Business-government relations in the digital age

Corporate responses to policymaking in the European Union

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CHAPTER 2

Multinational Enterprises, Industry 4.0 and Sustainability: A Multidisciplinary Review and Research Agenda[3]

2.1 Introduction

Humankind faces critical challenges to its survival, security and prosperity. Socio-economic inequality within and across countries is rising, with the risk of further exacerbating (inter)national conflicts and political polarization (UN, 2020). Furthermore, the ecological disruption to our planet is worse than previously thought, and accelerating faster than predicted (UN, 2021a). While international calls for considering the human environment and a more sustainable development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 41), are not new (cf. Haas, 2022; Kolk, 2016), acting upon them now is widely considered as more urgent than ever.

An actor with a major impact in this regard is the multinational enterprise (MNE). MNEs constitute critical players when it comes to sustainability, broadly defined. They have extensive carbon footprints (López et al., 2019), resulting from activities around the world, and hold crucial positions in global value chains (GVCs), affecting jobs and livelihoods of entrepreneurs, workers and entire communities. Furthermore, MNEs have been facing growing pressures from stakeholders to respond to social, environmental and economic issues occurring in the locations in which they operate (Kolk, 2016), and to develop a 'corporate purpose' (George & Schillebeeckx, 2022). In short, MNEs constitute agents of change in relation to sustainability, but it remains an open question whether the changes MNEs bring about are for better or for worse.

According to scholars and practitioners, digital or "Industry 4.0" (I4.0) technologies can contribute to the realization of sustainability (Ching et al., 2022; Ghobakhloo et al., 2021; Sachs et al., 2019; Satyro et al., 2022). More specifically, these technologies have been argued to provide unique

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opportunities to, for example, tackle climate change (Cowls et al., 2021; EC, 2021), address poverty and hunger (FAO, 2018; Ning et al., 2021), and/or promote circularity (Ciulli et al., 2020; Jensen, 2021). Yet, it has also been noted that they can engender unprecedented challenges and risks, such as threatening human rights (UN, 2021b; Zuboff, 2019), fueling inequalities (Schor & Attwood-Charles, 2017; UNCTAD, 2021) and increasing emissions (Cowls et al., 2021; Gibney, 2022).

Hence, how digital solutions are designed and deployed has a fundamental influence on the role they play in the transition to a greener and more equitable future. MNEs spearhead the development and utilization of digital technologies: digital MNEs, measured by market value, are among the largest firms in the world (Fortune, 2022), and non-digital ('traditional') MNEs have unique resources, capabilities and competitive motivations to pursue a digital transformation in their international activities and in that of their network partners. Hence, MNEs have the critical responsibility to realize the opportunities that digital technologies create and to mitigate their constraints, in order to contribute to sustainable development (Ciulli & Kolk, 2023). For these reasons, illuminating the implications for sustainability of MNEs' engagement with I4.0 is particularly relevant.

However, as this question has raised increasing attention from scholars in different disciplines over the last years, contemporary scientific understanding of the intersection between MNEs, I4.0, and sustainability is fragmented. This precludes academics from offering insights and recommendations to policymakers and practitioners on how to leverage the positive aspects of digitalization, while preventing or mitigating the negative consequences. While extant studies consider the international business dimensions of corporate social responsibility (CSR) (Pisani et al., 2017); how I4.0 impacts the business operations of MNEs (Ahi et al., 2022; cf. Luo & Zahra, 2022); and the intricate dynamics between I4.0 technologies and the circular economy (Awan et al., 2022; Eisenreich et al., 2022; Hallioui et al., 2022; Rejeb et al., 2022; Toth-Peter et al., 2023), we are not aware of any work that systematically integrates the various strands of knowledge on how the implementation and diffusion of I4.0 by MNEs impacts sustainability. In other words, we lack a comprehensive, multidisciplinary framework that highlights what we know, and more importantly, what we do not yet know about the intersection between MNEs, I4.0, and sustainability.

Our review makes several contributions. To start with, it critically appraises the state of the art of multidisciplinary research at the intersection of MNEs, I4.0, and sustainability. In doing so, we synthesize academic knowledge from a highly heterogenous set of disciplines, and thereby stimulate scholarship among complementary, yet very often distinct research communities. At the same time, our review exposes four important shortcomings in the current literature: the relative absence of conceptual and theoretical rigor; the overrepresentation of commentary and perspective pieces; the inattention to the specificities of MNEs; and the lack of focus on specific digital technologies. Stemming from the shortcomings identified in extant literature, we design a research agenda that can guide scholars in advancing knowledge at the intersection of MNEs, I4.0, and sustainability. More broadly, our review underscores the critical role of MNEs in digitalization and sustainability. We submit that the positive and negative implications of I4.0 for society in social, economic and environmental sustainability depend for a large part on the actions and motivations of MNEs. Hence, it is incumbent upon managers to recognize their responsibility in facilitating the next push towards a more equalitarian and sustainable world.

This chapter proceeds as follows. Section 2 explains our methodology, outlining the sample, search procedures, the logic of the analysis and its key concepts. We subsequently summarize the 'state of the art' on MNEs, I4.0 and sustainability. Next, section 4 elucidates significant gaps in the literature and identifies several research avenues and questions scholars can explore. We conclude with a reflection on the theoretical, practical and policy implications of our work.

2.2. Methodology

2.2.1. Sample

The focal subject of this study is deliberately multidisciplinary given that the topic can be illuminated from different perspectives, such as international business, information systems and ethics. We therefore opted to cover a wide array of academic journals. Specifically, we consider all journals listed in the

2021 Academic Journal Guide (AJG) (CABS, 2021) with a ranking of 2 and above (N = 996). The AJG includes general management and IB journals, but also outlets in innovation studies, information systems, human resources, operations and technology management, regional studies and social sciences more broadly. Our sampling method included conceptual, empirical and review articles, as well as editorials and commentary/perspective pieces. Conversely, we excluded book chapters, book reviews, scientific letters, data papers, and reprints. We covered the period 2009 up to and including 2022, and checked forthcoming (online first/in press/early view) articles. It is important to note that, although the term I4.0 became widely used in 2015 (Schwab, 2015), we consider all articles that discuss the utilization of digital technologies as potentially germane to our review. Hence, we define I4.0 as relating to the individual or complementary utilization of digital technologies, such as AI, BDA, cloud computing, blockchain and the IoT. For this reason, we took 2009 as our starting point, to make sure that all possibly relevant articles would be included (see below). We used Thomson Reuters' Web of Knowledge database and our keyword searches focused on the title, author keywords, and abstract.

Our search proceeded in four main steps (see *Table 2.1* for an overview of the steps, including the keywords, operators, and search results). First, we retrieved all articles on the topic of sustainability, approached as covering environmental, social and economic dimensions (cf. Elkington, 1994; Kolk, 2016; see also section 2.3). Second, we retrieved all articles on the topic of I4.0. As I4.0 is usually employed as an "umbrella term" (Szalavetz, 2019, p. 385) for multiple novel digital technologies, we sought inspiration from the work of consultants, policymakers, and prior academic research to compile a list of the most relevant underlying technologies, also shown in *Table 2.1* (Ahi et al., 2022; EC, 2018; GeSI & Deloitte, 2019; McKinsey, 2018; PwC, 2016). Hence, in our search we approached the concept of 'I4.0' as denoting the individual or complementary utilization of these digital technologies. Third, we identified the articles focused on MNEs. For this selection, a careful look was taken at recent literature reviews in top tier IB journals (Pisani et al., 2017; Sun et al., 2021) but, as our target was MNEs specifically, we excluded more generic terms such as 'regional' and 'global'. Finally, we built on these searches to retrieve all articles at the intersection of sustainability, I4.0 and

MNEs. At this point, our sample consisted of 1753 articles. It is important to note that we had not yet excluded any scientific journals at this stage.

Table 2.1. Systematic search procedure

Query	Objective	Query	Results
1	Find all articles on sustainability	sustainab* OR green OR eco* OR environment* OR "climate change" OR clean OR circular* OR biodivers* OR pollution OR "human rights" OR hunger OR poverty OR poor OR social OR societ* OR health OR "well-being" OR peace OR migration OR education OR econ* OR "bottom of the pyramid" OR "base of the pyramid" OR inclus* OR "employment" OR "decent work" OR equality OR inequalit* OR "grand challeng*"	13,472,002
2	Find all articles on multinational enterprises	multinational OR subsidiar* OR MNE* OR MNC* OR TNC* or "transnational corporation*"	81,785
3	Find all articles on digitalisation and industry 4.0	digit* OR cloud OR "internet of things" OR "IoT" OR "machine learning" OR "artificial intelligence" OR "AI" OR "augmented reality" OR blockchain OR robotic* OR automation OR platform OR "social media" OR "social network" OR "sharing econ*" OR "additive manufacturing" OR "3D printing" OR cybersecurity OR "5G" OR mobile OR "big data" OR "Industry 4.0"	2,281,743
4	Find all articles on additional CSR dimensions	"social responsibilit*" OR "CSR" OR "social strateg*" OR "stakeholder*" OR "corporate citizen*" OR "ethic*" OR "corporate philanthropy" OR "corporate citizen*"	485,747
6	All articles on the intersection of sustainability or CSR, MNEs, and Industry 4.0	(#1 OR #4) AND #2 AND #3	1754

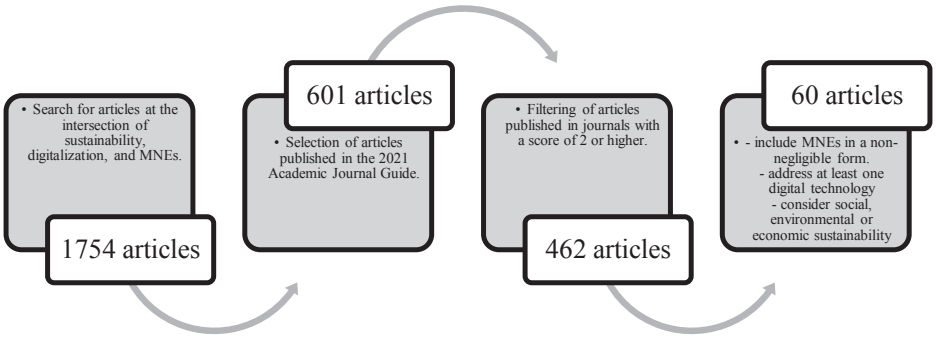
Note: The search (on titles, abstracts and keywords) was performed on Thomson Reuters' Web of Science within the time period from 2009 up to and including 2022.

