The economics of pension reforms

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The Economics of Pension Reforms

The financial sustainability of pension arrangements and the resulting need for reform are high on the agendas of national policymakers as well as of international organizations. Indeed, many countries have undertaken, or plan to undertake, measures to enhance the sustainability of their pension arrangements. This dissertation discusses and investigates several topics on pension reforms. First, it presents and discusses a new and comprehensive dataset of pension reforms throughout the world.
It further empirically and theoretically explores the determinants of pension reform measures. We find substantial evidence that the current state of the economy drives the likelihood of reform measures, and not the expected long term demographic developments. Furthermore, we find that these determinants differ between OECD and non-OECD countries. Moreover, it empirically investigates the effects of pension systems and their reforms on voluntary household savings.

Ron van Maurik (1985) holds a MSc in Economics (2012) from the University of Amsterdam. In September 2013, as a PhD student he joined the Macroeconomics and International Economics group at that same institution where he worked under the supervision of Prof. Dr. Roel Beetsma and Dr. Ward Romp.

The Economics of Pension Reforms Ronnie van Maurik

University of Amsterdam

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The Economics of Pension Reforms

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The greatest struggle of my generation is that our way has already been paved for us. Our dreams and destinations have already been decided upon. We go to school to go to university and we go to university to become doctors, bankers or lawyers. Having a successful career is what gives us praise, and indeed, for a long time, above living happily ever after I wanted to be successful. I was pursuing broken dreams build on broken promises. The revolution of my generation is not an external one, it is an internal one: to grow up and hold onto our childhood dreams; to unlearn what we have been taught to be true; to set sail and go against all expectations; to show the world what is like to be one *with* all, and not one *against* all.

In September 2013, in an attempt to be successful, I started as a PhD-student under the supervision of Roel Beetsma and Ward Romp. In the years that followed I have been working on the book that is now materialized in front of you. Writing this dissertation and the processes I have gone through in the meantime have not always been easy, and it would have been even harder without certain people in my life. A simple acknowledgement as this does not give them all the credits they are worthy of, but it is a start.

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In February 2015, I accidently hit myself on the head with mountaineering equipment and for the next eight months I was surrounded by a dense layer of fog. I (un)learned a lot about myself during that time. As the fog lifted, I began to see the world differently than before. A concussion “shakes” you straight, that is for sure. It was time to restore what was mine, and to become the man I wanted to be. Admittedly, for a while I walked around doubting whether to continue or quit my PhD. Fortunately, I did not quit, but instead used it as a tool for personal growth. Eventually, I “remembered” that circumstances do not matter, but that only your state of being matters. With this in mind and spirit I changed my perspective on things, and work would never be the same again.

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Ron van Maurik

June, 2017

Authors

Description of a new and comprehensive dataset of pension reform measures

Authors: R. van Maurik, R. Beetsma, and W. Romp.

The determinants of pension reform measures: theory and empirical evidence for the OECD

Authors: R. van Maurik, R. Beetsma, and W. Romp.

What drives pension reform measures? A comparative analysis between OECD and non-OECD countries

Author: R. van Maurik

The effects of pension arrangements and their reforms on voluntary household savings

Author: R. van Maurik

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Chapter 1

Introduction and overview

1.1. The background

The word “crisis” seems to be catchy. I guess the word “crisis” spelled in bold capital letters sells newspapers. Besides the terms “banking crisis” and “financial crisis” we have seen many headlines including the themes “pension crisis” and “aging crisis”. The aging crisis and ensuing pension crisis do not come as a surprise and are actually the result of good news: many of us are living longer, significantly longer. Better still, today’s elderly are overall healthier and more vital. To make a comparison; I remember my grandmother as a lady with geraniums behind her window, and from her chair she peeked through her window down on the street and kept an eye out for everything that moved. Maybe my imagination is running away with me but I am pretty sure she also had a side view mirrors attached to the window’s frame through which she observed the other side of the street without moving a muscle in her neck. In between all the excitement she witnessed, she read the obituaries to see who had finished the race the days before. However, if I look at today’s elderly, I do not encounter many of such clichés. Instead, some of these retirees are so vital the word “retiree” does not apply to them: they do not seem to be getting tired at all.

How come such good news is rarely celebrated, but is, instead, often viewed with concern, especially by those who are still young and are faced with even higher longevity expectations? This is because many countries have social security systems which are not dynamic and do not adapt to the economic and demographic changes. This way, an aging population entails increasing costs for current and future working generations who are paying for current retirees. Let us *illustrate* the usual social security system and how demographic changes have led to a predicament, or, if you will, a pension or aging crisis:


The usual retirement party is financed by three pillars of the old-age social security system.
A first pillar, which in most countries is financed on a Pay-As-You-Go basis, meaning that the current labour force pays for current pension benefits.
A second pillar, which is financed on a Fully-Funded basis, meaning that employees can contribute to an occupational pension arrangement which pays out upon retirement.
A third pillar, which consists of personal pension savings and/or life insurances.
The main predicament presents itself in the first pillar. An aging population and decreased fertility rate led to an increase of the retirees to workers ratio.
This implies that relatively few workers bear the burden of relatively many pension payouts. Over time, this has become unstable.

As a respond to economic and demographic changes, social security systems, all over the world, have been or are being reformed. Many countries have legislated and/or implemented measures to enhance the sustainability of their social security system. The main theme of this thesis revolves around such reforms. More specifically, this thesis reviews the trends and facts of pension reforms, it investigates the main political and macroeconomic drivers of pension reforms, it explores whether these drivers differ between OECD and non-OECD countries, and it investigates the consequences of such reforms on voluntary household savings.

1.2. Overview

This dissertation investigates in a number of ways the origins and consequences of pension reforms. In this subsection, we discuss the overview of this thesis. Chapter 2 serves as an introduction to the main theme of this thesis: pension reforms. In that chapter, we present and discuss a new and comprehensive dataset of pension reforms throughout the world. This dataset will be used in all subsequent chapters. Chapter 3 empirically explores the determinants of pension reforms based on real-time information available at the moments of reform. In chapter 4 we investigate whether these determinants differ between OECD and non-OECD countries. Chapter 5 empirically investigates the effects of pension systems and their reforms on voluntary household savings. Although the chapters are linked with one another, they are all self-contained and can therefore be read separately from other chapters.

Chapter 2, entitled “Description of a new and comprehensive dataset of pension reforms”, presents and discusses a new and comprehensive dataset of pension reforms measures over a long time span and a broad set of countries. The reform measures include the substantial institutional reform measures, as well as the smaller incremental reform measures. We have gathered data on institutional reform measures for all countries for the time span 1980 – 2013. For the incremental pension reform measures, we have gathered data for 151 countries, most of them covering the time span 1995 – 2013. For the first 24 OECD members, we have data on both institutional and incremental reform measures over the period 1970 – 2013. Further, we discuss some trends in both the institutional and the incremental reform measures. Regarding the former, the most evident trend has been the adoption of fully funded – defined contribution (FF-DC) schemes. During the period 1980 – 2013, a total of 38 countries have added a private second pillar, either as a supplement to or a substitute for the first pillar. Furthermore, the most salient trends of incremental reform measures took place in

the OECD. In the years preceding the millennium shift, 1995 - 1999, there were a substantial number of reform measures expanding pension arrangements. However, from our data it seems that the recent global economic and financial crisis has given a boost to reform measures aimed at reducing the generosity of pension arrangements. For the non-OECD countries in our dataset, trends are not so clearly visible.

Chapter 3, entitled "The determinants of pension reform measures: theory and empirical evidence for the OECD", we empirically explore the determinants of pension reform measures in OECD countries based on real-time information available at the moments the measures were taken. We distinguish three reform regimes: a regime characterized by reforms that expand pension arrangements through coverage and eligibility, a regime characterized by contractionary reforms aimed at increasing financial and fiscal sustainability and stimulating work incentives, and a regime that combines expansionary and contractionary reforms. Going from the earlier to the later part of our sample, expansionary reform activity falls, while contractionary and simultaneous expansionary and contractionary activity increases. Reform activity responds primarily to the contemporaneous budgetary and economic situation. Only for the expansionary regime we find that responses to these developments change over time, with the negative responses to increased ageing projections, unemployment and the deficit becoming stronger and the positive responses to GDP growth also becoming stronger. As pension reforms are primarily aimed at the longer run, the substantial role of the current state of the public budget and the economy is remarkable. Furthermore, we present a simple theoretical framework that can simultaneously explain why the cyclical state of the economy can trigger adjustments in pension generosity, while projected changes in the old-age dependency ratio cannot.

Chapter 4, entitled "What drives pension reforms? A comparative analysis between OECD and non-OECD countries", extends the empirical analysis in chapter 3, although it can be read separately. In this chapter, we investigate which factors determine the likelihood of pension reform measures for a total of 151 countries over the period 1995 - 2013. We distinguish the same three reform regimes as in Chapter 3. We find that the factors driving pension reform regimes are different for the OECD and the non-OECD countries. For the OECD countries, the current state of the public budget and the economy play a substantial role in determining reform decisions. For the non-OECD countries, an increase in the projected old age dependency ratio lowers the likelihood of contractionary reform. We hypothesize that this is because many of these countries still have rather underdeveloped pension systems, whilst the need for pension system development increases as longevity

expectations rise. Also, underdeveloped systems make it difficult to impose contractionary measures.

Chapter 5, entitled “The effects of pensions arrangements and their reforms on voluntary household savings”, empirically investigates the effects of pension arrangements and pension reform measures on voluntary household savings. We apply a panel of 19 OECD countries over the time period from 1970 till 2013. We distinguish between contemporaneous changes in pension arrangements and the legislation of pension reform measures which are expected to affect the pension system in the future. We use a unique comprehensive dataset of pension reform measures in which we distinguish between different reform types. According their expected effect (positive, ambiguous, or negative) on voluntary household savings, we categorize pension reform types into reform regimes, namely a positive, ambiguous, or negative reform regime. For the reform regime that is expected to positively affect voluntary household savings we find some evidence that it indeed does so. This result is, however, not very robust to variations of the regression specification. Further, we find evidence that reforms with an expected negative or ambiguous effect have a non-linear effect on voluntary household savings. The magnitude of their effect depends on the replacement rate. If the replacement rate is high (low) we find that such a reform has a relatively higher (lower) effect on savings. Furthermore, when including lags of the pension reform measures, we find that reforms with an expected negative effect on voluntary household savings indeed have a negative effect. This finding is robust to variations of the regression specification, but not to changes in the sample period. Moreover, we find very robust evidence that the mandatory replacement rate negatively affects the voluntary household savings rate. We find no statistical significant evidence that the statutory retirement age has an effect on voluntary household savings.

Chapter 2

Description of a new and comprehensive dataset of pension reform measures

2.1. Introduction

Demographic developments leading to ageing populations have been putting great strains on retirement provision in large parts of the world. Indeed, in recent decades, many countries have conducted pension reforms of some kind. A number of reform measures have been fundamental, leading to substantial institutional changes. However, most reform measures have been incremental or parametric.

This paper describes and discusses a newly constructed, comprehensive dataset of pension reform measures that have been conducted throughout the world in the past decades. We have gathered information on both *institutional* and *incremental* pension reform measures. For the *institutional* reform measures, we have compiled a data set covering all countries for the time-span from 1980 till 2013. Over this period 1980 – 2013 we have recorded 61 institutional reform measures throughout the world. For the first 24 OECD members, we have gathered data on institutional reform measures for the period 1970 – 2013. Data on *incremental* reform measures has been gathered for a total of 151 countries, covering the time span 1995 – 2013, except for the first 24 OECD members, which cover again the time span 1970 – 2013. To the best our knowledge this is the most comprehensive dataset on pension reform measures constructed to date. Previous datasets cover a shorter time span or a smaller set of countries. Furthermore, most other datasets focus only on institutional reforms and neglect the smaller incremental reforms.

The remainder of this paper is as follows. Section 2.2 discusses some existing datasets on pension reforms. Section 2.3 describes the new dataset. Section 2.4 provides an overview of the trends in both the institutional and incremental reforms carried out throughout the

world. Section 2.5 summarizes the main trends and discusses the potential uses of this dataset.

2.2. Comparison with existing datasets

There exist a substantial number of descriptive analyses of pension reform measures in a specific country or region. For example, Edwars (1998) describes the pension reform in Chile in the beginning of the 1980s, while Hirose (2011) discusses the pension reforms that took place in Central and Eastern Europe after the fall of the Iron Curtain. However, to the best of our knowledge, comprehensive datasets classifying different pension reform measures in a comparable way are rather scarce. Institutional reform measures tend to be relatively well documented, while some papers provide a rather comprehensive overview of such reforms. Smaller, incremental reform measures are not so well documented.

The Pension watch (2014) provides the 'HelpAge International Pension Watch Database' comprised of large pension reform packages. The dataset extends far back in time and covers many countries. However, it is not complete, while furthermore it does not clearly distinguish between institutional and incremental reforms. Schwarz and Demirguc-Kunt (1999) provide an overview of major institutional reforms (as well as smaller, incremental reforms). However, they only cover the period 1992 – 1998. While this period is relatively short, it has been turbulent in terms of structural reforms. Holzmann *et al.* (2004) provide an overview of the main reforms in Europe. The Wold Bank (2006) gives an overview of all the reforms that have been conducted with World Bank assistance. Further, there exist overviews of specific types of reforms, such as the privatization of the second pillar (for example, Orenstein, 2013).

Comparable datasets on incremental reform measures are relatively scarce. The most comprehensive dataset that of the OECD (2013), which regularly updates its overview of pension reforms that have taken place within the OECD. Hence, it covers only a limited group of countries, while it does not cover a broad timespan: comprehensive data on pension reforms are available only from 2004 and onwards.

2.3. The construction of our dataset

This section describes the construction of our dataset on institutional and incremental reform measures. The full set of countries included in our data is listed in Appendix 2.A.1. A

substantial amount of the input is obtained from the International Social Security Association (ISSA, 2014), which provides well-documented information on social security reforms based on press releases. In addition, we make use of information from the International Labor Organization (ILO, 2014), which provides information on the legislation of old-age social security reforms.

For the reform measure date, we always take the year in which the reform was officially legislated, which may be different from the year in which the implementation starts. The main reason for is that in our further research we want to focus on the factors that triggers pension reform measures. Hence, this requires us to focus on the information that is available at the moment that the reform is enacted. In addition, the implementation date often cannot be uniquely determined, because a reform may take place in a number of steps. This is often the case for an increase in the statutory retirement age, which may even take decades to fully materialize.

We do not include all reform measures on old-age social security, because some countries have a history of numerous negligible reforms. Whether a reform can be considered negligible may be somewhat subjective. However, we try to apply consistent sets of selection criteria in this regard.

2.3.1. Institutional reforms

Data on institutional reform measures are gathered from Schwarz and Demirguc-Kunt (1999), Holzmann *et al.* (2003), the World Bank (2006), Holzmann (2012), and various other sources. The full set of institutional reforms can be found in Appendix 2.A.2.

Institutional reform measures are reforms that bring about substantial change in the underlying institutional structure of the retirement scheme. We focus only on first- and second-pillar pension reform measures. First-pillar pensions are public pensions. These are mainly intended to smooth consumption and combat poverty in old age, usually by guaranteeing a minimum pension upon retirement. Most of the first-pillar pension schemes are of the pay-as-you-go (PAYG) type, meaning that in any period the workers in that period pay the pensions of those who are retired in that period. The second-pillar pension are the occupational pensions linked to being an employee. In most countries, these pensions come on top of the first pillar pensions. A common institutional reform measure in the past decades has been the introduction of a fully-funded defined contribution (FF-DC) scheme, either to complement the existing first pillar or to replace it. With an FF-DC scheme, the second pillar takes the form of an individual retirement account that accumulates through contributions

during one's working life and that can be drawn upon during retirement. The other major type of fully-funded system is a fully-funded defined-benefit (FF-DB) system, in which the benefits after retirement are given.

Our criteria to select institutional reform measures are:

- An institutional change to the first pillar. For example, in recent decades a number of European countries shifted from a PAYG-DB to a PAYG notional defined contribution (NDC) scheme in the first pillar.
- The adoption of a second pillar when none exists before. The second pillar can be public or private. It can be added as a supplement pillar to an already existing primary first pillar, it can substitute the first pillar partly, or it can replace the first pillar entirely, as happened with the full privatization in Chile in 1981.
- Nationalization of the second pillar. In recent years, nationalization of the second pillar has occurred in a number of countries. Some countries, such as Hungary, have fully nationalized the second pillar and used the accumulated funds to plug the hole in the public budget. Other countries have conducted a partial nationalization or allowed for voluntary transfers from the second to the first pillar.
- The adoption or elimination of provident funds (PF). A PF is an occupational pension fund usually governed by the state. We categorize such reform measures as belonging to the second pillar, because provident funds only exist for employees or for certain sectors. Quite a few East Asian and African countries used to have, or still have, a PF. Some countries, such as Nigeria in 1994, have shifted to a pure PAYG system which does not hold any assets. Papua New Guinea has shifted from a PF to a privately-owned FF-DC scheme.

As a result, we distinguish between 12 types of institutional reform measures:

1. A transition from PAYG-DB to a FF-DC as the primary system.
2. A transition from PAYG-DB to a FF-DB as the primary system.
3. Supplementing an existing primary first pillar with a FF-DC system.
4. Supplementing an existing primary first pillar with a FF-DB system.
5. Supplementing an existing primary second pillar with a first pillar.
6. A transition from a PAYG-DB scheme to a PAYG - NDC as the primary scheme.

7. Nationalizing the second pillar.
8. A transition from FF-DB to FF-DC.
9. A transition from FF-DC to PAYG-DB as the primary system.
10. Adopting a PF as the primary system.
11. A shift from a PF to PAYG as the primary system.
12. A shift from PF to FF-DC as the primary system.

2.3.2. Data on incremental reform measures

For the incremental reform measures our main data sources are the OECD (2012, 2013) and the International Social Security Association (2014) for the period 1995 – 2013, while for the period 1970 - 1994 our main data source is the International Labor Organization (2014).

Incremental reform measures are reforms to existing pension schemes. There exists a broad array of different incremental reform measures. The incremental reform measures included in our dataset meet one or more of the following criteria:

- Such reform measures affect the entire population. For example, Greece in 2012 raised the statutory retirement age for a full pension from 65 to 67.
- Ethnical-based reform measures. These reforms often affect a relatively large group in the population. An example is the extension of coverage of retirement provision to immigrants. For example, in 1986 Spain extended coverage of social security to immigrants and their children.
- Gender-based reform measures. Examples are the equalization of pension rights between men and women. Obviously, such a reform affects a very substantial part of the population. For example, in 1997 Belgium decided to gradually align the retirement age of women with the male retirement age of 65.
- Reforms affecting the entire public sector / all civil servants. For example, in 2010 France decided to gradually increase the pension contribution rates of civil servants from 7.85% to 10.55% (by 2020).
- Reforms affecting the entire private sector. An example are changes in the regulation of pension fund asset portfolios. For example, in 2006 Turkey relaxed the investment restrictions on pension funds by reducing the minimum percentage of assets to be invested in government bonds holdings and by allowing for investments in more popular investment vehicles. Another example concerns new restrictions on

mandatory private pensions, such as in 2009 in Switzerland when it reduced the minimum rate of return on private pensions.

- Reform measures affecting an entire age group. For example, in 1982 Denmark allowed involuntarily unemployed individuals in the age category of 55 – 60 years to apply for a pension benefit instead of an unemployment benefit.

We do not include in our dataset the following reform measures:

- Reforms that only affect a very specific sector and that do not lead to externalities to other sectors. For example, in 1986 Portugal lowered the retirement age for seafarers engaged in fishing activities to 55 years.
- We neglect reforms at the subnational level. In some countries, the US probably being the best example, there exists (semi)-independent legislation on retirement provision at the subnational level.

As a result, we classify the various incremental reform measures according to their objective, which following for example the OECD (2012, pp. 35-44) by and large are:

1. Coverage.
2. Generosity and adequacy.
3. Financial and fiscal sustainability.
4. Work incentives.
5. Administrative efficiency.
6. Internal security.
7. Pension fund usage for external security.
8. Increasing labour mobility.
9. Equalization of pension rights of men and women.

Importantly, we classify reform measures such that all the reforms in the areas of "Coverage" or "Generosity and adequacy" go into the direction of an expansion of the pension system, while all the reforms in the areas of "Financial and fiscal sustainability" and "Work incentives" go into the direction of contracting the pension system. Nearly each one of the above objectives gives rise to several sub-categories. These sub-categories refer to the means

used to attain the objective. For example, for the objective of 'Generosity and adequacy' we construct the following subdivision of possible measures:

1. Increase benefits.
   1.1. Increase/secure basic pension.
   1.2. Increase indexation rate.
   1.3. Provide additional (to regular) pension benefits.
2. Decrease retirement age.
   2.1. Decrease statutory retirement age.
   2.4. Decrease optional retirement age.
3. Tax favourable policies.
4. Others.

As another example, the objective of 'Financial and fiscal sustainability' comprises the following possible measures:

1. Increase contribution rate.
2. Decrease benefits.
   2.1. Decrease basic pension.
   2.2. Decrease indexation rate.
3. Increase statutory retirement age.
4. Elimination of other old-age benefits.
5. Tax increasing policies.

'Others' covers anything that cannot be categorized under one of the other subcategories. Appendix 2.A.3 contains a complete and detailed list of all the possible measures as well as further explanation where necessary.

2.4. Pension reform measure trends

This section provides an overview of the pension reform measure trends that have taken place at the global level as well as at the regional level. We discuss first the trends in institutional reform measures and then those in the incremental reform measures.

2.4.1. Institutional reform measure trends

For a long time after World War II a PAYG-DB scheme was the norm. However, demographic changes have caused the number of beneficiaries to grow faster than the number of contributors and the prospect for the coming decades is a substantial further increase in the old-age dependency ratio. Of the various options, lower benefits are often not viable, given the need to guarantee a subsistence income for the elderly, while further increases in the contribution rate lead to costly distortions to the economy, given that they benefit the elderly rather than the workers themselves. Hence, policymakers have come up with other solutions, such as the switch from a single-pillar pension scheme to a multi-pillar pension scheme.

2.4.1.1. The adoption of a private second pillar

The most salient institutional reform measure trend in recent decades has been the introduction of fully-funded private second pillars. Table 2.1 provides a record of the countries that did this in the period 1980 – 2013. We observe that in this period a total of 38 countries introduced a private second pillar, either to substitute for or to complement the first pillar. Most of these are FF-DC schemes. In 1994 the World Bank published its famous book "Averting the Old Age Crisis", in which it advocated the adoption of multi-pillar pension systems. Arguably, the book had substantial influence on pension system policy in Latin America, where some countries added a private second pillar to their PAYG first pillar and others even substituted their first pillar with a private second pillar. This happened in Mexico, Bolivia and El Salvador in the 1990s. Towards the end of the previous millennium this development sparked over to the Central and Eastern Europe (CEE) countries. In the period 1997 – 2004 a total of 13 Eastern European and former Soviet countries introduced a private second pension pillar.

2.4.1.2. Nationalization of the second pillar

Recently, a number of countries have partly or completely nationalized their private second pillar. In 2007, forced by budgetary stress Argentina was the first to do so. It was followed by Bolivia in 2010. Shortly after, under budgetary pressure from the financial and economic crisis, a number of CEE countries have done the same. In 2010 Hungary was nearly declared bankrupt and needed to reduce its deficit. It responded by completely nationalizing its second pillar. Poland, the Czech Republic and Slovakia followed suit by partly privatizing their second pillar. Table 2.2 provides a complete summary.

2.4.1.3. A switch from PAYG-DB to PAYG-NDC

In recent decades, a number of countries have switched from a PAYG-DB scheme to a PAYG-NDC scheme (see Table 2.3 for an overview). This is a publicly administered collective DC system based on PAYG principles. The advantage of a PAYG-NDC scheme is that it is actuarially fairer than a conventional PAYG system, because participants contribute to a (fictitious) individual account, which keeps track of a participant's contributions and grosses these up by a fictitious return. The scheme is PAYG, because the benefits paid to the current retirees are financed entirely by current workers. Hence, there is no accumulation of savings.

