which in turn is owned by a company in sector 829 (administrative and support activities sector). In order to explore the sectoral specialization, we classified the sectors by their dominant position in chains of size three (in terms of value), finding six categories: only source, only conduit, only sink, source+conduit, source+sink, conduit+sink and source+conduit+sink (see Supplementary Methods). For instance, sectors prevalent in the source position were assigned to the source group. Figure 2.5A summarizes our findings. We found that while the source category is relatively diversified in terms of sectors, this is not the case for conduit and sink sectors. The conduit positions in the chains are dominated by ‘Holding companies’ (prominent in the Netherlands). Sinks are specialized
by sector as well, with ‘Administrative’ (829, prominent in Luxembourg) and ‘Unknown’ (prominent in sink-OFCs) sectors attracting the majority of the value. Two sectors are prominent in both source and conduit position, ‘Head offices’ (701) and ‘Wholesale trade’ (46) sectors.

The concentration is more pronounced at the end of the chains, where administrative and office support (829, driven by Luxembourg), oil industry (08/09, driven by Russia) and manufacture of computers (26, driven by Hong Kong and Taiwan) are the main sectors. As expected since sink-OFCs are usually associated with secrecy, companies with missing sectors (00, driven by sink-OFCs) also appear at the end of the chains. Finally, sectors that are evenly distributed among sectors correspond to other types of financial companies (sector 64). Different sectors appear in different parts of the chains, with only a small number of sectors appearing in the conduit and sink positions.

### 2.3.5 Sectoral-geographical specialization

Finally, we investigated if the geographical specialization in conduits correlates with a sectoral specialization. Since conduit-OFCs have favorable legislation for the establishment of only a few concrete types of entities (e.g., head offices, or holding companies), we expected that the majority of the value going through a conduit-OFC would be concentrated in one or a few sectors. Figure 2.5B shows the sectoral specialization for different conduit-OFCs as well as Luxembourg and Hong Kong, given their relevance as sink-OFCs and their position in the European Union and in proximity of China. For each country in the horizontal axis we show three columns. The leftmost column represent the distribution of
sectors of the companies located in the source country, the middle columns represent the distribution of sectors in the conduit country, while the right columns represent the distribution of sectors in the companies within the sink-OFCs. In general, we observe that while the source sector is generally known, this is not the case for the sink sector. Consequently with their classification as sink-OFCs, 40% of LU and 70% of HK companies involved in chains ending in sink-OFCs have missing sector information. We found that the Netherlands (NL), the United Kingdom (GB), Switzerland (CH) and Singapore (SG) are specialized in holding companies (code 642), while Ireland (IE) (together with GB) specializes in activities of head offices (code 701).

For chains using Luxembourg as a conduit, 90% of the value ends up in an unknown sector in a sink-OFC. Similar trends are observed for HK, SG and IE. For Switzerland, 70% of the value ends in sector 089 in Jersey. We observe the 641|642|641 sandwich in GB, corresponding mainly to HSBC. Manufacturers of electronics and computers (261 and 262) use predominantly HK as conduit, while holding companies use the Netherlands and Luxembourg as conduits, and other financial sectors use Ireland. Finally, we observe that Dutch companies are owned by companies in sector 829 (concentrated in Luxembourg). Hence, we observe a clear sectoral specialization of conduit-OFCs.

2.4 Discussion

Prior work on OFC identification used either qualitative assessments of policies and regulations or a quantitative approach based on ratios of foreign investment to GDP. Here we develop a novel method for OFC identification by analyzing the transnational ownership network based on global corporate ownership chains. By investigating which countries are used predominantly as owners in the chain we are able to find a set of 24 sink-OFCs. We show that the majority of investment from and to sink-OFCs occurs through only five jurisdictions (conduit-OFCs): the Netherlands, the United Kingdom, Switzerland, Ireland and Singapore. The Netherlands and the United Kingdom rank among the largest countries in global cross-border direct investment, according to IMF data. Thus, it could have been expected that these two countries would also appear in a firm-level analysis of the global corporate ownership network, such as ours. However, our method for the first time
uncovers the role of both countries as dominant conduits within transnational corporate ownership chains. This granular analysis sheds new light on the outsized role of the Netherlands and the United Kingdom in global finance.

We find a clear geographical specialization in the offshore financial network (Haberly & Wójcik, 2015a, 2015b): the Netherlands is the conduit between European companies and Luxembourg. The United Kingdom is the conduit between European countries and former members of the British Empire, such as Hong Kong, Jersey, Guernsey or Bermuda. Hong Kong and Luxembourg, being themselves sink-OFCs, also serve as the main countries in the route to typical tax havens (British Virgin Islands, Cayman Islands and Bermuda). The specialization is not only geographical, but also present at the sector level. For instance, the Netherlands is specialized in holding companies, the United Kingdom in head offices and fund management, Ireland is prominent in financial leasing and head offices, Luxembourg in support activities, Hong Kong and Switzerland are characterized under the “Other financial activities category”, which encompasses commodity dealing, financial intermediation and derivatives dealing. Companies choose to centralize their investment apparatus in specific jurisdictions according to the tax regulations of the jurisdiction, its bilateral tax treaties, and its sectoral advantages. Our network approach thus sheds light on the geographic structure of the global ownership network, finding that only a small set of territories act as sinks of ownership chains (most of them under British sovereignty), and even a smaller subset act as conduits for ownership structures to sinks.

Our approach identifies, characterizes and ranks OFCs and as such helps to increase transparency of and insight in highly complex international corporate financial structures. The developed method to identify OFCs improves previous attempts such as the list of tax havens published by the European Union in 2015, where countries such as Luxembourg or the Netherlands—the most prominent sink-OFC and conduit-OFC (see Supplementary Table S5)—were not included. The European Union list also does not rank jurisdictions, giving the same status to the British Virgin Islands and to Anguilla, while in fact 170 times more value ends in the former than in the latter.

Since the financial crisis, the G20 and the OECD have increased pressure on tax evasion (Weyzig, 2013). However the effects of these efforts have
been modest (Johannesen & Zucman, 2014). Our contribution can help regulators target the policy to the sectors and territories where the offshore activity concentrates. While efforts usually focus on small exotic islands, we showed that the main sinks of corporate ownership chains are highly developed countries which have signed numerous tax treaty agreements (Luxembourg and Hong Kong). Moreover, we showed that only a small number of conduits canalize the majority of investments to typical sink-OFCs such as Bermuda, British Virgin Islands, Cayman Islands, or Jersey (which, in fact, are all under the sovereignty of the United Kingdom). Targeting conduit-OFCs could prove more effective than targeting sink-OFCs, since—while new territories with low or no corporate taxes are continuously emerging—the conditions for conduit-OFCs (numerous tax treaties, strong legal systems, good reputation) can only be found in a few countries.

Future work could investigate the resilience of the network, in order to find points of action for legislators. For instance, an estimation of the changes in corporate structures at the global scale following the implementation of a policy could be calculated by co-analyzing tax treaties, trade networks, and corporate ownership chains (in the same vein as Weyzig (2013)). Future work can also compare the structure and resilience of the ownership network with other networks such as the airline (Verma, Araújo, & Herrmann, 2014) or trade networks (Lee & Goh, 2016), finding how trade (representing ‘real’ economy), ownership (representing flux of value) and airlines (representing connections between countries) are interlinked.

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CHAPTER 3

Offshore Financial Centers and the Great Fragmentation of the Firm: Coordination and Profit Centers

In this chapter we expand on my distinction between sink-OFCs and conduit-OFCs and further characterize profit centers and coordination centers. Instead of looking only at corporate ownership structures, we explicitly detail the process of the operational and legal-financial unbundling of the firm, a process that we call “the great fragmentation of the firm.” We argue that holding companies are a key component in the conceptualization of MNCs. Furthermore, we disaggregate the structure of the firm in its basic functions: manufacturing affiliates, shared service centers, R&D facilities, intermediate holding companies and top holding companies. We show that in the European Union the location of different types of subsidiaries is associated with different macro-institutional and tax indicators. Furthermore, we use cluster analysis to find complementarities between the types of subsidiaries that countries are able to attract, which allows us to identify five different FDI attraction profiles. The countries corresponding to each FDI attraction profile are highly successful at attracting specific combinations of subsidiaries. Two of these FDI attraction profiles are successful at attracting holding companies and as such can be considered offshore financial centers; we name them profit centers and coordination centers. Profit centers are jurisdictions that attract both top and intermediate holdings of MNCs and a disproportionate amount of their profits. They do so through extremely low tax rates and lenient regulation. Coordination centers are jurisdictions that attract intermediate holdings of MNCs and high value-adding shared service centers, and as such play a central role in the coordination of the different functions of MNCs. They do so via a highly skilled workforce, good infrastructure, a stable political climate, and tax features specifically created to attract conduit holding companies. These tax features include low withholding taxes, a large network of double tax treaties, and
the presence of patent boxes and special treatment of group interest income. Interestingly, we find that all European conduit-OFCs are, in fact, coordination centers. They are not only important in relation to financial flows, but also attract managerial and other high-value adding activities, pointing to a wider role of these conduits not only as empty conduits of financial flows, but as orchestrators of tax avoidance. While our analysis is restricted to E.U. data, I argue that Singapore, the only non-European conduit-OFC, should also be considered a coordination center. Among E.U. sink-OFCs, we find that Malta and Cyprus correspond to profit centers, and Luxembourg can be considered both a profit and a coordination center—a double role that we also expect from Hong Kong.

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Abstract

Economic globalization has pressured countries to compete with one another for firms’ investment capital. Analyses of such competition draw heavily on foreign direct investment (FDI) statistics. In and of themselves, however, FDI statistics are merely a quantification of the value of firms’ investment projects and tell us little about the heterogeneity of these projects and the distinct patterns of competitive dynamics between countries they generate. Here, we create a more sophisticated understanding of international competition for FDI by pointing out its variegated nature. To do so, we trace what we all the “great fragmentation of the firm” to distinguish between five categories of FDI: manufacturing affiliates, shared service centers, R&D facilities, intermediate holding companies, and top holding companies. Using a novel combination of firm-level and country-level data, we identify for each of these different categories which European Union member states are most successful in attracting it, what macro-institutional and tax arrangements they rely on to do so, and what benefits they receive from it in terms of tax revenues and employment creation. In this way, we are able to identify five distinct “FDI attraction profiles” and show that competition for FDI increasingly appears to take place amongst subsets of countries that compete for similar categories of FDI.

3.1 Introduction

A defining feature of the most recent wave of economic globalization is the dramatic expansion of global foreign direct investment (FDI). Annual flows of global FDI have expanded from $205 billion in 1990 to $1.4 trillion in 2017 (Figure 3.1A). The worldwide stock of FDI has expanded accordingly. Whereas in 1990 it stood at $2.2 trillion, in 2017 this figure has risen to $31.5 trillion (Figure 3.1B). Motivated by the anticipated benefits from incoming FDI, which include both concrete short-term benefits, such as increased tax revenues, growing employment, and GDP growth, as well as more intangible long-term ones, such as knowledge spillover effects, productivity gains, and a reduction of current account deficits, national governments have become increasingly preoccupied with improving the attractiveness of their countries’ investment climates in order to outcompete other countries in the global race for FDI.
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(Porter 1990; Cerny 1990; Stopford, Strange, and Henley 1991; Elkins, Guzman, and Simmons 2006; Jensen 2008; Thomas 2011).

Figure 3.1. The increasing importance of Foreign Direct Investment. (A) FDI inflows by region (B) FDI stock by region. All FDI data was collected from the UNCTAD World Investment Report (2018).

Such international competition for FDI presents one of the main dynamics in contemporary capitalism and, accordingly, has become a key research focus of scholars studying the international political economy. By now, a substantial literature has emerged that interrogates the phenomenon of international competition for FDI from a political economy perspective. Although this literature is vast and both theoretical and methodological approaches are heterogeneous, at its core three broad strands of literature can be identified.

A first strand of political economy literature on international competition for FDI approaches the phenomenon from the perspective of the firm and asks what factors drive the decisions of TNCs on where to locate their foreign investments. Amongst the main ‘locational determinants’ of FDI that scholars have identified are: socio-economic factors, such as market size, infrastructure, labor costs and exchange rates (Yu and Walsh 2010; Bellak, Leibrecht, and Riedl 2008), human capital (Globerman and Shapiro 2002; Blonigen and Piger 2014), agglomeration effects, and cultural and geographical distance (Bénassy-Quéré, Coupet, and Mayer 2007; Blonigen and Piger 2014); political-institutional factors, such as political (in)stability (Globerman and Shapiro 2002), political regime type (Jensen 2003; Bailey and Warby 2019), regulatory frameworks (Bénassy-Quéré, Coupet, and Mayer 2007), and openness to foreign trade and capital flows (Desai, Foley, and Hines 2004; Blonigen and Piger 2014); and factors related to the specificities of countries’ tax regimes, such as the availability of tax and investment treaties, as well as statutory and effective

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1The IPE literature on FDI per se is much broader. However, in this article we limit our focus on that part of the literature that deals specifically with international competition for FDI.
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corporate income tax rates (Devereux and Griffith 1998; de Mooij and Ederveen 2003).

A second strand of literature approaches the phenomenon from the perspective of global markets and their interaction with the international state system. Work in this strand of literature typically uses formal models to explore how the increased footlooseness of firms, especially since the 1990s, has pressured national governments into competing with one another to attract TNCs’ cross-border investments. Although some studies look at the way in which governments try to compete on the basis of labor standards (Davies and Vadlamannati 2013; Olney 2013) and environmental regulations (Dong, Gong, and Zhao 2012; Elliott and Zhou 2013), the vast majority of studies in this strand of literature focuses specifically on the ways in which governments use taxation policies to increase the attractiveness of their country’s investment climate. Studies on such international tax competition have, for instance, looked at the way in which pressures to compete affect big and small countries differently and how such pressures are mediated by national politics and institutions (Genschel and Seelkopf 2016; Basinger and Hallerberg 2004; Jensen 2008; Li 2006). Scholars have also looked at the extent to which tax competition may lead to races to the bottom or top, or give rise to other forms of competitive (or cooperative) dynamics (Genschel and Schwarz 2011; Keen and Konrad 2013; Wilson 1999; Brueckner 2003; Swank 2016; Devereux, Griffith, and Klemm 2002), as well as the overall welfare effects of such dynamics (Avi-Yonah 1999; Genschel 2001; Swank 1998).

A third strand of literature approaches the phenomenon from the perspective of individual states. Studies in this strand of literature typically adopt a comparative perspective to explore how specific historical legacies and variations in political-economic regimes have shaped the ways in which countries engage differently with the pressures emanating from the increased footlooseness of firms, and how certain, especially Central and Eastern European, countries have come to rely more heavily than others on FDI to generate jobs and economic growth. Specifically, studies in this strand of literature open up the black box of the state to look at the institutional complementarities that underpin such FDI-led growth regimes (Myant and Drahokoupil 2011;

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2Given the scope of our paper, we limit our discussion here to studies that focus on European countries.
Nölke and Vliegenthart 2009); the social and industrial policy tools they rely on (Brazys and Regan 2017; Thomas 2011); the political coalitions that support and sustain them (Drahokoupil 2009; Bohle and Greskovits 2012), as well as their distributional implications (Fink 2006; Regan and Brazys 2018).

In this paper we speak to each one of these strands of literature by challenging a key assumption they all share. That is the assumption that FDI is a monolithic phenomenon. In line with such an understanding, most studies on international competition for FDI rely heavily on inward FDI statistics. We contend that such an approach is problematic because FDI statistics are merely a quantification of the number or value of TNCs’ cross-border investments. They tell us very little about the character of the actual investment projects that are financed by these investments. This is an important shortcoming because these investment projects are extremely heterogeneous.

We are certainly not the first to emphasize the heterogeneity of FDI. The existing literature proposes several ways of disaggregating FDI statistics. One is to disaggregate FDI on the basis of TNCs’ motivations for their cross-border investment projects. This implies a conceptual distinction between ‘horizontal’ FDI, where TNCs duplicate existing operations abroad in order to gain access to new markets, and ‘vertical’ FDI, where TNCs invest in a upstream or downstream operations, and which is motivated by a desire to optimize production chains (Beugelsdijk, Smeets, and Zwinkels 2008). Another way is to distinguish between investments in new assets (i.e. ‘greenfield’ FDI) and the acquisition, leasing and licensing of already existing assets (i.e. ‘brownfield’ FDI) (Auerbach, Hassett, and Slemrod 1993). These distinctions are meaningful, but fail to account for variations in the actual business functions realized through different investment projects. Compare, for instance, a TNC’s investment in a manufacturing plant in Poland with the relocation of its headquarters to Malta. Both the benefits that the host countries can expect to
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Reap from these investments and the macro-institutional features they require to attract them are likely to vary considerably.\(^3\)

In this paper, we propose a functional disaggregation of FDI. We draw on insights from the International Business and Management literature (e.g., Desai (2009); Braunerhjelm and Ekholm (1998)) to trace the fundamental restructuring over the last couple of decades of the organizational design and legal-financial structure of large internationally operating firms, a process we propose to refer to as the great fragmentation of the firm. This allows us to disaggregate FDI into five categories based on the specific business function performed by the foreign subsidiaries in which the investment is made. Specifically we distinguish between FDI in manufacturing affiliates, shared service centers, R&D facilities, intermediate holding companies and top holding companies. We then compile a novel dataset which combines firm and country-level data and that allows us to assess, for each category of FDI, which EU member states are most successful in attracting it, some of the political benefits their governments may receive from doing so, and which tax incentives and macro-institutional features are present in countries that attract these different categories of FDI. We conclude by profiling countries according to the specific combinations of categories of FDI they attract. This prompted us to identify five, what we call, FDI-attraction profiles: manufacturing centers, back-office centers, innovation centers, coordination centers and profit centers.

By developing the notion of the “great fragmentation of the firm” and functionally disaggregating FDI, we shine a new light on debates in all three

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3Previous literature has disaggregated FDI by the sector of the investment, distinguishing for instance between investments in the secondary and tertiary sectors, or between investments made by IT companies and pharmaceutical companies (e.g. Yu and Walsh (2010); Regan and Brazys (2018); Papke (1991); Stöwhase (2005)). Such a sectoral disaggregation is helpful only to some extent. In today’s economy, the distinction between sectors have blurred. For instance, manufacturing firms increasingly engage in service activities. Similarly, a key source of profits for all kinds of TNCs today is the management and exploitation of financial and intellectual property assets. Scholars have also disaggregated FDI in ‘real’ and ‘financial’ FDI (e.g. Desai, Foley, and Hines (2004); Devereux, Lockwood, and Redoano (2008); Jones and Temouri (2016); Clausing (2016)), measuring ‘real’ FDI using wages or fixed assets. In any case, with the partial exception of (Defever 2006), the literature does not try to disaggregate FDI by the business function realized through the investment.

4Due to the uniqueness of the activities and organisational design of firms operating in the financial services industry, we limit our analysis to non-financial firms.

5Our aim is not to give a full account of all the potential benefits, in terms of economic performance, a national economy may receive from different categories of FDI. Rather, our aim is to give an indication of some of the more immediate political benefits, in terms of employment creation and tax revenues, that are associated with attracting the different categories of FDI.
strands of literature discussed above. First, we advance existing knowledge about the factors that drive TNCs’ foreign investment decisions by showing that different types of FDI are associated with different locational determinants. Second, we introduce a new way of thinking about the structure and dynamics of international competition for FDI. Our identification and characterization different FDI attraction profiles suggests that the increased footloosness of firms has not translated into countries competing for FDI in a race of all against all, but rather that countries occupy different niches in which they compete for specific categories of FDI. It is in this sense that the title of our paper speaks of countries competing not for capital, but for capitals. Third, our characterization of FDI attraction profiles also contributes to debates about the political-institutional underpinnings and distributional implications of FDI-led growth regimes. Given our finding that each FDI attraction profile comes with its own kinds of benefits, and thus favors distinct social groups, we should expect different FDI attraction profiles to be politically supported by different kinds of interest coalitions.

The paper proceeds as follows. The following two sections develop the theoretical and analytical framework that underpins the empirical analysis that will be presented in the second part of the paper. Section 3.2 discusses the “great fragmentation of the firm”. Section 3.3 then provides a schematic depiction of the anatomy and geographical dispersion of the contemporary firm. Specifically, it distinguishes between five different types of group subsidiaries, which correspond to our five different categories of FDI. The paper then turns to the empirical analysis. Section 3.4 details the analytical approach and discusses the data used for the analysis. Subsequently, section 3.5 presents the results of the analysis. Finally, section 3.6 concludes by summarizing our results and suggesting some of the implications of these results for policymaking and further research.

### 3.2 The great fragmentation of the firm

The impressive expansion of global FDI in recent decades has been a symptom of a fundamental reorganization during that period of the architecture of TNCs. This reorganization, we propose, is best understood in terms of a fragmentation and geographical dispersion of TNCs’ operational activities and legal-financial structure, a phenomenon we will refer to as the great fragmentation of the firm.
3.2. The great fragmentation of the firm

Conceptually, the great fragmentation of the firm can be thought of as transpiring on two levels of corporate organization. At the operational level, the notion of the great fragmentation of the firm captures the unbundling and geographical dispersion of TNCs’ operational activities. This level of the great fragmentation has been well-documented in the International Business and Management literature as well as the Political Economy literature on Global Value Chains and Global Production Networks. This body of literature discusses how, driven by growing demands to maximize shareholder value, and facilitated by advances in information and communication technology (ICT) and gradual reductions in trade and investment barriers, from the 1980s onwards large firms increasingly began to unbundle, outsource and relocate part of their operational activities offshore. Over time, these processes have resulted in the emergence of global value chains through which large TNCs, so-called “lead firms”, organize and coordinate their productive operations across geographies (Gereffi, Humphrey, and Sturgeon 2005; Coe, Dicken, and Hess 2008). Most salient in this regard, both politically and in terms of scholarly interest, has been the relocation of TNCs’ manufacturing activities to low labor-cost countries.

However, the offshoring of operational activities has not been confined to manufacturing activities. Since the second half of the 1990s, TNCs have increasingly been unbundling, outsourcing and offshoring business support services as well (Mclvor 2010). The offshoring of business support services has involved not only back office and support operations, such as human resource management, legal services, and accounting (Wilson 1995), but also front-office operations such as customer support and even research and development activities (Dachs, Stehrer, and Zahradnik 2014). As of recently, the unbundling and geographical dispersion of TNCs operational activities has also come to affect those functions that traditionally were combined in the TNC’s global corporate headquarter. For example, TNCs’ global treasury and financing function might be separated from other headquarter functions to be performed by a separate legal entity operating from a jurisdiction that provides the optimal institutional environment for the performance of that specific function. Similarly, strategic management might be offshored to jurisdictions that provide large pools of managerial talent and that are conveniently located in the proximity of major markets.
At the *legal-financial level* of corporate organization, the great fragmentation of the firm involves processes of legal restructuring and financial innovation that enable firms to more efficiently capture the value created by their globalized operational activities. This dimension of the great fragmentation is currently being explored in the emerging literature on Global Wealth Chains (Seabrooke and Wigan 2017; Bryan, Rafferty, and Wigan 2017). Based on our reading of this literature, we distinguish three important features of the rethinking of the legal-financial organization of the corporate group. A first feature has been the interposition of (intermediate) holding companies in group ownership structures. These are companies that engage in narrowly defined activities such as the holding of equity or debt stakes in group subsidiaries or the holding of rights to the (sub)licensing of intellectual property. The use of holding companies has increased significantly since the 1990s. For example, assets held by intermediate holding companies in the Netherlands have increased from under 1.8 EUR trillion in 2006 to 3.8 EUR trillions in 2015. For Germany, assets held by intermediate holdings increased by 1400% from 1989 to 2001 (Weichenrieder, Mintz, and Others 2008.)

A second feature has been the rearrangements of important value-creating assets, especially intellectual property such as copyrights, patents, and trademarks, across group subsidiaries. Through intra-group transactions and cost-contribution agreements, either intellectual property assets themselves, or (parts of) the rights to the income streams generated by those assets are transferred to group holding companies established especially for the purpose of holding those assets.

A third feature concerns innovative approaches to intra-group financing arrangements, often supporting a strategy called “earnings stripping”. In the case of earnings stripping, subsidiaries located in high-tax jurisdictions are financed by subsidiaries located in low-tax jurisdictions. The interest on the debt paid by the subsidiary in the high-tax jurisdiction reduces the taxable profits reported in that jurisdiction, while the interest income registered in the low-tax jurisdiction is taxed at a very low rate—or is not taxed at all.

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6Data on Special Financial Institutions from De Nederlandsche Bank.
7Cost-contribution agreements are contracts in which two entities agree to contribute financially toward the development or production of an asset or the execution of a service. In exchange for their financial contribution, parties to the contract receive a proportionate share of the economic benefits arising from the asset or service.
3.3 The Anatomy and Geographical Dispersion of Corporate Groups

Over the last couple of decades, the operational and legal-financial fragmentation of the TNC has resulted in a transformation of the large firm from a functionally diverse, but legally and jurisdictionally contained enterprise to a multi-subsidiary corporate group, in which different functions are fulfilled by specific subsidiaries that often exist as separate legal entities in different jurisdictions. A typical TNC, or corporate group, nowadays has dozens, if not hundreds of subsidiaries, each of which fulfills a specific role in the broader scheme of the corporate group (Figure 3.2). Although the constellation and specific functions of individual subsidiaries are idiosyncratic and unique for each corporate group, for analytical purposes we distinguish between five broad types of subsidiaries. These are manufacturing affiliates; shared service centers; R&D facilities, top holding companies; and intermediate holding companies. Below, we discuss for each of these types of subsidiaries the kinds of activities

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8Throughout this article we use the terms “transnational corporation” (TNC), “multinational” and “corporate group” interchangeably.

9The function may even be so specific that it pertains only to a particular transaction and a limited period of time. If such subsidiaries are not dissolved after their specific purpose has dissipated, this may, over time, result in their becoming obsolete; an artefact of the past.
they engage in, their specific function in the broader scheme of the corporate
group, the macro-institutional arrangements and tax incentives that can be
expected to attract these types of activities, and the benefits that countries can
expect to receive from the hosting of such subsidiaries.

### 3.3.1 Manufacturing affiliates

A first type of subsidiary is the manufacturing affiliate. Beginning in the
1960s, and increasingly so with the gradual abandonment of international trade
and capital barriers in the 1980s and 1990s, TNCs began to outsource and
relocate parts of their manufacturing operations to foreign locales. Initially,
such relocations primarily involved the most routine and labor-intensive of
TNCs’ manufacturing operations and were driven above all by a search for labor
cost advantages. Over time, however, TNCs increasingly began to relocate more
complex tasks and have moved beyond cost savings to consider such things
as worker skills, infrastructure, and government trade and investment policies
(Ellram, Tate, and Petersen 2013).

In addition to the benefit of low labor costs and other institutional factors,
manufacturing affiliates often make use of special regimes available in the new
host country. Such “special economic zones” typically offer a combination of tax
and tariff incentives and may even exclude firms operating in those zones from
labor, environmental and ownership regulations that apply to firms operating
elsewhere in the country (Farole, Akinci, and Gokhan 2011).

Manufacturing activities are typically the most labor-intensive subsidiaries
of a corporate group. So when a TNC relocates parts of its manufacturing
operations abroad, this is generally believed to have significant and beneficial
employment-creating effects in the manufacturing sector of the new host
country (Harrison and Rodríguez-Clare 2010). Moreover, the offshoring
of manufacturing operations by a lead firm in a particular global supply
chain may also give a significant boost to the non-exporting segment of the
manufacturing sector in the new host country as local suppliers flock around
the lead firms production operations, potentially giving rise to the emergence
of manufacturing, or industrial, clusters.
3.3.2 Shared service centers

A second cluster of group subsidiaries consist of shared service centers. These are subsidiaries that provide centralized support services to other group entities. This may involve both low value-adding back-office operations, such as information technology, human resource management and accounting, as well as higher value-adding services, such as procurement, marketing, sales and distribution. Some firms have opted for an outsourcing strategy, in which specific services (mostly the lower value-adding back-office operations) are provided by a third party service provider. A trend in recent years, however, has been for TNCs to centralize and “in-source” some or all business support activities and have them performed by a captive entity (Lewin and Peeters 2006; Bondarouk 2014). This entity, known as a “shared service center” (SSC), then provides the services to other group entities. Such an SSC may serve the entire corporate group or selected group entities operating in a specific geographical region or line of business.

Two considerations may lie behind the establishment of shared service centers. The first is cost reduction. SSCs allow corporate groups to benefit from economies of scale and avoid duplication of services across subsidiaries. Moreover, when located in jurisdictions that provide inexpensive labor, the establishment of SSCs can result in substantial savings on labor costs. An increasingly important driver for the growing use of SSCs, however, is a desire to source new organizational capabilities. TNCs increasingly discover that offshoring technical, professional and administrative activities allows them to tap into new pools of highly qualified staff (Lewin and Volberda 2011).

Regardless of which of these considerations prevails, the successful implementation of SSCs relies heavily on the availability of good transportation and ICT infrastructure and the availability of an English speaking workforce (Doh, Bunyaratavej, and Hahn 2009). Taxes, on the other hand, appear to play only a secondary role in TNCs’ decisions where to locate their SSCs. A survey conducted by management consulting firm Deloitte amongst 311 large firms that had established over 1,000 SSCs found that 70% of companies do not take taxation into consideration when choosing the location of their SSCs. We expect that this might be partly explained by the fact that SSCs are often run as cost,
rather than profit centers and thus make little or no taxable profits. Still, 17% of companies setting up SSCs do so with the objective to reduce their global tax burden—for instance through transfer pricing strategies.\footnote{12}

The benefits countries receive from hosting SSCs come primarily in the form of job creation. This may be effectuated in two ways. First, SSCs can be large employers in the service sector of a country’s economy. The previously mentioned Deloitte survey\footnote{13} found that 43% of the SSCs in their sample employed more than 100 people, with 15% employing more than 500 people. SSCs may also contribute to job creation in a more indirect way. The establishment of SSCs in a particular country may provide a boost to the domestic services sector in that country, thereby contributing to job creation in the sector, or attract large multinational business service firms to a country. Moreover, since SSCs “sell” their services to group entities located in other countries, host countries see their services exports increase and their current account balance strengthened.

3.3.3 Research and development (R&D) facilities

A third cluster of group subsidiaries consists of TNCs’ R&D facilities. These are subsidiaries that are responsible for TNCs’ product innovations. Although up until the 1990s these activities used to be performed in the context and proximity of TNCs’ global headquarters, increasingly TNCs are relocating them across jurisdictions (Dachs, Stehrer, and Zahradnik 2014).

Existing literature identifies three main motives underlying the internationalization of TNCs’ R&D activities. The first is for TNCs to adapt the design and development of their goods and services to the specific needs of local markets. This is typically done for markets that are especially important for a firm’s sales figures. Another motive for the relocation of R&D facilities is to bring them in closer proximity to TNC’s previously offshored manufacturing operations. Finally, a third, and increasingly prominent, motive underlying the relocation of R&D activities away from TNCs’ home country is a desire to establish a presence in highly innovative regions and cities. TNCs relocating their R&D activities to such regions do so to get access to local talent and knowledge.

\footnote{12}{For example, Starbucks’ centralized procurement SSC, located in the Netherlands, played an important role in the tax planning strategy the company had adopted in order to minimize the tax burden on its European operations (Kleinbard 2013).}

\footnote{13}{https://www2.deloitte.com/content/dam/Deloitte/dk/Documents/finance/Deloitte-SSSurvey-Interactive.pdf}
Important considerations taken into account by TNCs seeking to tap into local innovative capacities are the availability of highly qualified personnel and a high density of universities and other types of research institutions (Dachs, Stehrer, and Zahradnik 2014; Cantwell and Piscitello 2002). The cost of R&D personnel appears to be of only minor importance in the R&D location decision (Dachs, Stehrer, and Zahradnik 2014). Instead, TNCs value countries, and regions within countries, that provide for attractive living conditions that make it easy to attract additional knowledge workers from abroad.

Although there appears to be consensus in the literature that macro-institutional factors dominate TNCs’ R&D offshoring decisions, tax incentives are said to play a role as well (Cantwell and Mudambi 2000; Hines 1994). Tax incentives for R&D activities may involve tax credits for R&D expenditures or so-called patent or innovation boxes, whereby income emanating from qualifying IP is taxed at a reduced rate (Evers, Miller, and Spengel 2015). Especially the latter type of incentive has become widely used in Europe over the last decade. As of June 2017, 14 European jurisdictions had introduced some form of innovation box. Moreover, to attract foreign high-skilled workers, and thus increase their attractiveness as a location for TNCs’ R&D activities, some jurisdictions have implemented temporary tax reductions for personal income taxes for foreign knowledge workers.

When it comes to the potential benefits that host countries might reap from the relocation of R&D activities, discussions in the literature tend to focus on the promise of knowledge spillovers and productivity gains (Hejazi and Safarian 1999; Saggi 2002; Kim and Park 2017). However, research on the policy strategies that governments adopt to attract FDI in R&D suggests that national investment promotion agencies consider the quantity and quality of jobs created as some of the most important factors in their evaluation of potential R&D investment projects.

### 3.3.4 Top holding companies

The fourth cluster of group subsidiaries we identify are top holding companies. Top holding companies are companies that appear at the apex of a corporate group’s ownership structure and therefore are often referred as the group’s

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14 These are Belgium, Cyprus, France, Hungary, Ireland, Italy, Liechtenstein, Luxembourg, Malta, the Netherlands, Portugal, Spain, the canton of Nidwalden in Switzerland, and the UK (Chen et al. 2017).
“global ultimate owner” (GUO). These entities play a key role in the legal-financial organization of the group. The location of the top holding company generally determines the legal home of a corporate group and thereby not only the company law under which it operates, but in many cases also its tax residency.\footnote{15} Since a large fraction of profits are typically transferred to the top holding company, the tax residency of that company plays a key role in the consolidated tax rate of the group (Dischinger, Knoll, and Riedel 2014). For publicly listed TNCs, the top holding company is also the legal entity whose shares are traded on a stock exchange and thus administers the group's relationship with its external shareholders. This means that the tax regime of the jurisdiction in which the top holding is domiciled determines how dividend payments to shareholders are taxed.

Not all top holdings, however, are the same. The traditional top holding company would be domiciled in the jurisdiction from which the group originated and not only fulfill a key role in the legal-financial organization of the corporate group, but also act as the group's global headquarters and thus perform most or all of the corporate functions responsible for the orchestration of the group's global value chains: strategic management, shared services, and compliance and reporting. In today's fragmented TNC, these functions are increasingly unbundled and relocated to jurisdictions that provide the optimal conditions for the performance of those specific functions (Desai 2009; Baaij et al. 2015). Examples of traditional headquarter functions that TNCs may detach from their top holding and relocate across borders are the staff function (resulting in the establishment of SSCs), the group financing and treasury function (resulting in group financing companies—see next subsection), and the strategic management function (resulting in divisional and regional headquarters—see next subsection).

Given the large impact of the tax regime that applies to a top holding on the overall tax burden of a corporate group, TNCs have large incentives to transfer their top holding to a jurisdiction with low corporate income tax rates and/or more favourable legislation (Baaij et al. 2015; Voget 2011). In the period 1997–2007, 6% of all multinationals relocated their headquarters to another jurisdiction by means of corporate inversions or mergers with a foreign
firm. Over 50 percent of US multinationals that relocated their headquarters to another jurisdiction by means of corporate inversions in the period 1990–2016, did so to countries with no corporate income tax—mainly the Cayman Islands, Bermuda and the British Virgin Islands (Slangen, Baaij, and Valboni 2017). Transferring the top holding to another jurisdiction may have other non-tax related benefits as well. For instance, it has been suggested that top holding relocations may enable TNCs to improve communication and knowledge exchange with investors, and give them access to new pools of managerial talent.

The benefits that countries receive from hosting top holding companies thus very much depend on the scope of the activities performed by the top holding. When a top holding company only serves as legal seat, but carries out few or no real activities, then benefits for the host country come almost exclusively in the form of increased revenues from corporate taxes and incorporation fees. If, on the other hand, a top holding company carries out some or all of the traditional corporate headquarter functions, substantial employment benefits for the host country can be expected. Global headquarter functions are associated with high-quality jobs, and can potentially give rise to agglomeration effects and result in significant knowledge spillovers (Davis and Henderson 2008).

### 3.3.5 Intermediate holding companies

These are holding companies that may appear anywhere under the top holding in a corporate group’s ownership structure. Intermediate holding companies appear in different forms and may be used for a number of purposes. One such a purpose is the tax-efficient channeling of the value that is created by operating subsidiaries to the parent company. To achieve this, debt or equity investments made by the parent company are not made directly into a foreign subsidiary, but indirectly through an intermediate holding company, or “conduit” entity. Returns made on those investments are then channeled back to the parent company through the conduit entity in the form of interest or dividend payments. Intermediate holdings may also be used for the channeling of royalty payments. Such “royalty conduits” may receive royalty payments because they are the legal owner of an intellectual property asset itself or because they own the economic rights to the royalty income generated by the

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16 The host country may also benefit from indirect forms of employment creation. The legal and financial reporting obligations that come with the maintenance of top holding companies provide work for the offshore services sector (i.e. trust firms, tax advice, legal advice, etc.) in the host country.
asset due to a licensing agreement with the group entity that legally owns the asset. The above described dividend-, interest-, and royalty conduit functions may also be combined in a single intermediate holding company.

The archetypical intermediate holding company is one that has few employees and plays only a minor role in managing and directing group activities. This may be different, however, in the case of intermediate holding companies that combine pure holding activities (i.e., the holding and administering of assets, be they financial, tangible, or intangible assets) with strategic, coordinating or capital management functions. The best example of such multifunctional intermediate holding companies are regional headquarters. Regional headquarters are typically designed to both hold the equity capital of operational subsidiaries active in the relevant region and to engage in strategic decision-making and coordinating functions regarding the TNC’s activities in that region. It is also not uncommon for a regional headquarters to accommodate a shared service center offering business support services to operating subsidiaries in that specific region. Another example is the group financing company, sometimes also referred to as the group’s treasury. These are entities that are responsible for the management of intra-group financial transactions, such as intra-group lending, group liquidity management, hedging, and other financial operations that had traditionally been part of the finance function of the corporate headquarter.

A number of institutional features can make a jurisdiction an especially attractive location for the establishment of intermediate holding companies and/or regional headquarters. One is the availability of the institutional infrastructure necessary to support intermediate holdings companies: a stable and efficient state apparatus, sufficiently advanced ICT infrastructure, and the availability of knowledgeable tax advisors, trust firms, and other types of business services (Wójcik 2013; Eicke 2009). For group treasuries, having access to deep and developed capital markets may represent an important consideration. Perhaps even more important for TNCs’ decisions where to locate their intermediate holding companies, however, are the specificities of a jurisdiction’s tax regime. One such specificity is the absence of withholding taxes on outgoing and incoming dividend, interest and royalty payments, or the availability of reduced rates on such payments. Typically, therefore, intermediate holding companies are located in jurisdictions that provide
TNCs with access to an extensive network of bilateral tax treaties, enabling them to significantly reduce the tax costs of funneling payments through a specific jurisdiction. Other aspects of a country’s tax regime that TNCs may consider in the location decision for their intermediate holding companies are the administrative burden created by tax compliance and the existence and enforcement of anti-avoidance provisions. Finally, the availability of investment treaties with countries in which an envisioned holding company’s subsidiaries are located may further increase the attractiveness of a jurisdiction as a location for an intermediate holding company.

From a country perspective, the benefits that come with the hosting of intermediate holding companies depend very much on the extent to which these companies are pure conduit entities or engage in a broader scope of activities. For intermediate holding companies that act as pure conduit entities, the benefits should primarily be looked for in additional tax revenues and indirect employment effects. Effective tax rates on the dividends, interests, and royalties that flow through these entities may be minimal, but because of the sheer size of these flows, they may generate substantial tax revenues for the host country nevertheless. In the case of the Netherlands, for instance, financial flows through intermediate conduits of EUR 4 trillion (five times the size of the country’s GDP) contribute an estimated EUR 3 to EUR 3.4 billion in taxes, salaries and services hired (Kerste et al. 2013; van den Berg et al. 2008). Conduit entities themselves employ few employees, but the establishment and maintenance of intermediate holding companies requires the services of local corporate service providers (i.e. notaries, trust firms, tax advisors, lawyers, etc.) and thus has employment-creating effect in those sectors. This is different, however, when the intermediate holding company also serves as a regional headquarter. In this case, the intermediate holding company might employ substantial numbers of employees and contribute significantly to a country’s services exports.

The representation of the anatomy of the contemporary firm sketched in the previous paragraphs is, of course, a highly stylized one. Explicitly distinguishing between FDI in these five different types of operations does, however, provide a degree of analytical traction that has been missing in previous analyses of international competition for FDI. In the ensuing analysis we exploit this analytical traction to develop a more sophisticated understanding of this
phenomenon. Specifically, we answer three simple questions: Which EU countries attract which types of FDI? What institutional and tax arrangements do they use to do so? And what are the benefits they receive from doing so in terms of tax revenues and employment creation?

### 3.4 Analytical approach, data and visualization

#### 3.4.1 Analytical approach

To answer these questions we conducted a two-step analysis. In a first step we determined for each of the five categories of FDI identified in section 3.3 which EU member states are most successful in attracting those activities. Because the available data on FDI does not distinguish between the different types of investment projects that are financed by the FDI flows, we constructed a set of indicators that gauge the intensity of the economic phenomena and activities associated with each type of FDI. Throughout the remainder of the article we denote these indicators as activity indicators.

In a second step we collected at a range of macro-institutional and tax policy indicators to understand which macro-institutional features and tax policies may be associated with those countries that are most successful in attracting the different categories of FDI. For example, based on our reading of the literature, we include labor costs and corporate income tax rates as possible determinants of foreign direct investments in manufacturing affiliates, while we include the availability of low withholding taxes as a possible determinant for investments in intermediate holding companies. Throughout the ensuing text, we label our indicators using square brackets (e.g. [Governance]).

The motivations for our indicators and the exact operationalization of each indicator can be found in Table S1 and section S5 in the Appendix.

#### 3.4.2 Data

To construct our indicators we use a combination of macro (country-level) and micro (firm-level) statistics. Macro statistics were collected from Eurostat, World Bank Open Data, the International Bureau of Fiscal Documentation, and

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17 Our sample corresponds to all countries covered by the Interest and Royalty Directive (2003/49/EC) and the Parent-Subsidiary Directive (2003/123/EC)—i.e., all countries from the European Union and Switzerland.
UNCTADstat. Since we obtain the majority of our indicators from Eurostat, we generally lack data on Switzerland. Micro statistics were collected from the Orbis database. Orbis collects information on over 250 million public and private firms worldwide from official country registrars and other country collection agencies, and it is a frequently used source of data (Vitali, Glaeffelder, and Battistion 2011; Johannesen, Tørsløv, and Wier 2016; Garcia-Bernardo et al. 2017) that offers good coverage for EU’s firms (Garcia-Bernardo and Takes 2017). All indicators were calculated as the mean value for the period 2007–2017, or a subset of the period when data was not available for all years. Our selection of the 2007–2017 period reflects two considerations. The first is purely pragmatic; this is the only period for which all databases provide data. The second is that our activity indicators reflect stocks of FDI, rather than flows. This implies that each indicator reflects investments accumulated prior to the period. Because, as stated in the introduction, we decided to focus our analysis on non-financial corporations, we restricted the Orbis and Eurostat data to include only non-financial corporations. For a complete description of all the indicators, including sources, time data availability and descriptive statistics see Tables S1—S6 in the appendix as well as the Supplementary Methods section. In order to ensure replicability and cumulative knowledge-building, all our indicators and Python code are available at https://osf.io/preprints/socarxiv/7ugbr under public license Creative Commons Attribution-ShareAlike 4.0.

3.4.3 Visualization of the results

Normalization

Our visualization strategy assigns a color to a numerical value, where blue corresponds to low values and red corresponds to high values. Using the same matching between colors and numerical values in all variables would be infeasible since the range of our variables varies by several orders of magnitude. While the average tax rate of multinationals is 0.18 ($\pm$ 0.07), the average time to complete and submit taxes is 192.2 ($\pm$ 99) days. In order to visualize the results effectively, we need to normalize all variables so that they lie in the same range. A common normalization strategy (StandardScaler) is to subtract the mean and divide by the standard deviation, which standardizes all variables to have mean equal to zero and standard deviation equal to one. However, this strategy is not robust to outliers—such as Malta with an FDI stock 16 times the size of its GDP. Instead, we use another normalization strategy (RobustScaler) where we subtract the median and divide by the interquartile range—the range
between the 1st quartile (25th percentile) and the 3rd quartile (75th percentile) (Figure 3.3A). Figure 3.3B visualizes the data on FDI flows in 2017 (Figure S2 in the Appendix) using both RobustScaler and StandardScaler. When using RobustScaler we are able to see both the outliers (Malta and Cyprus) and countries attracting high FDI stocks (Belgium or Netherlands) in red, while for the StandardScaler strategy only the outliers are visible.

**Clustering**

We use the activity indicators to identify countries that compete for a specific category of FDI. We make use of a clustering algorithm to guide our interpretation of the results. The clustering algorithm calculates the distance between two countries based on the differences between all activity indicators. For instance, in Figure 3.3B there are two variables (RobustScaler and StandardScaler). There is a small distance between two countries if they have similar values for both variables. The algorithm then constructs a tree, where countries appear in adjacent branches if the distance between them is small—e.g. Cyprus and Malta, or Luxembourg, Ireland, Switzerland, the Netherlands and Belgium.

To arrange countries into groups, many different clustering algorithms can be used. Each of these techniques uses its own distance formulas, and thus yields different results. In order to avoid cherry-picking a clustering technique that produces “meaningful” results, we apply the default algorithm and use the results only as a starting point, on the basis of which we then cluster the countries manually. The initial clustering is provided in Figure S3. A detailed explanation of the clustering algorithm and its possible variations is provided in the Supplementary Methods.

**Country summaries and FDI attraction profiles**

We summarized how successful countries are at attracting each category of FDI by using the sum of all activity indicators, separating low and high value-adding activities (see section S4 in the Appendix). In order to compare the European countries among themselves, the success of each country was then normalized using the method from section 3.4.3. We created the six FDI-profiles using the information from cluster analysis of each of the five types of FDI, and by using cluster analysis on the cluster summary (see section S4).
3.5. Results

3.5.1 Manufacturing affiliates

We first identified those countries that attract disproportionate amounts of TNCs' manufacturing affiliates. We found a prominent cluster of countries composed of Romania, Hungary, Poland, Slovakia, Czechia, Estonia, Malta and Bulgaria (Figure 3.4A). All these countries engage primarily in low value-adding manufacturing activities in which they show high levels of wage-adjusted productivity. Moreover, this cluster of countries receives greenfield investment flows in the manufacturing sector of 2.0% (±0.8%) of their GDP, which contrasts with the 0.4% (±0.3%) received by all other countries. There is, however, a broad distinction within this cluster between those countries in which a large fraction of the labor force is employed in foreign owned companies in the manufacturing sector and those for which this fraction is much smaller (Figure 3.4B). In Malta, Romania, Estonia, Hungary, Slovakia, and Czechia the number is 6.9% (±1.8), whereas for Poland and Bulgaria it is 3.7% (±0.5%). For the latter group of countries, however, a number of factors might partly explain

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18 Three countries (Lithuania, Latvia and Croatia) receive relatively large greenfield FDI flows (0.9% ±0.4%). However, given their small size and the fact that only a small fraction of their labor force is employed in foreign owned companies in the manufacturing sector, we do not consider them as countries that attract disproportionate numbers of manufacturing affiliates.
these relatively low numbers. For Poland, the country’s large population size has a significant downward effect on the percentage of the labor force employed by foreign firms. The raw number of jobs created in that country, however, is 680,000, considerably higher than the numbers for countries of similar size, such as Spain and Italy (386,000 and 429,000 respectively). For Bulgaria, the size of greenfield investment suggests that a future increase in the number of jobs in foreign-owned manufacturing operations can be expected.

We next moved to the macro-institutional and tax arrangements associated with the countries previously identified (Figure 3.4C). As anticipated, since we assume cost reductions to be the primary motivation for the offshoring of manufacturing operations, all countries previously identified score low on all macro-institutional indicators when compared with the EU average. As Figure 3.3C shows, labor costs are especially low in Romania and Bulgaria. These countries’ exceptionally low labor costs may be an important factor in explaining why since 2007, the year they joined the European Union, these countries have been the largest recipients of greenfield FDI in manufacturing activities. Regarding the tax indicators (which, in Figure 3.4C are separated from the macro-institutional indicators by a thin white line), we see that all the identified countries have corporate income tax rates that are significantly lower than those for most other European countries, with the notable exceptions of Ireland and Cyprus. They also all stand out both in terms of the number of tax incentives targeted specifically to investments in manufacturing activities and in terms of the low levels of withholding taxes that they levy on outbound dividend payments. We also observe that all countries that attract manufacturing affiliates, except Slovakia and Czechia, had signed large numbers of investment treaties, but not tax treaties, with Western Europe before they entered the European Union. This suggests that withholding tax considerations are secondary to the securing of property rights in TNCs’ decisions where to locate their offshored manufacturing activities.

### 3.5.2 Shared service centers

We next identified countries that attract disproportionate numbers of TNCs’ SSCs. Here we identified three clusters of countries that do so (Figure 3.5A). All countries in those three clusters (with the notable exceptions of Poland and Bulgaria, which we will discuss below), see a relatively large fraction of their labor force employed in foreign owned SSCs. The first cluster, consisting
Figure 3.4. Manufacturing affiliates. (A) Activity indicators, (B) benefits, and (C) macro-institutional features and tax incentives associated with attracting manufacturing affiliates. The identified clusters of countries is marked with a gray bracket (A,C) and different shades of orange (B). See Table A1 for a complete explanation of the indicators. Countries are sorted according to their assigned cluster.
of the Netherlands, Ireland, United Kingdom and Luxembourg attracts high value-adding SSC activities, has high wage-adjusted productivity and receives large amounts of greenfield investments in SSC activities. The second cluster, composed of Finland, Austria, Belgium and Sweden also attracts high value-adding SSC activities but shows lower wage-adjusted productivity and also somewhat lower levels of greenfield investment in SSCs. We interpret this difference as the second cluster being somewhat less attractive as a location for TNCs’ high value-adding SSC operations and therefore attracting fewer such operations. The third cluster, composed of Poland, Bulgaria, Romania, Hungary, Czechia, Portugal and Estonia, is characterized by low value-adding activities but high levels of adjusted productivity. In this third cluster, foreign owned SSCs employ 1.3% (±0.5%) of the labor force, compared to 4.1% (±4.7%) and 1.7% (±0.3) for the first and second clusters respectively (Figure 3.5B). However, Bulgaria receives the second highest flows of greenfield FDI and we thus expect employment numbers to increase in the following years. In the case of Poland, the large size of their labor force causes a downward bias in the share of the labor force employed in foreign owned SSCs. In fact, the raw number of workers in foreign owned SSCs in Poland (372,000) is two to four times higher than the number for Romania (183,000), Portugal (107,000), Czechia (102,000) and Hungary (78,000).

Looking at the macro-institutional and tax policies associated with the countries in those three clusters (Figure 3.5C), we make the following observations. High value-adding SSC activities (first and second clusters) take place in countries that combine high levels of human capital, governance and infrastructure with an expensive, but highly productive labor force, while the contrary is true for low value-adding activities (third cluster). Similar to the manufacturing case, tax considerations appear to be secondary to macro-institutional determinants in TNCs’ decisions where to locate their SSC activities. We assume this to be a result of the fact that most SSCs are run as cost centers and therefore do not make substantial amounts of taxable profits.

3.5.3 R&D facilities

Thirdly, we identified countries that attract disproportionate amounts of TNCs’ R&D facilities. We found two clusters of such countries (Figure 3.6A). The first consists of a heterogeneous group of highly developed countries. All countries in this cluster have a large R&D sector, evidenced by the large share of their labor
**Figure 3.5. Shared service centers.** (A) Activity indicators, (B) benefits, and (C) macro-institutional features and tax incentives associated with attracting shared service centers. The three identified clusters of countries are marked with gray brackets (A,C) and different shades of orange (B). See Table A1 for a complete explanation of the indicators. Countries are sorted according to their assigned cluster.
force employed in corporate R&D facilities and the large numbers of patent applications by both domestic and foreign firms. Moreover, these countries all display high levels of R&D expenditure financed from abroad, which indicates that a significant proportion of R&D operations in those countries is conducted by foreign owned firms. This is further confirmed by the fact that, corrected for the size of their economies, these countries show high numbers of patent applications by foreign owned companies. Three countries within this cluster (Belgium, Ireland and the United Kingdom) distinguish themselves from the others in that foreign owned firms account for 42–45% of all patent applications in those countries—compared with 16–31% in the rest of the cluster. The second cluster consists of Hungary, Bulgaria and Czechia. Compared to the first cluster, R&D takes a much less prominent role in these countries’ economies, as evidenced by the much lower fraction of their labor forces employed in R&D operations as well as the low number of patent applications by domestic firms (Figure 3.6B). They do, however, receive high values of foreign R&D expenditure, suggesting that foreign firms see them as suitable locations for their offshored R&D activities nevertheless.

To get a deeper understanding of the differences between the two clusters, we then looked at the macro-institutional and tax features of these countries. For the first cluster of highly developed countries, fluency in English, ICT infrastructure, graduates in science and technology and quality of life highly correlate with foreign owned R&D activities (Figure 3.6C). This was expected, since TNCs operate R&D facilities in those countries where the skills are located. The top three countries by foreign R&D investment (Austria, Switzerland and Finland) rank 4th, 2nd, and 3rd for quality of life and 6th, 3rd and 2nd for graduates in science and technology. For the second cluster of countries, low labor costs appear to dominate over other indicators. Most likely, the fact that these countries see comparably large amounts of their total R&D expenditures come from foreign owned companies and see a large percentage of their domestic patent applications come from foreign owned companies as well, is due to the prominent presence of foreign owned manufacturing activities in those countries. As explained in section 3.3.2, one motivation for TNCs to relocate some of their R&D activities is to have them in the proximity of their already offshored manufacturing operations. Finally we found that R&D incentives (with the notable exception of the patent box) are correlated with R&D activity. However, we also found a number of countries (i.e. Sweden,
Figure 3.6. R&D facilities. (A) Activity indicators, (B) benefits, and (C) macro-institutional features and tax incentives associated with attracting R&D facilities. The two identified clusters of countries are marked with gray brackets (A,C) and different shades of orange. See Table A1 for a complete explanation of the indicators. Countries are sorted according to their assigned cluster.
Austria or Denmark) that offer only a small number of R&D incentives but nevertheless attract high levels of foreign R&D investments. This indicates that tax considerations play only a secondary role to the availability of talent in those countries.

3.5.4 Top holdings

We identified two clusters of countries that attract disproportionate amounts of TNCs’ top holding companies (Figure 3.7A). The first cluster is composed of the three smallest EU member states: Cyprus, Luxembourg and Malta. The second is composed of Ireland, Switzerland, the Netherlands and the United Kingdom. Both clusters attract disproportionate amounts of top holding companies, but countries in the first cluster attract the highest numbers relative to the sizes of their GDPs. Countries in the first cluster also seem to enjoy more significant benefits from hosting top holdings, at least as far as tax revenues are concerned. They raise tax revenues of 5.4% (±0.3%) of their GDP from corporations, compared with 2.5% (±0.5%) in other European countries (Figure 3.7B). The main difference between the two clusters, however, concerns the profit rate of foreign firms (Figure 3.7A). The profit rate in the first cluster is 511,000 (±230,000) EUR /employee significantly higher than the profit rates in the second cluster (59,000 ±7,530 EUR /employee) and all other countries (69,000 ±38,000EUR /employee). Furthermore, the three clusters differ from each other in terms of their differential score on the difference in profit rates between multinational and domestic companies. For the first cluster this difference stands at 135,000 (±187,000) EUR /employee, for the second at 17,000 (±23,000) EUR /employee, and for the third at -59,000 (±36,000) EUR /employee. For all other countries this difference stands at -58,000 (±44,000) EUR /employee.

The difference between the countries in the first and second cluster becomes more pronounced when their scores on the macro-institutional and tax indicators are considered (Figure 3.7C). Most importantly, the effective tax rates (ETRs) for countries in the second cluster are significantly higher than those

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19 Arguably, with a strong presence of the Big Four, a high number of GUOs and high profit rates, Denmark would also be a candidate for this group. However, we decided to exclude it for two reasons. First, the comparatively low value of equity assets held by companies in that country suggests that Denmark primarily harbors top holdings of rather small and inconsequential TNCs. Second, the low profit rates when compared with domestic companies suggest that the relatively high number of GUOs in Denmark has little to do with TNCs’ tax planning strategies.

20 Assuming an employee cost of $100,000 US dollars across countries.
Figure 3.7. Top holdings. (A) Activity indicators, (B) benefits, and (C) macro-institutional features and tax incentives associated with attracting top holdings. The three identified clusters of countries are marked with gray brackets (A,C) and different shades of orange. See Table A1 for a complete explanation of the indicators. Countries are sorted according to their assigned cluster.
for countries in the first cluster. We find the median ETR for companies with revenues higher than one million dollars to be 3.9% in Luxembourg, 9.8% in Cyprus, 28.0% in Malta, and 20.6% (±6.0%) in all other European countries. In the Maltese case, however, the effective tax rate excludes an up to six-sevenths refund to shareholders on the tax paid. Including this refund in the calculation would bring the ETR down to 4-8%. Moreover, the low ETRs that multinationals pay in these countries do not necessarily apply to domestic companies. We found that the tax paid by TNCs in countries that belong to the first cluster is up to 11 percentage points lower than the tax paid by their domestic counterparts.

We interpret our finding that countries in the first cluster combine low effective tax rates with relatively high profit rates of multinationals, and above those of domestic companies, as an indication that TNCs locate their top holding in those countries primarily for reasons of tax planning. Countries in the second cluster, with lower profit rates of multinationals, larger economies, a higher score on the governance indicator, and higher effective tax rates for multinationals, seem to be able to attract a larger fraction of top holdings that are not exclusively motivated by tax planning considerations, meaning, for example, actual global or regional headquarters. Another difference between the three clusters concerns the absence of an extensive network of tax treaties in the first one. We interpret the apparent unwillingness of countries to sign tax treaties with countries in the first cluster as another indication that TNCs locate their top holdings in Cyprus, Malta, and Luxembourg mainly to reduce their tax burden. For countries in the second and third cluster, on the other hand, we interpret their ability to sign tax treaties with large numbers of countries as an indication that the top holdings located in those countries are perceived as more legitimate by potential treaty partners. Finally, our results further suggest that countries may increase their attractiveness as a location for TNCs’ top holding companies by offering low withholding taxes on dividends and providing for a lenient and efficient tax legislation (low number of anti-avoidance provisions and short time needed to prepare taxes).

21Estonia is worthy of special mention. It appears to have all the right conditions to be identified as a top holding jurisdiction—a small economy, lenient and efficient tax legislation, minimal taxation. It also harbors a large number of GUOs. However, the low scores of the country on all the other activity indicators suggest that the country may be attracting large amounts of top holdings of small and inconsequential TNCs (possibly related to personal finance and wealth management) but does not play a significant role as a preferred jurisdiction for top holdings of bigger TNCs.
3.5.5 Intermediate holdings

Lastly, we identified three clusters of countries that attract disproportionate amounts of intermediate holding companies, or conduits (Figure 3.8A). The first cluster is composed of Hungary, Malta and Cyprus. Countries in this cluster are all specialized in one type of intermediate holding company. Cyprus operates as a pure dividend conduit, as evidenced by its high value of conduit investment. Hungary and Malta attract disproportionally large payments for the use of intellectual property, reflecting their status as preferred jurisdictions for royalty conduits. The second cluster is composed of a prominent group of multi-purpose countries: Luxembourg, Netherlands, Switzerland, Ireland, Belgium and the United Kingdom. All countries in this group exhibit high values for all types of holding activities. For the case of the United Kingdom, its large GDP—3.4 times higher than the second largest country in the cluster—downplays the importance of the country as a conduit jurisdiction. The third cluster we identified consists of four countries that attract moderate amounts of holding companies: Finland, Sweden, Austria and Denmark. Countries in this group are frequently used as dividend conduits, and occasionally as royalty and interest conduits.

We next analyzed the macro-institutional indicators correlated with the clusters (Figure 3.8C). We found that countries in the second and third clusters have good governance, a highly developed ICT and financial infrastructure, and a large presence of the Big Four. Contrary, countries in the first cluster exhibit comparatively lower levels of governance and infrastructure (at similar levels than Spain or France), which suggest that tax determinants may be the key to their success. Indeed, we found that all three countries have no withholding taxes, a low number of anti-avoidance provisions, and the most generous patent boxes in Europe. The patent box in Hungary (established in 2003) offers a tax rate of 5% on qualifying royalty income, the Maltese patent box (established in 2010) provides a full exemption for all qualifying royalty income, and the Cyprus patent box (established in 2013) offers an 80% exemption in gross profits (tax rate below 2.5%).

The second cluster of countries is also characterized by the presence of a generous patent box, and either the presence of the notional interest deduction or another tax incentive targeting group interest payments. The high correlation between the patent box score and the success to attract royalty
Figure 3.8. Intermediate holdings. (A) Activity indicators, (B) benefits, and (C) macro-institutional features and tax incentives associated with attracting intermediate holdings. The two identified clusters of countries are marked with gray brackets (A,C) and different shades of orange. See Table A1 for a complete explanation of the indicators. Countries are sorted according to their assigned cluster.
holdings indicates that royalty holdings (but not R&D activities) are attracted to places with generous patent boxes, which is consistent with the literature on patent location (Evers, Miller, and Spengel 2015; Karkinsky and Riedel 2012). Moreover, the correlation between the presence of measures granting special tax treatment for interest income and the loans held by non-financial corporations in a country indicates that interest holdings may be attracted to places with generous interest incentives. Moreover, countries in this group have either no or low withholding taxes (Luxembourg and the Netherlands), or an extensive network of tax treaties (Switzerland, Belgium, United Kingdom). The only exception is Ireland, with moderate withholding taxes and a relatively shallow network of tax treaties. However, withholding taxes in Ireland can be avoided by using a holding company in a third EU country that has an extensive network of tax treaties, since intra-group payments in the EU are exempt from withholding taxes. Countries in this second cluster also have a large network of investment treaties, ensuring investor rights and increasing the attractiveness of a country for dividend holdings. Finally, countries in the third cluster are characterized by the highest levels of governance, reduced regulation and incentives, evidenced by the lack of anti-avoidance provisions and interest incentives.

3.5.6 Towards a typology of “FDI attraction profiles”

To summarize and wrap up the results of our analysis we then profiled all countries according to the different types of FDI they attract. We identified six groups of countries (Figure 3.9), each of which we indicated with a unique color mark in the bar just above the country labels. One group of countries (indicated with the white color mark) consists of a heterogeneous set of big and small countries (Germany, France, Slovenia, Spain, Italy, Greece, Latvia, Croatia, and Lithuania) that all appear to be rather unsuccessful in attracting FDI of any category. Countries in each of the other five groups all successfully attract distinct combinations of two or more categories of FDI. We call these distinct combinations “FDI attraction profiles”. Below we briefly discuss each of these profiles in more detail.

The FDI attraction profile that is marked in grey, and which is associated with Hungary, Czechia, Bulgaria, Romania, Slovakia, and Poland, revolves primarily around TNCs’ offshoring of manufacturing activities. For this reason, we dubbed countries associated with this profile manufacturing centers. Apart
Towards a typology of “FDI attraction profiles”

from manufacturing activities, all countries in this group attract at least some degree of (primarily low value-adding) SSC activities. It is conceivable that this particular combination of manufacturing and low value-adding SSC FDI is the result of a sequential phenomenon in which TNCs first offshore their manufacturing operations to those countries and, after having had good experiences with the country’s investment climate, decide to also relocate some of their lower value-adding SSCs to the country. After all, in decisions regarding SSC (re)locations that are primarily motivated by cost reductions TNCs seem to consider location factors that are very similar to those that are considered in decisions regarding the (re)location of manufacturing activities. Such a pattern of “sequential FDI” has indeed been identified in the International Business literature as a mechanism that might explain TNCs’ location decisions when offshoring activities (Oman 2000; Kogut 1983). Two of the countries associated with the manufacturing centers profile (the Czechia and Hungary) also attract a small amount of R&D activities. As we suggested earlier, this may be an artefact of TNCs’ preference to have some of their R&D activities located in the proximity of their previously offshored manufacturing operations. Hungary is a special case in this group of countries because it has also been able to attract substantial numbers of intermediate holding companies due to its aggressive tax incentives (see section 3.5.2).