Next, we proceeded with narrowing down the article selection to those published in journals of the 2021 AJG. For this purpose, we joined the AJG table with the table of 1754 articles based on the journals' International Standard Serial Number (ISSN). This operation resulted in a new table which included all rows from the original table of 1754 articles, and the matching rows from the AJG table. If an article in the original table was published in a

journal featured in the AJG, it should have the journal ranking indicated in the corresponding row. Instead, if its journal was not featured in the AJG, it would have a missing ranking in the resulting table, and could thus be discarded. However, due to unforeseen inconsistencies between these two tables in terms of the ISSN, not all journals in the AJG were properly matched. We thus manually checked the rows with missing journal rankings to correct errors. For example, MIS Quarterly, a top journal in information systems, had different ISSNs in the two original tables. In the end, out of the 1754 articles, 601 were successfully matched. We also kept the list of articles for which a match was not found and checked whether the exclusions were correct. During this check, we identified certain journals that we decided to include, such as the Journal of International Business Policy, which is not listed in the 2021 AJG, but considered to be a strong and respectable outlet within the field of IB, as the sister journal of Journal of International Business Studies (both key journals of the Academy of International Business). Next, we filtered the list to only journals with an AJG ranking of 2 or higher . At this point, we had 472 articles published in 202 distinct journals.

We proceeded to read the title, keywords, and abstract of each article to determine whether it should be included in the final sample. To qualify for our final sample, articles had to meet the following three criteria: (1) they included MNEs in a non-negligible form; (2) they addressed at least one I4.0 technology; and (3) they considered social, environmental, or economic sustainability in relation to one or more I4.0 technologies. One author took primary responsibility for coding, while another cross-checked the coding to ensure reliability. When discrepancies arose, we discussed and resolved inconsistencies. In the end, this resulted in a final selection of 60 articles (see *Figure 2.1* for an overview of the stages leading to the final sample).

Figure 2.1. Overview of the main stages leading to the final sample.



2.2.2. Analysis

We scrutinized the 60 articles on the core dimensions in line with the focus of our paper as outlined above. First, we zoomed in on the specific novel digital technology addressed. As there are different stages of diffusion of digital technologies, this analysis aimed to assess the degree to which they have already been covered by extant literature. To this end, we classified the articles based on the categories specified in the search (see section 2.1). A substantial number of studies addressed more than one technology, with some grouping them using the I4.0 umbrella term. Further, some studies focused on "digitization" or "digitalization" in general terms, referring to various technologies in the text, but without using the I4.0 term. We also categorized these studies addressing digitalization or covering multiple digital technologies as "Industry 4.0".

Second, since digital technologies may differ in implications as well as degrees of adoption and diffusion across countries, we also considered the inherent IB "geographic focus" dimension, to map the locations included in the 60 articles. In keeping with previous work (cf. Pisani et al., 2017), we classified the countries covered into "developed", "emerging" and "developing". Studies that could not be assigned to any of the country categories, as they did not focus on a specific location or type(s) of countries, were coded as "generic" (conceptual or empirical). We also identified articles

with a comparative approach ("comparative") between different country types, or that had a very broad, albeit clearly defined, geographic focus ("multiple types of countries").

Third, we analyzed the sample on the sustainability dimension. For this purpose, we adopted the distinction into social, environmental, and economic sustainability, which has been employed in multiple studies on sustainability (e.g., Ciulli & Kolk, 2019; Hahn et al., 2010). We specifically sought, when going through the 60 articles, for topics related to Bansal's (2005) definition of these three facets of sustainability, where environmental sustainability denotes those human activities that do not deteriorate the planet's land, air and water resources; social sustainability entails that all members of society enjoy equal access to opportunities and resources; and economic sustainability promotes a reasonable quality of life. We captured both the (potential) positive and negative implications of I4.0 with respect to all three dimensions, as discussed in more detail in the next section that contains our findings.

2.3 Multinationals and industry 4.0 through the sustainability triplet

As explained above, we identified 60 articles matching our search criteria. *Figure 2.2* plots the total number of publications per year. The results demonstrate how interest in MNEs, I4.0, and sustainability has grown in recent years: there were no papers fitting our criteria prior to 2012, just 1 each year up to 2017, and then a clear overall increase after 2018, although with some variation between the years. As could be expected given our focus on MNEs, IB journals account for the largest number of articles (15), the business journals for 11, and the remaining 34 were published in other areas, such as information systems, operations research and marketing. The fact that research in these disciplines appears only a handful of times suggests that these studies are more 'incidental', rather than being part of a concerted research effort. Moreover, most journals in our list had only a single publication (for more details see *Table 2.2*), which seems to further underscore the fact that our subject matter is still in a relatively embryonic state.

Two journals stand out in terms of the number of publications: *Technological Forecasting and Social Change*, and the *Journal of Cleaner Production*, which both have 5 publications and account for a quarter of all empirical research in our sample. As such, we observe that, although they are

not IB outlets, these two journals are at the forefront of advancing academic knowledge at the intersection of MNEs, I4.0 and sustainability. Interestingly, most of the articles in our final sample are published in journals with a ranking of 2 or 3 (51 in total). Only 6 articles in our sample are published in journals with a ranking of 4, and just 2 in a so-called 4* journal, marked as the highest category in the AJG . The subsections below delineate the key insights emerging from the 60 articles, with respect to types of digital technologies, geographies, and sustainability dimensions. *Table 2.3* presents an overview of the technological focus, geographic scope, and sustainability dimensions covered by the articles in our sample.

Table 2.2. Overview of journals and number of articles for each outlet.

Journal	Field	Ranking	# of Articles
Technological Forecasting and Social Change	Innovation	3	5
Journal of Cleaner Production	Sector	2	5
Journal of Business Research	Management	3	4
Business Process Management Journal	Operations Research	2	3
Journal of World Business	International Business	4	2
International Business Review	International Business	3	2
Journal of International Management	International Business	3	2
Socio-Economic Review	Social Sciences	3	2
International Journal of Information Management	Information systems	2	2
Multinational Business Review	International Business	2	2
Third World Quarterly	International Business	2	2
Thunderbird International Business Review	International Business	2	2
Journal of International Business Studies	International Business	4*	2
Academy of Management Perspectives	Management	4	1
Global Strategy Journal	Strategy	4	1
Human Resource Management	Human Resources	4	2

Journal	Field	Ranking	# of Articles
Academy of Management Discoveries	Management	3	1
Business & Society	Management	3	1
Business Strategy and the Environment	Social Sciences	3	1
California Management Review	Management	3	1
Cambridge Journal of Economics	Social Sciences	3	1
Development and Change	Social Sciences	3	1
Energy Economics	Economics	3	1
Industry and Innovation	Innovation	3	1
Information Systems Frontiers	Information Systems	3	1
International Journal of Human Resource Management	Human Resources	3	1
Journal of Business Ethics	Management	3	1
Journal of International Marketing	Marketing	3	1
Review of International Political Economy	Social Sciences	3	1
Strategic Organization	Strategy	3	1
Africa Journal of Management	Management	2	1
Behaviour & Information Technology	Information Systems	2	1
Competition & Change	Management	2	1
Current Issues in Tourism	Sector studies	2	1
Economics of Innovation and New Technology	Economics	2	1
Information Communication & Society	Social Sciences	2	1
Journal of International Business Policy	International Business	NA	1

Figure 2.2. Number of articles per year

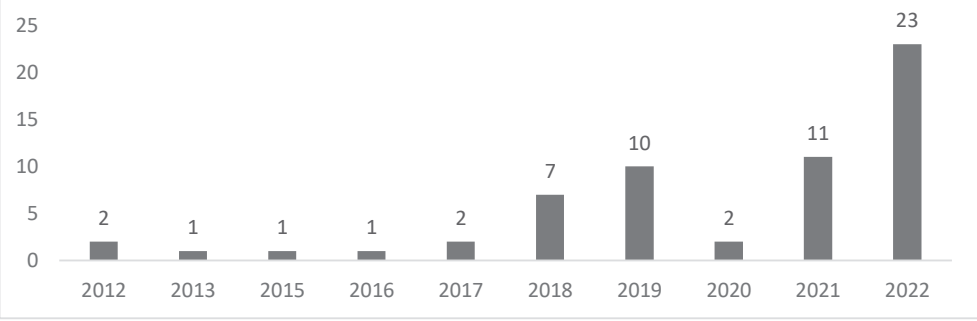


Table 2.3. Overview of the number of articles per type of digital technology, geography and sustainability dimension.