In 1994, Sweden was the first country to legislate such a system. It replaced its traditional PAYG-DB system by an earnings-related PAYG-NDC system. Benefits paid to retirees are a function of a basic pension, contributions made during working life, current economic conditions and current longevity prospects. By linking benefit levels to longevity prospects the scheme is made more dynamic than the traditional PAYG-DB systems, because it allows for automatic parametric adjustments to the scheme. The rate of return paid on the scheme is not based on financial market performance, but instead on the performance of the economy, which makes the scheme more resilient to major shocks (Palmer 2000).[1] So far, a total of nine countries have introduced a PAYG-NDC scheme. Most of these systems still contain a DB element because they provide a basic minimum pension to guarantee an adequate level of old-age income.

2.4.1.4. From PF to PAYG-DB or FF-DC

In recent decades some countries have supplemented their provident fund or replaced it with another arrangement as the primary scheme, most commonly a public PAYG-DB system or a private FF-DC. Overall, provident funds have decreased in popularity. A possible explanation may be that they are relatively prone to corruption, because they hold assets, whereas traditional PAYG-DB systems do not. Table 2.4 provides an overview of the reforms.

[1] For a more thorough overview on the Swedish PAYG-NDC system, its framework and issues, we refer the reader to Palmer (2000).

2.4.2. Incremental reform measure trends

This subsection discusses trends in incremental reform measures.[2] We do this for three subsets of our full dataset. First, we look at the full set of countries, 24 in total, that were OECD member over the entire sample period 1970 – 2013 (exceptions are Australia which joined the OECD in 1971 and New Zealand which joined in 1973). Next, we explore the full set of 34 OECD countries over the period 1995 – 2013. Finally, we turn to the non-OECD countries over the period 1995 - 2013.

2.4.2.1. First 24 OECD members over the period 1970 - 2013

Figure 2.1 summarizes for this subsample by year the total number of incremental reforms of each type. To read the figure, take as an example the reforms in the area of "Coverage". In 1970 a total of three reforms where legislated in this area. These reforms could have been enacted by different countries or even all by the same country. The same country could also have enacted reforms in more than one area.

A number of observations stand out from Figure 2.1. First, we observe that incremental reforms were relatively uncommon in general during the 1970s and early 1980s. The average annual number of reforms in the 1980s exceed that in the 1970s and it increased further in the 1990s. During the 1990s pension schemes generally became more of a topic of discussion and as of the mid-1990s we observe a further increase in the annual average number of reforms. Up to the early 80s, the far majority of the reforms were in the areas of "coverage" and "generosity and adequacy". From the mid-eighties and on more diversity emerged in the types of incremental reforms. In particular, reforms in the area of "Financial and fiscal sustainability" became more important. This is also the case for reforms in the area of "Administrative efficiency", often done by increasing administrative supervision by the government, and "Internal security", mainly done by strengthening portfolio or systemic regulation. Finally, since the early / mid – nineties, measures to increase "Work incentives" have become more prevalent.

To obtain a clearer picture of the main reform items "Generosity and adequacy" and "Financial and fiscal sustainability", in Figure 2.2 we depict by year the number of reforms in

[2] To the extent that our narrative resources indicate that some institutional reform includes measures that expand or contract the pension system (or other measures included in the set of incremental reforms) the institutional reform will also be included in the set of incremental reforms. However, information for example of the format "a shift from PAYG to FF-CC" does not provide any indication of an expansion or a contraction of the system and, hence, will not lead to the institutional reform being included in the set of incremental reforms.

these areas. It is noteworthy that reforms in the area "Generosity and adequacy" peaked during the height of the dot.com bubble at the end of the nineties / beginning of the 2000s, while between the peak in the mid-nineties and the global economic and financial crisis, there was a downward trend in reforms in the area of "Financial and fiscal sustainability". Reform measures in the latter area increased sharply in the aftermath of the global economic and financial crisis, with a peak in 2011.

2.4.2.2. The full sample of 34 OECD countries over the period 1995-2013

Figure 2.3 should be read in the same way as Figure 2.1. It is not easy to observe clear trends. There is some indication that the total number of reforms that make the system more generous, i.e. the reforms in the area of "Coverage" and in the area of "Generosity and Adequacy", falls on average after the peak year 2004. Clearer is the observation that the number of reforms in the area of "Financial and fiscal sustainability" is higher during the years 2009 – 2012 than before, which may be a direct consequence of the deterioration of the public budgets following the global economic and financial crisis. The most popular measures during this period are an increase in the statutory retirement age and an increase in the contribution rate.

We further observe quite a substantial number of reforms for the purpose of "Internal security" shortly since the onset of the global economic and financial crisis. In 2009, we observe a total of 13 legislated reforms that promote "Internal security". These are reforms aimed at more portfolio regulation or more systemic regulation.

2.4.2.3. Non-OECD countries over the period 1995-2013

This subsample consists of a total of 117 countries. Figure 2.4 depicts the numbers of incremental reform measures in the various areas over the period 1995-2013. We make the following observations. First, in contrast to the OECD samples, we observe some decline in the total number of reform measures after 2005. Second, the total number of expansionary reform measures, i.e. measures in the areas of "Coverage" and "Generosity and adequacy" seems to fall as of that year. The tendency to expand systems until the middle of the first decade of this century is likely explained by the fact that many poorer countries were still in the process of building up decent old-age retirement systems. Unlike for the OECD countries, we do not see an increase in the number of contractionary reforms, i.e. reforms in the areas of "Financial and fiscal sustainability" and "Work incentives" in the aftermath of the global economic and financial crisis, possibly because the non-OECD countries were on average hit

less severely by the crisis, while their demographic prospects are more optimistic and their pension arrangements are still rather meagre. Figure 2.5 separately shows the number of reforms in the three aforementioned major areas.

2.4.3. Regional differences

To acquire some further insight into the pattern of reform measures, we split the subsample of non-OECD countries over the period 1995-2013 further into geographical areas. Overall, we thus have over the period 1995 – 2013 data on incremental reform measures for the following dissection of the overall country sample:

- 34 OECD countries
- 18 European non-OECD countries
- 37 African countries
- 27 Latin American countries (excluding Chile and Mexico, which are OECD member)
- 35 countries from Asia and Oceania (excluding Israel and Turkey, which are OECD members).

Figure 2.6 shows the total number of incremental reform measures that have taken place in a given year by group or region. For example, in the year 1995 the OECD enacted a total of 32 incremental reforms.

We will refer to reform measuress in the areas of “Coverage” and “Generosity and adequacy” as “expansionary reforms”. Hence, the number of expansionary reforms is the sum of the numbers of reforms in the areas of “Coverage” and “Generosity and adequacy”. Reforms in the areas of “Financial and fiscal sustainability” and “Work incentives” will be referred to as “Contracting reforms”. Hence, the number of contracting reforms is the sum of the reforms in these two areas. Figures 2.7 and 2.8 depict the numbers of expansionary, respectively contracting, reforms per year for the various country groups and regions, divided by the number of countries in the respective groups or regions. We average the numbers of reforms to be better able to compare reform intensities, because the country groups and regions differ in size. As an example, we observe from Figure 2.7 an average number of expansionary reforms of 0.353 in 1995 for the Latin-America region. This number equals a number of 11 expansionary reforms legislated in 1995 in Latin-America divided by the number (27) of

countries in Latin America. We observe that in most of the years the OECD group features the highest intensity of expansionary and contracting reforms. In particular, since the start of the recent global economic and financial crisis, the intensity of contracting reforms was relatively high in the OECD compared to other groups or regions, while Latin America takes a comfortable second positions. The number of expansionary reforms in the OECD seems to have dropped since 2005 compared to the decade before. The other regions, except for non-OECD Europe, on average exhibit less expansionary reform activity since the start of the crisis then in the years before.

2.5. Conclusion

This paper has discussed the construction of a new, comprehensive dataset of pension reform measures throughout the world. More specifically, the dataset comprises a subsample consisting of major, institutional reform measures for the first 24 OECD members over the period 1970 – 2013, a subsample consisting of incremental reform measures in the first 24 OECD members over the period 1970 – 2013 and a subsample consisting of incremental reform measures in 151 countries over the period 1995 – 2013. For the latter subsample, we explore separately trends in the groups of OECD and non-OECD countries, as well as for a further split of the latter group into regions.

We discuss some trends in both the institutional and the incremental reform measures. Regarding the former, the most evident trend has been the adoption of an FF-DC schemes. During the period 1980 – 2013, a total of 38 countries have added a private second pillar, either as a supplement to or a substitute for the first pillar. The most salient incremental reform measure trends took place in the OECD. In the years preceding the millennium shift, 1995 - 1999, there were a substantial number of measures expanding pension arrangements. However, the recent global economic and financial crisis has given a boost to reforms aimed at reducing the generosity of pension arrangements. For the non-OECD countries in our dataset, trends are not so clearly visible. For these countries, we do not observe a reduction in the generosity of pension arrangements following the recent crisis. This may be explained by the more favourable demographic prospects of the non-OECD countries and the on average milder effects of the recent global economic and financial crisis. Also, their pension arrangements are far less generous to start with.

The dataset described in this paper can be of very useful for future research on pension reform measures. Theories and empirical evidence on what triggers pension reform

measures is limited and evidence available in existing reports tends to be focused on a limited number of observations (e.g., James and Brooks, 2001, Orenstein, 2005, and Brooks, 2007). Politicians claim to act on the basis of long-term goals, but the limited existing evidence related to what happened after the recent global economic and financial crisis suggests that they may give as much attention to current economic and budgetary situations.

To our knowledge there is no large-scale systematic econometric evidence on the driving forces behind pension reform measures. James and Brooks (2001) are among the few who have conducted empirical research on pension reform measures, but they focus only on the triggers of the reforms towards a FF-DC scheme. Other than that, empirical evidence is to a large extent based on casual observations. For example, as argued by Orenstein (2013), there existed a worldwide policy-paradigm advocating the privatization of pension systems. This dataset can be of assistance in obtaining more systematic econometric evidence about the factors that drive pension reform measures. It can also assist in providing systematic answers to what the consequences of different types of pension reforms are, for example in terms of savings, labour markets and growth.

2.T. Tables

Table 2.1: Private second pillar reform measures

Country	Year of Legislation	Year of Implementation	Reform Basics	Old System Status
Chile	1974	1981	PAYG-DB to FF-DC as primary system	Closed completey
Switzerland	1982	1985	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
United Kingdom	1986	1988	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Seyshelles	1987	1987	adding a FF-DC to existing PF	Fully Functional
Australia	1987	1992	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Peru	1992	1993	adding supplementary FF-DB system to existing primary first pillar	Reformed, open to new workers
Colombia	1993	1994	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Argentina	1994	1994	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Uruguay	1995	1996	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Mexico	1995	1997	PAYG-DB to FF-DC as primary system	Closed completey
Bolivia	1996	1997	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
El Salvador	1996	1998	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
Hungary	1997	1998	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Kazakstan	1997	1998	PAYG-DB to FF-DC as primary system	Closed completey
Denmark	1998	1999	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Bulgaria	1999	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Croatia	1999	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Costa Rica	2000	2001	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Lativa	2000	2001	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Macedonia	2000	2005	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Estonia	2001	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Kososvo	2001	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Dominican Republic	2001	2003	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
Lithuania	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Slovakia	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Ukraine	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Romania	2004	2007	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Uzbekistan	2004	2005	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Taiwan	2004	2005	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Nigeria	2004	2004	PAYG-DB to FF-DC as primary system	Closed completey
Panama	2005	2008	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Norway	2005	2006	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Brunei Darussalam	2008	2010	Adding FF-DC pillar to exisitng PF	Fully Functional
Maldives	2008	2010	Adding upplementary FF-DC system to existing pension scheme	Fully Functional
Ghana	2008	2010	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Brunei	2009	2010	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Armenia	2010	2013	adding supplementary FF-DB system to existing primary first pillar	Reformed, open to new workers
Malawi	2011	2011	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers

Note: main sources are Schwarz and Demirguc-Kunt (1999), Holzmann *et al.* (2003), the World Bank (2006) and Holzmann (2012).

Table 2.2: Nationalization reform measures

Country	Year of Legislation	Year of Implementation	Reform Basics	Old System Status
Argentina	2007	2008	Nationalize Second Pillar	Closed completey
Bolivia	2010	2011	Nationalize Second Pillar	Closed completey
Hungary	2010	2010	Nationalize Second Pillar	Closed completey
Poland	2011	2014	Extension of 1st pillar through partly nationalization of 2nd pillar	Fully Functional
Czech Republic	2011	2013	Extension of 1st pillar through partly nationalization of 2nd pillar	Reformed, open to new workers
Slovakia	2012	2012	Extension of 1st pillar through partly nationalization of 2nd pillar	Fully Functional

Note: main sources are Schwarz and Demirguc-Kunt (1999), Holzmann *et al.* (2003), the World Bank (2006) and Holzmann (2012).

Table 2.3: NDC Reform measures

Country	Year of Legislation	Year of Implementation	Reform Basics	Old System Status
Sweden	1994	1999	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, closed to new workers
Italy	1995	1995	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Latvia	1995	1996	PAYG-DB to PAYG-Notional Account (NDC) as primary system	NA
Poland	1997	1999	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Kyrgyzstan	1997	1998	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Mongolia	1999	2000	PAYG-DB to PAYG-Notional Account (NDC) as primary system	NA
Russian Federation	2001	2002	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Norway	2006	2011	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Egypt	2010	2012	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers

Note: main sources are Schwarz and Demirguc-Kunt (1999), Holzmann *et al.* (2003), the World Bank (2006) and Holzmann (2012).

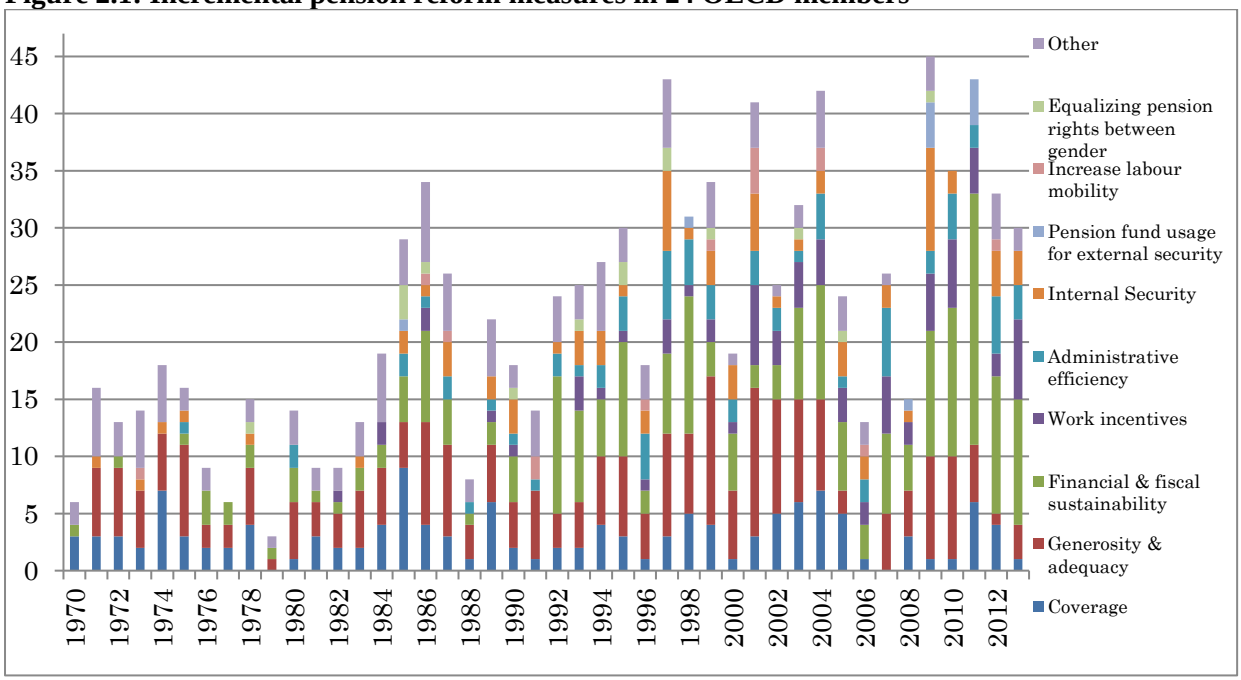
Table 2.4: Provident fund reform measures

Country	Year of Legislation	Year of Implementation	Reform Basics	Old System Status
Seyshelles	1987	1987	adding a FF-DC to existing PF	Fully Functional
Indonesia	1992	1993	Adopting PF next to civil servant pension scheme	Reformed, open to new workers
Nigeria	1993	1994	shiftng from PF to PAYG system as primary scheme	Closed completey
Zambia	1996	1996	shiftng from PF to PAYG system as primary scheme	Closed completey
Tanzania	1997	1998	shiftng from PF to PAYG system as primary scheme	Closed completey
Papua New Guinea	2000	2002	Shifting from PF to FF-DC as primary system	Closed completey
Seyshelles	2005	2005	shiftng from PF to PAYG system as primary scheme	Closed completey
Brunei Darussalam	2008	2010	Adding FF-DC pillar to existing PF	Fully Functional

Note: main sources are Schwarz and Demirguc-Kunt (1999), Holzmann *et al.* (2003), the World Bank (2006) and Holzmann (2012).

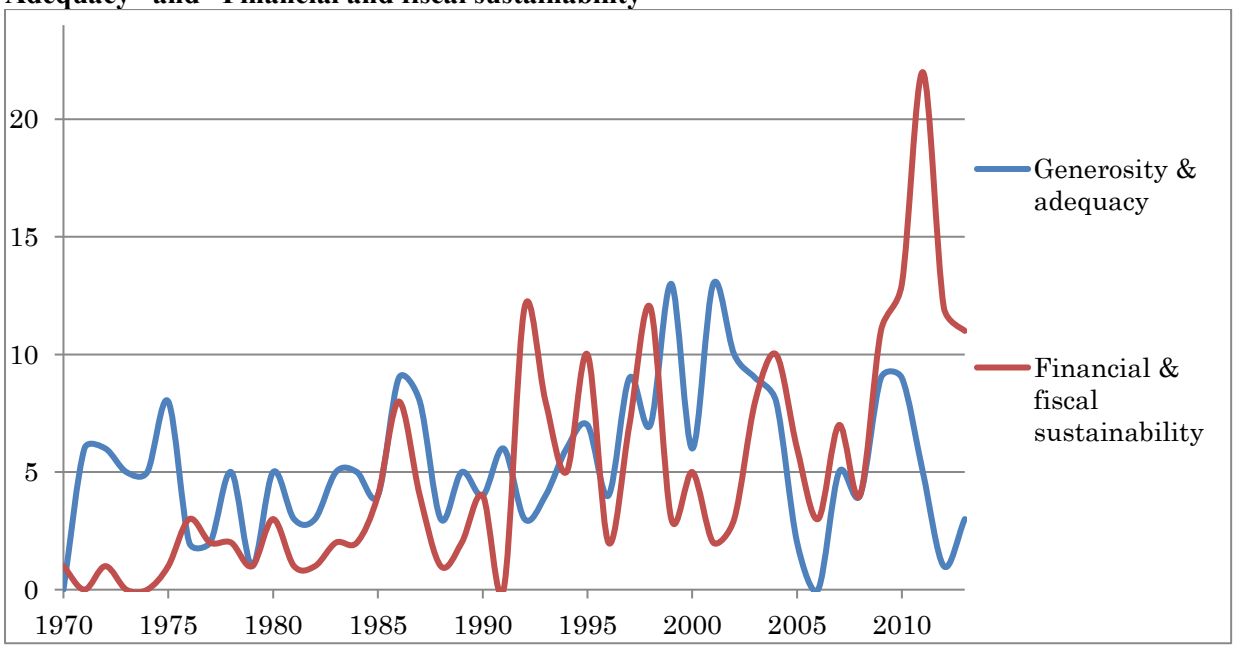
2.F. Figures

Figure 2.1: Incremental pension reform measures in 24 OECD members



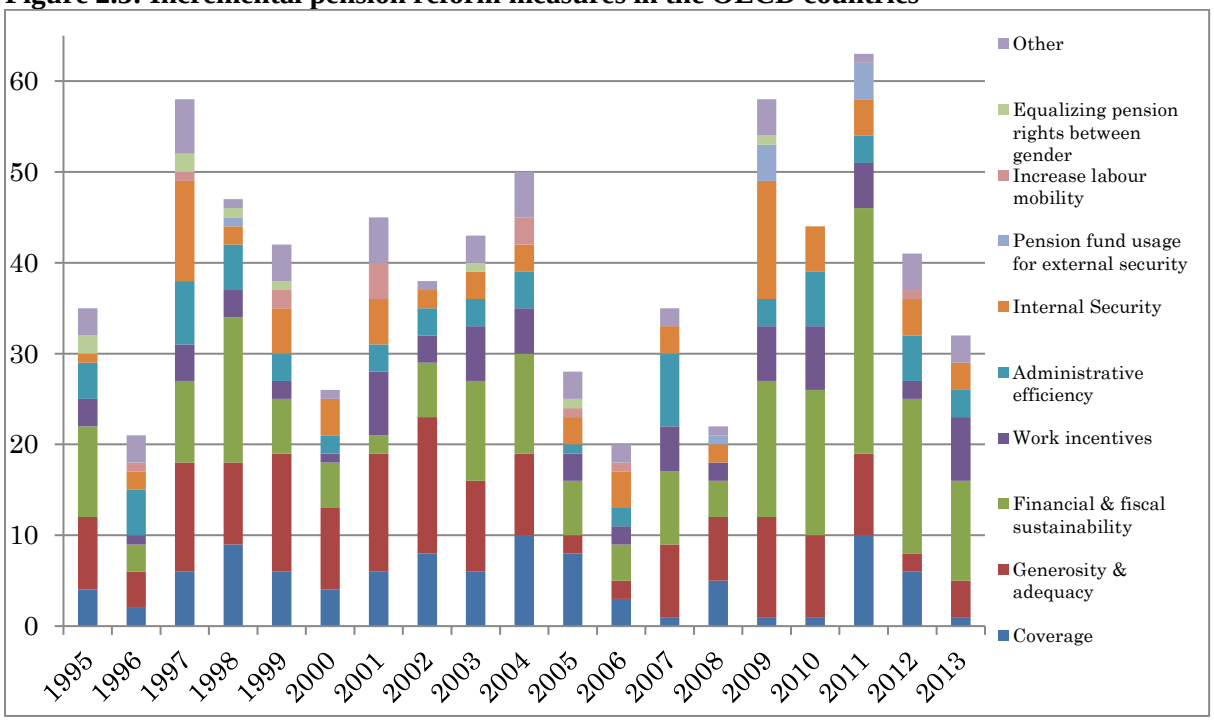
Note: each colour counts the number of incremental reforms in the indicated area.

Figure 2.2: Number of incremental pension reform measures in the areas of "Generosity and Adequacy" and "Financial and fiscal sustainability"



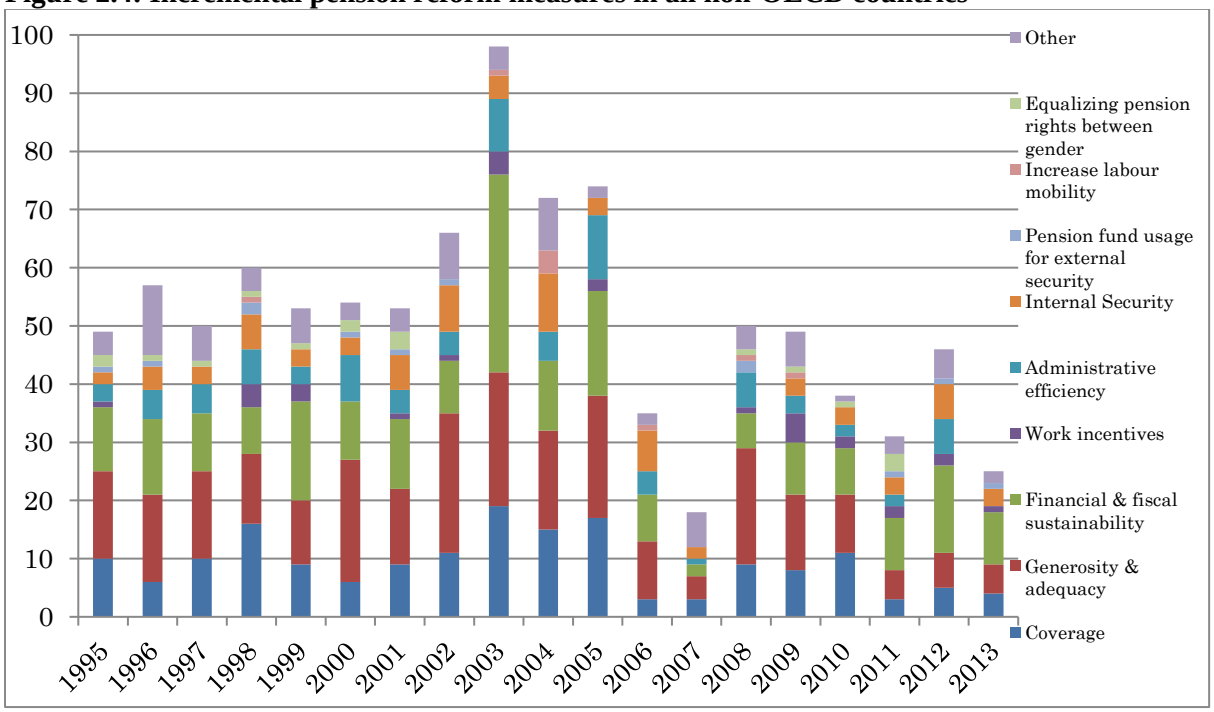
Note: the figure counts the number of incremental reform measures in the indicated area for the first 24 OECD members.