The second FDI attraction profile, which is associated with Portugal and Estonia, combines low value adding SSC activities with a limited amount of high value adding SSC activities. We refer to countries associated with this profile as back office centers. The reason these countries are successful in attracting SSCs may lie in their unique macro-institutional features. Both countries combine low labor costs with an efficient workforce and above average ICT infrastructure. Their success in attracting top holding companies, however, probably has more to do with the specificities of their corporate tax regimes. Estonia only taxes corporate income once it is distributed to shareholders, which is an attractive regime for small individually-owned companies, while Portugal harbors within its borders the Madeira international business center, where no withholding taxes are levied and which offers a statutory tax rate of only 5%.

The third FDI attraction profile, which we label innovation centers, is associated with Sweden, Denmark, Finland and Austria (marked in yellow). The main strength of these countries is their ability to attract TNCs’ R&D affiliates. We
attribute these countries’ ability to do so primarily to their macro-institutional features. All countries offer large numbers of STEM graduates, good ICT infrastructure, and a stable political climate. Interestingly, none of these countries seems to rely on exceptionally generous patent boxes or other kinds of tax incentives to be successful in attracting TNCs’ R&D facilities. Apart from the FDI in R&D, most of these countries also attract a considerable number of intermediate and top holdings. The attraction of holdings is correlated with good access to financial markets, and the presence of a stable government providing efficient regulation.

The fourth FDI attraction profile that we identified is without doubt the most encompassing one. This profile (indicated in blue) combines all categories of FDI except for manufacturing activities. However, what is unique about the countries associated with this profile is their ability to attract high value-adding SSCs and intermediate holding companies. Because of the central role of these two functions in the coordination of global supply
Towards a typology of “FDI attraction profiles” and wealth chains, we dubbed this the coordination centers profile. This unique combination of activities is partly explained by these countries’ macro-institutional endowments. All countries in this group provide for a highly skilled workforce, good infrastructure, and a stable political climate. However, tax incentives appear to play a significant role as well. Most of these countries provide for low withholding taxes and tax incentives specifically created to attract holding companies, such as patent boxes and special treatment of group interest income. We believe that the explanation for the emergence of this particular FDI attraction profile should be looked for in the proactive role of the offshore services sector in shaping tax and financial regulatory policies in these countries. Although this hardly confirms our expectation, all countries associated with the coordination profile display an exceptionally high presence of the Big Four accounting firms (see Figure 3.8C).

We labelled the fifth and final FDI attraction profile the profit centers profile. The two countries associated with this profile (Cyprus and Malta) primarily attract top holding companies, but also, to a somewhat lesser extent, intermediate holding companies. The extraordinary high profit rates of multinationals that we found for those two countries indicate that the top holdings they attract are mainly of the sort that are used for profit shifting purposes, rather than those that engage in substantial global headquarter activities. We thus conclude that these countries owe their status as a preferred location for top holdings almost exclusively to the specificities of their tax regimes. Taking into account Malta’s special tax refund scheme, both countries have effective tax rates that are amongst the lowest in the EU. The centrality of such low effective tax rates makes it that the profit center profile can only be a feasible FDI attraction profile for countries with very small domestic economies. This is because in such countries, the additional tax revenues generated by taxing the activities of intermediate holding companies more than offset the reduction in tax revenues from domestic companies.

3.6 Conclusion

In this paper we have challenged the monolithic understanding of FDI that underpins most of the political economy literature dealing with international competition for FDI. To do so we first traced the great fragmentation of the firm to distinguish between five different categories of FDI: manufacturing affiliates,
3.6. Conclusion

shared service centers, R&D facilities, intermediate holding companies (conduits) and top holding companies (sinks). Using a combination of micro and macro statistics, we then showed for each category of FDI which European countries are most successful in attracting it and identified some of the benefits they obtain from doing so. We also identified a range of macro-institutional and tax indicators present in countries that attract these different categories of FDI. Finally, we summarized our findings by profiling countries according to the different categories of FDI they attract. In this way, we were able to identify five distinct groups of countries, each of which attracts a distinct combination of categories of FDI. We called these distinct combinations “FDI attraction profiles” and labelled the five FDI attraction profiles that we found to coexist in the European Union manufacturing centers, back-office centers, innovation centers, coordination centers, and profit centers.

Three important lessons can be learned from our results. The first of these pertains to the locational determinants of FDI. Our results show that each type of FDI is correlated with distinct macro-institutional and tax indicators. This implies that, from a TNC’s perspective, the perceived attractiveness of potential host countries and, ultimately, TNCs’ decisions where to invest, are different for different types of subsidiaries. Future studies on the locational determinants of FDI can build on the analytical framework we developed in this paper to carefully establish the effect of macro-institutional and tax determinants on each type of FDI.

A second lesson that can be drawn from our results has to do with our understanding of the structure and dynamics of international competition for FDI. Our results show that different countries attract different categories of FDI and rely on different types of macro-institutional and tax policies to do so. Competition for FDI thus appears to takes place amongst subsets of countries that compete for similar categories of FDI. It is in this sense that the title of this article makes reference to countries competing not for capital, but for capitals. This insight has important implications for policy initiatives at the EU level.

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22To do so, future studies could, for instance, use longitudinal regression models. Such studies will, however, face several challenges, such as incomplete data for some years, multicollinearity, endogeneity, and omitted variable bias (see e.g. Nielsen, Asmussen, and Weatherall (2017); Bénassy-Quéré, Coupet, and Mayer (2007); Blonigen (2005)). Such studies should also take into account the hierarchical location decision process of TNCs (Nielsen, Asmussen, and Weatherall 2017). This process is likely a multi-step one, where the firm first chooses series of potential candidates on the basis of the macro-institutional features, and only then the tax and policy features become relevant.
Towards a typology of “FDI attraction profiles”

that aim to curb aggressive tax competition. Tax policy-making in the EU is a highly politicized affair. Direct taxation is one of the few policy fields in which individual member states have successfully defended their sovereignty. As a result, any attempt to question the legitimacy of a specific tax incentive or instrument tends to run against opposition from those member states that rely on that incentive or instrument to attract internationally mobile FDI. Given the variegated nature of tax competition, we should not expect smaller member states to invariably be united in their attempts to block attempts orchestrated at the EU level to question the legitimacy of a specific tax incentives or instrument. Rather, we should expect member states to alternately side with and oppose ad hoc coalitions of countries, big or small, that initiate attacks on specific tax measures and instruments. Advocacy groups, international organizations, and even the European Commission would be wise to take the possible existence of such flexible coalitions into account when formulating policy proposals aimed at curbing the harmful aspects of international tax competition.

A third lesson that can be drawn from our results concerns the way in which we think about European countries’ growth regimes and specifically about the role of FDI therein. Previous research in comparative political economy has emphasized the FDI-dependence of some European countries’ growth regimes. The analysis presented in this paper, however, suggests that in the age of the great fragmentation, FDI-dependence seems to have become a feature that is shared by many European growth regimes. Moreover, our analysis shows that such FDI-dependence comes in different forms. Countries have developed distinct varieties of what we have called FDI attraction profiles. Given our finding that each FDI attraction profile comes with its own set of benefits, and thus favors distinct social groups, we can expect FDI attraction profiles to be politically supported by different kinds of interest coalitions. Future research could conduct in-depth case studies of national FDI attraction models to identify those interest coalitions, learn more about the specific historical and political conjuncture in which these models emerged, and identify the winners and losers of different FDI attraction profiles. Earlier studies have done this for a range of Central and Eastern European countries that we have associated with the manufacturing centers profile (Bohle and Greskovits 2012; Drahokoupil 2009; Nölke and Vliegenthart 2009). We know little, however, about the historical and institutional origins and evolution of other types FDI attraction profiles. Given their central role in the coordination of global supply
3.6. Conclusion

and wealth chains, especially countries associated with the coordination center profile merit closer scrutiny.

The analysis presented in this paper has a number of limitations that open up additional avenues for future research. We see two of them as especially fruitful. The first of these would be to extend the analysis presented in this paper to other parts of the world. In this regard, the Asia-Pacific region seems to be an especially suitable candidate. A process of regional economic integration in some ways resembling that in the European Union has been underway in that region since the mid-1980s under the auspices of the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation (APEC). For firms operating in that region, this has opened up the possibility to organize their corporate structures and processes on a regional, rather than national basis. Indeed, jurisdictions like Singapore and Hong Kong are known to be domiciles for large numbers of holding companies and regional headquarters, making it at least conceivable that they fulfill a role in that region that is not unlike the one played by the coordination centers we found in the EU. Whether the region also harbors the other FDI attraction profiles we identified in this article remains an open question.

Another limitation of our analysis that could be addressed in future research is that we have focused primarily on non-financial firms. Yet, financial firms (banking conglomerates, investment funds, insurance firms) have gone through a similar process of fragmentation. The emergence of multi-purpose financial service firms and the unbundling of front- and back-office operations in those firms have since the 1990s resulted in a geographical dispersion of the financial firm that is similar to the one experienced by non-financial firms. A typical investment fund nowadays is domiciled in Luxembourg or the Cayman Islands, the fund manager sits in London, while the back office paperwork is done in Dublin. International competition for each of these activities is as fierce for financial TNCs as it is for non-financial ones.

References

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CHAPTER 4

Tax Avoidance is Orchestrated in Coordination Centers

In this chapter we show that coordination centers play a key role in corporate tax avoidance. We do this by mapping the geographical dispersion of tax professionals, who are responsible for tax planning for MNCs. Accessing data on this profession is challenging, however. To obtain a representative sample of their location, we develop a novel data-collection method based on the advertisement tool of LinkedIn: the LinkedIn Campaign Manager. The LinkedIn Campaign Manager facilitates the targeting of advertisements to specific audiences, defined based on location, job title and company size, among other criteria. This allows us to target advertisements to tax professionals and obtain the potential total number of tax professionals that are theoretically able to see the advertisement. We then analyze this dataset to show that tax professionals are indeed located in coordination centers. Moreover, we show that while their location correlates with the location of financial and managerial activity, it correlates neither with the location of productive economic activity, nor with measures of financial secrecy or profit shifting. Given that coordination centers play a key role in the coordination of MNCs, it is not surprising that tax avoidance is also orchestrated from their midst in conjunction with finance and management. Finally, we did not find a significant relationship between tax professionals and measures of secrecy or profit shifting. This strengthens the view that profit centers (or sinks) are just empty shells where profits are booked.
This chapter is adapted from Garcia-Bernardo J. and Stausholm S.N. (Forthcoming) “Geography of tax professionals on LinkedIn: Coordination centers are the nexus between onshore production and offshore finance”. The pre-registration of this study, together with all code and data can be found at https://osf.io/tceyr/
Abstract

Tax avoidance by multinational corporations and high-net-worth individuals has gathered public, political, and academic attention in the last decade. While tax avoidance is driven by economic interests, it is in practice enabled by tax professionals. Corporate executives and high-net-worth individuals are not able to directly arrange the financial instruments to lower their global tax rate. Rather, they seek out advice from skilled tax professionals—wealth managers, lawyers, accountants, and consultants. This group of people are the ones responsible for the orchestration of tax avoidance. This chapter develops a novel methodology, leveraging the advertisement service of LinkedIn to map the geographical dispersion of tax professionals. We find that tax professionals, and with them the orchestration of tax avoidance, are located in coordination centers, which are highly developed jurisdictions that attract not only the holding companies of multinational corporations, but also corporate management and finance firms. These include the Netherlands, the United Kingdom, Luxembourg, Ireland and Singapore, amongst others. However, we do not find a significant relationship between the location of tax professionals and the location of corporate profits, financial secrecy, and productive economic activity.

4.1 Introduction

The principles of international taxation set by the League of Nations, together with the elimination of capital controls and the financialization of the economy, created the conditions required for tax avoidance (Chapter 1). By strategically placing trusts, shell companies, distributor intermediaries, or important value-creating assets (e.g. intellectual property or interest-bearing loans) in low-tax jurisdictions, multinational corporations and high-net-worth individuals can shift income towards offshore financial centers and reduce their tax bill. The study of tax avoidance has been tackled within different disciplines. These include theoretical and empirical research in economic geography (Wójcik, 2013, Haberly & Wójcik, 2015, Coe, Lai, & Wójcik, 2014), economics (Tørsløv, Wier, & Zucman, 2018, Zucman, Fagan, & Piketty, 2015, Janský & Palanský, 2019), international political economy (Seabrooke & Wigan, 2017, Bryan, Rafferty, & Wigan, 2017, Christensen & Hearson, 2019, Palan, 2002), and economic sociology (Harrington, 2017a). In general, these bodies of literature
have conceptualized and measured the geography of “tax havens” or “offshore financial centers” (OFCs)\textsuperscript{1} what constitutes one, where they are, and to whom they provide services.

These bodies of literature identify and measure OFCs through two approaches: by measuring the misalignment between the location of financial activity and “real” activity; and by analyzing the institutional framework of the country. The misalignment approach identifies OFCs as the countries where profit accumulates (e.g., Hines and Rice \textsuperscript{1994}, Tørsløv et al. \textsuperscript{2018}, Cobham and Janský \textsuperscript{2019}) or by the size of the financial sector (e.g., Fichtner \textsuperscript{2018}). The institutional approach identifies OFCs as those countries exhibiting certain legal features, such as low corporate tax or banking secrecy. The three main examples of the latter approach are the Financial Secrecy and the Corporate Tax Haven Indices by the Tax Justice Network (Cobham, Janský, & Meinzer, \textsuperscript{2015}), and the highly controversial and politicized black lists of “tax havens” or “uncooperative jurisdictions.”

In Chapter 2 and 3 I identify two types of OFCs: profit centers and coordination centers. Profit centers—which I also refer to as sink-OFCs—are jurisdiction that offer financial secrecy and absence of taxes, and are used to hide individual assets and shift corporate profits. They correspond to the archetypal idea of a tax haven. Coordination centers, on the other hand, offer a high degree of secrecy and low taxation, combined with onshore characteristics such as a strong legal system, a wide network of tax and investment treaties with other countries, a highly skilled workforce, good infrastructure, and unrestricted access to financial markets. They act as “conduits” through which capital is routed (Chapter 2 see also (Damgaard, Elkjaer, & Johannesen, \textsuperscript{2019}) and connected to management (Chapter 3). Examples of these jurisdictions are Singapore, Hong Kong, the Netherlands, Ireland, Luxembourg and Switzerland. While these studies are extremely valuable for conceptualizing offshore financial centers, and their relevance as a destination (or conduit) of profits and assets, they do not clarify whether tax avoidance is actually orchestrated from those jurisdictions.

\textsuperscript{1}The term “tax haven” refers to a particular aspect of the jurisdiction (absence of tax, usually found together with financial secrecy) while “offshore financial center” or “offshore jurisdiction” refers to a particular outcome (the successful attraction of offshore finance). The use of different terms is highly dependent on the academic discipline and they are often used interchangeably. Here we will use offshore financial center
4.1. Introduction

While tax avoidance as a phenomenon is driven by economic interests, it is in practice enabled by tax professionals. CEOs and high-net-worth individuals do not have the expertise required to directly arrange the financial structures required to lower their global tax rate. Rather, they seek out advice from skilled tax professionals. Tax professionals are lawyers, wealth managers, consultants and accountants with expertise in the highly technical fields of international tax law, corporate taxation, accountancy, and wealth protection (OECD, 2008). They advise corporations and individuals, devising financial products that allow their clients to move assets offshore and escape taxation (Sikka & Willmott, 2013; Jones, Temouri, & Cobham, 2018; Ajdacic, Heemskerk, & Garcia-Bernardo, 2019; OECD, 2008; Russell & Brock, 2016; Wójcik, 2013). Moreover, they advise governments on the design of tax policy (Seabrooke & Wigan, 2017), and serve as intermediaries between multinational corporations and the state (Chapter I).

While their role in the development of tax planning has been conceptualized in the economic geography literature (Wójcik, 2013), demonstrated empirically (Poon, Tan, & Hamilton, 2019; Wainwright, 2011; Harrington, 2017a), and acknowledged by international organizations (OECD, 2008), previous research on the geography of tax professionals has suffered from a lack of comprehensive empirical data (Wójcik, 2013). As such, we do not know which jurisdictions play a systematic role in the orchestration of global tax avoidance. In this paper, we develop a novel empirical strategy based on LinkedIn data. Our approach allows us to pinpoint the cities and countries where tax professionals are located, and thereby establish the locations from which tax avoidance is orchestrated.

Understanding the locations where tax avoidance is orchestrated is not only important for the conceptual understanding of tax avoidance, but it also opens potential avenues for legislation. Current efforts by the OECD (2017) establishes that lawyers, accountants, financial advisors, banks and other service providers are required to report to tax authorities on any structures created on behalf of their clients that could be used to hide the ownership of assets. If these tax professionals are located in profit centers, which are typically uncooperative

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2The lack of adequate data is partly a consequence of the confidentiality provided by OFCs, which allows MNCs and individuals to hide their activities from governmental and public scrutiny. Moreover, the controversial nature of tax avoidance discourage openness from tax professionals—see e.g. Harrington (2017b) in the context of wealth managers.
jurisdictions, regulation targeting tax professionals will most likely fail. The concentration of tax professionals in profit centers has indeed been noted by some researchers. (Poon et al., 2019), using the (highly biased) data from the Panama Papers, find that many intermediaries in tax avoidance are placed in small offshore financial centers. On the other hand, other researchers have identified the importance of coordination centers—and particularly London—in the orchestration of tax minimization strategies (Clark & Monk, 2014; Wainwright, 2011; Beaverstock, Taylor, & Smith, 1999).

In this paper, we map the geography of these tax professionals. We argue that tax avoidance is explained not solely by the regulatory frameworks provided by offshore financial centers, but additionally by the practices and skills of people who devise tax minimization strategies. We run an exhaustive regression analysis which allows us to establish the locational determinants of tax professionals. We find that tax professionals co-locate with financial and managerial centers, but not with “real” economic production, nor with measures related to financial secrecy or profit shifting. Our analysis reveals that the orchestration of tax avoidance takes place in coordination centers, from which the global game of tax planning, shell companies, and asset hiding is coordinated.

Our novel research design leverages the advertisement service of LinkedIn to obtain data on tax professionals across 203 jurisdictions. This methodology allows us to overcome the challenges of the general lack of data on offshore financial centers (IMF, 2000). We thereby answer calls to explore the financial geographies of taxation and offshore (Coe et al., 2014; Aalbers, 2018), and overcome the problems of limited empirical evidence on geography of tax professionals (Wójcik, 2013). Our research indicates that legislation affecting tax professionals can be achieved with the cooperation of only a few developed countries, and exposes avenues to potential regulation by legislators.

The paper proceeds as follows: Section 4.2 describes our data collection method using the professional networking site LinkedIn. Section 4.3 analyzes the geographical distribution of tax service professionals, showing the jurisdictions and cities where they are concentrated. Section 4.4 uses a regression analysis to systematically identify the factors correlated with the location of tax
professionals. Finally, Section 4.5 discusses the implications of our findings and concludes.

4.2 Methodology and data collection

4.2.1 Extracting data from LinkedIn

The increase in usage of social networks has provided new opportunities for marketing. Companies such as Facebook, LinkedIn and Twitter now allow users to create personalized marketing campaigns targeted at specific locations, age groups and other variables. In order to facilitate the creation of ads, social networks share the potential number of users reached by those personalized ads. This has allowed researchers, for example, to measure gender bias disaggregating by location or industrial sector (Fatehkia, Kashyap, & Weber, 2018; Haranko, Zagheni, Garimella, & Weber, 2018). Here, we devised a novel methodology using the LinkedIn Campaign manager to analyze the geographical distribution of tax professionals. The LinkedIn Campaign manager facilitates the targeting of advertisements to specific audiences, defined based on location, job title and company size, among other options. LinkedIn is a superior resource for analyzing tax professionals because, unlike other social networks, most active LinkedIn users share their employment status and exact job title. This allows us to design advertisements targeting users with specific job titles, such as tax lawyer or wealth manager.

![Figure 4.1](image.png)

**Figure 4.1.** Division of tax professionals into two groups: corporate tax services and personal tax services. Corporate tax services are divided into two subgroups: transfer pricing professionals and tax strategy professionals. Personal tax services are identified with wealth managers.

Our approach enables us to collect data even for small offshore financial centers where there is normally little or no data available. This is especially important for the study of tax professionals, since a significant portion of their activity may occur in these jurisdictions. It could be argued that analyzing tax professionals on a national level perhaps overestimates the
importance of national borders in the transnational practice of tax avoidance (Christophers, 2012). However, while tax professionals are indeed servicing a transnational market, their national distribution is relevant for two reasons: First, national borders determine the legislation that applies to the activities of tax professionals. Second, while capital is hypermobile, human capital is still sticky. The professional services that are necessary for capital to be hypermobile are not themselves hypermobile. This is not to say that they are fixed to these places and could not change positions—but moving people is much harder than moving profits from one offshore financial centers to another. Because of this, analyzing their geography shows where the orchestration of tax avoidance takes place.

| Table 4.1. Operationalization of our search strategy. For targets 1–4, we excluded the profiles matching the following job titles: tax compliance manager, tax preparer, tax audit, tax inspector, tax collector, tax examiner, tax preparer, revenue agent. The list of inclusion and exclusion was created manually based on the options containing “tax” provided by the campaign manager. LinkedIn automatically translates all titles in local languages to English. Furthermore, our approach enables us to go beyond macro-level designations of employee groups such as industry groups, and actually break the data down by specific job titles, ensuring that we are not counting irrelevant titles. We collect information from two groups of tax professionals: corporate tax and personal tax (Fig. 4.1). Corporate tax is composed of two subgroups. The subgroup “transfer pricing” includes all users with that string in their title, who presumably work on transfer pricing matters for multinational |
corporations. The subgroup “tax strategy” includes all corporate tax titles such as “international tax specialist” that are not related to transfer pricing, and may be internal within companies or external consultants. Personal tax contains “wealth managers,” which refers to people working on personal tax and wealth protection for high-net-worth individuals. Finally, we also created a group entitled “all tax professionals,” which includes all the job titles in the other groups as well as more ambiguous titles such as “tax specialist.” LinkedIn also allows the exclusion of users from the advertisement. We used this function to exclude all tax professionals with jobs related to tax compliance or collection. Table 4.1 shows the exact job titles used in each group.

For each of the 231 available jurisdictions and 308 selected cities (see Sections S4 and S5 for a complete list and our selection criteria), we collected the number of people that would be reached by an advertisement targeting each of our four groups (transfer pricing, tax strategy, wealth management, and all tax professionals). The campaign manager does not provide an exact count for the audience reached, but only rounded numbers (e.g. it provides 300+, 3000+ or 30000+ for counts between 300–310, 3000–3100 and 30000–31000—see Section S1 for a more detailed explanation). We also designed advertisements targeted at profiles related to the location of non-financial economy (e.g., engineers), managerial control, and the financial sector (see Table 4.1). Those titles are used in the regression analyses in Section 4.4.

4.2.2 Data verification

The main challenge when analyzing social media data is to confirm external validity and rule out the possibility of systematic biases. The use of LinkedIn varies greatly between countries. While 70% of the U.S. workforce uses LinkedIn, only 15% of the Indian workforce does. Within countries, the use of LinkedIn depends on the profession analyzed. The use of LinkedIn in internationally-oriented professions such as corporate tax or wealth management will be higher than the one in domestically-oriented professions such as teaching. In order to ensure external validity, we must ensure that the coverage of tax professionals is similar across countries. This can be done by comparing the collected dataset with an external dataset from a verified source. In our case, analyzing coverage is extremely difficult given the lack of data on tax professionals in almost every countries. However, we overcame this limitation by comparing the number of employees in Deloitte on LinkedIn
Data verification

with the numbers in the official Deloitte national websites collected by Murphy and Stausholm (2017). Deloitte is a company whose employees are comparable to tax professionals in type of education, client contact and prestige. If the number of employees found on LinkedIn and the official websites is similar, this strongly indicates that most tax professionals do register on LinkedIn. In order to collect the data from Deloitte, we targeted an advertisement at employees in all Deloitte entities available on LinkedIn. We find a 98% correlation between the per capita number of professionals on LinkedIn and the per capita number that the company claims on their web page (Fig. 4.2). Therefore, we argue that LinkedIn is a representative source of information for analyzing tax professionals. We also analyzed the coverage for our other search queries (e.g. CEO or accountant), which allowed us to verify the quality of all our search queries except for CEOs and CXOs (all chief officers), which we discarded (Section S2).

Figure 4.2. Data verification. Number of employees per 1000 people according to the local Deloitte websites—versus number of employees per 1000 people according to LinkedIn. The correspondence between ISO2 codes and country names can be found in the Appendix.

4.3 Descriptive analysis: Geographical distribution of tax professionals

We start by describing the geographical distribution of tax professionals. We do this in three steps. We first analyze whether tax professionals are highly concentrated geographically compared with other professions. Secondly, we
4.3. Descriptive analysis: Geographical distribution of tax professionals

focus on the jurisdictions where they concentrate. Thirdly, we zoom in on the jurisdictions to analyze the cities where tax professionals are located.

We first compared the skewness of the distribution of tax service professionals per capita to other professions using Lorenz curves (Fig. 4.3). Professions that require direct contact with their object of study (e.g. doctors, engineers or accountants) are distributed similarly to the user base of LinkedIn. Interestingly, tax professions exhibit the most unequal distributions, which indicates that tax professionals—and with them the orchestration of tax avoidance—are located in few jurisdictions rather than being spread out.

![Figure 4.3. Lorenz curves and Gini coefficients.](image)

Figure 4.3. Lorenz curves and Gini coefficients. All variables are divided by population, which gives all jurisdictions the same weight in the analysis. More unequal distributions create lower curves (higher Gini coefficients). The gray diagonal line dividing the plot signals a hypothetical uniform distribution.

Secondly, we focus on the specific locations where tax professionals concentrate. First, we are interested in the location of tax professionals in absolute numbers. While these are correlated with country size, the absolute numbers indicate the locations where most of the activity of tax services take place. We found that 66% of all tax professionals are located in the United States and the European Union, although these locations account for only 12% of the worldwide population. This signifies the prevalent role of the developed world with respect to tax planning. Secondly, we visualized the number of tax professionals per capita (Fig. 4.4), which reveals the countries where tax services are relatively important. This can for example be because the tax system is complex, because there are a lot of potential clients who are present there, or because the country is in some way important in the global infrastructure of
Data verification

tax. We found that tax professionals are disproportionately located in European OFCs\footnote{We divide OFC into coordination and profit centers. We use the list of coordination centers from Chapter 3: The Netherlands, Ireland, the United Kingdom, Switzerland, Luxembourg and Belgium. We add Hong Kong and Singapore given their similarity to coordination centers. We use the list of sink-OFCs from Chapter 2 as profit centers, excluding Luxembourg and Hong Kong, which we had already categorized as coordination centers.}, the United States (US), Canada (CA), Singapore (SG) and Hong Kong (HK) (Fig. 4.4). Importantly, profit centers, with the exception of the Cayman Islands (KY), Curaçao (AN) and Bermuda (BM), are not locations where tax services are disproportionately located either in absolute or relative terms, although US corporations shift US $23, $18 and $34 billion dollars to the Bahamas (BH), Panama (PA) and the British Virgin Islands (VG) respectively, and such jurisdictions are likely also important for individuals. The discrepancy between the location of assets and profits and the location of tax professionals indicates that the majority of global tax services are provided from a few countries in the developed world.

![Figure 4.4](image-url)

**Figure 4.4. Tax professionals are concentrated in the developed world.** (A–C) Distribution of aggregated tax professionals (tax partners, lawyers, advisers, consultants, counsels, accountants, directors, managers, and specialists; corporate tax, international tax, transfer pricing and wealth managers). (A–B) Bubble size is proportional to the number of tax professionals per capita in (A) the world and (B) Europe. Coordination centers are marked in black. (C) Number of tax professionals per million people.

Next, we asked whether the location of tax professionals depends on the type of services that they provide. We answered this question by disaggregating and mapping the location of three groups of tax professionals: tax strategy professionals, transfer pricing professionals, and wealth managers. Figure 4.5

\footnote{We divide OFC into coordination and profit centers. We use the list of coordination centers from Chapter 3: The Netherlands, Ireland, the United Kingdom, Switzerland, Luxembourg and Belgium. We add Hong Kong and Singapore given their similarity to coordination centers. We use the list of sink-OFCs from Chapter 2 as profit centers, excluding Luxembourg and Hong Kong, which we had already categorized as coordination centers.}
4.3. Descriptive analysis: Geographical distribution of tax professionals

shows the absolute number of tax service professionals in countries (y-axis), as a function of the relative number of tax professionals per accountant (x-axis). Since we would expect accountants to be distributed similarly to tax professionals that deal with routine business operations, normalizing by the number of accountants allows us to analyze tax avoidance without being affected by jurisdictions with a higher amount of finance and business services, for example because they attract a more international clientele or because they have more obfuscated regulatory regimes. However we report the plots normalized by population in the supplementary material, showing highly similar patterns. The upper right corners of all plots in Figure 4.5 show the jurisdictions where the absolute and relative number of professionals is larger than the median plus the interquartile range—the range between the 1st quartile (25th percentile) and the 3rd quartile (75th percentile). The lower right corner shows the places where the relative distribution is larger than the threshold but the absolute number is below the threshold.

For our first group, tax strategy, we found that coordination centers—the Netherlands (NL), Ireland (IE), Switzerland (CH), Belgium (BE), the United Kingdom (GB), Luxembourg (LU), Hong Kong (HK) and Singapore (SG), together with the United States (US) and Canada (CA), exhibit a high absolute and relative number of professionals (upper-right corner of Fig. 4.5A). Tax strategy professionals are also important in China (CN), Malaysia (MY) and Indonesia (ID), as well as two European countries: Italy (IT) and Germany (DE). Profit centers have a high relative number of tax strategy professionals, but low absolute numbers (lower-right corner of Fig. 4.5A), which indicates that while tax professionals are important for profit centers, those jurisdictions play a secondary role in the global orchestration of tax avoidance.

The location of transfer pricing professionals is more evenly distributed (Fig. 4.5B). While the Netherlands (NL), Singapore (SG), Switzerland (CH), Luxembourg (LU) and Germany (DE) have high absolute and relative numbers of transfer pricing professionals, the difference between them and the rest of European countries is small.

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4 Using the median and interquartile range instead of the mean and standard deviation provides a less susceptible measure to outliers. In the case of normally distributed values, the robust measure is equivalent to the mean plus 1.35 standard deviations.

5 Hungary (HU), Austria (AT), Finland (FI) or Denmark (DK) also exhibit high absolute and relative numbers of professionals, but lower than the other countries.
Figure 4.5. Number of professionals per capita vs. absolute number of professionals for: (A) tax strategy professionals, (B) engineers, (C) wealth managers, and (D) transfer pricing professionals. Dashed lines denote the median plus the interquartile range. Red countries denote the median plus the interquartile range. Red countries are Canada, the United States and Australia. Purple countries are the rest of the EU member states and all other countries are visualized in grey.
4.3. Descriptive analysis: Geographical distribution of tax professionals

Figure 4.6. Tax professionals locate within cities: x-axis shows number of tax professionals relative to population. Y-axis shows the absolute number of tax professionals. Both cities (in black) and countries (in gray) are included in the plot. Note that some jurisdictions are so small that they are identical to their main city (e.g., Luxembourg)
The distribution of wealth managers also highlights the relevance of Western countries. A large share of wealth managers are concentrated in France (FR), Germany (DE), Austria (AT), Switzerland (CH) and Luxembourg (LU) (Fig. 4.5C). Similarly to the tax strategy graph, Hong Kong (HK), Singapore (SG) and Malaysia (MY) are amongst the countries with the highest absolute and relative numbers of wealth managers, as well as the United States (US) and Canada (CA) (Fig. 4.5C). However, the Netherlands, the largest conduit jurisdiction and one of the countries with the highest absolute and relative numbers of corporate tax professionals (Fig. 4.5A–B), has a similar proportion of wealth managers to the one found for most European countries. Similarly to the corporate tax groups, profit centers exhibit the highest concentrations of wealth managements, but low absolute numbers. Malta (MT), however, appear now in the upper-right quadrant.

The three tax professions contrast with the distribution of the number of engineers (Fig. 4.5D). Engineers are more equally distributed, and coordination centers exhibit similar numbers of engineers per accountant to other developed countries. As expected given that corporate services are the main export of profit centers, those jurisdictions have low absolute and relative numbers of engineers.

Tax professionals are not uniformly spread across the world, but are rather concentrated in high-income countries, in particular coordination centers such as the Netherlands, Switzerland, Singapore, the United Kingdom, Luxembourg and Hong Kong (top right corners of Figures 4.5A–C), and other developed countries such as the United States and Canada. The bulk of tax services take place in those locations, and they also exhibit a high number of tax professionals per capita. These are places from which tax avoidance is orchestrated, attracting headquarters, high value-adding shared service centers as well as holding companies. In the lower right corners of Figures 4.5A–C we observe jurisdictions where tax services are disproportionately large relative to population but are overall quite small. Their relatively small size indicates that they are not places from which global activity can be coordinated, nor in which many clients can be consulted with. Many of the jurisdictions in this field are places with low or no tax rates, with high secrecy, and most of the places here can be understood as “tax havens.”
Finally, we asked whether tax professionals are also concentrated within specific cities in countries. For this, we plotted the relative and absolute number of tax professionals in both cities and countries (Fig. 4.6). We find that tax professionals concentrate in the main cities within the jurisdictions found in Figure 4.5. The concentration of tax professionals within cities provides an important nuance to the data, showing that tax avoidance is orchestrated within specific “global cities”. For instance, New York has a much higher proportion as well as concentration of tax professionals than Washington DC, providing a more detailed view of where the tax avoidance is orchestrated.

4.4 Regression analysis: Locational determinants of tax professionals

The analysis of Section 4.3 indicates that tax service professionals are generally located in large European and American cities rather than in profit centers. In this section we systematically analyze whether tax professionals are correlated with offshore activity, economic activity, managerial activity, or financial activity.

4.4.1 Methods and data

We estimated the following model:

\[ TP = \alpha + \beta_1 EA + \beta_2 FA + \beta_3 OA + \beta_4 MA + \beta_5 HNWI + \gamma Controls, \]  

where TP is the location of the four groups of tax professionals: transfer pricing, tax strategy, wealth managers and all tax professionals as detailed in Section 4.2.1. Our main independent variables are economic activity (EA), financial activity (FA), managerial activity (MA), offshore activity (OA) and the location of high-net-worth individuals (HNWI). The exact operationalization, descriptive statistics, and the information of sources for all variables can be found in Table 4.2 and their expected relationship with tax professionals is detailed in the subsequent paragraphs.

Firstly, we wanted to assess to what extent the global distribution of tax professionals is determined by economic activity. If tax professionals are a necessary aid to individuals and companies, then their location should correlate
Methods and data

140

All tax professionals
Transfer pricing
Tax strategy
Wealth management
nEngineers
nAccountnts

Indicator

Operationalization

English speaking
Governance

Credit Rating

Audience
Population

nFinance
nCOOs
nCFOs
Profits
Fin_Secrecy
Haven_Score
nHNWI

BIS

GFCF
Consumption

Log10 LinkedIn users with job titles detailed in Table 1.
Log10 LinkedIn users with job titles detailed in Table 1.
Log10 LinkedIn users with job titles detailed in Table 1.
Log10 LinkedIn users with job titles detailed in Table 1.
Log10 LinkedIn users with the title "engineer"
Log10 LinkedIn users with the title "accountant", excluding "tax
accountant"
Log10 of gross fixed capital formation (constant 2010 USD)
Log10 of final consumption expenditure by households and non-profit
institutions serving households (constant 2010 USD)
Log10 of the sum of consolidated positions on counterparties (USD).
Table B4 of the Consolidated banking statistics.
Log10 LinkedIn users with the job function Finance
Log10 LinkedIn users with job title COO
Log10 LinkedIn users with job title COO
Log10 misaligned profits with a minimum cut of $1 billion
Financial Secrecy Score, by the Tax Justice Network
Corporate Tax Haven Score, by the Tax Justice Network
Log10 of the number of high net worth individuals (adults with wealth
above 50 millions)
Log10 of Linkedin users by country (using the Campaign Manager)
Log10 of population. The missing population (24 countries) was added
manually.
Trading Economic credit rating, composed from the credit ratings by
Moody’s, S&P, Fitch and DBRS
Official language 1 in the CEPII GeoDist dataset
First PCA component of the six dimensions of the Worldwide Governance Indicators project
Statutory corporate tax level
Time to prepare and pay taxes (hours)
Log10 of gross domestic product divided by population. The missing
data on GDP and population was added manually

CIT
Tax complexity
GDP per capita

2010
2014–2018

Feb. 2019

Feb. 2019
2014 - 2018

Feb. 2019
Feb. 2019
Feb. 2019
2019
2019
2019
2018

Q3 2018

2014–2018
2014–2018

Feb. 2019
Feb. 2019
Feb. 2019
Feb. 2019
Feb. 2019
Feb. 2019

Year

Janský & Palanský (2019)
IC.TAX.DURS (WBD)
NY.GDP.MKTP.KD
SP.POP.TOTL (WBD)

Mayer & Zignago (2011)
info.worldbank.org

tradingeconomics.com

LinkedIn
LinkedIn
LinkedIn
missingprofits.world
financialsecrecyindex.com
corporatetaxhavenindex.org
Global Wealth Report—Credit
Suisse
LinkedIn
SP.POP.TOTL (WBD)

BIS

NE.GDI.FTOT.KD
NE.CON.PRVT.KD

LinkedIn
LinkedIn
LinkedIn
LinkedIn
LinkedIn
LinkedIn

Source

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2014–2018
2014–2018
2014–2018

Table 4.2. Variables used in the regression analysis, sources, year and operationalization. We kept the average of all years available.


positively with economic activity. It is however not straightforward to measure economic activity in a way that is separated from the financial flows that can be generated by artificial profit booking (Damgaard et al., 2019). We created four approaches to measure only “real” economy—i.e., the places in which physical capital is being invested, where innovation takes place, and where businesses sell their products. First, we included household consumption, which measures the demand-side economic activity as purchases of final goods and services. Second, gross fixed capital formation measures total investment on tangible assets, thus excluding loans and intellectual property. Third, we included the number of accountants on LinkedIn, as this is a comparable profession needed more broadly for all companies. If tax service professionals (some of whom might have a background as accountants) are servicing all types of companies in the same way as accountants, then their numbers should be correlated positively. Finally, we also included the number of engineers on LinkedIn, which acts as a proxy for activity in productive industries. If tax service professionals are important to productive companies, then there should be a positive correlation between the two professional groups. These four measures are intended to each capture part of the “real” economy and we use them to ensure that our conclusions are not made solely due to the choice of indicator.

Secondly we wanted to test the correlation of tax professionals with financial activity. We expected a positive correlation given the importance of taxation for the financial sector (Hampton, 1996). We employed two measures of financial activity. First, we used “consolidated positions on counterparties resident in the country” from the Bank for International Settlements (BIS) as a measure of the country's relevance in the global financial system. Second, we used the number of employees in the financial sector obtained from LinkedIn as a measure of the importance of the financial sector in each country.

Thirdly, we tested the correlation between tax professionals and the centers of managerial control. We expected that tax professionals mostly service the “managerial” part of multinational firms, rather than production lines. Therefore we expected tax service professionals to be positively correlated with the number of managers. We collected the number of chief operating officers (COO’s) and chief financial officers (CFO’s) from LinkedIn to represent the location of the management. As detailed in Section 4.2.1, we excluded the
Methods and data

number of chief executive officers given that it would include many freelancers and directors of small firms.

Fourthly, we tested the correlation between the number of tax professionals and three measures related to offshore financial centers. The first and second measures of offshore activity are based on the financial secrecy score and the corporate tax haven score from the Tax Justice Network (see Cobham et al., 2015 for information on the methodology). These scores rank countries according to more than 100 indicators related to financial secrecy or corporate tax avoidance. Our third measure of offshore activity captures profits shifted by multinational corporations, using the approach from Tørsløv et al. (2018) (see Section S3 for a detailed explanation).

Fifthly, we tested the correlation between tax service professionals and the number of high-net-worth individuals. We assumed that some of the tax service professionals, particularly wealth managers, service high-net-worth individuals. Therefore we expected that these are positively correlated. We used data from Credit Suisse on the number of millionaires by country.

Finally, we identified some confounding factors, and included them in our regressions. First, population is expected to be the main factor affecting the number of tax professionals⁶. Likewise, we included the number of LinkedIn users in each country. Second, countries with higher tax rates may increase the demand for tax services. As such, we included the corporate income tax rate. Next, we expected countries with good governance to attract higher investments and with them a higher presence of tax professionals. We operationalized governance using a mix of the six dimensions of the Worldwide Governance Indicators project⁷. Similarly, countries with higher credit ratings are likely to be seen as more attractive to investors, and would require a higher presence of tax professionals. We included the Trading Economics credit rating, composed from the credit ratings by Moody’s, S&P, Fitch and DBRS. The average wealth of the country may also affect the ability to hire tax professionals. We

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⁶Since we are log-transforming the variables, using population as a control is identical to using the per capita version of the variables: \( \log(X/\text{population}) = \log(X) - \log(\text{population}) \)

⁷The six dimensions are voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption. The mix was created as a weighted sum of the variables with the weights 0.374, 0.367, 0.425, 0.414, 0.434, 0.430. The weights were calculated using principal component analysis, which calculates a linear, orthogonal decomposition of the dimensions in such a way that the first component accounts for the maximum amount of variability (in this case 84%).
included GDP per capita to account for this. Finally, we also included the complexity of the tax system using the time to prepare and pay taxes, since more complicated tax systems require more professional expertise even without the aim of avoiding taxes.

Our data is not complete for all variables. LinkedIn data is complete for all countries that do not face US sanctions (Cuba, Syria, Sudan, North Korea and Iran). However, data from the World Bank and other sources is missing for some countries, especially small offshore financial centers, where we expected to locate a relatively large proportion of tax professions. Since the data is not missing completely at random, dropping the jurisdictions where data is not available would result in biases. In order to avoid this, we imputed the missing data and ran the regressions in both the imputed and the original datasets. Firstly, we manually added the values of population and GDP for 24 missing countries, using external sources linked in the Wikipedia page of those countries. Secondly, we employed K-nearest neighbors (KNN) imputation to perform the imputation. For each country, the five most similar countries are found and their average was used to impute the missing data. This was carried out using the fancyimpute package in Python. In order to avoid giving variables with larger values a larger weight, we scaled the variables before the imputation using the standard function BiScalar function. This gives equal importance to all variables and improves the quality of the data imputation (Hastie, Mazumder, Lee, & Zadeh, 2015). After the imputation we re-scaled the variables back to their original magnitude. Table S1 shows the descriptive statistics for both the original and imputed datasets.

Since our independent variables are positively correlated, we ran two versions of the regressions in each dataset, one in which we included all the independent variables together, and one in which we include each independent variable independently. The location of HNWI is only included in the analysis of the location of wealth managers. For the regressions where all the variables are included, there are several possibilities for each independent variable. For instance when we are testing the effect of managerial control on the number of tax strategy professionals, we need to choose an operationalization of economic activity (consumption, gross fixed capital formation, number of engineers or number of accountants). We used principal component analysis (PCA) in the imputed dataset to combine the variables into one component (Section S4). The
PCA weights calculated using the imputed dataset were used also to combine the variables in the original dataset and the city-level dataset.

4.4.2 City-level regressions

We included regressions at the city level as a robustness test. We proceeded in the same way as with the country-level regressions, with two important differences. Firstly, we did not have any measure of offshore activity at the city-level, and as such we excluded this independent variable from the analysis. Secondly, with the exception of population data from the United Nations, all our variables come from LinkedIn. In order to control for country-level variables, we ran random intercept models, where each country has its own intercept. This allows us to control for variables such as human capital, governance, the use of English, etc. The descriptive statistics of the variables present in this dataset can be found in Table S1.

4.4.3 Regression analysis: Locational determinants of tax professionals

Figure 4.7 summarizes the results of the 140 regressions using the country-level imputed dataset and the city-level dataset. The country-level dataset without imputation contains fewer observations and it was used as a robustness check (Fig. S1). Figure 4.7 summarizes the effect sizes of the independent variables (rows) on the dependent variables (columns). The independent variables are grouped with horizontal lines in five groups: economic activity (EA), financial activity (FA), managerial activity (MA), offshore activity (OA) and high-net-worth individual activity (HNWI). Figure 4.7A visualizes the effect sizes in the regressions that include all independent variables together. Figure 4.7B contains the regressions adding the independent variables one by one. Each combination of dependent and independent variables has two triangles. The top triangle corresponds to the country-level regression and the bottom triangle corresponds to the city-level regression. Red colors indicate positive coefficients, blue colors indicate negative coefficients and white indicates a non-significance relationship at the 5% significance level. Variables at the country level (marked with an asterisk next to the names in the rows) are not used in the city-level regressions and their corresponding triangles are left white.
All variables except for financial secrecy (Fin_Secrecy) and corporate tax haven score (Haven_Score) are log-transformed and the effect size can be interpreted in terms of percentage change. For example the uppermost-left triangle visualizes the relationship between the number of engineers and the number of all tax professionals. Since the effect size is -0.4, it can be interpreted that a 1% increase in the number of engineers is associated with a decrease of 0.4% in the number of all tax professionals. The financial secrecy and haven scores range from 40 to 100, and a 1 point increase in the score can be interpreted as increases or decreases to the number of the specific profession by a percentage equal to the effect size. For example the effect of the haven score on the transfer pricing profession is 2.7 in the regressions with all independent variables included. That implies that a 1 point increase in the haven score is associated with a 2.7% increase in the number of transfer pricing professionals. The associated regression tables can be found in the OSF repository.

We find that some of our five groups of independent variables have a strong and statistically significant effect on the location of tax professionals. In our first group, measuring economic activity, we find a positive relationship between the location of accountants (nAccountants) and the location of tax professions; and a negative relationship between the location of engineers (nEngineers) and the location of tax professionals. We find no consistent relationship between GFCF or Consumption and the location of tax professionals. We argue therefore that there is no general relationship between economic activity and the location of tax professionals. More industrial countries, which are expected to have a higher number of engineers, may require fewer tax services. We argued in the methods section that if tax professionals were servicing all types of companies in the same way as accountants, then their numbers should be correlated positively. Given that the other indicators discard a relationship between economic activity and the location of tax professionals, the relationship with accountancy may be driven by an endogeneity relationship.

Secondly, we find a strong and significant relationship between the location of finance and the location of all tax professionals. This is true when using data on banking claims (BIS), but especially using the number of employees in the financial sector (nFinance).
Thirdly, we find an equally strong and significant relationship between the location of corporate managers (nCOOs and nCFOs) and tax professionals.

Fourthly, while there seems to be a relationship between the financial secrecy (Fin_Secrecy) and corporate haven scores (Haven_Score) and the location of some tax professionals, the relationship disappears or reverses in the non-imputed dataset (Fig. S1). This confirms our previous finding in Section 4.3 that tax professionals are not particularly concentrated in profit centers.

Finally, we find a relationship between the number of high-net-worth individuals and the location of tax services. However, this relationship
disappears in the non-imputed dataset, which could be due to the original low completeness of this variable.

Two further lessons can be learned from the results. The first lesson concerns the location of the different tax professions. With the exception of the possible relationship between wealth managers and offshore activity, we find similar locational determinants for all professions. This is, a strong relationship with the location of finance and managerial control, and weak or no relationship with the location of economic and offshore activity. The relationship between finance firms, corporate management and tax professionals confirms the pattern observed in Section 4.3—the orchestration of tax avoidance takes place in coordination centers. The second lesson concerns the magnitude of the effect sizes. We find that the coefficient of COOs, accountants and CFOs is around 0.5, while the coefficient of the employees in finance is around 1. This implies that the number of tax professionals and employees in finance increases as a power of the number of COO or CFO in a jurisdiction or city (Fig. S2).

4.5 Conclusion

Multinational corporations shift $600 billion–1 trillion of profits a year to low-tax jurisdictions. Likewise, individuals move their assets to offshore financial centers in an attempt to avoid taxation. In total, 8% of the world’s wealth is unreported, most likely hidden in offshore financial centers (Zucman et al., 2015). Tax professionals play a pivotal role in this process, devising the financial products that allow multinational corporations and high-net-worth individuals to move assets offshore and escape taxation.

In this paper, we contribute to the literature in four ways. First, we develop a novel methodological approach using the Campaign Manager of Linkedin. Our approach can be leveraged in further studies that focus on the geographical (co)location of professions at the city, regional and country level. Secondly, we show for the first time the locational determinants of tax professionals, revealing that they co-locate primarily in coordination centers together with corporate management and finance firms. Furthermore, we are able to zoom inside the countries to show that tax professionals are located within specific cities. Finally, we make our unique dataset on the location of tax professionals
available; this can be used in further research looking at the role of tax professionals and tax havens in the international financial system.

Our analysis has clear policy implications. It reveals the relevance of coordination centers in relation to the orchestration of tax avoidance, together with the United States, Canada, Indonesia, and Malaysia. The current focus on small, “rogue” states has led international organizations to publish “black lists” of uncooperative jurisdictions in the hope that naming and shaming will push them into submission. In practice tax avoidance can happen not just because these offshore financial centers exist, but because there are people who find out how tax can be avoided. If all offshore financial centers were to sink into the ocean tomorrow, tax professionals would be able to refocus their efforts toward new methods of minimizing taxes, for example by routing through companies in special economic zones, through companies benefiting from a tax holiday, or by negotiating for discretionary tax incentives with governments. In order for governments to effectively increase tax compliance, they cannot just focus on shaming other countries, but should also focus on regulating the services industry of tax avoidance that might be facilitated in their very own backyard.

References


REFERENCES


Regression analysis: Locational determinants of tax professionals


CHAPTER 5

Does it payoff to become a Multinational Corporation?

This chapter looks into the incentives of MNCs to internationalize, a crucial topic in the strategic management and international business fields. The literature on internationalization exposes four basic motivations to internationalize: access to resources, access to markets, efficiency gains, and acquisition of strategic assets (Thomsen, 1994; Blonigen, 2005). In this chapter, we analyze the efficiency gains hypothesis, which postulates that firms internationalize in order to increase performance. Measuring the pre-tax efficiency gains of MNCs, we find no support for this hypothesis at the within-firm level. However, it has been hypothesized that gaining access to the offshore system is an important motivation for the firm to internationalize (Picciotto, 1999; Palan, 1998). This would likely be reflected in higher after-tax efficiency gains, which paves the way for new studies looking at the after-tax efficiency gains of internationalization, and the role of profit and coordination centers in the process.
Chapter 5. Does it payoff to become a Multinational Corporation?

This chapter is adapted from Pisani, N., Garcia-Bernardo, J. & Heemskerk, E. (2020). Does it pay to be a multinational? A large-sample, cross-national replication assessing the multinationality-performance relationship. Strategic Management Journal.
Abstract

Does it pay to be a multinational? Despite decades of empirical research, we still do not know whether this is the case. We undertake a big data quasi-replication of Lu and Beamish (2004) and Berry and Kaul’s (2016) works to examine whether the multinationality-performance relationship is S-shaped. Using a 2009–2016 panel of nearly 900,000 observations comprising data from 247,355 firms based in 111 countries, we find evidence of an S-curve. Yet, additional analysis shows that in most single-country settings the S-curve is not supported, as large differences in terms of shapes and effect sizes exist across countries. Our study contributes to research on the multinationality-performance relationship and highlights the merits of a big data approach to assess the generalizability of key findings in the field.

Introduction

Whether and how multinationality affects firm performance represents a crucial question in the strategic management and international business fields. A substantial body of scholarly work has thus attempted to empirically verify whether and, if so, how a firm’s multinationality—i.e., the extent to which it undertakes value-adding activities outside its home country—impacts performance. More than 100 empirical studies on this topic have been published in the last decades, embracing a variety of theoretical approaches and a range of methodologies and samples. Despite these ongoing efforts, the results obtained to date have been disappointing: the literature has failed to offer a consistent set of empirical findings (Berry and Kaul, 2016; Cardinal, Miller, and Palich, 2011; Hennart, 2007; Hitt et al., 2006; Kirca et al., 2011). The M-P relationship has been found to be insignificant or very weak (Tallman and Li, 1996), negative (Denis, Denis, and Yost, 2002), U-shaped (Lu and Beamish, 2001), inverted U-shaped (Gomes and Ramaswamy, 1999), and S-curved (Contractor, Kumar, and Kundu, 2007). Thus, we still do not know whether it pays to be a multinational. The mixed findings on such a crucial question have led to sharp criticisms of this literature. In response to this, scholars

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1As noted by Kirca et al. (2011) in their meta-analytic review and echoed by Berry and Kaul (2016), “multinationality,” “degree of internationalization,” “international diversification,” “geographic diversification,” and “international expansion” refer to the same construct. In our work, as also clarified in the main text, we use the term multinationality to refer to the extent of a firm’s operations outside its home country.
have increasingly recognized the need for better empirical methodologies that for instance use longitudinal data and account for the endogeneity of the multinationality construct (Berry and Kaul, 2016; Contractor, 2012; Verbeke and Forootan, 2012).

A particularly influential contribution to the debate is by Lu and Beamish (2004, henceforth L&B). Studying a sample of 1,489 Japanese multinationals over 12 years, they found an S-curved relationship between multinationality and performance. Their rigorous methodological approach combined with a relatively large number of panel data observations has made their S-curve hypothesis convincing and widely accepted. In view of the influence of L&B’s (2004) contribution and in light of the mixed results in the literature, Berry and Kaul (2016, p. 2276; henceforth B&K) recently argued in Strategic Management Journal that “careful, large sample replication of L&B’s study in other samples and settings is therefore critical.” Hence, they conducted a careful quasi-replication of L&B’s study and used a longitudinal dataset of 2,023 U.S. multinational firms over an 18-year period from 1989 to 2007, which to date is one of the largest samples used to study the M-P relationship. However, their quasi-replication did not corroborate L&B’s main finding. Instead, B&K found a marginally significant U-shaped association between multinationality and performance in a subsample of manufacturing firms, which vanished when they properly accounted for the endogeneity of multinationality.

B&K’s work is an example of how beneficial quasi-replications are to advance the fields of strategic management and international business as they help us to understand whether central results are idiosyncratic to a specific setting or not (Bettis, Helfat, and Shaver, 2016b). Their inability to replicate the findings of L&B’s study has important implications for the literature on the M-P relationship. Methodologically, their results highlight the need for extreme caution when generalizing results across country contexts and emphasize the importance of careful replication. Theoretically, their findings speak to the growing stream of research questioning the validity of a causal effect of multinationality on performance. B&K’s work also broadens the question of

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2Verbeke and Forootan (2012) listed L&B's contribution as one of the 10 most influential studies in this literature, having totalized at the time of their analysis 346 Google scholar citations. As of December 5 2017, L&B's study has reached 1,112 google scholar citations, thus further corroborating its influence in the strategic management and international business fields.
whether there is a M-P relationship to include where and when a specific M-P relationship may be in place.

In this article, we undertake a big data quasi-replication of L&B and B&K’s studies, directly responding to the recent call of the Co-Editors of *Strategic Management Journal* for repeatable and cumulative knowledge (Bettis et al., 2016a). To test the S-curve relationship across a wide range of settings, we use a longitudinal dataset of almost 250,000 firms and their roughly 680,000 subsidiaries over a seven-year period (2009 to 2016). We are thus able to examine the M-P relationship using a panel of 889,865 firm-year observations. This big data approach allows us to test the empirical validity of the M-P relationship across 111 country settings and thus provides a comprehensive assessment of the S-curve hypothesis and its generalizability. The results of our big data analysis corroborate the presence of the S-shaped relationship between multinationality and performance.

Taking advantage of the fact that our data covers firms from over 100 countries, we perform additional analyses beyond the quasi-replication of L&B and B&K’s works. While the S-curve is corroborated as the general relationship between multinationality and performance, we find large differences across national settings, in terms of both shapes and effect sizes obtained. For instance, when restricting our analysis to U.S. firms, our results are aligned with the ones obtained by B&K as we also do not find empirical support for the S-curve hypothesis. This implies that when scholars study the M-P relationship in smaller samples restricted to a single country, they may find diverging results.

Our work contributes to research on the M-P relationship, and more broadly to the fields of strategic management and international business, in three important ways. First, our study offers a quasi-replication of L&B and B&K’s studies that goes beyond the examination of whether the M-P relationship holds in a particular country context. As B&K already noted, their failure to replicate the finding obtained by L&B may be due to the fact that their empirical analysis

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3As defined by Ethiraj, Gambardella, and Helfat (2016, p. 2191), quasi-replications “assess the generalizability of the results of prior studies to new contexts or the robustness of prior studies to different empirical approaches, methods, measures, and models” and use “equivalent or better quality data than the original study and replicate the methods and variable construction of the original study as closely as possible.”

4For other recent replication studies see the Special Issue in *Strategic Management Journal* appeared in November 2016.
Chapter 5. Does it payoff to become a Multinational Corporation?

is limited to a single country (the U.S.), and thus only indicates that the S-curve validated by L&B using a Japanese sample does not apply to that specific country context. Hence, they note that “only additional replications in other country contexts can tell us how truly generalizable the S-curve hypothesis is (or is not)” (p. 2289). Our quasi-replication of their studies across 111 country settings contributes to the debate about the value of studying the M-P relationship and the generalizability of the S-curve across different country settings. Our big data analysis provides empirical evidence in support of the S-curve hypothesis.

Second, our results push us to reflect on the theoretical relevance of the S-shaped curve. While when using the complete sample we empirically validate the S-curve hypothesis, the findings of our additional analyses clearly show that in most cases the S-curve cannot be empirically validated when restricting the sample to an individual country setting. Rather, we see that, when considering firms based in a single country, only a part of the S-shaped curve tends to be supported. Our results hence suggest that the competing empirical findings in the literature regarding the shape of the M-P relationship may be the result of differences in national contexts rather than fundamental theoretical disagreements. Our study offers compelling evidence that companies in a particular country (and time period) are most likely to display only a smaller section of the S-shaped curve.

Third, our analysis of almost 900,000 firm-year data points unveils the potential of big data and data science methods to (re)investigate central questions for the fields of strategic management and international business. While recent editorials in Academy of Management Journal have consistently underscored the importance of a big data approach in management research (George, 2016; George, Haas, and Pentland, 2014; George et al., 2016), little progress has been made in this area. We believe that our work shows the merits of a big data approach in strategic management and international business for three particularly relevant issues. The first issue is the one of sampling scale. The S-

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5A keyword search of the term “big data” in all the articles published in Academy of Management Journal and Strategic Management Journal resulted in the identification of only four articles that included this term in either the title, abstract, or keywords provided by the authors. Of these four articles, three are editorials and only one is an empirical study appeared in Strategic Management Journal that though uses a small sample to suggest that the sparse inverse covariance estimation technique used can help to build a bridge between strategic management and big data (Li et al., 2016).
curve hypothesis was empirically verified by L&B on a relatively small sample retrieved from a single country, yet has turned to be widely accepted in the literature and generalized to other (very different) country contexts. We show that despite B&K failed to find support using their U.S.-based sample this generalization was appropriate. A big data approach thus allows to extend the analysis to a much larger number of data points and settings. This leads to a more rigorous assessment of the extent to which a postulated relationship can be generalizable and, if so, under which conditions. The second issue is related to the problematic and often wrong assessment of p-values. With big data most statistical tests return significant results, forcing researchers into a correct assessment of p-values and the real magnitude of the effects under scrutiny. In our quasi-replication we carefully interpret effect sizes and visualize them in an intuitive way. These visualizations in turn can better inform management theory. Third, we respond to the call for increasing data availability and disclosure and the replicability of studies and thus include an extensive Appendix (which will also include all the codes of the big data analysis we undertook), to facilitate the replicability of our work in future investigations on this topic. As such, we hope to contribute to an important next step in the development of the cumulative and repeatable knowledge that will further advance the scholarly debate on the M-P relationship and, more broadly, the fields of strategic management and international business.

We structure the remainder of the paper as follows: first, we briefly review prior work on the M-P relationship and introduce the S-curve hypothesis. The methods section describes the data collection, the variables we operationalized, and the big data analysis we undertook. Finally, we discuss our findings and offer concluding remarks.

## 5.1 The Multinationality-Performance Relationship

Over the past decade a number of reviews have offered comprehensive analyses of the extensive body of scholarly work focusing on the M-P relationship, including its diverging theoretical postulations and mixed empirical findings (Hennart, 2007; Hitt et al., 2006; Kirca et al., 2011; Verbeke and Forootan, 2012). In Table 5.1 we report the 10 most influential contributions—that is the articles that to date have received the highest number of citations in
Chapter 5. Does it payoff to become a Multinational Corporation?

Table 5.1 also shows that almost all studies focused on individual countries, with the U.S. and Japan as the most popular choices. These works also tested their hypotheses on rather limited samples and restricted their analyses to cross-sectional estimations. The only work out of the 10 that employed panel data analysis and used random-effects to account for the longitudinal nature of the data is the influential study by L&B. They find an S-curved relationship when examining panel data of 1,489 Japanese firms.

The S-curve hypothesis is theoretically based on the well-established argument that newly internationalizing firms face liabilities of foreignness and newness when starting to expand abroad. As firms increase their level of multinationality they start enjoying the benefits stemming from their international presence. However, increasing costs of coordination progressively diminish the returns attributable to further internationalization. Thus, for higher levels of multinationality, L&B suggest that the M-P relationship turns into an inverted U-shaped. Three distinct phases thus characterize the relation between M and P. In Phase 1, firms face negative performance returns when they start internationalizing as a result of the substantial costs associated with the liabilities of foreignness and newness they face when expanding abroad. Phase 2 is instead characterized by positive performance returns; as the above-mentioned liabilities are overcome, firms start to enjoy the benefits derived from their increasing exposure to international markets. However, the advantages derived from their international presence increase at a decreasing rate while the coordination costs associated with the increasing multinationality grow at an increase rate. Therefore, once reached an optimal threshold, firms enter Phase 3 in which performance returns of multinationality start falling again. In the following section we document the quasi-replication of

Verbeke and Forootan (2012) report in their Table 5.1 the list of 12 most cited articles that empirically investigated the M-P relationship. It is interesting to note that all 10 articles reported in our Table 5.1 were already included in the ranking that Verbeke and Forootan did back in 2012. This further corroborates the influence of these 10 studies in this literature.
Table 5.1. The 10 most influential studies on the M-P relationship. The No. of citations in Web of Science were retrieved on December 5 2017.

<table>
<thead>
<tr>
<th>Citation ranking</th>
<th>Year</th>
<th>Authors</th>
<th>Journal</th>
<th>M-P relationship hypothesized</th>
<th>M-P relationship empirically shown</th>
<th>Source of data</th>
<th>Sample size</th>
<th>Country of sampled firms</th>
<th>Cross-section versus panel</th>
<th>Pooled cross-section, fixed or random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2000</td>
<td>Zahra, Ireland, and Hitt</td>
<td>Strategic Management Journal</td>
<td>Positive</td>
<td>Positive</td>
<td>Survey administered to firms</td>
<td>1,388 firms</td>
<td>USA</td>
<td>Cross-section</td>
<td>Not applicable</td>
</tr>
<tr>
<td>3</td>
<td>2001</td>
<td>Lu and Beamish</td>
<td>Strategic Management Journal</td>
<td>U-shaped</td>
<td>U-shaped</td>
<td>NIKKEI NEEDS tapes database and Japan Company Handbook Directory of Multinationals database</td>
<td>164 firms</td>
<td>Japan</td>
<td>Panel (12 years) - Total n. of observations not reported</td>
<td>Pooled cross-section/time-series</td>
</tr>
<tr>
<td>4</td>
<td>1996</td>
<td>Tallman and Li</td>
<td>Academy of Management Journal</td>
<td>Positive</td>
<td>Insignificant</td>
<td>Directory of Multinationals database</td>
<td>192 firms</td>
<td>USA</td>
<td>Cross-section</td>
<td>Not applicable</td>
</tr>
<tr>
<td>5</td>
<td>2004</td>
<td>Lu and Beamish</td>
<td>Academy of Management Journal</td>
<td>S-shaped</td>
<td>S-shaped</td>
<td>NIKKEI NEEDS tapes database and Japan Company Handbook Directory of the World's Largest Service Companies</td>
<td>1,489 firms</td>
<td>Japan</td>
<td>Panel (12 years) - Total n. of observations not reported</td>
<td>Random effects</td>
</tr>
<tr>
<td>6</td>
<td>2003</td>
<td>Contractor, Kundu, and Hsu</td>
<td>Journal of International Business Studies</td>
<td>S-shaped</td>
<td>S-shaped</td>
<td>Directory of the World's Largest Service Companies</td>
<td>103 firms</td>
<td>USA (42% of the sample) plus 9 other undisclosed countries (remaining 58% of the sample)</td>
<td>Panel (6 years) - Total n. of observations=364</td>
<td>Pooled cross-section/time-series</td>
</tr>
<tr>
<td>7</td>
<td>2000</td>
<td>Palich, Cardinal, and Miller</td>
<td>Strategic Management Journal</td>
<td>Inverted U-shaped</td>
<td>Inverted U-shaped</td>
<td>Meta-analysis of 82 studies</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>8</td>
<td>1989</td>
<td>Geringer, Beamish, and Dacosta</td>
<td>Strategic Management Journal</td>
<td>Positive</td>
<td>Positive</td>
<td>World Directory of Multinational Enterprises</td>
<td>200 firms</td>
<td>USA (59% of the sample) and Europe (remaining 50%)</td>
<td>Cross-section (Tests of mean differences)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>9</td>
<td>1999</td>
<td>Gomes and Ramaswamy</td>
<td>Journal of International Business Studies</td>
<td>Inverted U-shaped</td>
<td>Inverted U-shaped</td>
<td>Not reported</td>
<td>95 firms</td>
<td>USA</td>
<td>Panel (6 years) - Total n. of observations=570</td>
<td>Pooled cross-section/time-series</td>
</tr>
<tr>
<td>10</td>
<td>1988</td>
<td>Grant, Jammine, and Thomas</td>
<td>Academy of Management Journal</td>
<td>Positive</td>
<td>Positive</td>
<td>Not reported</td>
<td>304 firms</td>
<td>UK</td>
<td>Not applicable</td>
<td>Pooled cross-section</td>
</tr>
</tbody>
</table>
L&B and B&K’s studies that we undertook together with the additional analyses we performed to further our understanding of the M-P relationship.