Digital technology	**No. of articles**
Digital platforms	23
Digitalization	15
I4.0	7
Big data	4
Automation	3
AI	3
Cloud	2
IOT	2
Blockchain	1
Geography	
Generic	22
Emerging	17
Developed	13
Comparative	5
Multiple	3
Sustainability	
Social	
Social inequalities and vulnerabilities	16
Human rights	11
Impact of digital technologies on workers	6
Stakeholder engagement	4
Corruption	3
Economic	
Increased unemployment	9
Inclusive growth	7
Noncompliance with labour market regulations	4
Environmental	
Resource efficiency	10
Pollution	9
Smart cities	3
Green FSAs	2

2.3.1 Types of digital technologies

Digital platforms receive most attention in this category, but we also found numerous articles dealing with 'digitalization'. These articles do not focus on a single digital technology: they instead consider how multiple digital technologies, for example AI and blockchain (Ajwani-Ramchandani et al., 2021), complement each other in certain contexts; in other cases, scholars use the label I4.0 to capture the combination of different technologies. As we did not find significant differences in the bundles of technologies included under digitalization (e.g., George & Schillebeeckx, 2022) or I4.0 (e.g., Dilyard et al., 2021), we discuss these two categories together. Interestingly, other individual technologies (such as cloud computing and the Internet of Things, IoT) are hardly studied in relation to MNEs and sustainability, as illustrated in *Table 2.3*. Given these frequencies, we first present the key topics addressed regarding digital platforms, followed by the I4.0 and digitalization categories, and finally the other individual technologies.

Digital Platforms facilitate different kinds of exchanges, and several of the articles zoom in on social media, sharing platforms, internal enterprise platforms, mobile payment platforms, and other types of platforms owned by so-called "Big Tech" MNEs. The largest number of studies focus on social media, where scholars uncover multiple implications for MNEs and sustainability. A few studies address how social media platform MNEs expedite socio-political development within countries and communities by empowering individuals (Benmamoun et al., 2012; Kalliny et al., 2015; Kariippanon & Gurruwiwi, 2022). Relatedly, Li et al. (2022) direct their attention to social media users and uncover differences in their privacy preferences across countries that social media platform MNEs should recognize. Nwagbara (2013) explores the potential of social media to promote environmental sustainability and advance CSR communications of oil and gas MNEs in Nigeria, while Nasr et al. (2022) note that location-specific factors may affect user engagement with CSR posts shared by MNEs. Relatedly, Tian (2022) studies how political hostility impacts the rhetorical strategies of MNEs in China, underscoring the importance of social media channels to manage relationships with stakeholders and respond to socio-political conflict. Another group of articles focuses on sharing platforms. Much of this research scrutinizes the sustainability implications of the business models of Uber and

Airbnb, two MNEs centered on sharing platforms (Clancy, 2020; Dreyer et al., 2017; Marano et al., 2020; Parente et al., 2018; Punt et al., 2021; Uzunca et al., 2018). Scholars emphasize that sharing platform MNEs must consider the socio-economic impact of their operations on local stakeholders. For example, Dreyer et al. (2017) find that a developed-country sharing platform MNE like Uber must adapt its business model to local contexts in developing countries to avoid unintended negative impacts on vulnerable social groups, while Marano et al. (2020) assert that the disruptive business models of Uber and Airbnb generate distinct legitimacy challenges that confound market entry. Almost at the other end from an organizational perspective are internal enterprise platforms, where scholars scrutinize the sustainability consequences of MNEs adopting digital platforms within their firm. Research suggests that enterprise platforms can increase transparency and accountability inside the MNE (Hussain et al., 2019), achieve more sustainable energy usage (Loureiro & Labandeira, 2019) and facilitate greater external stakeholder involvement in innovation processes (Nylund et al., 2021).

We also found studies looking at other types of platforms owned by Big Tech MNEs. Tan and Tan (2012) posit that Google's decision to exit the Chinese market was as a culmination of the ethical and CSR conflicts with the government. Rikap (2022) discloses how Amazon predates value from suppliers and third-party firms participating in its platform. Coveri et al. (2022) argue that Amazon possesses enormous power due to its diversification strategy; control over digital technologies; uneven bargaining power with governments; and global labor fragmentation; and that it uses this power to dominate other firms and suppliers. Boyer (2021) instead juxtaposes a platform economy centered on Big Tech MNEs with those controlled by the state or by citizens, showing different implications for social relations and power distributions in society. Finally, a few studies focus on mobile payment platforms, discussing how they enable marginalized groups to access capital and new employment opportunities, and highlighting MNEs' positive role in fostering their use in contexts characterized by institutional voids (Kabengele & Hahn, 2021; Onsongo, 2019).

As highlighted previously, both I4.0 and digitalization are used as umbrella terms for a variety of digital technologies. A few studies take an industry-specific focus on digital technologies. Within the manufacturing

industry, scholars find that digitalization leads to greater unemployment based on the importance placed by MNEs on investing in digital technologies and upgrading firm-level capabilities (Plumwongrot & Pholphirul, 2022; Szalavetz, 2019). At the same time, Hauge (2021) argues that digitalization can exacerbate power differences between the Global North and South, by allowing Western MNEs to appropriate increasing shares of profits over a larger market. Laurenza et al. (2018) examine the Italian health care industry and postulate that a healthcare MNE deploying digital technologies can improve patients' wellbeing and quality of life, but also introduce privacy issues in terms of sharing sensitive medical data. Forcadell et al. (2020) investigate the global banking industry and find that the combination of digitalization and reputation for corporate sustainability lowers multinational banks' governance costs and expands their economic activities.

Our sample also contains articles that consider how I4.0 technologies affect global business processes. These studies highlight the challenges of digital nationalism and vulnerability in internationalization processes (Verbeke & Hutzschenreuter, 2021); why and how business seeks to influence digital policies (Kemmerling & Trampusch, 2022); the dynamics of digital technologies and corruption (Malik & Froese, 2022; Park & Xiao, 2021; Riaz et al., 2022); and the need to better understand how digital technologies shape international market entry, for example how AI minimizes human interaction and thus potentially lower customers' trust and commitment (Watson et al., 2018). Furthermore, scholars also contemplate how digitalization fosters global innovation networks, producing both economic winners and losers (Cano-Kollmann et al., 2018), and improves the resilience and environmental sustainability of GVCs (Dilyard et al., 2021). Finally, several studies take a more generic perspective on I4.0. This body of work studies how I4.0 technologies optimize resource efficiency and minimize waste within firms, innovation ecosystems, and smart cities (Ajwani-Ramchandani et al., 2021; Gholami et al., 2022; Oyinlola et al., 2022; Van den Buuse & Kolk, 2019). It also offers general observations and research recommendations about the new challenges and realities for MNEs in a digital world, also in relation to sustainability (Ahi et al., 2022; Cooke et al., 2019; George & Schillebeeckx, 2022; Ghauri et al., 2021; Satyro et al., 2022; Srinivasan & Eden, 2021; Yi et al., 2022).

A more limited number of articles target specific types of digital technologies. Four studies concentrate on BDA. The concerns of relinquishing control over this technology to (foreign) MNEs raise most consideration. Specifically, Chenou and Radu (2019) address the "right to be forgotten", as brought forward during negotiations between a big tech MNE, Google, and European Union (EU) regulators with respect to big data. Vila Seoane (2021) probes data localization requirements in India, accentuating how foreign MNEs, in concert with foreign governments and local actors, lobbied the national government to alleviate these measures in favor of free cross-border data flows. Mann (2018) discusses the social and economic downsides of giving foreign MNEs unique access to big data on the poor in emerging and developing countries, and underscores the importance of fostering a fairer distribution of benefits and local economic development. Automation comes to the fore in three articles, which argue that, while this technology allows MNEs to implement higher labor and environmental standards, it also reduces employment opportunities for lower-skilled workers (Munsamy et al., 2019; Narula, 2019; Plumwongrot & Pholphirul, 2022). Three studies in our sample focus on AI. Budhwar et al. (2022) evaluate the effects of employing AI in international human resource management on job losses and employee wellbeing. Dauvergne (2022) offers a critical perspective on the supposed greening effect of AI on global supply chains. And Malik et al. (2022) find that AI-assisted human resource management enhances employee experience, resulting in higher employee engagement, loyalty and commitment. We also identified two articles that address the deployment of IoT in MNEs' smart cities projects. Scuotto et al. (2016) detail how IBM adopted an 'open innovation model' to develop smart city projects in different locations, while Bresciani et al. (2018) highlight the importance of knowledge management capabilities and strategic alliances. There are also two articles that cover cloud computing. Gozman and Willcocks (2019) focus on the need for MNEs in regulated industries to manage the risks from outsourcing arrangements to cloud services providers, particularly with respect to data protection. Patchell and Hayter (2021) instead uncover how cloud MNEs develop new green firm-specific advantages (FSAs) inspired by the Sustainable Development Goals. Finally, blockchain is addressed in just one article, which investigates how this technology can be deployed by MNEs to increase the transparency of their global supply chains (McGrath et al., 2021).