Figure 2.3: Incremental pension reform measures in the OECD countries



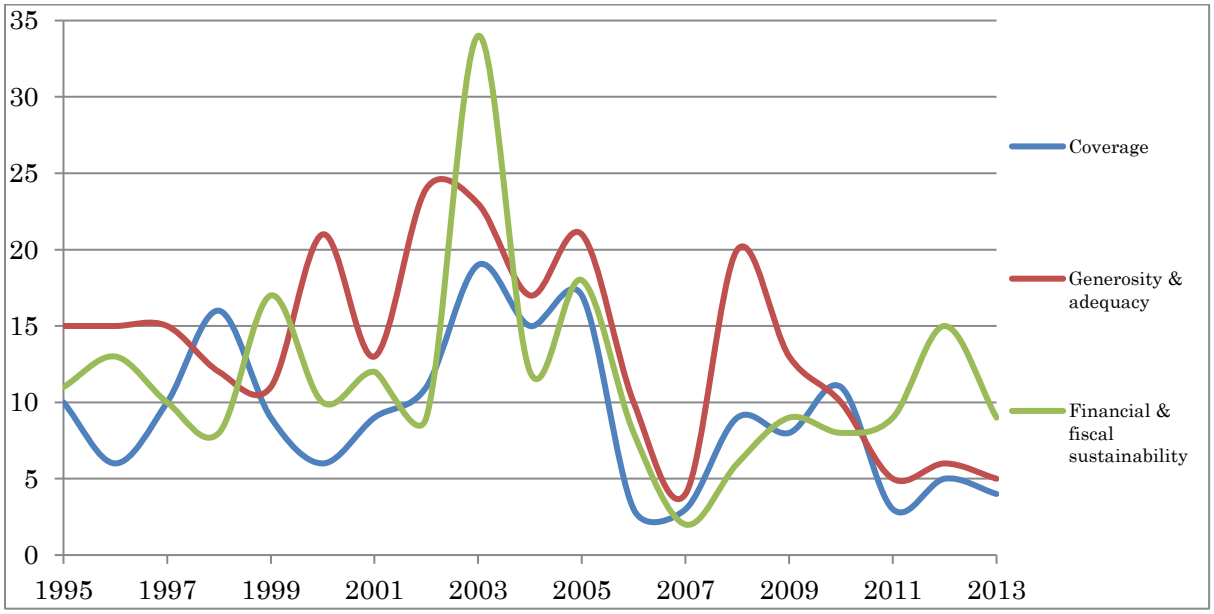
Note: see note to Figure 1

Figure 2.4: Incremental pension reform measures in all non-OECD countries



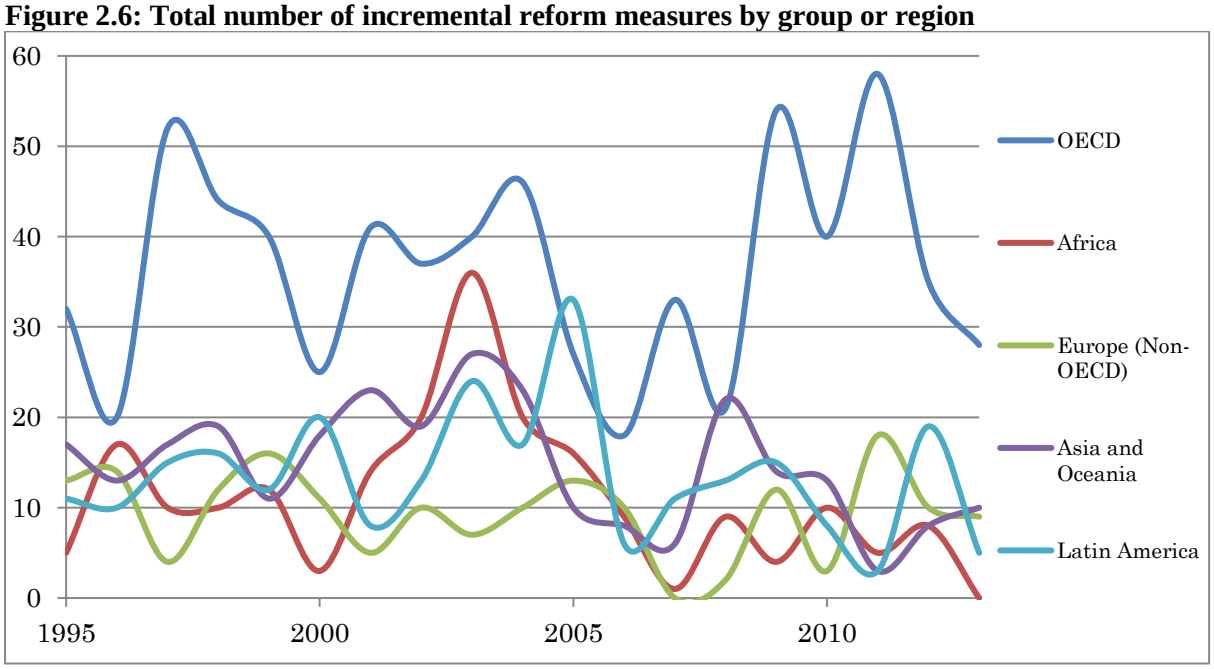
Note: see note to Figure 1

Figure 2.5: Number of incremental pension reform mesaures non-OECD countries in specific areas



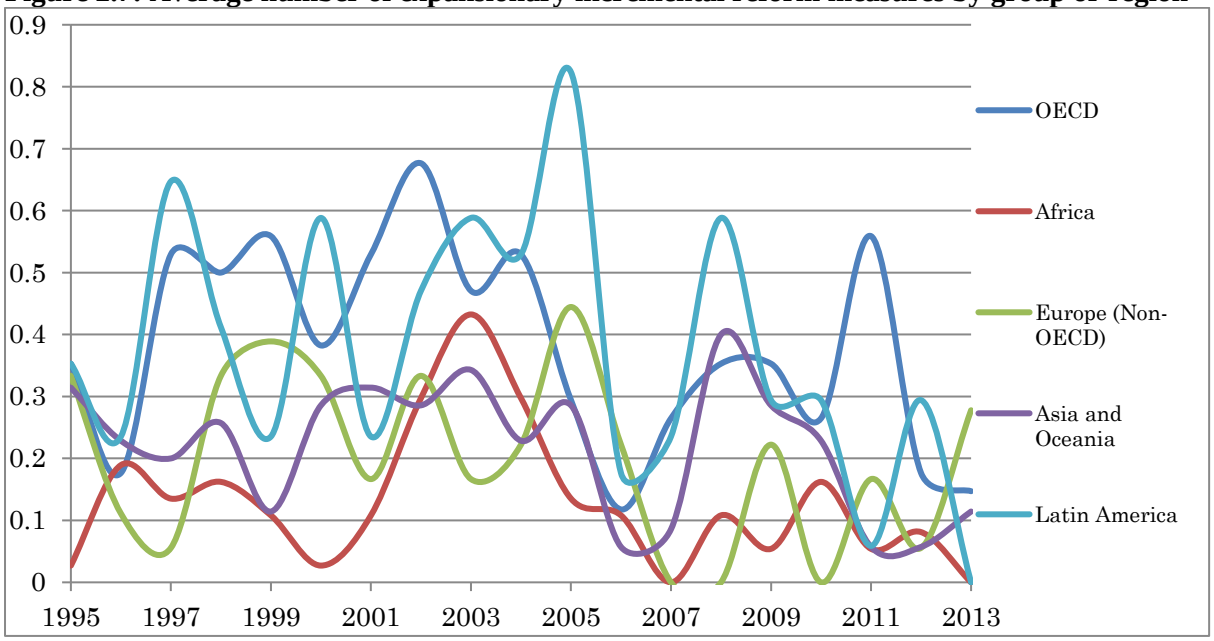
Note: the figure counts the number of reform measures enacting an incremental reform in the indicated area for the all the non-OECD countries.

Figure 2.6: Total number of incremental reform measures by group or region



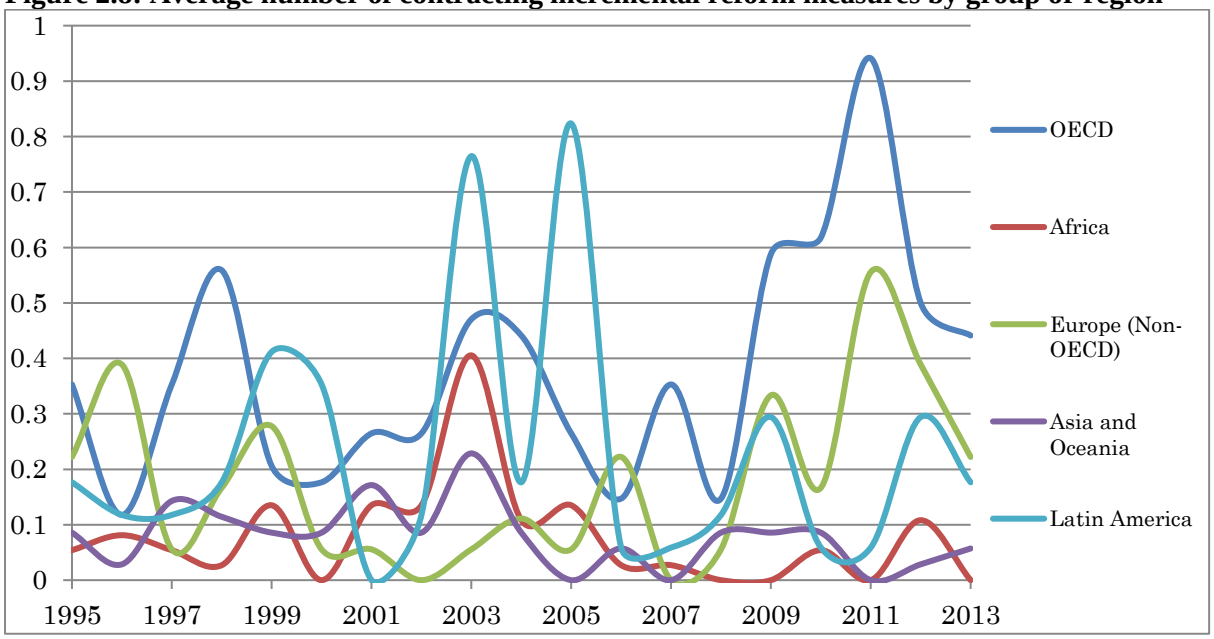
Note: the figure counts the number of reforms enacting an incremental reform measures in the indicated country-group

Figure 2.7: Average number of expansionary incremental reform measures by group or region



Note: the figure counts the number of expansionary reform measures enacting an incremental reform in the indicated area for the all the non-OECD countries.

Figure 2.8: Average number of contracting incremental reform measures by group or region



Note: the figure counts the number of contractionary reforms enacting an incremental reform measures in the indicated area for the all the non-OECD countries.

2.A. Appendices

2.A.1 Full set of countries included in our dataset

All OECD Countries and their entry dates (34)			
24 Members		**Later Entrants**	
Australia	(7 june 1971)	Chile	(7 may 2010)
Austria	(29 September 1961)	Czech Republic	(7 may 2010)
Belgium	(13 September 1961)	Estonia	(9 December 2010)
Canada	(10 April 1961)	Hungary	(7 May 1996)
Denmark	(30 May 1961)	Israel	(7 September 2010)
Finland	(28 January 1969)	Korea, Republic of	(12 December 1996)
France	(7 August 1961)	Mexico	(18 May 1994)
Germany (before 1989 West Germany)	(27 September 1961)	Poland	(22 November 1996)
Greece	(27 September 1961)	Slovakia	(14 December 2000)
Iceland	(5 June 1961)	Slovenia	(21 July 2010)
Ireland	(17 August 1961)		
Italy	(29 March 1962)		
Japan	(28 April 1964)		
Luxembourg	(7 December 1961)		
Netherlands, the	(13 November 1961)		
New Zealand	(29 May 1973)		
Norway	(4 July 1961)		
Portugal	(4 August 1961)		
Spain	(3 August 1961)		
Sweden	(28 September 1961)		
Switzerland	(28 September 1961)		
Turkey	(2 August 1961)		
United Kingdom	(2 May 1961)		
United States	(12 April 1961)		

All Non-OECD countries (117)			
Africa (37)	**Latin-America (27) (non-OECD)**	**Europe (18) (non-OECD)**	**Asia and Oceania (35) (non-OECD)**
Algeria	Argentina	Albania	Bahrain, The Kingdom of
Benin	Bahamas	Andorra	Bangladesh
Botswana	Barbados	Armenia	Brunei Darussalam
Burkina Faso	Belize	Belarus	Cambodia
Burundi	Bolivia	Bulgaria	China
Cabo Verde	Brazil	Croatia	Fiji
Congo	Colombia	Cyprus	French Polynesia
Congo, Democratic Republic	Costa Rica	Latvia	Hong Kong
Côte d'Ivoire	Cuba	Liechtenstein	India
Djibouti	Dominica	Lithuania	Indonesia
Egypt	Dominican Republic	Macedonia	Iran, Islamic Republic of
Ethiopia	Ecuador	Malta	Jordan
Gambia	El Salvador	Moldavo, Republic of	Lao People's Democratic Republic
Ghana	Grenada	Monaco	Lebanon
Kenya	Guatemala	Romania	Malaysia
Lesotho	Guyana	Russian Federation	Maldives
Malawi	Jamaica	Serbia	Marshall Islands
Mali	Nicaragua	Ukraine	Micronesia, Federated States of
Mauritania	Panama		Mongolia
Mauritius	Peru		Oman
Morocco	Saint Kitts and Nevis		Pakistan
Mozambique	Saint Lucia		Papua New Guinea
Namibia	Saint Vincent and The Grenadines		Philippines
Niger	Suriname		Qatar
Nigeria	Trinidad and Tobago		Samoa
Rwanda	Uruguay		Saudi Arabia
Senegal	Venezuela (Bolivarian Republic of)		Singapore
Seychelles			Sri Lanka
Sierra Leone			Syrian Arab Republic
South Africa			Taiwan
Swaziland			Thailand
Tanzania, United Republic of			United Arab Emirates
Togo			Vanuatu
Tunisia			Vietnam
Uganda			Yemen
Zambia			
Zimbabwe			

2.A.2. List of institutional reform measures

Country	Year of Legislation	Year of Implementation	Reform Basics	Old System Status
Chile	1974	1981	PAYG-DB to FF-DC as primary system	Closed completey
Switzerland	1982	1985	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
United Kingdom	1986	1988	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Australia	1987	1992	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Seyshelles	1987	1987	adding a FF-DC to existing PF	Fully Functional
Peru	1992	1993	adding supplementary FF-DB system to existing primary first pillar	Reformed, open to new workers
Indonesia	1992	1993	Adopting PF next to civil servant pension scheme	Reformed, open to new workers
Colombia	1993	1994	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Nigeria	1993	1994	shiftng from PF to PAYG system as primary scheme	Closed completey
Italy	1994	1995	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Argentina	1994	1994	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Mexico	1995	1997	PAYG-DB to FF-DC as primary system	Closed completey
Uruguay	1995	1996	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Lativa	1995	1996	PAYG-DB to PAYG-Notional Account (NDC) as primary system	NA
Sweden	1995	1999	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, closed to new workers
Bolivia	1996	1997	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
El Salvador	1996	1998	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
Zambia	1996	1996	shiftng from PF to PAYG system as primary scheme	Closed completey
Hungary	1997	1998	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Poland	1997	1999	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Kazakstan	1997	1998	PAYG-DB to FF-DC as primary system	Closed completey
Kyrgyzstan	1997	1998	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Tanzania	1997	1998	shiftng from PF to PAYG system as primary scheme	Closed completey
Denmark	1998	1999	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Bulgaria	1999	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Croatia	1999	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Mongolia	1999	2000	PAYG-DB to PAYG-Notional Account (NDC) as primary system	NA
Costa Rica	2000	2001	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Lativa	2000	2001	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Macedonia	2000	2005	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Papua New Guinea	2000	2002	Shifting from PF to FF-DC as primary system	Closed completey
Dominican Republic	2001	2003	PAYG-DB to FF-DC as primary system	Reformed, closed to new workers
Estonia	2001	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Russian Federation	2001	2002	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Kososvo	2001	2002	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Lithuania	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Slovakia	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Ukraine	2003	2004	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Romania	2004	2007	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Uzbekistan	2004	2005	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Taiwan	2004	2005	adding supplementary FF-DC system to existing primary first pillar	Fully Functional
Nigeria	2004	2004	PAYG-DB to FF-DC as primary system	Closed completey
Panama	2005	2008	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Norway	2005	2006	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Seyshelles	2005	2005	shiftng from PF to PAYG system as primary scheme	Closed completey
Norway	2006	2011	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Sweden	2006	NA	Switch from DB to DC funds	NA
Argentina	2007	2008	Nationalize Second Pillar	Closed completey
Chile	2008	2009	Adding supplementary 1st pillar to existing primary 2nd pillar	Fully Functional
Ghana	2008	2010	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Maldives	2008	2010	Adding PAGY system as primary pillar and supplementary FF-DC system to existing pension scheme for only public sector workers	Fully Functional
Brunei Darussalam	2008	2010	Adding FF-DC pillar to exisitng PF	Fully Functional
Brunei	2009	2010	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Bolivia	2010	2011	Nationalize Second Pillar	Closed completey
Hungary	2010	2010	Nationalize Second Pillar	Closed completey
Egypt	2010	2012	PAYG-DB to PAYG-Notional Account (NDC) as primary system	Reformed, open to new workers
Armenia	2010	2013	adding supplementary FF-DB system to existing primary first pillar	Reformed, open to new workers
Poland	2011	2014	Extension of 1st pillar through partly nationalization of 2nd pillar	Fully Functional
Czech Republic	2011	2013	Extension of 1st pillar through partly nationalization of 2nd pillar	Reformed, open to new workers
Malawi	2011	2011	adding supplementary FF-DC system to existing primary first pillar	Reformed, open to new workers
Slovakia	2012	2012	Extension of 1st pillar through partly nationalization of 2nd pillar	Fully Functional

2.A.3. Description of objectives

2.A.3.1 Description of objectives: institutional reform measures

We classify institutional reform measures along five different dimensions, each of which provides complementary information of the same reform. In the various dimensions we may subcategorize the reforms under one of multiple options. In this way we try to capture the essence of the reforms in a simple and comprehensive manner.

Dimension 0: Radical reform measure; yes or no
We indicate whether a given reform was radical or not.

Dimension 1: Creation, structural change, and nationalization or privatization.
Along this dimension we capture any change occurring in the first or second pillar. We distinguish between three types of change: creation, structural change, and nationalization or privatization.

1. *Reform measures to the first pillar*: includes all reforms that start, change or expand a first pillar.
   1.1. Creation of first pillar.
   1.2. Structural change: these include all reforms that change the structural setup of the first pillar. An example is the switch from a PAYG-DB to a PAYG-NDC system.
   1.3. Extension of first pillar through nationalization of second pillar: this includes all policies that involve nationalization of the second pillar.
      1.3.1. Full nationalization
      1.3.2. Partial nationalization
      1.3.3. Voluntary transfers from second pillar to first pillar
2. *Reform measures to the second pillar pension*: includes all reforms that start, change or expand a second pillar.
   2.1 Creation of second pillar.
   2.2 Structural change: these include all reforms that change the structural setup of the second pillar. An example is a shift from an FF-DB system to an FF-DC system.

2.3 Extension of second pillar through privatization of first pillar: this includes all policies that involve privatization of old-age social security institutions.

2.3.1 Full privatization.

2.3.2 Partial privatization.

2.3.3 Voluntary transfers from first pillar to second pillar.

Dimension 2: Primary or supplementary pillar/mandatory or optional pillar/ or closed down.
This dimension provides insight into the role the first and second pillar in social security scheme after the reform. In makes clear which pillar is the main one after the reform. It also captures the possibility of a shutdown of a pillar after a reform and it indicates whether the participation is voluntary or mandatory.

3. *Status first pillar under new system after radical reform*

3.1 Optional primary pillar.

3.2 Mandatory primary pillar.

3.3 Optional supplementary pillar.

3.4 Mandatory supplementary pillar.

3.5 Closed down.

3.6 Phased out.

4. *Status second pillar under new system after radical reform*

4.1 Optional primary pillar.

4.2 Mandatory primary pillar.

4.3 Optional supplementary pillar.

4.4 Mandatory supplementary Pillar.

4.5 Closed down.

4.6 Phased out.

Dimension 3: Type of radical reform measures.
This dimension contains separate sub-categories for each encountered institutional reform.

5. *Which type of the radical reform measures.*

5.1 PAYG-DB to FF-DC as primary system.

5.2 PAYG-DB to FF-DB as primary system.

5.3 Adding supplementary FF-DB system to existing primary first pillar.

5.4 Adding supplementary FF-DC system to existing primary first pillar.

5.5 Adding supplementary 1st pillar to existing primary 2nd pillar.

5.6 PAYG-DB to PAYG-NDC as primary system with FF supplementary pillar.

5.7 Nationalize second pillar.

5.8 From FF-DB to FF-DC.

5.9 From FF-DC to PAYG-DB as primary system.

5.10 Adopting a PF as primary system.

5.11 From PF to PAYG as primary system.

5.12 From PF to FF-DC as primary system.

Dimension 4: new system in relation with previous system.

This dimension provides insight into how the new system operates in relation to the old system.

6. *New system reform type after radical reform measure.*

6.1 There was no system before.

6.2 Substitution: the new system has completely substituted the old system.

6.3 Mixed: elements of the new system are mixed/merged with the old system. The old system has therefore been reformed.

6.4 Parallel: the new system operates in parallel to the old system. Hence, the latter is completely functional. The new system operates independently of the old system.

Dimension 5: Status old system.

This dimension captures what is left of the old system after the reform.

7. *Status old system.*

2.4 There was no system before.

2.5 Fully functional.

2.6 Reformed, open to new workers.

2.7 Reformed, closed to new workers.

2.8 Closed completely.

2.9 Open to all.

2.A.3.2. Description of objectives: incremental reform measures

1 *Coverage:* measures to enhance pension coverage. These are a means to fight old-age poverty by ensuring that more elderly people are entitled to a pension income. These measures comprise:

1.1 Extended mandatory participation: the introduction or extension of mandatory occupational pensions.

1.2 Extended voluntary participation: these measures include, for example, automatic enrolment in voluntary schemes, or providing more opportunities for access to pension schemes for groups that are not covered by pension funds automatically.

1.3 Increase family coverage: For example, widows who did not make pension contributions themselves are entitled to their deceased husband's pension.

1.4 Coverage: other.

2 *Generosity and Adequacy*: Expansionary measures to guarantee sufficient old-age pension income and the possibility to retire at a decent age. Unlike coverage, which focuses on the share of the population being targeted, adequacy focuses on whether the received pensions cover subsistence income, or more.