### 5.2 Data and Methods

#### 5.2.1 Sample

We obtained our data from Bureau van Dijk’s Orbis database. Orbis is a unique and increasingly used information provider that covers over 200 million entities (parent firms and subsidiaries) worldwide and is compiled from official country registrars and other country collection agencies. For each available corporate entity, we extracted its unique identifier, country, sector (NACE Rev. 2), operating revenue, total assets, debt-to-equity ratio, intangibles, return on assets, and global ultimate owner. The global ultimate owner is a parent firm which owns at least 50 percent of the company, either directly or indirectly, and is not itself owned by any other firm. We identify our unit of analysis (firms) with global ultimate owners. We collected these data for each year from 2009 to 2016.

The entire Orbis dataset contains data on over three million firms with at least one subsidiary. Having said that, it was impossible to retrieve the firm level data that is necessary to replicate L&B and B&K’s studies for the vast majority of these firms. These sample limitations are in line with previous research as also evidenced by the relatively small number of observations used in the 10 most cited articles in the M-P relationship (see Table 5.1 above). We describe a number of steps we took to account for these limitations as a potential source of bias below. Specifically, we followed common procedure and analyzed the impact of sampling bias using Heckman’s (1979) two-stage estimation procedure. As documented in the robustness checks, we found only small differences in the coefficients which do not change the interpretation of the results, thus corroborating that sampling does not raise concerns in our analysis.

After having excluded all firms with missing data and incorporated the necessary lags, our final sample consisted of 247,355 firms owning on average

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7 For a direct link to the website refer to: http://orbis.bvdinfo.com

8 For recent studies using data from the Orbis database see for instance the recent works of Bertrand and Lumineau (2016) and Olsen, Sofka, and Grimpe (2016).
681,115 subsidiaries each year. This leads to a final panel of 889,865 firm-year observations over the entire period. While B&K exclusively focused on multinationals—i.e., “firms with at least some foreign investment” (B&K, p. 2278)—L&B included purely domestic firms as well. We followed L&B’s approach and thus included in our sample both purely domestic and multinational firms. Our final working sample consists of an unbalanced panel of 889,865 firm-year observations which covers firms based in 111 countries worldwide and includes domestic and multinational firms, both private and publicly listed. This is to date the largest sample ever used to study the M-P relationship.

5.2.2 Measures

We develop our variables to match the measures used by L&B and B&K as closely as possible. For our independent variable, we follow L&B and B&K and create the *Internationalization* index:

$$
\text{Internationalization}_i = \frac{1}{2} \left( \frac{N\text{Countries}_i}{\max(N\text{Countries})} + \frac{N\text{Subsidiaries}_i}{\max(N\text{Subsidiaries})} \right)
$$

The internationalization of a firm $i$ in each year thus depends on the number of countries ($N\text{Countries}$) and the number of foreign subsidiaries ($N\text{Subsidiaries}$). The first part of the equation is normalized by the maximum number of countries in which any firm has subsidiaries. The second part is normalized by the maximum number of subsidiaries of any firm. In order to test the S-shaped relationship, we also create the quadratic and cubed term of the *Internationalization* index and name them *Internationalization squared* and *Internationalization cubed* respectively. The dependent variable, return on assets ($\text{ROA}$), is calculated using the ratio of a firm's operating profit to its total assets. This differs slightly from the definition in B&K and L&B’s studies, in which ROA is calculated as the ratio of net income (obtained by subtracting taxes and interests from the operating profit). We expect this not to affect our results as this is only a small variation in the way of calculating ROA and we consistently use the same measure for all firms in our sample.

The main difference between our analysis and those of L&B and B&K is that we do not include their proxy of a firm's intangible assets (named “R&D Intensity”
in their works) in our analysis. While they included it to test the moderating effect of intangible assets on the M-P relationship, we restrict our focus on the main relationship between *Internationalization* and *ROA*. We choose to exclude a firm's intangible assets even as control variable in our analysis due to the relatively low availability of information on this measure in the Orbis database—its inclusion would in fact reduce our sample to 31,845 firm-year observations. Note, moreover, that the coefficient of “R&D intensity” in B&K’s analysis is not significant in any of the models used. Additionally, the coefficients of their independent variables are barely affected by the inclusion of the interaction term between “R&D Intensity” and *Internationalization*. Despite this, we perform additional analyses (reported in the robustness checks below) to examine whether the exclusion of intangible assets may have an effect on our results. The results of our additional analyses corroborate that when running our fully-specified model using the subsample of firms for which we can control for their levels of intangible assets (still a larger sample than the one used by B&K which totals 21,297 firm-year observations), our results do not change and the coefficient of our operationalization of intangible assets is not significant. This allows us to conclude that the exclusion of intangible assets from our main analysis does not raise concerns for the purpose of this study.

In addition to our dependent and independent variables, we include the same controls used by B&K to quasi-replicate L&B’s original work. The only difference vis-à-vis B&K’s study is that we exclude the variable exchange rate. We omit this control variable from the main replication analysis given that reliable information on exchange rates is retrievable for only 71 of the 111 countries considered in our study. Thus, its inclusion would imply the reduction of our working sample by approximately 50,000 observations. Having said that, as a robustness check (reported below) we rerun our fully-specified model on the subsample for which it is possible to take into account the exchange rate (846,482 firm-year observations). The results obtained in this robustness check corroborate the presence of the M-P relationship, also when accounting for the endogeneity of the *Internationalization* construct.

As B&K do, we control for a firm’s size, its debt-to-equity ratio, its export intensity as well as its extent of product diversification. *Parent size* is measured using the total turnover of the firm. The variable *Parent export intensity* is calculated as the fraction of revenues allocated to subsidiaries outside the
parent country. Product diversification is calculated using the Berry-Herfindahl index (1 - Herfindahl index: \( 1 - \sum_{s \in \text{sector}} p_s^2 \)), where \( p_s \) is the fraction of revenues produced in subsidiaries of sector \( s \), and sectors are aggregated at the NACE Rev. 2 highest level (letter-level). In addition, we include both industry-fixed effects (at the highest level) and country-fixed effects in the random-effects estimation models, as done in L&B and B&K. As B&K we are unable to control for firm’s advertising intensity and thus also exclude it from our quasi-replication of L&B’s work. As done by both L&B and B&K, we lag all independent variables by one year. Table 5.2 presents detailed information on the variables, while Table 5.3 reports the summary statistics and correlations of these measures.

<table>
<thead>
<tr>
<th>No</th>
<th>Variable Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ROA</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Internationalization</td>
</tr>
<tr>
<td>3</td>
<td>Intangibles</td>
</tr>
<tr>
<td>4</td>
<td>Parent size</td>
</tr>
<tr>
<td>5</td>
<td>Parent debt-to-equity ratio</td>
</tr>
<tr>
<td>6</td>
<td>Parent export intensity</td>
</tr>
<tr>
<td>7</td>
<td>Parent product diversification</td>
</tr>
<tr>
<td>8</td>
<td>Exchange rate</td>
</tr>
<tr>
<td>9</td>
<td>Country</td>
</tr>
<tr>
<td>10</td>
<td>Industry sector</td>
</tr>
<tr>
<td><strong>Instrumental variable</strong></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Export intensity by Industry/Country/Year</td>
</tr>
</tbody>
</table>

Table 5.2. Measures

Methods

L&B use random-effects while B&K use fixed-effects panel regression estimations. Both studies base their choice on the Hausman test, which tests for the consistency of random-effects when compared with fixed-effects (less efficient but consistent). Since our main goal is to replicate both L&B and B&K’s studies,

\[ \text{For additional information on Eurostat Statistical Classification of Economic Activities in the European Community refer to: http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2} \]
we report both random-effects and fixed-effects estimations. Furthermore, we include the Mundlack correction—which allows to explicitly model the between and within effects (see the robustness checks below for additional information on this correction)—because some authors have suggested it as an alternative for the Hausman test (e.g., Greene [2012]). The issue at stake is that the Hausman test may reject the null hypothesis even when only small correlations between the independent variables and the error term are present, and the bias of using random-effects is minimal (Clark and Linzer, 2015). This is especially problematic in the context of large data for which any correlation results in a rejection of the null hypothesis of the Hausman test (Ahn and Moon, 2014). Thus, in view of the fact that our fully-specified model is tested on a sample of almost 900,000 firm-year observations, we consider both random-effects and fixed-effects estimations in our analysis.

We run all random-effects and fixed-effects panel regressions using the R package *plm* version 1.6-5 (Croissant and Millo, 2008). We create the regression summaries using the R package ‘stargazer’ version 5.2. Endogeneity is controlled for using a two-stage least squares (2SLS) model, in the same vein as L&B and B&K do. As L&B do not show the results of this analysis and also do not discuss what instruments they use for the first stage, we (as B&K) cannot replicate exactly the procedure used in their study. However, we try to replicate their robustness check and use Export intensity by industry, country and year as our first instrument. We expect that firms pertaining to a specific industry and country and characterized by a higher average export intensity are likely to be more international, but do not expect that export intensity aggregated at the industry and country levels will have an effect on the profitability

---

**Table 5.3. Summary statistics**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ROA</td>
<td>0.063</td>
<td>0.157</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Internationalisation</td>
<td>0.003</td>
<td>0.013</td>
<td>-0.011</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Intangibles</td>
<td>0.007</td>
<td>0.029</td>
<td>-0.039</td>
<td>0.244</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Parent size</td>
<td>6.688</td>
<td>1.096</td>
<td>0.027</td>
<td>0.348</td>
<td>0.233</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Parent debt-to-equity ratio</td>
<td>0.847</td>
<td>1.508</td>
<td>-0.139</td>
<td>0.005</td>
<td>-0.008</td>
<td>0.02</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Parent export intensity</td>
<td>0.035</td>
<td>0.153</td>
<td>-0.019</td>
<td>0.364</td>
<td>0.121</td>
<td>0.156</td>
<td>-0.007</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Product diversification</td>
<td>0.127</td>
<td>0.202</td>
<td>-0.025</td>
<td>0.112</td>
<td>-0.01</td>
<td>0.068</td>
<td>-0.007</td>
<td>0.072</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>8 Exchange rate</td>
<td>102.220</td>
<td>6.182</td>
<td>0.021</td>
<td>0.011</td>
<td>0.012</td>
<td>-0.057</td>
<td>-0.018</td>
<td>-0.026</td>
<td>-0.038</td>
<td>1.000</td>
</tr>
</tbody>
</table>

---

10 The package is directly downloadable at: [https://cran.r-project.org/web/packages/stargazer/index.html](https://cran.r-project.org/web/packages/stargazer/index.html). More information about ‘stargazer’ is available at: [https://sites.google.com/site/marekhlavac/stargazer](https://sites.google.com/site/marekhlavac/stargazer).
of a given company, thus satisfying the exclusion restriction of a two-stage estimation procedure. Contrary to the instruments chosen by B&K to try to replicate the robustness check performed by L&B, our instruments are valid for all industries represented in our sample, and not only for the manufacturing subsample. Thus, this allows us to run this robustness check on the entire sample. As suggested by Wooldridge (2010), we use the quadratic and cubed terms of our first instrumental variable Export intensity by industry, country and year to generate our second and third instruments to account for the endogeneity of Internationalization squared and Internationalization cubed. The robustness check performed (and reported below) allows us to conclude that the findings obtained in our main analysis are confirmed when accounting for the endogeneity of the Internationalization construct.

Finally, another important issue is associated with a potential sample selection bias due to the fact that complete company information is not always available. While this issue is not investigated by L&B and B&K in relation to the reduction of their final working samples as a result of missing values in their original panels, we do assess it here. If missing values are non-random—i.e., unobservable variables have an effect on the availability of data—our findings may be biased as a result of sample selection. To address the potential selection bias in our analysis we use the Heckman’s (1979) two-stage estimation procedure. We first create two dummy variables. The first, D_INCLUDED, scores 1 if the firm is included in our final sample and 0 otherwise. The second, D_FOREIGN, scores 1 if data on foreign subsidiaries is available, and 0 otherwise. We expect D_FOREIGN to be correlated with D_INCLUDED since companies with information on foreign subsidiaries are more likely to report complete information and thus be included in our final sample. Having said that, we expect D_FOREIGN to be unrelated with the profitability of the firm, thus satisfying the exclusion restriction of Heckman’s (1979) two-stage estimation procedure. The results of this estimation procedure are reported in the robustness checks and lead us to conclude that sampling does not raise concerns in our analysis.
5.3 Results

5.3.1 Main results of the quasi-replication

Table 5.4 provides a comparison of our large-scale empirical setting vis-à-vis the samples used by L&B and B&K on the reported summary statistics. Samples’ characteristics are comparable across the three studies, except for the mean value of Internationalization. Firms in our sample are on average less international, with a mean of 0.003 (±0.013), a smaller value compared to 0.04 (±0.09) obtained in L&B’s study and 0.10 (±0.09) in B&K’s work. This difference is due to two reasons. First, our sample contains purely domestic firms and so does the one used by L&B. Conversely, B&K restrict their analysis to multinational firms. Moreover, as our sample size is considerably larger, we include many more purely domestic and small firms than L&B. Second, the Internationalization index is scaled by the maximum number of countries and subsidiaries in the sample, and one of the firms in our sample operates in 134 countries. The mean number of countries in which a multinational firm operates slightly differs across samples: 4.82 for our sample, 5.57 and 8.11 for L&B and B&K’s samples respectively. Similarly, the average number of subsidiaries for multinationals slightly differs as well: 18.25 for our sample, 11.88 and 19.23 in L&B and B&K’s samples respectively.

Table 5.5 shows the results of our replication of the main models. Model 1 presents the results from L&B’s study (their model 5, on page 2005). Model 2 gives the random-effects estimation results obtained by B&K (their model 1, on page 2282) and Model 3 the fixed-effects estimation results that was also obtained by B&K (their model 4, on page 2282). Models 4 and 5 show the results of our large-scale quasi-replication using random-effects and fixed-effects estimation respectively. Overall, we see evidence of the effect of all linear, quadratic, and cube terms of Internationalization in both our random-effects and fixed-effects estimation models. We are therefore able to replicate the results from the original L&B’s study, finding support for the S-shaped relationship between multinationality and performance.

We subsequently analyze the effect size of Internationalization for the three studies and, as in B&K, compare the samples in terms of standard deviations. Thus, in Figure 5.1 we report Internationalization measured in number of standard deviations in the horizontal axis and plot its effect size on
Table 5.4. Sample comparisons. Comparison of means and standard deviations across Lu and Beamish (2004), Berry and Kaul (2016), and our study

<table>
<thead>
<tr>
<th></th>
<th>L&amp;B sample</th>
<th>B&amp;K sample</th>
<th>Our sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROA</td>
<td>0.04 (0.05)</td>
<td>0.04 (0.16)</td>
<td>0.063 (0.157)</td>
</tr>
<tr>
<td>Internationalization</td>
<td>0.04 (0.07)</td>
<td>0.10 (0.09)</td>
<td>0.003 (0.013)</td>
</tr>
<tr>
<td>Intangibles</td>
<td>0.01 (0.02)</td>
<td>0.03 (0.19)</td>
<td>0.007 (0.029)</td>
</tr>
<tr>
<td>Parent size</td>
<td>11.06 (1.48)</td>
<td>13.71 (1.83)</td>
<td>6.688 (1.096)</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>3.26 (6.75)</td>
<td>2.17 (2.67)</td>
<td>0.847 (1.508)</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>0.10 (0.15)</td>
<td>0.05 (0.21)</td>
<td>0.035 (0.153)</td>
</tr>
<tr>
<td>Product diversification</td>
<td>0.57 (0.18)</td>
<td>0.24 (0.25)</td>
<td>0.127 (0.202)</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>120.77 (12.35)</td>
<td>1.00 (0.09)</td>
<td>102.220 (6.182)</td>
</tr>
<tr>
<td>Number of companies</td>
<td>1,489</td>
<td>2,023</td>
<td>247,355</td>
</tr>
</tbody>
</table>

ROA. The figure shows similar trends across studies. The effect on ROA reaches a minimum when Internationalization increases to 2-3 standard deviations, corresponding to a decrease in ROA between 2 and 7 percentage points. After reaching such minimum, ROA increases for higher values of Internationalization (with the only exception of L&B’s study for which ROA decreases even further). Note, moreover, that only 3 percent of firms in our sample reach Internationalization values larger than 2-3 standard deviations (11% in B&K’s sample, not reported in L&B’s study). This implies that only the most international firms actually gain from internationalization.

5.3.2 Robustness checks of the quasi-replication

Having compared our results with the ones obtained by L&B and B&K in the full sample, we now look at the robustness of these findings by undertaking a number of additional checks. To do so, we closely follow the robustness checks reported by B&K. Models A1 to A6 (Table I in the Appendix) replicate the robustness checks for several different subsamples. The sign of the coefficients remains unaltered across all models and the S-shaped relationship is empirically validated for the subsamples of large firms (i.e., with at least 10 subsidiaries, Models A1–A2) and multinational firms (Models A3–A4). Note that L&B use listed firms for their analysis and our robustness checks show that the S-shaped relationship is not significant for the subsample of listed firms in our sample (Models A5–A6).

We also checked the robustness of our findings after dropping each control from the final model as both L&B and B&K do (Table II in the Appendix). The
<table>
<thead>
<tr>
<th>Model</th>
<th>1 (L&amp;B, RE, their model 5)</th>
<th>2 (B&amp;K, RE, their model 1)</th>
<th>3 (B&amp;K, FE, their model 4)</th>
<th>4 (RE)</th>
<th>5 (FE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
</tr>
<tr>
<td>Internationalization</td>
<td>-0.38</td>
<td>-0.02</td>
<td>-0.42</td>
<td>-0.651</td>
<td>-0.315</td>
</tr>
<tr>
<td></td>
<td>(-10.95)</td>
<td>[0.92]</td>
<td>[0.16]</td>
<td>[&lt;0.0001]</td>
<td>[0.00004]</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>0.75</td>
<td>0.21</td>
<td>0.85</td>
<td>5.081</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>[-0.052]</td>
<td>[0.92]</td>
<td>[0.16]</td>
<td>[&lt;0.0001]</td>
<td>[0.00004]</td>
</tr>
<tr>
<td>Internationalization cubed</td>
<td>-5.3</td>
<td>-0.73</td>
<td>-0.85</td>
<td>-0.499</td>
<td>-0.527</td>
</tr>
<tr>
<td></td>
<td>[-0.052]</td>
<td>[0.92]</td>
<td>[0.16]</td>
<td>[&lt;0.0001]</td>
<td>[0.00004]</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.015</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>[-17.53]</td>
<td>[0.13]</td>
<td>[0.01]</td>
<td>[&lt;0.0001]</td>
<td>[0.00004]</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>0</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.012</td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(-9.54)</td>
<td>[0.01]</td>
<td>[0.72]</td>
<td>[&lt;0.0001]</td>
<td>[0.00004]</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>-0.02</td>
<td>0.01</td>
<td>-0.01</td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(-3.18)</td>
<td>[0.56]</td>
<td>[0.33]</td>
<td>[0.047]</td>
<td>[0.292]</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.023</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(-3.98)</td>
<td>[0.47]</td>
<td>[0.65]</td>
<td>[0.000]</td>
<td>[0.002]</td>
</tr>
<tr>
<td>Observations</td>
<td>(Not reported)</td>
<td>21,297</td>
<td>21,297</td>
<td>889,865</td>
<td>889,865</td>
</tr>
<tr>
<td>R2</td>
<td>0.1</td>
<td>0.08</td>
<td>0.1</td>
<td>0.042</td>
<td>0.005</td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Random</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
</tr>
<tr>
<td>F Statistic/Wald Chi</td>
<td>1130.02</td>
<td>94.79</td>
<td>8.39</td>
<td>147</td>
<td>642503</td>
</tr>
</tbody>
</table>

**Table 5.5. Main replication results.** All independent variables are lagged by one period. As B&K did, L&B’s results reported in Model 1 have (t-stats in parentheses) as reported in the original L&B’s article. All other models report (robust standard errors in parentheses) and [p-values in brackets].

S-shaped relationship remains significant across models, with the exception of Model A9 (Parent debt-to-equity ratio dropped, random-effects estimation), in which the linear term of Internationalization is not significantly different from zero. We continue with testing the robustness of our findings when using different lags (Table III in the Appendix). The S-shaped relationship remains significant for all random-effects estimations, and for all fixed-effects
estimation models except for the regression with a three-year lag in the ROA (Model A16). Table IV in the Appendix shows comparable results for the linear and quadratic models compared with the ones obtained by B&K (their models 4 and 16), a negative effect of Internationalization for the linear model, and a U-shaped relationship for the quadratic model. In Figure I in the Appendix we show the linear, quadratic, and S-curved relationships across seven large economies. Note that a variety of shapes and effect sizes are found across these individual country settings. Models A25 and A26 (Table V in the Appendix) use the mean-centered variables to account for collinearity (in the same vein as L&B and B&K do) and show the robustness of the S-shaped relationship to these additional checks.

The S-curve relationship holds also when using random-effects estimation and a 2SLS model to account for the endogeneity of Internationalization (Model A27, Table V in the Appendix). However, when using fixed-effects estimation and a 2SLS model (Model A28, Table V in the Appendix), only the linear term of Internationalization remains significant. Whereas the sign of the squared and cubic terms is maintained, both coefficients are not any longer significant. The difference in the effect sizes on ROA in Model A27 and A28 vis-à-vis the ones obtained in our main analysis is illustrated in Figure II in the

Figure 5.1. The S-curve across Lu and Beamish (2004), Berry and Kaul (2016), and our study. One standard deviation of Internationalization corresponds to 0.09 (L&B and B&K) and 0.028 (this study) units of Internationalization. Both random-effects (RE) and fixed-effects (FE) estimations are plotted for B&K and our study. Both B&K’s models are not significant and are only plotted to be able to compare the different effect sizes obtained across the three studies.
Appendix. The Figure illustrates that when we account for the endogeneity of our main independent variable *Internationalization*, its effect size on *ROA* is diminished in both random-effects and fixed-effects estimations. Having said that, note that when also including the *Exchange rate* control and thus running our 2SLS fixed-effects estimation model on a subsample of 846,482 firm-year observations (Model A32, see below for further details on this additional check), the results obtained entirely support the presence of an S-shaped curve. As such, our study overall corroborates the S-curve hypothesis also when accounting for the endogeneity of the *Internationalization* construct.

In addition to the robustness checks undertaken by L&B and B&K we perform additional tests to verify the robustness of our findings. First, we look at the smaller subsample with available information on intangibles (Models A29 and A30 in Table VI in the Appendix). For this smaller subset of firms we create a variable named *Intangibles* which corresponds to the ratio of intangible assets to total assets and include it as control. Our findings show that the coefficient of *Intangibles* (-0.00004 for the random-effects estimation regression; -0.0001 for the fixed-effects estimation regression) is never significantly different to zero. Moreover, the coefficients of our main independent variables do not change in magnitude or sign when including *Intangibles*.

Next, we rerun our fully-specified model on the subsample for which it is possible to account for the exchange rate. Information on real effective exchange rates is available from the International Monetary Fund for 71 of the 111 countries considered in our study.\textsuperscript{11} The resulting subsample after including the variable *Exchange rate* as control variable comprises 846,482 firm-year observations. The S-curve is confirmed in both the random-effects (A31, in Table VI in the Appendix) and fixed-effects (A32, Table VI in the Appendix) estimation models. We also rerun both models using a 2SLS estimation to account for the endogeneity of the *Internationalization* construct in an effort to replicate as closely as possible the model used by B&K. In both cases the S-curve hypothesis is empirically validated (A33 and A34, Table VI in the Appendix).

After looking at the effect of *Intangibles* and *Exchange rate*, we explicitly model the between-effects and within-effects separately (Model A35 in Table VI in the Appendix). For this, we use the Mundlak (1978) correction, in particular

\textsuperscript{11}For additional information on the data we retrieved to construct our *Exchange rate* variable, refer to: http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B.
the within-between formulation of the model (Bartels, 2008; Bell and Jones, 2014). In this formulation, the heterogeneity bias is explicitly modeled by adding the higher-level mean at the group level of each time-varying covariate, accounting for the between effect. As expected given that we find similar results for our random-effects and fixed-effects estimation models (see Table 5.5 above), we obtain a significant S-shaped relationship for both the within and between parts of the model. The empirical evidence we find in support of the S-curved relationship at both levels (between and within) suggests that using random-effects estimation in our models could actually result in a more efficient estimation of the coefficients.

In Model A36 we account for potential selection bias by using Heckman’s (1979) two-stage estimation procedure. In the first stage, we model $D_{INCLUDED}$ using $D_{FOREIGN}$, all our independent variables, industry and country-fixed effects. Next, we create the inverse Mills ratio ($IMR$), which we subsequently include in a random-effects estimation model, our second stage, in which $ROA$ is modeled as a function of $IMR$ and all our independent and control variables. We compare the results of this regression with the results of our main regression (Table 5.5) without $IMR$ and find only minor differences. Overall, the changes in the coefficients when using Heckman’s (1979) two-stage estimation procedure remain small and do not change the interpretation of the results, thus corroborating that sampling does not raise concerns in our analysis.

5.3.3 Additional analyses

In addition to the quasi-replication of L&B and B&K’s studies, our big data approach allows us to test the M-P relationship across individual country settings. Table 5.6 shows the results of both random-effects and fixed-effects estimation models when restricting our sample to firms based in the U.S. (to compare our results with the ones obtained by B&K), Japan (to relate our results with the ones reported in L&B’s study), and Germany. Contrary to L&B’s findings, our results show a significant but inverse S-shaped relationship for Japan (and only when using random-effects estimation). However, this relationship loses significance when focusing on the largest 1,489 Japanese firms—a sample that more closely resembles the one used by L&B. Table 5.6 also shows that when restricting both our random-effects and fixed-effects estimations to our subsample of U.S. firms, we fail to find empirical support for the S-curve hypothesis. This is an important finding as it corroborates the
results of B&K, who are also not able to replicate L&B's results when focusing on their panel data of U.S. multinationals. More generally, the results reported in Table 5.6 underscore B&K's conclusion that scholars need to carefully consider the peculiarities of the country context, including the specificity of the time period considered.

<table>
<thead>
<tr>
<th>Model</th>
<th>ROA</th>
<th>ROA</th>
<th>ROA</th>
<th>ROA</th>
<th>ROA</th>
<th>ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (US firms, RE)</td>
<td>0.08</td>
<td>0.125</td>
<td>0.186</td>
<td>0.235</td>
<td>-0.366</td>
<td>-0.519</td>
</tr>
<tr>
<td>7 (US firms, FE)</td>
<td>-0.166</td>
<td>-0.244</td>
<td>-0.081</td>
<td>-0.103</td>
<td>-0.177</td>
<td>-0.292</td>
</tr>
<tr>
<td>8 (Japanese firms, RE)</td>
<td>-1.527</td>
<td>-0.397</td>
<td>-1.752</td>
<td>-1.568</td>
<td>1.865</td>
<td>2.322</td>
</tr>
<tr>
<td>9 (Japanese firms, FE)</td>
<td>-1.282</td>
<td>-1.77</td>
<td>-0.732</td>
<td>-0.944</td>
<td>-1.652</td>
<td>-2.485</td>
</tr>
<tr>
<td>10 (German firms, RE)</td>
<td>1.889</td>
<td>-0.039</td>
<td>3.36</td>
<td>2.807</td>
<td>-3.264</td>
<td>-4.204</td>
</tr>
<tr>
<td>11 (German firms, FE)</td>
<td>-2.642</td>
<td>-3.389</td>
<td>-1.64</td>
<td>-2.063</td>
<td>-3.638</td>
<td>-5.536</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>[0.629]</td>
<td>[0.608]</td>
<td>[0.021]</td>
<td>[0.024]</td>
<td>[0.039]</td>
<td>[0.076]</td>
</tr>
<tr>
<td>Internationalization cubed</td>
<td>[0.234]</td>
<td>[0.823]</td>
<td>[0.017]</td>
<td>[0.097]</td>
<td>[0.259]</td>
<td>[0.351]</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.076</td>
<td>0.042</td>
<td>0.01</td>
<td>0.009</td>
<td>-0.003</td>
<td>0.003</td>
</tr>
<tr>
<td>Parent dept-to-equity ratio</td>
<td>-0.004</td>
<td>-0.01</td>
<td>-0.002</td>
<td>-0.005</td>
<td>-0.001</td>
<td>-0.002</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>0.045</td>
<td>-0.007</td>
<td>-0.003</td>
<td>-0.006</td>
<td>0.005</td>
<td>0.013</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.023</td>
<td>-0.001</td>
<td>-0.021</td>
<td>-0.02</td>
<td>-0.011</td>
<td>-0.006</td>
</tr>
<tr>
<td>Observations</td>
<td>15,023</td>
<td>15,023</td>
<td>10,076</td>
<td>10,076</td>
<td>27,154</td>
<td>27,154</td>
</tr>
<tr>
<td>R2</td>
<td>0.09</td>
<td>0.01</td>
<td>0.071</td>
<td>0.025</td>
<td>0.046</td>
<td>0.013</td>
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<td>Fixed or random effects</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
</tr>
<tr>
<td>F Statistic</td>
<td>61.629 (df = 24; 14998)</td>
<td>17.649 (df = 7; 11894)</td>
<td>30.689 (df = 25; 10050)</td>
<td>28.020 (df = 7; 7529)</td>
<td>51.734 (df = 25; 27128)</td>
<td>36.555 (df = 7; 19064)</td>
</tr>
</tbody>
</table>

Table 5.6. Additional analysis focusing on U.S., Japanese, and German subsamples. All independent variables are lagged by one period. All models report (robust standard errors in parentheses) and [p-values in brackets].

We therefore continue by exploring the M-P relationship in 24 individual countries. Figure 5.2 shows that there is sizable heterogeneity across national settings. First of all, countries differ in the 'length' of the curve, that is, in the number of firms that reach higher levels of internationalization. In
the U.S. and Switzerland for instance there are firms that score 0.3 on the *Internationalization* index. Yet in many other countries, firms do not reach this level of *Internationalization*. In countries such as China, Brazil, Spain, and Italy the curve is consistent with the first part of the general S-shaped curve but is cut off because there are no observations with high levels of *Internationalization*. Indeed, the final part of the S-shaped curve observed in our full sample is based on a relatively small set of observations compared with the first part. Thus, studies working with small samples will find it extremely difficult to find empirical evidence in support of a full S-shaped relationship.

Moreover, Figure 5.2 also shows that some countries display curves that are not consistent with (parts of) the S-curve, such as the inversed S-shape curves in Japan and India. These findings suggest that the national context is a highly relevant factor for the relationship between multinationality and performance. The institutional and geographical context may be such that the initial costs attributed to the first phase of internationalization are severely diminished (such as Japan) or exacerbated (such as Australia). Likewise, French firms only reap the benefits of internationalization once it reaches a much higher level compared with (for instance) Australian firms.

**Figure 5.2. The S-curve across 24 individual country setting.** Random-effects estimation is used for each model plotted. The dashed line shows the S-curved obtained when analyzing our full sample using random-effects estimation. Models for which a significant relationship is found are shown with a dark solid line. Models for which at least one of the coefficients (linear, quadratic, or cubic) is not significant are shown with a light solid line. See Figure III in the Appendix for the equivalent figure using fixed-effects estimation.
To conclude, our additional analysis shows that while the S-curve emerges as the overall relationship when examining the full sample, firms that are based in particular countries may be faced with different realities. This brings us back to the overview of most influential studies as listed in Table 5.1. We chose (as B&K did) to quasi-replicate L&B’s study that hypothesized and found an S-shaped curve because of its influence and well-developed research design. Yet, among the other influential studies we also find positive and (inverted) U-shaped relationships. Note that, as evidenced in Figure 5.2 above (as well as in Figures I and III in the Appendix), we also found a variety of shapes and effect sizes when restricting our analysis to individual country contexts.

In sum, our findings show that the S-shape hypothesis on the M-P relationship is an attractive and compelling overarching theoretical framework, one that can reconcile the different findings in national settings if we interpret them as observable parts of the general S-shaped curve. At the same time, this implies that whereas for some firms it may pay to be a multinational, this does not certainly apply to any firm, especially across different country contexts.

### 5.4 Conclusion

Does it pay to be a multinational? A substantial number of studies have investigated the relationship between multinationality and performance to respond to this question. Despite considerable scholarly efforts, the literature has failed to provide a consistent answer. In this study, we undertook a big data quasi-replication of L&B and B&K’s works and thus investigated whether the M-P relationship is S-shaped. To do so, we used a longitudinal dataset of almost 250,000 firms and their roughly 680,000 subsidiaries over a seven-year period (2009 to 2016). This allowed us to examine the M-P relationship using a panel of 889,865 firm-year observations across 111 country settings. This is to date the largest sample ever used to test the M-P relationship. Our results corroborated the presence of an S-shaped relationship between multinationality and performance as suggested by L&B.

Beyond the quasi-replication of L&B and B&K’s earlier studies, we undertook additional analyses to take advantage of the large number of observations constituting our sample. The analysis of individual country contexts showed large differences in the curves obtained across different country settings,
in terms of both shapes and effect sizes obtained. While the S-curve was empirically verified as the general relationship between multinationality and performance, we found considerable dissimilarities across national settings. For instance, when focusing on U.S. firms, our findings are aligned with the ones obtained by B&K as we also failed to find empirical evidence supporting the S-curve hypothesis. This implies that when scholars examine the M-P relationship in smaller samples restricted to a single country, they may find diverging results, often observing a smaller part of the general S-curve. Furthermore, our analysis suggests (as evidenced in Figure 5.1) that only the most international firms are actually able to benefit from their internationalization efforts.

Our work contributes to the fields of strategic management and international business research and, more specifically, to the literature on the M-P relationship in three ways. First, our analysis provided a quasi-replication of L&B and B&K’s studies well beyond the peculiarities of an individual country context. To do so, we embraced a big data approach to examine the extent to which the S-curve hypothesis is truly generalizable across 111 country settings. Our analysis did provide empirical support in favor of an S-curved relationship between multinationality and performance. Second, our findings clearly showed that while the S-shape hypothesis holds when considering our full sample, the S-curve often does fail to be empirically validated when restricting the sample to an individual country. Instead, only a part of the S-shaped curve tends to be supported when considering a specific country setting. Thus, our analysis suggests that firms in a given country (and time period) are most likely to display only a smaller section of the S-shaped curve.

Third, our analysis demonstrates the potential of big data and data science methods to (re)assess central questions for the fields of strategic management and international business. Specifically, we believe our study showed the merits of a big data approach in three distinct ways. First, our big data approach gave the opportunity to extend the analysis to a much larger number of data points and settings, thus leading to a more rigorous examination of the extent to which a key relationship such as the one between multinationality and performance can be generalizable and, if so, under which conditions. Second, the usage of almost 900,000 firm-year observations required a correct assessment of p-values and, consequently, a cautious interpretation of effect sizes. Third, the
inclusion of an extensive Appendix (which will also contain all the codes of
the analysis), will facilitate the replicability of our study in future investigations
on this topic, importantly contributing to the development of cumulative and
repeatable knowledge that will further advance the scholarly debate on the M-P
relationship.

This study also has limitations. First, being a quasi-replication of earlier studies,
we tried to replicate the methods and measures used by both L&B and B&K
as closely as possible. However, we were unable to reproduce their analysis
completely. For instance, we did not include firms’ advertising intensity and
intangible assets in our main analysis whereas L&B did. While we did take
additional steps to account for these changes in our empirical specifications,
future studies could find better ways to cope with the challenges posed by quasi-
replications studies. Second, while we did take into account the endogeneity of
the multinationality construct, we echo B&K’s comment and hope that future
studies will take an even more sophisticated way of controlling for this issue.
Even though the technique we (and B&K) used to control for endogeneity
remains valid, future works could delve deeper into this fundamental matter.

Third, while we are able to point at the striking cross-national differences in
the M-P relationship, we have to leave it to future work to uncover what are
the intervening variables that shape the M-P relationship in particular contexts.
A keen eye for how institutional differences at the firm, sector, and national
levels hinder or strengthen a positive relationship between multinationality
and performance seems a particularly expedient way forward. Future large-
scale panel analysis can for instance take into account the impact of rule of
law, capital market maturity, or firm level elements such as the use of offshore
financial centers or peer group competition on the M-P relationship, to name
just few of the many possible interacting variables.

In conclusion, our findings are in support of an S-shaped relationship between
multinationality and performance. Does it pay to be a multinational? Yes
it does, but certainly not for all firms. Additionally, our results show that
only the most internationalized firms actually benefit from their international
expansion. For all other firms the increase in internationalization comes at the
expense of lower return on assets. Thus, the S-curved relationship between
multinationality and performance does exist, but not always or everywhere.
5.4. Conclusion

References


Additional analyses


5.4. Conclusion


CHAPTER 6

Effective Tax Rates and Profit Shifting to Offshore Financial Centers

This chapter analyzes offshore financial centers in relation to misaligned profits—that is, profits found in a jurisdiction without corresponding real activity. Using six different datasets on U.S. MNCs, we find a similar and small set of jurisdictions accounting for the majority of misaligned profits. Among such profit centers we find Bermuda, the Cayman Islands, the British Virgin Islands and Puerto Rico. Importantly, we find that coordination centers—in particular the Netherlands, Ireland, Switzerland and Luxembourg—are able to attract a large share of the profits of U.S. MNCs, which was not so much the case a decade ago. We also find that the location of misaligned profits correlates extremely well with the effective tax rate paid by MNCs in the jurisdiction, but not with the statutory tax rate. Coordination centers such as the Netherlands or Luxembourg, with relatively high statutory corporate tax rates, are able to attract a large fraction of U.S. profits through low effective tax rates. This, as we explored before, is due to their ability to offer lower tax rates to financial profits. The low effective tax rates and high profits in coordination centers reflect the challenges of regulating corporate tax avoidance. Introducing withholding taxes and economic sanctions is a feasible policy in the case of far-flung Caribbean islands. Coordination centers, however, are strong, developed countries, and are used by MNCs as bases from which to invest in other countries. Introducing capital barriers to those countries is politically and economically difficult. This limitation of policy options is likely to intensify tax competition.
Abstract

A growing body of economics literature shows that multinational corporations (MNCs) shift their profits to tax havens. We contribute to this evidence by comparing a range of available data sets focusing on US MNCs, including country-by-country reporting data which has been released in December 2018 for the first time. With each of the datasets, we analyse the effective tax rates that US MNCs face in each country and the amount of profits they report. Using country-by-country reporting data, we have been able to establish that lower effective corporate tax rates are associated with higher levels of reported profits when compared with different indicators of real economic activity. This corresponds to the notion that MNCs often shift profits to countries with low effective tax rates—without also shifting substantive economic activity. Consequently, we identify the most important tax havens for US MNCs as countries with both low effective tax rates and high profits misaligned with economic activity.

6.1 Introduction

The existence and scale of profit shifting from countries where multinational corporations (MNCs) locate their production and retail operations to other countries, often labelled tax havens, where they report profit thanks to lower taxation, has been extensively discussed in economics literature. US-headquartered MNCs are a good example of such practices. As established by e.g. Clausing (2009), Zucman (2014), the United States Joint Committee on Taxation (2014) and Clausing (2016) using various methods, government revenue foregone due to profit shifting amounts to approximately one fifth of the US corporate tax base. In a related strand of research, Guvenen, Mataloni Jr, Rassier, and Ruhl (2017) find that profit shifting leads to an undercalculation of US GDP and go on to argue that the missing corporate profits should be reattributed from a small group of tax havens. While all of these studies rely on the US government’s Bureau of Economic Analysis (BEA) survey of MNC data, Dowd et al. (2017) use confidential corporate tax returns to confirm the importance of profit shifting and show that reported profits are much more sensitive to tax rate changes in low tax countries than in high tax countries. However, data sets other than those provided by the BEA and the
combinations thereof have thus far been seldom used in economics literature on US-headquartered MNCs.

To contribute to the existing body of academic literature as well as to ongoing policy discussions, we use the newly available country-by-country reporting (CBCR) data set released for the first time in December 2018 by the Internal Revenue Service (IRS). In contrast to other data sources, IRS CBCR includes the most reliable country-level information about MNCs’ tax payments and profits to date; moreover, it covers an extensive range of countries, including tax havens often omitted from existing data sources. By design, the IRS CBCR data set does not suffer from a selection bias in country coverage since, for the first time, MNCs have been required to report on country-by-country basis for all countries worldwide where any given MNC has any economic activity. Although CBCR data are as not as detailed as previously discussed (Murphy, 2009, Murphy and Sikka, 2015, Wójcik, 2015), they constitute an improvement in comparison with existing data sources in at least some aspects, including e.g. the quality of tax payment information and country coverage. Furthermore, while De Simone and Olbert (2019) use other already existing data to show that the requirement for large MNCs to share their CBCR data with governments has already had its effect on MNCs’ transparency, even prior to the publication of CBCR data, this paper aims to provide the first evidence of the effective tax rates of MNCs using the newly published IRS CBCR data set itself.

This study utilizes IRS CBCR data to answer two interrelated research questions. First and foremost, we aim to establish which tax havens are most important for US-headquartered MNCs. We define most important tax havens as countries where US-headquartered MNCs pay low effective tax rates (ETRs) while reporting large amounts of profits and little economic activity (misaligned profit). The primary research question will be answered in three steps. First, we estimate ETRs, calculated as ratios of taxes and gross income. Second, we quantify the scale of misaligned profit, measured as the profits lacking proportionate economic activity in terms of assets, revenue or employees; using newly available CBCR data, we then revisit questions of profit shifting scale and destinations as practiced by US MNCs. In the third step, we examine the relationship between ETRs and misaligned profits to test whether more misaligned profits are reported in countries with lower effective tax rates, thus indicating key tax havens.
6.1. Introduction

Examining both ETRs and misaligned profits as well as their relationship makes good sense since, we argue, they are two sides of the same coin. On the one hand, countries compete with each other to attract MNCs’ reported profits by lowering their ETRs. A country’s ETR can thus be used as a proxy of its tendency to attract foreign profits. On the other hand, a country’s success in attracting profits can be measured by the misaligned profits reported in that country. While both measures are the result of interactions between MNCs, the country in question and other countries, we argue that enabling low ETRs is primarily at the governments’ discretion while reporting profits without proportionate economic activity is ultimately due to the MNCs’ actions. Both ETRs and misaligned profits have been studied before, but few studies have focused on their interrelationship. Profit shifting studies typically use only one data source, such as the BEA for US MNCs, and the opportunity to combine several suitable datasets has thus far been significantly underexploited.

Our secondary research objective aims to identify how the new IRS CBCR data set differs from existing data sets. We answer this question both conceptually and empirically while providing answers to our primary research question throughout the paper. We compare IRS CBCR to other available relevant data sources in terms of basic variables included in the data as well as using the estimated indicators of ETRs and misaligned profits. Examined data sources include the BEA’s and Eurostat’s foreign affiliate statistics, controlled foreign corporation data provided by the IRS and two private databases which include company balance sheet information, Bureau van Dijk’s Orbis and Standard & Poor’s Compustat. Comparing these data sets with IRS CBCR is of interest due to the arguably superior quality of country-level information about MNCs’ tax payments and profits as well as the better country coverage found in the IRS CBCR data set; we will show exactly how much the various data sets differ.

By exploiting a variety of available data sources, we reach several consistent findings that we briefly preview here. While strong correlation between individual datasets is generally the case, we also highlight important conceptual and statistical differences between the data sources: for example, the extent of this correlation differs across economic variables and country groups. We estimate effective tax rates and profit misaligned with economic activity and find a negative correlation between these two: the lower the effective tax rate, the higher the profits misaligned with economic activity. Indeed, across all data
sets, we locate several countries with US MNCs activity which share a number of common characteristics. These tax havens exhibit low ETRs and high shares of profits in contrast with much lower shares of employee numbers and other indicators of economic activity.

By utilizing the findings outlined above, we aim to contribute to the existing body of literature in several ways. These intended contributions are described below.

Various kinds of ETRs have been designed by economists and accountants to shed light on corporate income tax rates actually applicable to MNCs. ETR values may be derived either from legislation or from actual data on companies’ economic activities, including their profits and taxes. A basic distinction thus exists between so-called forward-looking (ex ante) law-based ETRs, which have been heavily used in relevant academic literature to date, and backward-looking (ex post) MNC-data-based ETRs, such as the one we employ here (a more detailed recent comparative discussion of the two is provided by Janský, 2019). Through forward-looking ETRs, derived from hypothetical business models, are certainly useful for some purposes, they are less effective than backward-looking ETRs in the case of MNCs. Recent examples with good discussions of related literature have applied the forward-looking ETR methodology by Devereux and Griffith (2003) to EU member states (Spengel et al., 2014, the European Commission, 2018), G20 countries (Congressional Budget Office, 2017) and 36 OECD and other countries (Hanappi, 2018). However, since backward-looking ETRs depict the actual taxation of MNCs, they are capable of providing a good indication of the extent to which particular countries actually use low taxes to attract MNCs and this is also why we focus on backward-looking ETRs in this paper.

We follow the common approach of estimating ETRs as ratios of corporate income tax and gross income and apply this approach to all utilized data sources. Several existing studies have estimated ETRs using BEA data, including Bosworth, Collins, and Chodorow-Reich (2007), Stewart (2014), Clausing (2016), Cobham and Janský (2019), Wright and Zucman (2018) and Tørrsløv, Wier, and Zucman (2018). For example, Desai, Foley, and Hines (2004) use BEA data to estimate ETR as the ratio of foreign income taxes paid to foreign pre-tax income for each affiliate and use the medians of these rates as country-level
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observations for each country and year. Mutti and Grubert (2004) estimate country average effective corporate income tax rates with another US-centred data source, the so called US Treasury Form 5471 by US controlled foreign corporations in manufacturing. Perhaps even more promising in terms of accuracy is the use of confidential corporate tax returns, as recently used to estimate ETRs by the Government Accountability Office (2008) and Dowd et al. (2017) for the United States, the latter using averages weighted by positive profits, with which we are able to compare our estimates.

In addition to ETRs, misaligned profits are a second key indicator used in this paper. We estimate the scale of misaligned profits as the profits lacking proportionate economic activity in terms of assets, revenue or employees. This is a similar but broader measure than profit shifting indicators commonly found in literature. Profit shifting by US MNCs has long been well recognised in economics literature (Hines and Rice, 1994, Grubert, 2012, Dowd et al., 2017, Guvenen, Mataloni Jr, Rassier, and Ruhl, 2017), including its transfer mispricing channel (Clausing 2003, Bernard, Jensen, and Schott, 2006, Flaaen 2017). Both US-centred (Clausing, 2009, Zucman, 2014, United States Joint Committee on Taxation, 2014) and cross-country estimates (Clausing, 2016, Tørsløv et al., 2018, Cobham and Janský, 2018, Janský and Palanský, forthcoming) agree that profit shifting is costly in terms of foregone revenue, in particular for the US government.

The relationship between profit shifting and ETRs has been somewhat less intensively studied. Using US data from the Internal Revenue Service, the Government Accountability Office (2008) shows that effective tax rates on US MNCs' foreign operations vary considerably by country and that ETRs correlate with the locations where income is reported. Wright and Zucman (2018) use BEA data to show that in sectors other than oil, the effective foreign tax rate has fallen by half since the late 1990s and that almost half of this decline results from the rise of profit shifting to tax havens. Relying on the same data source, Cobham and Janský (2019) show a rough correlation between ETRs and misaligned profits. In contrast with these previous studies, we use the newly available and, in some respects superior, CBCR data to investigate this relationship.
Furthermore, to address our secondary research question, we aim to shed new light on the extent to which the IRS CBCR data is useful for studying ETRs and profits in tax havens. We would like to investigate whether the CBCR data in fact re-establish appropriate disclosure and ultimately the accountability of multinational corporations, as for example Cobham, Janský, and Meinzer (2018) have argued. OECD (2018) envisions that its Base Erosion and Profit Shifting (BEPS) Action 11 final report’s key recommendation to collect aggregated and anonymised CBCR data will play an important role in supporting the OECD/G20 Inclusive Framework’s ongoing work on BEPS measurement and monitoring. While OECD (2018, p. 42) stresses the usefulness of such data for governments, this paper focuses on contributing to academic research and to an evidence base for policy discussions. To paraphrase OECD (2018, p. 42), our aim is to provide researchers and the public with a more complete view of the global activities of the largest MNCs. We agree with OECD (2018, p. 42) that one of the major challenges associated with measuring profit shifting is that only limited information is available on the location of MNCs’ income, taxes, and business activities and that CBCR represents a step forward in supporting the measurement of profit shifting with jurisdiction-specific information. We aim to estimate the scale of the improvement that the CBCR data represents by comparing it with other available data sources.

Last but not least, we aim to address important policy issues and thus contribute to ongoing discussions. Governments around the world and economists in policy forums at OECD and elsewhere have been recently dealing with the question of how taxing rights on income generated from cross-border activities in the digital age should be allocated among jurisdictions (OECD, 2019, p. 5). The OECD’s latest proposals are divided into two groups and our work is relevant to both. According to OECD (2019, p. 6), the so-called Pillar One focuses on the allocation of taxing rights, and seeks to undertake a coherent and concurrent review of profit allocation and nexus rules. Pillar Two focuses on the remaining BEPS issues and seeks to develop rules that would provide jurisdictions with a right to “tax back” where other jurisdictions have not exercised their primary taxing rights or where payment is otherwise subject to low levels of effective taxation. While our misaligned profit estimates are relevant to profit allocation discussions in Pillar One, our effective tax rates estimates speak directly to low levels of effective taxation referred to in Pilar
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Moreover, our results confirm how the two, misaligned profits and ETRs, or Pillars One and Two, are interrelated.

We structure the rest of the paper as follows. First, we describe and compare the data sources. We then introduce our methodology, focusing on the indicators of ETRs and misaligned profits. Third, we present our results, providing descriptive statistics and statistical comparisons of the various datasets as well as estimates of effective tax rates and misaligned profit and their relationship. Finally, we conclude and discuss policy implications.

6.2 Data

To contribute to the existing body of literature and answer our two research questions, we exploit a new dataset and its combinations with a range of previously utilized data sets. Most of these data sets are well-established sources for studying MNCs. BEA was recently employed and described by Wright and Zucman (2018), Eurostat by Tørsløv, Wier, and Zucman (2018), Compustat by Dyreng, Hanlon, Maydew, and Thornock (2017), data on US-controlled foreign corporations by Mutti and Grubert (2004), and Orbis by Garcia-Bernardo, Fichtner, Takes, and Heemskerk (2017). More general overviews of relevant data sources for the study of profit shifting of MNCs around the world and specifically in the US are provided by OECD (2015) and Keightley and Stupak (2015), respectively. In contrast, IRS CBCR has only recently been released and as such has hardly been used for any analysis, until autumn 2019 with the exception of social media (e.g. Setser, 2019). As of mid-October 2019, two other papers have used the data and both are concurrent to our paper and both are focused on the evaluation of recent policy proposals: one is by Cobham, Faccio, and FitzGerald (2019) and another one is by International Monetary Fund's (IMF) de Mooij, Liu, and Prihardini (2019). Given the relative lack of academic literature using and describing this new data set, IRS CBCR is introduced in more detail below.

6.2.1 Country-by-country reporting data

CBCR data on US-headquartered MNCs for 2016 was published only in December 2018 by the IRS. The following description of the data draws primarily on information available from the IRS (2019a) for the relevant Form 8975. It focuses on United States persons who constitute the ultimate parent
entity of a United States multinational enterprise (US MNC) group with annual revenue for the preceding reporting period of over $850 million. The filer must list the US MNC group’s constituent entities, indicating each entity’s tax jurisdiction, country of organization and main business activity, and provide financial and employee information for each tax jurisdiction in which the US MNC conducts business. Supplied financial information includes revenues, profits, income taxes paid and accrued, stated capital, accumulated earnings, and tangible assets other than cash. IRS CBCR data includes information on both income taxes paid (income tax paid on a cash basis) and accrued (total accrued current income tax expense recorded on taxable profits or losses, reflecting only operations in the relevant annual period and excluding deferred taxes or provisions for uncertain tax liabilities).

Several notable aspects of IRS CBCR data are worth discussing in greater detail. Having considered these aspects, we find the data suitable and insightful for the analysis at hand; however, we also expect qualitative improvements in future data releases. First, the data constitute a sample rather than a full sample since the tables released by the IRS state that “all figures are estimates based on a sample”. This implies, as we learned from information provided by an IRS staff member, that filing by companies was not mandatory for that first reporting year of 2016 and only approximately three quarters of all relevant companies submitted the required information. Since it is not possible to establish which companies submitted the information and how representative or biased the sample might be, we would like to highlight this as a concern and a potential explanation of some of the differences observed below. Nevertheless, we continue to work with the data as provided, assuming that the sample might be close to a representative or a full sample. Only data released in future years based on full samples will prove or disprove this assumption.

Second, IRS CBCR data do not include foreign controlled US corporations, which file country-by-country reports in a foreign country rather than in the US. However, these corporations are included, in another data source we use, i.e. the US Treasury Form 5471 on controlled foreign corporations. Even more promisingly, these corporations will be included in the CBCR data for large MNCs headquartered in other countries than the US, which are bound to be published in 2020.
A third specific feature of IRS CBCR data is its inclusion of a “stateless” option as one of the country categories. IRS instructions (2019a) and a follow-up clarification provide an explanation which we briefly sum up here. According to these instructions, in case an MNC group includes any stateless entities, these must be reported by the MNC. Also, any business entity that does not have a tax jurisdiction of residence is considered stateless (this could include income difficult to allocate to one specific country). These stateless entities include US–organized constituent entities that are fiscally transparent US business entities (perhaps including partnerships) as well as any other constituent entities of a US MNC group that do not have a tax jurisdiction of residence. The stateless category may include any amount of pass-through income which should have actually been reported in the US or in another country, where it would thus change the value of our estimated ETRs and misaligned profit. Future clarifications by the IRS should shed more light on what is included in this stateless category as it is an important category by the scale of income.

A fourth notable aspect is the past accumulation of earnings in foreign countries by US MNCs, in which cases taxation has been effectively deferred. IRS CBCR data include information on accumulated earnings (which are negative for some countries, i.e. accumulated losses). We understand the concept of accumulated earnings as overlapping with that of permanently reinvested earnings; furthermore, it is worth noting that with the passage of Public Law 115–97 both the accumulated earnings and any new earnings not taxed on a current basis will no longer need to be designated as permanently reinvested earnings (Joint Committee on Taxation, 2018). Permanently reinvested earnings constitute a financial accounting concept reflecting the cumulative amount of foreign earnings designated as “indefinitely reinvested” for which no accrued income tax expense is recorded on financial statements (Laplante and Nesbitt, 2017). In other words (Mock and Simon, 2010), if a firm has a plan in place (i.e. sufficient evidence) to retain unremitted earnings offshore indefinitely, the earnings may be designated as permanently reinvested earnings and the firm may defer recording the US income tax expense attributable to these foreign earnings until such earnings are repatriated back into the US, or until they are no longer considered indefinitely reinvested (otherwise the income tax expense attributable to deferred taxes on unremitted foreign earnings is to be recorded e.g. in filings to the SEC).
CBCR data released for US MNCs are a pioneering component of a worldwide effort. In 2020, the OECD is scheduled to publish aggregated CBCR data for large MNCs (as outlined in Annex C of a recent report by the OECD, 2018) and IRS CBCR data are a preliminary part of that larger release. According to the OECD (2018), OECD/G20 Inclusive Framework members have agreed to provide three main data tables summarising information reported on CBCR according to jurisdictions where MNCs operate and the tax rates they face. IRS published the CBCR data using a similar structure featuring three main tables. Table A2 in the Appendix lists the table titles for comparison. Given the similarity, we can expect that CBCR data published by IRS are a good proxy for what might be published for other countries (the main difference likely being the lower number of MNCs and the related need to suppress more information for confidentiality reasons). Nevertheless, some differences are to be found as well. Two of the IRS tables contain a sectoral breakdown: IRS Table 1D provides the number of constituent entities by main business activities and IRS Table 2 reports the same breadth of information as IRS Table 1A by major industry group for a smaller number of specific countries. In contrast, IRS provides information by effective tax rate of multinational enterprise subgroups in IRS Table 3, but lacks an overview of MNC activities based on the tax rate faced by whole MNCs, as discussed by OECD (2018) and expected as OECD Table 2. There are also other disadvantages. For example, the information is provided in aggregated form, although the data includes far more information than similar CBCR data for individual banks (Bouvatier, Capelle-Blancard, and Delatte, 2017, Janský, 2018) or extractive industry companies. Despite this, certain characteristics of the CBCR data make it the best available data set for some research questions. These characteristics include no double counting of related party dividend payments as well as the fact that a check-the-box election for foreign eligible entities does not affect their tax jurisdiction of residence of the foreign entity and thus has no impact on CBCR.

6.2.2 Other data sources
Additional data sources relevant to US MNCs are briefly compared in this section. Though we use all available data sources, some are used more frequently than others—for example, we consider IRS CBCR to constitute a preferred data set for our empirical analysis in a number of respects; on the other hand, Compustat has only limited use for us given the unavailability of country-level unconsolidated data. Table 1 below provides a brief comparison
of the data sources relevant for US MNCs and Table A2 in the Appendix provides a more detailed overview of the various sources. For example, BEA provides a number of data series for income of MNCs. Its net income series includes double-counting as discussed by Clausing (2016), among others. In contrast, we choose two alternative measures that we distinguish as BEA (based on profit-type return and likely to underestimate profits) and BEA 2 (the best currently available measure developed by Clausing, 2019) in Table 6.1 and henceforth.

The various data sets differ conceptually with respect to the sample of companies included. Sample coverage and data source overlaps are outlined in Figure 6.1. The BEA and Eurostat data sets include the largest sample of US MNCs (they both include practically all of them). Separately from IRS CBCR, other data collected and published by the IRS is based on information about US persons with respect to controlled foreign corporations (CFCs) (IRS, 2019b). An IRS CFC includes a stratified random sample, oversampling large MNCs, of all US persons (e.g., corporations, individuals, trusts), similarly to data used by Grubert and Mutti (2000). Also, a future version of IRS CBCR should include all large US MNCs; this is reflected in Figure 6.1 (on the other hand, the currently available version, as discussed above, only provides a sample). These four data sources (i.e. BEA, Eurostat, IRS CFC and IRS CBCR) in principle cover all MNCs and thus do not suffer from any sample selection bias. In contrast, Orbis does not guarantee a full or representative sample and, as systematically and empirically shown below, the opposite is sometimes true.

The data sets also differ in the level of country reporting detail. While the private Orbis data set reports on all countries and jurisdictions where information is available, the government-supported data sets BEA, Eurostat, IRS CFC and IRS CBCR suppress or aggregate some countries’ information, mainly for confidentiality reasons. Interestingly, IRS CBCR reports on a wider range of countries than BEA, including some small tax havens. In theory, the data sets could be combined to benefit from each others’ conceptual strengths. For example, BEA might be compared with IRS CBCR to provide information on the properties of large MNCs while Orbis might be adjusted for coverage by combining it with either BEA or IRS CBCR. In turn, Orbis might be used as a source of its detailed ownership information in the form of the global ultimate owner of each entity, for which Orbis uses a threshold of 50% to determine
### Table 6.1: Available data sources relevant to US MNCs

<table>
<thead>
<tr>
<th>Tax variables</th>
<th>Definitions</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBIT (profit before taxes)</td>
<td>Includes profits before income tax</td>
<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
</tr>
<tr>
<td>Profits (profit or loss before taxes)</td>
<td>Includes profits before income tax (value added with personnel costs excluded)</td>
<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
</tr>
<tr>
<td>Net income</td>
<td>Cross-sectional sample</td>
<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
</tr>
<tr>
<td>Income taxes accrued</td>
<td>Profit-type return – net, interest paid</td>
<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
</tr>
<tr>
<td>Income taxes accrued</td>
<td>Current earnings and profits</td>
<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
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<td>IRS CBCR (all) and IRS CBCR* (only with positive profits)</td>
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legal ownership. Several such comparisons are tested in practice in the results section below.

![Figure 6.1. US MNC data source overlaps.](image)

**Figure 6.1. US MNC data source overlaps.** This is an illustrative diagram only. For representation purposes, the distributions shown are less skewed than the empirical distributions.

A further challenge presented by all data sets is the difference between accounting and tax concepts of profit and tax. In line with balance sheet regulations and methodologies utilized by individual data sets, these data sources are based on financial accounting rather than on tax accounting. As a result, the data indicates amounts paid by MNCs in taxes according to financial accounting rather than amounts in fact paid and reported as such to a tax authority. It is important to distinguish between data on taxes paid according to financial or tax accounting, as they differ e.g. with respect to how they deal with carry-losses, deductions or depreciations. Tax and accounting literature on this topic is available, including a review of research in accounting for income taxes by Graham, Raedy, and Shackelford (2012), in which the authors argue that this is a complex area of financial reporting because the rules and principles that govern accounting principles are sometimes different from those that govern income tax reporting. Still, it is possible to measure the difference between the two concepts.

The leading indicator in this accounting literature is the book-tax conformity, which is a measure of the scale of alignment between tax and financial reporting. Proposals for increasing book-tax conformity argue that the dual system in the US has enabled firms to simultaneously manage their taxable income downwards and their book income upwards. Hanlon and Maydew (2009) discuss the implications of this for MNCs. Their simulations, conducted using US data, indicate that, under book-tax conformity, the tax base would be broadened. Hanlon, Maydew, and Shevlin (2008) acknowledge that increasing book-tax conformity could curtail both earnings management and aggressive
tax planning, but empirically find that it could also result in a decrease in how informative the firms’ accounting earnings are. With financial reporting data limited to our data sources—and no information acquired on the basis of tax accounting—we are left with a potential bias in the data that we use for tax, but we cannot quantify or control that bias with the available data. The scale of this bias is hinted at in a recent paper that uses UK tax returns data and compares it with accounting data. Bilicka (2019) finds that the ratio of taxable profits to total assets reported by foreign multinational subsidiaries is half that of comparable domestic standalones and that the majority of the difference may be attributed to the fact that a higher proportion of foreign multinational subsidiaries report zero taxable profits. She documents how the estimated difference is related to profit shifting and shows that using accounting data leads to much smaller estimates of the difference.