2.3.2. Geographic focus

A key aspect relevant to IB is the geographic focus of studies. The largest number of articles, 22 out of 60, are generic in nature, as they are not geared towards a specific country or location. Within this body of work, 13 are literature reviews, perspectives or editorials (Ahi et al., 2022; Boyer, 2021; Budhwar et al., 2022; Cano-Kollmann et al., 2018; Dauvergne, 2022; Dilyard et al., 2021; George & Schillebeeckx, 2022; Ghauri et al., 2021; Parente et al., 2018; Srinivasan & Eden, 2021; Verbeke & Hutzschenreuter, 2021; Watson et al., 2018; Yi et al., 2022), and five are conceptual studies (Kemmerling & Trampusch, 2022; Malik & Froese, 2022; Nylund et al., 2021; Rikap, 2022). In addition, there are four empirical articles that either do not specify the countries in their research design, or cover topics that are global or location-agnostic in nature (Gholami et al., 2022; McGrath et al., 2021; Munsamy et al., 2019; Patchell & Hayter, 2021).

Interestingly, the second largest group of articles (17) focuses on emerging markets. Out of these 17, 11 are single-country studies. China raises particular interest with its unique and challenging institutional, technological and cultural context (Cooke et al., 2019; Park & Xiao, 2021; Tan & Tan, 2012; Tian, 2022). There is also attention for MNEs operating in emerging markets on the African continent, namely in relation to the potential of social media to promote sustainability in Nigeria (Nwagbara, 2013), sharing business models in South Africa (Dreyer et al., 2017), and mobile payment services in Kenya (Onsongo, 2019). Our sample also includes three studies on India, examining the circular economy (Ajwani-Ramchandani et al., 2021) data sovereignty (Vila Seoane, 2021), and AI-assisted human resource management (Malik et al., 2022); and one on Brazil, which investigates the environmental and social challenges and opportunities of I4.0 technologies, among others, for MNEs (Satyro et al., 2022). Further, several studies include multiple emerging countries grouped together under a particular label, such as the Arab world (Benmamoun et al., 2012; Kalliny et al., 2015), the Global South (Hauge, 2021), or 'simply' emerging markets (Kabengele & Hahn, 2021; Narula, 2019; Plumwongrot & Pholphirul, 2022).

Thirteen articles focus exclusively on developed countries and cover diverse topics and geographies. Most of this research constitutes single-

country studies. Two studies in Italy examine how MNEs' adoption of I4.0 technologies facilitates the development of smart cities and the improvement of the health care system (Bresciani et al., 2018; Laurenza et al., 2018). A couple of studies in Australia examine the use of digital technologies by Aboriginal communities neighboring a multinational mining company (Kariippanon & Gurruwiwi, 2022), and how digitalization thwarts corrupt practices by enhancing the transparency of information flows (Riaz et al., 2022). A number of developed countries in our sample occur only once: scholars examine I4.0 technologies by MNEs' foreign subsidiaries in the Hungarian manufacturing sector (Szalavetz, 2019); the micro effects of I4.0 technologies and digital platforms in the UK (Hussain et al., 2019); sharing platform MNEs and the housing crisis in Ireland (Clancy, 2020); and how BDA architectures of MNEs advance sustainable innovation in Portugal (Santos et al., 2017). In addition to these single-country studies, five articles analyze empirical data from multiple countries. One study focuses on the EU (Chenou & Radu, 2019), two others scrutinize data from many developed countries (Gozman & Willcocks, 2019; Van den Buuse & Kolk, 2019), while the final two concentrate on a selection of three (Loureiro & Labandeira, 2019) and 14 developed countries (Forcadell et al., 2020).

We only found three articles examining multiple types of countries. Scuotto et al. (2016) employ data on smart cities from developed (Spain, Italy, Belgium, Qatar and the U.S.) and emerging (Brazil) countries, but their analysis centers around IBM's strategy at the city level, most importantly its vision of smart cities and open innovation. Mann (2018) applies a political economy perspective to BDA using data from various African economies, both developing and emerging, although her discussion refers to African economies as a whole. This concerns the need to move beyond treating the poor as beneficiaries of big data, to instead perceiving them as potential economic producers. Finally, Oyinlola et al. (2022) study how digital innovations can foster a transition towards circular value chains in Nigeria (classified as emerging country), Uganda and Zambia (developing countries). The authors find, in all three countries, that MNEs play a critical role in the national plastic value chains, but that a full transition towards sustainable circular value chains will require regulatory changes, namely addressing regulatory barriers to digital solutions and implementing extended producer responsibility regulations.

Finally, it is noteworthy that some of the articles take a comparative approach to digital technology in developed and emerging/developing countries. Interestingly, three studies compare the market entry of sharing platform MNEs in different countries. In particular, Uzunca et al. (2018) analyze the institutional strategies of Uber and Airbnb in Egypt, the UK and the Netherlands, underscoring that Uber's business model alleviates a public safety issue in Egypt: the sexual harassment of women in public transport. Punt et al. (2021) study the location decisions of Uber in North America, Europe, Asia, Africa, South America and Oceania, and obtain partial support for their hypothesis that Uber is attracted to locations with relatively weak labor market institutions. Marano et al. (2020) evaluate the internationalization challenges faced by Uber and Airbnb in Australia, South Africa, the UK, India, Hong Kong and the U.S. In India and South Africa, the two MNEs experienced relatively strong enforcement actions aimed at abolishing their regulatory violations, including fines, seizing of corporate assets, police raids and jailing of service providers. With a different focus, Nasr et al. (2022) scrutinize the CSR marketing of MNEs from China, India, France and the U.S., showing that, in contrast to emerging markets, CSR posts in developed countries are not effective in obtaining legitimacy; in fact, they can diminish it. Finally, Li et al. (2022) note that social media platform MNEs should account for differences in platform users' privacy concerns in China, the U.S. and South Korea.

2.3.3. The Sustainability Triplet

We now turn to our discussion of the sustainability dimensions covered in our sample. *Table 2.4* summarizes the key insights of each article in our sample related to the sustainability dimensions addressed, categorized by the type of research (as well as showing, through different font types, the geographic scope covered by the work). This table illustrates how the majority of the studies in our sample address social sustainability in relation to MNEs and I4.0 technologies, followed by environmental and economic sustainability, which both receive similar amounts of academic scrutiny. Considering this, we first discuss social sustainability, followed respectively by economic sustainability and environmental sustainability.

Table 2.4. Key insights of each article in our sample in relation to social, economic, and environmental sustainability (different fonts relate to findings from different settings; see note below table; table continues on next page).

	Social Sustainability
Empirical	• *Digital technologies can improve the quality of life of health care patients, as well as the quality of working conditions for employees and transparency in MNEs* (Hussain et al., 2019; Laurenza et al., 2018). • *Digital technologies challenge contemporary perceptions of privacy and human rights* (Chenou & Radu, 2019). • *The digitalization of accounting standards addresses transparency problems in MNEs' corporate governance* (Riaz et al., 2022). • *MNEs and their digital technologies help facilitate political and social reform within local communities* (Kariippanon & Gurruwiwi, 2022). • Ethical, political and cultural conflicts arise when digital MNEs expand business activities to countries with authoritarian governments (Tan & Tan, 2012). • Circular economy business models must be adapted to local contexts to create stakeholder value and avoid unintended negative impacts on vulnerable social groups (Dreyer et al., 2017). • Platform MNEs can help alleviate social problems and public safety issues, such as access to public transport and sexual harassment (Uzunca et al., 2018). • MNEs and their digital technologies help facilitate political and social reform within countries (Kalliny et al., 2015). • Digital technologies can encourage firms to engage in anti-corruption practices by contributing to their corporate reputation and innovativeness (Park & Xiao, 2021). • MNEs lobby national governments in tandem with local actors and foreign governments to soften data localization requirements (Seoane, 2021). • MNEs can use social media to improve their legitimacy, but must be aware of local cultural and social factors, as well as geopolitical tensions between their home and host countries (Nasr et al., 2022; Tian, 2022). • AI-assisted human resource management enhances employee experience, leading to improved employee commitment, loyalty, and engagement (Malik et al., 2022). • Conflicting national data privacy laws create regulatory challenges for MNEs wishing to benefit from cloud computing (Gozman & Willcocks, 2019).