2.1. Increased benefits: raising the benefit level is the most direct way of ensuring sufficient pension income at old age.

2.1.1. Increased/more secure basic pension: this refers to an increase in the most basic pension benefit. In general, this refers to first-pillar payments.

2.1.2. Increased indexation rate: many pension schemes provide for indexation of existing pension entitlements so as to compensate for price or wage increases.

2.1.3. Provide addition benefits: this refers to the introduction of additional benefit schemes besides the existing ones.

2.2. Decrease retirement age: reducing the pension age allows to worker to retire earlier and still receive an adequate pension. We distinguish between reducing the statutory and the voluntary retirement age.

2.2.1. Decrease statutory retirement age: a decrease of the official retirement age as set by the law.

2.2.2. Decrease optional retirement age: individuals get the option to retire earlier, assuming they have the means for it.

2.3. Tax favourable policies: measures that make the tax-treatment of pensions more favourable for any of the three pension pillars. For example, a reduction of taxes on occupational pension benefits or a tax reduction on long-term private savings that before a certain age can only be withdrawn at the cost of a tax reduction.

3. *Financial and fiscal sustainability*: measures to increase the long-run financial and fiscal stability of the pension system as a whole.
   3.1. Increased contribution rate: by increasing the contribution rate, but keeping the benefits and other parameters constant, the system becomes more sustainable.
   3.2. Decreased benefits: reduced pension expenditures raise financial sustainability.
      3.2.1. Decreased basic pension
      3.2.2. Decreased indexation rate
   3.3. Increase in statutory retirement age: all reforms that raise the official retirement age. This reduces the amount of benefits paid and increases the amount of contributions into the scheme. Note the distinction with changing the optional retirement age. The latter falls under the header of work incentives.
   3.4. Elimination of other old-age benefits: this comprises the elimination of all additional old-age benefits. An example is the elimination of a lump-sum payment granted upon retirement.
   3.5. Tax increasing policies: this includes all pension-related increases in taxes. An example is an increase in the tax on occupational pension benefits.
4. *Work incentives*: measures aimed at stimulating the labor supply, mainly focused on older individuals. An example are measures to discourage early retirement.
   4.1. Financial benefit after certain age: financial incentives are provided for people who continue to work beyond a certain age.
   4.2. Possibility to put pension on hold: Especially in DC schemes, retirement income depends on the value of the accumulated portfolio of pension savings. Providing the opportunity to put the pension on hold might incentivize the employee to work longer.
   4.3. Increasing the optional retirement age: Individuals are discouraged from retiring early.
   4.4. Tightening access or imposing a financial penalty for early retirement: these measures make it more (financially) burdensome or even impossible to access early retirement. For example, early withdrawals of second-pillar pensions can be made less attractive by imposing a penalty.

5. *Administrative efficiency*: administrative inefficiencies lead to higher costs, thereby reducing the attractiveness of a pension plan.
   5.1. Merger of schemes: a merger of pension schemes may reduce administrative costs by reducing the multiplication of administrative activities.
   5.2. Umbrella institution: several countries have established governmental institutions that cope with the pension administration of private pension funds.
   5.3. State supervision: state supervision may be imposed in order to prevent fraud and poor administration.
6. *Internal security:* these include reforms that make the system less internally risky.
   6.1. Portfolio regulation: measures that require changes in portfolio management. Examples are changes in investment restrictions that lead to more diversified portfolios.
   6.2. Systemic regulation: regulatory measures to make the system less prone to exogenous risks. For example, stricter guidelines for pension plans and rules to prevent excessive risk taking by pension funds.
7. *Pension fund usage for external security*: pension capital may be used to stimulate domestic (financial) markets.
   7.1. Real estate purposes: Pension funds may be given incentives to invest in real estate, for example the government may provide tax advantages for such investments in order to stem a fall in the value of real estate.
   7.2. Advantage for domestic investments: Pension funds may be provided with financial incentives to invest domestically.
8. *Increasing labour mobility*: If an employee switches jobs, he may be confronted with a need to switch to another pension fund, causing so-called portability losses (resulting in a ceteris paribus reduction in pension benefits). Measures to reduce such disincentives to moving jobs are a shortening of the vesting period, reduced final wage losses and reduced penalty costs. We do not explicitly distinguish the various types of measures.
9. Equalization pension rights men and women: these include all policies that make the system more equal among different sexes.
   9.1. Equalizing retirement age: these include all reforms that reduce the difference in retirement age between men and women.
   9.2. Equalizing financial benefits: these include all reforms that reduce the difference in pension benefits received by men and woman.

2.A.4. Some examples of the classification of incremental reforms

This appendix provides a number of examples of the classification of reforms starting from the formulation in the original sources.

Denmark 1986:

Abrahamson and Wehner (2003) write "In 1986, the LO proposal with a few changes was endorsed by the Social Democrats, who suggested a pension scheme introduced by law covering all wage earners who did not already have occupational pension savings in one of the existing schemes."

We classify this as: 1.1. Coverage: extended mandatory participation.

Belgium 1971:

ILO NATLEX (2014) writes "Royal Decree adapting certain legal provisions with the provisions of the Act of 21 December 1970 establishing a National Social Insurance Institute for freelancers."

We classify this as: 1.4. Coverage: other.

France 1983:

Gordon (1988) writes "In France, the normal retirement age under employer pensions was 65 until 1983, when all the complementary schemes based on collective agreements lowered the normal retirement age to 60 to bring them into line with the national provision approved in 1982, which introduced full career pensions at age 60 for all workers with 37.5 years of insurance."

We classify this as: 2.2.1. Generosity and Adequacy: Decrease statutory retirement age

Portugal 2005:

ISSA (2014) writes "According to the new measures the retirement age for the civil service (60 years old) will be gradually increased, by 6 months a year, until it reaches 65 years in 2015. At the same time, the years of insurance necessary to claim a retirement pension will also be gradually increased, by 6 months a year, from 36 years until it reaches 40 years in 2013."

We classify this as: 3.3. Financial and fiscal sustainability: increase in statutory retirement age

Switzerland 2009:

OECD (2012) writes "Minimum rate of return on mandatory private pensions cut from 2.75% to 2% in 2009 and to 1.5% from 2012."

We classify this as: 3.2.2. Financial and fiscal sustainability: decreased indexation rate.

Greece 2013:

OECD (2012) writes "A reduction in monthly pensions greater than €1,000 (US$1,299) by 5 per cent to 15 per cent (depending on income)."

We classify this as: 3.2.1. Financial and fiscal sustainability: decreased basic pension.

Belgium 2005:

ISSA (2014) writes "All those who continue to work after reaching 62 will receive a supplementary pension bonus: the financial rewards will increase with the number of years worked."

We classify this as: 4.1. Work incentive: financial benefit after certain age.

France 1989:

ILO NATLEX (2014) writes "Loi no 89-1009 renforçant les garanties offertes aux personnes assurées contre certains risques." […] "Arts. L 731-1 à L 731-6, L 731-8 et suivants du Code de la Sécurité Sociale, 1992. Cette loi modifie profondément le droit de la prévoyance complémentaire afin de renforcer la protection des assurés dans les opérations de prévoyance complémentaire des compagnies d'assurance, des institutions paritaires de prévoyance et des mutuelles. […] Une commission de contrôle des institutions de retraite, de prévoyance complémentaire et des mutuelles est instituée.[…]"

We classify this as: 5.3. Administrative efficiency: state supervision.

Ireland 2012:

ISSA (2014) writes "Plans that do not have the required level of risk reserves (varying by plan) in place by the deadline must prepare a funding proposal to the Pension Board, which monitors and regulates private pensions in Ireland. The board estimates that providing for the risk reserve will increase overall plan funding requirements by approximately 10 per cent."

We classify this as: 6.2. Internal security: systemic regulation.

Iceland 2009:

ISSA (2014) writes “On December 8, 2009, 16 pension funds established the Icelandic Investment Fund (IIF) to aid Iceland's economic recovery from the recent international financial crisis. The move to use pension fund money to help stabilize the economy was recommended by the International Monetary Fund following the October 2008 collapse of the country's financial system. This brought the financial markets to a standstill and led to dramatic currency depreciation, higher interest rates, and a decline in asset prices.”

We classify this as: 7.2. Pension fund usage for external security: advantage for domestic investments.

Portugal 1988:

Rodrigues (2006) writes “In 1988, the unified pension regime was implemented to foster the mobility of workers between public and private sectors, bringing the two systems closer together.”

We classify this as: 8. Increasing labour mobility.

Chapter 3

The determinants of pension reform measures: theory and empirical evidence for the OECD

3.1. Introduction

Reform measures to enhance the financial sustainability of pension arrangements are high on the agendas of national policymakers as well as of international organizations. So far, however, systematic empirical investigation of the determinants of pension reform measures is in short supply. This is unfortunate, because the outcomes of such an analysis may provide insights into the circumstances that are most conducive to successful pension reform.

This paper makes three contributions to the literature on pension reform. Our first contribution is that, following a "narrative approach" based on reading relevant documents, we construct a new dataset on pension reform measures in OECD countries over the period 1970 – 2013. This is one of the most comprehensive datasets on pension reform measures that exist to date, covering a large set of countries over a long sample period, while it is the first dataset trying to capture all reform measures that affect the generosity and, hence, the cost of pension arrangements. Further, the dataset differs from many existing datasets in that it focuses on the countries that have been OECD member (almost) from the start. So far, research has mostly focused on pension reforms in Latin America and the Central and Eastern European countries (e.g., see Madrid, 2002; Brooks, 2007b; and Orenstein, 2005, 2013). These reforms are dominated by the privatizations in the 1980s and 1990s, often following the early example of Chile.

The pension reform measures in our dataset concern legislated measures that in one way or the other affect the public budget. This does not only include changes to public pension provision, but, for example, also measures that stimulate a later take up of a private pension, so that individuals are employed and pay taxes for longer. We categorize the reforms into "expansionary" and "contractionary" and define three regimes. The "Expanding only"

regime is characterized by measures that increase coverage, eligibility and/or the pension benefit level, while the "Contracting only" regime is characterized by measures aimed at increasing financial and fiscal sustainability and/or stimulating work incentives. Finally, there is the "Expanding and contracting regime", which prevails when expansionary and contractionary measures occur in the same year. We find that over time expansionary reform activity becomes less frequent, while the incidence of contractionary measures and expansionary and contractionary measures happening simultaneously increases.

Our second contribution is that, using our new dataset, we explore the determinants of pension reform measures in a systematic econometric analysis that links the reform regimes to the demographic, economic and budgetary information available at the moment of their legislation. We also investigate the role of political variables, economic and financial crises and the presence of supranational fiscal constraints for reform. Econometric analyses on this scale of the pension reform determinants are sparse, if they exist at all. None of the three regimes are affected by current or projected future demographic changes. This is remarkable, as we would a priori expect reform measures to be closely linked to long-run financial sustainability considerations. By contrast, we find that business cycle indicators – broadly defined, so capturing economic growth, unemployment and the state of the public finances – play a substantially larger role. In particular, a worsening of the business cycle enhances the likelihood of the "Contracting only" and the "Expanding and contracting" regimes, while it reduces that of the "Expanding only" regime during the second part of the sample period. Anecdotal evidence supports these findings. After a decades-long stagnation of the debate in the Netherlands, under pressure of the economic and financial crisis only a few weeks were needed in 2012 to decide on a schedule to gradually increase the public-pension retirement age. A year earlier, France and the UK already decided to raise the retirement age more rapidly than originally planned, while in 2013 Spain decided to raise the retirement age. There is also anecdotal evidence of favourable circumstances being conducive to expansionary reform. An example is Belgium in 1997, when real GDP growth was expected to accelerate to $2^1/_4$% (OECD, 1997), with the introduction of a minimum pension amount for each year in employment for at least one-third of the normal working time.

As our third contribution, we construct an original theoretical framework that can account for the observed empirical regularities. The model features a lump-sum adjustment cost of the changing an existing pension arrangement. Numerical analysis shows that the model can replicate the responsiveness of pension arrangements to the business cycle and their non-responsiveness to current and projected demographic developments.

Our paper connects in different ways to the literature. First, while systematic econometric analysis of pension reform measures is rare, recently some papers constructed datasets of pension reforms. In particular, after constructing our own dataset we became aware of Spruk and Verbic (undated) and Leibrecht and Fong (2017), who construct similar, but less detailed datasets.[3] The focus in the empirical analysis of Spruk and Verbic is on the political determinants of reforms and in Leibrecht and Fong on the political, economic and social determinants of retirement income privatization. In contrast to their results, we find that political and demographic variables turn out to essentially play no role for pension reform measures, while variables indicating the state of the economy are all important. The fundamental difference is that, in contrast to these two papers, we link reform activity to ***changes*** in (projected) old-age dependency ratios and ***not*** their level. Changes are crucial, because only a change can explain why a reform occurs now and not at some arbitrary other moment. A final difference is that we also provide a theoretical explanation for our finding that pension reform measures are mostly explained by the state of the economy, and not by (projected) demographic changes.

Our paper relates also to other work exploring the determinants of pension arrangements and the drivers of changes in pension arrangements. The literature has suggested a number of plausible driving factors of such changes.[4] First, there is the potential role of demography. Persson and Tabellini (2000) describe two opposing effects of a higher old-age dependency ratio on the size of a PAYG system. In an older society, on the one hand the rate of return on contributions to a PAYG system is lower, making the system less attractive, while on the other hand population ageing enhances the political weight of the elderly, making it harder for politicians to engage in contractionary reform. Other studies (e.g. Gonzales-Eiras and Niepelt, 2008) relate changes in social security to its intergenerational risk sharing aspects. Empirically, however, the role of the demography is not so clear-cut (e.g., Blinder and Krueger, 2004). While theory suggests that demography is an important determinant for PAYG pension reform, the empirical evidence is weak. In fact, for the U.S. and Western Europe, Razin ***et al***. (2003) even find a negative correlation between

[3] Spruk and Verbic (undated) construct a dataset for 34 countries over the period 1970-2013, focusing on the transition from unfunded to funded pension schemes. Leibrecht and Fong (2017) for a broader cross-section of countries, but a shorter time period, identify the privatization of retirement income systems. Crucial differences with our dataset are that (1) we try to capture any reform measure that affects the generosity of pension arrangements, leading to a substantial increase in the number of observations, and (2) we classify these measures into whether they make the arrangement more or less generous.

[4] Other suggested factors than those discussed are availability of information and social dialogue (e.g., Boeri and Tabellini, 2012), peer adoption (e.g., Brooks 2007a) and political factors (e.g., Giuliano et al., 2013).

the old-age dependency ratio and the generosity of social security transfers. Second, the size of the implicit pension debt is a potential determinant to reform PAYG defined-benefit pensions (James and Brooks, 2001). Third, external constraints, such as those imposed by Europe's Stability and Growth Pact, may stimulate pension reform. Bertola and Boeri (2002) argue that such constraints may have stimulated a reduction in the generosity of social security after 1997. Fourth, pension arrangements can be highly distortionary, leading employees to work less or retire earlier than under a system that gives stronger incentives for work – see, e.g., the contributions in Gruber and Wise (2009). The correction of such distortions may be another reason for reform. Finally, there is the role of ideology. Pension privatization in Latin America was stimulated by the paradigm shift towards neo-liberalization inspired by Thatcherism and the promotion of private pensions by international organizations such as the World Bank (see World Bank, 1994, Brooks, 2007b, and Orenstein, 2005 and 2013), which also emphasized the benefits of a deepening of the capital markets, increased private savings and higher economic growth.

Our main empirical finding – the timing of pension reform measures is related to the business cycle – is closely related to the crisis-induced reform literature (Rodrik, 1996, Abiad and Mody, 2005, Bonfiglioli and Gancia, 2015, Ranciere and Tornell, 2015, Mahmalat and Curran, 2017). Thompson (2009) finds that structural reforms are typically legislated during periods of poor economic performance. However, our analysis differs in fundamental ways from that in the crisis-induced literature. While the latter tends to focus on financial liberalization, trade liberalization and inflation and sovereign indebtedness issues, we focus on pension reform measures. These reform measures are special, since sustainability issues associated with pension provision due to future demographic changes are known well in advance. The "regular" crisis-induced reform literature focuses on contemporaneous rather than anticipated future crises. This may not be surprising: this literature suggests that an economic crisis may be a particularly suitable moment for reform, because only then policymakers become sufficiently aware of the need to fix structural deficiencies through fundamental reform (Tommasi and Velasco, 1996, and Tommasi, 2017). A second difference is that our dataset allows us to focus on both contractionary reform measures and expansionary reform measures. We find that the timing of contractionary reform measures is related to a weak economy. Expansionary reform measures, which include such structural reform measures as an expansion of the coverage of women, tend to be implemented during economic upswings. Such expansionary reform measures are not considered in the crisis-induced literature. We rationalize the timing of both contracting and expanding reform

measures in a model with implementation costs, where the net gains of reform measures fluctuate with the economic situation, not the political constraints that prevent reforms.[5]

The remainder of the paper is organized as follow. Section 2 presents the data. Section 3 sets up the empirical framework, while Section 4 reports and discusses the estimation results. In Section 5 we construct and numerically analyse our theoretical framework to account for our empirical findings. Further technical details, details on the construction of our data and the results of a number of robustness tests are available from our homepages.

3.2. The data

3.2.1. The data on pension reform measures

Our identification of reform measures is based on a narrative approach. In each year, and for each country, we list the changes in pension arrangements based on a careful reading of documents from the International Social Security Association (ISSA, 2014), the OECD 2012, 2013) and the International Labor Organization (ILO, 2014), both of which provide information on (legislation on) social security reforms. In cases where additional information is needed, we consult other, mostly national sources. A full list of all the consulted sources is attached to the dataset, which is available from the internet. Reforms comprise both smaller (parametric) and more fundamental changes to pension arrangements. We do not try to make an explicit distinction between small and large reform measures, to avoid the danger of being subjective in making such a distinction.

We date reform measures according to the year in which they are legislated. The reason is that we want to explain reform decisions on the basis of the information that is available at the moment the decision was made. It is obviously conceivable that in many instances the discussion about the reform started in the year before the reform was legislated, or possibly even earlier. However, it is practically unfeasible to uncover for each reform the moment when such a discussion was started, while deviating from the year of legislation would introduce another source of arbitrariness. In our analysis, we will show that our empirical findings are robust to using moving averages of the explanatory variables of the reform. Hence, this issue seem to be of only limited relevance.

[5] There is a literature on political and legal constraints that prevent policymakers to pursue reform in normal times, but that become softer during a crisis. See, for example, Swagel's (2015) recount of the US Treasury's failure to persuade banks to strengthen their capital position prior to the crisis, while bank regulators were able to force banks into recapitalizing themselves after the start of the crisis.

We divide reforms measures that are relevant for our analysis into four categories[6]: (1) "Coverage", the number of reform measures that expand the coverage of the pension arrangement, for example by loosening the eligibility criteria; (2) "Generosity and adequacy", the number of reform measures that expand the generosity of the pension system, for example by raising the benefit level; (3) "Financial and fiscal sustainability", the number of reform measures that enhance the financial sustainability of the pension arrangement, for example by reducing benefits or by raising the retirement age; (4) "Work incentives", the number of reform measures that enhance work incentives, for example by introducing bonuses for working after the minimum age at which pension benefits can be collected. Besides these reform categories, there are various other possible measures, for example pertaining to financial safety, that are not of interest for our purposes and that we thus do not separately categorize. Examples of how we classify measures on the basis of available text passages are found in Appendix 3.A.1.

The categories "Coverage" and "Generosity and adequacy" can be considered as "expansionary", because, if a reform in either of these two categories takes place, (long-run) pension obligations will increase. By contrast, the categories "Financial and fiscal sustainability" and "Work incentives" can be considered "contractionary", implying a reduction in the (long-run) pension obligations. The majority of the reforms concern reforms in the first, public pillar, while a minority concerns reforms in the second pillar, but only to the extent that these are expected to affect the public budget.

Aggregating across the sample countries, Figure 3.1 depicts the number of each type of reform by year. To clarify the figure, take as an example the year 1970. In this year a total of four reforms have been legislated in our set of sample countries, three in the category "Coverage" and one in "Financial and fiscal sustainability". We observe some tendency towards an increasing number of reforms as time progresses. Early in the sample period, the reforms are predominantly of the expansionary type, while in later periods the reforms tend to be mostly of the contractionary type.

We create two dummy variables. The dummy "Expansion" is one if at least one reform measure falls within "Coverage" or "Generosity and adequacy", and zero otherwise. The variable "Contraction" is one if at least one measure falls within "Financial and fiscal sustainability" or "Work incentives", and zero otherwise. Using our dummies, we define three different reform ***regimes***. The first is "Expanding only", which is captured by a dummy

[6] The dataset also contains reform measures that do not belong to these four categories, but these have no direct or clear effect on government finances and as such are not included in the analysis.

equal to one if the dummy "Expansion" is one ***and*** the dummy "Contraction" is zero. It is zero otherwise. The second regime is "Contracting only", which is captured by a dummy equal to one if the dummy "Expansion" is zero ***and*** the dummy "Contraction" is one. It is zero otherwise. Finally, there is the regime of "Expanding and contracting", which is captured by a dummy equal to one when ***both*** dummies "Expansion" and "Contraction" are one, while it is zero otherwise. The idea of this three-way dissection, and in particular of the definition of a regime "Expanding and contracting", is that governments may buy off public or political resistance to contractionary measures by at the same time expanding the system somewhat in other dimensions. This interpretation is supported by the fact that in the majority of the cases when expanding and contracting measures occur in a country in the same year, these reforms are described as a combination of measures in a single text piece in the ISSA (2014) documentation.

Table 3.1 lists for each sample country the number of reform measures in each category. There are substantial differences in the numbers of measures carried out by our sample countries. France and Greece, with 54 and 44 measures, respectively, enacted the largest number, while Iceland and Norway, with 7 and 11 measures, respectively, enacted the smallest number.

Table 3.2 reports the number of reforms of each type over the full sample period and for each of the two sub-sample periods when we split the full sample into sub-samples of equal length (1970 – 1991 and 1992 – 2013). The total number of expansionary reform measures is 110+166=276 distributed over 244 (country, year) - combinations, implying that for some countries in some years there is more than one expansionary measure, while the number of (country, year) - combinations with expansionary reforms ***only*** is 184. In other words, there are 244-184=60 (country, year) - combinations that fall into the "Expanding and contracting" regime. Further, the total number of contractionary reforms is 133+63=196, distributed over 159 (country, year) - combinations, while the number of (country, year) - combinations with contractions only is 99. Finally, there are 159-99=60 (country, year) - combinations that fall into the "Expanding and contracting" regime.

We observe that there is a reasonable balance of expansionary measures over the two sub-periods, although the second sub-period features slightly more of them. By contrast, contractionary measures are far more prevalent in the second sub-sample than in the first sub-sample. Only a quarter of the measures categorized as "Financial and fiscal sustainability" and only a tenth of the measures categorized as "Work incentives" take place in the first sub-period. Further, about three-quarters of the instances of the "Contracting only" regime occur

in the second sub-period, while the same holds for the regime of "Expanding and contracting".

Table 3.3 provides further details on the "Expanding and contracting" regime, where we report the frequencies of the various combinations of expansionary and contractionary measures. These frequencies are quite well in line with the relative overall frequencies of the two types of expansionary measures and the two types of contractionary measures. The highest frequency is formed by the combination of "Generosity and adequacy" and "Financial and fiscal sustainability", which is in line with the fact that "Generosity and adequacy" is more prevalent than "Coverage" and that "Financial and fiscal sustainability" is more prevalent than "Work incentives". Hence, the Table 3.3 does not reveal an obvious combination of contractionary and expansionary measures that is preferred by the policymakers.

3.2.2. The demographic variables

We use two demographic variables in our analysis: the change of the current old-age dependency ratio and the change of the projected 25-year ahead old-age dependency ratio. The old-age dependency ratio is measured as the number of people of 65 years and older divided by the number of people in the age group 15-64 years. The demographic projections and current data are taken from the various issues of the World Population Prospects of the United Nations. Each issue reports the current value and projects the future old-age dependency ratio, with projections done for intervals of 5, 10 or 15 years. The projections furthest into the future range from twenty-two years ahead to a century ahead, depending on the issue. For the missing years we interpolate the ratio using the surrounding years for which we do have projections. Appendix 3.A.4.1. describes in detail how these variables are constructed.