In addition to the data sets used here, data sets with potentially relevant information on US MNCs do exist, but are not directly used in our paper for two different reasons. First, at least two data sources are available only to US government workers or US citizens with approved access: confidential firm-level information from the US governmental Bureau of Economic Analysis’ foreign affiliate statistics (e.g. Blonigen, Oldenski, and Sly, 2014) and tax returns data from the IRS (e.g. Dowd et al 2017, whose estimates are used for comparison purposes below). These two data sources have a number of clearly advantageous characteristics (i.e. full, company-level data sample) which are discussed in detail in published research which does make use of them. However, since these data sources are not readily available to researchers and indeed are unavailable to foreign researchers (we do not have access to them), we do not include them in our comparisons. Second, IMF and United Nations Conference on Trade and Development each publish country-pair or country-level data on foreign direct investment. These foreign direct investment stocks only partly reflect the activities of US MNCs, since other investments such as private equity (Mesias, 2015, p. 17) or collective investment institutions (OECD, 2008, p. 23) are included in FDI statistics as far as their basic FDI criteria are met. For these reasons we consider the above mentioned data sources impractical for inclusion in our comparisons or empirical analysis.
6.3 Methodology

For each pair of examined data sets, we start by visualizing the correlation for each of our indicators: profits, taxes, revenue, number of employees and assets. This exercise enables us to understand which data sets are comparable and to detect outliers. We then analyse the difference in the total value of the indicators in selected geographic regions, which provides us with information about regions for which a given data set is most suitable. Next, we analyse ETRs and misaligned profit—described in detail in sections 3.1 and 3.2. These indicators are established in academic literature and fall into three groups of measures of tax burden, profits relative to economic activity and other, as discussed by OECD (2018). Finally, we analyse the relationship between misaligned profit and ETRs. Various methodological dilemmas associated with examined indicators, emerging in the case of each of the data sets, are dealt with as systematically and openly as possible. For example, in the case of IRS CBCR data we have the option of either using the data set for all MNCs or only the data set for those with positive profit before income tax. While the former data set is more comparable with BEA, the latter might suffer from a practice where MNCs prefer to report losses in countries with high taxes, while locating their profits in countries with low taxes, which would bias the sample in favour of MNCs with positive profits only. On the other hand, the calculated ETRs of the latter dataset are more robust to yearly fluctuations. On balance, we use both data sets, but we adopt the latter as a standard for comparisons with other data sources.

6.3.1 Effective tax rates

We estimate ETRs at country level as an indicator of the amount of taxes paid by MNCs in various countries. We estimate ETRs as consistently as possible across a range of data sets. For example, in the case of Orbis, ETRs are calculated using the unconsolidated accounts of foreign entities of US MNCs, as described in Janský (2019), and in contrast to ETRs using consolidated company data as in, for example, Garcia-Bernardo, Janský, and Tørslo (2019). For each US MNC affiliate in the Orbis data, we divide accrued corporate income tax by gross income to calculate their ETR. We then use a weighted average of these ETRs to arrive at a country-level ETR for all MNC affiliates in a given country. We estimate ETRs using unconsolidated company data for firms $f$ in country $c$ and year $t$ in the following way:
Effective tax rate $\text{Etr}_{ct} = \frac{\sum_{f \in c} \text{Corporate income tax}_{fct}}{\sum_{f \in c} \text{Gross income}_{fct}}$, where the sum of corporate income tax is the sum of unconsolidated taxes accounted for in the balance sheets of MNC affiliates located in country $i$. Also, the sum of gross income is the sum of these taxes and unconsolidated net income accounted for in the balance sheets of the MNC affiliates located in country $c$ (definitions in the various data sets are detailed in Table 6.1 above and Table A2 in the Appendix). This provides us with a weighted average of the company-level ETRs of MNC affiliates located in country $c$. While we focus on a specific country $c$, the US (domestic), we also estimate ETRs for other countries $c$ with available data (and presenting a weighted average of these in the results section (foreign) for comparison. For Orbis we carry out this aggregation from company- to country-level ourselves, whereas for BEA, IRS CFC and IRS CBCR we only have access to already aggregated country-level information.

ETRs estimated using unconsolidated data enable us to study how much the ETRs that US MNCs face differ across countries or from statutory tax rates (CIT). When compared with statutory rates, ETRs reveal the effect of tax deductions (including tax holidays and other ad hoc arrangements) and other tax provisions that co-determine tax paid by MNCs and how they differ across countries. For example, if an MNC affiliate makes use of tax incentives or is granted an advantageous tax ruling, then its ETR is bound to be lower than the statutory rate.

Effective tax rates also differ depending on whether taxes are accrued or paid. In financial accounting, the difference between the two corresponds to deferred taxes (accrued taxes that are not paid). US MNCs were taxed by the US government on their worldwide income, but they were able to defer such taxes by keeping profits offshore (typically in conduit tax havens). According to IRS CBCR data, US MNCs deferred a total of $14.9$ billion in 2016, which reduces ETR from $18.9$% to $17.4$%. For other countries, the differences between ETRs calculated using tax paid and tax accrued are small (Figure A2 in the Appendix), since deferred taxes correspond to only a small fraction of all taxes. The relatively small difference might also result from deferred liabilities and assets offsetting each other when aggregated across MNCs.
6.3.2 Misaligned profit

The misaligned profit indicator shows the difference between the location of MNCs’ profits and the location of those MNCs’ economic activity. As such, it helps us shed light on the upper bound of profits which might be artificially shifted from where economic activity takes place to other countries. The methodological approach we employ here draws on Janský (2017) and builds on existing literature. For example, Tørsløv et al. (2018) use the ratio of pre-tax corporate profits (net of interest and depreciation) to employee compensation as their main profit shifting indicator. We use the misaligned profit measure as in Cobham and Janský (2019), which operationalises what the OECD stated when it launched its BEPS initiative in 2013 with the specific aim of reforming international corporate tax rules so that they “better align rights to tax with economic activity” (OECD 2013: 11). The following formula shows how we estimate MNCs’ misaligned profit for each country $c$ and year $t$:

$$
\text{Misaligned profit}_{ct} = \frac{\text{Economic activity}_{ct}}{\sum_c \text{Economic activity}_{ct}} \cdot \sum_i \text{Profit}_{ct} - \text{Profit}_{ct},
$$

where profit is gross profit (the sum of net income and income taxes, summed up from positive values of all companies in the case of company-level data) and total global profit is the sum of all profit across all countries. The share of economic activity is estimated using either revenues, tangible assets, number of employees, wages, or a combination of those indicators for the given country, divided by that indicator’s global total.

Our estimation of misaligned profits enables us to simulate the distribution of profits in case they were allocated in line with the indicators of economic activity, commonly known as formula apportionment or unitary taxation. One of the most important reforms, the Common Consolidated Corporate Tax Base (CCCTB), was proposed by the European Commission (2011) and European Commission (2016). Under the CCCTB, economic activity is estimated as one-third tangible assets, one-third sales, and one-third split equally between compensation costs and a number of employees. Let us make two brief notes on how we operationalise the CCCTB estimates. In the case of sales we use information on where the sales are reported rather than the otherwise preferred information on the location of the final customer, especially since data are
usually available only on the former. Also, since we do not have information on employee compensation costs for most data sets, we approximate employee compensation costs as the product of the number of employees and GDP per capita, which—given the lack of available data—is a rough but reasonable assumption. We use this as our preferred formula and we refer to CCCTB below for this specific combination of economic activity indicators. Additionally, we provide results for components of economic activity other than the preferred CCCTB combination, i.e. individual indicators of sales, tangible assets, total assets, employment and compensation. This enables us to understand which countries would benefit from increasing the weight of a specific component, and which components more closely reflect the current allocation of profits across countries.

6.4 Results

In the results section, we begin by studying descriptive statistics and empirically comparing the most relevant available data sets on US MNC. We then move on to effective tax rates and misaligned profits and, ultimately, their combination using the IRS CBCR data.

6.4.1 Descriptive statistics

For the most part, we find that the data sets are strongly correlated with each other, but we also highlight a number of empirical differences between them (Figure 6.2). The correlation between CBCR, BEA, BEA 2, and Eurostat for the number of employees, turnover and tangible assets is very high (88–99%) for all combinations (Fig. 6.2A–C). The correlation between Orbis and CBCR or BEA data is lower, between 51 and 79%. However, the correlation between Eurostat and Orbis* is very high (97% for employees and 96% for turnover), which indicates that the data in Orbis is good for European countries. The correlation between all data sets for profits is lower although still high (75–87%) (Fig. 6.2D), likely because the different databases use different definitions of profits (see Table 6.1). For taxes, we once again see excellent correlation between CBCR and BEA (93–100%), while Orbis has moderate correlations (62–72%). The correlation between IRS CFC and IRS CBCR is moderate, however, unlike the case of Orbis, this is caused by only four large outliers: the Netherlands, Luxembourg, Bermuda and Cayman Islands (Fig. 6.2E). The correlation without the four countries increases to 92%. Since the IRS CFC data
Figure 6.2. Correlation between the data sets. IRS data on companies with positive profit (CBCR*), IRS data on all companies (CBCR), IRS data on all CFCs with positive profits (CFC*), BEA data (BEA), BEA data without income cost adjustment (BEA 2), Eurostat data and Orbis data on companies with positive profits (Orbis*). The correlation is visualized for the five indicators analyzed: (A) Employees, (B) Turnover, (C) Tangible assets, (D) Profits, and (E) Taxes accrued. For each of the colored squares, representing the correlation between CBCR* and other databases, a scatter plot showing the outliers is shown.
included foreign entities owned by US persons (corporations and individuals), this indicates that foreign entities of non-corporations are more predominant in those jurisdictions than foreign entities of MNCs.

Next, we analyse the correlation between our base data set (CBCR*) and all other data sets (Fig. 6.2, scatter plots below each correlation matrix), which provides information about which databases provide consistent estimates for which countries. In general, we see that most countries lie close to the diagonal. However, that is not the case for Orbis, for which several countries are covered less thoroughly. For tangible fixed assets, some countries have higher coverage in Orbis compared with other databases. This is due to the use of fixed assets instead of tangible fixed assets in Orbis (Table 6.1), which includes intangibles and overestimates the assets in countries where holding companies are typically situated (e.g. United Kingdom, Ireland, the Netherlands, Belgium).

Since the differences between the data sets seem to be linked to specific regions (e.g. South America), we continued by investigating the coverage at the regional level (Figure 6.3). For this, we visualize the share of the CBCR* data that is present in other data sets (1 corresponds to equal coverage). At first sight, we observe substantial heterogeneity in the observed data coverage. For example, Orbis* has almost no coverage of most information in Africa, South-East Asia, Latin America and the Middle East, while it is comparable, largely together with BEA, BEA 2, and Eurostat, for most variables for the EU member states. For North-East Asia and Canada, Australia and New Zealand, Orbis* contains approximately 2/3 of the information present in the other databases (with the exception of Canada, for which Orbis* has poor data). Comparing BEA and CBCR to CBCR*, we see that BEA and CBCR usually contain higher revenues, employees, assets and taxes. This is expected since both samples include all companies, while CBCR* includes only companies with profits. The increased coverage in BEA and CBCR is more marked for Africa, the Middle East, CA/AU/NZ, and especially offshore financial centres. As expected since using “profit-like returns” underestimate the profits that have been shifted, the coverage of profits in BEA is only 12.7% in such countries, while for other regions it is within 32% (Middle East), 18% (Africa) or 13% (other regions) of the CBCR data. This is corrected in the BEA 2 data, which uses “Income without current-cost adjustment” similarly to Clausing (2019). Finally, since IRS CFC data includes all US persons, it generally exhibit higher coverage than IRS CBCR.
Figure 6.3. Differences between samples by region. Aggregated values of IRS data on companies with positive profits (CBCR*) compared with the following data sets: IRS data on all companies (CBCR), IRS data on all CFCs with positive profits (CFC*), BEA data (BEA), BEA data without income cost adjustment (BEA 2), Eurostat data and Orbis data on companies with positive profits (Orbis*) samples. Coverages below one (shaded in green) indicate higher values in the CBCR* data set. The list of countries by region can be found in the Appendix. Note that the BEA sample is more comparable with CBCR (not CBCR*), since both samples include all companies, including those with negative profits. Orbis uses fixed assets instead of tangible assets, which leads to the overestimation of assets in (A).
6.4.2 Effective tax rates (ETRs)

Having compared the raw indicators, we now focus on our first derived variable: ETRs (taxes accrued over profits). For ETRs, we include two extra data sets. The first data set (Dowd et al, 2017) uses micro-data from confidential tax returns to calculate ETRs for individual companies, and also calculates the average ETR after discarding the 5% most extreme observations (we use the two most recent years included in the study, 2010 and 2012). The second data set, with statutory corporate income tax rates collected from various sources by Janský and Palanský (2019), includes the statutory corporate income tax rates (CIT in Figure 6.4) for the year 2016.

We begin our analysis by calculating the ETRs for US subsidiaries of US MNCs (domestic) and, in addition, for foreign subsidiaries of US MNCs (Table 6.2). We find large differences between the databases regarding domestic tax rates. The completeness of Orbis is only around 1% for both profits and taxes, but the estimated tax rates are the closest to CBCR data. BEA includes multinationals with large domestic presence, and both the profits ($1,077 B) and taxes accrued (306B) are larger than evidenced in the other databases. CBCR yields lower estimates for profits than Compustat ($472B compared with $867B), but similar estimates for taxes accrued ($151B compared with $185B). The effective foreign tax rates are closer, ranging from 10.7 to 24%. Here, the completeness of Orbis is around 80% for both profits and taxes accrued. BEA data once again produces larger reported profits ($536B) and taxes accrued ($103B). CBCR yields similar estimates for profits when compared with Compustat ($437B compared with $438B), but lower levels of taxes accrued ($85B compared with $119B). BEA 2 and IRS CFC data produce comparable profits ($896B and $1093B) and taxed accrued ($103B and $116B) to those yielded by IRS CBCR.

We next disaggregate foreign effective tax rates at the country level. The correlation between data sets decreases to 29–57% (Fig. 6.4A). The lower correlation is between the CBCR* and BEA databases is particularly surprising given the quality of both data sets. However, the correlation increases with the

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<th>CBCR*</th>
<th>CBCR</th>
<th>CFC*</th>
<th>BEA</th>
<th>BEA 2</th>
<th>Orbis*</th>
<th>Compustat</th>
</tr>
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<tbody>
<tr>
<td>Domestic</td>
<td>18.9%</td>
<td>21.4%</td>
<td>-</td>
<td>28.5%</td>
<td>-</td>
<td>19.4%</td>
<td>32.0%</td>
</tr>
<tr>
<td>Foreign</td>
<td>11.6%</td>
<td>17.5%</td>
<td>10.7%</td>
<td>19.4%</td>
<td>11.6%</td>
<td>19.0%</td>
<td>24.0%</td>
</tr>
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</table>

Table 6.2. Foreign and domestic tax rates from different sources
Figure 6.4. Estimates of effective tax rates  (A) Correlation between IRS data on companies with positives profits (CBCR*), IRS data on all companies (CBCR), IRS data on all CFCs with positive profits (CFC*), BEA data (BEA), BEA data without income cost adjustment (BEA 2), Orbis data on companies with positive profits (Orbis*), tax returns data from IRS (Dowd et al) and statutory corporate income tax (CIT) rates. (B) ETR by region. The tax rate is unweighted for all but Dowd et al and CIT, since data on profits and taxes by region is unavailable for those data sets. (C–G): Correlation between CBCR* and (C) CIT rates, (D) CBCR, (E) BEA, (F) Orbis*, and (G) Dowd et al. Countries where the estimations differ by more than 50% are annotated.
BEA 2 data, which includes shifted income to shell companies. The average tax rates for all regions are within 5 percentage points, with the notable exceptions of Africa and offshore financial centres (Fig. 6.4B). In general, the correlation is affected by the presence of outliers (Fig 4C–G). In the comparison between CIT (Fig. 6.4C) and CBCR* those outliers are caused by large tax deductions in some countries (e.g. Luxembourg, the Netherlands, Puerto Rico, Panama, Switzerland), as well as by fluctuations in the 2016 profits earned in some countries (e.g. Austria, Venezuela and Greece are outliers in all comparisons). Another reason for the variation is the secrecy of some jurisdictions (Cayman Islands, Panama, Luxembourg), which produces an overestimation of the tax rates for offshore financial centres in all data sets, and especially in Orbis*.

6.4.3 Misaligned profits

We continue by calculating the misaligned profits using the formula proposed by CCCTB to calculate economic activity (1/3 tangible assets, 1/3 revenue, 1/6 number of employees and 1/6 wages). Figure 6.5 provide estimates of misaligned profit using our data sets for the top 10 countries with the highest missing (negative) and excess (positive) profits. The largest trading partners of the United States, including Canada, Australia, China, Brazil are, consistently across the data sets, among the countries with the largest negative misalignments (Fig. 6.5A), i.e. where more profits should be reported if they were perfectly aligned with economic activity.

While the estimations of misaligned profits are consistent across databases, the estimations of excess profits are more variable, partly due to the low availability of data in BEA (e.g. the Bahamas) and Orbis (most countries in the list). However, some clear patterns do emerge; the Netherlands, Ireland, Bermuda, Puerto Rico, UK Caribbean (mainly Cayman Islands and British Virgin Islands), Singapore, Switzerland and the Bahamas are the countries with the highest excess profits (Fig. 6.5B). Unsurprisingly, given the use of fiscally transparent entities and entities with no tax jurisdiction in tax avoidance strategies, Stateless also appears among the top jurisdictions for positive misaligned profits, but we are not able to draw any firm conclusions regarding this category before

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1Including the United States in the analysis would reveal that the country with the largest negative misalignment is the United States (Fig. A4). We chose to exclude the US from the analysis because 2/3 of US multinationals’ total activity is domestic, which greatly distorts the total revenues, assets and employee numbers and thus also the calculation of misalignment profits for all other countries.
further clarifications from the IRS since Stateless could, for example, include any amount of pass through income that should have actually been reported in the US or another country, which would have changed our estimates. Except for Stateless, these results are consistent across the data sets with at most one of them showing in the other direction (such as the negative estimate for Switzerland using CBCR with negative profits included). The only surprising country in the list is Japan, which has high ETRs. These results are consistent with other US-centred studies such as Zucman (2014) and Cobham and Janský (2019a), which point to a similar set of tax havens using only the BEA data.

Figure 6.5. Top 10 countries with the largest negative (A) and positive (B) misaligned profits. (A) Negative misalignment. (B) Positive misalignment. The misalignment profits are calculated using the CCCTB formula, where the location of assets, revenue, employees and wages determines the expected location of the profits. The databases used were: IRS data on companies with positive profits (CBCR*), IRS data on all companies (CBCR), IRS data on all CFCs with positive profits (CFC*), BEA data (BEA), BEA data without income cost adjustment (BEA 2), Orbis data on companies with positive profits (Orbis*). The location of the accumulated earnings (divided by 10) is marked in brown (CBCR* (acc. Earn.).

The IRS CBCR data also provides us with information about accumulated earnings (the cumulative amount of foreign earnings designated as “indefinitely reinvested” for which no accrued income tax expense is recorded on the financial statements). We use this information to obtain a long-term perspective on the location (Fig. 6.6B), finding that indefinitely reinvested profits accumulate in the same locations as excess profits, with the exceptions of Singapore, the Bahamas and Japan.
The higher granularity of the CBCR data enables us to learn about some of the geographically smaller tax havens. For example, the CBCR data provides information separately for the Cayman Islands and the British Virgin Islands (while BEA aggregates them into "UK Caribbean"). Thanks to this, we can observe that the Cayman Islands are more important than the British Virgin Islands in terms of misaligned profit. Similarly, Puerto Rico is not treated separately in BEA but comes out as one of the jurisdictions with the highest excess profits in the IRS CBCR, second only after the Stateless category. Puerto Rico’s importance can be traced to the pharmaceutical industry (see for example Tørsøv et al., 2018).

The CCCTB formula tries to account for the main components of real activity. However, different formulas allocate profits to different places. Table 6.3 shows the most advantageous factor (or least disadvantageous) for each country. If profits are allocated according to revenue, the countries where MNCs book their sales would benefit (e.g. Switzerland, Ireland, Singapore, Hong Kong); this would also be a less disadvantageous option for some important tax havens (e.g. Bermuda, Cyprus, UK Caribbean, the Netherlands). Among the countries that increase their profit share across all bases, the most advantageous factor is always either number of employees or wages, where highly developed countries prefer wages and all others prefer employee numbers. The findings suggest that (tangible) assets would be favoured by a number of countries that are rich in natural resources (e.g. Nigeria, Qatar, Chile, Norway) as well as some other countries such as Bangladesh and Thailand. Overall, these results are relevant for the European Commissions’ CCCTB proposals and, more recently, OECD’s (2019) ongoing work on the so called Pillar One, which focuses on the allocation of taxing rights. Even more generally, our results highlight why some countries might be in favour of specific proposals, assuming they are incentivised by increased tax base in the form of profits.

6.4.4 Relationship between ETR and misaligned profits

We now test the hypothesis that low ETRs are correlated with higher excess profits and we thus investigate the relationship between the variables observed so far. Figure 6.6A plots misaligned profit as a share of allocated profits using the CCCTB formula. Countries below the zero line are missing profits, while countries above the zero line have excess profits. The size of each country is proportional to the total misaligned profits. This enables us to see that
<table>
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<th>Turnover</th>
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<td>Cyprus</td>
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<td>Netherlands</td>
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<td>Singapore</td>
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<td>Hong Kong</td>
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<td>Panama</td>
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<td>Belgium</td>
<td>India</td>
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<td>Assets</td>
<td>Vietnam</td>
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<td>Luxemborg</td>
<td>Saudi Arabia</td>
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<td>Nigeria</td>
<td>Argentina</td>
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<td>Jersey</td>
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<td>Ireland</td>
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<td>Egypt</td>
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<td>UAE</td>
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Table 6.3. Most advantageous component of the CCCTB formula by country.
the excess profit in UK Caribbean is larger than the missing profits in any of Canada, Germany, Mexico or China, despite the former having less than 150,000 inhabitants while the latter have populations of between 37 and 1300 million.

Given the extreme outliers in the data, we tested our hypothesis that lower ETRs are positively correlated with higher excess profits using a logistic regression, where the dependent variable is a dummy variable indicating whether the misalignment is positive (Fig. 6.6B). We find that all (7/7) countries with ETRs below 11% and absolute misaligned profits above one US billion have positive misaligned profits. In terms of coefficients, increasing the ETR by one percentage point decreases the odds-ratio by 0.40 units (CI [-0.67,-0.13]), while the correlation is weaker for CIT: increasing the CIT by one percentage point decreases the odds-ratio by 0.10 units (CI [-0.19,-0.01]). This was expected, since large shares of the missing profits are located in countries with relatively large CITs but also large tax deductions on profits derived from loans and intangibles, products that are typically used by MNCs to shift profits.

Finally, we perform the same analysis using accumulated earnings (Figure A3 in the Appendix). Unsurprisingly, given the correlation between the location of excess profits and accumulated earnings, we find that the ETR alone explains a large fraction of the variability in the data.

6.5 Conclusion

When the effects of the 2017 US tax reform on US MNCs are discussed in the future, there should be ample evidence available based on the newly published country-by-country reporting data. These CBCR data, released for the first time in December 2018 for the year 2016, promise to capture the reform's effects on profit shifting across various countries well. In this paper, we have compared this new data source with other available, more established data sources on US MNCs while also providing new estimates of effective tax rates, misaligned profit and their interrelationship.

Our results answer two research questions. First, we have identified the most important tax havens for US MNCs—where high profits are misaligned with economic activity—as countries with low effective tax rates. These include Bermuda, Ireland and The Netherlands, confirmed across most of our
6.5. Conclusion

Figure 6.6. Correlation between ETR and misaligned profits (A) Relationship between the ETR and profit misalignment (measured as profits in excess of expected profits). Note that countries with the highest positive misalignment tend to have lower ETRs. (B) Relationship between ETR and the probability of positive misalignment. (C) Relationship between CIT and the probability of positive misalignment for countries with at least USD 100 million absolute misalignment. Line indicates the modelled logistic regression and shaded area indicates 95% confidence intervals calculated from 1000 bootstrap samples. Countries in (B) and (C) have been slightly moved vertically to improve legibility. The confidence intervals for the coefficient of ETR/CIT are (B) [-0.67, -0.13] and (C) [-0.19, -0.006].
datasets. Moreover, we have revealed how sensitive formula apportionment is in making these observations. We have established that if profits were allocated according to revenue, countries where MNCs book their sales would benefit (e.g. Switzerland, Ireland, Singapore, Hong Kong), and that this scenario would also be less disadvantageous for several important tax havens (e.g. Bermuda, Cyprus, UK Caribbean, The Netherlands). While revenue would favour tax havens, such formula apportionment might still be favourable to the current status quo. Existing literature stipulates that agreement on a specific formula would be difficult; we thus also provide a quantification of the challenges ahead. In answer to our secondary question, we have found that the IRS CBCR data, in particular when published as a full sample in the future, are conceptually superior in some respects, such as country coverage, to existing datasets. Furthermore, we have indicated that they differ substantially when compared empirically.

Our results are relevant and timely for recent and ongoing policy debates at OECD, both Pillars One and Two discussed recently by OECD (2019), and elsewhere, including those that consider the potential introduction of effective minimum taxes on MNCs’ profits. In view of the low ETRs we have observed for many countries and their negative correlation with misaligned profits, one form or another of global minimum tax, which is a part of Pillar Two proposal, might be worth exploring. On the basis of presented evidence we have not been able to clarify what form this should take or what effects an implementation of this proposal might have. However, our research clearly highlights a need for the determination of specific data sources and explicit definition of rates, ETRs or otherwise, as an integral part of future policy debates.

In addition to these policy aspects, at least two promising areas for further research associated with profit shifting using this combined data set based on leading data sources have emerged. First, while a majority of existing economics literature on profit shifting by MNCs estimates the semi-elasticity of reported profits with regard to tax rates, this kind of analysis could be revisited using all currently available data sets. Second, general literature on the determinants of foreign direct investment (e.g. Djankov, Ganser, McLiesh, Ramalho, and Shleifer, 2010, Economou, Hassapis, Philippas, and Tsionas, 2017) could be revisited in the light of the newly available data. For example, our various
estimates of ETRs might be employed instead of the traditionally used statutory rates.

References


Relationship between ETR and misaligned profits


United States Joint Committee on Taxation. (2014). *Technical explanation, estimated revenue effects, distributional analysis, and macroeconomic analysis of the Tax
6.5. Conclusion


CHAPTER 7

The Effect of Profit Shifting on the Decline of Effective Tax Rates of Multinational Corporations

This chapter builds on the previous analysis of profit shifting and develops a framework to decompose the decline of effective tax rates for both E.U. and U.S. MNCs. We find that effective tax rates have decreased in the last decade by 9.7% and 7.1% respectively, and that both the tax rates on profits made domestically and abroad have declined similarly. We show that the majority of the decline in tax rates is explained by falling statutory tax rates and tax bases, and increased profit shifting only accounts for between 5% (E.U. MNCs) and 30% (U.S. MNCs) of the decline in effective tax rates. Importantly, profit shifting has increased the most to Switzerland (4.2 percentage points), the Netherlands (4.0 percentage points), Ireland (3.3 percentage points) and Singapore (2.7 percentage points). Compared with 2005, an extra 14.2% of the global profits of U.S. MNCs are booked in those four coordination centers, which highlights the growing importance of those jurisdictions. As mentioned in the previous paragraph, the growing importance of coordination centers may intensify tax competition. While increased profit shifting explains only up to one third of the decline in effective tax rates, the reduction in statutory tax rates and tax bases can be a response to profit-shifting-promoted tax competition. In this sense, our analysis coincides with the implications of Keen et al. (2014), which shows that the revenue losses to governments from tax competition are potentially four to six times larger than that from profit shifting itself.
This chapter is adapted from Garcia-Bernardo, J., Torslov, T. & Jansky, P. (2019). Decomposing Multinational Corporations’ Declining Effective Tax Rates (No. 2019/39). Charles University Prague, Faculty of Social Sciences, Institute of Economic Studies. The entire (non-proprietary) data and code can be found at https://osf.io/nu42h/
Abstract

We develop a new methodology to decompose the observed decline in multinational corporations’ (MNCs’) effective tax rates into profit shifting to tax havens and several other components. We apply this methodology to the best available data for MNCs headquartered in the US—from the Bureau of Economic Analysis—and in the EU—from Orbis—and we arrive at three main findings. First, we estimate that between 2005 and 2015 increased profit shifting directly explains only 30% and 5% of the 7 and 9 percentage point declines in effective tax rates for US and EU MNCs, respectively. At the same time, we note that profit shifting might explain more of the decline indirectly, through its effects on domestic taxation, i.e. taxation of MNCs in their home country; this is responsible for more than 50% of the overall decline in effective tax rates for both US and EU MNCs. Second, we find that US MNCs have primarily benefited from domestic tax base reductions, most of which can be explained by sectoral changes, while the statutory rate remained constant. Third, we show that EU MNCs have mainly benefited from falling domestic statutory rates and we observe similar patterns across EU home countries, host countries and sectors. Overall, while we confirm that profit shifting is increasing in scale, we also highlight that it may have even more prominent indirect effects.

7.1 Introduction

In the past few decades, public and academic awareness of tax avoidance by multinational corporations (MNCs) has increased dramatically. During the 2010s the Lux-Leaks (ICIJ, 2014) and Paradise Papers (ICIJ, 2017) revealed how MNCs such as Apple and Amazon had been avoiding virtually all foreign taxes using subsidiaries in countries such as Ireland and Luxembourg. Recent studies show that these cases are not unique, but part of a systematic pattern. The amount of profits shifted to tax havens is $600-$1100 bn. every year, according to some of the latest studies (e.g. OECD, 2015; Clausing, 2016; Tørslov, Wier, and Zucman, 2018; Janský and Palanský, 2019). This corresponds to around 10% of global profits or 40% of all MNCs’ non-headquarter-profits being shifted to tax havens without a corresponding shift in the location of assets, employees or turnover.
Increases in profit shifting are likely to lead to reductions in MNCs’ consolidated effective tax rates (ETRs), defined as their global tax payments divided by global profits. The existing empirical evidence points mostly separately to these two phenomena—increasing profit shifting and declining ETRs—occurring concurrently over the past few decades. And it is thus not yet clear how much of that observed decline in ETRs can be explained by the increased profit shifting and how much it is driven by other factors, such as changes in statutory tax rates, tax bases or sectoral composition. Related questions, such as how much corporate income tax MNCs actually pay and where and how this develops over time, also lack definitive answers to date.

In this paper we ask the question of what is behind the observed decline in MNCs’ ETRs. In order to investigate the decline, we develop a framework for decomposing the MNCs’ consolidated ETRs. This formalised and systematic framework enables us to decompose all of the decline in MNCs’ ETRs into meaningful components. It thus enables us to understand whether the decrease in ETRs is caused by a decrease in domestic taxation, i.e. the tax that MNCs pay in their home country—the country where their headquarters are located, by a decrease in foreign taxation, i.e. the tax that MNCs pay in their host countries—countries in which their foreign affiliates are located, or indeed by an increase in profit shifting or few other minor factors we describe below. Moreover, our framework enables us to decompose changes in ETRs into changes in the statutory tax rate and changes in the tax base, i.e. the share of profits taxed at the statutory tax rate. For simplicity, we label all changes that result in lower ETRs and are not changes in the statutory rate as reduced tax bases. These reduced tax bases could arise for a number of different reasons, including new tax holidays or increased tax breaks for research and development. Even the best available data at our disposal lack the needed detail to distinguish between these different reasons for reduced tax bases, but otherwise the data do allow for a detailed decomposition.

Specifically, we decompose the decline in MNCs’ ETRs into eight components. A decline in ETR could occur due to changes in domestic taxation, either through reductions in the domestic statutory rates (first component) or thanks to a reduced domestic tax base (second). Similarly, there could be changes in foreign taxation either in terms of the foreign statutory rates (third) or foreign tax bases (fourth). Another component is the possibility of changes in profit
shifting (fifth), defined as a change in the location of foreign profits that results in lower taxation. Also, let us note that in the decomposition, profit shifting includes genuine movement of activities as well as artificial shifting of profits since we do not attempt to separate these two practices given the limitations of the data. The other, final three components, which turn out to be mostly of minor importance, are: globalisation (sixth), which captures any increases in foreign profits at the cost of domestic profits; residual (seventh), which reflects the fact that changes in foreign and domestic taxation occur at the same time as their relative weights change; and, finally, changes in unobserved profits (eighth), which explain any observed decline due to unobserved profits in one of the data sources. In addition to this main eight-component decomposition, we provide decompositions considering individual home countries separately as well as a group (i.e. the EU), analysing the influence of individual host (foreign) countries, and into account changes in sectoral compositions.

We apply this decomposition framework to data on MNCs headquartered in the US (US MNCs for short thereafter)—from the Bureau of Economic Analysis—and in the EU (EU MNCs)—from Orbis—between 2005 and 2015 and reveal three main findings.

First, we show that profit shifting is on the rise, but it is far from being directly responsible for all of the observed decline in MNCs’ ETRs. Looking at the trends in ETRs since 2005, we see that the overall ETRs have declined by 7.1 ppts for US MNCs and by 8.7 ppts for their EU. We estimate that between 2005 and 2015 increased profit shifting to tax havens directly explained only 30% of the decline in ETRs for US MNCs and 5% for EU MNCs. However, profit shifting may have explained more of the observed decline in ETRs indirectly, through its knock-on effects on both domestic and foreign taxation.

Second, we find that US MNCs have primarily benefited from domestic tax base reductions, i.e. in the US. Of the 7.1 ppts reduction in ETRs, we find that 3.9 ppts are due to changes in the taxes paid on profits booked in the US. The remainder is explained by reductions in statutory tax rates abroad (1.5 ppts), and by profit shifting towards foreign affiliates with lower taxation (2.1 ppts). This means that 30% of the decrease in the US MNCs’ ETRs since 2004 is directly linked to profit shifting. The bulk of the reduction in ETRs can be explained by US MNCs paying less tax on the profits they earned in the US,
Effects of Profit Shifting in Corporate Taxation

despite the statutory tax rates remaining constant during this period. Moreover, we find in an additional sectoral decomposition analysis that MNCs’ sector composition changes explain slightly more than a half of the observed decline in US MNCs ETRs, primarily as a result of increasing importance of the finance and insurance sector, which might indicate a real sectoral shift or profit shifting. This identified importance of sectoral changes for declines in US MNCs’ ETRs is in line with Barrios & d’Andria (2016), who use Orbis data to show that profit shifting elasticities have a strong industry-specific component, although we do not find such importance for EU MNCs, as well as more recent analysis by Janský (forthcoming) showing industry heterogeneity in tax havens with BEA data for US MNCs.

Third, when applying the framework to the EU MNCs in the same period, we find that 3.4 ppts of the 8.7 ppts decrease in their ETRs is driven by changes in statutory taxation in these MNCs’ home countries. Changes in domestic tax bases account for 2.5 ppts, changes in foreign countries’ statutory tax rates 0.8 ppts and changes in foreign tax bases 0.9 ppts. Changes in unobserved profits account for 1.3 ppts. Similar to what we observed for US MNCs, profit shifting only directly explains a minority of the observed change in ETRs (0.4 ppts). Overall, we show that EU MNCs have mainly benefited from falling domestic statutory rates and we observe similar patterns across EU home countries, host countries and sectors. We observe no substantial differences neither across individual EU member states nor across host countries EU MNCs invest in. Also, taking into account changing sectoral composition over time does not explain much of decline in ETRs in terms of domestic taxation and actually is increasing foreign taxation for EU MNCs.

Our findings are consistent with tax competition between countries. When trying to compete for MNCs’ operations and profits, countries generally use two categories of tax incentive tools: reductions in their statutory tax rates (usually thought to be important for the intensive margin of tax competition), or increased permitted deductions to the tax base (usually thought important for the extensive margin of tax competition). Using data on OECD-countries, Devereux and Sørensen (2006) find that during the ‘80s and ‘90s the effective marginal tax rate on profits (important for intensive margin decisions) only fell towards the end of the period, whereas the effective average taxation fell throughout the period. In our results, we observe two different patterns in our
two groups of EU MNEs and US MNEs. The EU member states have reduced EU MNCs’ tax payments by lowering their statutory tax rates rapidly since the ‘90s while broadening the tax bases only moderately, therefore likely reducing both the average and marginal ETRs. The US, conversely, refrained from any statutory tax changes until 2018 and instead reduced the average ETR for its MNCs by allowing firms—on average—to pay considerably lower taxes on their corporate profits despite a constant statutory rate.

While the reductions in statutory tax rates and tax bases are not directly caused by profit- or activity-shifting, such tax policies are likely affected by tax competition and these ETR reductions could thus indirectly be driven by profit-shifting (Keen and Konrad, 2012). To illustrate this, think of a world where the elasticity of capital with regard to profit taxation approaches infinity due to extreme profit shifting. In this extreme case, the optimal tax rate would be 0% and there would be no direct revenue loss due to profit-shifting. One could, however, argue that profit-shifting generates a revenue loss indirectly through limiting the use of corporate taxation. This thought experiment is used by Keen et al. (2014) in order to illustrate that the observed revenue loss is only part of the losses generated by tax competition. If all effective tax reductions were just the result of changing opinions on how to generate tax revenue—unaffected by outside pressure—this indirect loss would be zero. If, however, some share of effective tax reductions are a reaction to increasing tax competition, the indirect effects this generates should be carefully considered. Devereux, Lockwood, and Redoano (2008), focusing on OECD countries, show that a statutory tax rate reduction of 1 ppt in other countries is on average associated with a statutory rate decrease of 0.7 ppts in the home country. This suggests that countries currently react rather strongly to tax competition. Keen et al. (2014) calls this the “strategic spillover”, and underlines the importance of the losses generated by this as comparable to those observed through profit- and activity-shifting.

When we show that profit shifting in itself can explain at most 30% of US MNCs’ ETRs’ reduction during the past few decades, this means that up to 70% of that reduction could potentially be due to strategic spillovers. This ratio is not far from the extent identified in the previous literature on the levels of strategic vs. base spillovers. In what they call a highly speculative calculation based on country-level data, Crivelli, de Mooij, and Keen, (2016) find that losses through strategic spillovers are likely three times higher than direct losses due to profit
The results of our paper are based on MNCs alone; including non-MNCs could reveal that revenue losses due to strategic spillover are in fact a substantially larger share of all revenue losses. This is because when countries make reductions in their domestic tax rates in order to compete for profits and investments, those reductions affect non-MNCs as well as MNCs. This should be considered carefully when weighing the merits of the current international tax system against new proposals. Such proposals include the destination taxation proposed by Auerbach et al. (2017), or various implementations of formulary apportionment, such as the Common Consolidated Corporate Tax Base (CCCTB) proposed by the European Commission (2016) or those proposed by the OECD (2019) and the IMF (De Mooij, Liu, & Prihardini, 2019).

Our paper informs two different areas of economic literature: the literature on backward-looking ETRs for firms, and the literature on profit shifting and tax competition. Much of the literature on backward-looking effective taxation, which are ETRs estimated from data on firms as we in this paper, for example, is based on a method presented by Desai, Foley, and Hines (2004), who used the US Bureau of Economic Analysis (BEA) data to estimate ETRs as the ratio of foreign income taxes paid to foreign pre-tax income. For the sake of completeness, let us note that backward-looking ETRs differ from so-called forward-looking ETRs, which model a rate for hypothetical companies on the basis of the existing legislation often using a method developed by Devereux and Griffith (2003) and used by several other papers including Spengel et al. (2014) and Hanappi (2018). Having access to the affiliate-level micro-data behind the BEA, they are able to calculate the ETR for each affiliate and use the medians within each country as country-level ETRs. Variations of this method were later used on aggregate data (using means rather than medians) by Stewart (2014), Clausing (2016), Cobham and Janský (2019), Wright and Zucman (2018), Tørslov et al. (2018) or Garcia-Bernardo, Janský, and Tørslov (2019), among others. Whereas most of these papers only study foreign affiliates, in this paper we additionally include data on the parent country, the US, which constitutes more than half of the MNCs’ activity and value added and is therefore of key importance for the MNCs’ overall ETRs.

For EU MNCs, Orbis is the preferred data source and it has previously been used to estimate ETRs. Egger, Loretz, Pfaffermayr, and Winner (2009b), Egger, Eggert, & Winner (2010), and Garcia-Bernardo, Janský, and Tørslov (forthcoming), have
all studied MNCs’ ETRs using subsidiary-level data from Orbis or its Europe-only version Amadeus, focusing on the MNCs’ foreign owned subsidiaries. An alternative data source, Compustat, used recently by Thomsen and Watrin (2018) in a rare paper that estimates ETRs for both the US and the EU, but it does not provide information on the location of subsidiaries. We therefore use Orbis to create a data set on EU MNCs that is comparable to the BEA’s data set on US MNCs, including domestic subsidiaries. Despite still being much less complete than the US data, this enables us to cover most EU MNC activity along with the US in our analysis, which has not previously been done with these two data sources to our knowledge.

The paper also relates to a vast literature on tax competition, spanning back to the early 1980s (see Keen and Konrad, 2012, for a review), and to the more recent literature on profit shifting, including Hines and Rice (1994), Huizinga and Laeven (2008), Dharmapala and Riedel (2013), Johannesen, Tørsløv, and Wier (2017) and Wier and Reynolds (2018). The profit shifting literature has primarily been interested in the practice of shifting profits without moving real activity, and has either estimated the elasticity of corporate profits or the amount of profits moved. While the purpose of this paper is to analyse changes in corporate taxation, a back-of-the-envelope-calculation of the profit-shifting magnitude in our data puts the “excess” amount of profits located in tax havens in line with other studies at a minimum of $150–200 bn. for US firms alone (see appendix section 5). Our analysis does not find any evidence to suggest that there is less profit shifting than previous papers have found. We do, however, find that profit shifting has intensified moderately in the last two decades, and that domestic policy changes and reductions in statutory tax rates have resulted in a much larger decline in MNCs’ tax payments than the decline caused through the direct effects of increased profit shifting.

The literature on tax competition covers both competition over tangible capital and competition over reported profits and profit shifting (see e.g. Slemrod and Wilson, 2009; Hong and Smart, 2010; Johannesen, 2010; and the application in Keen and Konrad, 2012, of the model by Kanbur and Keen, 1993, on commodity tax competition to measure profit shifting). Our paper contributes by setting up a simple framework that can be used to compare the potential direct effects of profit- and activity-shifting with the effects of changes in how countries tax profits domestically. While we do not isolate the effect of profit shifting, as
defined in the literature, we identify an upper bound for its effect on ETRs over time. We find that strategic spillovers potentially affect ETRs 2 and 15 times more than the upper bound of direct profit shifting effects for US and EU MNCs, respectively. It is thus possible that the use of changes in domestic taxation in an attempt to avoid losing tax base results in much greater revenue costs than the loss of revenues through profit shifting directly.

The rest of the paper continues as follows: section 7.2 introduces the data used in our analyses, first BEA for US MNCs and then Orbis for EU MNCs, and describes the basic descriptive statistics on ETRs over time, section 7.3 provides a formal framework for the decomposition of the ETR, section 7.4 presents and discusses the results of the applied decomposition, and section 7.5 concludes.

7.2 Data description

7.2.1 Data on US MNCs: BEA—Foreign affiliate statistics

In order to describe US MNCs' ETRs, we use the BEA's “Activities of US Multinational Enterprises” dataset. It provides worldwide information on the profits and taxes paid by US MNCs and is freely available at the BEA website, from which we used, in particular, the tables “US parent companies” and “Majority-owned foreign affiliates”. This data has been published since the 1950s, annually since 1982. Every 5 years a benchmark survey has been carried out, which includes every US MNC and much richer data. The earliest year with profit and tax statistics comparable across parent-firms and affiliates, as well as across years, is the 1994 benchmark survey. This means that we can follow where profits were reported and where taxes were paid in a consistent manner from 1994 onwards.

It is important to note that due to the aggregation of the data, it is impossible to balance the “panel” of firms, in order to determine what differences are driven by changes in the sample over time. We define an MNCs as any firm with a permanent establishment abroad, permanent establishment being the legal definition of a firm's permanent base of operations. This means that in any given year, a number of new firms are included in the sample because they recently established activity abroad. Conversely, any firm that closes its last permanent establishment abroad is dropped from the sample. It should thus be noted that while the share of profits reported domestically in the US seems
quite constant over time, it could be affected by the properties of firms entering and exiting the data. Both firms that are newly active abroad and those closing their foreign activities are likely to have a high share of activity in the US. A period of rapid growth (or decline) in the number of firms in the BEA could thus underestimate (or overestimate) the share of profits booked domestically vis-à-vis a balanced panel.

Another note on using aggregate data for calculating ETRs is that in aggregate data, one firm's losses offset another firm's profits. If, in a given year, firms have large losses, the total taxable profits will be low and this will inflate the tax rate. On average, however, this should be offset by the firms that made losses in previous years and deduct these in their current profit base. There is of course the one-sided risk of firms never using their accrued deductions, e.g. due to bankruptcies. While it is important to keep these things in mind, even if tax rates are affected by such problems, this paper analyses changes over time and thus removes all level differences of the potential bias. In other words: for a bias to occur in analyses of differences over time, the above effects must be increasing or decreasing over time, since all level effects are removed.

We had to make some important choices with regard to the definitions of our variables of interest. To calculate an ETR we have to choose a common measure of profit. When creating a benchmark definition of profit, we want to avoid double-counting profits, which would lead us to excessively low estimated ETRs and a downwards-biased consolidated ETR. It is a well-known problem that the BEA-data includes profit variables (such as “net profits”) that include profits which were already taxed elsewhere, such as equity income from foreign affiliates. Any measured ETRs using such measures could be heavily downwards biased by double counting, and any changes in the ETRs over time could be due to changes in the double counting. Second, we want to be able to observe the profit measure in both subsidiaries and parent firms across time and in different tax jurisdictions. Third, we want the profit measure to come as close to a “meaningful” tax base as possible. This point will always be a matter for discussion, because there is no clear consensus about what constitutes a “meaningful” tax base. However, since we mainly want to analyse changes over time and across countries, we primarily need a constant benchmark from which we can measure deviations. This can readily be done from the BEA dataset, since its definitions of profits are defined centrally by the BEA and do not vary
in any way—e.g., do not include any country-specific definitions of profits or deductions.

To address these challenges as well as we can, we base our benchmark profit measure on the “Profit-Type Return” category from the overview tables in the BEA, similarly to Wright and Zucman (2018). We then subtract “Net interest paid” since this is usually deductible from taxable profits. “Profit-type return” in BEA is explained as: “an economic accounting measure of profits from current production”. It is gross of taxes and all capital gains/losses as well as income from equity investments. We are thus certain that these profits are not counted twice. Our measures of profits and taxes are highly correlated with other operationalizations of profits and taxes using other databases (Garcia-Bernardo et al., 2019). Our profit measure assumes that no capital gains or equity income is taxable, and that all interest expenses are deductible. The measure will be imperfect to the degree that firms are in fact taxed on certain equity investments (in such cases we overestimate the tax rates), and where thin capitalisation rules are binding (in such cases we underestimate the tax rates). On a consolidated scale, however, the tax rates will vary only as a function of changes in the location of profits, in the tax rates themselves, or in the valid deductions from taxable profits. If a country does not consider parts of this benchmark tax base to be taxable, we could see those as “deductions” from the benchmark tax base. This enables us to look at what share of profits are deducted in each country, as well as whether the tax base has been broadening or narrowing in each country over time.

In addition to a consistent profit measure, we need a good measure for taxes paid. Here we use the only information available in the BEA: “US income taxes paid” and “Foreign income taxes paid”. In addition to taxes paid on corporate income that year, “US income taxes paid” includes deferred taxes and taxes on repatriated profits. It thus includes all tax liabilities accrued in that period either upon earning or repatriating profits. Repatriation tax is a tax on foreign profits, which means that dividing by the US tax base artificially increases the domestic tax rate. On the other hand, the money is levied by the US and does not reflect taxation imposed by a foreign country. It is, to our knowledge, not possible to disentangle this repatriation tax from income tax in the BEA, which leaves us with little choice but to accept it as part of what we consider as US income tax.
When we can, we consider the average of three consecutive years rather than single years since losses in one year can be used as deductions in the following year. In the results presented below, the base period is thus “2004–2006” and the end period is “2014–2016”, consistently for both BEA and Orbis. For the BEA data, the use of consecutive years’ data in this way is only possible from 2004 onwards, because prior to 2004 the necessary data in the BEA was only included in the five-yearly benchmark surveys. Overall, throughout this paper, we use 2005 to refer to the period 2004–2006, and 2015 to refer to the period 2014–2016.

In terms of sector composition, the BEA data contains information for sectors of foreign affiliates and for sectors of US parent companies. Therefore, the BEA data enables us, similarly to Janský (forthcoming), to identify the sectors of MNC affiliates, but not the sectors of their US parent companies. Sectors of US parent companies are available only for US parent companies themselves, not their foreign affiliates. So, using the data available, we are only able to identify what sector the MNCs’ foreign affiliates operate in, knowing that these are likely affiliates of MNCs whose US parent companies are in different sectors.

7.2.2 Data on EU MNCs: Orbis

Describing EU MNCs is more challenging than describing their US counterparts, since no central statistics office collects and publishes the data required. In order to approximate the data required for such a comparison, we aggregate data from the Orbis micro-database.

Orbis is a proprietary database created by Bureau van Dijk, a subsidiary of Moody’s. It contains information on over 300 million public and private firms worldwide from a variety of country-specific data suppliers. The observational unit for MNCs is entity-year, where an entity can either be a consolidated MNC, or an unconsolidated account of a subsidiary belonging to an MNC. Our original dataset contains information on 13,330 MNCs at the consolidated level. We purposely choose to restrict the sample in order to maintain a balanced panel and as such directly study the reduction of ETRs at the MNC-level. MNCs were removed if they did not have any observable activity abroad, made losses throughout the sample period, did not have at least 50% of their consolidated profits observable in (parent + subsidiaries), or did not have at least 10 observations in the 2004–2016 period (see appendix section 3 for a more
detailed description of the data work in Orbis). This results in our final dataset containing financial information on 2,633 EU MNCs including 15,386 country-level observations and 145,095 country-year observations. We have sufficient data for 23 out of the 28 EU member states as of 2019. Compared with the original dataset, we include 30% of the profits and 33% of the taxes. As we explain in appendix section 3, we also create less restrictive data samples and use them as robustness checks.

To make the Orbis data comparable to the BEA data, we aggregate various categories of financial information. The consolidated accounts are already observed, and need not be changed. We do, however, want to describe what share of the consolidated profits are reported where, and what taxes are paid on it. This means summing up all subsidiary activities by country, which has two limitations in Orbis. Firstly, a well-known problem with using Orbis for this purpose is that the sum of subsidiary activity often exceeds the consolidated activity of the group, due to joint ventures and partial ownership of subsidiaries. If all subsidiaries were owned 100% by their so-called “ultimate owner” (or MNC), the sum of unconsolidated accounts should in theory equal the consolidated accounts. Otherwise, the consolidated accounts are incompatible with unconsolidated accounts without further work. We solve this by correcting each subsidiary’s financial information to include only the share which is owned by the ultimate owner in question (MNC).

The second limitation of Orbis is that equity income from foreign subsidiaries is included in the parents’ unconsolidated profit accounts. This inevitably leads to double counting, since they are also booked as profits in the subsidiary, but the taxes are only booked once. To correct for this, we study the operating profits when looking at EU firms; these are gross of taxes and financial profits. Leaving out financial profits enables us to avoid double-counting profits and to obtain realistic ETRs. If we had included financial profits, the result of including the equity income would be a decrease our effective domestic tax rate estimate to 13% in the EU. Avoiding double counting this way is thus a necessity, but it introduces possible new problems: our estimate of ETR will likely be inflated for any MNCs for whom financial profits constitute a significant share of their total profits. However, the consistency of our results in our robustness checks indicates that our results are not due to systematic bias or to our use of operating profits data.
Using the consolidated or global ETR lends two main advantages over studying the unconsolidated (or local) ETR. Firstly, it is the most relevant tax rate from the perspective of the MNCs, since this is ultimately what they hope to minimise through tax planning, and also the most relevant from the perspective of global public finances, since it more accurately describes the tax revenue received. Secondly, it is conceptually sound: the denominator—global consolidated profits of an MNC—is well defined relative to the country-specific profit definition that is often used to measure unconsolidated ETRs and which might differ across countries, for example, due to different ways of accounting for equity and interest income.

For statutory corporate income tax rates, we use the OECD Tax Database's calculated average top-statutory tax rate both for the US and countries in the rest of the world.

7.2.3 Trends in the taxation of domestic and foreign corporate profits

A common trend in corporate taxation has emerged over recent years in both the US and the EU: MNCs based in both regions have been paying tax at similar and decreasing effective rates on both their domestic and foreign profits between 2005 and 2015.

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<tr>
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<th>US MNCs</th>
<th>EU MNCs</th>
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<tbody>
<tr>
<td>Total</td>
<td>32.3</td>
<td>25.2</td>
</tr>
<tr>
<td>Domestic taxation</td>
<td>34.6</td>
<td>28.5</td>
</tr>
<tr>
<td>Foreign taxation</td>
<td>28.3</td>
<td>18.7</td>
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<tr>
<td>Unobserved profits</td>
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Table 7.1. Summary of effective tax rates’ changes (%). Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

First of all, looking at the aggregate numbers, we observe that US MNCs paid an average ETR in the period 2015 of 25.2%, which can be decomposed into an ETR of 28.5% on domestic profits and 18.7% on foreign profits (Table 7.1). EU MNCs had ETRs of 22.4% on average, decomposed into 23.9% on domestic profits, 20.3% on foreign profits, and 19.9% on unobserved profits. Three conclusions can already be reached from these numbers. Firstly, that MNCs pay substantially more taxes on average than in the examples from the offshore leaks such as Paradise Papers (ICIJ, 2017), but also substantially less than they
would if they paid at the relevant statutory corporate tax rates. Secondly, that US MNCs are subject to higher ETRs at home than abroad. Thirdly, that EU- and US MNCs face similar ETRs. Finally, looking at the trends since 2004, we see that the ETRs have declined by 8.7 ppts for EU based MNCs and by 7.1 ppts for their US counterparts.

Over the past four decades, the average statutory tax rate on corporate profits has more than halved worldwide. This downward trend in corporate taxation is observed in virtually every country in the world. Figure 7.1A describes the pattern of falling statutory tax rates in the EU and the US. The EU time-series falls incrementally over the period, whereas the US corporate tax rate falls in two major jumps in 1988 and 2018. Figure 7.1A also illustrates the difference between statutory and effective tax in the US. The taxes actually paid on domestic profits by US firms (non-MNCs and MNCs) began to fall long before the second statutory tax rate reduction in 2018, and since the last financial crisis, the US ETRs have been closer to the EU’s average statutory tax rate than the average statutory rate in the US.

The consolidated ETR on profits encompasses all tax policy tools into one easily measured fraction: the fraction of profits ultimately paid in taxes. Figure 7.1B shows the ETR paid by US MNCs, derived from the BEA, and the ETRs of EU MNCs, derived from the Orbis database, both for our study sample (section 7.2) and the full sample at the consolidated level derived from Orbis (using both operating profits (EU ETR) and total profits (EU ETRp)). Both rates fall at roughly the same speed and at similar levels; this is true not only for consolidated ETRs (Fig. 7.1B), but also for both ETRs on domestic (Fig. 7.1C) and foreign (Fig. 7.1D) profits.

Figure 7.1 shows that the ETRs for EU- and US MNCs have been falling at similar speeds. Figure 7.1A suggests that the continual decrease in statutory tax rates in the EU probably drove some change in the domestic profits of EU MNCs, and in foreign profits of both EU- and US MNCs. It is, however, not possible to uncover the original drivers of this process without further analysis—e.g. whether changes in statutory tax rates, changes in tax bases, or increased profit shifting to low-tax jurisdictions gave rise to the trend. In this paper we develop a decomposition framework to systematically analyse the contribution of these different effects, which we present in the next section.
Figure 7.1. Corporate income tax rates in the US and the EU. For US (dark red) and EU (light blue) MNCs. (A) Domestic tax rate from 1980 to 2016, showing the corresponding domestic statutory tax rates (dashed lines). (B) Consolidated tax rate. For EU MNCs, the tax rate of the full sample using consolidated accounts is visualized, using operating profits (dotted) and total profits (dashed) as the denominator of the tax rate. (C) Domestic tax rate (D) Foreign tax rate. Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.
7.3 The decomposition of consolidated effective tax rates

In this section we provide a theoretical framework for the decomposition of consolidated ETRs, which enables us to further analyse some of the trends we described in the previous section. We first describe the main decomposition and then turn to explaining decomposition at the host country and sector levels.

We define the consolidated ETR as the corporate income taxes an MNC pays worldwide, divided by their worldwide (consolidated) profits. An MNC’s consolidated ETR is by definition the average of the ETRs paid in its various countries of operation, weighted by the share of profits in each country. When carrying this decomposition across the time dimension, we can describe the changes in the consolidated tax rate vis-à-vis the changes in each ETR as well as the changes in the profit share of each country. Furthermore, we differentiate whether the ETR changes are driven by statutory rate changes or changes in deviations from the statutory tax rates.

Equation 7.3 states that the consolidated ETR is the average of the ETRs paid abroad and domestically, weighted according to the profits reported in each country:

\[ \tau_C = \omega_D \tau_D + \omega_F \tau_F + \omega_U \tau_U \]

where \( \tau_C \) denotes the consolidated ETR for all MNCs headquartered in a given country, \( \omega_D \) is the share of profits that are reported domestically, \( \omega_U \) is the share of profits that have unobserved sources (in the Orbis database) and \( \tau_D, \tau_F \) and \( \tau_U \) are the domestic and foreign ETRs paid on those profits. This leaves us with three components, which can be analysed separately over time.

A generic difference between periods can be formulated as below:
7.3. The decomposition of consolidated effective tax rates

\[ \Delta \tau_C = \omega_D \Delta \tau_D + \omega_F \Delta \tau_F + \Delta \omega_D (\tau_D - \tau_F) + \Delta \omega_D (\Delta \tau_D - \Delta \tau_F) + \omega'_U \tau'_U - \omega_U \tau_U - \Delta \omega_U \tau'_F \]

Here, \( \Delta \) is the short hand notation for the change in the variable between periods. The “domestic taxation” effect denotes the initial weight of the domestic component times the change in the domestic tax rate. In other words, the change in consolidated tax rate due to domestic tax changes had the profit distribution been constant through the period. The “foreign taxation” effect does the same for the foreign component. The “globalisation” effect adds the effect of changes in weights between the periods; moving profits abroad yields the tax rate change \((\tau_F - \tau_D)\), assuming no changes in rates \((\Delta \omega_D\) denotes profits moved the other way—“home”—hence the sign difference). The fourth term, “residual”, accounts for the fact that rates do change at the same time as the weights. For the case of EU MNCs, we need to account for changes in the ETRs on the profits unobserved in the data. Since it is not illuminating to separate changes in base from changes in tax rates, we add a generic term accounting for the entire variation: \( \omega'_U \tau'_U - \omega_U \tau_U \), where the apostrophe marks the period 2. The extra term, \(-\Delta \omega_U \tau'_F\), arises from a residual term \((\Delta \omega_F + \Delta \omega_D)\), which is zero for US MNCs since \(\omega_F = (1 - \omega_D)\), and is \(\Delta \omega_F + \Delta \omega_D = -\Delta \omega_U\) for EU MNCs. This change is multiplied by the ETR for foreign profits in the second period, which we denote with \(\tau'_F\).

Having decomposed the change in consolidated ETRs into foreign and domestic tax effects, we can then further decompose these components into the effects of statutory tax changes and effects caused by deviations from the statutory tax rates. The domestic tax rate can be written as:

\[ \tau_D = \overbrace{S_D}^{\text{Statutory rate (domestic)}} + \overbrace{(\tau_D - S_D)}^{\text{Deviation from statutory rate (domestic)}}, \]

where \(S_D\) is the statutory tax rate at home, and \(\tau_D\) as before is the ETR actually paid. The ETR equals the statutory tax rate minus any deviations from the statutory tax rate. Since this is purely an identity-exercise of the tax rate, not including weights at all, the difference over time can simply be written as:
\[ \Delta \mathcal{T}_D = \frac{\Delta S_D}{\text{Domestic statutory rate}} + \left( \frac{\Delta \mathcal{T}_D}{\text{Domestic tax base}} \right), \quad (7.4) \]

where domestic statutory rate depicts the change in domestic statutory rates over time. We put the change in deviation from statutory rates under the label “domestic tax base” since these deviations likely stem from changes to the tax base.

The foreign taxation consists of many different countries, each with a weight, statutory rate and effective rate. The equation below states that the foreign tax rate is the weighted average of all the N countries denoted \( i \in \{ F_1, F_2, \ldots, F_N \} \).

\[ \mathcal{T}_F = \sum_{i=1}^{N} \omega_{F_i} \mathcal{T}_{F_i}, \quad (7.5) \]

where \( \sum_{i=1}^{N} \omega_{F_i} = 1 \).

Similar to the domestic case, we decompose this into the statutory rate and deviations from this:

\[ \mathcal{T}_F = \sum_{i=1}^{N} \left( \omega_{F_i} S_{F_i} + \omega_{F_i} (\mathcal{T}_{F_i} \text{ - } S_{F_i}) \right), \quad (7.6) \]

Analogous to equation \( 7.3 \) the following gives us the changes in the above equation between periods:

\[ \Delta \mathcal{T}_F = \sum_{i=1}^{N} \left( \omega_{F_i} \Delta S_{F_i} + \omega_{F_i} (\Delta \mathcal{T}_{F_i} \text{ - } \Delta S_{F_i}) + \Delta \omega_{F_i} \mathcal{T}'_{F_i} \right), \quad (7.7) \]
7.3. The decomposition of consolidated effective tax rates

This equation states that the change in the foreign component of the consolidated ETR can be decomposed into three terms, weighted across all foreign countries. The first term, foreign statutory rate, denotes the change in average weighted statutory tax rates, keeping the weights across countries constant. The second term, foreign tax base, is the change in deviations from the statutory tax rate between the periods (again keeping weights constant across countries). These two first terms correspond to changes in foreign taxation. The third term—the “profit shifting” effect—is the change in the consolidated ETR if the ETRs in each country remained as in period 2, but the weights (tax base) moved between countries. Since \( \sum_{i=1}^{N} \omega_{F_i} = 1 \) still holds in period 2 we must also have that \( \sum_{i=1}^{N} \Delta \omega_{F_i} = 0 \). Any changes here thus come from the tax base moving between differently taxed jurisdictions.

Overall, we decomposed the change in ETRs into eight components: two related to domestic taxation (domestic statutory rate, domestic tax base), three related to foreign taxation (foreign statutory rate, foreign tax base, profit shifting), and three others (globalisation, residual, unobserved profits). In terms of the home country level, below we present results of estimating this decomposition for one headquarter country such as the US or an individual EU member states as well as aggregately for a group of home countries, the EU.

In addition to the main decomposition described so far, we can also differentiate between various host countries and we can also estimate the effect of sectoral compositions, which we now discuss in turn.

The decrease in foreign ETRs over time can be mapped at the host country level. To facilitate the interpretation of the results, we slightly adapt equation 7.3 as:

\[
\Delta \mathcal{T}_F = \sum_{i=1}^{N} \left( \omega_{F_i} \Delta \mathcal{T}_{F_i} + \Delta \omega_{F_i} (\mathcal{T}'_{F_i} - \overline{\mathcal{T}}_{F_i}) \right),
\]

(7.8)

where \( \overline{\mathcal{T}}_{F} \) is the mean tax in period 2. Since \( \Delta \omega_{F_i} = 0 \), we have that \( \Delta \omega_{F_i} k = 0 \), where \( k \) can be any constant. By using \( \mathcal{T}'_{F} \), we can assess whether
profits have been shifted to countries that have below or above average ETRs. This facilitates the interpretation of the results, since countries that gain profits ($\Delta \omega_{F_i} > 0$) and have a below-average tax rate ($T'_{F_i} - \overline{T_F} < 0$) will have a negative contribution to the tax rate.

The decrease in ETRs can be also mapped at the sector level. For both the BEA dataset and the Orbis dataset, we have information on each firm’s main industrial sector $S \in \{1, 2 \ldots M\}$, for both the domestic tax base and the aggregated tax base. Similar to the decomposition by host country, we can decompose the decrease in ETRs into effects of sector composition and the rest as:

$$\Delta T_C = \sum_{s=1}^{M} \left( \omega_S \Delta T_S + \Delta \omega_S (T'_S - \overline{T_S}) \right),$$

where $\Delta T_C$ is the decrease in ETRs due to foreign or domestic taxation, $\omega_S$ is the weight of sector $S$ and $T'_S$ is the ETR for firms in that sector in the second period. With the decomposition framework outlined, we now turn to discussing its estimates in the same order.