	• Digital platforms face unique internationalization challenges due to their disruptive business models (Marano et al., 2020). • Augmented reality has high applicability for product-level social sustainability development (Gholami et al., 2022). • Platform MNEs must be mindful of between-country differences in privacy concerns and privacy decisions when designing their platforms (Li et al., 2022).
Conceptual	• Digital technologies are paving the way toward political and social change, and the social media phenomenon in the Arab world is being spearheaded by American MNEs, notably Facebook, Twitter, and Google (Benmamoun, 2012). • Digital technologies introduce new opportunities and challenges to minimize the use of corruption (Malik & Froese, 2021). • Industry 4.0 technologies have the potential to include stakeholders more intimately in a firm's innovation processes (Nylund et al., 2021). • The power and control of large digital MNEs are to be understood as levers for coordinating global production and influencing world societies (Coveri et al., 2022). • Digitalization creates novel digital power resources for firms throughout sectors (Kemmerling & Trampusch, 2022).
Generic	• MNEs can deploy digital technologies to improve their relationships with stakeholders and promote CSR (Nwagbara, 2013). • Industry 4.0 technologies are likely to exacerbate tensions between the high-knowledge and low-knowledge segments of emerging economies (Cano-Kollmann et al., 2018). • Industry 4.0 technologies impact how workers are hired and trained, as well as their commitment and loyalty (Cooke et al., 2019). • Digital technologies can both create and hinder trust between the firm and its internal and external stakeholders (Watson et al., 2018). • The entry of foreign digital MNEs may trigger ethnic and socioeconomic discrimination (Verbeke & Hutzschenreuter, 2021). • MNEs' digitalization initiatives have substantial social impacts, both positive and negative, through their CSR initiatives and their GVCs (Srinivasan & Eden, 2021). • Digital technologies might exacerbate power differences between the Global North and South by allowing Western MNEs to appropriate increasing shares of larger markets (Hauge, 2022). • Digital technologies have the potential to afford Big Tech MNEs enormous social and political power (Boyer, 2022).

	• Artificial intelligence can improve and decrease employee wellbeing, depending on how it is deployed (Budhwar, 2022). • The idea of 'ecosystem social responsibility' constitutes a useful concept to examine internationalization and extend global CSR research (Yi et al., 2022).
	Economic Sustainability
Empirical	• *Sharing platforms increase housing prices, create taxation problems and incentivize illegal economic activities* (Clancy, 2022; Uzunca et al., 2018). • Digital platforms provide new employment and financial opportunities for disenfranchised groups (Dreyer et al., 2017; Kabengele et al., 2021; Onsongo, 2019; Uzunca et al., 2018). • Automation can lead to significant job losses for low-skilled workers and employment opportunities for high-skilled workers (Plumwongrot & Pholphirul, 2022; Satyro et al., 2022; Szalavetz, 2019). • Digital platforms often do not comply with labor market regulations or seek out locations with lower regulatory scrutiny (Punt et al., 2022).
Conceptual	• Big tech MNEs can, under certain conditions, predate value from suppliers and third parties participating on their platform, as well as accumulate vast amounts of political power (Rikap, 2022).
Generic	Automation reduces opportunities for unskilled workers and increases opportunities for skilled workers (Cano-Kollmann et al., 2018). MNEs must consider the poor as autonomous economic agents in the context of data analytics (Mann, 2018). Automation has detrimental consequences for the poor and uneducated, especially for women (Narula, 2019). Further research is needed to understand the economic consequences of digital technologies (Parente et al., 2018). Firm internationalization can be impeded by digital nationalism (Verbeke & Hutzschenreuter, 2021). Digitalization presents the MNE with increasing geopolitical, organizational, and market tensions (George & Schillebeeckx, 2022). New digital technologies have significant economic implications for firm strategies and cross-border management (Ghauri et al., 2021). Advanced technologies have significant implications for MNEs' location choice, governance structures and exchange of knowledge (Ahi et al., 2022). Artificial intelligence will have a profound impact on job security (Budhwar, 2022).
	Environmental Sustainability

Empirical	• *Digital platforms can reduce energy usage and facilitate sustainable heating and cooling patterns* (Loureiro & Labandeira, 2019). • *Reputation for corporate sustainability can help address MNEs' digitalization challenges* (Forcadell et al., 2020). • Technology and individual incentives can be combined to facilitate a circular economy and reduce pollution, given the right incentives and local context (Ajwani-Ramchandani et al., 2021; Oyinlola et al., 2022). • MNEs and digital technologies can improve the environmental sustainability of cities, provided that MNEs acquire certain capabilities and local knowledge (Bresciani et al., 2018; Scuotto et al., 2016; Van den Buuse & Kolk, 2019). • Digital technologies can substantially reduce the energy requirements of MNEs' operations (Munsamy et al., 2019; Santos, 2017). • Blockchain technologies can improve transparency and sustainability across GVCs (McGrath et al., 2021). • MNEs can develop and diffuse green FSAs, thereby contributing to the SDGs (Patchell & Hayter, 2021). • Big data has the highest applicability for developing sustainable products (Gholami et al., 2022).
Conceptual	
Generic	MNEs can use digital technologies to promote environmental sustainability (Nwagbara, 2013). Industry 4.0 technologies can be used to increase the resilience and sustainability of GVCs (Dilyard et al., 2021) Artificial intelligence might not be greening global supply chains due to increased resource extraction and overconsumption (Dauvergne, 2022). Digitalization has the potential to reduce MNEs' emissions (George & Schillebeeckx, 2022).

Note: The 'Generic' label includes literature reviews, commentary/perspective pieces, and editorials. Italic text corresponds to insights from developed countries; underlined text corresponds to insights from emerging countries; regular texts correspond to insights from both developed and emerging countries.

Social sustainability articles often discuss implications of digital technologies for human rights more generally, as well as for workers, marginalized and vulnerable social groups; there is also research on the opportunities that digital technologies provide to MNEs for communicating with their stakeholders; and studies that focus on how digitalization affects corrupt behavior. In the area of human rights, a substantial number of articles delineates how MNEs deploying digital technologies are urged to manage demands over (cross-border) privacy and data protection (Chenou & Radu, 2019; George & Schillebeeckx, 2022; Ghauri et al., 2021; Gozman & Willcocks, 2019; Laurenza et al., 2018; Li et al., 2022; Tan & Tan, 2012; Vila Seoane, 2021; Watson et al., 2018). A key insight emerging from this body of work is that the institutional context regarding these issues is highly fragmented, challenging MNEs to undertake an internationally coordinated approach. For example, George and Schillebeeckx (2022) highlight that MNEs are confronted with increasingly stringent local regulations that impose data privacy requirements and give citizens data ownership rights, while Gozman and Willcocks (2019) point at the challenges of the outsourcing of cloud services that derive from conflicting (cross-border) data privacy laws across countries. Besides engendering potential risks for human rights, digital technologies may also support citizens in their fight for fundamental rights. Research particularly elucidates how social media platforms, made available by MNEs like Twitter and Facebook, empower citizens in authoritarian countries to push for political and social change (Benmamoun et al., 2012; Kalliny et al., 2015).

Regarding the impact of digital technologies on workers, there is research on the (potentially) positive consequences, for example by increasing employees' health, safety and wellbeing (Budhwar et al., 2022; Cooke et al., 2019; Hussain et al., 2019; Laurenza et al., 2018; Malik et al., 2022). Conversely, scholars also mention the downsides of I4.0 technologies, such as social isolation, social conflict and dehumanization (Ahi et al., 2022; Cooke et al., 2019). We also identified several articles that cover the impact of MNEs deploying digital technologies on marginalized and vulnerable social groups. Here, researchers suggest that the digitalization of MNEs' GVCs may result in the exclusion of their most vulnerable suppliers, and that the entry of foreign digital MNEs may trigger ethnic and socioeconomic discrimination (Verbeke & Hutzschenreuter, 2021), and exploitation of the uneducated and the poor

(Dreyer et al., 2017; Marano et al., 2020). Others highlight the social impacts on local communities engendered by the entry of digital MNEs, such as Airbnb exacerbating the housing crisis in Ireland (Clancy, 2020), and social media platform MNEs triggering the erosion of traditional values in Aboriginal communities (Clancy, 2020; Kariippanon & Gurruwiwi, 2022). We also came across work that addresses or encourages research on social inequality from a more meso- and macro-level perspective, including the social and political strategies of MNEs and their business models (Boyer, 2021; Coveri et al., 2022; Hauge, 2021; Kemmerling & Trampusch, 2022; Oyinlola et al., 2022; Parente et al., 2018; Rikap, 2022; Srinivasan & Eden, 2021; Yi et al., 2022). Interestingly, some scholars find that digital technologies, when tailored to the local context, present new opportunities for MNEs to communicate and engage with stakeholders (Nasr et al., 2022; Nwagbara, 2013; Tian, 2022), and even involve external stakeholders intimately throughout the supply chain and innovation processes (Nylund et al., 2021). Finally, three studies address corruption, which digitalization can both enable (Malik & Froese, 2022) and discourage (Park & Xiao, 2021; Riaz et al., 2022).