3.2.3. The economic and budgetary variables

Our set of economic and budgetary variables comprises per-capita real GDP, inflation as measured by the GDP deflator and the consumer price index, government debt, government revenues, government expenditures, the unemployment rate, the yield on short-term debt, the yield on long-term debt, exports and imports. These variables are mostly taken from the OECD Economic Outlook, the OECD National Accounts, the European Commission's Ameco dataset, the IMF World Economic Outlook and the World Bank. Appendix 3.A.4.2. provide more details on the sources and the precise description of these variables.

3.2.4. The political variables

Our political variables are obtained from the Comparative Political Data Set I (Armingeon *et al.*, 2015). The variables we use relate among others to the composition of the cabinet, the composition of the parliament, the political orientation of the government and the parliament, and elections. A detailed description of these variables is given in Appendix 3.A.4.3.

3.2.5. Other variables

Finally, we use crisis indicators taken from Laeven and Valencia (2012) and dummy variables to indicate the participation (or not) in the European Union (EU) as of 1992,[7] which the year when the Maastricht Treaty was signed, or the Eurozone as of the year of entry. A detailed description of these variables is given in Appendix 3.A.4.4.

3.3. The empirical framework

The literature suggests that demographic (Persson and Tabellini, 2000), macroeconomic and budgetary (Thompson, 2009), and political and crisis variables (Drazen and Grilli,1993, and Tommasi and Velasco, 1996) may affect the propensity to (pension) reform measures. We will try to explain reform decisions on the basis of real-time information available at the moment when reform measures are enacted. Our baseline specification will be a logit regression that links the reform decision to the projected change in the old-age dependency ratio, GDP growth, the public deficit and unemployment. With these baseline variables included, we can explore the role of demographic projections in promoting pension reform measures as well as the role of the state of the economy as captured through different indicators.[8] We thus consider GDP growth, the public deficit and unemployment all as indicators of the current state of the economy. We include these variables jointly in our regression, because their correlation is far from perfect. For example, labour hoarding generally causes cyclical movements in unemployment to lag behind cyclical movements in output. Also, in the past high unemployment rates have often encouraged the search for alternative channels to shed employees, such as through early retirement.

Our empirical approach deviates in a potentially important way from that suggested by the political-economy models, such as Cooley and Soares (1999), Persson and Tabellini

[7] Our sample does not include countries that entered the EU later.
[8] Elaborate prior experimentation shows that these are the (only) variables for which there is a systematic role in explaining reform decisions.

(2000) and Tabellini (2000) – see Galasso and Profeta (2002) for a survey. The empirical predictions of these models are usually based on the *current* demographic balance among the cohorts,[9] while in our empirical specification we include demographic ***projections***. Equity considerations could lead to contractionary pension measures in order to spread the cost of future increases in the old-age dependency ratio more evenly across the cohorts, in particular by shifting some of the cost also to the cohorts currently alive. Later, we will also estimate generalizations of our baseline specification in which we include additional variables to explore the relevance of potential other driving forces behind the reform measures.

We adopt a logistic regression specification and model the probability $p_{it,r}$ of being in reform regime r ("Expanding only", "Contracting only" and "Expanding and contracting") as:

$$p_{it,r} = \frac{\exp(z_{it,r})}{1+\exp(z_{it,r})} \tag{1}$$

where $z_{it,r}$ is a reform specific function f_r of the explanatory variables

$$z_{it,r} = f_r(BASEVAR_{it}, ADD_{it}), \tag{2}$$

with

$$BASEVAR_{it} = (\Delta OAD_{it}, \Delta OAD25_{it}, GROWTH_{it}, DEF_{it}, UNEMPL_{it})' \tag{3}$$

the vector of baseline explanatory variables and ADD_{it} is a vector of additional variables. Here, $OAD25_{it}$ is the projected 25 years ahead old-age dependency ratio, $GROWTH_{it}$ is the GDP growth rate in country i over the sample period, DEF_{it} is the government's budget deficit as a share of GDP and $UNEMPL_{it}$ is the unemployment rate. ΔOAD_{it} and $\Delta OAD25_{it}$ measure the change of the current old-age-dependency ratio and the change of the 25-years ahead projection of that ratio (see Appendix 3.A.4.1.). All explanatory variables will be measured in per cent or in percentage points (in the case of ΔOAD_{it} and $\Delta OAD25_{it}$). For each possible reform regime r, we will run a separate logistic estimation, so that the alternative to ending up in regime r is to end up in a regime in which no reform measures are taken. The motivation for this approach is that for the various regimes we identify some

[9] Many of these analyses feature a model in which there is a repeated vote about the generosity of the pension system, hence often it is the location of the current median voter that determines the system's generosity.

difference in the years for which we detect structural changes in the relationship between the reform measures and the explanatory variables. However, as our robustness analysis below shows, applying multinomial logit regressions in which the various reform regimes are imposed to be mutually exclusive leaves our results unaffected.

In the following, we will always assume that the relationship between $z_{it,r}$ and our set of explanatory variables is (piecewise) linear. We will also always include country-fixed effects.[10] However, we do not include of time-fixed effects. They would lead to rather uninformative results, as the explanatory variables tend to be rather highly correlated across the OECD countries.

3.4. Results

This section describes and interprets the results of our regression analysis. However, before turning to the estimations, we will test for the existence of breaks in the relationship between the explanatory variables and the incidence of the various regimes.

3.4.1. Break tests

The breakpoint testing procedure involves estimating a logit regression for regime r in which we specify

$$z_{it,r} = \left(\alpha_{0i,r} + D_y\gamma_{0i,r}\right) + \left(\alpha_r + D_y\gamma_r\right)' BASEVAR_{it} + \delta_r' ADD_{it}$$

where D_y is a dummy that takes a value of zero before year y, and of one as of year y, $\alpha_{0i,r}$ and $\gamma_{0i,r}$ capture country-fixed effects, and α_r and γ_r are coefficient vectors of appropriate dimensions. Hence, we allow for a break in the country-fixed effect as well as the coefficients of the explanatory variables as of year y. To avoid the number of coefficients from becoming too large, we do not allow the coefficients on the control variables to shift between the sub-sample periods. We let y run over the years 1980 – 2003, implying that we require a minimum of 10 years before and after a potential break. For each of our three reform

[10] Including country-fixed effects in a panel logit regression produces biased coefficients (Chamberlain, 1980). To avoid this bias, we also estimate the coefficients of our explanatory variables through conditional logit. Comparing the estimated coefficients of the explanatory variables under conditional and regular panel logit shows that these are virtually identical, indicating at most only a very small bias. The drawback of conditional logit is that this method does not generate the potentially large country-fixed effects needed for the mean marginal effects.

regimes, Figure 3.2 depicts the reciprocal of the p-value associated with the hypothesis that $D_y = 0$, while varying y over the years. We denote the year in which the test statistic reaches its minimum p-value by y^*. We find that $y^* = 1988$ for the "Expanding only" regime, $y^* = 1992$ for the "Contracting only" regime and $y^* = 1997$ for the "Expanding and contracting" regime. Figure 3.2 shows that the break points can be very clearly identified for each of the regimes.

3.4.2. Baseline estimates

Our baseline specification consists of equations (1) – (3), with D_y set to D_{y^*}, therefore allowing for a change in the coefficients of the explanatory variables in the year for which we identified a break above. Hence, each reform regime features a different break year. In our baseline, we try to explain the reform regime on the basis of current and projected changes in the old-age dependency ratio, GDP growth in deviation from its national average over time, the deficit and the unemployment rate.

Table 3.4 presents the coefficient estimates for our baseline specification for the "Expanding only" regime. Column (1) shows that in the period before 1988 none of the estimated coefficients are significant.[11] The period as of 1988 reveals some differences compared to the period before. First, the coefficient on the change in the projected future old-age dependency ratio exhibits a statistically significant fall and, hence, becomes negative. However, the Wald test that this coefficient is zero in the second sub-period cannot be rejected, suggesting that a projected increase in future ageing fails to exert a significantly negative effect on expansionary reform. Second, the coefficient associated with the GDP growth variable exhibits a significant upward jump and becomes significantly positive at the 1% level in the second sub-period, indicating that policymakers now also pay attention to the state of the economy when considering whether or not to expand pension arrangements: higher-GDP growth (relative to average growth over time) leads to more expansionary pension measures. This link may be driven by the fact that higher growth generates higher revenues from pension contributions or tax payments, thereby providing room for expansion. Also, workers' wages tend to grow faster during expansionary periods, which likely creates political pressure for benefit recipients to share in the rise in welfare.

The estimates presented in Table 3.4 do not provide us with direct information on the magnitude of the effect of a marginal increase in an explanatory variable on the likelihood

[11] Here, and in the sequel, we mean by significance that a coefficient is significant at the 10% or a higher level.

that the "Expanding only" regime will materialize. As can be seen from model (1) – (3), the size of the effect depends on the values of the explanatory variables at which it is evaluated. Table 3.5 reports for the "Expanding only" regime the mean marginal effects of changes in the explanatory variables calculated at their averages over the full sample or the relevant subsample. We observe that for the sub-period after 1988 a one-percentage point increase in the growth rate of the economy (relative to its average over time) raises the likelihood of the "Expanding only" regime by 2.1 percentage points. While the effect of a change in this variable during the second sub-period is significant, its magnitude is rather limited.

The estimates for the "Contractions only" regime also fail to provide any evidence of a role for the change in the current and projected old-age dependency ratio, neither in the first nor in the second sub-sample. This may be a bit surprising as many countries have started raising official retirement ages, allegedly motivated by rising current and future life expectancy. Yet, we do observe an important role for the state of the economy, as captured by the growth variable, which in both sub-periods exerts a significantly negative effect (at the 5% level) on the likelihood of a "Contracting only" regime. As Table 3.5 reports, the mean marginal effects during the second sub-period, again evaluated at the sub-sample averages of the independent variables, on the likelihood of the "Contracting only" regime are -1.6 percentage points for a one-percentage point increase in the economy's growth rate and 1.5 percentage points for a one-percentage point increase in the unemployment rate. We also observe that, going from the first to the second sub-period, the size of the mean marginal effects roughly triples in absolute magnitude.

Our final set of baseline regressions concern the "Expanding and contracting" regime. The coefficient estimates are reported in Column (3) of Table 3.4. The constant exhibits an upward jump in 1997. Again, the current and projected changes in the old-age dependency ratio play no role in explaining the likelihood that an "Expanding and contracting" regime materializes. As before, only the current state of the economy plays a role, this time captured by the effect of the public deficit. One may ask whether pension reform measures have potential feedback effects on the deficit, thereby biasing its coefficient. However, the effects of reform measures are unlikely to have a material feedback effect, as they are likely dominated by all the other changes in public spending, while the effects of contractionary measures tend to be mostly felt in the longer run. Table 3.5 shows that the mean marginal effect of a one-percentage point increase in the public deficit raises the likelihood of the

"Expanding and contracting" regime by 0.6 percentage points in the first sub-period and by 1.0 percentage points in the second sub-period.

3.4.3. Robustness

3.4.3.1. Multinomial logit

The above regressions ignore the fact that our reform regimes, including the "No reform" regime, are mutually exclusive. This fact can be exploited using a multinomial logit model. However, the drawback is that, if we want to allow for a structural break, this break has to occur at the same date for all possible regimes, while the above regressions based on the logit model clearly indicated different breakpoints for the various regimes. For this reason, we employed the standard logit model for our baseline. Here, we check the robustness of our baseline results by repeatedly estimating the multinomial logit model, while varying the common breakpoint for our three reform regimes.[12] Table 3.6 reports the estimates. Columns (1), (2) and (3) report the coefficient estimates for "Expanding only", "Contracting only" and "Expanding and contracting", assuming that the common breakpoint for the three reform regimes is 1988, 1992 and 1997, respectively. Hence, these breakpoints correspond to those found earlier for our three reform regimes. In each instance we only report the coefficient estimates for the reform regime we are interested in. We observe that the estimates are very similar to those from the ordinary logit estimations. Using the information from the Wald tests, the coefficients and standard errors of the variables that were statistically significant before remain significant and hardly change in magnitude. Moreover, there are no instances of variables that are significant under multi-nominal logit, but not significant under the ordinary logit estimation.

3.4.3.2. Averages of explanatory variables

The analysis so far has implicitly assumed that the recorded reform measures are driven by state of the economy and the demographic factors in the year they are legislated. However, the design and the legislative process underlying many reform measures, especially the larger ones, may take some time to materialize. Hence, on the one hand the relevant information set that forms the input for a reform decision may also include realizations of relevant variables

[12] Concretely, the likelihood $p_{it,r}$ of a reform regime of type r in country i in period t is $p_{it,r} = \frac{\exp(z_{it,r})}{1+\sum_{h=1}^{R}\exp(z_{it,h})}$, where h counts over the set of reform regimes "Expanding only", "Contracting only" and "Expanding and contracting". Hence, $R = 3$. The likelihood of ending up in the "No reform" regime is $1 - \sum_{h=1}^{R} p_{it,h}$.

in earlier years. To deal with this possibility, we allow our reform regimes to be explained by averages of current and past values of our explanatory variables. On the other hand, including too many lags into these averages would render it difficult to detect any effects on the likelihood of reform measures. Hence, we choose two lags as a reasonable compromise. Our specification of $z_{it,r}$ in (1) now becomes:

$$z_{it,r} = \left(\alpha_{0i,r} + D_y\gamma_{0i,r}\right) + \left(\alpha_r + D_y\gamma_r\right)' \sum_{j=0}^{2} BASEVAR_{i,t-j},$$

Table 3.7 repeats the baseline regressions reported in Table 3.4. We observe that the projected old-age dependency ratio is significant for both "Expanding only" and "Contracting only" in the first sub-sample. The signs of the coefficient, positive and negative, respectively, may be not be as expected, but a potential reason for these signs may be that projected increases in life expectancy were felt to necessitate the creation of better pension provisions for a growing group of future elderly. However, as shown by the Wald test statistics, the projected old-age dependency ratio loses in both cases significance in the second sub-period. The deficit is significant with a negative sign for the "Expanding only" regime in the first sub-period, but it loses significance in the second sub-period. Also, in contrast to the baseline regression, for this regime GDP growth is insignificant in the second sub-period. For the "Contracting only" regime, the second-period GDP growth rate is again highly significant, while unemployment remains significant at the 10% level, indicating that the state of the economy continues to play an important role in determining the likelihood of reform measures. Similarly, for the "Expanding and contracting" regime, the effect of the deficit on the likelihood of reform continues to be significantly positive.

3.4.3.3. Additional economic controls

In this subsection we expand the baseline regressions with economic control variables, always including one additional control at a time. The additional controls that we include are openness of trade ($OPENNESS_{it}$), CPI inflation ($INFLATION_{it}$), general government debt as a share of GDP ($DEBT_{it}$) and the average of the short-term (3-month) and the long-term (10-year) public debt yield ($INTEREST_{it}$). The results for the regimes "Expanding only", "Contracting only", and "Expanding and contracting", are respectively reported in Tables 3.8-3.10. For "Expanding only", only the coefficient on $OPENNESS_{it}$ is significant: an increase in openness makes expansionary measures less likely, possibly because in more

open economies it more important to restrain labor costs in order to remain competitive. For the other two regimes, none of the additional controls are significant. Baseline variables that were significant (insignificant) before remain so. Hence, we conclude that the state of the economy remains the main driving force behind pension reform measures.

3.4.3.4. Supranational budgetary constraints

Supranational budgetary constraints could motivate the adoption of reform measures (Bertola and Boeri, 2002), especially those reforms that improve the public budget in the shorter run, thereby allowing such constraints to be obeyed. A substantial part of our sample concerns EU countries that have tried to meet the criteria for accession to the Eurozone in the run-up to Economic and Monetary Union during most of the nineties and that have been bound by these criteria since they entered of the Eurozone. These criteria constitute an upper-bound on the public deficit – GDP ratio of 3% and an upper-bound on the public debt – GDP ratio of 60% (e.g., see Beetsma and Uhlig, 1999, Beetsma and Debrun, 2007). Also EU countries that do not take part in the common currency are, in principle, bound by these criteria and are supposed to take appropriate measures if they violate these criteria. To investigate their influence on the likelihood of reform measures, we construct a dummy $D\_MAASTRICHT_{it}$ that takes on a value of one for each EU country as of 1992, i.e. after the Maastricht Treaty was signed, if it was already an EU member in that year, or for countries that joined the EU later as of the year of joining. The dummy is zero in all other cases. Similarly, we introduce a dummy $D\_EUROZONE_{it}$ that is one for each Eurozone member as of the year it joined the Eurozone and zero, otherwise.

Table 3.11 reports the results when we add either the Maastricht or the Eurozone dummy to the baseline regressions. The Maastricht dummy is never significant. However, the Eurozone dummy is significantly positive for the "Contracting only" regime, suggesting that the fiscal constraints under the Eurozone may have played a role forcing governments to adopt contractionary measures. The GDP growth rate remains significant in both sub-periods, although its significance weakens a bit in the second sub-period. Hence, the conclusion that the current state of the economy is an important driving force behind pension reform remains unaltered.

3.4.3.5. The role of political variables

Spruk and Verbic (undated) point to the potential role of the ideological leaning of the government and the possible role of elections.[13] This subsection tries to address the role of these and other political factors. We do this by each time expanding the baseline regression by one political variable and checking whether the coefficient estimates under the baseline have undergone material changes and whether the political variable is significant. The results are reported in Table 3.12. The coefficients on the explanatory variables hardly change compared to their initial estimates. The Wald tests for the significance of their second-period values are found in Table 3.13. In terms of significance, they are always the same as under the baseline. Overall, the evidence of the state of the economy as a major main driver of pension reform measures remains strong. To save space, we do not report the coefficient estimates of the baseline variables, and limit ourselves to the coefficient estimates of the political parties.

Political variables are significant in only one case. An increase in RAE_LEG_{it}, the degree of fractionalization of the parliament, exerts a positive effect on the chances to expand the pension system. This may be explained by the possibility that with more fractionalization there is a larger need for bargains in which the various fractions in parliament get something to their liking. In all other instances, the political variables play no role. This is the case, in particular for (1) $\text{CABINET\_INDEX}_{\text{it}}$, which weighs the seats in the cabinet held by right-wing, centrist and left-wing parties: a higher value means a shift in seats from left- to right-wing parties; (2) $\text{GOV\_PARTY}_{\text{it}}$, which captures the political color of the government: the higher it is, the stronger is the position of the left-wing parties in government; (3) GOV_GAP_{it}, which captures the ideological difference between the new and old cabinet: a higher value implies a larger left-ward ideological shift of the government; (4) $PARLIAMENT\_INDEX_{it}$, which captures the average political color of the parties in parliament: a higher value implies a more right-wing average orientation of the parliament; (5) $D\_ELECTION_{it}$, a dummy for an election year; (6) $\text{GOV\_NEW}_{\text{it}}$, a dummy for whether the

[13] Cukierman and Tommasi (1998) argue that left-wing governments might be better placed at convincing the population of the long-run benefit of market-oriented reforms.

government is new; and (7) GOV_CHAN_{it}, the number of government changes in a year.; (8) GOV_TYPE_{it}, indicates the strength of the government party/parties in parliament.[14]

3.4.3.6. Controlling for crises

In our final robustness test, we investigate whether, in line with the crisis-induced reform hypothesis (see, for example, Drazen and Grilli, 1993, Tommasi and Velasco, 1996, Rodrik, 1996, and Drazen and Easterly, 2001), controlling for a crisis affects our baseline estimates. Based on the data in Laeven and Valencia (2012) we define a dummy D_CRISIS_{it} that takes a value of one in all the cases in which they identify the occurrence of either a banking crisis, a currency crisis or a sovereign debt crisis, as well as in the case a sovereign debt restructuring takes place. Because their dataset only spans the period up to 2011, our sample period is now ends in the year 2011. The number of times a crisis coincides with one of the reform regimes is rather limited.[15] Hence, one should be careful not to over-interpret any of the results in this subsection. Table 3.16 reports the results. The crisis dummy is only significant (at the 10% level) for the "Contracting only" regime, in which case it exerts a positive effect on the likelihood of a contractionary reform. In this case, the growth rate loses significance in the second sub-period, likely because crisis periods capture a substantial fraction of the periods in which growth is low, so that the explanatory power of the latter variable is taken away. In none of the other cases anything changes to the significance of the baseline explanatory variables, indicating that the state of the economy (including the potential situation of a crisis) remains a major driving force behind reform measures.

3.5. A theoretical framework

In our empirical analysis, we found at most only limited evidence of projected future changes in the old-age dependency ratio on pension reform measures. By contrast, there was rather substantial evidence of the current state of the economy, broadly defined, on reform measures. This section presents a simple theoretical framework that can simultaneously

[14] We have also explored whether the results are affected by including changes in the political variables (except for those in GOV_GAP_{it} and GOV_NEW_{it}, which are already differences, and $D\_ELECTION_{it}$. These estimation results are reported in Table 3.15. Only the change in RAE_LEG_{it} is significant (at the 10% level) in the "Expanding only" regression and the change in GOV_TYPE_{it} (at the 10% level) in the "Expanding and contracting" regression. However, the baseline variables are significant or insignificant when they were so before in the baseline regressions.

[15] The exact numbers are: crisis and "Expanding only" is 18, crisis and "Contracting only" is 21, and crisis and "Expanding and contracting" is 13.

explain why the cyclical state of the economy can trigger adjustments in pension generosity, while projected changes in the old-age dependency ratio have less power in doing so.

There is a political party that runs the current government and discounts the future at a factor $0 < \pi < 1$. This factor captures both the government's innate time preference as well as a potential reduction in its effective discount factor resulting from the possibility of losing office to a political competitor. The current government cares – among other things – about the income position of the elderly as measured by the pension pay-out $P > 0$.[16] The latter is chosen taking into account current and future economic and demographic conditions. Current economic conditions are fully summarized by an exogenous stochastic business cycle indicator $Y > 0$. It follows a Markov process with a stationary distribution. Hence, all the shocks to Y are of a temporary nature.

The demography in our theoretical framework is captured by the old-age dependency ratio, which is defined as the ratio of all retirees over all workers. Ideally, forecasts about the old-age dependency ratio would be based on the population pyramid and the fundamental demographic forces: fertility, mortality and migration. In most countries, the current size of each cohort is well known. Levels of fertility and mortality change only slowly over time. Thus, when fertility or mortality is high in one year, this is likely also the case the next year. This implies a strong, but not perfect, serial correlation in these two components. International migration is more volatile, but some degree of serial correlation should be expected, because the driving economic, legal, political and social conditions tend to change only slowly over time (e.g., Preston *et al.*, 2000). In addition, in most developed countries, migrant flows in the various age categories are small relative to the existing cohorts. All these factors render the old-age dependency ratio relatively predictable in the short to medium term.

Modelling the three fundamental sources of demographic change explicitly and keeping track of all the cohorts is well beyond the scope of this paper. The curse of dimensionality would cause the state space to explode. Instead, we try to capture the current and projected future demographic situation with only the current old-age dependency ratio B and the long-run level b to which B is expected to converge. Such a long-run level exists if the demography is stable, which is the case when migration flows, age-specific fertility and age-specific mortality rates are constant. In view of the continuing medical progress, especially this last assumption seems unrealistic. However, a constant link of the retirement

[16] The positive value of P implies that transfers from the old to the young are excluded.

age to life expectancy would continue to produce a constant long-run age-dependency ratio even when mortality rates are falling. We allow for temporary fluctuations in migration flows, fertility and mortality reduction by assuming that the pair (b, B) follows a (highly-persistent) time-stationary Markov process. We also assume that b and B are independent of Y.