### 7.4 Results

By applying the framework we set out above, the BEA and Orbis datasets can be used to decompose changes in ETRs for US and EU MNCs over time. In practice, we can and do decompose the change in US and EU MNC tax rates using a handful of calculated variables. We need the consolidated tax rate in both periods, the foreign and domestic ETRs of both periods, the share of profits at home in both periods and the counterfactual foreign tax rates with weights as in the first period but rates as in the second, and vice versa. The entire code we use in these calculations and the associated non-proprietary data can be found online at the Open Science Framework website [https://osf.io/nu42h](https://osf.io/nu42h). Our data do not only enable us to decompose the domestic and foreign components of the ETR as indicated in Table 7.1 above, but also to provide more detailed decompositions, for example, into the foreign component to see
which countries contribute most to changes in MNCs’ ETRs, as outlined in the framework in section 7.3.

The main results of our decomposition are in Table 7.2. Its first column, Table 7.2.I, shows the change in the ETR at which US MNCs paid between 2005 and 2015, decomposed according to our framework (a more detailed calculation of the results in Table 7.2 is included in Table A3 in the Appendix.). The total reduction by 7.1 ppts, from 32.3% to 25.2%, is explained almost equally by domestic changes (3.9%) and changes in foreign taxation (3.5%). Since the statutory tax rate in the US changed very little in this period, almost all the domestic variation is explained by firms paying a lower effective rate than the statutory rate on average. We show that this is not likely to be explained by the rise of S-corps in section 1 of the appendix, since the decline in ETRs for non-S-Corp domestic US firms was similar to what we see for the domestic part of US MNCs. Furthermore, we can explain the 3.5 ppts drop due to foreign ETRs mostly by a larger share of the tax base being located in lower tax countries (2.1%, or 30% of the 7.1 ppt reduction) and partly (1.6%) by falling statutory tax rates across the board, counteracted by a slight broadening of the base.

<table>
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<th></th>
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</thead>
<tbody>
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<td>Effective tax rate 2005</td>
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<td>32.8</td>
<td>31.1 (28.9, 32.9)</td>
<td>38.3</td>
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<tr>
<td>Effective tax rate 2015</td>
<td>25.2</td>
<td>26.2</td>
<td>22.4 (18.5, 28.4)</td>
<td>32.3</td>
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<td>Difference</td>
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<td>-6.7</td>
<td>-8.7 (-11.8, -3.1)</td>
<td>-6.0</td>
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<tr>
<td>Domestic taxation (1 + 2)</td>
<td>-3.9</td>
<td>-3.6</td>
<td>-5.9 (-8.5, -3.0)</td>
<td>-4.3</td>
</tr>
<tr>
<td>1 Domestic statutory tax rate</td>
<td>-0.2</td>
<td>-0.2</td>
<td>-3.4 (-4.6, -2.4)</td>
<td>0.4</td>
</tr>
<tr>
<td>2 Domestic tax base</td>
<td>-3.7</td>
<td>-3.4</td>
<td>-2.5 (-5.1, 0.1)</td>
<td>-4.7</td>
</tr>
<tr>
<td>Foreign taxation (3 + 4)</td>
<td>-1.5</td>
<td>-1.1</td>
<td>-1.6 (-2.3, -0.1)</td>
<td>-0.5</td>
</tr>
<tr>
<td>3 Foreign statutory tax rate</td>
<td>-1.6</td>
<td>-1.4</td>
<td>-0.8 (-1.0, -0.4)</td>
<td>-1.4</td>
</tr>
<tr>
<td>4 Foreign tax base</td>
<td>0.1</td>
<td>0.3</td>
<td>-0.9 (-1.4, 0.5)</td>
<td>0.8</td>
</tr>
<tr>
<td>5 Profit shifting</td>
<td>-2.1</td>
<td>-2.3</td>
<td>-0.4 (-1.3, 0.0)</td>
<td>-0.7</td>
</tr>
<tr>
<td>6 Globalisation</td>
<td>0.2</td>
<td>0.2</td>
<td>0.7 (-0.1, 2.2)</td>
<td>-0.7</td>
</tr>
<tr>
<td>7 Residual</td>
<td>0.1</td>
<td>0.2</td>
<td>-0.2 (-2.1, 0.9)</td>
<td>0.2</td>
</tr>
<tr>
<td>8 Unobserved profits</td>
<td></td>
<td></td>
<td>-1.3 (-3.6, 3.1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.2. Decomposition of the decrease in effective tax rates over time (%). Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

To enable a closer comparison to the results on EU firms discussed below, Table 7.2.II shows the results of the decomposition for US MNCs including net interest paid. This paints a picture of the US firms paying less than the statutory tax rate on their domestic profits, on average, while countries throughout the rest of the world continue to lower their statutory tax rates. Any profit-shifting between individual states in the US, and any usage of the special tax
rules in Puerto Rico would also be included in the “domestic tax effect”; our
decomposition does not single these effects out (the case of Puerto Rico is
described in more detail in the appendix to Tørsøv et al., 2018). Traditional
profit shifting between countries is shown in component 5 (and possibly also
6 and 7), whereas domestic reactions to tax competition will be caught in
components 1 and 2, and potentially 7. It is important to note that the
reductions in ETRs seen in the table could easily be a reaction to profit shifting
going (component 5). Had the US not allowed firms to pay taxes at ETRs below
the statutory rate on average, the result might simply have been an erosion of
the US tax base.

For EU MNCs we show the decomposition results on the basis of Orbis in
Table 7.2.III. We include confidence intervals that we calculate using 1000
bootstrapping samples. The 8.7 ppt reduction in the ETRs for EU MNCs is
explained by various forces. Changes in statutory tax rates at home explain 3.4
ppts of the decrease and changes in tax base explain a further 2.5 ppts. Changes
in foreign taxation account for 2 ppts of the decline; this is explained in equal
parts by changes in foreign statutory tax rates (0.8 ppts), change in foreign bases
(0.9 ppts), and profit shifting (0.4 ppts, or 5% of the 8.7 ppt reduction). These
forces are complemented by changes in the amount of profits unobserved in
the data and the tax rate applicable to them. 35% of profits are in unobserved
locations in Orbis in period 1; this reduces to 9% in period 2 (Table A2). This
reflects an increase in the data quality in Orbis in recent years, and contributes
to a decrease in the observed ETR of 1.3 ppts. When we consider only the profits
whose locations are observed in Orbis, however, the pattern is similar to that
from the US: domestic changes dominate foreign changes, since the domestic
base is approximately two times larger than the foreign base (Table A2). We
find that domestic taxation components (which can be considered as strategic
spillovers) are 2 and 15 times larger than profit shifting component for US and
EU MNCs (2.1 vs 3.9 and 0.4 vs. 5.9), respectively. However, for EU MNCs,
the change in domestic taxation is driven by both statutory rate changes and
changes in the tax base.

For US MNCs we have BEA data stretching further in the past then the 2005–
2015 period and the remaining two columns in Table 7.2 show the results.
Table 7.2.IV shows the same decomposition but for the period from 1994 (data
from the benchmark survey) until 2005. In this period, the reduction in effective
taxation for US firms was similar (6.0 ppts), but a larger share of that reduction is explained by domestic policy (4.3 ppts). In fact, almost 80% of the reduction in ETRs in this period corresponds to a decrease in the tax base. This might be due to deductions at home or increased use of domestic tax havens such as Puerto Rico. (In this period the S-corps did become more popular and about 5 ppts. of domestic US profits moved from C-corps to S-corps - if this happened in the MNC-sector as well, this could explain some of the fall, but to separate this effect properly we would need to have access to a data set splitting US MNCs into S-corps and C-corps.) Furthermore, changes in foreign profits explain 1.1 ppts of the decrease; these are explained equally by profits being moved to lower tax locations (0.7 ppts) and a drop in the statutory rates (1.4 ppts) that was not fully counteracted by base widening (-0.5 ppts). In this period, the globalization effect also contributed to the decrease in tax rates (0.7%). Finally, Table 7.2.V shows results for the period 1994 until 1999 (both sets of data from the benchmark surveys). In this period, there was practically no change in taxation. The domestic tax rate increased slightly and this was compensated by a decrease in foreign taxation.

We further study the decomposition over individual years rather than between two specific periods to understand whether the changes in ETRs and the components has been gradual sudden. In Figure 7.2 as well as in Table A2, we show that for US MNCs (Fig. 7.2A), most of the decrease in domestic taxation took place shortly before the financial crisis, and levels then stabilized. The decrease in foreign taxation due to profit shifting and foreign tax rate changes took place more gradually, and particularly in the period between 2010–12 and 2014–16. For EU MNCs (Fig. 7.2B), the decrease in taxation occurred more gradually, decreasing until the period 2008–10 and then increasing again until 2011.

While domestic taxation is directly responsible for more than 50% of the overall decline in ETRs for both US and EU MNCs, profit shifting might explain some of this decline indirectly. Results of both Table 7.2 and Figure 7.2 show that changes in the domestic taxation of MNCs are responsible for the majority of the decline in the ETR for US MNCs since 1994 and EU MNCs since 2004. A counterfactual world in which ETRs do not change at all is of course highly unlikely. It is possible that changes in domestic taxation are a means of avoiding increases in profit shifting, in which case we could argue that they are partially
driven by profit shifting practices. They are, however, not directly due to profit shifting.

![Graph](image)

**Figure 7.2.** Evolution of effective tax rates. *Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.* *Note: The horizontal line at zero marks the tax rate in 2005.*

In addition to the possibility of profit shifting indirectly affecting domestic taxation component of declining MNCs’ ETRs’ decomposition, profit shifting might also indirectly affect the taxation of non-MNCs in a similar way. In a way, Table 7.2 only shows us part of the picture, because the taxation of non-MNCs can also be affected by changes in the effective taxation of domestic profits. In the period between 2004 and 2016, non-MNCs in the US experienced a similar reduction in effective taxation as we have observed for MNCs, which aligns well with the ETR shown in Figure 7.1. Table A1 shows the development of the ETRs for all non-S-Corp US firms, both MNCs and non-MNCs. This is by definition more driven by the US profits than the results in Table 7.2 which were only for MNCs. Since we exclude S-corps, this analysis excludes 20% of the profits made by US MNCs (as detailed in Table A1 in the Appendix), much as unobserved profits account for 10% of the profits in our EU MNC sample. However, where we know the total effective taxation of the unobserved profits in Orbis, we do not know how much (extra dividend-) taxes S-corps pay effectively. This should be investigated when better data becomes available, since this is another key part of the effective taxation picture. Table A1 shows that the slightly smaller tax reduction of 6.6 ppts is even more dominated by US profits, and only 1.1% pt. of the reduction is due to profits moving between foreign countries. Since including domestic firms increases the weight of the domestic component of the decomposition, the importance of components that are not directly linked to profit shifting increase.

It is thus clear from the results we have presented that the decline in ETRs caused by reactions to tax competition—the strategic spillover—potentially
represents an important cost within the current tax system that is often overseen in the debate. Higher levels of profit shifting might be responsible for lower taxation of both MNCs and non-MNCs. We hypothesise but are not able to test this with the current data that not only are ETRs lowered through profit shifting directly, but the tax base of MNCs and non-MNCs that remains in the country is, in reaction to profit shifting, then taxed at a lower rate than would be the case, had profit shifting not existed.

7.4.1 Decomposition by home country

We now decompose ETRs of EU MNCs by individual EU home country and present these more granular results in addition to the aggregate results for the EU as a whole presented so far. For this analysis, we focused on the nine countries with the largest MNCs (by profits). Our sample selection in Orbis is restrictive, and retains only MNCs for which we have information, at the subsidiary-level, about the majority of the total profits and taxes (section 7.3 and appendix section 3). This enables us to calculate the point estimates more accurately, at the expense of larger confidence intervals. Nonetheless, the decomposition by home country shows a similar pattern to that found in our decomposition for all EU MNCs. The decrease in effective taxation is confirmed in all these countries except France and Sweden (Table A5 in the Appendix), and is driven by a decrease in statutory tax rates, both on domestic and foreign profits. An increase in profit shifting is only confirmed for two countries, Germany and Spain, although the sign is generally negative for the Netherlands, Denmark, Finland and Sweden and these results are confirmed in our robustness check using different Orbis sample (Tables A6 and A7).

7.4.2 Decomposition by host country

Next, we ask which countries contribute the most to the decrease in foreign taxation (equation 7.3). This can be decomposed into changes in foreign taxation ($\omega_F, \Delta \tau_F$) and the profit shifting effect ($\Delta \omega_F, (\tau' - \bar{\tau}_F)$). As explained in section 7.3 $\bar{\tau}_F$ corresponds to the average tax rate in period 2, and facilitates the interpretation by giving a negative weight to countries where the weight increases and the ETR is below the average foreign ETR. We visualize the two components in Figure 7.3.

We find evidence of more substantial sectoral shifts for US MNCs than for EU MNCs. Figures 3A and 3C show the change in ETRs ($\omega_F, \Delta \tau_F$), plotting the
Decomposition by host country

Figure 7.3. Different countries' contributions to the decrease in foreign taxation and profit shifting.

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes:
- Different countries' contributions to the decrease in ETRs for US MNCs (A & B) and EU MNCs (C & D).
- The decrease in ETRs due to foreign taxation is mapped in (A) and (C), while the decrease in ETRs due to profit shifting is in (B) and (D). Note the lack of a clear pattern in (D), which reflects the lack of any substantial effect from increased profit shifting on the decrease of taxation for EU MNCs.
- The decrease in ETRs due to profit shifting is mapped in (B) and (D), as well as due to increased foreign taxation in (B) and (D).
weight of the country \((\omega_{F_i})\) against the change in taxation \((\Delta T_{F_i})\). Figures 3B and 3D show the profit shifting effect \((\Delta \omega_{F_i}(T'_{F_i} - F_i, \bar{T}'_{F_i}))\), plotting the taxation in the country relative to the average \((T'_{F_i} - \bar{T}'_{F_i})\) against the change in weight \((\Delta \omega_{F_i})\). Figure 7.3A shows for US MNCs that the countries with the highest weight have generally decreased their ETR, particularly the United Kingdom, Canada, Japan, and the Netherlands. Figure 7.3B shows for US MNCs that the countries with the lowest tax rates have generally increased in weight, particularly Switzerland, the Netherlands, Ireland, Singapore, and the U.K. Caribbean islands. Conversely, the countries with the highest tax rates have generally decreased in weight, e.g. Australia, Norway and France. For EU MNCs, we observe that particular countries contributed strongly to the observed decrease in ETRs (Figures 3C and 3D), particularly the United Kingdom, Spain, Norway, Sweden, France, Germany and Italy (Fig. 7.3C). As expected given the low value of the profit shifting component to the decrease in ETRs, we do not see a clear pattern in Figure 7.3D. While Norway is an outlier with a high tax rate, only Austria, Brazil and Ireland combine both a below-average tax rate and an increase in weight larger than 1 ppt.

### 7.4.3 Decomposition by sector

Finally, we investigate whether the observed decrease in ETRs could be due to changes in the sectoral composition of the studied MNCs. We find that this is indeed partly the case for US MNCs, but much less so for EU MNCs (Table 7.3). For US MNCs, changes in the weight of different sectors account for 3.7 ppts out of the 6.8 ppts reduction in effective taxation, primarily as a result of changes in the Finance and Insurance sectors (Fig. 7.4A–B). When we consider only changes in foreign taxation, sectoral changes can account for 7.7 ppts out of the 10.7 ppts decrease. This is due to an increase in the financial, real estate and pharmaceutical sectors (which face low tax rates abroad), and a decrease in the petroleum and coal products and mining sectors (which usually face resource taxes) (Fig. 7.4C–D). In the light of these results, we can say that only half of the -3.7 ppts decrease in the ETR on the domestic tax base of US MNCs is attributable to real changes in tax base. For the changes related to the foreign base only one third of the 3.5 ppts decrease is attributable to changes in statutory tax rates and in the base shifted between foreign countries. Given the limitations of the data, we are unable to differentiate whether what we observe is a real change in sectors or profit shifting.
For EU MNCs, the sectoral decomposition indicates that most of the decline in ETRs cannot be explained by change in the sectoral composition (only -1.4 ppts out of -12.6 ppts for domestic taxation) and for foreign taxation the sectoral change is positive at 7.3 ppts and might thus actually lead to underestimating the decline in ETRs had the sectoral composition stayed unchanged. In order to check the robustness of this result for EU MNCs, we replicate the analysis keeping only manufacturing MNCs, and the results are maintained (Table A4).

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<tr>
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<th>US MNCs</th>
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<tr>
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Table 7.3. Summary of effective tax rates’ sectoral decomposition (%). Note that the numbers in Table 7.3 do not match exactly with those in Table 7.2. This is due to some sectors, including some major ones such as “Mining”, having negative profits or taxation. Excluding those sectors would distort the comparison with the rest of the analysis. Instead, we set the profits and taxes of those sectors to zero. For US MNCs this was done for US mining companies in the domestic sector. For EU MNCs, sector “P” (education) was set to zero for the domestic taxation, sectors “P”, “D” (electricity) and “J” (IT) for the foreign taxation, and sectors “P”, “D”, “J”, “M” (professional), “G” (wholesale and retail trade), and “E” (water supply) for the unobserved profits. Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

7.5 Conclusion

This paper shows that while profit shifting is important, declines in ETRs might be dominated in magnitude by the strategic spillovers of tax competition. From the point of view of a country’s tax revenue authority, tax competition likely causes more revenue loss indirectly through countries’ policy reactions, than the losses caused by the practice of profit shifting directly. Using data from the BEA and Orbis, we have shown that the decline in the ETRs for US- and EU MNCs since the mid-2000’s has been driven mainly by the lowering of statutory tax rates, and only to a much lesser degree by shifting profits into countries with lower taxation. This indicated that the revenue losses to strategic spillover are potentially 2 and 15 times as large than the losses from profit shifting directly for US and EU MNCs, respectively.
Figure 7.4. Sectoral changes in taxation for US MNCs. Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.
One of this paper’s key contributions is that it presents an EU data set comparable to the US BEA-data on MNCs. This has enabled us to examine the similarities and differences between US- and EU MNCs. We show that both groups of MNCs have paid tax on their consolidated profits at similar effective rates since 2004, and that those rates have declined markedly in that period. While both rates fell somewhat as a result of profits being moved to lower taxed subsidiaries, the effective rate declines are, in both cases, primarily explained by domestic taxation and statutory tax rate reductions abroad. For the US MNCs, the ETR increasingly fell below the statutory rate. For the EU MNCs, most of the decline was explained by falling statutory tax rates at home.

The large indirect cost of profit shifting is likely the largest cost associated with current international tax rules. When we analyse only the direct revenue costs of profit shifting, we are potentially ignoring the majority of the problem. Analysis of changes in strategic spillover effects will be crucial when evaluating the current tax system against other potential systems, such as the CCCTB, the destination cash flow tax or a global minimum corporate income tax as part of the OECD’s 2019 Pillar Two proposals for taxing the digital economy.

References
7.5. Conclusion


CHAPTER 8

Assessing Data Quality in the Orbis Database

This chapter analyzes the completeness of the main dataset used in this dissertation: Orbis. The Orbis dataset contains information from over 300 million companies, compiled from country registers and other country collection agencies. Moreover, it presents a novel method to increase the accuracy of the dataset. While the article focuses on board interlock data, the same data is used throughout the dissertation.
Abstract

Nowadays, social network data of ever increasing size is gathered, stored and analyzed by researchers from a range of disciplines. This data is often automatically gathered from API’s, websites or existing databases. As a result, the quality of this data is typically not manually validated, and the resulting social networks may be based on false, biased or incomplete data. In this paper, we investigate the effect of data quality issues on the analysis of large networks. We focus on the global board interlock network, in which nodes represent firms across the globe, and edges model social ties between firms—shared board members holding a position at both firms. First, we demonstrate how we can automatically assess the completeness of a large dataset of 160 million firms, in which data is missing not at random. Second, we present a novel method to increase the accuracy of the entries in our data. By comparing the expected and empirical characteristics of the resulting network topology, we develop a technique that automatically prunes and merges duplicate nodes and edges. Third, we use a case study of the board interlock network of Sweden to show how poor quality data results in distorted network topologies, incorrect community division, biased centrality values and abnormal influence spread under a well-known diffusion model. Finally, we demonstrate how the proposed data quality assessment methods help restore the network structure, ultimately allowing us to derive meaningful and correct results from the analysis of the network.

8.1 Introduction

Over the past few decades, the amount of digital information has been doubling roughly every two years. At the same time, there is an ongoing and prevailing desire to extract meaningful knowledge from this data. Although many knowledge discovery methods and techniques are scalable to larger volumes of data, “big data” (Ward & Barker, 2013) has the significant and largely unaddressed problem of “veracity” (Hashem et al., 2015). This refers to the fact that the explosion in the amount of available data has resulted in a situation in which researchers can no longer manually validate the quality of their data (Wand & Wang, 1996). Data quality most dominantly relates to questions of completeness (what part of the data do we have, and what part do we miss?) and accuracy (is the data that we have correct and suitable for answering our particular domain questions?). Issues with data quality have an
estimated cost ranging from $611 billion (Eckerson, 2006) to $3.1 trillion (IBM estimate) per year in the United States alone. As such, increased importance has been given to data quality in the information systems literature (Ouzzani, Papotti, & Rahm, 2013). Assessing and correcting data quality issues (data cleaning) is a main pre-processing step often required in the analysis data (Han, Kamber, & Pei, 2012). Here we specifically set out to assess how these issues can be addressed in the context of (social) network analysis.

In this paper we focus on so-called corporate networks, in which links represent particular relationships between corporations. Ties in corporate networks can be based on a variety of relationships between firms, including trade (Wilhite, 2001), borrowing and lending of money (Battiston et al., 2016), ownership (Vitali, Glattfelder, & Battiston, 2011), or as we analyze in this paper: shared board members. In these networks of interlocking directorates, also referred to as board interlock networks, a node represents a firm and an edge between two firms denotes that these firms share at least one board member or director. An example of a board interlock network is given in Figure 8.1. Board interlocks are common practice in today’s corporate world, and over the past century, social scientists have extensively studied the causes and consequences of board interlocks. See for example the excellent overview given in (Mizruchi, 1996), where Mizruchi discusses how interlocks relate to collusion, monitoring (e.g., banks keeping an eye on firms they invested in), legitimacy (attracting board members with a particular reputation in a certain area that is of importance to the firm), individual career advancement and social cohesion (social ties among the upper class). Previous research has established that networks of interlocking directorates facilitate the spread of governance routines and practices, the exchange of resources, communication and the dissemination of new ideas (Burris, 2005; Davis, 1991). Since a significant number of directors has positions at two or more firms, the board meetings of these firms connect the majority of big businesses in the world. For instance, Davis (Davis, 1991) discusses how the majority of the corporate elite would rapidly be infected by a contagious disease as a result of the small world property of the network of interlocking directorates.

Corporate networks have interesting topological characteristics common to all real-world networks, including a fat tailed degree distribution, the emergence of a giant component and very low pairwise distances between nodes (Battiston
8.1. Introduction

Figure 8.1. Sample of the Swedish network of interlocking directorates. Based on largest 120 firms in terms of revenue, connected through 422 interlocks. Color and size are proportional to node degree. Layout created in Gephi (http://gephi.org) using the ForceAtlas2 algorithm.

& Catanzaro, 2004. Researchers have thus applied established social network analysis methods and techniques (Streeter & Gillespie, 1993) to corporate networks. Community detection has been used to understand the geographical dimension of the structure of these networks (Heemskerk & Takes, 2016; Vitali & Battiston, 2014) and centrality measures provide insight into powerful firms and countries in the network (Takes & Heemskerk, 2016).

Initially, social scientists studied only small networks of interlocking directorates, typically based on a few hundred firms and their relationships. Researchers carefully double-checked the data they manually gathered from annual reports of the companies involved. Nowadays, large databases on
Data Quality in the Orbis Database
corporations are provided by commercial corporate information providers such as Orbis, BoardEx, ThomsonOne and Bloomberg, including information on their financial performance and board composition. The availability of these databases with millions of firms allows our board interlock networks to be automatically constructed from the available firm and board member data. Here, we focus on a dataset extracted from Orbis, a large information provider that gathers data from country registers across the world, and then makes this data available through one database (for details, see Section 8.2). The sheer volume of contemporary corporate network data (Heemskerk et al., 2018) means that it is no longer possible to manually check each firm, let alone their board composition, for correctness. However, the quality of our data is diverse across countries and country registers. Indeed, two problems of data quality (completeness and accuracy) come into play here. Note that other common aspects of data quality (Rahm & Do, 2000), such as illegal values and varying value representations, are already corrected by the information provider.

The first data quality issue, completeness, is not necessarily problematic, for example when we have a dataset in which data is missing completely at random (MCAR), or when missing values are directly correlated with a known variable (MAR). We find that in our dataset information about some attributes (e.g., number of employees) is correlated with other attributes with better availability—it is MAR. However, often it is not the attributes but the companies themselves that are not present in the data, meaning that data is missing not at random (MNAR). This may result in severe problems, because if non-random parts of the data are missing, we can no longer consider it a reliable sample and derive meaningful results for the system represented by the dataset as a whole. For example, if we blindly use the data provided by information provider Orbis to compare countries, we observe that the average Mexican firm is larger than the average firm in the United States. In turns out that this is due to lower data quality in Mexico, where many small companies are not included in the data, thus increasing the average size of a company. If we want to derive meaningful and actionable insights from the board interlock network of these corporations, we need to know exactly which firms we are missing.

A second problem, accuracy, is that we have no prior indication of whether there are duplicates in our data. These duplicates can be accidental, for example as a result of entity resolution errors introduced when the data was gathered by the
8.1. Introduction

information providers, but they can also be the result of administrative reasons. Firms often organize themselves in multiple legal entities and parent-subsidiary constructions to facilitate the autonomy of local branches, departments or, most often, for certain legal or financial benefits. We want to disregard these types of administrative firms and their relationships from the network, such that we are able to derive meaningful and representative results from a network in which a node represents one distinct and autonomous firm, and an edge represents a true board interlock between these firms, facilitating the type of social relation between firms discussed in our short survey of board interlock research provided above. Importantly, our analysis does not deal with other types of accuracy problems, such as misspelling or misfielded values (Rahm & Do, 2000).

The two data quality issues of completeness and accuracy of corporate datasets obviously affect the topology of board interlock networks. Missing, spurious or duplicate nodes or edges affect the analysis of the network, for example in terms of topological properties, community division, centrality and the diffusion of information (Kossinets, 2006). In a previous paper by Heemskerk et al. (Heemskerk et al., 2018), we provided a flowchart to identify data quality problems in big corporate network data. In this paper, we provide the methods and algorithms to resolve two large issues: completeness and accuracy. For the issue of completeness we present in Section 8.3.1 a new quality assessment method to analyze which part of the global firm data can be used to ensure meaningful results. While several tools have been created to impute missing values in a variable (Rahm & Do, 2000), methods to assess (and ultimate impute) missing rows are scarce and dependent on domain-specific models (Schafer & Graham, 2002). Here, we create a model that require little information on the underlying distribution and that could be extended to other social systems exhibiting long tail distributions (see Section 8.6). For the aspect of accuracy, Section 8.3.2 proposes a data correction technique that uses network characteristics to filter spurious firms and connections in the corporate network. While deduplication is a common problem in data cleaning (Rahm & Do, 2000), it is usually tackled using string similarity—see (Peled, Fire, Rokach, & Elovici, 2016) for a review and a discussion of how adding network similarity increase deduplication quality. Here, we extend this procedure by looking at the neighborhood of each node in the network, and provide detailed data analysis and mapping rules to detect and correct duplicate entries in bipartite
networks. To demonstrate how results change from fuzzy to more meaningful as data quality issues are addressed, we analyze in Section 8.4 their effect on the network topology, centrality and influence spread in the network of interlocking directorates of Sweden. Next, we show in Section 8.5 that the proposed method of assessing and correcting the quality of corporate network data is essential to ensure that results from analyzing the network are not a mere product of systematic biases in the data, but instead provide actually meaningful insights. Finally, in Section 8.6 we discuss how the proposed method of assessing and correcting data quality are generalizable to other domains.

8.2 Data

This section outlines how we collected our dataset, followed by a description of how we constructed the board interlock network that is analyzed in the experimental sections.

We started by creating a snapshot of the Orbis database\(^1\) in November 2015, including all 160 million active companies (no branches, foreign entities or business marked as ‘single location’) and all 90 million directors holding a position at these companies. For each company we extracted its country, operating revenue, number of employees and global ultimate owner (GUO). The GUO of a company is a controlling shareholder (directly or indirectly owning at least 50% in shares) that is not owned by any other company. For each company we extracted all top executive (chiefs and directors) affiliations in the set of firms, obtaining 65 million current positions. This dataset is the object of study in our analysis of completeness in Section 8.3.1.

Next, we constructed the Swedish firm-to-firm board interlock network, where only Swedish firms are considered, and companies are connected if they share one or more directors. The resulting Swedish network is composed of 260,611 companies and 1,269,560 edges. Although the network also contains many uninteresting small components of at most a handful of nodes, we focus on its giant component—in which the lion share of economic activity in Sweden takes place. This connected undirected graph contains a total of 94,496 nodes and 1,050,907 edges. In Section 8.3.2 and Section 8.4 we assess the quality in terms

\(^1\)Orbis, Bureau van Dijk, \url{http://orbis.bvdinfo.com}
of accuracy of this network dataset, investigating its topology and the results of applying methods such as centrality and influence spread models.

8.3 Methods

The two major components of data quality, namely data completeness and accuracy, are discussed and addressed in the two subsections below. Apart from explaining the method in a general sense, we specifically discuss how it is applied in the context of corporate data and the corporate board interlock network. In a more general sense, for completeness, we provide a procedure to quantify missing rows. For accuracy, we provide with both a procedure to quantify duplicated rows and with transformation rules to correct for it.

8.3.1 Completeness

Ensuring proper data analysis results requires unbiased representative samples of a population. Unbiased representative samples are obtained when the distributions of each variable in the sample match the distributions in the real population. However, the distributions in the population are generally unknown, i.e., the dataset has data missing not at random (MNAR). In the case of our corporate data, we usually either lack information about the distribution of company sizes in a given country, or have only aggregated data—e.g., the number of small, medium and large companies available.

Here, we propose to use aggregated data on segments of the data to test the completeness of the full dataset. For instance, Figure 8.2 shows the coverage of our corporate dataset by category (in terms of number of employees) as reported by the European statistics bureau. Some countries (e.g., Norway (NO), Sweden (SE), Finland (FI) and Estonia (EE)) have very complete information (all bars are close to the horizontal line). However, some countries have relatively bad data quality (e.g., Poland (PL), the Netherlands (NL) and Germany (DE)). Moreover, we see that countries with bad data quality usually have good information for large companies and bad information for small companies. In order to understand the magnitude of the bias we first find the precise relationship between quality and aggregate (macroeconomic) measures, using segments (countries) with available aggregated data. We then use this relation to extrapolate to segments (countries) without information. In this section, we

\[^2\text{EUROSTAT,}\ http://ec.europa.eu/eurostat\]
Completeness

apply our method to a dataset on corporations, where aggregated information at country level is available. However, our method can be applied to all datasets where aggregated information on one or more of the attributes is available, if we have a priori knowledge of the underlying distribution. In Section 8.6 we further discuss the generalizability of our approach.

We start by modeling the company size (in terms of its operating revenue) as a lognormal distribution. Lognormal distributions arise naturally in multiplicative processes, where the growth (in this case revenue) between time \( t - 1 \) and \( t \), denoted \( R_t - R_{t-1} \), depends on the combinations of a series of factors \( F_k \) (for example, random fluctuations, type of business, population density, income of customers, etc.): \( R_t - R_{t-1} = F_k \cdot R_{t-1} \). This model is known as Gibrat’s law (Gibrat, 1931). The idea here is that the size (represented by revenue) of companies varies in size according to \( F_k \). After a certain total time \( t \) (corresponding to the present time) it holds that

\[
R_t = R_0 \cdot \prod_{k=1}^{t} (1 + F_k), \quad (8.1)
\]

and

\[
\log R_t = \log R_0 + \sum_{k=1}^{t} \log (1 + F_k). \quad (8.2)
\]

When using short time scales the effect of the factors is small, and \( \log (1 + F_k) \approx F_k \) and thus:

\[
\log R_t = \log R_0 + \sum_{k=1}^{t} F_k. \quad (8.3)
\]

Assuming that \( F_k \) are independent and identically distributed (i.i.d.) we obtain that \( R_t \) is lognormally distributed (central limit theorem) (Mitzenmacher, 2004). Moreover, a small change in the model, namely that the number of time iterations varies for different companies, produces power-law tails (Mitzenmacher, 2004; Montroll & Shlesinger, 1983), which we observe in our data, as we show at the end of this section. It is worth noting that the combinations of the factors within \( F_k \) are likely to follow lognormal distributions themselves. For instance, personal income follows lognormal distributions with power-law tails (Mitzenmacher, 2004; Montroll & Shlesinger, 1983) and population densities have long tails (Mitzenmacher, 2004).
Figure 8.2. Percentage of companies present in the data as a function of the number of employees working at these companies: < 10, 10-19, 20-49, 50-249 and ≥ 250 employees (GE250).
Either if $F_k$ are i.i.d. or if they exhibit long tails, revenue distributions can be well fitted by lognormal distributions. Lognormal distributions are characterized by two parameters: scale $\sigma$ and location $\mu$, such that $R \sim \ln \mathcal{N}(\mu, \sigma^2)$. Importantly, the standard deviation $s$ is proportional to the mean $m$:

$$\log(s) = \log(m) + \frac{1}{2} \log \left( e^{\sigma^2} - 1 \right)$$  \hspace{1cm} (8.4)

When the means and standard deviations of the revenue of all companies in a country are plotted against each other, the values for every country with enough data lie in a straight line (see Figure 8.3A), indicating that all countries share the same $\sigma$. Since $\sigma$ clusters around 2.0 in countries with known better quality (see Figure 8.3B), we fixed $\sigma = 2.0$.

Although this approach allows us to fix the scale and find the maximum likelihood $\mu$ parameter of the distributions, $\mu$ would be biased by data quality. In particular, we know that rich countries have better quality and a better reporting
Table 8.1. Predictors for the mean company revenue in a country ($\hat{R}$), and average coefficient of the support vector (mean effect), obtained using the Python sklearn (http://scikit-learn.org) package with a linear kernel and the default penalty parameter (1). The rightmost columns shows the percentage of simulations in which the variable was among the top 10 predictors. Only the indicators present in more than 20% of the repetitions were considered. If the variable code is preceded with 'log', then this variable was log-transformed.

<table>
<thead>
<tr>
<th>Variable code</th>
<th>Variable name</th>
<th>Mean effect</th>
<th>% Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>NY.GDP.PCAP.KD_2013</td>
<td>GDP per capita (constant 2005 US$)</td>
<td>0.283048</td>
<td>23.2</td>
</tr>
<tr>
<td>SH.XPD.PUBL.GX.ZS_2013</td>
<td>Health expenditure, public (% of government ex...</td>
<td>0.220553</td>
<td>25.7</td>
</tr>
<tr>
<td>logAG.YLD.CREL.KG_2013</td>
<td>Cereal yield (kg per hectare)</td>
<td>0.207313</td>
<td>24.8</td>
</tr>
<tr>
<td>logIC.TAX.DURS_2013</td>
<td>Time to prepare and pay taxes (hours)</td>
<td>-0.200198</td>
<td>24.0</td>
</tr>
<tr>
<td>AG.YLD.CREL.KG_2013</td>
<td>Cereal yield (kg per hectare)</td>
<td>0.198041</td>
<td>22.4</td>
</tr>
<tr>
<td>logTX.VAL.MRCH.RS.ZS_2013</td>
<td>Merchandise exports to developing economies in...</td>
<td>0.191862</td>
<td>22.8</td>
</tr>
<tr>
<td>logCE.EXP.DURS_2013</td>
<td>Time to export (days)</td>
<td>-0.184246</td>
<td>21.4</td>
</tr>
<tr>
<td>BM.TREP.WKR.CD.DT_2013</td>
<td>Personal remittances, paid (current US$)</td>
<td>0.179447</td>
<td>27.5</td>
</tr>
<tr>
<td>SPRUR.TOTL.ZG_2013</td>
<td>Rural population growth (annual %)</td>
<td>0.174098</td>
<td>27.8</td>
</tr>
<tr>
<td>IC.TAX.TOTL.PZS_2013</td>
<td>Total tax rate (% of commercial profits)</td>
<td>-0.169697</td>
<td>33.4</td>
</tr>
</tbody>
</table>

We then estimated the logarithm of the theoretical mean of the revenue distribution $\log (\hat{R})$ by using world development indicators (WDI). Since $\log (\hat{R}) = \mu + \sigma^2/2$ and $\sigma = 2.0$, estimating $\log (\hat{R})$ is equivalent to estimating $\mu$. In order to prevent overfitting, we fitted 1000 linear models using support vector regression on random samples containing 75% of the countries. We iteratively dropped the worst indicator until we found a core of 10 indicators. As shown in Table 8.1, the main indicator is GDP per capita. In fact, this indicator alone can explain 72% of the variability in OECD countries (82% if Norway is excluded). In general, larger income taxes and bureaucracy times are correlated with smaller companies, while larger productivity, GDP per capita and personal remittances paid are correlated with larger companies.

After estimating the revenue average we confirmed that it closely matches the average extracted from the OECD data ($R^2 = 0.91$). We then used this

---

3OECD SSIS.BSC.ISIC4, Cat. 05_82_LESS_K

4The aggregated revenue of companies in India and Canada was estimated from the GDP of the country using the linear relationship between $\log GDP$ and $\log (total revenue)$ of the other countries ($R^2 = 0.975$)

relationship between $\log(\hat{R})$ and WDI indicators to estimate $\log(\hat{R})$ for all countries in the world. Next, we hypothesized that companies are added to the source database in decreasing order of revenue. If this would be true, there would be a quasi-linear country-level relationship between the estimated average using WDI indicators ($\hat{R}$), and the product of the percentage of companies present in the dataset ($C$) and the average revenue in our dataset ($R^{Obs}$). We found that this was indeed the case ($R^2 = 0.82$), and the three variables are related as follows:

$$\log C = -1.3855 - 0.954 \log(R^{Obs}) + 1.1120 \log(\hat{R}). \quad (8.5)$$

Thus, for any given country we can now calculate the theoretical average ($\hat{R}$) (and $\mu$) using WDI indicators, and the completeness using the theoretical average and our dataset average. Finally, we compared the distribution of revenues in our dataset with the expected distribution using $\mu$ and $C$ (Fig. 8.4A). As expected, countries with good quality in Figure 8.2 also have good quality in Figure 8.4A. Canada, Australia and the US have sharp peaks at specific revenue bins, which are caused by lax reporting requirement in those countries. Moreover, similarly to income distributions (Mitzenmacher, 2004; Montroll & Shlesinger, 1983), we observe that revenue distributions are well-described by lognormal distributions with power-law tails for the $\sim 1\%$ larger companies (Fig. 8.4B–D). We conclude from Figure 8.4A that data quality in terms of completeness for large firms is generally good, while data quality for small firms depends on the considered country.

### 8.3.2 Accuracy

In addition to the problem of missing data, we may have duplicated data, which relates to the aspect of accuracy. Gathering and combining data from different sources is an error prone process, as often there is a lack of unique identifiers for entities (in our case, firms and directors). This issue is often referred to as the entity identification problem (Han et al., 2012). In case of corporate data, it means that companies can be reported several times or split into several parts for administrative or financial reasons, as discussed in Section 8.1. To counter this, we propose two techniques:
Figure 8.4. (A) Fraction of companies present (cell color intensity) by revenue category (horizontal axis) per country (vertical axis). (B–D) Distribution of company revenue in our database (orange) and distribution estimated using $\mu$ and $C$ (blue), for (B) Sweden, (C) Germany and (D) New Zealand.

1. An *a posteriori network construction step* in which we merge nodes (companies) with exactly the same board of directors and the same GUO (or having no GUO).

2. An *a posteriori topology-based correction step* in which we merge all nodes (companies) sharing a similar board and similar *position* in the network. To compute the similarity of boards of two companies, we...
Accuracy

used the ratio of shared directors to total unique directors (Jaccard similarity, see (Crandall, Cosley, Huttenlocher, Kleinberg, & Suri, 2008)). We then clustered all companies to obtain sets of firms where each pair of companies shared at least half of the members in the board of directors (Jaccard similarity greater or equal to 0.5). To guarantee that each company in the cluster had a minimum similarity of 0.5, we used complete linkage clustering (Rasmussen, 1992). Then, we further clustered the groups based on their local position in terms of a) degree, b) average neighbor degree, c) local clustering coefficient and d) average neighbor local clustering. All nodes with a similar board and with these four properties within 80% of each other are then merged together. While other threshold values are possible, our results are robust to variations in this parameter: changing the parameter to 90% or 70% changed the final number of nodes only by 2.2% and 2.4%, respectively.

Although the first fix is specific for our corporate network data, the second method of finding similar network positions is applicable to any social network dataset. As the method ultimately uses structural network attributes to combine duplicated entities, it is generally applicable to any affiliation network where data comes from different sources. See section 8.6 for examples of domains where this approach can be useful.

8.4 Results and Discussion

After analyzing the completeness of our data (Section 8.3.1), we have chosen to use the network of Sweden to demonstrate the effect of the two accuracy fixes proposed in Section 8.3.2. As shown in Figure 8.4, Sweden (SE) has high completeness across all company sizes, which will prevent confounding interactions between completeness and accuracy. We investigate the effect on network topology in Section 8.4.1, community detection in Section 8.4.2, centrality in Section 8.4.3 and finally diffusion in Section 8.4.4.

<table>
<thead>
<tr>
<th></th>
<th>Nodes</th>
<th>Edges</th>
<th>Density</th>
<th>( \bar{\text{deg}} )</th>
<th>CC</th>
<th>( \bar{d} )</th>
<th>Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original</td>
<td>94496</td>
<td>1050907</td>
<td>0.0119%</td>
<td>22.2</td>
<td>0.93</td>
<td>7.78</td>
<td>177.8 (10.0)</td>
</tr>
<tr>
<td>Step 1</td>
<td>60904</td>
<td>225887</td>
<td>0.0061%</td>
<td>7.4</td>
<td>0.57</td>
<td>7.94</td>
<td>128.8 (4.2)</td>
</tr>
<tr>
<td>Step 2</td>
<td>50733</td>
<td>139173</td>
<td>0.0054%</td>
<td>5.5</td>
<td>0.41</td>
<td>8.02</td>
<td>112.4 (5.2)</td>
</tr>
</tbody>
</table>

Table 8.2. Topological properties of the Swedish board interlock network.
8.4.1 Topology

The original Swedish board interlock network has 94,496 nodes and 1,050,907 edges in the largest component (Section 8.2), which is reduced to 50,733 nodes and 139,173 edges after the two steps (Section 8.3.2). Table 8.2 shows the number of nodes (firms), edges (board interlocks), density, average degree $\overline{deg}$, graph clustering coefficient $CC$, average node-to-node distance $\overline{d}$ and average number of communities (see (Streeter & Gillespie, 1993) for definitions of these common network metrics).

As expected given that we are merging clusters with high local clustering, the average degree and local clustering are reduced. Indeed, an average degree around 6 is far more realistic in board interlock networks than 22. The power of our approach is further reflected in the network visualizations. Figure 8.5A–C shows the original Swedish network, and the network after Steps 1 and 2 described in Section 8.3.2. While most of the edges in the original network were intra-corporate administrative ties, the successive steps were able to filter out such clusters and provide a representative final network topology.

8.4.2 Community detection

A common step in the topological analysis of social networks is community detection, where the network is divided in a set of communities—i.e., clusters of nodes more densely connected among each other than with other parts of the network. In the case of corporate networks, community detection has for example been used to analyze the business proximity between geographical regions, showing marked differences in globalization across the world (Heemskerk, Takes, Garcia-Bernardo, & Huijzer, 2016).

Poor data quality distorts the clusters discovered by community detection algorithms, especially in affiliation networks such as the interlocking directorate network. For instance, using the well-known Louvain algorithm based on modularity maximization (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008) the original network is divided into 178 communities, as shown in the rightmost column of Table 8.2 (values between parentheses denote standard deviations as a result of the random initialization of the algorithm). This value corresponds to an average of 531.5 companies per community, yet each corporate structure creates its own community (Fig. 8.5D), thus impairing the analysis of relationships between corporations. In contrast, the networks in
Step 1 and Step 2 are divided into only 129 and 112 communities, respectively (see Table 8.2), meaning that each community consists on average of 472.9 and 451.4 companies. Since clusters typically correlate with geographical regions (Heemskerk et al., 2016), companies can choose to expand to communities where their own directors have ties, or choose a new director highly embed in the target community.

### 8.4.3 Centrality

A typical step in social network analysis is to find the most prominent actors in the network, which is done using centrality measures. In this example, we choose three common measures: *degree centrality*, in which the importance of each node is proportional to its number of connections; *PageRank centrality*, in which the importance depends on the sum of the PageRank of your neighbors damped by a factor; and *betweenness centrality*, that relates the importance of
Figure 8.5E–H shows how local clustering and three centrality measures—degree, betweenness and PageRank—are affected by our data quality fixes. In general, our filtering mechanism smooths the distribution of centrality measures. While the degree distribution of the original data exhibits a fat tail (Fig. 8.5E), with some companies linked to up to 500 other companies, this was not the case for the data after Step 1 and 2. This is largely due to the reduction of clusters with high local clustering (Fig. 8.5F). Importantly, the distributions of betweenness and PageRank (Fig. 8.5G–H) are only minimally disturbed, showing a reduction in the number of nodes with very high betweenness, likely due to a reduction in clusters of high degree nodes.

Next, we tested if our data quality fixes improved our ability to obtain correct and thus actionable insights from a centrality analysis. In order to answer this question, we analyzed the correlation between the ranking of Swedish companies by number of employees and market capitalization with the ranking of companies given by degree, by PageRank and by betweenness centrality (Fig. 8.6). We found that each correction step increased the correlation between the ranking based on economic measures and the ranking based on network measures. This was especially the case for degree centrality (Fig. 8.6AD), but only to a very small extent for betweenness centrality (Fig. 8.6BE). Moreover, we found that the rankings obtained by all three network measures are comparable, which indicates that central nodes have more connections (degree), link
to other important firms (PageRank), and act as bridges between distant firms (betweenness). Finally, we found that the ranking given by market capitalization closely matches the ranking given by centrality (Spearman's rank correlation of 0.6 for the top 200-500 companies), showing that larger companies have also more central roles in the network.

In general it is hard to interpret the results of network analysis metrics and as such how actionable insights may be obtained. In case of centrality, it is not always obvious what it means to be more central in a network according to a particular measure. Directors seeking career advancements may pursue more positions at more central firms in the board interlock network (Davis, 1991). However, it is not clear how to achieve this from the perspective of the director. For instance, a director may choose to link to peripheral but promising companies, or attempt to maximize their influence by connecting to well-connected companies. We found that well-connected firms (large PageRank centrality) also act as bridges to other regions (large betweenness centrality). Since market capitalization (but not number of employees) is highly correlated with all centralities, in order to advance their careers directors could aim to be employed by companies with high market valuations. Moreover, directors can make themselves more attractive by linking to small but promising industries, allowing top firms to maintain their betweenness centrality scores in the network.

8.4.4 Diffusion model

As board interlock networks are assumed to play a big role in the diffusion of information between corporations, we tested how accuracy can affect the results of a SIR (susceptible, infected, recovered) model. These models are commonly applied to model information diffusion, as for example in the case of information among investors or technology diffusion between companies (Geroki, 2000; Shiller & Pound, 1989). To illustrate the effects of data quality, we have chosen to apply a simple SIR model: starting with one randomly infected node, at each iteration of the algorithm, each infected node infects their neighbors with probability 0.5, and recovers (becoming immune) with probability 0.3. Figure 8.6G shows the results of running 1000 simulations.

First, the process dies off in 19%, 27% and 37% of the simulation runs for respectively the original data and the data after Steps 1 and 2. Second, the
final equilibrium differs. Removing the clusters with high degree nodes slows down the spreading cascade and the percentage of nodes infected during the process, from 74% of infected nodes using the original network to 67% using the post Step 1 network and 63% using the post Step 2 network. These results are likely due to the larger number of high degree nodes in the original network, which allows for more possibilities of infection, and to the ‘reservoir’ effect of clusters—the infection quickly spreads within the clusters, infecting neighbors for a longer time until all nodes in the cluster recover.

8.5 Conclusions

The experiments in this paper demonstrate how insights and predictions obtained from social network analysis can be biased if the original data is of poor quality. If we want to ensure that network analysis results are correct, we must clean our data. For this, we first must determine the quality of the underlying data and where needed correct for it. To investigate the effect of data quality, in this paper we used corporate board interlock networks in which corporations are connected by shared board members.

The underlying company data is collected in a distributed fashion in different countries. Since the missing information is not distributed at random, assessing the completeness of this data is challenging. To address this problem, we used aggregated data from the OECD and fitted lognormal distributions to the revenue of the companies of each country. This enabled us to calculate the number of missing companies for different revenue ranges, allowing for a thorough assessment of how much data we are missing in each country. In general, our approach can be summarized as: (1) Dividing our sample in groups (e.g. by country) and determining the type of distribution of one of our variables (2) Finding the parameters of the distributions by group using external aggregated data—e.g. macroeconomics or aggregated statistics. (3) Using the relationship between aggregated data and the parameters to find the parameters for the groups where aggregated data is not available (4) Assessing if our sample is representative by comparing theoretical and empirical distributions.

The second problem addressed in this paper dealt with the accuracy of the data. This originates from the fact that data comes from multiple merged data
Diffusion model sources, and from the inherent way in which companies organize themselves. In order to not overestimate the importance of for example small companies, we proposed a method to merge corporate structures and remove spurious nodes. For this, we suggest two \textit{a posteriori} solutions to correct the network topology, where we identified duplicated companies—entities belonging to the same corporate structure—if they had similar boards of directors and similar structural positions in the network.

In our experiments, we investigated the effect of data quality by visualizing the networks to show how the original biased network becomes a clean network. First, we have demonstrated how our correction approach fixed the overall network topology. Second, we showed that the community structure of the network is no longer biased to corporate groups. Third, we have highlighted how the correlation between the most central nodes in the network and the nodes with higher market capitalization increases for the networks that were processed by our approach. Finally, we have shown how a simple SIR model demonstrates that bad data quality network data produces significant distortions in the propagation results.

8.6 Generalizability and future work

Although we have in our experiments explicitly demonstrated the applicability of our method in board interlock networks, as already explained in Section 8.3, the proposed techniques could be used across different kinds of network data.

The completeness assessment approach outlined in Section 8.3.1 can be applied to networks in which we know the distribution of one of the variables of the nodes in the dataset, and where aggregated data on segments of the data is available. This makes our approach applicable to the analysis of (co-)citation networks, for example to investigate if the considered data sample is biased toward high impact publications. We could use the average number of citations to fit lognormal distributions for different journals (Radicchi, Fortunato, & Castellano, 2008), and use those distributions to assess the completeness of the sample. Similarly, inter-event times in social communication (for instance emailing, tweeting or messaging) can also be well fitted by lognormal distributions (Doerr, Blenn, & Van Mieghem, 2013), whose parameters may depend on the characteristics of the person. If we have a sample of the
messages, we can assess its bias using the distribution of inter-event times. In
general, an increasing number of academics and companies are continuously
collecting fine-grained data. However, the collected data is rarely complete,
and often only aggregated data is available. For instance, a company may
use a snowball sampling strategy to collect information for different Twitter
users, where starting from a hub they collect all the people that mentioned in
the tweets. While the most important actors will quickly be collected, since
hubs usually connect with other hubs (Barabási, 2009), that is not the case for
peripheral nodes. Using just the distribution of the number of followers and
aggregated statistics on the number of Twitter users per country, our approach
could be used to asses the completeness of the sample, complementing
structural measures of sampling quality (Leskovec & Faloutsos, 2006).

Furthermore, the accuracy fixes discussed in Section 8.3.2 can be applied
when networks are compiled from multiple sources and have not been merged
correctly. For instance, consider combining data on people from different
sources (e.g., Linkedin, AngelList and CVs) based on their name. Since the
affiliations in Linkedin, AngelList and the CV are correlated, it is likely possible
to use our method to identify unique people. In general, our approach can a
posteriori help correct issues resulting from the entity identification problem in
any type of bipartite network.

While our paper focuses on completeness and accuracy of nodes, future work
can use similar principles to assess the completeness and accuracy of edges
in the network. Finally, extensions to dynamic networks in which timestamp
attributes are present, could be investigated, providing possible contributions
in the form of real-time data quality assessment.

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CHAPTER 9

Conclusion

The emergence and growth of multinational corporations brought acute challenges to the international tax system. The principles that were set in place to solve the problem of double taxation created opportunities for widespread tax avoidance. Nowadays 40% of all foreign profits of multinational corporations are shifted towards low-tax jurisdictions (Tørsløv, Wier, & Zucman, 2018). This is possible through the transformation of operating profits (e.g. selling coffee) into financial profits (e.g. royalties received for the right to use the image of a mermaid on a polyethylene cup). By strategically placing holding companies and value-creating assets in low-tax jurisdictions, MNCs can charge subsidiaries in high-tax jurisdictions, and erode the operating profits from higher-tax jurisdictions via royalties, interest, leasing of assets, or management and advertisement fees. As a reaction to this, and in an effort to remain a “competitive” location for foreign investment, governments around the world have decreased corporate income tax rates and provided generous tax incentives.

While the relevance of tax avoidance has been recognized since the late 20th century, quantitative research on tax avoidance has been hampered by a lack of data (IMF, 2000). This dissertation has employed an interdisciplinary approach to open the black box of corporate tax avoidance, combining theories and methods from political science, economics, international business and management, and computer science. This interdisciplinary approach allows me to show (I) the existence of two types of offshore financial centers: profit centers and coordination centers; (II) that holding companies have become a crucial constituent of MNCs, and that they are placed in offshore financial centers; (III) the extent to which offshore financial centers are responsible for the decrease in effective tax rates; and (IV) the relevance of coordination centers in the orchestration of corporate tax avoidance (see Table 9.1 for a visual summary of how these jurisdictions are relevant across the dissertation).
The list of jurisdictions included is as follows: Chapter 2: conduit jurisdictions, as well as Luxembourg and Hong Kong—which have features of both sink and conduits. Chapter 3: coordination centers. Chapter 4: jurisdictions with a disproportionate number of professionals working in corporate tax strategy. Belgium has an above average number of tax professionals but lower than the other jurisdictions. Chapter 6: Countries with misaligned profits of at least $10 billion. Hong Kong has positive misalignment of around $1 billion. Chapter 7: Countries where U.S. MNCs have increased their reported profits in the last 10 years. Chapter 8: outliers in the modeling of corporate sizes ($\sigma > 2.5$). Belgium and Luxembourg have above average $\sigma (2 < \sigma < 2.5)$. Countries for which data was not available are marked with a dash.

Most importantly, this dissertation reveals the increasing relevance of coordination centers with respect to corporate tax avoidance. I argue that coordination centers, together with large MNCs, are the largest winners from corporate tax avoidance. One could argue that profit centers also benefit from corporate tax avoidance. The GDP per capita of Bermuda is, after all, the fifth highest in the world\footnote{Below Monaco, Liechtenstein, Luxembourg and Macao, \url{https://data.worldbank.org/indicator/NY.GDP.PCAP.CD}} and 37% higher than the GDP per capita of the U.S. However, these benefits are usually tied to an economic and political elite (Palan, Murphy, & Chavagneux, 2013). In Bermuda, 23% of the population live in poverty according to the economist and former Head of Research for the Bank of Bermuda, Robert Stubbs\footnote{https://issuu.com/robertstubbs0/docs/poverty}. Conversely, coordination centers have been able to profit from attracting foreign investment with similar increases in inequality as neighbor countries (Fig. 9.1). This is likely to be the case because coordination centers not only attract empty holdings of MNCs, but also regional headquarters, treasuries, and other high value-adding activities. As discussed below, this increases the political and societal challenges associated with corporate tax avoidance.

Four important lessons can be drawn from the results of this dissertation. The first lesson deals with the distribution of power between states and corporations. The rise of capital mobility and financialization has increased the
Figure 9.1. Coordination centers and similar countries. The Netherlands, Switzerland, Luxembourg and Ireland (in green) are compared with Germany, France, Sweden, Finland and the European Union (in light gray). (A) Gross national income (GNI) per capita compared with the average “high income” country. Note that GNI is less susceptible to tax-related distortions of macroeconomic statistics than GDP. (B) Share of income obtained by the wealthiest 1%. Sources: (A) the World Bank Data (B) the World Inequality Database.

ability of firms to establish subsidiaries and shift profits to offshore financial centers. This has increased the structural power of business over the state (Babic, Garcia-Bernardo, Huijzer, & Valeeva, forthcoming). One example of how this manifests itself is that large multinational corporations are able to obtain generous tax advantages from governments. Companies such as Amazon, McDonalds, Apple, Starbucks and Fiat have obtained favorable treatment with respect to the price that they are able to charge subsidiaries for the use of their financial products, reducing their tax rates (Hardeck & Wittenstein, 2018). Since these tax incentives are only available to large MNCs, tax avoidance has also increased the power of large firms vis-à-vis small- and medium-sized enterprises.

Beyond skewing the power balance between large MNCs and states and domestic firms in favor of the former, the rise of capital mobility has also increased the power of coordination centers. Coordination centers attract not only the profits of MNCs through low taxation on financial profits, but also high value-adding shared service centers as well as corporate management. The recent reforms regarding tax avoidance have especially targeted profit centers, which in turn strengthens the position of coordination centers—hence they are expected to continue growing in power and importance. The emergence of coordination centers has also reduced the tax sovereignty of third countries, limiting their ability to tax corporate profits. While countries could prevent

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3This is done through secret Advance Pricing Agreements (Gunn & Luts, 2015; Luja, 2016).
profit shifting to profit centers via withholding taxes, countries cannot prevent profit shifting to coordination centers. Partially because of this lack of tax sovereignty, and fostered by discourses around “national competitiveness,” governments around the world have been urged to reduce corporate income tax.

The second lesson deals with the future reforms of the international tax system. Stiglitz (2017, ch. 13) mentions that:

Reforms in the offshore banking centers, established as tax and regulatory avoidance havens, only took on momentum after September 11. This should not come as a surprise; these facilities exist as a result of deliberate policies in the advanced industrial countries, pushed by financial markets and the wealthy.

Since 2001, and especially since the financial crisis of 2007, reforms have focused on eliminating secrecy in offshore financial centers, eliminating gaps and mismatches in tax rules, and aligning economic substance (i.e. sales, assets and employees) with value creation (i.e. profits). All major OFCs have now signed “Tax Information Exchange Agreements” with other countries (OECD, n.d.), and tax professionals and other intermediaries are required to play an active role in reporting possible instances of tax avoidance to tax authorities (OECD, 2017). The Base Erosion and Profit Shifting (BEPS) project, an international collaboration project mainly under the auspices of the OECD, was set up to close gaps and mismatches in tax rules (where a lot of progress is being made) and to align economic substance with value creation. However, MNCs can easily create the minimally required economic substance in those countries where they choose to book their profits, for example by adding shared service center activities to their holding companies. Indeed, the overlap that we found in our analysis between countries attracting shared service centers and intermediate holding companies suggests that this is already common practise. This might, in fact, reinforce rather than discourage international tax competition. In general, these reforms have strengthened coordination centers, which is reflected in an increased share of profits being booked in these jurisdictions.

This dissertation also contributes to the evaluation of the potential consequences of formulary apportionment, also known as unitary taxation. Unlike the current tax system, where countries have the right to tax the profits booked
within the jurisdiction, under formulary apportionment countries would have
the right to tax a share of the global profits of the MNCs, typically calculated
using a formula based on the fraction of global corporate turnover, tangible
assets and employees present within the jurisdiction. The countries would then
decide on the tax rate applied to their share of the profits. While multinationals
can move “real” activity (employees, assets or revenue) to low-tax jurisdictions,
it is generally agreed that it would curb profit shifting (Clausing, 2016). This
system is already in place to distribute US federal taxes among the different
States, and it is currently being evaluated by the OECD, IMF and EU (Chapter 6
and (De Mooij, Liu, & Prihardini, 2019 OECD, 2019 European Commission,
2011)). For example, the EU has proposed a formula in which one third of
the profits are allocated according to tangible assets, another third according
to revenue, and the last third according to the number of employees and the
employee costs. In line with the results of this dissertation, there are two
potential challenges to this proposal. The first one is a political one: the
formula that weighs assets, employees and revenue has a large impact on the
amount of profits allocated to each country. As such, agreeing on a common
formula will undoubtedly be a highly politicized issue (Ylönen & Teivainen,
2018). In general, less developed countries would prefer a formula weighted
towards the number of employees, while more developed countries will prefer
formulas based on revenue and cost of employees. The second challenge is
that by curtailing the opportunities for international tax competition for profits,
this may incentivize countries to use tax incentives to compete for assets and
employees (Keen, 2001 Clausing, 2016). MNCs will have large incentives to
further outsource operations located in high-tax jurisdictions, and move high
value-adding activities to coordination centers.

The third lesson relates to the study of economic statistics, and more specifically
to their use in analyzing the effects of tax policy. The increasing importance
of intangible and financial assets for multinational corporations, together with
the relevance of multinational corporations in today’s economy, greatly distorts
macroeconomic statistics (Linsi & Mügge, 2019). Recent studies have shown
that 40% of total FDI is conduit investment—that is, the routing of investment
without creating any associated substance (Casella, 2019 Haberly & Wójcik,
As such, these distortions play a key role in directing tax policy. Meta-
analysis on existing research shows that a 1% increase in taxation decreases
FDI by approximately 3% (De Mooij & Ederveen, 2003). Chapter 3 shows that researchers should take the fragmentation of the firm into consideration. If we want to really understand the effect of tax policy on investment, we need to go beyond research on numbers that primarily indicate conduit activities, and start measuring real economic activity.

Finally, the fourth lesson relates to recent studies in wealth inequality. The erosion of taxation and the growth of capital power has fueled within-country inequality, which has laid the base for public unrest across Europe and Latin America, and underpinned the rise of the extreme right and social populism. Within-country inequality has been generally increasing since the 1980s (Alvaredo, Chancel, Piketty, Saez, & Zucman, 2017). Worldwide, the top 0.1% owns the same wealth as the bottom 50%. In the United States, the wealthiest 3500 people (top 0.001%) own the same as the bottom 50% (roughly 160 million people). This can be attributed to the multiplicative growth of wealth accumulation (returns are multiplied by the current wealth) and the erosion of wealth-equalizing institutions (Piketty, 2015; Scheffer, Van Bavel, Van De Leemput, & Van Nes, 2017). Partially as a result of tax avoidance and the decrease in corporate income tax rates, jurisdictions have increasingly shifted the tax burden from capital to labor, and especially consumption. As a result, the progressivity of the tax system has completely disappeared (Saez & Zucman, 2019b). While the top 350 people (top 0.0001%) paid a tax rate of 70% in 1950, now they pay 23%. Meanwhile, the bottom 160 million people pay around 25% of their income in taxes (Saez & Zucman, 2019b; Leonhardt, 2019). This is a consequence of the reliance of the wealthiest on income from financial sources (capital gains, dividends, rental income), which is taxed at a reduced rate (Saez & Zucman, 2019b, 2019a), and the use of offshore financial centers by wealthy individuals (Alstadsæter, Johannesen, & Zucman, 2018, 2019; Zucman, Fagan, & Piketty, 2015). The top 1% now receives over 70% of all capital income (dividends, capital gains, rents and interest), and owns 90% of the offshore wealth (Zucman, 2019). This dissertation brings new insights into the inequality debate in two ways. First, it shows how the wealth-equalizing institutions have been eroded by the actions of offshore financial centers—directly through tax avoidance, and indirectly through tax competition. Second, it provides us with a target for legislation by showing that the orchestration of tax avoidance takes place in coordination centers. Instead of shaming small-
island jurisdictions into compliance, we should aim legislation efforts towards coordination centers.

Corporate tax avoidance seriously compromises public spending. This not only affects inequality by reducing welfare spending, but thwarts initiatives that require state intervention. Climate change is the main example. The cost of carbon emissions is not included in the price of products—this is the “impeccable” economic logic of pollution. Because of this, transitioning to “less efficient,” cleaner energies requires public spending, which tax avoidance seriously compromises. Targeted taxation through a carbon tax could also help raise the needed funds and account for the externalities of carbon emission—as reflected in the work of Bill Nordhaus on the social cost of tax, for which he was awarded the Nobel Memorial Prize in Economic Sciences (Appelbaum, 2018).