The set of economic sustainability articles largely centers around increased unemployment, noncompliance with labor market regulations and inclusive growth. Specifically, a substantial number of articles suggest that the deployment of digital technologies among MNEs may cause higher unemployment, particularly for low-skilled workers (Budhwar et al., 2022; Cano-Kollmann et al., 2018; Dreyer et al., 2017; Ghauri et al., 2021; Munsamy et al., 2019; Narula, 2019; Plumwongrot & Pholphirul, 2022; Satyro et al., 2022; Szalavetz, 2019). For example, Plumwongrot and Pholphirul (2022) note the job losses triggered by MNEs' increased use of automation and robots, while Narula (2019) asserts investments in automation to be especially detrimental to employment opportunities for women in the Bangladeshi apparel industry. Concurrently, however, employment opportunities that are created by digital technologies for high-skilled workers exclusively (Plumwongrot & Pholphirul, 2022; Satyro et al., 2022) can further exacerbate conflicts and social resentment within and between nations (Cano-Kollmann et al., 2018). We also found studies on noncompliance with labor market regulations, where scholars point out that digital MNEs are often not (fully) compliant with such regulations or seek out localities with lower levels of

consumer protection (Marano et al., 2020; Parente et al., 2018; Punt et al., 2021; Uzunca et al., 2018). For example, the fact that sharing platform MNEs consider workers as independent contractors rather than employees results in substantial limitations in the latter's negotiating power, for instance with respect to holiday pay and insurance (Marano et al., 2020; Uzunca et al., 2018).

On the other hand, there are articles that elucidate how digital technologies can promote inclusive growth. When deploying digital technologies, MNEs may enable groups that were historically excluded from economic opportunities, such as women and/or uneducated persons, to gain access to income or capital (Dreyer et al., 2017; Kabengele & Hahn, 2021; Mann, 2018; Onsongo, 2019; Oyinlola et al., 2022). For example, Uber's entry into South Africa gave local drivers access to "opportunities that were previously unavailable (access to car and smartphone, and income generation)" (Dreyer et al., 2017, p. 93). Moreover, the introduction of mobile money payment services by MNEs in African economies allowed individuals at the 'bottom of the pyramid' to acquire microloans that they used to finance new businesses (Kabengele & Hahn, 2021; Onsongo, 2019; Oyinlola et al., 2022). Finally, some articles call for further research on the economic consequences of digital technologies, such as national competitiveness (Parente et al., 2018).

Environmental sustainability research in our sample mostly emphasizes the positive environmental impacts of digital technologies, particularly in terms of pollution reduction, resource efficiency, smart city development, and, more generally, in furthering green FSAs. Several studies show that digital technologies prompt MNEs to reduce pollution, particularly by decreasing the costs of monitoring their environmental footprint. For example, scholars find that this helps reduce plastic and packaging waste, and thus facilitates the realization of a circular economy (Ajwani-Ramchandani et al., 2021; Oyinlola et al., 2022). In addition, scholars indicate that automation and IoT can allow MNEs to lower their carbon dioxide (CO2) emissions (George & Schillebeeckx, 2022; Munsamy et al., 2019). Regarding improved resource efficiency, it was found that store managers of a Spanish MNE adhere to more sustainable heating and cooling patterns when they receive information on the financial and environmental costs of their energy use (Loureiro & Labandeira, 2019). Moreover, digital technologies can also be

utilized to optimize energy demands throughout the MNE (Ahi et al., 2022; Munsamy et al., 2019; Santos et al., 2017), and even entire industries and GVCs (Ahi et al., 2022; Dilyard et al., 2021; McGrath et al., 2021). However, Dauvergne (2022) points out that digital technologies' micro-level gains in sustainability, such as productivity and efficiency gains, are likely outweighed by macro-level losses such as increased resource extraction and overconsumption. In the three studies on smart cities, there is attention for ways in which MNEs provide or utilize digital technologies to improve cities' environmental sustainability in areas such as energy, waste, water and transportation (Bresciani et al., 2018; Scuotto et al., 2016; Van den Buuse & Kolk, 2019). Scholars note that MNEs need to develop new (knowledge) capabilities and strategic alliances with local stakeholders to overcome barriers to smart solutions, such as low digital competences of certain societal groups and lack of local embeddedness. Finally, a few articles zoom in on green FSAs, pointing out that firms purposefully develop and deploy green resources. Forcadell et al. (2020) find that international banks can overcome their digitalization challenges by building a strong reputation for corporate sustainability. Furthermore, Patchell and Hayter (2021, p. 1) assert that cloud computing multinationals are developing and diffusing "environmentally driven firm specific advantages".

2.4. A Future Research Agenda

Our literature review offers five critical insights for scholars who conduct research at the intersection of MNEs, I4.0 and sustainability. First, notwithstanding growing interest from academics across various scientific disciplines, the relatively limited number of articles and the overrepresentation of 'lower level' journals in our sample suggest that research is still in its infancy. Second, the number of conceptual studies that introduce, apply, extend, or nuance theoretical frameworks and constructs is limited. Hence, there exist numerous opportunities to introduce more conceptual rigor in research on this topic. Third, a substantial part of the extant literature consists of commentary and perspective pieces, which offer useful reflections and ideas about future studies, but lack meticulous empirical analysis (see *Table 2.4*). Fourth, although the work we reviewed considered the role of MNEs, in several instances their specificities, such as ownership, governance structure,

and internationalization strategy, have received scant attention. As a result, the implications for sustainability of deploying I4.0 technologies in an international context have not been fully explicated. Fifth, while some articles hint at the possibility that different technologies have distinctive consequences for sustainability, articles focusing on individual technologies are limited, which means that technology-specific benefits and downsides have not been sufficiently illuminated. With this in mind, we propose a research agenda below to guide scholars interested in further studying MNEs, I4.0 and sustainability (see also a summary of main research avenues in *Table 2.5*).

Table 2.5. Suggested research avenues, research questions and theoretical concepts and frameworks.

Sustainability dimension	Research Avenue	Research questions	Theoretical Concepts and Frameworks
Social	Human rights in the digital age	• How and when can MNEs prevent their digital technologies from being used to suppress or limit human rights in developing and emerging countries? • How do MNEs cope with differences between countries regarding preferences on how human rights should be embedded in digital technologies such as AI? • How can MNEs ensure that the adoption of AI does not perpetuate existing biases and discrimination in their operations and decision-making processes? • How do MNEs manage the need to democratize access to digital solutions and protect users' data?	• Political CSR • Corporate citizenship • Corporate purpose
	The regulatory landscape of digital technologies with respect to social issues	• How do digital MNEs negotiate with different national and regional policymakers, as well as civil society organizations, about the design of a governance framework addressing the ethical implications and risks of digital technologies for fundamental rights? • How can foreign digital technology MNEs deal with regulatory voids on data- and AI-related ethics and rights? • What strategies can MNEs utilize to overcome regulatory inconsistencies between countries in relation to data governance? • What information strategies can digital MNEs use to achieve	• Multi-level governance • Resource dependence theory • Institutional strategy • Corporate political strategy

Sustainability dimension	Research Avenue	Research questions	Theoretical Concepts and Frameworks
		legitimacy in a foreign country, given the various local cultural and social factors at play? • How do geopolitical tensions between home and host countries impact the internationalization of digital MNEs?	
	Corporate power in the digital age	• How do digital MNEs manage the risk that data from which AI-enabled applications are designed are biased and unrepresentative of local contexts? • How do MNEs deal with accumulating corporate powers through I4.0 and how does this affect the rights of the most vulnerable persons in lower-income countries? • What types of power over other stakeholders do different digital technologies present to digital MNEs and what policies can be constructed to limit their negative effects? • Under what conditions do different digital technologies enhance or limit corporate corruption?	• Game theory • Transaction cost economics • Corporate corruption • Power-dependence theory
Economic	Employment	• How do the economic opportunities offered by I4.0 relate to MNE governance structures, ownership and internationalization strategies? • How does the deployment of digital technologies affect individuals with intersectional disadvantages in developing and emerging countries? • To what extent does MNEs' deployment of digital technologies have a direct or indirect impact on inclusive growth in developed countries?	• Bottom-of-the-pyramid strategies • Intersectionality

Sustainability dimension	Research Avenue	Research questions	Theoretical Concepts and Frameworks
	Working conditions inside the MNE	• How can MNEs deal with the dark side of introducing digital technologies to manage human resources? • How does the introduction of digital technologies impact employee satisfaction? • How do MNEs address the ethical challenges of using digital technologies to hire and train employees, and how does this impact their organizational commitment?	• Corporate citizenship • Stakeholder theory • Organizational justice
	Localization	• How do 'conventional' MNEs integrating I4.0 across their manufacturing subsidiaries interact with local governments with respect to employment-related effects? • How do foreign digital MNEs recombine their digital FSAs with local firms' assets to address economic sustainability issues? • To what extent does MNEs' location choice for data centers in emerging and developing countries have a direct or indirect impact on inclusive growth? • How can digital and manufacturing MNEs harness additive manufacturing's potential to empower local entrepreneurs in lower-income countries?	• Asset recombination • Country-specific advantages • Glocalization
Environmental	The environmental costs of digitalization	• How do digital technology MNEs manage the environmental shortcomings of their digital solutions' international scaling? • How do MNEs define and measure the environmental impact of digital solutions? • How do business model- and location-specific factors affect	• GVC analysis • Business model innovation • Circular economy

Sustainability dimension	Research Avenue	Research questions	Theoretical Concepts and Frameworks
		the international scaling of IoT, blockchain- or AI-enabled circular business models?	
	Greening GVCs	• How can MNEs recombine their digital FSAs with customers' local assets to increase circularity? • Does the participation in dataspaces improve the environmental sustainability of MNEs global operations? • How do digital technology MNEs leverage diverse digital technologies and degrees of standardization or adaptation to accelerate a circularity transition across different countries? • How do MNEs facilitate a digitally-enabled green transformation within a GVC and address different challenges among their suppliers?	• Ecosystem CSR • Green FSAs • Corporate sustainability
	Partnerships for digital sustainability	• How do digital technology ventures/MNEs leverage big data, IoT and/or AI to encourage customers' pro-environmental behavior across different institutional contexts? • How do location-specific factors impact the efficacy of information strategies that digital MNEs utilize to encourage pro-environmental behavior? • How do foreign digital MNEs interact with local stakeholders concerning the trade-off between digitalization and energy costs? • How do foreign digital MNEs interact and negotiate with local governments concerning the trade-off between the need for data sharing for environmental sustainability on the one hand, and	• Multi-stakeholder initiatives • Political CSR • Liability of disruption • Institutional entrepreneurship

Sustainability dimension	Research Avenue	Research questions	Theoretical Concepts and Frameworks
		data privacy and protection on the other? • How do digital MNEs interact with stakeholders in the standardization of measurement and monitoring of the environmental footprint of digital technologies?	