We assume that the government's instantaneous utility is fully determined by current economic and demographic conditions. Hence, it can be written as $U(P, Y, B)$. We exclude financing of the pension system with government debt, so there exists an upper-bound $\bar{P}(Y, B) < \infty$ on P, which is determined by Y and B. Instantaneous utility is strictly concave in P, and increasing and concave in Y. Strict concavity in P arises, for example, in a situation in which an endowment needs to be divided over various generations (higher pension payout is at the cost of working generations) or when a higher pension payout reduces resources available for other public spending. For simplicity, we assume that U is continuous and twice differentiable in all its arguments. We denote the pension benefit that maximizes instantaneous utility by

$$\tilde{P}(Y, B) = \underset{P}{\operatorname{argmax}}\, U(P, Y, B).$$

The literature (see, e.g., Gonzalez and Eiras, 2008, and Ciurila and Romp, 2015) suggests that there are two opposing forces of the old-age dependency ratio B on the optimal pension payout chosen by a politician. A higher old-age dependency ratio raises the cost of the pension system, putting downward pressure on the individual pension payout, but it also increases the electoral weight of the group of retirees, which causes upward pressure on the individual payout. Ciurila and Romp (2015) conclude that in a probabilistic voting setting an office-seeking politician will divide the financial burden of a higher old-age dependency ratio over all generations by increasing the contribution and at the same time cutting the *per-retiree* pension benefit. This suggests a downward sloping relationship between B and the optimal individual pension pay-out $\tilde{P}$, so $\tilde{P}_B(Y, B) \leq 0$, which requires $U_{PB} \leq 0$. Finally, we assume that windfall gains are divided over both the active and retired part of the population, hence $U_{PY} \geq 0$, so $\tilde{P}_Y(Y, B) \geq 0$. A special case that satisfies these assumptions is when the government maximizes $U = f(G) + Bv(P)$ subject to $G + BP = Y$, where the functions $f(\cdot)$ and $v(\cdot)$ are continuous, increasing and strictly concave, G is an amount of a public good and

Y is an exogenous endowment. Hence, the government aims at optimally allocating a given endowment over public good and pension provision. Another special case, which we will use later, is where $\tilde{P}$ is proportional to Y and instantaneous utility only depends on the optimal payout relative to the current payout, so instantaneous utility can be written as $U = u\big(Y\tilde{P}(1,B)/P\big)$, with $u(\cdot)$ strictly concave and $\tilde{P}(1,B)$ positive, but decreasing in B. For now, we continue with the more general setup.

Changing the pension benefit P comes at a fixed utility cost $K > 0$ to the government, irrespective of whether the benefit is raised or reduced. There is no cost associated with keeping the existing benefit unchanged. Note that this specification rules out possible electoral costs of changing the benefit through a lower probability of being re-elected. We consider a discrete time setting, hence the government is free to implement a change at fixed moments, as long as it pays the fixed cost K. Note that the same cost applies to both an increase and a reduction in the individual pension benefit. The government's optimization problem is described by

$$V(P,Y,B,b) = \max_{P'} U(P',Y,B) - I(P'-P)K + E[V(P',Y',B',b')|Y,B,b], \quad (4)$$

where $I(\cdot)$ is an indicator function, such that $I(x) = 0$, if $x = 0$, and $I(x) = 1$, if $x \neq 0$. The expectation of the continuation value is well-defined due to the assumption that Y and (B,b) follow Markov processes. The government's problem of selecting the optimal pension benefit P' is comparable to a standard optimal pricing problem with menu costs or any other (s,S)-type of model, but with one additional complexity: the government has additional information concerning the next period's situation via the long term old-age dependency ratio b.

3.5.1. Necessary and sufficient conditions for change and no change of benefit

Each period the government compares the value of changing the pension system now (V^N) with the value of postponing a change (V^P). The government sets a new level $P' \neq P$ for the pension benefit if and only if $V^N > V^P$. We use the convention that in the case of equality, the pension benefit remains unchanged. The value of changing the system now is

$$V^N(Y,B,b) = \max_{P} U(P,Y,B) - K + \pi E[V(P,Y',B',b')|Y,B,b], \quad (5)$$

with $V(\cdot,\cdot,\cdot,\cdot)$ as defined in (1). The value of retaining the current pension benefit includes the costs K of future adjustments, and is given by

$$V^P(P,Y,B,b) = U(P,Y,B) + \pi E[V(P,Y',B',b')|Y,B,b]. \quad (6)$$

Using the maximum instantaneous gain defined as

$$F(P,Y,B) \equiv \widetilde{U}(Y,B) - U(P,Y,B) \geq 0, \quad (7)$$

we can formulate sufficient and necessary conditions for a change.

Proposition 1: If $F(P,Y,B) \leq (1-\pi)K$, then $V^P(P,Y,B,b) \geq V^N(Y,B,b)$, so postponing is optimal. Hence, $P' = P$. If $F(P,Y,B) > (1+\pi)K$, then $V^N(P,B,b) > V^P(P,Y,B,b)$, so implementing a change is optimal. Hence, $P' \neq P$.
Proof. See Appendix 3.A.2.

Note that both sufficient conditions only depend on the ***current*** business cycle situation (Y), the *current* old-age dependency ratio (B) and the ***current*** pension payout (P). The demographic forecast b is potentially only possibly relevant in the region not covered by the two inequalities in the above proof, i.e. the region for which $(1-\pi)K < F(P,Y,B) \leq (1+\pi)K$.

The intuition behind Proposition 1 is the following. Consider a government who inherits a pension benefit that is "currently fairly optimal" given the current state of the business cycle and the current old-age dependency ratio. That is, the maximum instantaneous gain does not exceed $(1-\pi)K$. At the same time this government is aware of the fact that the demographic forecasts are such that the inherited pension benefit is unsustainable in the future. Hence, it faces two options: change the pension benefit now to make the pension system future proof or keep the pension benefit at the inherited level and change it in the future. Postponing the change in pension benefit has three advantages over the first option. First, the government also postpones paying the fixed cost. Second, the government does not have to set a pension benefit that potentially lowers the current instantaneous utility. Third, in the next period, the government can freely choose the pension benefit that is optimal from that period onwards. Clearly, provided that the inherited benefit is "fairly optimal", it will

never be optimal to change the pension benefit now in order to ensure sustainability of the system in the future. In other words, information about the future is irrelevant in this case.

A similar argument holds if the current economic situation is such that the inherited pension benefit is "currently far from optimal". That is, the maximum instantaneous gain exceeds $(1+\pi)K$. In this case, the government will always want to change the pension benefit, irrespective of the demographic forecasts. In taking a decision about the new benefit level, it may take knowledge about the future into account. On the one hand, if both the current state of the business cycle and the demographic forecast are such that the pension benefit should be cut, the government may want to set a new level that reduces the chance of another cut in the future, so as to avoid paying the adjustment cost again. On the other hand, if the current situation asks for an unsustainable increase in the generosity of the pension benefit, the government knows that it will have to change the pension benefit again in the next period. Hence, it might just as well choose $\tilde{P}$.

3.5.2. Implementation

To implement our model, we make five assumptions:

1. Instantaneous utility of the government only depends on the ratio of the optimal pension benefit $\tilde{P}$ and the current level of the pension benefit P.
2. This optimal benefit $\tilde{P}$ is proportional to the business cycle indicator Y.
3. The logarithm of the business cycle indicator follows an AR(1) process:
$$\log(Y') = \phi_y \log(Y) + \varepsilon, \quad \varepsilon \sim N(0, \sigma_\varepsilon^2).$$
4. The current old-age dependency ratio gravitates geometrically to its long-run value:
$$B' = \lambda B + (1-\lambda)b, \quad 0 < \lambda < 1.$$
5. The long-run old age dependency ratio takes on discrete values $b^i \in (0,1)$ and features constant transition probabilities p_b^{ij}:
$$Prob\left(b' = b^j \middle| b = b^i\right) = p_b^{ij}.$$

The strongest assumption is Assumption 4. This clearly violates the non-monotonicity over time in the forecasts of the old-age dependency ratio. In most countries, the old age-dependency ratio is expected to peak between 2030 and 2050, and then gravitate towards a lower value. However, to model such a more realistic forecast one would need a higher dimensional demographic model, which would complicate the model significantly, without

adding additional insights. Our assumption is in line, though, with official predictions for the very long run.

Our dataset does not contain values of the pension payout, only dates when pension reforms were enacted. This implies that we can freely transform P as long as jumps are preserved. Moreover, $V(\cdot,\cdot,\cdot,\cdot)$, $U(\cdot,\cdot,\cdot)$ and K are in utility terms, so we can also freely use affine transformations, without changing the optimal timing of reforms in the model. Under Assumptions 1 and 2, we can write instantaneous utility as

$$U(P,Y,B) = u\big(Y\tilde{P}(1,B)/P\big).$$

By construction, $u(\cdot)$ has a maximum at 1. $\tilde{P}(1,B)$ is positive and decreasing in B, so a natural first-order approximation is $\tilde{P}(1,B) \approx Ae^{-cB}$, where $A > 0$ is a scaling factor and $c > 0$ measures the sensitivity of the optimal payout $\tilde{P}$ with respect to fluctuations in B. Under Assumption 3, the unconditional variance of $\log Y$ is $\sigma_y^2 \equiv \sigma_\varepsilon^2/\big(1-\phi_y^2\big)$. Now, define $y \equiv \frac{1}{\sigma_y} log(Y)$, $p \equiv \frac{1}{\sigma_y}\log[P/A]$. $k \equiv -\frac{1}{2}u''(1)\sigma_y^2 K$, and $\gamma \equiv c/\sigma_y$. Then, we can rewrite the full optimization problem (4) up to a second-order approximation as the following minimization problem which has the same timing of reform measures:

$$v(p,y,B,b) = \min_{p'}(y-\gamma B-p')^2 + I(p'-p)k + \pi E[v(p',y',B',b')|y,B,b] \quad (8)$$

$$y' = \phi_y y + \xi_t, \qquad \xi_t \sim N\big(0,1-\phi_y^2\big) \quad (9)$$

$$B' = \lambda B + (1-\lambda)b \quad (10)$$

$$Prob\big(b' = b^j \big| b = b^i\big) = p_b^{ij} \quad (11)$$

3.5.3. Calibration

We discretize the business cycle indicator y to mimic the AR(1) process as closely as possible using 201 grid points. These grid points and the corresponding transition probabilities are determined using the Rouwenhorst (1995) method (see Kopecky and Sueren, 2010, for a formal analysis). For the AR-coefficient ϕ_y, we use the typical value used in the business cycle literature of 0.8 per quarter, which translates to 0.41 per year.

The discount factor π captures time discounting and the probability of the current government losing power. One period corresponds to one year, so we set time discounting to 0.98, corresponding to a time preference rate of about 2% a year, which is in the ballpark

range of the literature. The probability of losing power is very country specific. We use the data of Armingeon *et al.* (2015) to calculate the yearly probability of an ideological change.[17] This probability varies between 0 and 50 percent. The probability of losing power clearly dominates the traditional time discounting. In our baseline simulations we use a value of 0.75 for π. Sensitivity analysis shows that our results are robust, even for extreme values of 0.5 and 0.9.

To calibrate the demographic processes, we choose the minimum and maximum values of the 25 year ahead old-age dependency ratios. The minimum value in our data is 13% (Japan, 1970) and the maximum value is 63% (also Japan, 2014). To capture all fluctuations of this projected old age dependency ratio, we divide the assumed 10 – 70% range into 6 equally sized bins of 10 percentage points each. This yields 6 central points ranging from 15% to 65%, which we use as the grid points for our long-run old-age dependency ratio b. In our dataset, the forecast of the old age dependency ratio changes bins in 8% of the years, so we set the diagonal values of the transition matrix to 92% and all off-diagonal values to 8/5%. Our results are robust to alternative symmetric divisions of the remaining 8% over the off-diagonal values. For the current old-age dependency ratio we use an evenly spaced grid of 21 points ranging from 15% to 65%. The adjustment parameter λ is set to generate a half time of 25 years, so $\lambda^{25} = 0.5$.

This leaves us with the choices of the adjustment cost parameter $k > 0$ and the effect of the old-age dependency ratio on the optimal pension benefit, as summarized by $\gamma > 0$. We can use these two parameters without a clear empirical counterpart to match observed frequencies of the pension reforms and estimated coefficients in our empirical analysis.

Graphs 3 and 4 show the sensitivity of our model simulations to various values of k and γ. We solve the model using the structural parameters and simulate the economy starting in the unconditionally expected state and with the corresponding optimal pension payout in that state, i.e. the one that minimizes the first term on the right-hand side of (8). We then simulate 10,000 hypothetical periods and in every period check whether it is optimal to implement a contracting or expanding reform. If it is optimal to implement a reform, we set the pension benefit to the choose the new optimal one given the current state and continue the simulation. Using the simulated data and the corresponding optimal reform decisions, we

[17] We take the variable $CABINET\_INDEX_{it}$, which measures the ideological composition of the government through the percentages of total cabinet posts held by right-, center- and left-wing parties. The probability of an ideological change is the fraction of years that this variable changes by at least 10 percent. It ranges from zero for Switzerland to around 50 percent for Italy.

perform the usual logit regressions with the change in the business cycle indicator, the change of the current OAD ratio and the change in the long-term projected OAD ratio (and an intercept) as explanatory variables. The adjustment cost parameter varies between 0.1 and 10. The relevance of the current old-age dependency ratio as represented by γ ranges from 0 to 20. These intervals for k and γ and are wide enough to capture the observed probabilities of a reform, and the *z*-values reported earlier for the regressions based on the actual data.

Figure 3.3 shows the probability of a reform on the vertical axis. The reform probability exhibits hardly any sensitivity to variations in γ. Hence, the reform probability is (almost) completely determined by the fixed adjustment cost. This implies that we can always use the fixed adjustment cost to match the observed probability of a reform.

Figure 3.4 shows the *z*-value of the current old-age dependency ratio in the simulated logit regressions for contractionary reforms, in which the pension benefit is reduced. The graph for expansionary reforms is the mirror image of this graph. The *z*-value is mostly determined by γ, and for values of γ smaller than approximately 3, this coefficient is not significantly different from zero. The standard deviation of *B* implied by our Markov process is 0.09, so with a value of γ of 3, a one standard deviation fluctuation of *B* has the same immediate welfare loss as 0.27 standard deviations of y (which by construction has a standard deviation of 1).

3.5.4. Model fit

We fix all parameters to their baseline values, except the adjustment cost parameter. This adjustment cost parameter is closely related to the number of reform measures in each country, which varies widely across the countries. In our sample period, France implemented at least one reform measure in 24 out of the 44 years (55% of all years), while Iceland merely implemented a reform measure in 14% of all years. We capture this heterogeneity using a country-specific fixed adjustment cost. We set the adjustment cost parameter for each country such that the probability of a reform in our simulated data of 100,000 draws matches the fraction of years in which a country actually implemented a reform measure. This leads to two potential errors: the actual economic developments are not properly matched by our simulated data and some actual reform measures in our dataset belong to one reform "package", but are implemented in different years. The bias of the first source of errors is unclear; the second source will lead us to take a too low value of k.

To determine the model fit we compare the timing and direction of the actual reform regimes to the timing and direction as predicted by our theoretical model. We solve our

model for the baseline parameters and for each of the country-specific adjustment cost parameters. As the actual business cycle indicator y we use the first principal component of the three time series of economic growth, unemployment and the budget deficit of the country. We start the simulation with the optimal pension system implied by the actual economic and demographic situation in the first sample year. Then, for every year, we check whether the economic and demographic situation in the actual data changes enough to make it optimal to change the pension payout. If this is the case, then we choose the new optimal pension payout which leads to either a predicted contracting reform or a predicted expanding reform.

Table 3.17 reports how often a predicted reform coincides with an actual reform in the correct direction, using various time windows to capture potential political delays. We see that the model correctly predicts an expanding reform for 19.2% of the actual country-year combinations featuring a regime with an expanding reform measure, i.e. an "Expanding only" or an "Expanding and contracting" regime. Similarly, the model correctly predicts a contracting reform for 22.0% of the actual country-year combinations with a "Contracting only" or "Expanding and contracting" regime. In reality, due to legislative lags it may take some time before a planned reform measure actually materializes. Therefore, Table 8 also reports the fraction of correct predictions if we allow for the possibility of a one- or two-year lead of the model prediction of a reform relative to an actual reform regime. In other words, in the next-to-last column the model prediction is considered correct if it takes place one year before or in the same year as the actual reform regime (and is in the correct direction as described above). If we allow for a two-year lead of the model, it correctly predicts 49.2% of the actual regimes with an expanding reform measure and 54.1% of the regimes with a contracting reform measure.

The crucial question is how good the model is if we compare its performance to a situation in which reforms occur randomly. Hence, we use a Monte Carlo simulation to compare the number of correct reforms using our model to the number of correct reforms when reforms are scattered randomly in our sample. To prevent a bias strengthening our model, in our simulation we randomly assign reforms to country-year combinations, such that for each country the number of years with a random reform coincides with the actual number of years in which a reform regime occurred in that specific country, as in the calibration of the adjustment cost. Each of the randomly assigned reforms has a 50% probability of being of the expanding type and a 50% probability of being of the contracting type. For every draw in our simulation, we determine for each element of the given set of actual country-year

combinations with a reform regime whether it is predicted by a randomly assigned reform with a correct direction. We use 100.000 draws to give us the probability density function of the number of correct predictions by our randomly-assigned reforms. The values between brackets in Table 8 report the fractions of the draws in which the number of correct predictions under the random reform allocation is at least as high as under our theoretical model. For example, when the window is confined to the same year, in about one-third of the draws does the random assignment of reforms do at least as well as our model in correctly predicting a regime with an expanding reform measure. If we allow for implementation lags, so leading predictions, the performance of our model, compared to random draws, increases substantially. The Monte Carlo analysis shows that the model especially adds predictive power for regimes with a contracting reform measure. If reforms are randomly allocated, the probability of outperforming the model, i.e. of correctly predicting at least 54.1% of the regimes with a contracting measure (with a possible lead of two years) is merely 1.6%.

3.6. Concluding remarks

In this paper, we empirically explored the determinants of pension reform measures. To this end we used a narrative approach to construct a unique and comprehensive dataset of pension reform measures for a broad set of OECD countries in the period since the start of the seventies. Reform measures included both expansionary and contractionary measures. The determinants that we considered comprised demographic, economic, budgetary, political and crisis variables, as well as the supranational budgetary constraints on the EU countries. Crucially, we measured the determinants of reform measures in "real time". That is, we tried to explain reform decisions on the basis of information that was available at the time the reform decision was made. Also crucially, we included the *changes* in the current and projected old-age dependency ratios, as only changes can explain why a reform could occur now if it had not occurred earlier.

We found no effect of current and projected demographic changes on the propensity to undertake reform measures. By contrast, we found quite substantial evidence that the current state of the economy, broadly defined, is the main driver of both expansionary and contractionary reform measures. We constructed a simple theoretical model with an adjustment cost of changing the pension arrangement that can account for the responsiveness to the business cycle and the non-responsiveness to demographic forecasts.

International institutions, like the OECD, the World Bank, and the European Commission advise countries to reform their pension arrangements so as to enhance their financial sustainability in anticipation of the ageing of their populations. Our results suggest that the effectiveness of these attempts may be highly dependent on the underlying state of the countries' economies and that these efforts are therefore best concentrated in times when their economies are in a downturn and their public budgets are under pressure. The 2005 reform of the EU Stability and Growth pact, however, allows countries to temporarily deviate from their (path to the) medium term objective due to costs of pension reform measures. However, such a deviation is not allowed from the 3% deficit limit, which is most likely to be binding during a recession. Hence, Eurozone member states are incentivized to implement their pension reforms outside recessions, which is precisely when they are, according to our results, less inclined to implement reforms that enhance the long-run sustainability of the pension system.

3.T. Tables

Table 3.1: Number of reforms by country and type					
	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives	Total
Australia	11	8	10	7	35
Austria	2	5	3	2	11
Belgium	6	14	3	3	24
Canada	6	10	4	2	21
Denmark	7	8	11	4	26
Finland	6	10	6	4	23
France	10	22	15	7	50
Germany	4	17	11	2	32
Greece	6	12	20	6	40
Iceland	5	1	0	1	7
Ireland	10	13	7	3	32
Italy	3	5	14	3	24
Japan	10	16	13	0	39
Luxembourg	6	12	8	2	24
Netherlands, the	2	7	7	2	17
New Zealand	5	1	9	2	16
Norway	1	5	3	2	10
Portugal	5	12	13	5	32
Spain	5	18	7	8	33
Sweden	2	8	6	4	19
Switzerland	7	6	13	2	28
United Kingdom	6	9	10	2	26
United States	5	12	18	1	35

Note: the column “Total” may be less than the sum of the columns to the left of it. The reason is that some reforms are a combination of measures falling into more than one category.

Table 3.2: Number of (country, year) combinations by type, period and reform regime			
	1970-2013	1970-1991	1992-2013
Coverage (1)	110	52	58
Generosity and adequacy (2)	166	79	87
Expanding (1+2)	244	115	129
Expanding only	184	101	83
Financial and fiscal sustainability (3)	133	32	101
Work incentives (4)	63	7	56
Contracting (3+4)	159	36	123
Contracting only	99	22	77
Expanding and Contracting	60	14	46
Total (1+2+3+4)	343	137	206

Note: "Expanding (1+2)" reports the number of different (country, year) combinations with one or more expansionary reforms. Because there are (country, year) combinations with both a "Coverage (1)" and "Generosity and adequacy (2)" reform, the sum of "Coverage (1)" and "Generosity and adequacy (2)" exceeds "Expanding (1+2)". Analogous for "Contracting (3+4)" and "Total (1+2+3+4)".

Table 3.3: Details on the "Contracting and expanding" regime		
	Financial and fiscal sustainability	**Work incentives**
Coverage	23	12
Generosity and Adequacy	36	23

Table 3.4: Logit estimations for the baseline regressions

Independent variables	(1) Expanding Only	(2) Contracting Only	(3) Expanding and Contracting
ΔOAD	0.272	-0.184	0.387
	(0.78)	(-0.24)	(0.61)
$\Delta OAD25$	0.163	0.006	-0.112
	(1.07)	(0.02)	(-0.38)
$GROWTH$	-0.033	-0.184**	0.178
	(-0.62)	(-2.21)	(1.57)
DEF	-0.040	-0.051	0.230**
	(-0.86)	(-0.64)	(2.56)
$UNEMPL$	0.048	0.133	-0.032
	(0.97)	(1.63)	(-0.37)
D_y	-0.522	0.848	1.743**
	(-1.30)	(1.49)	(2.56)
$D_y * \Delta OAD$	-0.420	0.704	-0.322
	(-0.92)	(0.83)	(-0.41)
$D_y * \Delta OAD25$	-0.302*	-0.033	0.196
	(-1.67)	(-0.11)	(0.60)
$D_y * GROWTH$	0.193***	0.040	-0.137
	(2.63)	(0.40)	(-1.00)
$D_y * DEF$	0.072	0.026	-0.118
	(1.40)	(0.31)	(-1.25)
$D_y * UNEMPL$	-0.026	-0.002	0.049
	(-0.48)	(-0.02)	(0.51)
Wald test for significance of coefficients in 2nd sub-period			
ΔOAD	0.24	2.11	0.02
$\Delta OAD25$	2.09	0.06	0.39
$GROWTH$	9.35***	6.35**	0.27
DEF	0.84	0.34	4.75**
$UNEMPL$	0.28	5.95**	0.08
Log-likelihood	-446.1	-278.5	-187.9
N	989	989	860
LR	55.07	82.15	59.43
p-value	0.01	0.00	0.00

Notes: (i) Figures between parentheses are t-values. (ii) Further, *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. (iii) $D_y = D_{1988}$ for the "Expanding only" regime, $D_y = D_{1992}$ for the "Contracting only" regime, and $D_y = D_{1997}$ for the "Expanding and contracting" regime, where D_y is a time dummy that takes a value of 0 (1) before (as of) the year y. (iv) We

use the Wald test to test the individual significance of the second-period coefficients. Under the null hypothesis, the Wald test statistic, $\frac{(\hat{\theta}_{j,r}-\theta_0)^2}{Var(\hat{\theta}_{j,r})}$, where $\hat{\theta}$ is the maximum likelihood parameter estimate under the unrestricted model and θ_0 the parameter value under the null hypothesis, converges to a chi-square distribution with one degree of freedom. In our case, $\hat{\theta}_{j,r} = \hat{\alpha}_{j,r} + \hat{\gamma}_{j,r}$ and $\theta_0 = 0$, where *j* refers to the *j*'th explanatory variable. (v) "N" is the number of observations, "LR" is the likelihood ratio test for the null hypothesis that the explanatory variables are jointly insignificant. It is chi-square distributed with degrees of freedom equal to the number of explanatory variables. "p-value" is the p-value for the likelihood ratio test that the explanatory variables are jointly significant.