Fixing the tax system is, in my opinion, one of the largest challenges that societies face in the 21st century with regard to ensuring a sustainable and prosperous future. If we want to reduce inequality, raise revenue to transition to cleaner energies, and contribute to the well-being of our entire society, we need to reinstate progressive and targeted taxation. This is only possible if we are able to tax capital, which requires a thorough understanding of how offshore finance creates the conditions for tax avoidance. A radical transformation of the international tax system, whereby the potential harmful effects of coordination centers are limited, should be the focus for policy efforts towards thwarting corporate tax avoidance.

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APPENDICES

The appendices of all chapters—also referred to as “supplementary information”—can also be found online at https://osf.io/49swa/
Appendix of Chapter 2
Uncovering Offshore Financial Centers: Conduits and Sinks in the Global Corporate Ownership Network

Javier Garcia-Bernardo¹, Jan Fichtner¹, Frank W. Takes¹,², and Eelke M. Heemskerk¹

¹CORPNET, Amsterdam Institute for Social Science Research, University of Amsterdam, Nieuwe Achtergracht 166, 1018 WV, Amsterdam, The Netherlands
²LIACS, Department of Computer Science, Leiden University, Niels Bohrweg 1, 2333 CA, Leiden, The Netherlands
*{garcia,j.r.fichtner,takes,e.m.heemskerk}@uva.nl

Supplementary Methods

Cities in Isle of Man (IM), Jersey (JE) and Guernsey (GG)

Companies under the country code of the United Kingdom in the following cities were assigned to IM, JE and GG:

<table>
<thead>
<tr>
<th>Code</th>
<th>Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM</td>
<td>DOUGLAS, RAMSEY, CASTLETOWN, ONCHAN, PEEL, BRADDAN, PORT ERIN, BALLASALLA, PORT SAINT MARY, LAXEY, SAINT JOHN’S, KIRK MICHAEL, SANTON</td>
</tr>
<tr>
<td>JE</td>
<td>SAINT HELIER, JERSEY, SAINT CLEMENT, SAINT SAVIOUR, SAINT PETER, SAINT MARTIN, SAINT LAWRENCE, SAINT Ouen, TRINITY, SAINT JOHN, SAINT MARY, ST HELIER, GROUVILLE, ST. HELIER, ST. HELIER, JERSEY</td>
</tr>
<tr>
<td>GG</td>
<td>GUERNSEY, ST PETER PORT, ST. PETER PORT, ST. PETER PORT, GUERNSEY, SAINT PETER PORT</td>
</tr>
</tbody>
</table>

Deconsolidation of financial statements

Deconsolidation takes place in two steps. In the first step, all companies under the same global ultimate owner are grouped and the ownership structure constructed. Starting from the bottom of the tree (the small subsidiaries) we tracked up the subsidiaries of companies with consolidated accounts. Moreover, we considered a company A subsidiary of a company B (with consolidated accounts) if they shared the same global ultimate owner and their values of revenue and number of employees were within 25% of each other, even when no ownership link was recorded in the database. We then iteratively (from the bottom of the tree to the root) subtracted the number of employees and the operating revenue of the subsidiaries.
In the second step, all companies with more than 1000 employees were grouped together. We considered company A subsidiary of a company B (with consolidated accounts) if their values of revenue were within 25% of each other. We then iteratively subtracted the operating revenue of the subsidiaries. This approach corrects for duplicated information among large companies.

**Normalization of ownership**

Since the information is collected by different country-level agencies and merged by Orbis, the sum of the stakes of the shareholders do not always add up to 100%. We corrected by collecting all direct ownership stakes. When the sum of the direct ownership stakes was below 100% we added total ownership up to 100%, when it was above we normalized the ownership to sum up to 100%.

**Mathematical formulation of country chains**

The paper provides an explanation of the process from ownership links to country chains based on the different construction steps. Here we outline the theoretical definitions of the concepts obtained in each of these steps.

In the global corporate ownership network \( N = (F, E) \), firms are represented as a set \( F \) of size \( n = |F| \). The set of ownership relations \( E \) contains a total of \( m = |E| \) pairs \((i, j)\) indicating that there is a directed ownership relation between firms \( i, j \in F \). Here, firm \( j \) owns \( i \) and thus value may flow from \( i \) to \( j \). The link weight \( w(i, j) \in [0; 1] \) or in short \( w_{ij} \) represents the ownership percentage of a relation \((i, j) \in E \). For example, the value of \( w_{ij} \) is equal to 0 for non-existing links, equal to 1 for fully owned subsidiaries of \( j \) and 0.3 in case of 30% ownership. The value of a node \( i \), denoted \( R(i) \) or in short \( R_i \), represents the (always positive) value of firm \( i \). Here we use the revenue of the firm.

Multiple ownership relations may together form an ownership path: an ordered sequence of firms in which each subsequent pair of firms is connected through an ownership link. So, for a path \( p \) of length \( \ell = |p| \) with firms \( p = (v_1, v_2, \ldots, v_\ell) \) it holds that \((v_i, v_{i+1}) \in E \) for \( 1 \leq i < \ell \). For brevity, in the paper such as a path is denoted \( v_1|v_2|\ldots|v_\ell \). A simple path has no repeated nodes, i.e., no cycles. The notion of multiplicative ownership \( w(p) \) or in short \( w_p \) models the ownership weight relation \( w(v_i, v_j) \) along a particular ownership path \( p = (v_1, v_2, \ldots, v_\ell) \) of length \( \ell = |p| \) as the multiplication of weights of the links between the subsequent nodes in the path, i.e.,

\[
 w_p = w(p) = \prod_{i=1}^{\ell-1} w(v_i, v_{i+1})
\]

The value \( V(p) \) of a path \( p \), in short \( V_p \), is defined as the value that flows from the first to the last node in the path, i.e., the product of the value of this first node and the multiplicative ownership of the path:

\[
 V_p = V(p) = R_{v_1} \cdot w_p
\]

An ownership chain of a firm \( v \) is an ownership path \( p \) which satisfies four criteria: it starts at node \( v \), it is a simple path (has no repeated nodes), it has a multiplicative ownership value of at least threshold \( \theta \), i.e., \( w_p \geq \theta \) and is maximal in length, i.e., cannot be extended by adding another node. Experiments with different values \( \theta \) are discussed in the section ‘Sensitivity analysis’ of
A node typically starts more than one ownership chain, and the set of all ownership chains starting at node \( v \in F \) is denoted \( C(v) \) or in short \( C_v \). Ultimately, \( C \) represents the set of all ownership chains in the network:

\[
C = \bigcup_{v \in F} C_v
\]

Each chain \( p \in C \) in the set of ownership chains is in fact a path of length \( \ell = |p| \). From an ownership chain, we can generate all possible subpaths of length 2, 3, \ldots, \( \ell \), which together we call the set of ownership chunks, denoted \( H \). The set of ownership chunks of length \( x \) is denoted \( H^x \). Each chunk \( q \in H \) has an associated value \( V^p(q) \) or in short \( V_q^p \). This value depends on the value of the first node in the ownership chain \( p \) that chunk \( q \) originated from, as well as the path followed from that node to chunk \( q \).

For each node \( v \), a function \( \phi(v) \to I \) indicates the country \( c \in I \) in which firm \( v \) is based. The function can be applied to both paths and individual nodes. For each previously obtained chunk \( q = (v_1, v_2, \ldots, v_x) \), we create a country chain in two steps. First, we map each node in the chunk to its respective country, obtaining:

\[
\phi(q) = (\phi(v_1), \phi(v_2), \ldots, \phi(v_x))
\]

Note that in the main text of the paper, for brevity when we talk about country chains we use the ISO 2-letter country codes combined with the shorthand notation discussed above, e.g., NL\( |\)LU\( | \)KY. Second, we merge any two subsequent nodes of the same country \( v_i, v_{i+1} \) in a mapped chunk \( \phi(q) \), i.e., if it holds that \( \phi(v_i) = \phi(v_{i+1}) \), replace this pair by \( \phi(v_i) \). This results in country chain \( g \). The valuation function \( V^\phi(g) \) of a country chain \( g \in G \) sums the weights of the ownership chunks that map to this particular country chain. For brevity, in the main text of the paper we again use \( V_g \) when it is clear from the context that we consider a country chain \( g \). Note that as a result of the second step, the length of a resulting country chain may be shorter than the length of the originating ownership chunk. Furthermore, multiple ownership chunks may result in the same country chain. Applying this process to all ownership chunks in \( H \) results in the full set of country chains \( G \). Analogously to before, we denote the set of country chains of length \( x \) as \( G^x \). These chains are the basis for the definitions of sink-OFC and conduit-OFC centrality proposed in the main text of the paper.

**Comparison of our data with Foreign Direct Investment (FDI)**

FDI reflects controlling ownership stakes in all the companies in one country by all the companies located in another country. In order to further assess the quality of our data, we compared the value of transnational ownership ties of firms from a particular country against the foreign direct investment (FDI) of that country, as provided by the IMF. Since some countries systematically under-report inward FDI, we kept for each country the maximum value between the value reported by the country, and the sum of outward FDI to that country as reported by the counterpart economies. The weighted ownership matches well with FDI data (Figure S1).

**Null model for Figure 3**

Companies own stakes of other firms across the world. When these stakes are aggregated at the country level, we obtain a fully connected network where the weight of the link corresponds to the sum of value flowing between the pair of countries. In order
Figure S1. FDI vs aggregated ownership data. (A) Fraction of revenue ending in country $c$ versus fraction of inward FDI associated to country $c$. (B) Fraction of revenue starting in country $c$ vs. fraction of outward FDI associated to country $c$. Since FDI reflects only controlling shareholdings, only chains with more than 50% ownership were included.

to keep only significant links, we created a null model where the weight between two countries was set to the product of the GDP of both countries. We kept only those edges with a weight 10 times larger than in the null model – after normalizing both networks to have the same sum of edge weights.

**Sector specialization**

Starting from the global corporate ownership chains of size three ($G^3$) we mapped each company to its corresponding sector code (NACE Rev. 2) as provided by Orbis. We then grouped all sectors according to their dominant position in chains of size three: the first position (source), second (conduit) and third (sink), finding six categories: only source, only conduit, only sink, source+conduit, source+sink, conduit+sink and source+conduit+sink, by using the criteria in Table S2.

Finally, the weight of a sector within a category (e.g., sink) was calculated as the sum of the value of the chains where the sector participates in its category (sink) minus the sum of the value of the chains where the sector participates in other categories (conduit or source). The weight was further normalized by the sum of the value of companies that participate in the network in such category.

<table>
<thead>
<tr>
<th>CAT</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the source position.</td>
</tr>
<tr>
<td>CO</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the conduit position.</td>
</tr>
<tr>
<td>SI</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the sink position.</td>
</tr>
<tr>
<td>SO+CO</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the source or conduit positions and $&gt; \frac{1}{3}$ of the times in each</td>
</tr>
<tr>
<td>SO+SI</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the source or sink positions and $&gt; \frac{1}{3}$ of the times in each</td>
</tr>
<tr>
<td>SI+CO</td>
<td>$&gt; \frac{1}{3}$ of all $G^3$ containing a given sector contain it in the sink or conduit positions and $&gt; \frac{1}{3}$ of the times in each</td>
</tr>
</tbody>
</table>
Supplementary Information

Sensitivity analysis

We investigated the effects of varying the thresholds used in Methods.

**Multiplicative ownership of 0.001:** We calculated the sink-OFCs and conduit-OFCs using thresholds for the multiplicative ownership equal to 0.1 and 0.01 (Figure S2). For the threshold of 0.1 two small sink-OFCs (Nauru and Monaco) fell out of this category, and three small sink-OFC were found (Aruba, Guernsey and Saint Kitts and Nevis, Figure S2A). A new small conduit-OFC was also found (Austria, Figure S2B). For the threshold of 0.01 we found the same classification of territories into sink and conduit-OFCs that we found using our original threshold (0.001), which indicates that we achieved convergence (Figure S2C–D). Further lowering the threshold would not provide new benefits and would significantly increase computational time.

![Figure S2](image-url)

**Figure S2.** Variation of chain value for different multiplicative ownership thresholds. sink-OFCs (orange) and conduit-OFCs (green) for threshold 0.1 (A–B) and 0.01 (C–D).

$S_c > 10$: We classified countries as sink-OFCs when the value remaining in the country was larger than ten times the GDP of the country ($S_c > 10$). The sink-OFC classification varies with the $S_c$ threshold as reflected in Table S3. The countries identified as conduit-OFCs vary with the $S_c$ threshold as reflected in Table S4. Importantly, the five large conduit-OFCs are found independently of the $S_c$ threshold studied (Table S4). When the $S_c$ threshold is increased to 100, several sink-OFCs (Luxembourg, Cyprus, Hong Kong, Marshall Islands, Gibraltar and Bahamas) become conduit-OFCs (Table S4 and Fig. S3), which indicates a double role of those jurisdictions as sink and conduit-OFCs.
Table S3. sink-OFCs for different thresholds of $S_c$

<table>
<thead>
<tr>
<th>Country</th>
<th>$S_c$ · GDP</th>
<th>$S_c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgin Islands, British</td>
<td>9.4 · 10^{11}</td>
<td>5235.2</td>
</tr>
<tr>
<td>Taiwan, Province of China</td>
<td>2.3 · 10^{11}</td>
<td>2277.4</td>
</tr>
<tr>
<td>Jersey</td>
<td>4.6 · 10^{11}</td>
<td>397.3</td>
</tr>
<tr>
<td>Bermuda</td>
<td>4.1 · 10^{11}</td>
<td>374.0</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>1.5 · 10^{11}</td>
<td>330.7</td>
</tr>
<tr>
<td>Samoa</td>
<td>3.7 · 10^{10}</td>
<td>276.4</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>1.4 · 10^{11}</td>
<td>225.3</td>
</tr>
<tr>
<td>Curacao</td>
<td>6.5 · 10^{10}</td>
<td>114.6</td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>3.7 · 10^{7}</td>
<td>99.6</td>
</tr>
<tr>
<td>Malta</td>
<td>1.7 · 10^{11}</td>
<td>99.3</td>
</tr>
<tr>
<td>Mauritius</td>
<td>1.6 · 10^{11}</td>
<td>75.3</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>8.1 · 10^{11}</td>
<td>71.1</td>
</tr>
<tr>
<td>Nauru</td>
<td>1.6 · 10^{9}</td>
<td>67.2</td>
</tr>
<tr>
<td>Cyprus</td>
<td>2.8 · 10^{11}</td>
<td>62.1</td>
</tr>
<tr>
<td>Seychelles</td>
<td>1.2 · 10^{10}</td>
<td>59.7</td>
</tr>
<tr>
<td>Bahamas</td>
<td>6.5 · 10^{10}</td>
<td>39.8</td>
</tr>
<tr>
<td>Belize</td>
<td>1.1 · 10^{10}</td>
<td>37.5</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>1.3 · 10^{10}</td>
<td>33.8</td>
</tr>
<tr>
<td>Anguilla</td>
<td>9.3 · 10^{8}</td>
<td>26.8</td>
</tr>
<tr>
<td>Liberia</td>
<td>6.2 · 10^{9}</td>
<td>17.5</td>
</tr>
<tr>
<td>Saint Vincent and the Grenadines</td>
<td>2.0 · 10^{9}</td>
<td>14.3</td>
</tr>
<tr>
<td>Guyana</td>
<td>8.1 · 10^{9}</td>
<td>14.1</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>7.4 · 10^{11}</td>
<td>14.0</td>
</tr>
<tr>
<td>Monaco</td>
<td>1.3 · 10^{10}</td>
<td>10.7</td>
</tr>
<tr>
<td>Saint Kitts and Nevis</td>
<td>1.2 · 10^{7}</td>
<td>8.3</td>
</tr>
<tr>
<td>Aruba</td>
<td>4.0 · 10^{9}</td>
<td>7.7</td>
</tr>
<tr>
<td>Panama</td>
<td>5.1 · 10^{10}</td>
<td>7.1</td>
</tr>
<tr>
<td>Qatar</td>
<td>2.3 · 10^{11}</td>
<td>6.6</td>
</tr>
<tr>
<td>Norway</td>
<td>3.4 · 10^{11}</td>
<td>3.4</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>5.0 · 10^{8}</td>
<td>3.2</td>
</tr>
<tr>
<td>San Marino</td>
<td>6.9 · 10^{8}</td>
<td>3.0</td>
</tr>
<tr>
<td>Saint Lucia</td>
<td>6.7 · 10^{8}</td>
<td>2.8</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>1.8 · 10^{11}</td>
<td>2.6</td>
</tr>
<tr>
<td>Libya</td>
<td>3.9 · 10^{10}</td>
<td>2.5</td>
</tr>
<tr>
<td>Dominica</td>
<td>2.3 · 10^{8}</td>
<td>2.4</td>
</tr>
<tr>
<td>United States</td>
<td>7.2 · 10^{12}</td>
<td>2.3</td>
</tr>
<tr>
<td>Iceland</td>
<td>6.1 · 10^{9}</td>
<td>2.3</td>
</tr>
<tr>
<td>Brunei Darussalam</td>
<td>5.6 · 10^{9}</td>
<td>1.7</td>
</tr>
<tr>
<td>Lebanon</td>
<td>1.3 · 10^{10}</td>
<td>1.6</td>
</tr>
<tr>
<td>Canada</td>
<td>4.6 · 10^{11}</td>
<td>1.3</td>
</tr>
<tr>
<td>Andorra</td>
<td>7.7 · 10^{8}</td>
<td>1.2</td>
</tr>
<tr>
<td>France</td>
<td>5.7 · 10^{11}</td>
<td>1.1</td>
</tr>
</tbody>
</table>

$C_{c(in/out)} > 1$ We classified countries as conduit-OFCs when the value going through the country into (out) of a sink-OFC was larger than the GDP of the country ($C_{c(in/out)} > 1$). The countries identified as conduit-OFCs are sensitive to changes in the $C_{c(in/out)}$ threshold. For instance moving the threshold from 1 to 0.1 would include a large set of countries into the conduit-OFC category (e.g., France, Germany, Norway, Russia). Moving the threshold from 1 to 10 would make The Netherlands and
Table S4. conduit-OFCs for different thresholds of $S_c$

<table>
<thead>
<tr>
<th>Country</th>
<th>Threshold 1</th>
<th>Threshold 10</th>
<th>Threshold 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>conduit</td>
<td>conduit</td>
<td>conduit</td>
</tr>
<tr>
<td>Belgium</td>
<td>conduit</td>
<td>conduit</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>conduit</td>
<td>conduit</td>
<td>conduit</td>
</tr>
<tr>
<td>Guernsey</td>
<td>conduit</td>
<td></td>
<td>conduit</td>
</tr>
<tr>
<td>Singapore</td>
<td>conduit</td>
<td>conduit</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>conduit</td>
<td>conduit</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>conduit</td>
<td>conduit</td>
<td></td>
</tr>
<tr>
<td>Panama</td>
<td>sink</td>
<td>conduit</td>
<td></td>
</tr>
<tr>
<td>Luxembourg</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Cyprus</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Gibraltar</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Bahamas</td>
<td>sink</td>
<td>sink</td>
<td></td>
</tr>
<tr>
<td>Barbados</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Belgium to be the only countries identified as conduit-OFCs (Figure S3C). However, we hypothesized that the set of identified conduit-OFCs constitute a homogeneous cluster. In order to test this, we clustered the territories using the KMeans algorithm from the sklearn Python package. We found that all big five conduit-OFCs are always found in the same cluster when we asked the algorithm to find two to six clusters (Figure S4). Moreover, Austria, Panama, Isle de Man, and Barbados are also often in the same cluster than the conduit-OFCs, which is expected since they have been considered tax havens. We found that a group of countries composed by The Netherlands, Belgium, Ireland, Singapore, United Kingdom and Switzerland always constitute their own cluster with threshold $C_{c(in/out)} = 1$. This cluster is different from the cluster of sink-OFCs (higher values of $C_c$) and the cluster(s) of other countries (lower values of $C_c$). Thus, we found that the division between conduit-OFCs and other countries occur naturally around $C_{c(in/out)} = 1$.

**Euroclear and Belgium as a conduit-OFC, Panama and Guernsey**

From the set of conduit-OFCs the peripheral position of Belgium stands out. Closer inspection of the underlying data reveals that Belgium derives its conduit-OFC status foremost from the ownership chains SHELL NL → Euroclear NL → Euroclear BE → Euroclear LU (Euroclear is a large custodian, which means that in this case there are no data available on the ultimate owners of this stake in Shell). Two other peripheral conduit-OFCs are Panama and Guernsey, since many GCOCs going to sink-OFCs go through the countries in comparison to their GDP. However, both jurisdictions are very small actors.

**Comparison of sink-OFC and conduit-OFC centrality with other rankings of offshore financial centers and tax havens**

We compared our ranking (based on the value entering the sink) of offshore financial centers to previous rankings and lists of countries (Table S5): (1) Oxfam2016\(^2\), a semi-quantitative assessment of jurisdictions based on the following criteria: “Relatively large role as a corporate tax haven; Corporate Income Tax rate as a proportion of the global average rate; No withholding tax (law, not tax treaties); Aggressive tax planning indicators – score for tax incentives; Lack of Controlled Foreign
Company rules – CFC; Lack of commitment to international efforts against tax avoidance.\textsuperscript{7} (II) FSI2015\textsuperscript{5}, a quantitative assessment of jurisdictions based on the secrecy index (a sum of 15 indicators correlated to financial secrecy) and the weight of the jurisdiction in the global trade of financial services. (III) EU2015\textsuperscript{4}, a simple list released by the European Union. (IV) IMF2000\textsuperscript{5}, a qualitative assessment based on regulatory framework of the jurisdictions\textsuperscript{6}. (V) IMF2008\textsuperscript{7}, based on the 46 jurisdictions invited to cooperate with the Information Framework\textsuperscript{7}. (VI) Fichtner\textsuperscript{8}, a quantitative approach based on the ratio of the external capital in a jurisdiction with its gross domestic product.

\textbf{Figure S3.} Sink (red) and conduit-OFCs (green) for different threshold of $S_c$: (A) 1, (B) 3, (C) 10, (D) 30 and (E) 100.
Figure S4. Clusters found using the KMeans algorithm for (A) 2, (B) 3, (C) 4, (D) 5 and (E) 6 clusters. Note that a group of countries formed by among others The Netherlands, Ireland, Singapore, United Kingdom and Switzerland appear always in the same cluster.
Table S5. Comparison of different rankings of countries. ‘Dest.’ corresponds to the value flowing into the jurisdiction. NN $S_c$ corresponds to the non-normalized sink centrality.

IMF2000 categories; 1: Non-cooperative 2: Below international standards 3: Generally cooperative. *The centrality of Belgium is based on an incorrect classification of one company by the data provider (see Supplementary Information)
References


Appendix of Chapter 3
SUPPLEMENTARY FIGURES

Figure S1. Median fraction of M&A flows (net) to greenfield FDI and M&A (net). M&A is measured as net cross-border M&A sales for the years 2003 to 2018. Greenfield FDI is measured as value of announced greenfield FDI projects. 95% confidence intervals of the median (in black) are calculated using 1000 bootstrapping samples. Data was collected from the World Investment Report Annex Tables for the years 2003-2017.
Figure S2. The FDI is not equally distributed across EU member states. FDI stock (2017) as a percentage of GDP (2017). All FDI data was collected from the UNCTAD World Investment Report (2018), GDP data was collected from the International Monetary Fund World Economic Outlook (2018).
Figure S3 (part 1). Initial clustering of the activity indicators (Cosine / average), and robustness to the change of the distance metric (Euclidean / average) and to the change of the linkage method (Average / Complete). The dendrogram on the left of each subplot visualizes the distance between countries. Countries appear in two connected branches of the tree if they share similar values for all indicators, and they appear in different branches of the tree if the value of the indicators is negatively correlated. The clusters identified in the main text are marked with numbers for comparison. Missing values are estimated using KNN (Methods).
Figure S3 (part 1). Initial clustering of the activity indicators (cosine / average), and robustness to the change of the distance metric (cosine / euclidean) and to the change of the linkage method (average / complete). The dendrogram on the left of each subplot visualizes the distance between countries. Countries appear in two connected branches of the tree if they share similar values for all indicators, and they appear in different branches of the tree if the value of the indicators is negatively correlated. The clusters identified in the main text are marked with numbers for comparison. Missing values are estimated using KNN (Methods).
Figure S4. Initial clustering of the FDI attraction profile. The dendrogram on top of each subplot visualizes the distance between countries. Countries appear in two connected branches of the tree if they share similar values for all indicators, and they appear in different branches of the tree if the value of the indicators is negatively correlated. The clusters identified in the main text are marked with colored boxes for comparison.
SUPPLEMENTARY METHODS

S1. Indicators

Table S1 contains a summary of the source, units and description of the indicators. Descriptive statistics for all indicators and pairwise-correlation matrices are provided in tables S2-S6 -- one for each category of FDI. All indicators in dollars were converted to euros using the average rate between 2007-2017: 1.295. This conversion is only relevant for the descriptive statistics since the normalization removes the units.

S2. Clustering algorithm

Clustering algorithms group countries together if they have similar values for all indicators. There are many different ways to calculate the similarity between two arrays of numbers. Two of the most common are euclidean distance and cosine similarity. Once the similarity between each pair of countries is computed, the aggregation step takes place. In the aggregation step, those two clusters that are most similar are combined into a higher-level cluster. This process is repeated several times, creating a hierarchical clustering. There are different measures of similarity between clusters. Examples are “single linkage”, where the similarity is the largest similarity between all the countries in cluster A and all countries in cluster B, “complete linkage”, where the similarity is the smallest similarity, and “average linkage”, where the similarity between clusters is the average similarity between each country of cluster A with each country of cluster B. In this paper, we used average linkage since we are trying to find classes of countries that are compact but also distinct from other clusters.

The choice of the similarity metric (e.g. euclidean or cosine) and the aggregation method (e.g. single, complete or average) strongly affects the clusters produced. In order to quantify and minimize the effect of the decisions we analyze the results in the light of our expectations, and provide with a sensitivity analysis (Figure S3) where we vary the similarity metric (cosine or euclidean) and the linkage method (average or complete) in order to assess the robustness of the clusters.

The following paragraphs detail our decision on how to assign countries to clusters when the different distance and linkage methods gave conflicting results.

Manufacturing affiliates

Malta, Slovakia, Czechia, Hungary, Poland, Bulgaria and Romania always appeared together as a compact cluster. We decided to include Estonia since both the greenfield FDI in manufacture and the percentage of jobs in manufacturing are high. While Slovenia could also have been included, we decided against it since both the greenfield FDI in manufacturing and the percentage of jobs in manufacturing are moderate -- more similar to Austria or Belgium than to the countries in the first cluster.

Shared service centers affiliates

We created a cluster with the United Kingdom and Luxembourg since they always appeared in the same cluster. We then added the Netherlands and Ireland because they appear together with the United Kingdom and Luxembourg in two specifications of Figure S3, and especially because they share high
value added per employee, high productivity and high greenfield FDI in support and technical activities, which are characteristics that only those four countries share. Then, we created a cluster with Switzerland, Denmark, Finland, Austria, Belgium and Sweden because they were always found together in the same cluster. We excluded France from the cluster (even when it appeared together in one specification) because of the low percentage of people employed in technical and support activities. Finally, we created a third cluster composed of Hungary, Romania, Czechia, Estonia and Portugal. While these countries typically appear in different parts of the dendrogram, they share extremely low value added per employee together with high percentages of the population employed in the sector, and high greenfield FDI in support and technical activities.

R&D affiliates

A large group of countries appeared always together: Germany, Switzerland, the Netherlands, France, Finland, Slovenia, Denmark and Sweden. We included Ireland, Belgium and Austria to the group because they appear in the neighboring cluster and share extremely high values of inward R&D expenditure by GDP, as well as high employment in the sector. Furthermore, we decided to create a second cluster with Czechia, Hungary and Bulgaria because they share a large inward R&D expenditure per GDP and have a high percentage of patents owned from foreign countries.

Top holdings

Cyprus Malta and Luxembourg create a compact cluster with extremely high scores of most activity indicators -- primarily because of their small size. Secondly, we created a cluster with Ireland, Netherlands, United Kingdom, Austria and Switzerland because of their high profit rates compared to domestic companies and their ability to attract top holdings. While the macro-institutional features of Ireland are closer to the first cluster, we decided to include it in the second cluster since its size is more similar to the second group. While Germany and France are not too different from Austria, we decided to exclude them from the clusters because they do not attract large numbers of top holdings or equity relative to their economy sizes. We finally created a third cluster with Belgium, Denmark, Sweden and Finland, characterized by attracting large numbers of top holdings, but with low profit rates.

Intermediate holdings

Malta and Hungary always appeared together during the clustering analysis. We added Cyprus to this cluster because of its similarity to Malta in all other indicators. We then created a second cluster, composed of Switzerland, Ireland, Luxembourg, and the Netherlands because those countries appeared always together. We further added Belgium because it appears close to the other countries in the dendrogram and shares high scores of all indicators with them. We also added the United Kingdom because it also appears close in the dendrogram, shares large values of conduit investment with them -- no other country does -- and has similar macro-institutional indicators. Finally, we created a third cluster composed of Sweden, Austria, Denmark and Finland because they always appear close to the countries in the second cluster but with lower ratios of all indicators, and because they have homogeneous macro-institutional indicators.
S3. Missing data

The clustering algorithm requires complete (non-missing) data, since it compares the similarity between two countries using all indicators. Since most indicators are from Eurostat, data on Switzerland is generally missing. Moreover, data on labor cost and ICT infrastructure is missing for the United Kingdom and Greece. Data imputation is possible in our case since the variables are correlated (see Tables S2-S6) and information in the missing indicators can be extracted from other indicators. In order to leverage the correlation between variables we used the KNN algorithm, where missing data is calculated from countries with similar values in the other variables using the Python package fancyimpute.

S4. Country summaries

We summarized how successful countries are at attracting each category of FDI by using the sum of all activity indicators: \( S = \sum_i x_i \), where \( S \) is the degree of success at attracting the specific type of FDI and \( x_i \) are the normalized activity indicators, \( i \), ranging from -2 for low levels of activity to +2 for high levels of activity. In order to compare the European countries among themselves, the success of each country was then normalized using the method from section 4.3.1 in the main text.

In order to capture only low value-adding manufacturing activities, we excluded the indicator “Value added manufacture / employee (foreign)” from the sum, and multiplied it instead: \( S = x'_{va} \sum_i x_i \), where \( x'_{va} = (\max(x_{va}) - x_{va}) \) is the normalized [Value added manufacture / employee (foreign)] indicator. Subtracting the indicator from the maximum value solves two problems. First, it ensures that all values of \( x'_{va} \) are positive. This prevents countries with low activity indicators (negative values of \( \sum_i x_i \)) and low value adding activities (negative values of \( x_{va} \)) from having a positive success (S). Second, it reverses the order of the data. Countries with low value added per employee are matched to high scores, giving a higher weight to countries where low value added activities take place. In order to separate low value-adding SSCs from high value-adding SSCs, we proceeded as in the manufacture case, with the difference that the success for high value-adding SSCs was calculated as \( S = (x_{va} - \min(x_{va})) \sum_i x_i \). By subtracting the minimum value from the indicator we ensure that all values are positive. This prevents countries with low activity indicators (negative \( \sum_i x_i \)) and low value added per employee (negative \( x_{va} \)) from having a positive success (S). Finally, for the category R&D operations, the indicators [# domestic owned patents / GDP] and [% foreign patents] are useful to profile different countries, but do not measure the intensity of foreign R&D operations in the respective country. To account for this, we excluded both indicators from the sum.
We used cluster analysis to create the FDI attraction profiles. Since the measures obtained by summing all indicators are only a crude measure of the intensity of FDI attraction, we combine it with our own, more qualitative, interpretation of Figures 4-8. For instance, Germany and Ireland have similar values of R&D, but in the German case they are driven by a high number of domestically owned patents / GDP, and in the Irish case by high values of inward R&D expenditure / GDP (see Figure 6). The following paragraph details our decision on how to assign countries to FDI attraction profiles when the different specifications of the cluster analysis yielded contradictory results.

- Manufacturing centers: All countries in this category were found as a compact cluster in all specifications of Figure S4.
- Coordination centers: Belgium, Netherlands and Ireland always appeared together in the cluster analysis (Figure S4). We decided to include Switzerland because it appears together in 3 out of 4 specifications and primarily because of its high levels of intermediate holdings (Figure 8). Luxembourg and the United Kingdom were often found together and were also included in the cluster since they share high levels of high-value adding SSCs (Figure 5), and because they play a key role in intermediate holdings (Figure 8) (García-Bernardo et al. 2017). While Germany appears in two specifications within the group, we decided to exclude it since they do not play an important role as a conduit location and have a low percentage of jobs in shared service centers (Figure 5).
- Innovation centers: Denmark, Finland, Sweden and Austria appear together in one specification and they appear together in Figure 6, 7, and 8. Based on Figure S4, France and Germany could have been included in this cluster, but we decided against it since they attract comparatively lower levels of R&D from foreign sources (Figure 6).
- Back-office centers: Estonia, Portugal and Spain appeared together in all clustered. We decided to exclude Spain because the high values in SSCs are mainly an artifact of its large population (Figure 5).
- Profit centers: We created a category of profit centers composed of Malta and Cyprus. This cluster is characterized by extremely high levels of top holdings (Figure 7).

S5. Operationalization

S5.1 Manufacturing affiliates

Activity indicators

We started by identifying countries that are successful in attracting manufacturing affiliates of foreign firms (MAFs). First, to get a sense of the importance of each country for the total population of MAFs in Europe, we looked at the share of the total number of MAF jobs in Europe that is captured by each country [Log # jobs manufacture (foreign)]. Second, we approximated the weight of MAFs’ activities in each country’s economy. To do so, we included the share of the country’s labor force employed by MAFs [% country jobs manufacture (foreign)]. Third, to approximate the extent to which these employment figures reflect investments made by foreign firms in new manufacturing operations, rather than merely a change
of ownership into foreign hands of manufacturing operations that had for long been in the country, we estimated the value of Greenfield FDI in manufacturing operations received by each country [Greenfield manuf. FDI / GDP]. Next, we distinguished between low value adding and higher value-adding manufacturing activities using the value added per employee in MAFs [Value added manuf. / employee (foreign)]. Finally, we also visualized the wage-adjusted productivity using the value added in the sector per employee [Productivity manuf. (foreign)] to determine the competitiveness of each country.

Macro-institutional indicators

From our reading of the literature (see section 3.1), we infer that most manufacturing offshoring involves relatively routine and labour-intensive tasks and that the main reason for TNCs’ to offshore these tasks is to reduce labor cost. Thus, we use [Labor cost] as our main macro-institutional indicator. However, to also account for the offshoring and reshoring of more complex manufacturing tasks, and to be able to distinguish between countries that are similar in terms of labor costs, we also included several other macro-institutional variables, such as the skill level of the workforce [Human capital], the presence of a stable and efficient political system [Governance], and good transportation infrastructure [Infrastructure] and telecommunication networks [ICT infrastructure].

Tax and policy indicators

We expect TNCs to offshore manufacturing activities to those countries that, given similar labor cost advantages, provide the most beneficial tax regime. Therefore, we incorporate into our analysis the statutory corporate income tax rate [CIT]. Because the tax rate that is actually paid by multinationals can depart widely from the statutory tax rate -- e.g., the average statutory rate in Luxembourg in 2007-2017 was 25.4%, while the ETR was 3.9% -- we include the effective tax rate to capture this feature [ETR (TNCs)] for each member state. Moreover, we assume that TNCs would like to repatriate profits generated by their manufacturing activities without facing double taxation. We therefore assess the ease with which profits can be transferred out of the country. We operationalize this by considering the withholding taxes on dividends levied by the host country [WHT dividends]. Moreover, both the level of withholding taxes on outbound payments and the terms and conditions of the investment in a country can be guaranteed through bilateral tax- and investment treaties. Since we assume Western European firms to be responsible for most of the relocations of manufacturing affiliates to EU member states, we also considered the

1 The value added per employee primarily reflects the productivity of the worker when comparing within an industrial activity. However, comparing the productivity across activities (e.g. in the manufacture sector in two different countries) reflects mainly the capital-labor ratio of the activity as such. In those cases, using the wage-adjusted productivity can provide a better estimate of the advantages of offshoring to the country.
number of bilateral tax- [# tax treaties Western EU] and investment treaties [# inv treaties Western EU] that possible host countries have signed with Western European countries. Finally, taxation of manufacturing activities can be further reduced through tax incentives granted in special economic zones or other forms of tax breaks on manufacturing investments. We capture this by considering the total number of such incentives in force in each member state [# incentives to manufacture].

S5.2 Shared Service Centers

Activity indicators

To identify countries that successfully attract SSC affiliates of foreign firms (SAFs), we developed the following approach. To isolate SSC activities from the rest of the service sector, we focus our analysis on two economic activities that we associate most directly with SSCs: “Professional, scientific, technical, administration” and “support service activities”. We then analyzed the available Eurostat data on these activities in the following way. First, to get a sense of the importance of each country for the total population of SAFs in Europe, we looked at the share of the total number of SAFs jobs throughout Europe that is captured by each country. Second, we approximated the weight of foreign owned SSCs’ activities in each country’s economy. To do so, we calculated the share of the country’s labor force employed in SAFs [% country jobs support | technical (foreign)]. Third, to assess the extent to which these employment figures reflect investments made by foreign firms in previously non-existing SSC operations, we estimated the value of Greenfield FDI that each country receives in the business service sector [Greenfield support | technical. FDI / GDP]. Next, we distinguished between low value adding and higher value-adding SSC activities using the value added per employee [Value added support | technical / employee (foreign)]. Finally, we also included the wage-adjusted productivity through the value added in the sector per employee [Productivity support | technical (foreign)] to determine the competitiveness of each country.

Macro-institutional indicators

As discussed in section 3.2, the offshoring of SSC activities can be motivated by two considerations: cost reduction and access to qualified staff. Assuming access to qualified staff as a motivation for the offshoring of SSC operations, we expect countries that successfully attract SSCs to exhibit high levels of [Human capital] and [Governance]. Assuming cost reduction as a motivation for the offshoring of SSC activities, on the other hand, we rather expect the presence of SSCs in a country to be correlated with low [Labor costs].

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2 We measure the number of tax treaties signed before 2000 since most Eastern European countries entered the EU in 2004. The incorporation to the EU entails the elimination of withholding taxes within corporate groups (EU Parent-Subsidiary Directive and EU Interests and Royalties Directive).

3 Codes M and N in the classification systems NACE Rev. 2 and ISIC Rev. 4
Moreover, because of the communicative nature of all kinds of SSC operations and the crucial role played by both transportation- and information and telecommunication infrastructure in them, we expect medium to high levels of both [Infrastructure] and [ICT infrastructure] as well as [English language] to be a requirement for both low- and high value-adding SSC operations.

**Tax and policy indicators**

The tax arrangements that matter for the location of SSCs depend mainly on the way in which the SSC is organized, and especially the way in which it is compensated for its services. As explained previously, SSCs can be organized either as a cost center or as a profit center. When organized as a cost center, SSCs operate with a fixed budget that is financed either directly by the global or regional headquarter or through a cost contribution agreement between selected group subsidiaries. In those cases we expect tax considerations to be of little relevance in TNCs’ decision where to locate their SSCs. When organized as a profit center, on the other hand, SSCs are compensated for their services through the payment of service fees by those group subsidiaries that make use of its services. In this case, we expect the availability of a wide network of tax treaties, which may lower withholding tax rates levied on incoming service fee payments, to be taken into account as an important consideration by TNCs when deciding upon a location for their SSC. To account for this, we included the indicator [# tax treaties] in our analysis. Moreover, minimizing taxation on the distribution of dividends may be an important consideration in TNCs’ location decision for SSCs that are set up as profit center. For this, we also considered the rate of withholding taxes on dividends levies by each jurisdiction [WHT dividends]. Finally, certainty in the long-term prospects of the investment could play a role in the location decision in countries with weaker institutions, which we operationalize with the number of bilateral investment treaties. [# of inv. treaties].

**S5.3 R&D facilities**

**Activity indicators**

Next we identified countries that are particularly successful in attracting TNCs’ R&D facilities. To do so, we first looked at the share of the country’s labor force employed in corporate R&D facilities [% country jobs R&D (total)]. Second, we captured the extent to which these employment figures reflect R&D activities of foreign firms. For this, we constructed an indicator that calculates for each country the total business expenditures on R&D financed from abroad adjusted for that country’s GDP [Inward R&D expenditure / GDP]. Third, we assessed the inventive performance of foreign firms in each country. For this we considered the number of patent applications to the European Patent Office made by foreign-
owned firms in each country, corrected for the size of each country’s economy [# foreign owned patents / GDP]. To be able to compare the inventive performance of foreign firms in a country with that of domestic firms, we also considered the number of patent applications made by domestically-owned firms, corrected for a country’s GDP [# domestic owned patents / GDP], as well as the percentage of the total number of patent applications accounted for by foreign owned firms [% patent foreign]

**Macro-institutional indicators**

A major driver of the internationalization of TNCs’ R&D activities is the ability to access pools of highly qualified knowledge workers. We therefore expect countries that are successful in attracting TNCs’ R&D facilities to characterized by high levels of human capital, especially in the field of science and technology. We captured this with two indicators, one of which measures the percentage of the population that has completed tertiary-level studies [Human capital], and the other measuring the percentage of graduates in science, technology, engineering and mathematics [STEM graduates]. Moreover, because the supply of highly qualified knowledge workers is scarce in most countries, we expect TNCs to highly value destination countries that provide attractive living environments for expatriate workers. Typically these are countries in which a large part of the population is fluent in English and in which the quality of life is perceived to be high. To capture these macro-institutional requirements, we considered the percentage of the population that speaks English [English Speakers] as well as the score each country is granted on the NUMBEO quality of life index [Quality of Life Index]. Finally, we assume R&D activities to require good IT infrastructure, which we captured with our [ICT infrastructure] indicator.

**Tax and policy indicators**

An increasing number of countries offers tax incentives designed specifically to attract R&D activities. These include partial wage tax exemptions for highly-skilled migrants, research tax credits, or super deductions. We analyzed their effect by including the total number of such incentives [R&D incentives]. Moreover, one of such incentives, the presence and terms of a patent/innovation box, may be particularly important to attract R&D facilities. For this, we included the generosity of the patent box in the country [Patent box score], which we constructed based on (Alstadsæter et al. 2018; Evers, Miller, and Spengel 2015; Chen et al. 2016) (see Supplementary Methods).

**S5.4 Top holdings**

**Activity indicators**

We captured the activities of top holdings using six indicators. Our first and second indicators measure the number of large [# large top holdings / GDP] and small [# small top holdings / GDP] top holdings
corrected for the size of the economy, where large holdings own at least 100 foreign subsidiaries, and small holdings own less than 10 foreign subsidiaries. Our third indicator [# large top head offices / GDP] captures the number of top holdings that are actively involved in strategic management and other headquarter activities. Our fourth indicator [Equity assets in country / GDP] measures the total value of equity assets held by all non-financial companies in the respective country divided by the country’s GDP. Because the main function of top holding companies is to hold equity stakes in its subsidiaries, we assume this ratio to be high for countries that host disproportionate large numbers of TNCs’ top holding companies. We developed our fifth and sixth indicators to capture profit shifting to top holdings. Because the average TNC engages in at least some degree of profit shifting to its top holding company (Johansson et al. 2017; Di Schinger, Knoll, and Riedel 2014), we expect after-tax profit rates (profit before tax / cost of employees) of multinationals in jurisdictions that harbor large amounts of top holdings to be relatively high [Profit rate (TNCs)], and especially we expect them to be higher than the profit rates of domestic companies [Profit rate (TNCs - domestic)].

Macro-institutional indicators

We expect four macro-institutional features to be correlated with countries that are successful in attracting top holding companies. The first of these concerns the size of a country’s economy [Log GDP]. Countries with small domestic economies have the largest potential incentives to set up the institutions and policies required to effectively engage in tax competition for top holdings (Wilson 1999). Secondly, because the top holding fulfills such a crucial function in the organization and management of the corporate group, we assume that TNCs would want this entity to be located in a country with a business-friendly and stable political climate. This we capture with our [Governance] indicator. Thirdly, since the offshore ecosystem is dominated by the United Kingdom, including its territories and former colonies, we expect countries that appear as preferred locations for TNCs’ top holdings to have a workforce that is fluent in English [English]. Finally, our fourth indicator [Big Four Staff / # companies] takes the relative staff size of the Big Four accounting firms in a country as a proxy for the services of the offshore services

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4 Note, however, that a high ratio of equity assets to GDP [Equity assets in country / GDP] may just as well suggest a prominent presence of intermediate holding companies (see section 4.1.5. below). This indicators is thus best understood as a necessary, but not a sufficient condition for a prominent presence of top holding companies in a country.

5 We measure the profit rate as gross profit divided by employee costs, rather than divided by sales, because this is less sensitive to tax-motivated manipulation of values (Clausing 2009).
industry (accountants, legal advisors, actuaries, tax advisors) required to set up and maintain their top holding companies in the respective jurisdiction (Murphy and Stausholm 2017).

**Tax and policy indicators**

We expect low corporate income tax rates for multinationals to be the most important feature of countries that successfully attract TNCs’ top holdings (Johansson et al. 2017). Because the tax rate that is actually paid by multinationals can depart widely from the statutory tax rate -- e.g., the average statutory rate in Luxembourg in 2007-2017 was 25.4%, while the ETR was 3.9% -- we use the effective tax rate to capture this feature. Countries may also minimize the administrative burden on TNCs by adopting lenient and light-touch tax legislation. We capture this with our indicators [# Anti-avoidance provisions] and [Time to Prepare Taxes]. Moreover, to present themselves as attractive locations for TNCs’ top holdings, countries may facilitate distributions of profits to shareholders by not levying any withholding taxes on dividends [WHT dividends]. A further feature that we include in our analysis concerns countries’ international tax- and investment treaty networks. We expect countries that attract top holdings through minimal tax rates not to have large networks of tax treaties [# tax treaties], because other countries would not be interested in signing treaties that would further facilitate the shifting of profits outside their borders. Countries that attract top holdings through moderate tax rates and outstanding macro-institutional features, on the other hand, are expected to have a broad network of tax treaties. This is the case because tax treaties ensure that TNCs do not face double taxation when engaging in profit shifting to top holdings -- for instance, to distribute dividends to shareholders. Finally, the tax rules that apply to multinationals need not necessarily be available to domestic firms. For this reason, we expect the effective tax rates of multinational companies to be lower than those of domestic firms in countries that attract large numbers of top holding companies [ETR (domestic - TNCs)].

### S5.5 Intermediate holdings

**Activity indicators**

We distinguish three types of intermediate holding companies: Intellectual property (IP) conduits, equity conduits and loan/finance conduits. We capture activities of the first type using charges for the use of IP [Charges for IP / GDP]. Activities of the second type are captured by measuring the total value of equity

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Note, however, that this last indicator is a hybrid one; it could equally be perceived as a reflection of the top holding activities, since a large presence of the Big Four would reflect a large demand for their services. In fact, the presence of the Big Four could even be perceived as a benefit that countries gain from hosting top holding companies in that it reflects an indirect employment benefit that they enjoy from doing so.
assets held by non-financial companies in each country as a share of GDP [Equity Assets in country / GDP] as well as each country’s conduit centrality [Conduit investment / GDP], which measures how prominently a country appears in the middle of equity structures. We capture the presence of finance conduits in a country by measuring the loan assets held by non-financial companies in the country, corrected for that country’s GDP [Loan assets in country / GDP].

**Macro-institutional indicators**

We assume four macro-institutional features to be of particular significance for TNCs decision on where to locate their intermediate holding companies. The first is a stable political climate, combined with a business-oriented government. For this we have constructed the [Governance] indicator. A second macro-institutional feature that we assume to be of relevance is the availability of good ICT infrastructure, as this is needed to coordinate the financial flows going through the holding companies [ICT infrastructure]. Moreover we use the relative staff size of the Big Four accounting firms in each country [Big Four Staff / # companies] as a proxy for the services of the offshore services industry required to set up and maintain intermediate holdings. Finally, we assume access to sophisticated financial institutions and deep and developed capital markets to be a requirement for the proper functioning of finance conduits [Financial Development Index].

**Tax and policy indicators**

National tax regimes constitute a key consideration in TNCs’ location decision for their intermediate holding companies. Given the fact that in many cases the very rationale for the use of intermediate holding companies is to transfer profits across jurisdictions while incurring as little taxation as possible, two requirements need to be met: outbound payments of royalties, interests or dividends made by intermediate holdings should not be subjected to withholding taxes [WHT royalty, WHT interest, WHT dividend], and a large network of tax treaties should be available to reduce withholding taxes on incoming payments [#of tax treaties] and [# of tax treaties (2000)]. Secondly, the tax regime needs to be light-touch with low bureaucracy [Time to Prepare Taxes] and lenient tax legislation [# Anti-avoidance provisions]. Moreover, for royalty conduits it is especially important to have access to an innovation- or patent box, which offers significantly reduced tax rates on income generated by by the receipts of royalty payments for the licensing of intellectual property, such as copyrights, patents or trademarks [Patent box score].

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7 See (Garcia-Bernardo et al. 2017) for a more detailed discussion of the concept of conduit centrality.

8 Note that both a high ratio of equity assets to GDP [Equity assets in country / GDP] and a relatively large staff size of the Big Four accounting firms [Big Four Staff / # companies] may just as well suggest a prominent presence of top holding companies (see note 6). These indicators are therefore best understood as necessary, but not sufficient conditions for a prominent presence of intermediate holding companies in a country.
finance conduits, two additional types of tax incentives are of specific importance. One is the notional interest deduction [Notional interest deduction], which allows companies financed with equity to deduct a fictional interest cost, calculated as the qualifying equity multiplied by the applicable NID rate, from their tax base (Kestens, Van Cauwenberge, and Christiaens 2012; Marres 2012). The second type of incentive includes other tax measures allowing special tax treatment for interest income [Other interest incentives], which we operationalized as all regimes providing an incentive to financing companies (Marres 2012). Finally, TNCs may consider the availability of investment treaties with those countries in which they have their other subsidiaries as an important factor in their decision where to locate an intermediate holding company. We therefore expect the availability of a large number of such treaties to be associated with countries that successfully attract TNCs’ intermediate holding companies [# of inv. treaties].

Marres, Otto. 2012. Tax Treatment of Interest for Corporations. IBFD.
**SUPPLEMENTARY METHODS**

Table S1: Indicator, name in dataset, unit of the, operationalization, available years and data source(s).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Name in dataset</th>
<th>Unit</th>
<th>Operationalization</th>
<th>Year</th>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity indicators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># jobs manuf. (foreign)</td>
<td>man_emp_mult</td>
<td>#</td>
<td>Persons employed - number (B)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
<td>1</td>
</tr>
<tr>
<td>% country jobs manuf. (foreign)</td>
<td>norm_man_emp_mult</td>
<td>%</td>
<td>Persons employed - number (B) / Labor Force</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08), (WBD: SL.TLF.TOTL.IN)</td>
<td>1</td>
</tr>
<tr>
<td>Value added manufacture / employee (foreign)</td>
<td>man_prod_mult</td>
<td>1000€/ employee</td>
<td>Apparent labour productivity (Gross value added per person employed) (B)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
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</tr>
<tr>
<td>Productivity manufacture (foreign)</td>
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<td>%</td>
<td>Simple wage adjusted labour productivity (Gross value added by personnel costs) (B)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
<td>1</td>
</tr>
<tr>
<td>Greenfield manuf. FDI / GDP</td>
<td>norm_fdi_greenfield_man</td>
<td>%</td>
<td>(Value of announced greenfield FDI projects, by destination * Number of employees in MAF's) / (Number of employees in all AF's * GDP)</td>
<td>2007-17</td>
<td>(UNCTADstat: WIR18_tab14), (Eurostat: fats_g1a_08), (WBD: NY.GDP.MKTP.CD)</td>
<td>1</td>
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<tr>
<td># jobs support</td>
<td>technical (foreign)</td>
<td>support_emp_mult</td>
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<td>Persons employed - number (M&amp;N)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
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<td>% country support</td>
<td>technical manuf. (foreign)</td>
<td>norm_support_emp_mult</td>
<td>%</td>
<td>Persons employed - number (M&amp;N) / Labor Force</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08), (WBD: SL.TLF.TOTL.IN)</td>
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<tr>
<td>Value added support</td>
<td>technical / employee (foreign)</td>
<td>support_prod_mult</td>
<td>1000€/ employee</td>
<td>Apparent labour productivity (Gross value added per person employed) (M&amp;N)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
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<tr>
<td>Productivity support</td>
<td>technical (foreign)</td>
<td>support_prod_adj_mult</td>
<td>%</td>
<td>Simple wage adjusted labour productivity (Gross value added by personnel costs) (M&amp;N)</td>
<td>2008-15</td>
<td>(Eurostat: fats_g1a_08)</td>
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<tr>
<td>Greenfield support</td>
<td>technical FDI / GDP</td>
<td>norm_fdi_greenfield_ssc</td>
<td>%</td>
<td>(Value of announced greenfield FDI projects, by destination * Number of employees in SAF's) / (Number of employees in all AF's * GDP)</td>
<td>2007-17 (except Eurostat, 2008-15)</td>
<td>(UNCTADstat: WIR18_tab14), (Eurostat: fats_g1a_08), (WBD: NY.GDP.MKTP.CD)</td>
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<td>Inward R&amp;D expenditure / GDP</td>
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<td>%</td>
<td>Business expenditure on R&amp;D (Sector: Total economy, Source: Abroad) / GDP</td>
<td>2007-16</td>
<td>(Eurostat: rd_e_berdfundr2), (WBD: NY.GDP.MKTP.CD)</td>
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<tr>
<td># foreign owned patents / GDP</td>
<td>norm_foreign_patents</td>
<td>#/€bn</td>
<td>Number foreign ownership of domestic inventions in patent applications to the EPO / GDP</td>
<td>2007-13 (Eurostat), 2007-17 (WBD)</td>
<td>(Eurostat: pat_ep_nfgn), (WBD: NY.GDP.MKTP.CD)</td>
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<td># domestic owned patents / GDP</td>
<td>norm_domestic_patents</td>
<td>#/€bn</td>
<td>Number domestic ownership of domestic inventions in patent applications to the EPO / GDP</td>
<td>2007-13 (Eurostat), 2007-17 (WBD)</td>
<td>(Eurostat: pat_ep_nfgn), (WBD: NY.GDP.MKTP.CD)</td>
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<td>% patents foreign</td>
<td>foreign_patents_perc</td>
<td>%</td>
<td>Number foreign ownership of domestic inventions in patent applications to the EPO / Number patent applications to the</td>
<td>2007-13</td>
<td>(Eurostat: pat_ep_nfgn)</td>
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<td>Description</td>
<td>Metric</td>
<td>Source Details</td>
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<tr>
<td>R&amp;D researchers / GDP</td>
<td>norm_researchers_rd</td>
<td>R&amp;D personnel and researchers in business enterprise sector (Type: Researchers, Sector: Total economy) / Labor force</td>
<td>%</td>
<td>2013-16 (Eurostat), 2007-17 (WBD) (Eurostat: rd_p_perqual11), (WBD: SL.TLF.TOTL.IN)</td>
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<td>Conduit investment / GDP</td>
<td>norm_investment_conduit</td>
<td>Conduit investment / GDP</td>
<td>%</td>
<td>2015 (Orbis (García-Bernardo et al. 2017) and (WBD: SL.TLF.TOTL.IN) 15</td>
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<tr>
<td>Charges for IP / GDP</td>
<td>norm_ip_payments</td>
<td>Charges for the use of intellectual property, payments / GDP</td>
<td>%</td>
<td>2007-17 (WBD: BM.GSR.ROYL.CD) and (WBD: SL.TLF.TOTL.IN)</td>
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<td></td>
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<tr>
<td>Equity Assets in country / GDP</td>
<td>norm_equity_trans</td>
<td>Median value of equity (assets) (Sector: Non-financial corporations, Type: Consolidated) / GDP</td>
<td>%</td>
<td>2007-17 (Eurostat: nasa_10_f_tr_1) and (WBD: SL.TLF.TOTL.IN) 18</td>
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<td>Loans Assets in country / GDP</td>
<td>norm_loans_trans</td>
<td>Median value of loans (assets) (Sector: Non-financial corporations, Type: Consolidated) / GDP</td>
<td>%</td>
<td>2007-17 (Eurostat: nasa_10_f_tr_1) and (WBD: SL.TLF.TOTL.IN) 18</td>
<td></td>
<td></td>
</tr>
<tr>
<td># small top holdings / GDP</td>
<td>norm_lth</td>
<td>Number of GUOs with less than 10 foreign subsidiaries / GDP</td>
<td>#/€bn</td>
<td>2017 (Orbis) 2007-17 (WBD) and (WBD: SL.TLF.TOTL.IN) 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td># large top holdings / GDP</td>
<td>norm_lth</td>
<td>Number of GUOs with at least 100 foreign subsidiaries / GDP</td>
<td>#/€tl</td>
<td>2017 (Orbis) 2007-17 (WBD) and (WBD: SL.TLF.TOTL.IN) 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td># large head offices / GDP</td>
<td>norm_hq</td>
<td>Number of GUOs with at least 100 foreign subsidiaries / GDP In the sector 70.10: Activities of head offices</td>
<td>#/€tl</td>
<td>2017 (Orbis) 2007-17 (WBD) and (WBD: SL.TLF.TOTL.IN) 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax revenue (%GDP)</td>
<td>tax_gdp</td>
<td>Taxes on capital as % of GDP - Income of corporations</td>
<td>%</td>
<td>2007-16 (Eurostat and Swiss Federal Statistics Office <a href="https://data.oecd.org/tax/tax-on-corporate-profits.htm">https://data.oecd.org/tax/tax-on-corporate-profits.htm</a>)</td>
<td></td>
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<tr>
<td>Macro-institutional indicators</td>
<td></td>
<td></td>
<td></td>
<td>2007-2014</td>
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<td></td>
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<tr>
<td>Human Capital</td>
<td>human_capital</td>
<td>Population aged 25-64 with tertiary education (levels 5-8)</td>
<td>%</td>
<td>2013-17 (Eurostat: edat_lfse_04)</td>
<td></td>
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<tr>
<td>Governance</td>
<td>governance</td>
<td>Average of the Worldwide Governance Indicators (WGI).</td>
<td>-</td>
<td>2007-17 (WBD: RQ.EST) 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>infrastructure</td>
<td>Quality of port infrastructure, WEF [1=extremely underdeveloped to 7=well developed and efficient by international standards] + *Logistics performance index Overall [1=low to 5=high]</td>
<td>-</td>
<td>2007-17 (WBD: Q, WEF.PORT.XQ), (WBD: LP.LPI.OVRL.XQ) 3</td>
<td></td>
<td></td>
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<tr>
<td>ICT infrastructure</td>
<td>ict_inf</td>
<td>Average maximum contracted download speed among enterprises with internet access</td>
<td>-</td>
<td>2010-2017 Eurostat: isoc_ci_it_en2 4</td>
<td></td>
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<tr>
<td>Labor cost</td>
<td>labor_cost</td>
<td>Average hourly labour costs</td>
<td>€/hour</td>
<td>2013-17 (Eurostat: isoc_ci_it_en2) 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English Speakers</td>
<td>english</td>
<td>Percentage of people who speak English as a mother tongue or foreign language in each European country.</td>
<td>%</td>
<td>2012 Special Eurobarometer 386</td>
<td></td>
<td></td>
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<tr>
<td>Log GDP</td>
<td>gdp_log</td>
<td>Log10 GDP</td>
<td>Log €</td>
<td>2007-17 (WBD: NY.GDP.MKTP.CD)</td>
<td></td>
<td></td>
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<tr>
<td>STEM bachelor graduates</td>
<td>stem_grad</td>
<td>Graduates (ISCED 6) from science, mathematics, computing, engineering, manufacturing &amp; construction fields per 1000 of the population aged 25-35</td>
<td>per 1000</td>
<td>2007-12 (Eurostat: educ_itertc)</td>
<td></td>
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<tr>
<td>Quality of Life Index</td>
<td>qual_life</td>
<td>-</td>
<td>Index composed of: &quot;Cost of living and purchasing power&quot;, &quot;Affordability of housing&quot;, &quot;Pollution including air, water, etc.&quot;, &quot;Crime rates&quot;, &quot;Health system quality&quot;, &quot;Traffic (commute times)&quot;</td>
<td>2012-18</td>
<td><a href="https://www.numbeo.com/quality-of-life">https://www.numbeo.com/quality-of-life</a></td>
<td></td>
</tr>
<tr>
<td>Big Four Staff / # companies</td>
<td>norm_big4_staff</td>
<td>per 1000</td>
<td>Number of employees per country</td>
<td>2017</td>
<td>(Murphy and Stausholm 2017) and (Eurostat: nama_10_add_e_1)</td>
<td></td>
</tr>
<tr>
<td>Financial Development Index</td>
<td>fin_dev</td>
<td>-</td>
<td>Measures the development state of financial institutions and markets in terms of their depth (size), access (ability to access the services), and efficiency (ability of institutions)</td>
<td></td>
<td>IMF [<a href="https://data.world/imf/financial-development-fd">https://data.world/imf/financial-development-fd</a>]</td>
<td></td>
</tr>
<tr>
<td>Tax indicators</td>
<td>cit_rate</td>
<td>%</td>
<td>Marginal corporate income tax ()</td>
<td>2007-17</td>
<td>Eurostat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wht_div</td>
<td>%</td>
<td>WHT dividends (base rate)</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wht_fees</td>
<td>%</td>
<td>WHT technical and management fees</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wht_int</td>
<td>%</td>
<td>WHT interests (base rate)</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>wht_roy</td>
<td>%</td>
<td>WHT royalties (base rate)</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td># of tax treaties Western EU</td>
<td>tax_treaties_we_2000</td>
<td>#</td>
<td>Number of tax treaties in place with EU15 + Switzerland</td>
<td>2000</td>
<td><a href="https://eoi-tax.com/jurisdictions/">https://eoi-tax.com/jurisdictions/</a></td>
<td></td>
</tr>
<tr>
<td># of inv treaties Western EU</td>
<td>inv_treaties_we</td>
<td>#</td>
<td>Number of bilateral investment treaties in place with EU15 Malta, Norway, Iceland Switzerland</td>
<td>2000</td>
<td>UNCTAD</td>
<td></td>
</tr>
<tr>
<td># of tax treaties</td>
<td>tax_treaties2000</td>
<td>#</td>
<td>Number of tax treaties in place</td>
<td>2000</td>
<td><a href="https://eoi-tax.com/jurisdictions/">https://eoi-tax.com/jurisdictions/</a></td>
<td></td>
</tr>
<tr>
<td># of inv. treaties</td>
<td>inv_treaties</td>
<td>#</td>
<td>Number of bilateral investment treaties in place with EU15 + Switzerland</td>
<td>2000</td>
<td>UNCTAD</td>
<td></td>
</tr>
<tr>
<td>ETR (TNCs)</td>
<td>tax_rate_median_mult</td>
<td>%</td>
<td>Median effective tax rate of all entities with a foreign GUI and &gt;$1million profits. Unconsolidated accounts.</td>
<td>2010-17</td>
<td>Orbis</td>
<td></td>
</tr>
<tr>
<td>ETR (domestic - TNCs)</td>
<td>adv_tax_rate_median</td>
<td>%</td>
<td>ETR [multinational enterprises] - ETR (TNCs)</td>
<td>2010-17</td>
<td>Orbis</td>
<td></td>
</tr>
<tr>
<td>Profit Rate (TNCs)</td>
<td>profit_rate_emp_median_mult</td>
<td>%</td>
<td>Profit before tax / cost of employees, of all entities with a foreign GUI and &gt;$1 million profits. Unconsolidated accounts</td>
<td>2010-17</td>
<td>Orbis</td>
<td></td>
</tr>
<tr>
<td>Profit Rate (TNCs - domestic)</td>
<td>adv_profit_rate_emp_median</td>
<td>%</td>
<td>Profit rate [multinational enterprises] - Profit rate (domestic firms)</td>
<td>2010-17</td>
<td>Orbis</td>
<td></td>
</tr>
<tr>
<td>Group treatment</td>
<td>group_treatment</td>
<td>0/1</td>
<td>Treatment of companies where profits and losses can be grouped together</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td># Anti-avoidance provisions</td>
<td>tax_anti_avoidance</td>
<td>#</td>
<td>Number of anti-avoidance measures</td>
<td>2008-17</td>
<td>IBFD</td>
<td></td>
</tr>
<tr>
<td>Thin capitalization rules</td>
<td>thin_cap</td>
<td>-</td>
<td>Thin capitalization rules</td>
<td>2004, 2008-17</td>
<td>(Blouin et al. 2014), IBFD</td>
<td></td>
</tr>
<tr>
<td>Notional interest deduction</td>
<td>nid</td>
<td>0/1</td>
<td>Presence of NID</td>
<td>2018</td>
<td><a href="https://dits.deloitte.com/#/HoldingSubMenu">https://dits.deloitte.com/#/HoldingSubMenu</a></td>
<td></td>
</tr>
<tr>
<td>Other interest incentives</td>
<td>gib</td>
<td>#</td>
<td>Number of incentives targeting interest payments examined</td>
<td>2012</td>
<td>(Marres and Weber 2012)</td>
<td></td>
</tr>
</tbody>
</table>
by the EU Code of Conduct Group

<table>
<thead>
<tr>
<th>Time to Prepare Taxes</th>
<th>time_prepare_tax</th>
<th>hours</th>
<th>Time to prepare and pay taxes (hours)</th>
<th>2007-17</th>
<th>(WID: IC.TAX.DURS)</th>
</tr>
</thead>
<tbody>
<tr>
<td># incentives to manufacture</td>
<td>manuf_incentives</td>
<td>#</td>
<td>Number of incentives to manufacture</td>
<td>2007-17</td>
<td>IBFD</td>
</tr>
<tr>
<td>Patent box score</td>
<td>total_patent</td>
<td>-</td>
<td>Generosity of the patent box</td>
<td>2017</td>
<td>(Alstadsæter et al. 2018; Chen et al. 2016)</td>
</tr>
</tbody>
</table>

Notes:
1) B and M&N correspond to the NACE Rev.2 sectors of Manufacture (B), Professional, scientific, technical, administration (M) and Support service activities (N).
2) Captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Perceptions are calculated using survey data from over 30 sources: http://info.worldbank.org/governance/wgi/index.aspxf#doc While governance is a contested variable (Abrahamsen 2000), the WGI indicators have been shown to be correlated with attracting foreign investment (Globerman and Shapiro 2002)
3) Each indicator was divided by the maximum possible score in order to give them equal weight.
4) Eurostat provides with the fraction of companies using several contracted download speeds. The speed limits are <2Mb, 2-10Mb, 10-30Mb, 30-100Mb and >100Mb. The average speed was calculated as \( \sum s \times p_s \), where \( s \) is the average speed contracted (1,6,20,60,200) and \( p_s \) the fraction of companies having that speed contracted.
5) Defined as total labour costs divided by the corresponding number of hours worked by the yearly average number of employees, expressed in full-time units. *Labour Costs (D) cover Wages and Salaries (D11) and non-wage costs (Employers’ social contributions plus taxes less subsidies: D12+D4-D5)
7) Data on withholding taxes, tax incentives and anti-avoidance mechanisms are extracted from the historical data of the International Bureau of Fiscal Documentation (IBFD). The historical data is available only at their Library and Information Centre in Amsterdam.
9) The median profit rate (profit before taxes / cost of employees) and the median tax rate (taxation / profit before taxes) was calculated for all companies with unconsolidated accounts and at least $1 million profits (before tax). Keeping only companies that make substantial profits allows us to calculate a stable tax rate across years. For the calculation on domestic companies, all companies resident in a country whose global ultimate owner is also a resident from that country and does not operate in any other country were considered. For the calculation on multinational companies, all companies resident in a country whose global ultimate owner is not a resident from that country were considered. Multinationals operating in their home country were excluded from the analysis
10) Anti-avoidance measures is the number of anti-avoidance provisions – rules introduced by governments to reduce tax avoidance and evasion. Five provisions are possible: transfer pricing legislation, thin capitalization legislation, controlled foreign company legislation, general anti-avoidance rule (GAAR), and other anti-avoidance legislation.
11) Tables 11.2.3,4,5,7 in (Marres and Weber 2012). Measures 11 and 13 were excluded since they were not implemented (the Netherlands) or only for one year (Hungary)
12) The number of tax incentives containing any of the following strings: “Develop”, “job”, “hire”, “industr”, “employm”, “manufac”, “zones”, “free”
13) The number of tax incentives containing any of the following strings: “r&d”, “research”, “intellectual”, “patent”, “innovation box”.
14) The patent box score is calculated as the geometric average between the number of years available, \( \frac{1}{1+IP \text{ tax rate}} \), and the sum of the all the benefits studied in (Alstadsæter et al. 2018): \( -1 \times \text{(Only patents and rights associated with patents)} + \text{(Applicable to existing IP)} + \text{(Applicable to acquired IP)} + \text{(Authority granting the IP right)} + \text{(Development condition)} + \text{(Capital gains included)} + \text{(Income from the sales of innovative products (embedded royalties))} + \text{(R&D can be performed abroad (or within a group))} + \text{(Cap)}. The coding scheme used was Y=1, N=0 and 0.5 for all other cases (e.g. Y* or d)).
15) We reconstructed all equity chains using individual ownership relationships. For instance if company CG (DE denoting Germany) is owned jointly by company C1 and C2, and company C1 is owned completely by C2, we have the equity chains C1:CG:CG:C1, C1:CG:C2, C2:CG:C1, and C2:CG:C2. We weighted the values in terms of the turnover of the first company in the chain (CG or C2 in the example) and the multiplicative ownership, in the same fashion than (Vitali, Gla ttefelder, and Battiston 2011). The multiplicative ownership in our example is 0.5 for C2 in C1:CG:C2 since C2 owns 50% of CG and C1 owns 100% of C2, 0.5 for CG:C2 in C1:CG:C2, and 1 for C1:CG:C2.
example above, investment goes through C\text{CLU} in the chain C\text{DE}:CLU:CMT. We define sink ownership as all the value that ends in a country minus all value that starts in the country. Specific details of the calculations can be found in (Garcia-Bernardo et al. 2017).