2.4.1. MNEs, I4.0 and social sustainability

Our review highlights how previous studies touch upon the dynamics of I4.0 for promoting human rights in the digital age. However, extant literature is largely silent on how digital technologies can be used to suppress human rights. Negative social implications may emerge when authoritarian governments adopt digital solutions (particularly those based on IoT, blockchain and AI). Therefore, it would be interesting to conduct a comparative investigation of how digital technology MNEs from different political systems address the (risk of) misuse and harmful use of their digital solutions by such governments. One notable example is TikTok, which has received significant criticism in recent times regarding its data practices and close ties to the Chinese government, and as a result is now planning to cooperate with U.S. MNEs to store data from American users in the U.S. (Murphy, 2022). In addition, we advocate for more research on how the deployment of specific digital technologies by MNEs impacts human rights, and how this relates to country-differences in human rights concerns. AI offers a particularly interesting case, as these applications are seen as exhibiting different degrees of social risk and will have an enormous impact on the way people live and work in the coming decades (EC, 2022a). Moreover, our review also reveals that privacy has received disproportionate attention in comparison to other human rights. Future research can thus analyze the risks of discrimination based on biased data powering AI applications deployed by MNEs. This is especially germane vis-à-vis vulnerable groups in lower-income countries, because collecting high-quality data is arduous in such "less digitized" environments (Gwagwa et al., 2021). In addition, while extant research hints at the possibility for digital technologies to alleviate societal problems in emerging countries, empirical evidence is scarce. We therefore welcome work that scrutinizes how technologies such as digital platforms, IoT, mobile services, and blockchain relate to, for example, modern-day slavery, gender inequality and child labor, especially in emerging and developing countries.

Relatedly, our review suggests that there is ample opportunity to further our understanding of how MNEs manage the regulatory landscape of digital technologies with respect to social issues. For example, the adoption of the EU's General Data Protection Regulation (GDPR) imposed restrictions on

all parties handling data within the EU and beyond, which affects MNEs due to its extraterritorial reach and 'copy-cat' data privacy laws enacted around the world. Even when often inspired by the GDPR, a phenomenon also labelled 'the Brussels effect' (Bradford, 2020), regulatory heterogeneity within and across regions and countries prevails. This offers several interesting research directions for IB scholars in general, and regarding nonmarket strategies in particular (for a recent review on international nonmarket strategies to which such work can be linked, see Sun et al., 2021). Areas for investigation might be how digital MNEs lobby and negotiate with different (sub-)national and regional policymakers, as well as civil society actors, about the design of governance frameworks addressing the societal implications of digital technologies. Here, we see ample opportunity to introduce theoretical frameworks from other disciplines such as political science and public administration. The literature on multi-level governance (Piattoni, 2009) is relevant in this regard, as it helps elucidate the distinct stakeholder pressures MNEs face in relation to the territorial organization of governments. Furthermore, it would be worthwhile for scholars to help shed light on how foreign digital technology MNEs deal with regulatory voids on data- and AI-related ethics and rights when providing their digital solutions in host countries where "ethical scrutiny, transparency, and democratic control are lacking" (Vinuesa et al., 2020, p. 3) or proper regulation is absent altogether (Gwagwa et al., 2021; Sharma et al., 2020). Such work has the potential to advance academic understanding of institutional strategies (for recent reviews, see Dorobantu et al., 2017; Marquis & Raynard, 2015), which has seldomly been conducted in relation to MNEs and digitalization.

Furthermore, a number of articles in our review scrutinize corporate power in the digital age. Various scholars illuminate how I4.0 introduces pathways for digital MNEs to exploit vulnerable stakeholders. A critical issue of contention, which previous studies have addressed only to a limited extent, concerns MNEs' ownership and control of personal data collected from blockchain, IoT devices and mobile apps. Although the joint use of IoT and blockchain in particular can increase transparency and traceability, the adoption of these two technologies requires data sharing among different actors, which could also lead to 'big brother' type of control over suppliers and workers, particularly those with lower digital literacy. More insight is thus needed into how the shift by MNEs towards digital business models impacts

supply chain partners, and how MNEs can properly account for data sharing and data privacy/protection issues. For example, empirical research could be conducted on how the digitalization of supply chains affects power distribution, information asymmetry and opportunistic behavior in transactions between the different actors involved. Similarly, we also advocate further empirical work on how digital technologies affect MNEs' (lack of) involvement in corruption across different institutional environments. Our review suggests that digital technologies can both encourage and discourage MNEs to engage in corrupt behaviors, but we lack a comprehensive understanding of how and under what circumstances different factors at the individual, firm, industry and/or country levels affect the decision to engage in corrupt business practices (or not). Furthermore, we believe that such research could also advance academic understanding of corporate corruption, which has received limited attention in comparison to government corruption (for a recent review on this topic, see Castro et al., 2020).

2.4.2. MNEs, I4.0 and economic sustainability

A key economic sustainability issue that emerges from our sample is the relationship between digitalization and employment, such as the high risk of job losses elicited by the diffusion of I4.0 in MNEs' manufacturing processes. It would be valuable to shed more light on this phenomenon through two complementary research directions. First, we encourage empirical and conceptual work that clarifies the rift between the 'winners' and 'losers' of digitalization inside the MNE. While extant research points to the differences between skilled and unskilled workers, it remains unclear how these skills relate to the specificities of the MNE, such as governance structure, internationalization strategy and ownership, and to types of (un)skilled workers (cf. Heredia et al., 2023). In addition, our review reveals that inclusive economic growth has only been studied within the context of emerging and developing economies, overlooking the fact that certain regions and/or social groups inside developed countries are also limited in their economic opportunities. Hence, we would recommend scholars to explore the degree to which the deployment of digital technologies by MNEs can initiate inclusive growth in developed nations as well. Another fruitful avenue for research concerns intersectional disadvantages. While studies indicate that the

economic disadvantages of I4.0 disproportionately affect the poor and lower-educated, there is a high degree of heterogeneity within these groups (Cooper, 2015). Indeed, extant research alludes to the fact that job losses due to automation disproportionately affect poor female workers, but there is a lack of comprehensive empirical evidence. Specifically, it is not clear how the diffusion of digital technologies affects the economic opportunities of disenfranchised ethnic, religious and linguistic minorities, people with long-term physical and mental impairments, or people with different gender identities and sexual orientations – especially in emerging and developing countries. Such research could benefit from revisiting the original definition of a stakeholder, namely any individual or group that affects or is affected by the strategic objective of the firm (Freeman, 1984). This would entail the unpacking the concept of the 'digitally vulnerable' within 'bottom-of-the-pyramid' strategies of MNEs to explore heterogeneities within this group (cf. Kolk et al., 2014).

Furthermore, scholars find that the integration of I4.0 technologies can improve working conditions inside the MNE by enhancing transparency and trust. However, extant literature places emphasis on potential efficiency gains rather than the rights and responsibilities of MNEs towards their employees, particularly in emerging and developing countries. We thus welcome additional research on digital technologies' impact on working conditions inside the MNE, including studies on how the integration of I4.0 inside the MNEs impacts employee perception of organizational justice, such as the fairness of hiring and firing; the degree to which algorithmic decision-making processes are viewed as legitimate; and how algorithmic management affects interpersonal interactions inside the MNE. Likewise, it would be interesting to explore if and how MNEs construct ethical guidelines for using digital technologies to hire, train and promote employees, and to what extent such guidelines differ between countries. Further empirical research is also needed on how digital technologies affect the working conditions inside MNEs. While extant work demonstrates that digital technologies can benefit employees through increased transparency and accountability, we lack empirical research on the 'dark side' of deploying such technologies, such as social isolation, dehumanization and lack of trust. In addition, scholars can build on insights that automation and robotics may be complementary to 'human' labor and, by relieving workers from heavier, less complex tasks, they could improve

working conditions, efficiency, competences and hopefully incomes (WTO, 2019). Such research could for example explore how the integration of automation and robotics in MNEs' operations works out in terms of "economic upgrading" (Barrientos et al., 2011; Gereffi & Lee, 2016) in developed, emerging and especially developing countries.