Table 3.5: Mean marginal effects of the explanatory variables

	(1)	(2)	(3)
Expanding only	1970-2013	1970-1987	1988-2013
ΔOAD	0.003	0.042	-0.019
	(0.08)	(0.78)	(-0.49)
$\Delta OAD25$	-0.003	0.025	-0.018
	(-0.23)	(1.08)	(-1.45)
$GROWTH$	0.013**	-0.005	0.021***
	(2.19)	(-0.62)	(3.14)
DEF	0.001	-0.006	0.004
	(0.12)	(-0.86)	(0.92)
$UNEMPL$	0.005	0.007	0.003
	(0.89)	(0.98)	(0.53)
D_{1988}	-0.060*	-0.013	-0.091**
	(-1.89)	(-0.41)	(-2.39)
Contracting only	1970-2013	1970-1991	1992-2013
ΔOAD	0.011	-0.006	0.058
	(0.42)	(-0.24)	(1.46)
$\Delta OAD25$	-0.001	0.000	-0.003
	(-0.08)	(0.02)	(-0.25)
$GROWTH$	-0.010***	-0.006**	-0.016***
	(-3.28)	(-2.31)	(-2.56)
DEF	-0.002	-0.002	-0.003
	(-0.78)	(-0.64)	(-0.59)
$UNEMPL$	0.008**	0.004*	0.015**
	(2.40)	(1.65)	(2.44)
D_{1992}	0.064***	0.050***	0.079***
	(3.51)	(2.81)	(3.82)
Expanding and contracting	1970-2013	1970-1996	1997-2013
ΔOAD	0.010	0.009	0.006
	(0.61)	(0.61)	(0.14)

$\Delta OAD25$	-0.001	-0.003	0.008
	(-0.19)	(-0.38)	(0.62)
$GROWTH$	0.005*	0.004	0.004
	(1.71)	(1.62)	(0.52)
DEF	0.007***	0.006***	0.010*
	(3.27)	(2.60)	(2.20)
$UNEMPL$	0.000	-0.001	0.002
	(-0.19)	(-0.36)	(0.28)
D_{1997}	0.089***	0.090***	0.085***
	(4.22)	(3.56)	(4.71)

Notes: the mean marginal effects are calculated at the averages of the explanatory variables over the full sample or the indicated subsample. Further, see Notes to Table 3.4.

Table 3.6: Multinomial logit estimations with baseline specification

	(1)	(2)	(3)
Independent variables	Expanding Only	Contracting Only	Expanding and Contracting
ΔOAD	0.333	-0.097	0.433
	(0.93)	(-0.12)	(0.66)
$\Delta OAD25$	0.169	0.015	-0.126
	(1.08)	(0.05)	(-0.42)
$GROWTH$	-0.034	-0.178**	0.176
	(-0.62)	(-2.13)	(1.53)
DEF	-0.038	-0.042	0.230**
	(-0.81)	(-0.53)	(2.52)
$UNEMPL$	0.063	0.143*	0.005
	(1.25)	(1.72)	(0.05)
D_y	-0.093	0.865	1.486**
	(-0.25)	(1.48)	(2.09)
$D_y * \Delta OAD$	-0.405	0.631	-0.229
	(-0.86)	(0.73)	(-0.29)
$D_y * \Delta OAD25$	-0.300	-0.048	0.206
	(-1.61)	(-0.16)	(0.62)
$D_y * GROWTH$	0.161**	0.053	-0.158
	(2.09)	(0.52)	(-1.13)
$D_y * DEF$	0.073	0.029	-0.141
	(1.40)	(0.35)	(-1.48)
$D_y * UNEMPL$	-0.014	0.010	0.094

	(-0.25)	(0.12)	(0.93)
Wald test for significance of coefficients in 2nd sub-period			
ΔOAD	0.05	2.09	0.19
$\Delta OAD25$	1.73	0.09	0.32
$GROWTH$	5.47**	4.56**	0.05
DEF	0.92	0.09	2.72*
$UNEMPL$	1.22	7.18***	1.81
Log-likelihood	-879.41	-874.88	-873.61
N	989	989	989
LR	196.04	205.08	207.63
p-value	0.00	0.00	0.00

Notes: see Notes to Table 3.4. The common breakpoints in Columns (1), (2) and (3) are 1988, 1992 and 1997, respectively.

Table 3.7: Baseline logit regressions - 3 year averages of explanatory variables

Independent variables	(1) Expanding Only	(2) Contracting Only	(3) Expanding and Contracting
ΔOAD_3Y	-0.346	-0.005	0.877
	(-0.61)	(0.90)	(0.80)
$\Delta OAD25\_3Y$	0.470*	-1.079**	-0.210
	(1.65)	(-2.18)	(-0.39)
$GROWTH\_3Y$	0.027	-0.350**	0.037
	(0.28)	(-2.29)	(0.21)
DEF_3Y	-0.092*	-0.015	0.259**
	(-1.71)	(-0.17)	(2.55)
$UNEMPL\_3Y$	0.084	0.080	-0.035
	(1.48)	(0.88)	(-0.37)
D_y	-0.185	0.491	1.923**
	(-0.46)	(0.83)	(2.56)
$D_y * \Delta OAD\_3Y$	0.239	-0.782	-1.038
	(0.33)	(-0.62)	(-0.80)
$D_y * \Delta OAD25\_3Y$	-0.533	0.995*	0.257
	(-1.57)	(1.86)	(0.43)
$D_y * GROWTH\_3Y$	0.074	-0.005	-0.058
	(0.66)	(-0.03)	(-0.29)
$D_y * DEF\_3Y$	0.082	-0.035	-0.137
	(1.43)	(-0.38)	(-1.30)

$D_y * UNEMPL\_3Y$	-0.042	0.040	0.041
	(-0.69)	(0.42)	(0.39)
Wald test for significance of coefficients in 2nd sub-period			
ΔOAD_3Y	0.05	0.19	0.05
$\Delta OAD25\_3Y$	0.12	0.17	0.03
$GROWTH\_3Y$	2.50	18.35***	0.04
DEF_3Y	0.07	1.03	3.66*
$UNEMPL\_3Y$	0.88	3.32*	0.01
Log-likelihood	-429.2	-270.8	-183.8
N	943	943	820
LR	40.50	87.53	56.68
p-value	0.17	0.00	0.00

Notes: (i) see Notes to Table 3.4. (ii) The addition "_3Y" indicates that we take the three-year moving average (with the current year being the last year in the moving average).

Table 3.8: Logit estimations additional economic controls: "Expanding only"

Independent variables	(1)	(2)	(3)	(4)
ΔOAD	0.288	0.275	0.288	0.283
	(0.83)	(0.79)	(0.83)	(0.81)
$\Delta OAD25$	0.190	0.183	0.168	0.172
	(1.23)	(1.19)	(1.10)	(1.13)
$GROWTH$	-0.0236	-0.0187	-0.0241	-0.0234
	(-0.44)	(-0.35)	(-0.45)	(-0.43)
DEF	-0.043	-0.040	-0.038	-0.039
	(-0.94)	(-0.87)	(-0.81)	(-0.84)
$UNEMPL$	0.053	0.050	0.037	0.043
	(1.07)	(1.00)	(0.71)	(0.89)
D_{1988}	0.112	-0.084	-0.180	-0.128
	(0.30)	(-0.23)	(-0.49)	(-0.34)
$D_{1988} * \Delta OAD$	-0.412	-0.417	-0.472	-0.438
	(-0.89)	(-0.91)	(-1.01)	(-0.96)
$D_{1988} * \Delta OAD25$	-0.346*	-0.326*	-0.300	-0.308*
	(-1.86)	(-1.78)	(-1.64)	(-1.69)
$D_{1988} * GROWTH$	0.168**	0.171**	0.177**	0.175**
	(2.23)	(2.26)	(2.35)	(2.28)
$D_{1988} * DEF$	0.061	0.067	0.062	0.068
	(1.19)	(1.31)	(1.19)	(1.31)
$D_{1988} * UNEMPL$	-0.025	-0.022	-0.020	-0.021
	(-0.45)	(-0.41)	(-0.37)	(-0.39)

$OPENNESS$	-0.014**			
	(-2.06)			
$INTEREST$		0.009		
		(0.79)		
$INFLATION$			0.002	
			(0.44)	
$DEBT$				0.004
				(0.17)
Wald test for significance of coefficients in 2nd sub-period				
ΔOAD	0.16	0.22	0.36	0.26
$\Delta OAD25$	2.52	2.18	1.88*	2.00*
$GROWTH$	7.35***	8.25***	8.33***	8.06***
DEF	0.23	0.56	0.46	0.63
$UNEMPL$	0.46	0.42	0.14	0.30
Log-likelihood	-444.4	-446.5	-446.7	-446.8
N	989	989	989	989
LR	58.61	54.37	53.95	53.78
p-value	0.01	0.01	0.02	0.02

Notes: see Notes to Table 3.4.

Table 3.9: Logit estimations additional economic controls: "Contracting only"

Independent variables	(1)	(2)	(3)	(4)
ΔOAD	-0.229	-0.173	-0.190	-0.163
	(-0.29)	(-0.23)	(-0.25)	(-0.21)
$\Delta OAD25$	0.008	-0.010	0.009	0.009
	(0.03)	(-0.04)	(0.03)	(0.03)
$GROWTH$	-0.189**	-0.186**	-0.184**	-0.181**
	(-2.24)	(-2.24)	(-2.22)	(-2.17)
DEF	-0.050	-0.047	-0.051	-0.056
	(-0.64)	(-0.59)	(-0.65)	(-0.71)
$UNEMPL$	0.127	0.127	0.139	0.129
	(1.54)	(1.55)	(1.64)	(1.57)
D_{1992}	0.686	0.786	0.862	0.952
	(1.16)	(1.36)	(1.51)	(1.59)
$D_{1992} * \Delta OAD$	0.688	0.668	0.727	0.718
	(0.80)	(0.79)	(0.86)	(0.85)
$D_{1992} * \Delta OAD25$	-0.026	-0.004	-0.037	-0.042
	(-0.09)	(-0.01)	(-0.13)	(-0.15)
$D_{1992} * GROWTH$	0.056	0.045	0.040	0.032

	(0.55)	(0.45)	(0.40)	(0.31)
$D_{1992} * DEF$	0.033	0.027	0.029	0.027
	(0.40)	(0.32)	(0.34)	(0.33)
$D_{1992} * UNEMPL$	-0.001	-0.003	-0.002	0.004
	(-0.02)	(-0.03)	(-0.02)	(0.04)
$OPENNESS$	0.010			
	(1.23)			
$INTEREST$		-0.012		
		(-0.72)		
$INFLATION$			-0.002	
			(-0.27)	
$DEBT$				0.024
				(0.61)
Wald test for significance of coefficients in 2nd sub-period				
ΔOAD	1.63	1.89	2.17	2.32
$\Delta OAD25$	0.03	0.02	0.07	0.09
$GROWTH$	5.39**	6.16**	6.37**	6.64***
DEF	0.16	0.22	0.27	0.45
$UNEMPL$	5.39**	5.17**	5.54**	6.11**
Log-likelihood	-277.64	-278.17	-278.42	-278.27
N	989	989	989	989
LR	83.77	82.71	82.22	82.51
p-value	0.00	0.00	0.00	0.00

Notes: see Notes to Table 3.4.

Table 3.10: Logit estimations additional economic controls: "Expanding and contracting"

Independent variables	(1)	(2)	(3)	(4)
ΔOAD	0.398	0.392	0.409	0.384
	(0.63)	(0.61)	(0.63)	(0.60)
$\Delta OAD25$	-0.110	-0.151	-0.132	-0.106
	(-0.37)	(-0.49)	(-0.44)	(-0.36)
$GROWTH$	0.179	0.159	0.196*	0.181
	(1.58)	(1.40)	(1.68)	(1.58)
DEF	0.231***	0.243***	0.239***	0.222**
	(2.58)	(2.67)	(2.65)	(2.38)
$UNEMPL$	-0.029	-0.059	-0.095	-0.032
	(-0.33)	(-0.67)	(-0.99)	(-0.37)
D_{1997}	1.823**	1.420**	1.534**	1.828**
	(2.53)	(1.97)	(2.21)	(2.45)

$D_{1997} * \Delta OAD$	-0.336	-0.282	-0.521	-0.318
	(-0.43)	(-0.36)	(-0.65)	(-0.41)
$D_{1997} * \Delta OAD25$	0.193	0.270	0.244	0.186
	(0.59)	(0.80)	(0.74)	(0.57)
$D_{1997} * GROWTH$	-0.140	-0.111	-0.155	-0.141
	(-1.03)	(-0.81)	(-1.11)	(-1.03)
$D_{1997} * DEF$	-0.119	-0.126	-0.145	-0.108
	(-1.27)	(-1.32)	(-1.53)	(-1.09)
$D_{1997} * UNEMPL$	0.049	0.060	0.064	0.050
	(0.51)	(0.62)	(0.65)	(0.52)
$OPENNESS$	-0.003			
	(-0.35)			
$INTEREST$		-0.043		
		(-1.41)		
$INFLATION$			0.013	
			(1.55)	
$DEBT$				0.018
				(0.29)
Wald test for significance of coefficients in 2nd sub-period				
ΔOAD	0.02	0,06	0,06	0,02
$\Delta OAD25$	0.38	0,76	0,65	0,35
$GROWTH$	0.23	0,38	0,27	0,25
DEF	4.75**	4,98**	3,38**	4,80**
$UNEMPL$	0.10	0.00	0,18	0,08
Log-likelihood	-187.8	-186.5	-186.6	-187.9
N	860	860	860	860
LR chi2(k)	59.55	62.23	61.97	59.51
Prob> chi2	0.00	0.00	0.00	0.00

Notes: see Notes to Table 3.4.

Table 3.11: Supranational budgetary constraints

	Expanding only		Contracting only		Expanding and contracting	
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
ΔOAD	0.281	0.296	-0.279	-0.278	0.368	0.367
	(0.81)	(0.85)	(-0.34)	(-0.34)	(0.54)	(0.59)
$\Delta OAD25$	0.173	0.176	0.00573	0.00968	-0.136	-0.103
	(1.13)	(1.15)	(0.02)	(0.04)	(-0.45)	(-0.35)

$GROWTH$	-0.0248	-0.0254	-0.175**	-0.178**	0.216*	0.171
	(-0.46)	(-0.48)	(-2.07)	(-2.10)	(1.79)	(1.52)
DEF	-0.0384	-0.0407	-0.0467	-0.0377	0.261***	0.218**
	(-0.83)	(-0.88)	(-0.58)	(-0.47)	(2.73)	(2.43)
$UNEMPL$	0.0443	0.0421	0.146*	0.141*	-0.0538	-0.0331
	(0.90)	(0.86)	(1.76)	(1.72)	(-0.60)	(-0.39)
D_y	-0.133	-0.0586	0.595	0.716	1.481**	1.891***
	(-0.35)	(-0.16)	(1.00)	(1.24)	(2.07)	(2.72)
$D_y * \Delta OAD$	-0.438	-0.448	0.768	0.784	-0.272	-0.346
	(-0.96)	(-0.98)	(0.86)	(0.89)	(-0.33)	(-0.45)
$D_y * \Delta OAD25$	-0.308*	-0.316*	-0.0317	-0.0383	0.216	0.193
	(-1.69)	(-1.73)	(-0.11)	(-0.13)	(0.65)	(0.59)
$D_y * GROWTH$	0.177**	0.162**	0.0327	0.0630	-0.177	-0.148
	(2.34)	(2.13)	(0.32)	(0.61)	(-1.24)	(-1.09)
$D_y * DEF$	0.0668	0.0628	0.0240	0.0232	-0.146	-0.104
	(1.30)	(1.22)	(0.28)	(0.28)	(-1.48)	(-1.11)
$D_y * UNEMPL$	-0.0206	-0.0179	-0.0216	-0.0105	0.0537	0.0574
	(-0.37)	(-0.33)	(-0.24)	(-0.12)	(0.55)	(0.60)
$D\_MAASTRICHT$	-0.0363		0.683		0.801	
	(-0.13)		(1.33)		(1.34)	
$D\_EUROZONE$		-0.326		0.697*		-0.557
		(-1.14)		(1.84)		(-1.08)
Wald test for significance of coefficients in 2nd sub-period						
ΔOAD	0.27	0.26	1.87	1.99	0.05	0.00
$\Delta OAD25$	1.99	2.12	0.06	0.07	0.35	0.43
$GROWTH$	8.09***	6.30**	6.34**	3.83*	0.25	0.08
DEF	0.64	0.38	0.28	0.12	4.97**	4.81**
$UNEMPL$	0.31	0.34	5.21*	5.68*	0.00	0.15
Log-likelihood	-446.8	-446.1	-277.5	-276.7	-187	-187.3
N	989	989	989	989	860	860
LR chi2(k)	53.77	55.08	83.96	85.65	61.24	60.59
Prob> chi2	0.02	0.01	0.00	0.00	0.00	0.00

Notes: see Notes to Table 3.4.

Table 3.12: Logit Estimations: adding political controls

	(1)	(2)	(3)
Independent Variables	Expanding only	Contracting only	Expanding and Contracting
CABINET_INDEX	-0.002	0.001	-0.001
	(-1.24)	(0.61)	(-0.36)
GOV_PARTY	0.08	-0.043	0.013
	(1.26)	(-0.53)	(0.13)
GOV_NEW	0.014	-0.028	0.43
	(0.06)	(-0.1)	(1.27)
GOV_GAP	-0.081	-0.182	-0.062
	(-0.79)	(-1.46)	(-0.38)
GOV_TYPE	0.069	-0.23	0.112
	(0.81)	(-1.96)	(0.73)
GOV_CHAN	-0.098	-0.185	0.304
	(-0.67)	(-0.91)	(1.31)
PARLIAMENT_INDEX	-0.002	0.001	-0.001
	(-1.16)	(0.82)	(-0.33)
RAE_LEG	0.026*	0.004	0.017
	(2.35)	(0.55)	(1.27)
D_ELECTION	-0.171	0.129	0.472
	(-0.90)	(0.53)	(1.60)

Table 3.13: Wald-test for significance baseline variables in second period when political variables are included

	CABINET INDEX	GOV PARTY	GOV NEW	GOV GAP	GOV TYPE	GOV CHAN	PARLIA-MENT INDEX	RAE LEG	ELECTION
Expanding only									
ΔOAD	0.26	0.26	0.27	0.27	0.31	0.30	0.26	0.02	0.29
$\Delta OAD25$	2.05	2.04	1.96	1.94	1.93	1.99	2.04	2.68	2.03
$GROWTH$	7.88***	8.09***	8.36***	8.43***	8.14***	8.32***	7.84***	7.16***	8.51***
DEF	0.64	0.65	0.69	0.72	0.76	0.79	0.65	0.77	0.74
$UNEMPL$	0.22	0.18	0.29	0.25	0.24	0.27	0.22	0.13	0.31
Contracting only									
ΔOAD	2.02	2.05	2.10	2.29	2.50	1.94	2.00	2.37	2.16
$\Delta OAD25$	0.06	0.07	0.06	0.1	0.05	0.05	0.07	0.12	0.07
$GROWTH$	6.06**	6.16**	6.35**	5.97**	5.81**	6.39**	5.91**	6.58**	6.43**
DEF	0.32	0.32	0.34	0.37	0.22	0.31	0.32	0.40	0.35
$UNEMPL$	5.90**	5.82**	5.94**	5.41**	5.60**	6.15**	5.86**	6.19**	5.90**
Expanding and contracting									
ΔOAD	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.14	0.04
$\Delta OAD25$	0.42	0.40	0.50	0.37	0.38	0.36	0.42	0.19	0.42
$GROWTH$	0.23	0.26	0.33	0.26	0.20	0.38	0.23	0.19	0.30
DEF	4.59**	4.65**	4.95**	4.74**	4.67**	4.72**	4.59**	4.36**	4.78**
$UNEMPL$	0.07	0.08	0.00	0.05	0.07	0.06	0.08	0.16	0.07

Notes: see Notes to Table 3.4.

Table 3.14: Logit Estimations: adding first difference of political controls

	(1)	(2)	(3)
Independent Variables	Expanding only	Contracting only	Expanding and Contracting
$\Delta CABINET\_INDEX$	0.002	0.004	0.000
	(0.79)	(1.34)	(-0.08)
ΔGOV_PARTY	-0.070	-0.197	-0.068
	(-0.70)	(-1.60)	(-0.43)
ΔGOV_TYPE	0.029	-0.099	0.294*
	(0.30)	(-0.84)	(1.96)
ΔGOV_CHAN	-0.037	-0.099	-0.019
	(-0.39)	(-0.77)	(-0.12)
$\Delta PARLIAMENT\_INDEX$	0.002	0.004	0.000
	(0.84)	(1.53)	(-0.10)
ΔRAE_LEG	0.019*	0.005	0.016
	(1.70)	(0.67)	(1.10)

Note: due to rounding significance of ΔGOV_TYPE in column (3) is at the 10% level, not at the 5% level.

Table 3.15: Wald-test for significance baseline variables in second period when the first difference of the political variables are included

	ΔCABINET INDEX	ΔGOV PARTY	ΔGOV TYPE	ΔGOV CHAN	ΔPARLIA-MENT INDEX	ΔRAE LEG
			Expanding only			
ΔOAD	0.26	0.27	0.27	0.28	0.25	0.05
$\Delta OAD25$	1.95	1.95	1.98	1.98	1.97	2.56
$GROWTH$	8.44***	8.43***	8.25***	8.35***	8.50***	7.16***
DEF	0.75	0.71	0.69	0.69	0.76	0.50
$UNEMPL$	0.28	0.25	0.30	0.29	0.28	0.60
			Contracting only			
ΔOAD	2.21	2.33	2.07	2.03	2.27	2.47
$\Delta OAD25$	0.10	0.11	0.04	0.05	0.12	0.13
$GROWTH$	5.98**	5.90**	6.21**	6.40**	5.85**	6.66***
DEF	0.31	0.37	0.32	0.37	0.30	0.44
$UNEMPL$	5.57**	5.37**	5.70**	5.97**	5.50**	6.34**
			Expanding and contracting			
ΔOAD	0.02	0.02	0.04	0.02	0.02	0.10
$\Delta OAD25$	0.39	0.37	0.26	0.39	0.39	0.21
$GROWTH$	0.27	0.26	0.31	0.26	0.27	0.21
DEF	4.72**	4.74**	5.02**	4.72**	4.71**	4.18**
$UNEMPL$	0.08	0.05	0.11	0.08	0.08	0.33

Notes: see Notes to Table 3.4.

Table 3.16: logit estimations: accounting for crises

	Expanding only	Contracting only	Expanding and Contracting
Independent variables	(1)	(2)	(3)
ΔOAD	0.276	-0.179	0.393
	(0.79)	(-0.23)	(0.61)
$\Delta OAD25$	0.173	0.003	-0.116
	(1.13)	(0.01)	(-0.39)
$GROWTH$	-0.023	-0.178**	0.179
	(-0.43)	(-2.15)	(1.58)
DEF	-0.041	-0.058	0.228**
	(-0.88)	(-0.73)	(2.55)
$UNEMPL$	0.044	0.132	-0.031
	(0.90)	(1.61)	(-0.35)
D_y	-0.185	0.711	1.695**
	(-0.50)	(1.23)	(2.44)
$D_y * \Delta OAD$	-0.434	0.713	-0.323
	(-0.95)	(0.84)	(-0.41)
$D_y * \Delta OAD25$	-0.310*	-0.041	0.198
	(-1.70)	(-0.14)	(0.61)
$D_y * GROWTH$	0.185**	0.063	-0.126
	(2.45)	(0.62)	(-0.92)
$D_y * DEF$	0.063	0.013	-0.125
	(1.23)	(0.16)	(-1.31)
$D_y * UNEMPL$	-0.019	0.011	0.054
	(-0.34)	(0.13)	(0.56)
D_CRISIS	0.253	0.569*	0.201
	(0.77)	(1.67)	(0.45)
Wald test for significance of coefficients in 2nd sub-period			
ΔOAD	0.28	2.22	0.02
$\Delta OAD25$	2.05	0.13	0.37
$GROWTH$	8.99***	3.82*	0.40
DEF	0.40	1.02	3.65*
$UNEMPL$	0.37	6.98***	0.13
Log-likelihood	-446.5	-277.1	-187.8
N	989	989	860
LR	54.34	84.84	59.63

p-value	0.01	0.00	0.00

Notes: see Notes to Table 3.4.