16) For each available entity, we collected the global ultimate owner (GUB), the parent firm who owns at least 50% of the company directly or indirectly and is not itself owned by any other firm), and counted the number of GUOs per country. The sector 70.10 (Activities of head offices) includes “overseeing and managing the related units, exercising operational control and day-to-day management” (Eurostat).

17) For the analysis of top holdings, we would like to focus on companies that has relocated to the jurisdiction. However, since we cannot distinguish between home-grown TNCs and relocated TNCs, and the home-grown TNCs will usually dominate the top holdings in a country, we use the profit rate and ETR of all TNCs’ affiliates as a proxy of the profit rate and ETRs of relocated top holdings.

18) Outliers are especially troublesome for the consolidated (net) indicators, since high fluctuations in one year can highly affect the average value. For instance in 2015, the consolidated value of loans (on the asset side) for non-financial corporations in Hungary was 20,485 € million, high above the average of 902 € million for the years 2007-2017 (excluding 2015). Using the median instead of the average reduces the weight of outliers. In the Hungarian case, the year 2015 increases the median by 66%, while the average is increased by 197%.

<table>
<thead>
<tr>
<th>Table S2: Unit, mean (M), standard deviation (STD), median (m), interquartile range (IQR) and pairwise correlations used for the category of FDI: manufacturing affiliates. In the Unit’s column “%” stands for percentage, “#” for number, and “-” for dimensionless.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Unit)</td>
</tr>
<tr>
<td>0: Value added manufacture / employee (foreign)</td>
</tr>
<tr>
<td>1: Productivity manufacture (foreign)</td>
</tr>
<tr>
<td>2: Greengage manuf. FDI / GDP</td>
</tr>
<tr>
<td>3: % country jobs manufacture (foreign)</td>
</tr>
<tr>
<td>4: Log # jobs manufacture (foreign)</td>
</tr>
<tr>
<td>5: Human Capital</td>
</tr>
<tr>
<td>6: Governance</td>
</tr>
<tr>
<td>7: Infrastructure</td>
</tr>
<tr>
<td>8: ICT Infrastructure</td>
</tr>
<tr>
<td>9: Labor cost</td>
</tr>
<tr>
<td>10: ETR (TNCs)</td>
</tr>
<tr>
<td>11: CIT</td>
</tr>
<tr>
<td>12: # incentives to manufacture</td>
</tr>
<tr>
<td>13: WHT dividends</td>
</tr>
<tr>
<td>14: # of inv treaties Western EU</td>
</tr>
<tr>
<td>15: # of tax treaties Western EU (2000)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table S3: Unit, mean (M), standard deviation (STD), median (m), interquartile range (IQR) and pairwise correlations used for the category of FDI: shared service centers. In the Unit’s column “%” stands for percentage, “#” for number, and “-” for dimensionless.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Unit)</td>
</tr>
<tr>
<td>0: % country jobs support/technical (foreign)</td>
</tr>
<tr>
<td>1: Value added support/technical/employee (foreign)</td>
</tr>
<tr>
<td>2: Productivity support/technical (foreign)</td>
</tr>
<tr>
<td>3: Greengage support/technical FDI / GDP</td>
</tr>
<tr>
<td>4: Log # jobs support/technical (foreign)</td>
</tr>
<tr>
<td>5: English Speakers</td>
</tr>
<tr>
<td>6: Human Capital</td>
</tr>
</tbody>
</table>
Table S4: Unit, mean (M), standard deviation (STD), median (m), interquartile range (IQR) and pairwise correlations used for the category of FDI: R&D facilities. In the Unit's column "%" stands for percentage, "#" for number, and "-" for dimensionless.

<table>
<thead>
<tr>
<th>Unit</th>
<th>M</th>
<th>STD</th>
<th>m</th>
<th>IQR</th>
<th>#Obs</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Inward R&amp;D expenditure / GDP %</td>
<td>0.12</td>
<td>0.09</td>
<td>0.09</td>
<td>0.13</td>
<td>29</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1: % country jobs R&amp;D (total) %</td>
<td>0.34</td>
<td>0.25</td>
<td>0.29</td>
<td>0.38</td>
<td>28</td>
<td>0.68</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2: # foreign owned patents / GDP #/ebn</td>
<td>0.56</td>
<td>0.36</td>
<td>0.52</td>
<td>0.63</td>
<td>29</td>
<td>0.69</td>
<td>0.81</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3: # domestic owned patents / GDP #/ebn</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>29</td>
<td>0.57</td>
<td>0.84</td>
<td>0.74</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4: % patents foreign %</td>
<td>39.2</td>
<td>16.1</td>
<td>39.2</td>
<td>21.5</td>
<td>29</td>
<td>-0.28</td>
<td>-0.51</td>
<td>-0.29</td>
<td>-0.69</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5: English Speakers %</td>
<td>33.4</td>
<td>22.5</td>
<td>28</td>
<td>24.8</td>
<td>28</td>
<td>0.44</td>
<td>0.42</td>
<td>0.29</td>
<td>0.24</td>
<td>-0.12</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6: Human Capital %</td>
<td>31.6</td>
<td>8.26</td>
<td>31.7</td>
<td>14.6</td>
<td>29</td>
<td>0.33</td>
<td>0.46</td>
<td>0.4</td>
<td>0.39</td>
<td>-0.49</td>
<td>0.52</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7: STEM bachelor graduates per 1000</td>
<td>0.66</td>
<td>0.36</td>
<td>0.68</td>
<td>0.48</td>
<td>29</td>
<td>0.6</td>
<td>0.73</td>
<td>0.6</td>
<td>0.78</td>
<td>-0.53</td>
<td>0.32</td>
<td>0.3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>8: ICT infrastructure -</td>
<td>52.3</td>
<td>17.2</td>
<td>51.5</td>
<td>23.7</td>
<td>28</td>
<td>0.24</td>
<td>0.59</td>
<td>0.39</td>
<td>0.4</td>
<td>-0.25</td>
<td>0.18</td>
<td>0.39</td>
<td>0.34</td>
<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>9: Quality of Life Index -</td>
<td>141</td>
<td>34.2</td>
<td>144</td>
<td>49.3</td>
<td>27</td>
<td>0.49</td>
<td>0.75</td>
<td>0.86</td>
<td>0.81</td>
<td>-0.62</td>
<td>0.5</td>
<td>0.62</td>
<td>0.73</td>
<td>0.36</td>
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<td>10: # R&amp;D incentives #</td>
<td>405</td>
<td>2.22</td>
<td>4</td>
<td>3</td>
<td>21</td>
<td>0.27</td>
<td>0.18</td>
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<td>0.12</td>
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<td>-0.02</td>
<td>-0.07</td>
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<td>11: Patent box score -</td>
<td>10.1</td>
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<td>1.79</td>
<td>29</td>
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<td>0.09</td>
<td>0.12</td>
<td>-0.11</td>
<td>0.16</td>
<td>0.3</td>
<td>0.28</td>
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Table S5: Unit, mean (M), standard deviation (STD), median (m), interquartile range (IQR) and pairwise correlations used for the category of FDI: top holdings. In the Unit’s column "%" stands for percentage, "#" for number, and "-" for dimensionless.

<table>
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<tr>
<th>Unit</th>
<th>M</th>
<th>STD</th>
<th>m</th>
<th>IQR</th>
<th>#Obs</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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<tbody>
<tr>
<td>0: Profit Rate (TNCs) %</td>
<td>112</td>
<td>154</td>
<td>68.3</td>
<td>43.7</td>
<td>29</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1: Profit Rate (TNCs - domestic) % points</td>
<td>-20.6</td>
<td>9.18</td>
<td>30.07</td>
<td>66</td>
<td>26</td>
<td>0.69</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2: # large top holdings / GDP #/ctl</td>
<td>103</td>
<td>272</td>
<td>26.9</td>
<td>61.1</td>
<td>29</td>
<td>0.67</td>
<td>0.83</td>
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<tr>
<td>3: # small top holdings / GDP #/ctl</td>
<td>35.7</td>
<td>84.6</td>
<td>11.4</td>
<td>12.1</td>
<td>29</td>
<td>0.91</td>
<td>0.47</td>
<td>0.53</td>
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<tr>
<td>4: # large top head offices / GDP #/ctl</td>
<td>2.24</td>
<td>4.33</td>
<td>2.93</td>
<td>29</td>
<td>-0.19</td>
<td>0.07</td>
<td>-0.08</td>
<td>-0.16</td>
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<td></td>
</tr>
<tr>
<td>5: Equity Assets in country / GDP %</td>
<td>2.49</td>
<td>4.48</td>
<td>1.07</td>
<td>2.09</td>
<td>28</td>
<td>0.26</td>
<td>0.74</td>
<td>0.82</td>
<td>0.12</td>
<td>0.05</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6: Governance -</td>
<td>1.22</td>
<td>0.44</td>
<td>1.17</td>
<td>0.77</td>
<td>29</td>
<td>0.06</td>
<td>0.44</td>
<td>0.29</td>
<td>0.07</td>
<td>0.33</td>
<td>0.4</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>7: English Speakers %</td>
<td>33.4</td>
<td>22.5</td>
<td>28</td>
<td>24.8</td>
<td>28</td>
<td>0.14</td>
<td>0.33</td>
<td>0.1</td>
<td>0.07</td>
<td>0.14</td>
<td>0.11</td>
<td>0.62</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8: Log GDP -</td>
<td>22.6</td>
<td>1.37</td>
<td>22.7</td>
<td>1.91</td>
<td>29</td>
<td>-0.5</td>
<td>-0.15</td>
<td>-0.46</td>
<td>-0.45</td>
<td>0.24</td>
<td>-0.3</td>
<td>-0.14</td>
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<td>0.37</td>
<td>0.31</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9: Big Four Staff / # companies per 1000</td>
<td>23.9</td>
<td>44.3</td>
<td>8.26</td>
<td>13.9</td>
<td>29</td>
<td>0.52</td>
<td>0.87</td>
<td>0.94</td>
<td>0.33</td>
<td>-0.02</td>
<td>0.87</td>
<td>0.4</td>
<td>0.23</td>
<td>-0.18</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>10: ETR (TNCs) %</td>
<td>18.1</td>
<td>7.07</td>
<td>19</td>
<td>7.87</td>
<td>29</td>
<td>-0.4</td>
<td>-0.15</td>
<td>-0.46</td>
<td>-0.45</td>
<td>0.24</td>
<td>-0.3</td>
<td>-0.14</td>
<td>-0.05</td>
<td>0.37</td>
<td>0.31</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11: ETR (Domestic - TNCs) % points</td>
<td>0.44</td>
<td>3.95</td>
<td>-0.05</td>
<td>2.93</td>
<td>29</td>
<td>0.34</td>
<td>0.61</td>
<td>0.55</td>
<td>0.27</td>
<td>0.07</td>
<td>0.48</td>
<td>0.28</td>
<td>0.11</td>
<td>0.07</td>
<td>0.51</td>
<td>-0.15</td>
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<tr>
<td>12: # of tax treaties #</td>
<td>79.1</td>
<td>19.1</td>
<td>77</td>
<td>35</td>
<td>29</td>
<td>-0.25</td>
<td>0.21</td>
<td>-0.02</td>
<td>-0.31</td>
<td>0.28</td>
<td>0.36</td>
<td>0.18</td>
<td>0.82</td>
<td>0.11</td>
<td>0.49</td>
<td>0.24</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13: WHT dividends</td>
<td>%</td>
<td>14.7</td>
<td>10.2</td>
<td>15</td>
<td>17.4</td>
<td>29</td>
<td>0.45</td>
<td>-0.05</td>
<td>-0.22</td>
<td>-0.37</td>
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<td>0.05</td>
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<td>-0.04</td>
<td>0.61</td>
<td>-0.13</td>
<td>0.39</td>
<td>-0.05</td>
<td>0.42</td>
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<tr>
<td>14: # Anti-avoidance provisions</td>
<td>#</td>
<td>-0.45</td>
<td>-0.05</td>
<td>-0.22</td>
<td>-0.37</td>
<td>0.49</td>
<td>0.05</td>
<td>0.3</td>
<td>-0.04</td>
<td>0.61</td>
<td>-0.13</td>
<td>0.39</td>
<td>-0.05</td>
<td>0.42</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15: Time to Prepare Taxes</td>
<td>hours</td>
<td>192</td>
<td>99.3</td>
<td>165</td>
<td>101</td>
<td>29</td>
<td>0.16</td>
<td>-0.52</td>
<td>-0.35</td>
<td>-0.23</td>
<td>-0.19</td>
<td>-0.42</td>
<td>0.66</td>
<td>-0.38</td>
<td>-0.07</td>
<td>-0.45</td>
<td>0.08</td>
<td>-0.24</td>
<td>-0.22</td>
<td>0.26</td>
<td>1</td>
</tr>
</tbody>
</table>

Table S6: Unit, mean (M), standard deviation (STD), median (m), interquartile range (IQR) and pairwise correlations used for the category of FDI: intermediate holdings. In the Unit’s column “%” stands for percentage, “#” for number, “0/1” for binary and “-” for dimensionless.

| Unit | M | STD | m | IQR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 0: Conduit investment / GDP | % | 0.26 | 0.83 | 0.02 | 0.07 | 29 | 1 |
| 1: Charges for IP / GDP | % | 1.62 | 3.76 | 0.44 | 0.27 | 29 | 0.12 | 1 |
| 2: Equity Assets in country / GDP | % | 2.49 | 4.48 | 1.07 | 2.09 | 25 | 0.82 | 0.27 | 1 |
| 3: Loan Assets in country / GDP | % | 1.69 | 4.11 | 0.53 | 1.03 | 25 | 0.83 | 0.4 | 0.95 | 1 |
| 4: Governance | - | 1.22 | 0.44 | 1.17 | 0.77 | 29 | 0.25 | 0.32 | 0.47 | 0.37 | 1 |
| 5: ICT infrastructure | - | 52.3 | 17.2 | 51.5 | 23.7 | 28 | -0.02 | 0.07 | 0.31 | 0.22 | 0.52 | 1 |
| 6: Financial Development Index | - | 0.6 | 0.21 | 0.86 | 0.35 | 29 | 0.17 | 0.19 | 0.37 | 0.24 | 0.58 | -0.14 | 1 |
| 7: Big Four Staff / # companies per 1000 | 23.9 | 44.3 | 8.26 | 13.9 | 29 | 0.9 | 0.29 | 0.87 | 0.92 | 0.4 | 0.13 | 0.31 | 1 |
| 8: # Anti-avoidance provisions | # | 3.71 | 0.65 | 3.94 | 0.92 | 29 | -0.16 | -0.23 | 0.05 | -0.03 | 0.09 | 0.19 | 0.18 | -0.19 | 1 |
| 9: National income deduction | 0/1 | 0.21 | 0.41 | 0.26 | 0.35 | 29 | 0.13 | 0.09 | 0.07 | -0.03 | -0.02 | 0.04 | 0.18 | 0.03 | -0.12 | 1 |
| 10: Other interest incentives | 0/1 | 0.39 | 0.83 | 0.25 | 0.28 | 25 | 0.59 | 0.36 | 0.82 | 0.74 | 0.34 | 0.13 | 0.34 | 0.59 | 0.09 | 0.28 | 1 |
| 11: Patent box score | - | 1.01 | 1.4 | 1.79 | 29 | 0.28 | 0.8 | 0.31 | 0.38 | 0.3 | -0.08 | 0.42 | 0.4 | -0.18 | 0.36 | 0.48 | 1 |
| 12: WHT Royalties | % | 13.6 | 9.87 | 15 | 16.7 | 29 | -0.34 | -0.11 | 0.25 | -0.27 | -0.23 | -0.19 | 0.15 | -0.38 | 0.44 | -0.02 | 0.22 | -0.11 | 1 |
| 13: WHT Interests | % | 8.82 | 9.6 | 8.33 | 16 | 29 | -0.25 | 0.09 | -0.3 | -0.16 | 0.29 | -0.3 | 0.08 | 0.14 | 0.05 | -0.09 | 0.26 | 0 | 0.21 | 1 |
| 14: WHT dividends | % | 14.7 | 10.2 | 15 | 17.4 | 29 | -0.24 | -0.02 | 0.05 | -0.06 | 0.3 | 0.27 | 0.52 | -0.13 | 0.34 | 0.01 | 0.05 | 0.03 | 0.53 | 0.26 | 1 |
| 15: Time to Prepare Taxes | hours | 192 | 99.3 | 165 | 101 | 29 | -0.32 | -0.32 | -0.42 | -0.37 | -0.66 | -0.25 | -0.45 | -0.45 | 0.28 | -0.02 | -0.3 | 0.41 | 0.14 | 0.42 | -0.23 | 1 |
| 16: # of tax treaties | # | 79.1 | 19.1 | 77 | 35 | 29 | -0.01 | -0.02 | 0.2 | 0.07 | 0.36 | -0.08 | 0.64 | 0.11 | 0.39 | 0.13 | 0.34 | 0.27 | 0.25 | 0.17 | 0.42 | -0.23 | 1 |
| 17: # of tax treaties (2000) | # | 47.2 | 21.9 | 43 | 33 | 29 | -0.1 | -0.12 | 0.09 | -0.06 | 0.3 | 0.01 | 0.49 | -0.04 | 0.45 | 0.08 | 0.27 | 0.12 | 0.29 | 0.06 | 0.38 | -0.11 | 0.86 | 1 |
| 18: # of inv. treaties | # | 37 | 25.6 | 29 | 29 | 29 | -0.01 | -0.27 | 0.13 | 0.02 | 0.16 | -0.03 | 0.33 | 0.08 | 0.44 | -0.09 | 0.22 | -0.08 | 0.06 | 0.18 | 0.34 | -0.02 | 0.73 | 0.71 | 1 |

Appendix of Chapter 4
SUPPLEMENTARY INFORMATION

Figure S1: Robustness check using the original dataset

The minimum number of observations is 26 for the regression looking at the effect of HNWI on the number of transfer pricing professionals and including at the same time all other independent variables. The maximum number of observations is 131, for the regression looking at the effect of the number of engineers on the number of all tax professionals (see Supplementary tables).
Fig S2: Increase in the number of tax professionals (TP) or employees in finance as a function of the number of chief executives (CXO). An arbitrary $k=1/10000$ is set in the relationship between tax professionals and chief executives $TP = k \cdot CXO^2$. This allows us to visualize the exponential relationship between the variables.
Fig S3: Replication of Figure 6, using population to normalize
Appendices

Table S1: List of variables, sources and descriptive statistics. The three numbers in the descriptive statistics are the average (standard deviation) N: number of non-missing observations.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Operationalization</th>
<th>Country Imputed</th>
<th>Country</th>
<th>City</th>
<th>Year and source</th>
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<tr>
<td>DV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All tax professionals</td>
<td>Log10 of the audience reached in LinkedIn with the job titles detailed in Table 1.</td>
<td>2.37 (0.94)</td>
<td>2.38 (0.95)</td>
<td>2.53 (0.91)</td>
<td></td>
</tr>
<tr>
<td>N: 207</td>
<td></td>
<td>N: 203</td>
<td>N: 215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer pricing</td>
<td></td>
<td>0.60 (0.82)</td>
<td>0.61 (0.83)</td>
<td>1.36 (0.34)</td>
<td>Feb. 2019 LinkedIn</td>
</tr>
<tr>
<td>N: 207</td>
<td></td>
<td>N: 203</td>
<td>N: 207</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax strategy</td>
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<td>1.68 (0.93)</td>
<td>1.69 (0.94)</td>
<td>1.89 (0.79)</td>
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</tr>
<tr>
<td>N: 207</td>
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<td>N: 203</td>
<td>N: 214</td>
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<td></td>
</tr>
<tr>
<td>Wealth management</td>
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<td>1.62 (0.81)</td>
<td>1.63 (0.81)</td>
<td>1.78 (0.78)</td>
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</tr>
<tr>
<td>N: 207</td>
<td></td>
<td>N: 203</td>
<td>N: 215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV: EA</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nEngineers</td>
<td>Log10 of the audience reached on LinkedIn with the title &quot;engineer&quot;</td>
<td>3.89 (0.97)</td>
<td>3.89 (0.97)</td>
<td>3.93 (0.72)</td>
<td>Feb. 2019 LinkedIn</td>
</tr>
<tr>
<td>N: 207</td>
<td></td>
<td>N: 203</td>
<td>N: 215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nAccountants</td>
<td>Log10 of the audience reached on LinkedIn with the title &quot;accountant&quot;, excluding &quot;tax accountant&quot;</td>
<td>3.46 (0.83)</td>
<td>3.46 (0.83)</td>
<td>3.24 (0.80)</td>
<td>Feb. 2019 LinkedIn</td>
</tr>
</tbody>
</table>
### Appendices

<table>
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<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean 2014-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFCF</td>
<td>Log10 of gross fixed capital formation (constant 2010 USD)</td>
<td>9.86 (0.96)</td>
</tr>
<tr>
<td></td>
<td>N: 207</td>
<td>10.15 (0.90)</td>
</tr>
<tr>
<td></td>
<td>N: 143</td>
<td>Mean 2014-2018</td>
</tr>
<tr>
<td></td>
<td>NE.GDLF.TOT.KD</td>
<td></td>
</tr>
<tr>
<td>Consumption</td>
<td>Log10 of final consumption expenditure by households and non-profit institutions serving households (constant 2010 USD)</td>
<td>10.28 (0.95) N: 207</td>
</tr>
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<td>nFinance</td>
<td>Log10 of the audience reached in Linkedin with the job function Finance</td>
<td>3.84 (0.86) N: 207</td>
</tr>
<tr>
<td>nCOOs</td>
<td>Log10 of the audience reached in Linkedin with the job title CDO</td>
<td>2.23 (0.84) N: 207</td>
</tr>
<tr>
<td>nCFOs</td>
<td>Log10 of the audience reached in Linkedin with the job title CDO</td>
<td>2.37 (0.83) N: 207</td>
</tr>
<tr>
<td>Profits</td>
<td>Log10 of the misaligned profits (USD) with a minimum cut of $1 billion</td>
<td>9.20 (0.44) N: 207</td>
</tr>
<tr>
<td>Financial Secrecy Score</td>
<td>Financial Secrecy Score, by the Tax Justice Network</td>
<td>0.47 (0.33) N: 207</td>
</tr>
<tr>
<td>nHNWI</td>
<td>Log10 of the number of high net worth individuals (adults with wealth above 50 millions)</td>
<td>0.74 (0.98) N: 207</td>
</tr>
<tr>
<td>Audience</td>
<td>Log10 of the number of profiles on Linkedin by country (using the Campaign Manager)</td>
<td>5.55 (0.86) N: 207</td>
</tr>
<tr>
<td>Population</td>
<td>Log10 of population. The missing population (24 countries) was added manually.</td>
<td>6.67 (0.99) N: 207</td>
</tr>
<tr>
<td>Credit Rating</td>
<td>Trading Economic credit rating, composed from the credit ratings by Moody's, S&amp;P, Fitch and DBRS</td>
<td>49.00 (24.35) N: 207</td>
</tr>
<tr>
<td>English speaking</td>
<td>Official language 1 in the CEPII GeoDist dataset</td>
<td>0.27 (0.44) N: 207</td>
</tr>
<tr>
<td>Governance</td>
<td>First PCA component of the six dimensions of the Worldwide Governance Indicators project</td>
<td>0.01 (2.17) N: 207</td>
</tr>
<tr>
<td>CIT</td>
<td>Statutory corporate tax level</td>
<td>0.21 (0.14) N: 207</td>
</tr>
<tr>
<td>Tax complexity</td>
<td>Time to prepare and pay taxes (hours)</td>
<td>235.81 (197.54) N: 207</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>Log10 of gross domestic product divided by population. The missing data on GDP and population was added manually</td>
<td>3.60 (1.07) N: 207</td>
</tr>
</tbody>
</table>
Appendices

Section S1. Minimum audience in LinkedIn

A minor obstacle using the LinkedIn Campaign manager is that it does not show results when the maximum audience falls below 300 people. In order to collect this information, we started by adding a jurisdiction with an audience between 300 to 400 people. Then, we added each of the remaining 230 jurisdictions and subtracted the base audience. For instance, if the audience of wealth managers in Luxembourg is 380 people, and the audience of wealth managers in Serbia is 30 people, we would add both countries and find the combined audience of 410 people, from which we subtracted the 380 people from Luxembourg.

Section S2 Comparisons in Eurostat:

Apart from the data on tax professionals, we collected LinkedIn data targeting profiles related to the non-financial economy, managerial control and the financial sector. In order to understand if our sample is representative across countries, we obtained data from Eurostat on those related professions. For instance, we compared the number of engineers on LinkedIn with the number of scientists and engineers according to Eurostat, or the number of COOs with the number of companies with at least 250 employees in Eurostat. The list of comparisons is:

- Credit institutions: number of persons employed (Eurostat table: tin00016).
- Accountants: Accounting, bookkeeping and auditing activities; tax consultancy (Eurostat table: shs_na_1a_se_r2).
- Engineers: Scientists and engineers from 25 to 64 years (Eurostat table: hrst_st_nocc).
- CEO/CXO/COO/CFO: Number of enterprises in the non-financial business economy with at least 250 persons employed (Eurostat table: tin00145)

The correlation between the per capita counts are 35% (CEO), 47% (CXO), 57% (financial sector), 58% (CFO), 59% (COO), 72% (Accountant) to 80% (Engineers). The correlations are very high for the two titles with the most comparable definitions (accountants and engineers), and relatively good for the loosely related titles (CFO, COO and financial sector). We excluded the CEO and CXO matches from the analyses since many freelancers and owners of small companies use the CEO title. While the focus on Eurostat does not guarantee that the pattern extends outside of the European

1 According to the campaign manager, there are 1.6 million chief executives in the United States. However, the occupational employment statistics (https://www.bls.gov/oes/current/oes111011.htm) record only 195,530 in May 2018. We tried to
Union, we only use these variables as robustness tests in our regression analysis.

Section S3:
We used the updated data from 2019 (https://missingprofits.world/), and set all countries where the shifted profits were below US $1 billion was to $1 billion. This allows us to study the countries that receive profits from other countries, while at the same time keep the countries with negative shifted profits in the sample. We set the threshold by looking at the distribution of misaligned profits. The misaligned profits are below $1 billion for the majority of non-tax havens and the small tax havens, and go up to $117 billions in Ireland.

Section S4: PCA
PCA calculates a linear, orthogonal, decomposition of the variables in a way that the first decomposed component captures the highest amount of variability. If we would, for example, do a PCA analysis on a dataset containing population and GDP, the first component would likely capture the size of the country (which affects both population and GDP), while the second component would capture something similar to GDP per capita. In order to give the same weight to all variables, we first normalized them and calculated the first component of PCA to combine them. Our combined variable accounts for 95%, 98%, 85% and 57% of the variance in the variables measuring economic, managerial, financial and offshore activities.

Section S4: List of jurisdictions studied
Algeria, Barbados, Ghana, Hungary, Mozambique, Swaziland, Montenegro, Isle of Man, Fiji, Namibia, Albania, Jordan, Timor-Leste, United Arab Emirates, Belgium, Senegal, Serbia, Cameroon, China, Afghanistan, Guatemala, Sierra Leone, Tonga, Chad, Paraguay, Mauritania, Equatorial Guinea, Singapore, Tanzania, Netherlands, Estonia, Kiribati, Norway, Tunisia, Nepal, Bosnia and Herzegovina, Malaysia, Denmark, United States, Slovak Republic, Hong Kong, Seychelles, Madagascar, South Sudan, Martinique, Bahrain, Korea, Cayman Islands, Gibraltar, South Africa, Switzerland, Niue, Spain, Moldova, Azerbaijan, Gambia, Bulgaria, Chile, Guyana, Marshall Islands, Macao, Belize, Myanmar, Malta, Nauru, Dominica, Sri Lanka, Turkmenistan, Sweden, Wallis and correct for this by selecting only companies with at least 1000 employees for CXOs. Given the lower correlation (47%) and that this filter would bias the results in sectors where large companies do not have a LinkedIn account, we decided to exclude the results of CXO with the company size filter as well.
Appendices

Futuna, Benin, Western Sahara, Andorra, Peru, Russian Federation, Guinea-Bissau, Bermuda, Ecuador, Ethiopia, Uganda, Equatorial Guinea, Malawi, Qatar, Samoa, Tajikistan, Colombia, Comoros, Croatia, France, Vietnam, Belarus, Cook Islands, Vatican City State (Holy See), India, Turks and Caicos Islands, Burkina Faso, Honduras, Democratic Republic of the Congo, Nicaragua, Morocco, Yemen, Lebanon, Latvia, Saint Vincent and the Grenadines, Dominican Republic, Finland, Haiti, Rwanda, Venezuela, Brazil, Norfolk Island, Botswana, Nigeria, Ireland, American Samoa, Bahamas, Faroe Islands, Bhutan, Congo, Romania, British Indian Ocean Territory, Northern Mariana Islands, Brunei Darussalam, Armenia, Costa Rica, Cape Verde, Eritrea, Portugal, Djibouti, Mali, Kuwait, Liberia, Grenada, Canada, Poland, Japan, Austria, Mauritius, Gabon, Slovenia, Pakistan, Kyrgyzstan, Niger, Papua New Guinea, Palestinian Territory, San Marino, Iceland, Czech Republic, Virgin Islands (U.S.), Mayotte, Zimbabwe, Vanuatu, Virgin Islands (British), Liechtenstein, Falkland Islands (Malvinas), Jersey, Sao Tome and Principe, Kenya, Philippines, Netherlands Antilles, Montserrat, Aruba, New Zealand, Puerto Rico, Bangladesh, Thailand, Macedonia, Solomon Islands, Laos, Israel, Kazakhstan, Guernsey, Guadeloupe, Lesotho, Georgia, Indonesia, Suriname, Somalia, Argentina, Iraq, Turkey, Australia, Cote D’Ivoire (Ivory Coast), Monaco, Saint Helena, Greece, Luxembourg, Palau, Saint Kitts and Nevis, Italy, Bolivia, Mexico, Kosovo, Germany, French Southern Territories, Cyprus, Federated States of Micronesia, Guam, Ukraine, Togo, Saint Lucia, Uruguay, Reunion, Trinidad and Tobago, Uzbekistan, Mongolia, Burundi, Muscat Governorate, Oman, Cambodia, Aland Islands, Egypt, Lithuania, Zambia, Tuvalu, Jamaica, French Guiana, Greenland, United Kingdom, New Caledonia, El Salvador, Pitcairn, Anguilla, Angola, Saudi Arabia, Panama, French Polynesia, Antigua and Barbuda, Central African Republic, Taiwan, Maldives, Libya.

Jurisdictions with a total audience (number of people reached in the location with no filters) below 10,000 were discarded: Falkland Islands, British Indian Ocean Territory, Montserrat, Norfolk Island, Niue, Pitcairn, Saint Helena, Ascension and Tristan da Cunha, French Southern Territories, Vatican

Cuba, Syria, Sudan, North Korea and Iran are not available locations in LinkedIn and were excluded. Curacao, Sint Maarten, Bonaire, Saba and Sint Eustatius are considered one location for LinkedIn and were combined into the Netherlands Antilles. Aruba, which seceded before the dissolution of the Netherlands Antilles, is not included within the Netherlands Antilles in LinkedIn.

Section S5: List of cities studied
We analyzed the 566 cities with a population of at least 500,000 starting from data from the United Nations (http://data.un.org/Data.aspx?d=POP&f=tableCode%3a240). We complemented this list with the list of global financial centers (https://en.wikipedia.org/wiki/Global_Financial_Centres_Index#cite_note-GFCI-6) for a total of 617 cities. We then matched those cities to the cities available in LinkedIn. The coverage from Korean and Ukrainian cities was poor compared with the LinkedIn coverage in Korea and Ukraine, which indicates that users in Korea and Ukraine do not provide their region. We deleted the data to avoid underestimating the users in those two countries. We finally manually ensured that all major Western cities were included in the sample. The final number of cities matched was 311.

Adelaide, Australia South Australia; Ahmedabad Area, India Gujarat; Al-Riyadh Governorate, Saudi Arabia Saudi Arabia; Alexandria Governorate Egypt; Algiers Province Algeria; Amman Governorate Jordan; Amsterdam Area, Netherlands North Holland Province; Antwerp Area, Belgium Flanders; Arequipa Region Peru; Asunción Province, Peru Ancash Region; Athens, Georgia Area Georgia; Auckland, New Zealand New Zealand; Bahrain Middle East; Baltimore, Maryland Area Maryland; Bandar Lampung Area, Lampung, Indonesia Indonesia; Bandung Area, West Java, Indonesia Indonesia; Bangkok Thailand; Banjarmasin Area, South Kalimantan, Indonesia Indonesia; Barcelona Area, Spain Catalonia; Basel Area, Switzerland Canton of Bern; Batna Province Algeria; Beijing China; Beirut Governorate Lebanon; Belo Horizonte Area, Brazil Minas Gerais; Belém Area, Brazil Pará; Bengaluru Area, India Karnataka; Berlin Germany; Bermuda Latin America; Bhopal Area, India Madhya Pradesh; Bilbao Area, Spain Basque Country; Birmingham, Alabama Area Alabama; Biskra Province Algeria; Blida Province Algeria; Bogotá D.C. Department Colombia; Bordeaux Area, France Aquitaine; Brasília Area, Brazil Distrito Federal; Bremen Germany; Brisbane, Australia Queensland; Bristol, United Kingdom United Kingdom; Brussels Capital Region Belgium; Bucharest, Romania Ilfov County; Budapest Hungary; Buri Ram, Thailand Territories; Béjaïa Province Algeria; Cairo Governorate Egypt; Calgary, Canada Area Alberta; California United States; Campinas Area, Brazil São Paulo; Cape Town Area, South Africa South Africa; Caracas Venezuela; Casablanca Prefecture, Morocco Grand Casablanca; Cayman Islands Latin America; Chaiyaphum Thailand; Changchun, Jilin, China Jilin; Chelyabinsk Region, Russian Federation Russian Federation; Chengdu, Sichuan, China Sichuan; Chennai Area, India Tamil Nadu; Chiang Mai Thailand; Chiang Rai Thailand; Chiba, Japan Japan; Chiclayo Province, Peru Lambayeque Region; Chisinau, Moldova Moldova; Chlef Province Algeria; Chongqing China; Coatzacoalcos Area, Mexico Veracruz Llave; Cologne Area, Germany North Rhine-Westphalia; Concepción Province, Peru Junín
Appendices

Region; Constantine Province Algeria; Copenhagen Area, Denmark Capital Region; County Dublin, Ireland Leinster; Curitiba Area, Brazil Paraná; Cyprus Europe; Córdoba, Spain Andalusia; Dalian, Liaoning, China Liaoning; Dallas/Fort Worth Area Texas; Delhi India; Denpasar Area, Bali, Indonesia Indonesia; Djelfa Province Algeria; Dongguan, Guangdong, China Guangdong; Dortmund Area, Germany North Rhine-Westphalia; Dresden Area, Germany Saxony; Duisburg Area, Germany North Rhine-Westphalia; Durban Area, South Africa South Africa; Düsseldorf Area, Germany North Rhine-Westphalia; Edinburgh, United Kingdom United Kingdom; Edmonton, Canada Area Alberta; Essen Area, Germany North Rhine-Westphalia; Fortaleza Area, Brazil Ceará; Frankfurt Area, Germany Brandenburg; Fukuoka, Japan Japan; Geneva Area, Switzerland Canton of Geneva; Genoa Area, Italy Liguria; Gibraltar Europe; Giza Governorate Egypt; Glasgow, United Kingdom United Kingdom; Goiânia Area, Brazil Goiás; Gothenburg, Sweden Västra Götaland County; Greater Atlanta Area Georgia; Greater Boston Area Massachusetts; Greater Buenos Aires Argentina; Greater Chicago Area Illinois; Greater Denver Area Colorado; Greater Detroit Area Michigan; Greater Jakarta Area, Indonesia Indonesia; Greater Los Angeles Area California; Greater Minneapolis-St. Paul Area Minnesota; Greater Philadelphia Area Pennsylvania; Greater San Diego Area California; Greater Seattle Area Washington; Greater St. Louis Area Missouri; Guadalajara Area, Mexico Jalisco; Guadalupe Area, Mexico Nuevo León; Guangzhou, Guangdong, China Guangdong; Guatemala City Guatemala; Guernsey Europe; Guiyang, Guizhou, China Guizhou; Haerbin, Heilongjiang, China Heilongjiang; Hamamatsu, Shizuoka, Japan Japan; Hamburg Germany; Hangzhou, Zhejiang, China Zhejiang; Helsinki Area, Finland Southern Finland; Hiroshima, Japan Japan; Hong Kong Asia; Houston, Texas Area Texas; Hyderabad Pakistan; Indore Area, India Madhya Pradesh; Irbid Governorate Jordan; Istanbul, Turkey İstanbul Province; Jaipur Area, India Rajasthan; Jambi Province, Indonesia Indonesia; Jersey Europe; Jerusalem District Israel; Jinan, Shandong, China Shandong; Johannesburg Area, South Africa South Africa; Johor Malaysia; Kanpur Area, India Uttar Pradesh; Kawasaki, Kanagawa, Japan Japan; Khon Kaen Thailand; Kingston upon Thames, United Kingdom United Kingdom; Kitchener, Canada Area Ontario; Kobe, Hyogo, Japan Japan; Kolkata Area, India West Bengal; Kraków Area, Poland Poland; Krasnodar Territory, Russian Federation Russian Federation; Krasnoyarsk Territory, Russian Federation Russian Federation; Kuala Lumpur Malaysia; Kumamoto, Japan Japan; Kunming, Yunnan, China Yunnan; Kyoto, Japan Japan; Lahore Pakistan; Las Palmas De Gran Canaria Area, Spain Canary Islands; Leipzig Area, Germany Saxony; Liechtenstein Europe; Lille Area, France Nord-Pas-de-Calais; Lisbon Portugal; Liverpool, United Kingdom United Kingdom; London, United Kingdom United Kingdom; Lucknow Area, India Uttar Pradesh; Luxembourg Europe; Lyon Area, France Rhône-Alpes; Maceió Area, Brazil Alagoas;
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Madrid Spain; Maha Sarakham Thailand; Makassar Area, South Sulawesi, Indonesia Indonesia; Malmo, Sweden Skåne County; Malta Europe; Manaus Area, Brazil Amazonas; Manchester, United Kingdom United Kingdom; Marseille Area, France Provence-Alpes-Côte d’Azur; Mascara Province Algeria; Mauritius Africa; Medan Area, North Sumatera, Indonesia Indonesia; Melbourne, Australia Victoria; Mendoza Province Argentina; Mexico City Mexico; Miami/Fort Lauderdale Area Florida; Milan Area, Italy Lombardy; Monaco Europe; Monastir Governorate Tunisia; Monterrey Area, Mexico Nuevo León; Montreal, Canada Area Quebec; Moscow, Russian Federation Russian Federation; Mumbai Area, India Maharashtra; Munich Area, Germany Bavaria; Murcia Spain; Málaga Area, Spain Andalusia; Médéa Province Algeria; NCR - National Capital Region, Philippines Philippines; NWFP Peshawar Pakistan; Nagoya, Aichi, Japan Japan; Nagpur Area, India Maharashtra; Nakhon Ratchasima Thailand; Nakhon Sawan Thailand; Nakhon Si Thammarat, Thailand Territories; Nanjing, Jiangsu, China Jiangsu; Nantes Area, France Pays de la Loire; Naples Area, Italy Campania; Natal Area, Brazil Rio Grande do Norte; New Delhi Area, India Delhi; New York United States; Newcastle, Australia New South Wales; Nice Area, France Provence-Alpes-Côte d’Azur; Niigata, Japan Japan; Nizhny Novgorod Region, Russian Federation Russian Federation; Northern Punjab Rawalpindi Pakistan; Nottingham, United Kingdom United Kingdom; Nova Iguaçu Area, Brazil Rio de Janeiro; Novosibirsk Region, Russian Federation Russian Federation; Okayama, Japan Japan; Omsk Region, Russian Federation Russian Federation; Oran Province Algeria; Osaka, Japan Japan; Ottawa, Canada Area Ontario; Padang Area, West Sumatera, Indonesia Indonesia; Palembang Area, South Sumatera, Indonesia Indonesia; Palermo Area, Italy Sicily; Panama Latin America; Paris Area, France Île-de-France; Pekanbaru Area, Riau, Indonesia Indonesia; Perm Territory, Russian Federation Russian Federation; Perth, Australia Western Australia; Phetchabun Thailand; Phoenix, Arizona Area Arizona; Port Elizabeth Area, South Africa South Africa; Port Said Governorate Egypt; Porto Alegre Area, Brazil Rio Grande do Sul; Poznań Area, Poland Poland; Prague, The Capital, Czech Republic Czech Republic; Pretoria Area, South Africa South Africa; Pune Area, India Maharashtra; Qingdao, Shandong, China Shandong; Quebec Canada; Recife Area, Brazil Pernambuco; Region IX - Zamboanga Peninsula, Philippines Philippines; Rio de Janeiro Brazil; Roi Et Thailand; Rome Area, Italy Lazio; Rosário do Sul Area, Brazil Rio Grande do Sul; Rotterdam Area, Netherlands South Holland Province; Saint Petersburg, Russian Federation Russian Federation; Saitama, Japan Japan; Salta Province Argentina; Salvador Area, Brazil Bahia; Samara Region, Russian Federation Russian Federation; Samut Prakan Thailand; San Francisco Bay Area California; San Juan Province Argentina; Santa Fe Province Argentina; Santiago Metropolitan Region Chile; Sapporo, Hokkaido, Japan Japan; Saratov Region, Russian Federation Russian Federation;
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Semarang Area, Central Java, Indonesia Indonesia; Sendai, Miyagi, Japan Japan; Shanghai China; Sheffield, United Kingdom United Kingdom; Shenyang, Liaoning, China Liaoning; Shenzhen, Guangdong, China Guangdong; Sidi Bel Abbès Province Algeria; Singapore Asia; Skikda Province Algeria; Sofia Province Bulgaria; Songkhla Thailand; Southern Punjab Multan Pakistan; Stockholm County Sweden; Stuttgart Area, Germany Baden-Württemberg; Suez Governorate Egypt; Surabaya Area, East Java, Indonesia Indonesia; Sydney, Australia New South Wales; São Luis Area, Brazil Maranhão; São Paulo Brazil; Sétif Province Algeria; Taipei City, Taiwan Taiwan; Tampa/St. Petersburg, Florida Florida; The Hague Area, Netherlands South Holland Province; Tianjin China; Tiaret Province Algeria; Tijuana Area, Mexico Baja California; Tlalnepantla Area, Mexico Mexico; Tlaquepaque Area, Mexico Colima; Tlemcen Province Algeria; Tokyo, Japan Japan; Toluca Area, Mexico Mexico; Tonalá Area, Mexico Colima; Toronto, Canada Area Ontario; Toulon Area, France Provence-Alpes-Côte d’Azur; Toulouse Area, France Midi-Pyrénées; Trujillo Venezuela; Turin Area, Italy Piedmont; Tèbessa Province Algeria; Ubon Ratchathani Thailand; Udon Thani Thailand; Valencian Community Spain; Valparaíso Region Chile; Vancouver, Canada Area British Columbia; Vienna Austria; Volgograd Region, Russian Federation Russian Federation; Voronezh Region, Russian Federation Russian Federation; Warsaw Area, Poland Poland; Washington United States; Wellington & Wairarapa, New Zealand New Zealand; Winnipeg, Canada Area Manitoba; Wrocław Area, Poland Poland; Wuhan, Hubei, China Hubei; Yokohama, Kanagawa, Japan Japan; Zapopan Area, Mexico Mexico; Zaragoza, Spain Aragon; Zürich Area, Switzerland Canton of Zürich; Łódź Area, Poland Poland

Section S6: List of ISO2 codes

Appendix of Chapter 5
APPENDIX

The multinationality-performance relationship

Table A-1 shows the 10 most influential contributions—that is the articles that to date have received the highest number of citations in SSCI—focused on the M-P relationship.\(^2\)

Measures

For our independent variable, we follow L&B and B&K’s works and create the *Internationalization* index:

\[
\text{Internationalization}_i = \frac{1}{2} \left( \frac{N\text{Countries}_i}{\max(N\text{Countries})} + \frac{N\text{Subsidiaries}_i}{\max(N\text{Subsidiaries})} \right)
\]

The internationalization of a firm \(i\) in each year thus depends on the number of countries (NCountries) and the number of foreign subsidiaries (NSubsidiaries). The first part of the equation is normalized by the maximum number of countries in which any firm has subsidiaries. The second part is normalized by the maximum number of subsidiaries of any firm. In order to test the S-shaped relationship, we also create the squared and cubed term of *Internationalization* and name them *Internationalization squared* and *Internationalization cubed* respectively. The mean number of countries in which a multinational firm operates slightly differs across samples: 4.82 for our sample, 5.57 and 8.11 for L&B and B&K’s samples respectively. Similarly, the average number of subsidiaries for multinationals slightly differs as well: 18.25 for our sample, 11.88 and 19.23 in L&B and B&K’s samples respectively. The dependent variable, return on assets (ROA), is calculated using the ratio of a firm’s operating profit to its total assets. This differs slightly from the definition in B&K and L&B’s studies, in which ROA is calculated as the ratio of net income (obtained by subtracting taxes and interests from the operating profit). We expect this not to affect our results as this is only a small variation in the way of calculating ROA and we consistently use such measure for all firms in our sample.

The main difference between our analysis and those of L&B and B&K is that we do not include their proxy of a firm’s intangible assets (named “R&D Intensity” in their specification) in our model. While they include it to test the moderating effect of intangible assets on the M-P relationship, we restrict our focus on the main effect of *Internationalization* on *ROA*. We also exclude it as control due to the relatively low availability of information on this measure in the Orbis database. We do so because the coefficient of “Parent R&D intensity” in B&K’s analysis is not significant in any of their specifications and the coefficients of their independent variables are barely affected by the inclusion of the interaction term between “Parent R&D Intensity” and *Internationalization*. Despite this, we perform additional analyses (reported in the robustness checks below) to examine whether the exclusion of intangible assets may impact our results. The results obtained in these additional tests allow us to conclude that the exclusion of intangible assets does not raise concerns for our study.

\(^1\) This is the online appendix to the article by Pisani, Garcia-Bernardo, and Heemskerk published in the *Strategic Management Journal* and titled “Does it pay to be a multinational? A large-sample, cross-national replication assessing the multinationality-performance relationship.”

\(^2\) Verbeke and Forootan (2012) report in their Table 1 the list of 12 most cited articles that empirically investigated the M-P relationship. All 10 articles reported in our Table A-1 were already included in their list.
## TABLE A-1
The 10 most influential studies on the M-P relationship

<table>
<thead>
<tr>
<th>Citation ranking</th>
<th>No. citations in Web of Science</th>
<th>Year</th>
<th>Authors</th>
<th>Journal</th>
<th>M-P relationship hypothesized</th>
<th>M-P relationship empirically shown</th>
<th>Source of data</th>
<th>Sample size</th>
<th>Country of sampled firms</th>
<th>Cross-section versus panel</th>
<th>Pooled cross-section, fixed or random effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1,084</td>
<td>1997</td>
<td>Hitt, Haskins, and Kim</td>
<td>Academy of Management Journal</td>
<td>Inverted U-shaped</td>
<td>Inverted U-shaped</td>
<td>S&amp;P COMPUSTAT database</td>
<td>251 firms</td>
<td>USA</td>
<td>Cross-section</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2</td>
<td>1,028</td>
<td>2000</td>
<td>Zahra, Ireland, and Hitt</td>
<td>Academy of Management Journal</td>
<td>Positive</td>
<td>Positive</td>
<td>Survey administered to firms</td>
<td>1,388 firms</td>
<td>USA</td>
<td>Cross-section</td>
<td>Not applicable</td>
</tr>
<tr>
<td>3</td>
<td>680</td>
<td>2001</td>
<td>Lu and Beamish</td>
<td>Strategic Management Journal</td>
<td>U-shaped</td>
<td>U-shaped</td>
<td>NIKKEI NEEDS tapes database and Japan Company Handbook</td>
<td>104 firms</td>
<td>Japan</td>
<td>Panel (12 years)</td>
<td>Total n. of observations not reported</td>
</tr>
<tr>
<td>4</td>
<td>497</td>
<td>1996</td>
<td>Taillant and Li</td>
<td>Academy of Management Journal</td>
<td>Positive</td>
<td>Insignificant</td>
<td>Directory of Multinationals database</td>
<td>102 firms</td>
<td>USA</td>
<td>Cross-section</td>
<td>Not applicable</td>
</tr>
<tr>
<td>5</td>
<td>462</td>
<td>2004</td>
<td>Lu and Beamish</td>
<td>Academy of Management Journal</td>
<td>S-shaped</td>
<td>S-shaped</td>
<td>NIKKEI NEEDS tapes database and Japan Company Handbook</td>
<td>1,489 firms</td>
<td>Japan</td>
<td>Panel (12 years)</td>
<td>Total n. of observations not reported</td>
</tr>
<tr>
<td>6</td>
<td>390</td>
<td>2003</td>
<td>Contractor, Kam, and Hsu</td>
<td>Journal of International Business Studies</td>
<td>S-shaped</td>
<td>S-shaped</td>
<td>Directory of the World’s Largest Service Companies</td>
<td>103 firms</td>
<td>USA</td>
<td>USA (42% of the sample) plus 5 other undisclosed countries (remaining 58% of the sample)</td>
<td>Panel (6 years)</td>
</tr>
<tr>
<td>7</td>
<td>354</td>
<td>2000</td>
<td>Palich, Cardinal, and Miller</td>
<td>Strategic Management Journal</td>
<td>Inverted U-shaped</td>
<td>Inverted U-shaped</td>
<td>Meta-analysis of 82 studies</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>8</td>
<td>339</td>
<td>1999</td>
<td>Garvey, Beamish, and Dueck</td>
<td>Journal of Management</td>
<td>Positive</td>
<td>Positive</td>
<td>World Directory of Multinational Enterprises</td>
<td>200 firms</td>
<td>USA (50% of the sample) and Europe (remaining 50%)</td>
<td>Cross-section (Tests of mean differences)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>9</td>
<td>289</td>
<td>1999</td>
<td>Gomez and Ramasamy</td>
<td>Journal of International Business Studies</td>
<td>Inverted U-shaped</td>
<td>Inverted U-shaped</td>
<td>Not reported</td>
<td>95 firms</td>
<td>USA</td>
<td>Cross-section (Tests of mean differences)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>10</td>
<td>279</td>
<td>1988</td>
<td>Grant, Jaworski, and Thomas</td>
<td>Academy of Management Journal</td>
<td>Positive</td>
<td>Positive</td>
<td>Not reported</td>
<td>304 firms</td>
<td>UK</td>
<td>Panel (13 years)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

1The No. of citations in Web of Science were retrieved on December 5 2017.
Another important difference vis-à-vis L&B and B&K’s models is that we exclude the variable exchange rate when using our full sample (while we regularly include it in the analysis focused on the subsample of multinational firms provided in the article). We omit this control variable given that reliable information on exchange rates is retrievable for only 71 of the 111 countries considered in our full sample. Thus, its inclusion would imply the reduction of our full sample by approximately 50,000 observations. Having said that, as a robustness check (reported below) we rerun both our random- and fixed-effects models on the subsample for which it is possible to take into account the exchange rate (846,482 firm-year observations) and the results are entirely aligned with the ones obtained excluding this variable.

In addition to our dependent and independent variables, we include the same controls used by B&K. Thus, we control for a firm’s size, its debt-to-equity ratio, its export intensity as well as its extent of product diversification. Parent size is measured (as logarithm) using the total turnover of the firm. The variable Parent export intensity is calculated as the fraction of revenues allocated to subsidiaries outside the parent country. Product diversification is calculated using the Berry-Herfindahl index (1 - Herfindahl index: $1 - \sum_{s=sector} p_s^2$), where $p_s$ is the fraction of revenues produced in subsidiaries of sector $s$, and sectors are aggregated at the NACE Rev. 2 highest level (letter-level). In addition, we include both industry-fixed effects (at the highest level) and country-fixed effects in the random-effects estimation models, as done by L&B and B&K. As B&K we are unable to control for firm’s advertising intensity and thus also exclude it from our analysis. As done by both L&B and B&K, we lag all independent variables by one year.

Robustness checks of the replication using our full sample

Having compared our results with the ones obtained by L&B and B&K in the article (see Table 4), in what follows we look at the robustness of these findings by undertaking a number of additional checks. Thus, in Table A-2 we check the robustness of our findings after dropping each control from the final models (Model 6 in Table 4 for the fixed-effects model estimation and Model 3 in Table A-4 for the random-effects model estimation) as both L&B and B&K do. The S-shaped relationship remains significant across all models, with the exception of the random-effects Model 3, in which the coefficient of the main term of Internationalization is not significantly different from zero. We continue with testing the robustness of our findings when using different lags (Table A-3). The S-shaped relationship remains significant for all random-effects estimations, and for all fixed-effects estimation models except for the regression with a three-year lag in the ROA (Model 2). Table A-4 shows comparable results for the main and squared models compared with the ones obtained by B&K (as also discussed in the main text focusing on the fixed-effects estimation shown in Table 4), a negative effect of Internationalization for the linear model, and a U-shaped relationship for the quadratic model (the models using fixed-effects and testing for the linear, quadratic, and cubic relationships are reported in the article in Table 4 as Models 4, 5, and 6 respectively). Models 4 and 5 in Table A-4 use the mean-centered variables to account for collinearity (in the same vein as L&B and B&K do) and show the robustness of the S-shaped relationship to these additional checks.

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3 For additional information on Eurostat Statistical Classification of Economic Activities refer to: http://ec.europa.eu/eurostat/statistics-explained/index.php/Eurostat+Statistical+Classification+of+Economic+Activities
## TABLE A-2

### Robustness to dropped controls

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (RE)</th>
<th>2 (FE)</th>
<th>3 (RE)</th>
<th>4 (FE)</th>
<th>5 (RE)</th>
<th>6 (FE)</th>
<th>7 (RE)</th>
<th>8 (FE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship tested</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
</tr>
<tr>
<td>Internationalization</td>
<td>-0.592</td>
<td>-0.320</td>
<td>0.004</td>
<td>-0.150</td>
<td>-0.687</td>
<td>-0.330</td>
<td>-0.729</td>
<td>-0.335</td>
</tr>
<tr>
<td></td>
<td>(0.052)</td>
<td>(0.077)</td>
<td>(0.047)</td>
<td>(0.076)</td>
<td>(0.050)</td>
<td>(0.075)</td>
<td>(0.052)</td>
<td>(0.076)</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>4.577</td>
<td>1.889</td>
<td>1.683</td>
<td>1.127</td>
<td>5.298</td>
<td>1.972</td>
<td>5.429</td>
<td>1.999</td>
</tr>
<tr>
<td></td>
<td>(0.477)</td>
<td>(0.533)</td>
<td>(0.395)</td>
<td>(0.519)</td>
<td>(0.497)</td>
<td>(0.527)</td>
<td>(0.507)</td>
<td>(0.528)</td>
</tr>
<tr>
<td></td>
<td>(1.054)</td>
<td>(0.900)</td>
<td>(0.800)</td>
<td>(0.866)</td>
<td>(1.140)</td>
<td>(0.899)</td>
<td>(1.154)</td>
<td>(0.899)</td>
</tr>
<tr>
<td>Parent size</td>
<td>-0.012</td>
<td>-0.010</td>
<td>-0.012</td>
<td>-0.010</td>
<td>-0.012</td>
<td>-0.010</td>
<td>-0.012</td>
<td>-0.010</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0002)</td>
<td>(0.0001)</td>
<td>(0.0002)</td>
<td>(0.0001)</td>
<td>(0.0002)</td>
<td>(0.0001)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Gearing</td>
<td>0.014</td>
<td>0.012</td>
<td>0.015</td>
<td>0.011</td>
<td>0.014</td>
<td>0.011</td>
<td>0.014</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.0003)</td>
<td>(0.001)</td>
<td>(0.0003)</td>
<td>(0.001)</td>
<td>(0.0003)</td>
<td>(0.001)</td>
<td>(0.0003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.007</td>
<td>-0.001</td>
<td>-0.003</td>
<td>-0.001</td>
<td>-0.003</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.023</td>
<td>-0.006</td>
<td>-0.017</td>
<td>-0.003</td>
<td>-0.023</td>
<td>-0.007</td>
<td>-0.023</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>889,865</td>
<td>195,205</td>
<td>889,865</td>
<td>195,205</td>
<td>889,865</td>
<td>195,205</td>
<td>889,865</td>
<td>195,205</td>
</tr>
<tr>
<td>F statistic</td>
<td>196.86</td>
<td>98.51</td>
<td>236.88</td>
<td>460.43</td>
<td>263.56</td>
<td>557.35</td>
<td>260.14</td>
<td>555.07</td>
</tr>
<tr>
<td>R square</td>
<td>0.03</td>
<td>0.01</td>
<td>0.04</td>
<td>0.04</td>
<td>0.01</td>
<td>0.04</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

1 All independent variables are lagged by one period. All models report (robust standard errors in parentheses) and [p-values in brackets].
## TABLE A-3

**Robustness to other lags**

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (Lag 3, RE)</th>
<th>2 (Lag 3, FE)</th>
<th>3 (Lag 2, RE)</th>
<th>4 (Lag 2, FE)</th>
<th>5 (No lag, RE)</th>
<th>6 (No lag, FE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship tested</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
</tr>
<tr>
<td>Internationalization</td>
<td>-0.319 (0.058) [-0.0001]</td>
<td>0.033 (0.099) [-0.0001]</td>
<td>-0.491 (0.053) [0.006]</td>
<td>-0.243 (0.087) [-0.0001]</td>
<td>-1.114 (0.052) [-0.0001]</td>
<td>-1.050 (0.069) [-0.0001]</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>3.004 (0.507) [-0.0001]</td>
<td>-0.106 (0.744) [-0.0001]</td>
<td>4.032 (0.460) [0.012]</td>
<td>1.551 (0.615) [-0.0001]</td>
<td>7.357 (0.539) [-0.0001]</td>
<td>5.127 (0.542) [-0.0001]</td>
</tr>
<tr>
<td>Internationalization cubed</td>
<td>-5.798 (1.102) [-0.0001]</td>
<td>-0.569 (1.460) [-0.0001]</td>
<td>-6.980 (0.964) [-0.0001]</td>
<td>-2.393 (1.025) [-0.0001]</td>
<td>-11.627 (1.248) [-0.0001]</td>
<td>-7.062 (1.023) [-0.0001]</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.012 (0.0004) [-0.0001]</td>
<td>0.002 (0.001) [-0.0001]</td>
<td>0.013 (0.0003) [-0.0001]</td>
<td>0.005 (0.001) [-0.0001]</td>
<td>0.022 (0.0003) [-0.0001]</td>
<td>0.038 (0.001) [-0.0001]</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>-0.010 (0.0002) [-0.0001]</td>
<td>-0.001 (0.0003) [-0.0001]</td>
<td>-0.011 (0.0003) [-0.0001]</td>
<td>-0.004 (0.0003) [-0.0001]</td>
<td>-0.015 (0.0003) [-0.0001]</td>
<td>-0.018 (0.0002) [-0.0001]</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>-0.004 (0.002) [-0.0001]</td>
<td>0.001 (0.004) [-0.0001]</td>
<td>-0.002 (0.002) [-0.0001]</td>
<td>0.005 (0.003) [-0.0001]</td>
<td>-0.007 (0.002) [-0.0001]</td>
<td>-0.016 (0.003) [-0.0001]</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.021 (0.001) [-0.0001]</td>
<td>-0.001 (0.003) [-0.0001]</td>
<td>-0.021 (0.001) [-0.0001]</td>
<td>-0.002 (0.002) [-0.0001]</td>
<td>-0.023 (0.001) [-0.0001]</td>
<td>-0.011 (0.002) [-0.0001]</td>
</tr>
<tr>
<td>Number of observations</td>
<td>492,858</td>
<td>108,115</td>
<td>671,370</td>
<td>147,274</td>
<td>1,195,723</td>
<td>262,299</td>
</tr>
<tr>
<td>Lag</td>
<td>3 years</td>
<td>3 years</td>
<td>2 years</td>
<td>2 years</td>
<td>0 years</td>
<td>0 years</td>
</tr>
<tr>
<td>F statistic</td>
<td>137.68</td>
<td>187.38</td>
<td>187.38</td>
<td>187.38</td>
<td>435.98</td>
<td>3,275.16</td>
</tr>
<tr>
<td>R square</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Random</td>
<td>Fixed</td>
<td>Random</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

1 All independent variables are lagged as specified in the lag row. All models report (robust standard errors in parentheses) and [p-values in brackets].
### TABLE A-4

Linear, quadratic, cubic (random-effects) and mean-centered models

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (RE)</th>
<th>2 (RE)</th>
<th>3 (RE)</th>
<th>4 (Mean-centered, RE)</th>
<th>5 (Mean-centered, FE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship tested</td>
<td>Linear</td>
<td>Quadratic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
</tr>
<tr>
<td>Internationalization</td>
<td>-0.104</td>
<td>-0.308</td>
<td>-0.651</td>
<td>-0.656</td>
<td>-0.359</td>
</tr>
<tr>
<td>(0.017)</td>
<td>(0.033)</td>
<td>(0.052)</td>
<td>(0.052)</td>
<td>(0.076)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>-0.104</td>
<td>-0.308</td>
<td>-0.651</td>
<td>-0.656</td>
<td>-0.359</td>
</tr>
<tr>
<td>(0.017)</td>
<td>(0.033)</td>
<td>(0.052)</td>
<td>(0.052)</td>
<td>(0.076)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Internationalization cubed</td>
<td>-0.104</td>
<td>-0.308</td>
<td>-0.651</td>
<td>-0.656</td>
<td>-0.359</td>
</tr>
<tr>
<td>(0.017)</td>
<td>(0.033)</td>
<td>(0.052)</td>
<td>(0.052)</td>
<td>(0.076)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.014</td>
<td>0.015</td>
<td>0.015</td>
<td>0.015</td>
<td>0.011</td>
</tr>
<tr>
<td>(0.0003)</td>
<td>(0.0003)</td>
<td>(0.0003)</td>
<td>(0.0003)</td>
<td>(0.0003)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>-0.012</td>
<td>-0.012</td>
<td>-0.012</td>
<td>-0.012</td>
<td>-0.010</td>
</tr>
<tr>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.0001)</td>
<td>(0.00002)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>-0.007</td>
<td>-0.005</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>[0.00003]</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.023</td>
<td>-0.023</td>
<td>-0.023</td>
<td>-0.023</td>
<td>-0.006</td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>[0.00001]</td>
</tr>
<tr>
<td>Number of observations</td>
<td>889,865</td>
<td>889,865</td>
<td>889,865</td>
<td>878,499</td>
<td>195,205</td>
</tr>
<tr>
<td>F statistic</td>
<td>264.51</td>
<td>263.02</td>
<td>261.80</td>
<td>259.21</td>
<td>478.34</td>
</tr>
<tr>
<td>R square</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Random</td>
<td>Random</td>
<td>Random</td>
<td>Random</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

1 All independent variables are lagged by one period. All models report (robust standard errors in parentheses) and [p-values in brackets].
2 The models using fixed-effects and testing for the linear, quadratic, and cubic relationships are reported in the article in Table 4 as Models 4, 5, and 6 respectively.
In addition to the robustness checks undertaken by L&B and B&K, we perform additional tests to verify the robustness of our findings. First, we look at the smaller subsample with available information on intangibles (Models 1 and 2 in Table A-5). For this considerably smaller subset of firm-year data points (31,845) we create a variable named Intangibles which corresponds to the ratio of intangible assets to total assets and include it as control. Our findings show that the coefficient of Intangibles is not significant in the fixed-effects model (p-value = 0.226) and the main results obtained in Model 6 in Table 4 are confirmed.