In addition, our review illustrates that, notwithstanding the observation in IB literature that digital technologies are location-agnostic (Luo, 2022), I4.0 has considerable economic antecedents and consequences at the local level. We thus recommend scholars to study the localization of digital technologies. One promising area within this topic is exploring how 'conventional' MNEs integrating I4.0 across their manufacturing subsidiaries interact with local governments with respect to employment-related effects; whether they try to address the economic shortcomings of their digital transformation; and how location-specific factors affect their practices. Furthermore, our review highlights that collaboration with local actors and value co-creation can be critical for the success and scaling of digital solutions. Over the last years, local digital start-ups have burgeoned in lower-income countries, and future research could thus explore how foreign digital MNEs recombine their digital FSAs with these local firms' assets to address economic sustainability issues, but also whether there are barriers, for example because they may be competing with each another or there might be a lack of high-quality data or infrastructures. Regarding the latter, the location of data centers is said to affect the "speed with which the cloud's capabilities can be accessed" (Fourie, 2019, p. 6) and can thus be important for the economic impact of digital technologies (Ciulli & Kolk, 2023). Notably, big tech firms such as Google and Microsoft have established AI centers in several African countries (Gwagwa et al., 2021). Yet we lack empirical research to assess the local economic effects of these facilities. It would therefore be worthwhile to investigate whether and when these MNEs' location choices have a direct or indirect impact on economic growth, for example in terms of locally AI-enabled innovation, job and income opportunities. In addition, future research can scrutinize the absence of infrastructure and connectivity, digital illiteracy and financial constraints, unclear regulatory structures and lack of information or misinformation (Tsan et al., 2021), particularly in (remote) areas where the contribution of digital solutions would be most important. For example, I4.0 facilitates distributed production, but it is an open question how digital and

manufacturing MNEs can harness its potential to empower local entrepreneurs in lower-income countries when they lack the means, skills or infrastructure to realize these opportunities for inclusive growth.

2.4.3. MNEs, I4.0 and environmental sustainability

Our review indicates that digital technologies may help MNEs reduce pollution and energy consumption, and increase resource efficiency. Despite these promising findings, a set of relevant questions remain to be addressed in relation to the environmental costs of I4.0, especially how they influence the internationalization of MNEs. Environmental drawbacks prominently come to the fore in the international scaling of digital technologies, which can compromise digital MNEs' legitimacy. A notable example of this concerns data centers, which facilitate digitalization and economic growth but consume significant amounts of energy (cf. Liang et al., 2022). To tackle this trade-off, digital MNEs must interact with local governments and communities regarding the location choice of their data centers. Failure to build public support and legitimacy can land digital MNEs in dire straits. For example, Meta had to suspend its planned 410-acre data center in Zeewolde (The Netherlands) following protests by local politicians citing its excessive energy requirements (Waterfield, 2022). AI may be highly energy intensive as well (Accenture, 2020). Particularly EU policymakers have emphasized the need for environmentally sustainable AI applications, calling for "the development and use of energy efficient algorithms" (Signatory Countries, 2021). Similarly, a key environmental shortcoming of the expansion of IoT is the escalating number of devices and equipment purchased by customers and the rapid obsolescence of gadgetry. This leads to considerable amounts of e-waste, which will increase dramatically with the diffusion of 5G (Council of the EU, 2020; Semuels, 2019), an issue that governments are trying to address to prompt circularity. Hence, we recommend scholars explore how the environmental drawbacks of digital technologies affect MNEs' internationalization strategies in general, and location choice in particular. Such research would also complement and add nuance to similar studies conducted at the country- and city-level (Bildirici & Ersin, 2023; Kurniawan et al., 2023; Muhammad et al., 2022).

Furthermore, extant research asserts that digital technologies can be used to improve the environmental sustainability of GVCs. Yet we lack systematic empirical evidence about the actual net environmental benefits that different digital technologies offer in GVCs. While recent research suggests that I4.0 technologies have a direct and positive effect on sustainable supply chain practices (Khan et al., 2023), the international dimensions remain opaque. In particular, it is unclear how MNEs collaborate with their GVC partners to leverage I4.0 for low-carbon solutions (for a notable exception that does not focus on MNEs, see Niehoff et al., 2022). Such collaborations require MNEs to tackle a broad range of issues, including concerns about data protection and loss of control, digital sovereignty, resistance to change, as well as a lack of competences or infrastructure. Scholars point out that firms often lack incentives to share data, even when this would benefit the environment (Serna-Guerrero et al., 2022). Future studies should thus investigate how MNEs facilitate a digitally-enabled green transformation in their GVC in light of these challenges. Interestingly, participating in so-called dataspaces is sometimes seen a route for MNEs to address the hurdles hindering this transformation. Indeed, in dataspaces, such as the Gaia-X Data Space Community (GAIA-X, n.d.), data exchanges between a broad range of organizations are made available for economic and societal purposes, while control and ownership are retained by companies and individuals generating such data. It would be worthwhile to explore if and how MNEs' participation in dataspaces can also help to improve the environmental sustainability of their internal operations and GVCs. Work in this realm could further our understanding of how MNEs develop and diffuse green FSAs within networks, especially if complemented with recent conceptual developments within internalization theory (Banalieva & Dhanaraj, 2019). This would also introduce more theoretical rigor, as our review highlights the paucity of conceptual work, especially on environmental sustainability and digitalization.

Moreover, our review suggests that the realization of environmental sustainability necessitates multi-stakeholder partnerships. Extant research highlights how MNEs engage with (local) governments to provide digital green solutions, for example in smart cities. Yet, governments are likely to be sensitive to the risks tied to data sharing, for instance from IoT devices, even if this can contribute to reducing CO2 emissions or increasing circularity.

Therefore, a promising area of research is how MNEs interact and negotiate with governments concerning the trade-off between the need for data sharing for environmental sustainability versus data privacy and protection. MNEs may also collaborate with non-profit organizations to develop and deploy digital solutions that tackle environmental issues. Further studies should explore to what extent such cross-sector partnerships can improve the communication and relationships between digital MNE and other external stakeholders in host countries, such as regulatory authorities and local communities, hence helping MNEs to overcome the 'liability of disruption' (Marano et al., 2020). In addition, despite the rising environmental concerns around digital technologies, there exist no standardized measurements of their environmental footprint, which makes it difficult to gauge their net benefits and drawbacks. Digital MNEs can play a key role here, as policymakers require their technical and industrial expertise to design tractable standards and measurements. This has led, for example, to the creation of the 'European Green Digital Coalition', which consists of digital MNEs that have pledged to support the EU's twin transition by investing in green technologies, developing methods and tools to measure the environmental impact of digital technologies, and co-creating recommendations and guidelines for green digitalization (Signatory Countries, 2021). Fruitful research areas would thus consist in scrutinizing how MNEs measure and communicate to stakeholders the environmental footprint of digital technologies, and how they cooperate with policymakers and civil society to develop common standards and measurements, in order to appraise and monitor digital technologies' environmental impact. Relatedly, MNEs have started leveraging IoT, big data and AI also to encourage pro-environmental behavior among their corporate and individual customers (e.g., Enel X, n.d.; Schneider Electric, 2022). Studying how digital technology MNEs harness IoT, BDA and AI to encourage customers' pro-environmental behavior and practices across different institutional contexts would therefore be interesting. Particularly with regard to the circular economy, observers have noted that increasing energy efficiency, product longevity, recovery and recycling requires stronger interrelationships between firms and their individual customers (Atos, 2019). Hence, further studies could investigate whether novel digital technologies, especially IoT and mobile apps, might help strengthen this relationship to

foster circularity, and how MNEs providing and/or deploying these technologies can recombine their digital FSAs with customers' local assets.

2.5. Implications and concluding remarks

Our article shows that there is growing, multidisciplinary attention for MNEs, I4.0 and sustainability. It summarized the 'state of the art', by distinguishing the attention assigned to diverse novel digital technologies, to their deployment by MNEs in different locations, and to the diverse social, economic and environmental implications. We find that scholars from various disciplines have devoted attention to the question of how the implementation of digital technologies by MNEs impacts social, economic and environmental sustainability. This attention is certainly warranted, given the critical role, for better or for worse, MNEs play in the world. We also note, however, that this multidisciplinary research has not at all lived up to its potential yet, with respect to the specific and potentially highly significant implications of novel digital technologies for the multiple sustainability issues that MNEs are confronted with. We therefore proposed many promising research directions for scholars interested in extending our knowledge on MNEs, I4.0 and sustainability.

Our review has several important implications for researchers, practitioners and policymakers alike. For researchers, our review highlights a lack of focus on specific digital technologies and concrete opportunities to increase the theoretical rigor with which they tackle the topic. More specifically, scholars need to move on from general perspectives and reflections on how I4.0 impacts the global business environment, including sustainability, towards empirical research that details the actual effects of different technologies, and how these relate to the motivations and actions of MNEs. For practitioners, our review underscores the central role of MNEs as agents of change in the transition towards a sustainable digitalization. As such, we submit that managers must recognize this responsibility and rethink the essence of the MNE. Finally, our review demonstrates that the institutional environment can both enable and constrain the ability of MNEs to bring about positive change through the deployment of digital technologies. Interestingly, since policymakers are already exploring the links between digitalization, resilience, 'human-centric' innovation and sustainability ('Industry 5.0'), our

field can truly contribute to such an agenda by rapidly moving forward in the directions suggested in this article.