Next, we rerun our fully-specified model on the subsample for which it is possible to account for the exchange rate. Information on real effective exchange rates is available from the International Monetary Fund for 71 of the 111 countries considered in our study. The resulting subsample after including the variable Exchange rate as control variable comprises 846,482 firm-year observations. The S-curved relationship between multinationality and performance is confirmed in both the random- and fixed-effects estimations (Models 3 and 4 in Table A-5).

After looking at the effect of Intangibles and Exchange rate, we perform further analyses building on earlier works supporting the adoption of hybrid or multilevel models (Bowen, 2007; Certo et al., 2017; Nielsen and Nielsen, 2010). Thus, we explicitly model the between- and within-firm effects separately (Model 5 in Table A-5) using the Mundlak (1978) correction, in particular the within-between formulation of the model (Bell and Jones, 2014). In this formulation, the heterogeneity bias is explicitly modeled by adding the higher-level mean at the group level of each time-varying covariate, accounting for the between effect. This approach is similar to the hybrid approach introduced by Allison (2005) and explained in Certo et al.’s work (2017). As expected—in view of the fact that we find similar results for our random- and fixed-effects estimations—we obtain a significant S-shaped relationship for both the within and between parts of the model. To account for the nested nature of our data, we also repeat our estimation using a multilevel model (Model 6 in Table A-5) in which the lower level is the firm-level while the higher one is the country-level (including industry fixed-effects). The results are entirely aligned with the ones obtained in our random-effects model. When using as higher-level the industry instead of the country (and thus including country fixed-effects in the model; the results of this additional model specification are available upon request), we obtain again very similar results in which the S-curve continues to be empirically validated.

Footnotes:

4 For additional information on the data we retrieved to construct our Exchange rate variable, refer to: http://data.imf.org/?sk=4C514D4B-B6B4-49ED-8AB9-52B0C1A0179B.

5 While having some advantages vis-à-vis fixed-effects models, both hybrid and multilevel models present the same methodological challenge that remains to be addressed—i.e., how to account for endogeneity when it can exist with both within- and between-firm variables (Certo et al., 2017). To our knowledge, no published study in the field has in fact used multilevel or hybrid models to examine a causal between-firm relationship using longitudinal (nested) data while also accounting for the endogeneity of the main predictor variable (whose source can be at different levels). To ensure this we reviewed all papers that use multilevel models published by the Strategic Management Journal. None of them discusses (and empirically accounts for) the potential endogeneity of the main predictor variable as we point out here.

6 Despite their several advantages vis-à-vis alternative model estimations, multilevel models have not been frequently used in the fields of strategic management and international business (Certo et al., 2017; Peterson, Arregle, and Martin, 2012). Multilevel models have the benefit to allow for the estimation of the effects of both time-varying and time-invariant variables at different levels of analysis. However, they do not allow to test for differences between within- and between-firm effects as they are embodied in the same coefficient. As also noted by Certo et al. (2017), multilevel and random-effects models report essentially the same results.
## TABLE A-5

Robustness results to further model specifications\(^1,2,3\)

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (Including intangibles, RE)</th>
<th>2 (Including intangibles, FE)</th>
<th>3 (Including exchange rate, RE)</th>
<th>4 (Including exchange rate, FE)</th>
<th>5 (Mundlak correction)</th>
<th>6 (Multilevel model)</th>
<th>7 (Heckman second-stage)</th>
<th>8 (Heckman second-stage including prior performance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship tested</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
</tr>
<tr>
<td>Dependent variable</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
</tr>
<tr>
<td>Internationalization</td>
<td>-0.159 (0.114)</td>
<td>-0.300 (0.054)</td>
<td>-0.639 (0.080)</td>
<td>-0.914 (0.077)</td>
<td>-0.359 (0.076)</td>
<td>-0.652 (0.328)</td>
<td>-0.317 (0.044)</td>
<td>-0.190 (0.039)</td>
</tr>
<tr>
<td>Internationalization squared</td>
<td>[0.162] (0.080)</td>
<td>[0.0001] (0.008)</td>
<td>[0.0001] (0.0001)</td>
<td>[0.0001] (0.0047)</td>
<td>[0.0001]</td>
<td>[0.0001]</td>
<td>[0.0001]</td>
<td>[0.0001]</td>
</tr>
<tr>
<td>Internationalization cubed</td>
<td>2.639 (0.510)</td>
<td>5.058 (0.542)</td>
<td>1.380 (0.867)</td>
<td>7.996 (0.533)</td>
<td>(1.66)</td>
<td>5.967 (0.380)</td>
<td>2.487 (0.333)</td>
<td>1.324 (0.333)</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.059 (0.005)</td>
<td>0.035 (0.0003)</td>
<td>0.014 (0.0001)</td>
<td>0.010 (0.0003)</td>
<td>0.016 (0.001)</td>
<td>0.011 (0.002)</td>
<td>0.014 (0.002)</td>
<td>0.011 (0.002)</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>-0.016 (0.001)</td>
<td>-0.013 (0.0001)</td>
<td>-0.012 (0.0002)</td>
<td>-0.010 (0.0001)</td>
<td>-0.014 (0.0002)</td>
<td>-0.010 (0.0002)</td>
<td>-0.012 (0.0002)</td>
<td>-0.014 (0.0002)</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>0.022 (0.009)</td>
<td>-0.005 (0.002)</td>
<td>-0.003 (0.003)</td>
<td>-0.002 (0.003)</td>
<td>-0.003 (0.004)</td>
<td>-0.004 (0.001)</td>
<td>-0.006 (0.001)</td>
<td>0.003 (0.001)</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>-0.013 (0.007)</td>
<td>-0.023 (0.001)</td>
<td>-0.007 (0.002)</td>
<td>-0.035 (0.003)</td>
<td>-0.006 (0.002)</td>
<td>-0.02 (0.006)</td>
<td>-0.031 (0.002)</td>
<td>-0.015 (0.002)</td>
</tr>
<tr>
<td>Intangibles</td>
<td>-0.00004 (0.0000)</td>
<td>-0.00001 (0.0000)</td>
<td>[0.016] (0.0003)</td>
<td>[0.0001] (0.0006)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exchange rate</td>
<td>0.0001 (0.0003)</td>
<td>0.0003 (0.0003)</td>
<td>[0.016] (0.0001)</td>
<td>[0.0001] (0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROA(t-1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.473 (0.002)</td>
<td>[0.0001]</td>
<td>[0.0001]</td>
<td>[0.0001]</td>
</tr>
<tr>
<td>IMR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.001 (0.001)</td>
<td>0.004 (0.001)</td>
<td>[0.018] (0.039)</td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>31,845 (24,677)</td>
<td>846,482 (177,755)</td>
<td>878,499 (889,865)</td>
<td>889,865 (889,865)</td>
<td>642,506</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wald Chi square / F statistic</td>
<td>25.86 (36.61)</td>
<td>371.31 (477.94)</td>
<td>520.28 (521,391.37)</td>
<td>61,441.20 (13,944.47)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R square</td>
<td>0.16 (0.01)</td>
<td>0.04 (0.01)</td>
<td>0.04 (0.04)</td>
<td>0.04 (0.04)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Random Fixed</td>
<td>Random Fixed</td>
<td>Both Fixed</td>
<td>Mixed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) All independent variables are lagged by one period. Models 1–4 and 6 report (robust standard errors in parentheses). All models report [p-values in brackets]. In model 5 each cell shows both the between effect (first number) and the within effect (second number).

\(^2\) Model 6 only contains industry dummies as the two levels considered are firm and country.

\(^3\) In Models 7 and 8 we only report the second-stage results of the Heckman’s two-stage estimation procedures. The first-stage results are available upon request.
We also perform additional analyses to account for the possibility that firms may self-select into the multinational (versus domestic) category due to unobserved firm characteristics and this may bias the results of our estimation. To take into account such potential selection bias in our analysis, we follow common procedure (Bascle, 2008) and use Heckman’s (1979) two-stage estimation procedure. In the first stage, we estimate the selection equation using a pooled probit model in which the limited (dummy) dependent variable \( MNE \) is the propensity to be a multinational versus a domestic firm—i.e., \( MNE \) scores 1 if the firm is a multinational and 0 if the firm is domestic—and use the set of control variables included in our Model 6 in Table 4 as our independent variables. In this first stage, we also include our main exclusion variable corresponding to the export intensity aggregated at the industry and country levels (Export intensity by industry, country, and year). We expect that firms pertaining to a specific industry and country characterized by a higher average export intensity are more likely to internationalize, but do not expect that export intensity aggregated at the industry and country levels has an effect on the profitability of a given company, thus satisfying the exclusion restriction of a two-stage estimation procedure. This is confirmed in our data as the pairwise correlation coefficient between Export intensity by industry, country, and year and \( MNE \) is 0.16 while the one between Export intensity by industry, country, and year and ROA is 0.01. The first stage allows for the computation of the inverse Mills ratio (IMR), which represents our selection parameter that is included in the second stage to account for potential selection bias and thus obtain consistent and unbiased coefficients. In the second stage, ROA is modeled as a function of IMR and all our independent and control variables as included in Model 6 in Table 4. The second-stage results (reported in Model 7 in Table A-5) are entirely aligned with those obtained without correcting for this potential selection bias. In view of the fact that a firm’s prior performance may also influence its likelihood to internationalize, we repeat the entire analysis adding the lagged profitability measure (i.e., ROA at time t-1) as control variable in both stages. The second-stage results (reported in Model 8 in Table A-5) are entirely aligned with those shown in Model 7. Thus, these additional analyses provide strong evidence that our findings do not suffer from this potential selection bias.

Finally, another issue is associated with the potential sample selection bias due to the fact that, while the entire Orbis dataset contains data on over three million firms with at least one subsidiary, it was obviously impossible to retrieve the firm-level data that is necessary to replicate L&B and B&K’s studies for the vast majority of these firms, especially the information necessary to construct Parent export intensity and Parent product diversification. If missing values are non-random—i.e., unobservable variables have an effect on the availability of data—our findings may be biased as a result of sample selection bias. To address the potential sample selection bias in our analysis we follow standard procedure (Bascle, 2008) and again make use of the Heckman’s (1979) two-stage estimation procedure. Thus, in the first stage we use approximately 1.5 million firm-year data points to model the propensity that a given observation forms part of our full working sample comprising 889,865 firm-year observations. The results of this additional check (available upon request) are entirely aligned with the ones shown in Models 7 and 8 in Table A-5, thus lending support to the conclusion that our findings do not suffer from potential sample selection bias.
# TABLE A-6

**First-stage regressions**

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (First-stage regression - Main term)</th>
<th>2 (First-stage regression - Squared term)</th>
<th>3 (First-stage regression - Cubed term)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>Internationalization</td>
<td>Internationalization squared</td>
<td>Internationalization cubed</td>
</tr>
<tr>
<td>Board internationalization</td>
<td>0.03</td>
<td>0.48</td>
<td>10.09</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.06)</td>
<td>(2.22)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
</tr>
<tr>
<td>Board internationalization squared</td>
<td>-0.001</td>
<td>-0.01</td>
<td>-0.36</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.002)</td>
<td>(0.08)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
</tr>
<tr>
<td>Board internationalization cubed</td>
<td>0.000006</td>
<td>0.0001</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.001)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
</tr>
<tr>
<td>Parent size</td>
<td>0.38</td>
<td>5.06</td>
<td>108.72</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(1.21)</td>
<td>(44.86)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
<td>[0.02]</td>
</tr>
<tr>
<td>Parent debt-to-equity ratio</td>
<td>0.03</td>
<td>0.66</td>
<td>23.07</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.48)</td>
<td>(21.99)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[0.17]</td>
<td>[0.29]</td>
</tr>
<tr>
<td>Parent export intensity</td>
<td>0.46</td>
<td>4.35</td>
<td>34.85</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(2.27)</td>
<td>(82.98)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[0.06]</td>
<td>[0.67]</td>
</tr>
<tr>
<td>Parent product diversification</td>
<td>0.64</td>
<td>9.67</td>
<td>261.27</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(2.83)</td>
<td>(114.06)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[0.001]</td>
<td>[0.02]</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>0.01</td>
<td>0.14</td>
<td>3.83</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.04)</td>
<td>(1.47)</td>
</tr>
<tr>
<td></td>
<td>[&lt;0.0001]</td>
<td>[&lt;0.0001]</td>
<td>[0.01]</td>
</tr>
<tr>
<td>Number of observations</td>
<td>102,113</td>
<td>102,113</td>
<td>102,113</td>
</tr>
<tr>
<td>F statistic</td>
<td>54.71</td>
<td>17.38</td>
<td>6.73</td>
</tr>
<tr>
<td>Fixed or random effects</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

---

1. All models report (robust standard errors in parentheses) and [p-values in brackets].
2. 2SLS fixed-effects model estimation is used for all models.
3. As we use both Internationalization and ROA in percentage points in our 2SLS estimations (thus, e.g., Internationalization varies from 0 to 100), we also use Board internationalization in percentage points to simplify the interpretation of the coefficients of the first-stage regressions. Board internationalization thus ranges from 0 to 100, with a mean of 14.69 and a standard deviation of 25.82.
Additional analyses of the replication using our subsample of multinational firms

In what follows we report the additional analyses and results relative to the replication using a 2SLS fixed-effects model estimation on our subsample of multinational firms (made of 102,113 firm-year observations) whose main findings are shown in the article. First, we provide further information on how we built our instrument Board internationalization. The instrument was constructed from Orbis data. It is based on the analysis of the 535,597 unique directors appointed by the 32,835 multinational firms included in our subsample. For every year $y$ and firm’s board of directors, we consider the directors appointed before $y$ and with resignation after $y$. Then, for each firm we calculate the fraction of directors with at least one other board executive position with another foreign firm (domiciled in another country), which corresponds to our measure Board internationalization. The construction of this measure thus involved the analysis of a very large number of boards’ positions, i.e. more than 5.5 million, most of which related to firms not included in our (sub)sample. While we were able to gather data on all the 535,597 appointed directors and their international interlocks for all the 32,835 multinational firms, the information on the exact year of appointment and resignation within the time period considered was not available for all directors. When such information was not readily available we used additional information provided by Orbis (such as, e.g., the status of the director [resigned/current], the date when the record was last updated in Orbis, the number of confirmation dates) to establish whether in a given year a specific director was already/still appointed in the corresponding board of directors or not.\footnote{7} In Table A-6 we provide the first-stage regressions using Board internationalization, Board internationalization squared, and Board internationalization cubed as our three instruments. The second-stage corresponds to Model 7 in Table 5 reported in the article.

To gauge instrument strength in our empirical setting, we begin by noting that all three instruments have significant coefficients in all three first-stage equations and the first-stage F-statistics testing the hypothesis that the coefficients of the instruments equal 0 are always larger than 10 (133.72, 34.94, and 11.36 respectively), exceeding the rule of thumb cutoff for weak instruments proposed by Staiger and Stock (1997). While Staiger and Stock’s (1997) rule and especially the more recently developed Stock and Yogo’s (2005) test for weak instruments have been widely used—also in strategy research as corroborated by, e.g., Semadeni, Whitters, and Certo (2014) and Bascle (2008)—there is ongoing research in the econometrics field to develop better approaches to test for instrument strength. This is especially because Stock and Yogo’s (2005) test relies heavily on the assumption of homoskedasticity, while data used in practice often violate this assumption. Building on these latest developments, we rely on the test developed by Montiel Olea and Pflueger (2013),\footnote{8} identified by Andrews, Stock, and Sun (2019) as currently the preferred test for detecting weak instruments, being robust to heteroskedasticity, time series autocorrelation, and clustering in the case of linear instrumental variables regressions with one endogenous regressor

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\footnote{7}{We follow standard procedure in network analysis research (using the non-parametric method implemented in the R package missForest) to determine whether in a given year a specific director was already/still appointed in the corresponding board of directors or not based on the available information. Further information on the procedure followed is available upon request.}

\footnote{8}{Pflueger and Wang (2015) introduce the Stata routine that implements the test for weak instruments by Montiel Olea and Pflueger (2013).}
and one or more instruments. Their approach appears of particular relevance in the context of our study given the longitudinal nature of our data.

The effective F-statistic of Montiel Olea and Pflueger (2013) that we obtain when using our three instruments is 184.80 (the corresponding critical value for $\tau = 5\%$ equals 23.70), thus rejecting the null hypothesis that our instruments are weak in our empirical setting. Given that our three endogenous regressors are the main, squared, and cubic terms of *Internationalization*, while our three instruments correspond to the main, squared, and cubed terms of *Board Internationalization*, to further gauge our main instrument strength we also perform the Montiel Olea-Pflueger test in the simplest case of a just-identified model with a single endogenous regressor (*Internationalization*) and a single instrument—i.e., our main instrument *Board Internationalization*. We obtain an effective F-statistic of Montiel Olea and Pflueger (2013) of 82.57 (the corresponding critical value for $\tau = 5\%$ equals 37.42). This result further corroborates that our instrument *Board Internationalization* is sufficiently strong to account for the endogeneity of *Internationalization* in our empirical setting.

B&K evaluate the strength of their two instruments when testing for a quadratic relationship between multinationality and performance using the Kleibergen-Paap Wald statistic, which in settings with a single endogenous variable is equivalent to the non-homoskedasticity-robust F-statistics—being equal to the effective F-statistic of Montiel Olea and Pflueger in the case of a single instrument (Andrews et al., 2019). To provide a close comparison between our and B&K’s instruments using the same approach, we also calculate the Kleibergen-Paap Wald statistic when testing for the quadratic relationship and using two instruments, i.e., *Board internationalization* and its squared term. We obtain a Kleibergen-Paap Wald statistic of 10.55, while the one obtained by B&K is 10.51. This result shows that our instruments perform very similarly to the ones used by B&K, thus lending additional support to our conclusion that they are sufficiently strong.

As emphasized by Andrews et al. (2019), to date there is still no known analog of the Montiel Olea and Pflueger approach for settings with multiple endogenous regressors, thus calling for more research on this econometric issue. To examine whether our results hold whether or not the instruments are weak, especially when testing for the quadratic and cubic relationships, we follow Andrews et al. (2019) and rely on the Anderson-Rubin (AR) test that is robust to weak identification—i.e., its probability of incorrectly rejecting the null hypothesis remains well-controlled also when the instruments are weak. The results we obtained show that the coefficients of the endogenous variables on the right-hand side of our main equations are never jointly significant in any of our model specifications, thus, by never rejecting the null hypothesis that these coefficients equal zero, the AR test further confirms our main finding that once we account for endogeneity we do not find any causal relationship between multinationality and performance.

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To date, the case with one endogenous regressor and one or more instruments is the one for which research on developing procedures for detecting weak instruments is most advanced. For this case, as mentioned in the text, Montiel Olea and Pflueger (2013) develop a test that is robust not only to heteroskedasticity, but also to serial autocorrelation and clustering. Refer to the forthcoming article by Andrews et al. (2019) for a comprehensive and up to date assessment of the literature on weak instruments in instrumental variable regressions. The forthcoming article and its supplementary materials are available for download here: https://scholar.harvard.edu/stock/publications/weak-instruments-iv-regression-theory-and-practice

The weak-instrument-robust AR test Chi square statistic equals 1.40 (p-value = 0.71) when testing for the linear, quadratic, and cubic relationships.
Being our system not over-identified in the case of the cubic relationship, we cannot directly test the exogeneity condition of our instruments. Given that in our main model estimations we also examine the existence of a (within-firm) linear and quadratic relationship between multinationality and performance, we follow Semadeni et al. (2014) and Bascle (2008) to test for the exogeneity of our three instruments in such cases. This is because the equations are over-identified when considering the linear and quadratic relationships (as we have 3 instruments for 1 and 2 endogenous regressors respectively). In both cases the Hansen’s J-statistic test does not lead to a rejection (for the linear case: Hansen J-statistic = 1.19 with p-value = 0.55; for the quadratic case: Hansen J-statistic = 0.99 with p-value = 0.32), thus corroborating that our instruments can be considered as exogenous in our setting. This also alleviates concerns about an over-identification problem when focusing on the linear and quadratic relationships.

To further assess the validity of our main instrument Board Internationalization in relation to its exogeneity, we also conduct the sensitivity analysis developed by Conley, Hansen, and Rossi (2012). To do so, we focus on the linear association and test the sensitivity of the effect of Internationalization on ROA by relaxing the exclusion restriction concerning Board Internationalization, thus dealing with the potential endogeneity of our main instrument in our empirical setting. The results obtained show that Internationalization remains statistically not significant (Coeff. = -1.13; p-value = 0.85) even when considering this level of uncertainty on the plausibility of the exclusion restriction of Board Internationalization, thus lending additional support to the main findings of our instrumental variable regressions reported in the article.

We also run a dynamic panel data model as an alternative way of assessing causality between multinationality and performance. To do so, we use the estimator outlined by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998), also known as system GMM. While this estimator allows some regressors to be endogenous, it does not assume that good instruments are available outside the immediate dataset; thus, it assumes that the only available instruments are internal, i.e., based on lags of the instrumented variables. Accordingly, using this dynamic panel data model estimator—though presenting several issues whose in-depth assessment goes beyond the purpose of this work—allows us to verify whether our main findings are robust to a different way of accounting for the endogeneity of multinationality. We run the model specifying lags 2 and 3 as instruments for our endogenous variables. We repeat the same models using as lags 2-3-4 and 2-3-4-5. Table A-7 reports the key coefficient estimates obtained when testing for the linear, quadratic, and cubic relationships and using the above-mentioned lag structures. As shown in Table A-7, we find no evidence in support of any causal relationship between multinationality and performance in any of the models considered, thus lending further support to our main findings shown in the article.

As mentioned previously, all our results are obtained requesting heteroscedasticity-robust standard errors. We also repeat the 2SLS estimation requesting not only heteroskedastic but also

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11 Conley et al.’s (2012) methodology builds on earlier econometric works that have developed sensitivity analyses for instrumental variables studies, see, e.g., Small (2007). A sensitivity analysis examines the impact of plausible amounts of invalidity of the proposed instruments on inferences of the relevant parameters. Clarke and Matta (2018) introduce the Stata routine that implements the “plausibly exogenous” estimation developed by Conley et al. (2012). To run our sensitivity analysis, we adopt the so-called “local-to-zero” estimation approach.
autocorrelation consistent standard errors and statistics that are therefore robust to both arbitrary heteroskedasticity and arbitrary autocorrelation and the results obtained do not change. Additionally, we perform the Cumby-Huizenga (1992) general test for autocorrelation which fails to reject the null hypothesis according to which there is no serial correlation (Chi square = 0.69; p-value = 0.41), thus further alleviating our concerns of the potential presence of serial correlation in our setting. To address the issue that prior profitability may influence the level of internationalization of a given firm, we also repeat our main model (Model 7 in Table 5) including the lagged profitability measure (i.e., ROA at time t-1) as additional control variable. The results obtained when adding this variable into our fixed-effects model specification (available upon request) are entirely aligned with the ones reported in Table 5, thus lending additional support to our conclusion that the results we obtained using the above-mentioned instrumental variable approach account for the potential endogeneity of multinationality.

Finally, our replication focuses on the time period 2009-2016 because 2016 is the last available year for which we were able to collect all the information necessary to run our 2SLS model. We did not collect data prior to 2009 as Orbis provides much less information for earlier years and this would have impacted our ability to closely replicate L&B and B&K’s work while also covering the variety of contexts that are instead assessed in the present work. To account for potential time effects in the period considered, we also repeat our main replication model (Model 7 in Table 5) including year dummies and the results obtained do not show any relevant change vis-à-vis the ones reported in Table 5.

Table A-8 shows the results corresponding to the additional analyses discussed in the article in relation to the variety of contexts included in our setting. While Models 1 and 2 focus on

**TABLE A-7**

**The coefficients of the M-P relationship when using dynamic panel data model estimation**

<table>
<thead>
<tr>
<th>Relationship tested</th>
<th>Coefficient / Wald Chi square</th>
<th>Cubic</th>
<th>Quadratic</th>
<th>Linear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Main term</td>
<td>Squared term</td>
<td>Cubed term</td>
<td>Wald Chi square</td>
</tr>
<tr>
<td>Lags 2-3</td>
<td>0.15</td>
<td>-0.006</td>
<td>0.0001</td>
<td>1474.12</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.01)</td>
<td>[0.0002]</td>
<td>[1474.12]</td>
</tr>
<tr>
<td></td>
<td>[0.43]</td>
<td>[0.63]</td>
<td>[0.76]</td>
<td></td>
</tr>
<tr>
<td>Lags 2-3-4</td>
<td>0.15</td>
<td>-0.006</td>
<td>0.0001</td>
<td>1475.45</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.01)</td>
<td>[0.0002]</td>
<td>[1475.45]</td>
</tr>
<tr>
<td></td>
<td>[0.40]</td>
<td>[0.65]</td>
<td>[0.80]</td>
<td></td>
</tr>
<tr>
<td>Lags 2-3-4-5</td>
<td>0.16</td>
<td>-0.006</td>
<td>0.0001</td>
<td>1474.88</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.01)</td>
<td>[0.0002]</td>
<td>[1474.88]</td>
</tr>
<tr>
<td></td>
<td>[0.38]</td>
<td>[0.63]</td>
<td>[0.77]</td>
<td></td>
</tr>
</tbody>
</table>

1 All dynamic panel data models are run using system GMM estimators on the subsample of 102,113 firm-year observations used to run our 2SLS fixed-effects model estimations shown in the article. Roodman (2009) introduces the Stata routine that implements dynamic panel data model estimation.

2 All independent variables are lagged by one period. All models report (robust standard errors in parentheses) and [p-values in brackets]. Both Internationalization and ROA are in percentage points.
### TABLE A-8

**Additional analyses**

<table>
<thead>
<tr>
<th>Model</th>
<th>1 (Japanese listed multinational firms)</th>
<th>2 (Japanese listed, large multinational firms)</th>
<th>3 (U.S. multinational firms)</th>
<th>4 (U.S. large, manufacturing firms)</th>
<th>5 (U.S. large, manufacturing firms)</th>
<th>6 (Multinational firms in other industry groups)</th>
<th>7 (Multinational SMEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship tested</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Cubic</td>
<td>Quadratic</td>
<td>Quadratic</td>
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<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
<td>ROA</td>
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<td>Internationalization</td>
<td>-9.97</td>
<td>-12.88</td>
<td>-9.51</td>
<td>3.43</td>
<td>2.67</td>
<td>-3.00</td>
<td>12.10</td>
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<tr>
<td>(35.04)</td>
<td>(48.29)</td>
<td>(13.99)</td>
<td>(3.11)</td>
<td>(3.12)</td>
<td>(7.95)</td>
<td>(25.29)</td>
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<tr>
<td>Internationalization squared</td>
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<td>1.45</td>
<td>1.48</td>
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<td>-0.22</td>
<td>0.25</td>
<td>-4.97</td>
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<tr>
<td>(4.07)</td>
<td>(5.44)</td>
<td>(1.88)</td>
<td>(0.32)</td>
<td>(0.32)</td>
<td>(0.77)</td>
<td>(9.36)</td>
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<td>Internationalization cubed</td>
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<td>-0.04</td>
<td>-0.04</td>
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<td>-0.01</td>
<td>-0.01</td>
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<tr>
<td>(0.12)</td>
<td>(0.16)</td>
<td>(0.04)</td>
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<tr>
<td>Parent size</td>
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<td>1.74</td>
<td>1.95</td>
<td>10.63</td>
<td>11.83</td>
<td>1.82</td>
<td>1.56</td>
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<tr>
<td>(3.67)</td>
<td>(6.50)</td>
<td>(6.06)</td>
<td>(8.32)</td>
<td>(8.34)</td>
<td>(1.18)</td>
<td>(0.39)</td>
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<tr>
<td>Parent debt-to-equity ratio</td>
<td>-1.20</td>
<td>-1.31</td>
<td>-1.75</td>
<td>-0.85</td>
<td>-0.79</td>
<td>-1.14</td>
<td>-0.98</td>
</tr>
<tr>
<td>(0.57)</td>
<td>(0.71)</td>
<td>(0.75)</td>
<td>(0.89)</td>
<td>(0.94)</td>
<td>(0.43)</td>
<td>(0.11)</td>
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<td>Parent export intensity</td>
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<td>(3.67)</td>
<td>(4.40)</td>
<td>(7.56)</td>
<td>(5.67)</td>
<td>(5.78)</td>
<td>(2.91)</td>
<td>(1.07)</td>
<td></td>
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<tr>
<td>Parent product diversification</td>
<td>4.18</td>
<td>7.06</td>
<td>-6.88</td>
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<td>-3.71</td>
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<td>-0.73</td>
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<tr>
<td>(20.61)</td>
<td>(30.00)</td>
<td>(7.45)</td>
<td>(4.70)</td>
<td>(4.97)</td>
<td>(1.81)</td>
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<tr>
<td>Exchange rate</td>
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<td>-0.13</td>
<td>-0.12</td>
<td>0.10</td>
<td>0.11</td>
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<tr>
<td>(0.37)</td>
<td>(0.54)</td>
<td>(0.17)</td>
<td>(0.24)</td>
<td>(0.24)</td>
<td>(0.06)</td>
<td>(0.03)</td>
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<tr>
<td>Number of observations</td>
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<td>Wald Chi square</td>
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<td>39.89</td>
<td>33.59</td>
<td>41.06</td>
<td>42.08</td>
<td>90.61</td>
<td>114.68</td>
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<tr>
<td>Fixed or random effects</td>
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<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
<td>Fixed</td>
</tr>
</tbody>
</table>

1 All independent variables are lagged by one period. All models report (robust standard errors in parentheses) and [p-values in brackets]. 2SLS fixed-effects model estimation is used for all models. Both **Internationalization** and **ROA** are in percentage points.

2 In Model 6 we provide the results obtained when restricting our focus to firms excluded from both manufacturing and service industry groups. The other industry group comprehends firms pertaining to the following sectors: Agriculture, Forestry and Fishing (A), Mining and quarrying (B), Electricity, gas, steam and air conditioning supply (D), Water supply; sewerage, waste management and remediation activities (E), and Construction (F). More information relative to each sector can be found here: [https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LIST_NOM_DTL&StrNom=NACE_REV2](https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LIST_NOM_DTL&StrNom=NACE_REV2)
subsamples of our Japanese setting, Models 3-5 focus on our U.S. setting. Model 6 tests for the presence of a cubic relationship in the other industry groups beyond the service and manufacturing ones, while Model 7 tests for the existence of a quadratic relationship between multinationality and performance in the case of multinational SMEs. The results obtained show no significant effect of the main and squared terms of Internationalization, thus failing to replicate the results of Lu and Beamish (2001), who instead found a U-curved relationship when focusing on SMEs.

REFERENCES


Appendix of Chapter 6
7 Appendix

List of countries by region:

EU28 = Bosnia and Herzegovina (BA), Cyprus (CY), Romania (RO), Croatia (HR), Finland (FI), Luxembourg (LU), Spain (ES), Austria (AT), Latvia (LV), Slovak Rep. (SK), Poland (PL), Italy (IT), Norway (NO), United Kingdom (GB), Netherlands (NL), France (FR), Hungary (HU), Germany (DE), Portugal (PT), Greece (GR), Bulgaria (BG), Belgium (BE), Estonia (EE), Denmark (DK), Malta (MT), Sweden (SE), Slovenia (SI), Ireland (IE), Lithuania (LT),

Africa = Sierra Leone (SL), Uganda (UG), Sudan (SD), Lesotho (LS), Eritrea (ER), South Sudan (SS), Réunion (RE), Togo (TG), Saint Helena, Ascension and Tristan da Cunha (SH), Seychelles (SC), Gabon (GA), Morocco (MA), Egypt, Arab Rep. (EG), Sao Tome and Principe (ST), Mauritania (MR), Ghana (GH), Malawi (MW), Equatorial Guinea (GQ), Madagascar (MG), Djibouti (DJ), Botswana (BW), Angola (AO), Guinea-Bissau (GW), Mauritius (MU), Congo (Dem. Rep.) (CD), Zimbabwe (ZW), Guinea (GN), Cameroon (CM), Burundi (BI), Ethiopia (ET), Niger (NE), Mali (ML), Rwanda (RW), Benin (BJ), Comoros (KM), Cabo Verde (CV), Tanzania, United Republic of (TZ), Senegal (SN), Kenya (KE), Algeria (DZ), Central African Republic (CF), Ivory Coast (CI), Mayotte (YT), Zambia (ZM), The Gambia (GM), Liberia (LR), Somalia (SO), Nigeria (NG), Libya (LY), Mozambique (MZ), Eswatini (SZ), Burkina Faso (BF), South Africa (ZA), Tunisia (TN), Chad (TD), Congo, Rep. (CG)

Southeast_Asia = Malaysia (MY), Singapore (SG), Laos (LA), Cambodia (KH), Timor-Leste (TL), Viet Nam (VN), Philippines (PH), Indonesia (ID), Myanmar (MM), Thailand (TH), Brunei Darussalam (BN)

Northeast_Asia = Russia (RU), Taiwan (TW), China (CN), Japan (JP), Korea, Democratic People's Rep. of (KP), South Korea (KR), Mongolia (MN)

Middle_East = Lebanon (LB), Jordan (JO), Oman (OM), Kuwait (KW), Ukraine (UA), Israel (IL), Iran (IR), Bahrain, Kingdom of (BH), West Bank (PS), Syrian Arab Republic (SY), Turkey (TR), Yemen, Republic of (YE), Iraq (IQ), Qatar (QA), Saudi Arabia (SA)

OFCs = Cyprus (CY), St. Vincent and the Grenadines (VC), Togo (TG), Seychelles (SC), Anguilla (AI), Samoa (WS), Liechtenstein (LI), Belize (BZ), Isle of Man (IM), UK Caribbean (Montserrat (MS), Cayman Islands (KY), Turks and Caicos Islands (TC), Virgin Islands, British (VG)), Mauritius (MU), Panama (PA), St. Kitts and Nevis (KN), Guyana (GY), Cayman Islands (KY), Bermuda (BM), Netherlands Islands, Caribbean (CW), Guernsey (GG), Gibraltar (GI), Marshall Islands, Republic of (MH), Jersey (JE), Barbados (BB), Virgin Islands, British (VG), Liberia (LR), Bahamas, The (BS)

Source: Authors.
Table A1. Indicative comparison of published IRS and expected OECD tables

<table>
<thead>
<tr>
<th>OECD (2018)</th>
<th>IRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD Table 1: Where do the business activities of MNCs take place?</td>
<td>IRS Table 1A: Country-by-Country Report (Form 8975): Tax Jurisdiction Information (Schedule A: Part I) by Major Geographic Region and Selected Tax Jurisdiction, Tax Year 2016</td>
</tr>
<tr>
<td></td>
<td>IRS Table 1B: Country-by-Country Report (Form 8975): Tax Jurisdiction Information (Schedule A: Part I) Limited to Reporting Entities with Positive Profit Before Income Tax by Major Geographic Region and Selected Tax Jurisdiction, Tax Year 2016</td>
</tr>
<tr>
<td></td>
<td>IRS Table 1C: Country-by-Country Report (Form 8975): Tax Jurisdiction Information (Schedule A: Part I) Limited to Reporting Entities with Negative or Zero Profit Before Income Tax by Major Geographic Region and Selected Tax Jurisdiction, Tax Year 2016</td>
</tr>
<tr>
<td>OECD Table 2: What are the tax rates paid by MNCs?</td>
<td>-</td>
</tr>
<tr>
<td>OECD Table 3: What is the relationship between tax rates and the business activities of MNCs?</td>
<td>IRS Table 3: Country-by-Country Report (Form 8975): Tax Jurisdiction Information (Schedule A: Part I) by Effective Tax Rate of Multinational Enterprise Sub-groups, Tax Year 2016</td>
</tr>
<tr>
<td></td>
<td>IRS Table 1D: Country-by-Country Report (Form 8975): Number of Constituent Entities (Schedule A: Part II) by Geographic Region, Selected Tax Jurisdiction, and Main Business Activities, Tax Year 2016</td>
</tr>
<tr>
<td></td>
<td>IRS Table 2: Country-by-Country Report (Form 8975): Tax Jurisdiction Information (Schedule A: Part I) By Major Industry Group, Geographic Region, and Selected Tax Jurisdiction, Tax Year 2016</td>
</tr>
</tbody>
</table>

Source: Authors on the basis of OECD (2018) and IRS data
### Table A2. Overview of the available data sources relevant for US MNCs

<table>
<thead>
<tr>
<th>Source</th>
<th>Code</th>
<th>Data availability</th>
<th>Period</th>
<th>Level of aggregation</th>
<th>Other sample restrictions</th>
<th>Other variables</th>
<th>Other MNCs than US?</th>
<th>Examples of references</th>
<th>Number of countries included</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRS</td>
<td>BEA</td>
<td>All controlled foreign corporations of US persons</td>
<td>1983-2016</td>
<td>Country- or industry-level aggregate data</td>
<td>Net income divided by the average parent ownership + foreign income taxes</td>
<td>Sales, net income, property, plant, and equipment, employees, total assets, among others.</td>
<td>Similar data available via country-specific sources (such as MiDi for Germany) or via Eurostat</td>
<td>Clausing (2019), Wright &amp; Zucman (2018), Cobbham &amp; Janský (2019)</td>
<td>55</td>
</tr>
<tr>
<td>IRS</td>
<td>BEA</td>
<td>All US headquartered MNCs</td>
<td>2016</td>
<td>Big US headquartered MNCs</td>
<td>Sales, income, interest paid</td>
<td>Sales, income, property, plant, and equipment, employees, total assets, number of employees, among others.</td>
<td>Similar data to be published later by OECD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRS</td>
<td>CBCR</td>
<td>CBCR (all companies) and CBCR* (only companies with positive profits)</td>
<td>2016</td>
<td>Country-level or industry-level aggregate data</td>
<td>Costs and revenues,销售收入 (excluding current-cost adjustment)</td>
<td>Sales, income, property, plant, and equipment, employees, total assets, number of employees, among others.</td>
<td>Similar data to be published later by OECD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEA</td>
<td>BEA</td>
<td>All US headquartered MNCs</td>
<td>1983-2016</td>
<td>Country- or industry-level aggregate data</td>
<td>Profit-type return – net interest paid</td>
<td>Sales, income, property, plant, and equipment, employees, total assets, number of employees, among others.</td>
<td>Similar data available via country-specific sources (such as MiDi for Germany) or via Eurostat</td>
<td>Clausing (2019), Wright &amp; Zucman (2018), Cobbham &amp; Janský (2019)</td>
<td>55</td>
</tr>
<tr>
<td>BEA</td>
<td>BEA</td>
<td>All US headquartered MNCs</td>
<td>2016</td>
<td>Big US headquartered MNCs</td>
<td>Sales, income</td>
<td>Sales, income, property, plant, and equipment, employees, total assets, number of employees, among others.</td>
<td>Similar data to be published later by OECD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
IRS CFC

All US persons (e.g., corporations, individuals, trusts)

2004-2012, every two years

Country-or industry-level aggregate data

Only companies with positive profits (the complete data is also available)

Current earnings and profits before income taxes

Income taxes

Assets, receipts, dividends, subpart F income, accumulate earnings and profits

Grubert & Mutti, 2000


Eurostat

All US headquartered MNCs
ca 2008-2016

Country-or industry-level aggregate data

Only foreign affiliates in the EU

Gross operating surplus (value added minus personnel costs.)

n. a.

Revenues, number of employees, wages

Yes, other developed, mainly European countries

Tørslov, Wier, & Zucman (2018)


Most big US publicly listed companies
ca 1990-2018

Consolidated firm-level data

Does not separate by country, only foreign/domestic

Profits (profit or loss before income tax)

Income taxes paid and accrued (including deferred)

Revenue, total assets, EBIT, intangible assets, among many others

Dyre, Hanlon, Maydew, & Thornock (2017)


Private database by Standard & Poor's

Orbis (all companies) and Orbis* (only companies with profits)

A non-random subsample of all companies ca 1990-2018

Consolidated and unconsolidated firm-level data

Sample quality and coverage differs by country

EBIT = Total Profits – Financial profits (include interest and equity income)

Income taxes accrued

Revenue, number of employees, tangible assets, total assets, among many others

Yes

Dyre, Hanlon, Maydew, & Thornock (2017)

Tørslov, Wier, & Zucman (2018)

Private database by Bureau van Dijk (owned by Moody's Analytics)

Source: Authors

Appendices
Figure A1. Tax accrued versus tax paid

Source: Authors on the basis of the IRS CBCR data.

Figure A2. Effective tax rate using tax accrued versus tax paid

Source: Authors on the basis of the IRS CBCR data.
Figure A3. Correlation between ETR and misalignment profits using accumulated earnings

Source: Authors on the basis of the IRS CBCR data.

Figure A4. Top 10 countries with the largest negative (A) and positive (B) misaligned profits with the US included (in contrast with Figure 5)

Source: Authors on the basis of the IRS CBCR, BEA and Orbis data.
Appendix of Chapter 7
Appendix

Section A1: US firms and the effect of S-corps on effective tax rates

S-corps constitute an important factor in the average effective taxation of US firms. These are important because they do not pay any corporate income taxes, but instead pay higher dividend taxation. In other words: the same taxes are paid on the profits, but these are not corporate taxes. Including these corporations in any sample of firms used to calculate ETRs will thus give serious biases towards 0. Unfortunately, the BEA-data includes these firms in all their statistics, which leaves researchers with a problem.

In order to say something about the magnitude of the use of S-corps, we use the IRS “Source of Income”-data, following the lead set by Wright and Zucman (2018). This, together with national accounts data from BEA, shows that the share of US domestic profits that are made in S-corps was fairly constant between 2004 and 2016 at about 20%. The level is shown in figure A1 below.

When considering the US national accounts data, presented in figure A2, we find that the effective tax rate of the whole domestic corporate sector fell from 26% to 20% between 2004 and 2016, while these numbers increase to 32% to 26% respectively when removing S-corps. The ETR is thus approximately 6 ppts higher when we only consider firms that pay their taxes as corporate taxes. In either case, the reduction over the period corresponds well with the 6.1% ppt decrease in domestic taxation of MNCs that we identified from the BEA data and show in the main tables of this paper. This points towards US MNCs getting just about the same effective tax reductions on their profits reported in the US as US non-MNCs get. S-corporations are unlikely to have caused the downwards trend in the domestic taxation of profits booked in the US between 2004 and 2016, although the ETR each year will seem low if they are not accounted for.

Figure A1: The share of US profits earned in S-corporations

Source: Authors on the basis of the IRS data (Statistics of Income).
Figure A2: The average effective tax rate on all US profits with and without S-corps

Source: Authors on the basis of the US national accounts data.

Table A1: Decomposition of the decline in US firms consolidated tax rates 2005-2015 with domestic corporations included (%)

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>% of total difference</th>
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</thead>
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<tr>
<td>Effective tax rate 2005</td>
<td>31.3</td>
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<tr>
<td>Effective tax rate 2015</td>
<td>24.7</td>
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<tr>
<td>Difference</td>
<td>-6.6</td>
<td>100.0</td>
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<tr>
<td>Domestic taxation (1 + 2)</td>
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<td>63.2</td>
</tr>
<tr>
<td>1 Domestic statutory tax rate</td>
<td>-0.2</td>
<td>3.5</td>
</tr>
<tr>
<td>2 Domestic tax base</td>
<td>-4.0</td>
<td>59.7</td>
</tr>
<tr>
<td>Foreign taxation (3 + 4)</td>
<td>-1.0</td>
<td>14.7</td>
</tr>
<tr>
<td>3 Foreign statutory tax rate</td>
<td>-1.3</td>
<td>19.6</td>
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<tr>
<td>4 Foreign tax base</td>
<td>0.3</td>
<td>-5.0</td>
</tr>
<tr>
<td>5 Profit shifting</td>
<td>-1.1</td>
<td>16.4</td>
</tr>
<tr>
<td>6 Globalisation</td>
<td>-0.2</td>
<td>2.6</td>
</tr>
<tr>
<td>7 Residual</td>
<td>-0.2</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.

Notes: Data on domestic corporate profits are obtained from the national accounts from BEA, data on MNC’s profits is from the BEA’s MNC survey, data on profits of S-corps is from the IRS’s SOI-database on corporate taxation.
### Section A2: The main decomposition of effective tax rates

#### Table A2: The basic decomposition components over time (%)

<table>
<thead>
<tr>
<th>Year</th>
<th>US MNCs Weighted Effective Taxation</th>
<th>US MNCs Foreign Effective Taxation</th>
<th>US MNCs Domestic Effective Taxation</th>
<th>EU MNCs Weighted Effective Taxation</th>
<th>EU MNCs Foreign Effective Taxation</th>
<th>EU MNCs Domestic Effective Taxation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004-2006</td>
<td>24.8</td>
<td>9.0</td>
<td>2.6</td>
<td>25.9</td>
<td>8.5</td>
<td>2.7</td>
</tr>
<tr>
<td>2005-2007</td>
<td>28.6</td>
<td>10.3</td>
<td>2.8</td>
<td>27.4</td>
<td>9.0</td>
<td>3.0</td>
</tr>
<tr>
<td>2006-2008</td>
<td>30.8</td>
<td>11.0</td>
<td>3.1</td>
<td>28.7</td>
<td>9.4</td>
<td>3.3</td>
</tr>
<tr>
<td>2007-2009</td>
<td>32.3</td>
<td>11.4</td>
<td>3.4</td>
<td>29.0</td>
<td>9.8</td>
<td>3.6</td>
</tr>
<tr>
<td>2008-2010</td>
<td>31.4</td>
<td>11.1</td>
<td>3.3</td>
<td>28.9</td>
<td>9.7</td>
<td>3.5</td>
</tr>
<tr>
<td>2009-2011</td>
<td>30.2</td>
<td>10.9</td>
<td>3.1</td>
<td>27.4</td>
<td>9.2</td>
<td>3.2</td>
</tr>
<tr>
<td>2010-2012</td>
<td>28.9</td>
<td>10.5</td>
<td>2.9</td>
<td>25.7</td>
<td>8.8</td>
<td>3.1</td>
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<td>2011-2013</td>
<td>27.5</td>
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<td>2.7</td>
<td>24.8</td>
<td>8.5</td>
<td>2.9</td>
</tr>
<tr>
<td>2012-2014</td>
<td>25.8</td>
<td>9.7</td>
<td>2.5</td>
<td>23.7</td>
<td>8.2</td>
<td>2.7</td>
</tr>
<tr>
<td>2013-2015</td>
<td>24.3</td>
<td>9.3</td>
<td>2.3</td>
<td>22.9</td>
<td>7.9</td>
<td>2.5</td>
</tr>
<tr>
<td>2014-2016</td>
<td>22.9</td>
<td>8.9</td>
<td>2.1</td>
<td>22.1</td>
<td>7.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Source: Authors on the basis of data from the Bureau of Economic Analysis and others.

Appendices
Table A3: Decomposition of the decrease in effective tax rates over time - summary of the calculations  

<table>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic taxation (1 + 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Domestic statutory tax rate</td>
<td>-0.2</td>
<td>0.63 (28.5-34.6)</td>
<td>-0.2</td>
<td>0.65 (28.7-34.3)</td>
<td>-0.2</td>
</tr>
<tr>
<td>2 Domestic tax base</td>
<td>-3.7</td>
<td>-0.63 (-10.5-4.7)</td>
<td>-3.4</td>
<td>-0.65 (-10.3-5.0)</td>
<td>-3.4</td>
</tr>
<tr>
<td>Foreign taxation (3 + 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Foreign statutory tax rate</td>
<td>-1.6</td>
<td>0.37 (24.5-29.0)</td>
<td>-1.4</td>
<td>0.35 (25.6-29.6)</td>
<td>-0.8</td>
</tr>
<tr>
<td>4 Foreign tax base</td>
<td>-0.1</td>
<td>0.37 (-0.4-0.7)</td>
<td>-0.3</td>
<td>0.35 (1.5-0.6)</td>
<td>0.9</td>
</tr>
<tr>
<td>Profit shifting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-2.1</td>
<td>0.37 (18.7-33.9)</td>
<td>-2.3</td>
<td>0.35 (20.6-36.8)</td>
<td>-0.4</td>
</tr>
<tr>
<td>Globalisation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.2</td>
<td>0.2</td>
<td>0.7</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Residual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>-0.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Unobserved profits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.0</td>
<td>0.0</td>
<td>1.3</td>
<td>-0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis. 

Notes: For each cell both the final result and the calculation used to obtain it are shown.
Section A3: Data selection in Orbis

We collected financial and ownership information from the Orbis database. Orbis collects information on over 300 million public and private firms worldwide from a variety of country data providers.

We extracted company ownership data from the Orbis database (http://orbis.bvdinfo.com) in March 2018. For each available entity, we extracted its country, taxes paid, profit (loss) before taxes and EBIT for each available year. For each global ultimate owner (parent firm which owns at least 50% of a company directly or indirectly and is not itself owned by any other firm), we extracted the consolidated taxation, profits, EBIT (aggregated for the entire firm) for each available year, and the list of subsidiaries (entities owned at least 50% by the global ultimate owner) for the entire range of the data: 2007 to 2017.

We then matched each entity to the corresponding global ultimate owner. If the owner was not known at the time of the financial information, the closest available year was used.

For each of the 46,423 global ultimate owners with consolidated accounts, we filtered those outside the EU 21 (the member states of the EU in 2004), where data quality is low (Garcia-Bernardo, Fichtner, Takes, & Heemskerk, 2017), to reach 28273 firms, and removed the state owned enterprises as in Babic, Garcia-Bernardo, and Heemskerk (2019) to reach 27054 firms; we kept those 27054 firms that were either public or private limited companies. We then removed firms that had either negative profits (19861 remaining) or fewer than 5 observations (12192 remaining). Out of the 28 EU member states as of 2019, we are left with data relating to 23 member states.

For each of the 12192 global ultimate owners, we aggregated the financial information on all its active subsidiaries (excluding the categories “branch” and “foreign company”) by country. In order to account for partial ownership, we first scaled each financial variable by the ownership stake (“total ownership” variable in Orbis) when this information was available, and used the average total ownership (87.7%) for subsidiaries where this information was not available. In the aggregation process, we removed subsidiaries for which information on profits or taxation was not available.

We then removed global ultimate owners for which we could not account at least 50% of their operating profits and taxes at the unconsolidated level, and those for which we accounted for more than 120% (for example because we did not have subsidiaries with losses). This reduced the sample to 5159 companies.

Then, to achieve a more balanced panel, we removed global ultimate owners for which we did not have at least 10 years of data (in the period 2004-2014), which further reduced the sample to 2653 companies. Finally, we removed 20 companies for which the effective tax rate was above 60% for the entire period as outliers. The final dataset contained 145095 country-year observations for those 2633 companies.

We created two robustness checks. One in which the threshold was set to 5 observations, which produced a set containing 5,119 global ultimate owners and 214599 country-year observations; and one where only combinations of country-global ultimate owner with positive profits and taxes were combined, containing 2633 companies and 100060 observations.
## Table A4: Robustness tests for Orbis (%)

| Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis. |

<table>
<thead>
<tr>
<th>Manuf. sample</th>
<th>Larger sample</th>
<th>Only positive</th>
</tr>
</thead>
</table>

### Effective tax rate 2005

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>30.4</td>
<td>28.8</td>
<td>33.2</td>
</tr>
</tbody>
</table>

### Effective tax rate 2015

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21.6</td>
<td>18.2</td>
<td>25.8</td>
</tr>
</tbody>
</table>

### Difference

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-8.7</td>
<td>-12.3</td>
<td>-2.3</td>
</tr>
</tbody>
</table>

### Domestic taxation (1 + 2)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-5.6</td>
<td>-7.8</td>
<td>-2.7</td>
</tr>
</tbody>
</table>

### Foreign taxation (3 + 4)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.2</td>
<td>-2.2</td>
<td>-0.4</td>
</tr>
</tbody>
</table>

### Foreign statutory tax rate

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.8</td>
<td>-1.0</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

### Foreign tax base

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.0</td>
<td>-1.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Profit shifting

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.2</td>
<td>-1.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Globalisation

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9</td>
<td>-0.1</td>
<td>4.4</td>
</tr>
</tbody>
</table>

### Residual

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.6</td>
<td>-4.3</td>
<td>0.1</td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.0</td>
<td>-4.4</td>
<td>3.3</td>
</tr>
</tbody>
</table>

### Unobserved profits

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.0</td>
<td>-4.4</td>
<td>3.3</td>
</tr>
</tbody>
</table>

### Domestic statutory tax rate

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.7</td>
<td>-2.2</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

### Domestic tax base

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>-2.0</td>
<td>0.7</td>
</tr>
</tbody>
</table>

### Profit in excess of tax rate

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>1.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Only positive

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.5</td>
<td>-1.4</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Table A5. Decomposition by home country (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>Germany</th>
<th>Spain</th>
<th>UK</th>
<th>France</th>
<th>Italy</th>
<th>Lithuania</th>
<th>Poland</th>
<th>Sweden</th>
<th>Netherlands</th>
<th>Denmark</th>
<th>Finland</th>
<th>Belgium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1</td>
<td>29.0</td>
<td>36.0</td>
<td>4.5</td>
<td>18.4</td>
<td>1.5</td>
<td>4.3</td>
<td>3.8</td>
<td>9.4</td>
<td>18.4</td>
<td>29.0</td>
<td>36.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Difference</td>
<td>9.4</td>
<td>6.0</td>
<td>5.3</td>
<td>14.9</td>
<td>1.5</td>
<td>5.3</td>
<td>4.3</td>
<td>5.3</td>
<td>14.9</td>
<td>9.4</td>
<td>6.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Effective improvement 2015</td>
<td>29.0</td>
<td>36.0</td>
<td>4.5</td>
<td>18.4</td>
<td>1.5</td>
<td>4.3</td>
<td>3.8</td>
<td>9.4</td>
<td>18.4</td>
<td>29.0</td>
<td>36.0</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Notes: The two numbers indicate the 95% confidence intervals of 100 bootstrap samples. Light red are the changes that are statistically significant.
This sample and the smaller sample do not lead to any conclusions that are significant in this sample.

Notes: Using the larger sample where a threshold of 5 observations was used (section A3). Light red are the squares that are significant for both this sample and the study sample. Dark red are the squares that are significant for both.

Panel A: Percentage change in return on assets in the sample

Table A3: Robustness tests for Orbis for the home country and their average for all other countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Germany</th>
<th>Italy</th>
<th>Spain</th>
<th>France</th>
<th>Denmark</th>
<th>Finland</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>3.7</td>
<td>2.2</td>
<td>3.3</td>
<td>2.9</td>
<td>3.7</td>
<td>2.9</td>
<td>3.5</td>
</tr>
<tr>
<td>2015</td>
<td>2.8</td>
<td>2.2</td>
<td>3.4</td>
<td>2.3</td>
<td>3.5</td>
<td>2.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Difference</td>
<td>0.9</td>
<td>0.0</td>
<td>0.1</td>
<td>0.6</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Effective lex rate</td>
<td>0.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Effective lex rate (5)</td>
<td>0.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Effective lex rate (10)</td>
<td>0.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Effective lex rate (20)</td>
<td>0.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
</tr>
<tr>
<td>Effective lex rate (50)</td>
<td>0.00</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
<td>1.00</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Source: Authors on the basis of data from the Bureau of Economic Analysis and Orbis.
Table A7: Robustness tests for Orbis for the home-country analysis. Keeping observations with positive profits and taxes only (%)

<table>
<thead>
<tr>
<th>Country</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18%</td>
<td>12%</td>
<td>9%</td>
</tr>
<tr>
<td>Germany</td>
<td>35%</td>
<td>34%</td>
<td>32%</td>
</tr>
<tr>
<td>Spain</td>
<td>33%</td>
<td>32%</td>
<td>30%</td>
</tr>
<tr>
<td>Holland</td>
<td>32%</td>
<td>31%</td>
<td>29%</td>
</tr>
<tr>
<td>France</td>
<td>30%</td>
<td>29%</td>
<td>27%</td>
</tr>
<tr>
<td>Denmark</td>
<td>28%</td>
<td>27%</td>
<td>25%</td>
</tr>
<tr>
<td>Sweden</td>
<td>25%</td>
<td>24%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Notes: Light red are the changes that are significant for the home country analysis only. Dark red are the changes that are significant in the sample larger than 500 firms.
Section A5: Back-of-the-envelope calculation of misreported profits

Following the method presented in Törslöf, Wier, and Zucman (2018), profit shifting can be proxied by the misalignment between profits and activity measured in terms of the wage bill. They calculate a macro indicator for profit-shifting, \( \pi \), dividing the profits earned by the wage bill in different sectors of different countries. In this section, we do a back-of-the-envelope version of this: we compare the ratio between profits and wage bill within all US MNCs, aggregated, and analyse where profits are in excess and where they are missing. However, we do so comparing very rough groups of countries, and thus likely underestimating the profits shifted. To illustrate the method, two time series are introduced in figures A3 and A4.

Figure A3 shows the amount of wages paid in the domestic and foreign affiliates of US MNCs, split into the effective taxation of the countries. It shows that in the categories we could name “low-tax countries” that have a tax rate below 15%, there is almost no personnel at all. The tax rate by which the countries have been split is kept constant across the period to avoid countries shifting between the groups.

Figure A4 shows the distribution of profits reported, using the same categories of countries. Here, the low-tax countries are very clearly an important factor for US MNCs. It is also remarkable how little profits there are compared to the wage bill in the domestic market.
Figure A4: Profits reported by US MNCs split by estimated effective tax rate abroad

Source: Authors on the basis of data from the Bureau of Economic Analysis.

The back-of-the-envelope calculation goes as follows (and is shown in table A8 for 2015): Calculate $\pi$ in a category of countries based on their effective taxation, and compare with the average $\pi$ of the US MNCs. If it is much higher than the average, the difference between the average and the measured $\pi$ is a rough estimate of the scale of inward shifting. Like this, just by looking at the very lowest taxed countries, we obtain a number close to those presented in the existing literature, at $189$ bn. from US MNCs alone (for a recent discussion of the estimates and associated BEA data challenges see, for example, Zucman, 2014, Clausing, 2019, Blouin and Robinson, 2019). An important note to bear in mind in this extremely simple calculation is that the BEA data do not always show exactly which countries profits and wages are in. Often, tens of countries are lumped together into one large group, such as "Other western hemisphere", including all Caribbean islands not explicitly mentioned. If havens are lumped together with larger non-haven countries, the average tax rate across the group might fall above 15%, which would take them completely out of the equation in this little calculation.

Table A8: Back of the envelope calculation for 2015

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Domestic</th>
<th>Foreign</th>
<th>Foreign &lt;10%</th>
<th>Foreign 10-15%</th>
<th>Foreign 15-25%</th>
<th>Foreign &gt;25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profits (USD bn.)</td>
<td>1551</td>
<td>1024</td>
<td>527</td>
<td>184</td>
<td>32</td>
<td>172</td>
<td>138</td>
</tr>
<tr>
<td>Percent of total profits (%)</td>
<td>100</td>
<td>66</td>
<td>34</td>
<td>12</td>
<td>2</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Wages (USD bn.)</td>
<td>2803</td>
<td>2192</td>
<td>612</td>
<td>44</td>
<td>6</td>
<td>197</td>
<td>365</td>
</tr>
<tr>
<td>Profit shifting indicator (%)</td>
<td>55</td>
<td>47</td>
<td>86</td>
<td>419</td>
<td>529</td>
<td>88</td>
<td>38</td>
</tr>
<tr>
<td>Amount shifted into countries if benchmark $\pi$</td>
<td>-189</td>
<td>160</td>
<td>29</td>
<td>64</td>
<td>-64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors on the basis of data from the Bureau of Economic Analysis.

Note: 2015 was chosen to enable comparison of the numbers with Torslav et. al. (2018), which also has the latest numbers from 2015. The $189$ bn. is obtained by adding the two rows named “Foreign <10%” and “Foreign 10-15%”. By coincidence this equals the amount missing from the domestic market on average; no causality implied by this observation.