Table 3.17: Fractions of country-year combinations with actual reform regimes correctly predicted by the theoretical model versus by a random allocation of reforms

	Same year	minus 1 year – same year	minus 2 years – same year
Expanding	19.2%	35.7%	49.2%
	(33.5%)	(21.2%)	(11.3%)
Contracting	22.0%	39.6%	54.1%
	(9.4%)	(4.1%)	(1.6%)

Notes: the number that is not in brackets is the fraction of actual reform regimes correctly predicted by our theoretical model, while the number within the brackets denotes the fraction of draws in which the share of correct predictions of the actual reform regimes is at least as high when reforms are randomly uniformly assigned over the sample years as under our theoretical model. A correct prediction occurs when (i) an actual "Expanding" or "Expanding and contracting" regime is matched with an expanding reform predicted by our theoretical model or the random allocation of a reform, and (ii) a "Contracting" or "Expanding and contracting" regime is matched with a contracting reform predicted by our theoretical model or the random allocation of a reform. The randomly distributed reforms are 50/50 randomly distributed as expanding or contracting.

3.F. Figures

Figure 3.1: Number of reforms in different areas

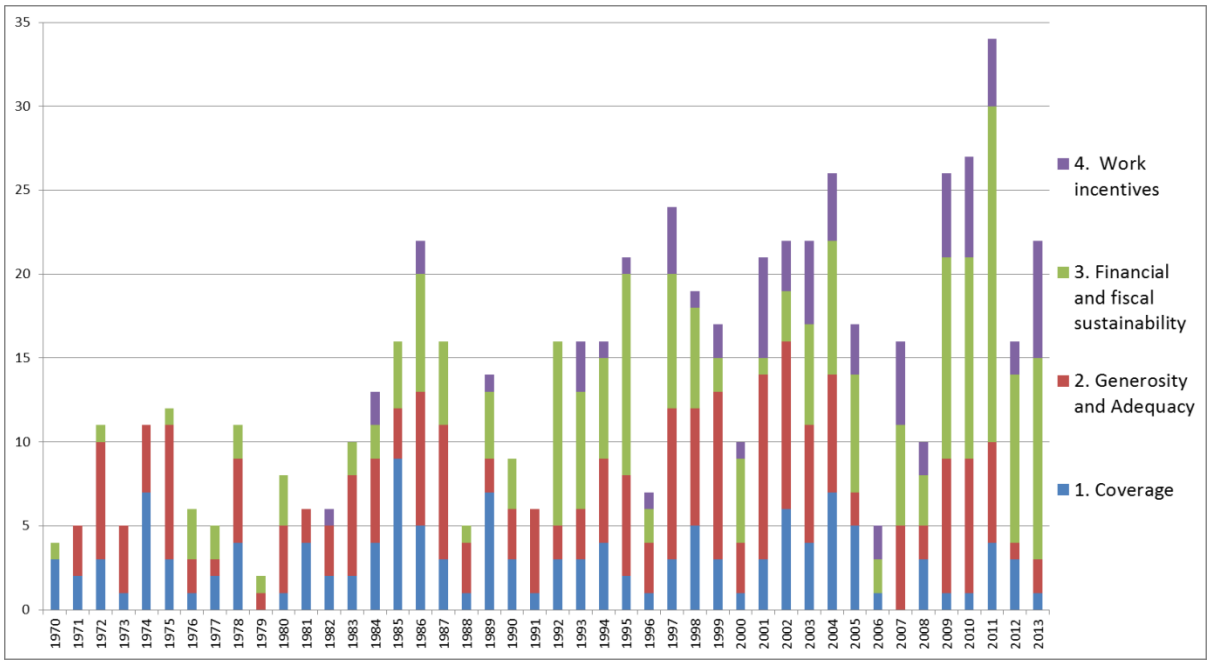
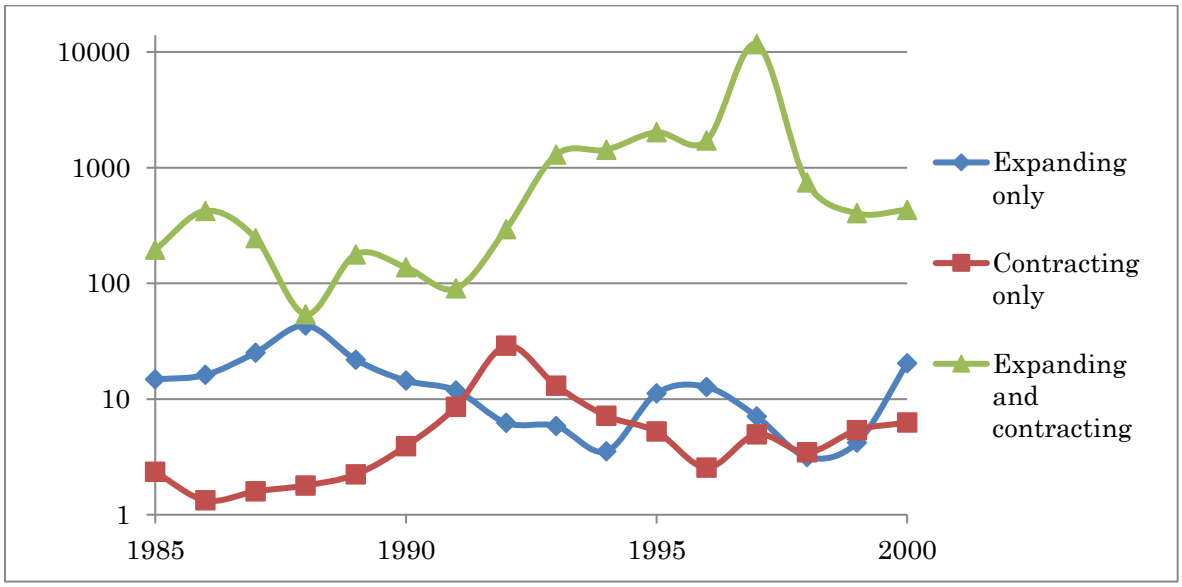


Figure 3.2: Reciprocal of p-value of test for significance structural break dummy



Note: scale is logarithmic.

Figure 3.3: Simulated probability of a reform (expanding or contracting) as a function of k and γ

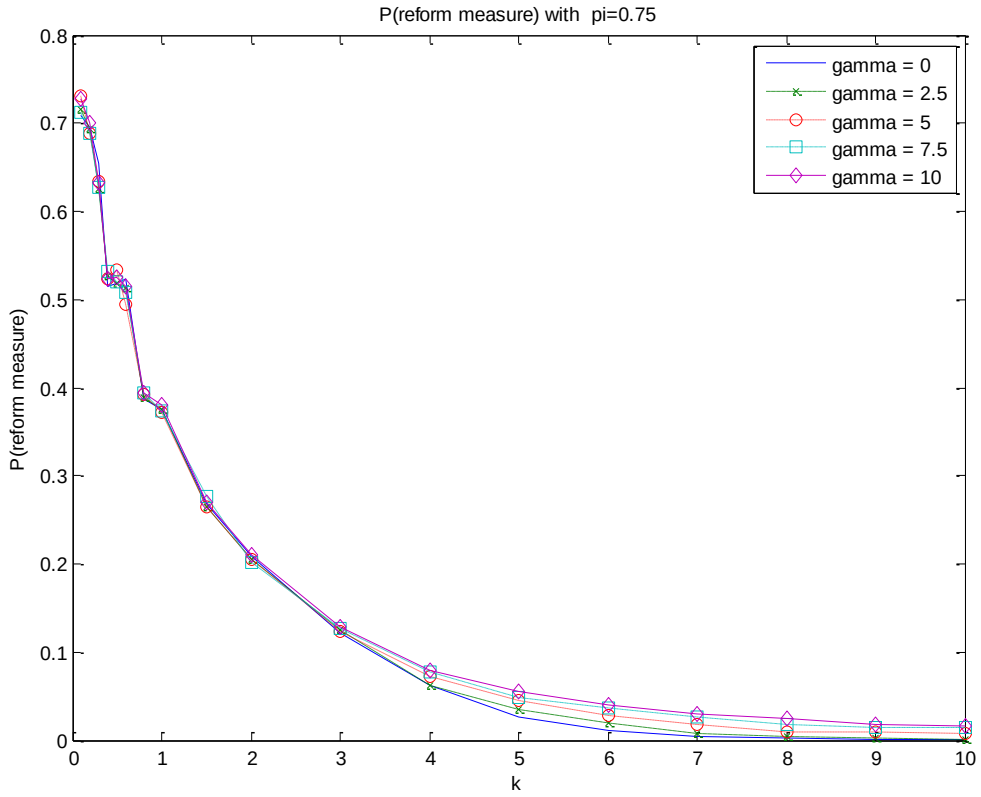
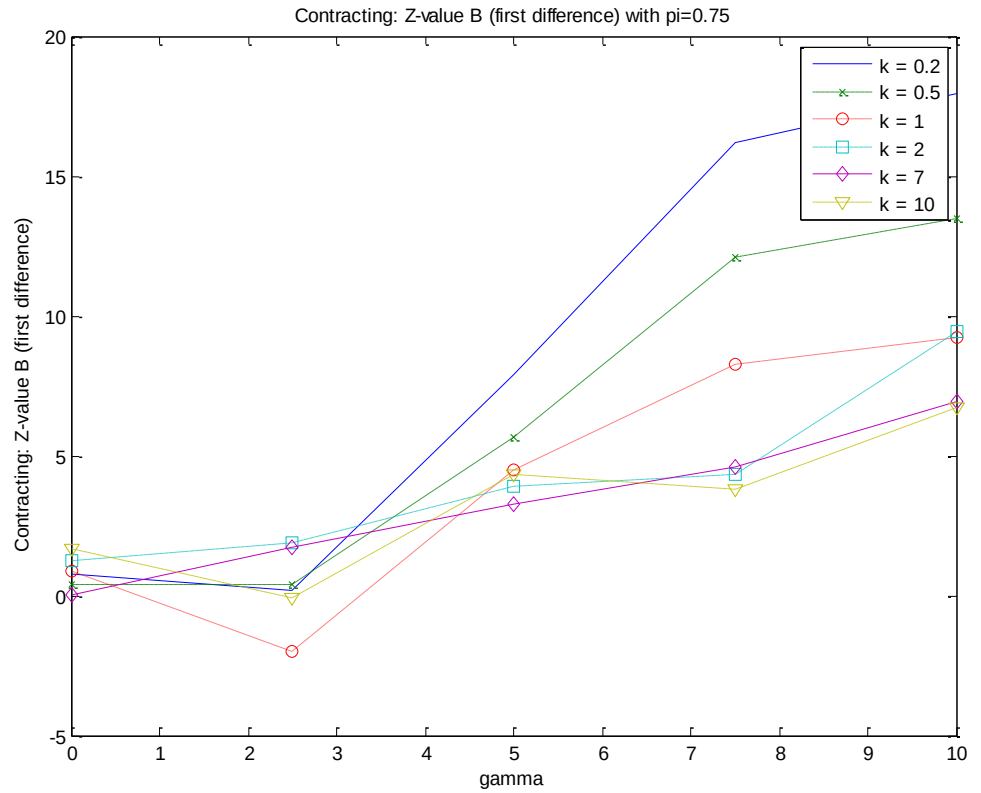


Figure 4: Simulated z-values of the current old-age dependency ratio as a function of k and γ



3.A. Appendices

3.A.1. Details on the collection of the reform data

A substantial amount of the input is obtained from the International Social Security Association (ISSA, 2014), which provides well-documented information on press releases and social security reforms. In addition, we make use of information from the International Labor Organization (ILO, 2014), which provides information on the legislation of old-age social security reforms.

As the date of the reform measure we always take the year in which the measure was officially legislated. This is not necessarily the year of implementation. The main reason for this is that in our further research we want to focus on what triggers pension reform measures. Hence, this requires us to focus on the information that is available at the moment that the measure is enacted. In addition, the implementation date often cannot be uniquely determined, because the measure is implemented in a number of steps. This is often the case for an increase in the statutory retirement age, which may take place in a large number of steps possibly covering a period of decades.

Reform measures can be institutional, such the replacement of the first by a second pension pillar, or they can be incremental. The far majority of the reform measures fall into the latter category. To avoid subjective judgments, we give each reform measure the same weight in our dataset, although we know that some reform measures are more substantial than others.

Below we provide a number of examples of the classification of reform measures starting from the formulation in the original sources.

Belgium 1971:

ILO NATLEX (2014) writes “Royal Decree adapting certain legal provisions with the provisions of the Act of 21 December 1970 establishing a National Social Insurance Institute for freelancers.”

We classify this as “Coverage”.

France 1983:

Gorden (1988) writes “In France, the normal retirement age under employer pensions was 65 until 1983, when all the complementary schemes based on collective agreements lowered the

normal retirement age to 60 to bring them into line with the national provision approved in 1982, which introduced full career pensions at age 60 for all workers with 37.5 years of insurance."

We classify this as "Generosity and adequacy".

Belgium 2005:

ISSA (2014) writes "All those who continue to work after reaching 62 will receive a supplementary pension bonus: the financial rewards will increase with the number of years worked."

We classify this as "Work incentives".

Portugal 2005:

ISSA (2014) writes "According to the new measures the retirement age for the civil service (60 years old) will be gradually increased, by 6 months a year, until it reaches 65 years in 2015."

We classify this as "Financial and fiscal sustainability".

Switzerland 2009:

OECD (2012) writes "Minimum rate of return on mandatory private pensions cut from 2.75% to 2% in 2009 and to 1.5% from 2012."

We classify this as "Financial and fiscal sustainability".

Greece 2012:

OECD (2012) writes "A reduction in monthly pensions greater than €1,000 (US$1,299) by 5 per cent to 15 per cent (depending on income)."

We classify this as "Financial and fiscal sustainability".

3.A.2. Proof of Proposition 1

Define V^N and V^P as in equations (5) and (6). An upper bound for V^N is given by a situation in which the pension benefit can be changed in the next period without adjustment cost, so

$$V^N(Y,B,b) \leq \tilde{U}(Y,B) - K + \pi E\left[\max_{P'} V(P',Y',B',b')|Y,B,b\right]. \qquad (12)$$

Analogously, a lower bound for V^N is attained when the government positively changes the pension benefit both now *and* in the next period, paying the adjustment costs:

$$V^N(Y,B,b) \geq \widetilde{U}(Y,B) - (1+\pi)K + \pi E\left[\max_{P'} V(P',Y',B',b')|Y,B,b\right]. \qquad (13)$$

A lower bound for V^P is given by a situation in which the government positively changes the benefit in the next period:

$$V^P(P,Y,B,b) \geq U(P,Y,B) - \pi K + \pi E\left[\max_{P'} V(P',Y',B',b')|Y,B,b\right], \qquad (14)$$

while an upper bound is given by a situation in which the government can freely change the pension benefit in the next period without adjustment cost:

$$V^P(P,Y,B,b) \leq U(P,Y,B) + \pi E\left[\max_{P'} V(P',Y',B',b')|Y,B,b\right] \qquad (15)$$

Subtracting (14) from (12) and combining with (12) yields

$$V^N(Y,B,b) - V^P(P,Y,B,b) \leq \widetilde{U}(Y,B) - U(P,Y,B) - (1-\pi)K = F(P,Y,B) - (1-\pi)K \leq 0,$$

hence the first result follows immediately. Subtracting (15) from (13) and combining with (13) yields

$$V^N(Y,B,b) - V^P(P,Y,B,b) \geq \widetilde{U}(Y,B) - U(P,Y,B) - (1+\pi)K = F(P,Y,B) - (1+\pi)K > 0,$$

hence the second result follows immediately as well.

3.A.3. The rescaled optimization problem

Under Assumptions 1 and 2, we can write instantaneous utility as

$$U(P,Y,B) = u\big(Z(P,Y,B)\big), \qquad with\ Z = YQ(B)/P, \quad and\ Q(B) = \tilde{P}(1,B).$$

By definition, $u(Z)$ has a maximum at 1. Hence, a second-order approximation around $Z = 1$ yields

$$u(Z) \approx u(1) + \frac{1}{2}u''(1)(Z-1)^2 \approx u(1) + \frac{1}{2}u''(1)(\log Z)^2,$$

with $u''(1) < 0$, since $u(\cdot)$ has a maximum at 1. Now, use Assumption 2, let $\sigma_y^2 = \sigma_\varepsilon^2/(1-\phi_y^2)$ denote the unconditional variance of $log(Y)$ and define

$$z \equiv \frac{1}{\sigma_y} log(Z), \quad and \quad y \equiv \frac{1}{\sigma_y} log(Y).$$

Hence, $var(y) = 1$. With this definition of z, the instantaneous utility is (up to a second-order approximation) proportional to z^2:

$$U(P, Y, B) \propto -z^2.$$

The final function form that requires a specification is $Q(B)$, with $Q(B) > 0$ and $Q'(B) < 0$ (since $\tilde{P}_B(\cdot, B)<0$). Hence, a natural first-order approximation is $Q(B) = Ae^{-cB}$, where $A > 0$ is scaling factor and $c > 0$ measures the sensitivity of the optimal payout $\tilde{P}$ with respect to fluctuations in B. Now define

$$q(B) \equiv \frac{1}{\sigma_y} \log[Q(B)/A] = -\gamma B, \quad \gamma = c/\sigma_y,$$

$$p \equiv \frac{1}{\sigma_y} \log[P/A].$$

Hence,

$$z = y - \gamma B - p.$$

Any level or scaling of the utility function can be completely offset by a similar scaling of the adjustment cost parameter. If we use $k = \frac{1}{2}u''(1)\sigma_y^2 K$, then the optimisation problem reduces to ?? as stated in the main text.

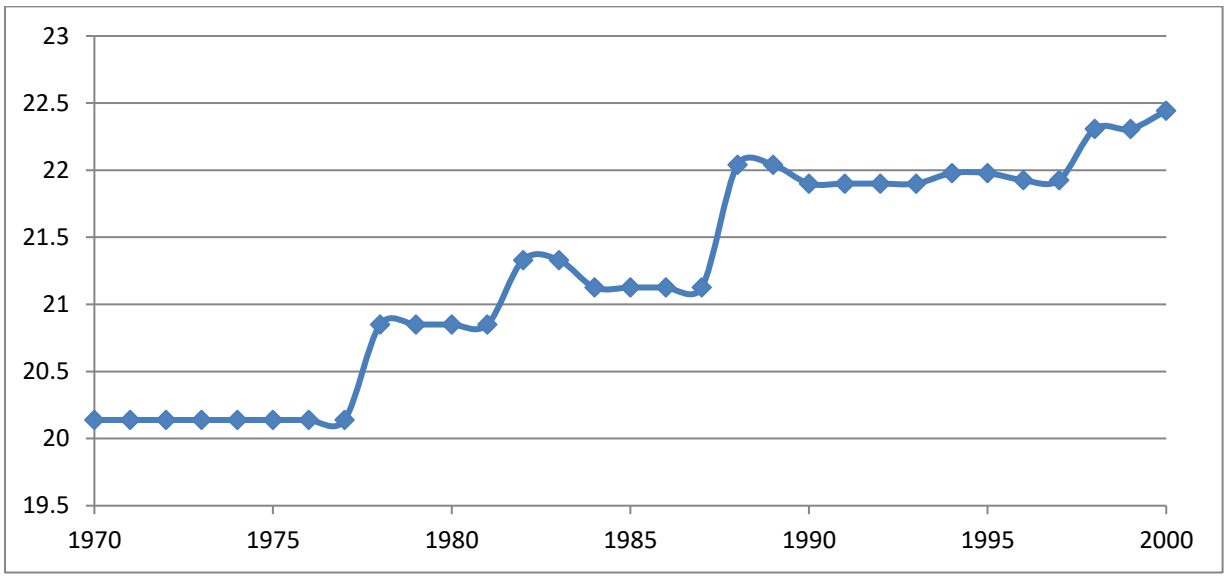
3.A.4. Details on the (construction of the) variables

3.A.4.1. Demographic Variables

Here we define the old-age dependency ratio (in percent) as the number of people of 65 and older divided by the number of people in the age category 15-64, times 100.

The United Nations regularly publish their World Population Prospects (UN-WPP), in which they estimate their old-age dependency ratio for years ahead. We take the UN-WPP as the source of the old-age dependency ratio, because it is the only source that since the 1970s has consistently made country-specific projections on the old-age dependency ratio (in fact, already since the 1950s it has made regional projections) and because the projections for a given year in the future are relatively stable. Figure 3.A.1 illustrates this by depicting the old-age dependency ratio in 1970 as projected in the years 1970 till 2000. The maximum deviation from the eventual realization in 2000 is less than 2.5 percentage points.

Figure 3.A.1: projection of the old-age dependency ratio in 2000 done in different years

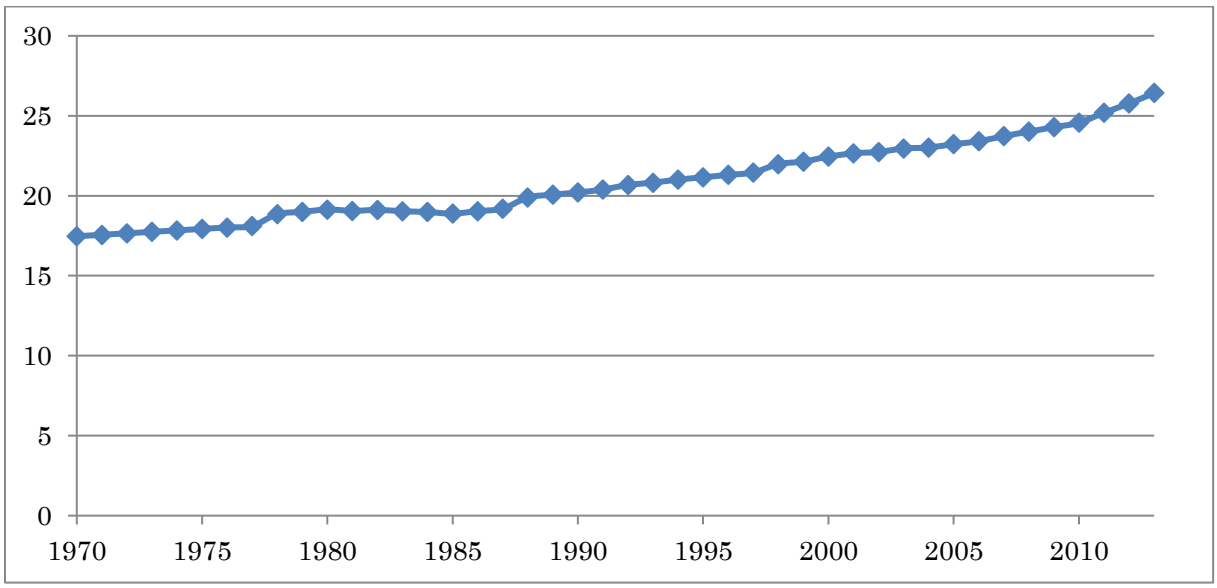


The detailed construction of the variables OAD_{it} and $OAD25_{it}$ is as follows. The years in which a new edition of the UN-WPP was published are 1973, 1978, 1982, 1984, 1988, 1900, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010 and 2012. Projections are only made for specific years ahead at 5-, 10-, or 15-year intervals.

We construct the current the old-age dependency ratio, OAD_{it}, i.e. the ratio at the moment of publication of the UN-WPP, as follows. Take as an example the year 1990. In this year a new edition of the UN-WPP was published. From this we can directly take the estimate of the old-age dependency ratio for 1990. Next take the year 1991. We do not want to use information that is not available in the year 1990, hence we only use data from the edition of 1990. Moreover, because the edition of 1990 gives forecasts with five year intervals, we linearly interpolate between the value of 1990 and the value of 1995. Hence, we obtain the real-time estimate of the old-age dependency ratio for 1991. Since we do not use information that has not yet been published we avoid using information on a sudden demographic shock before it has realized. Observe that the first edition of the UN-WPP that we use is the 1973 edition. In constructing the estimate for the old-age dependency ratio for 1970-1972, we have no other choice than to interpolate from the 1973 edition.

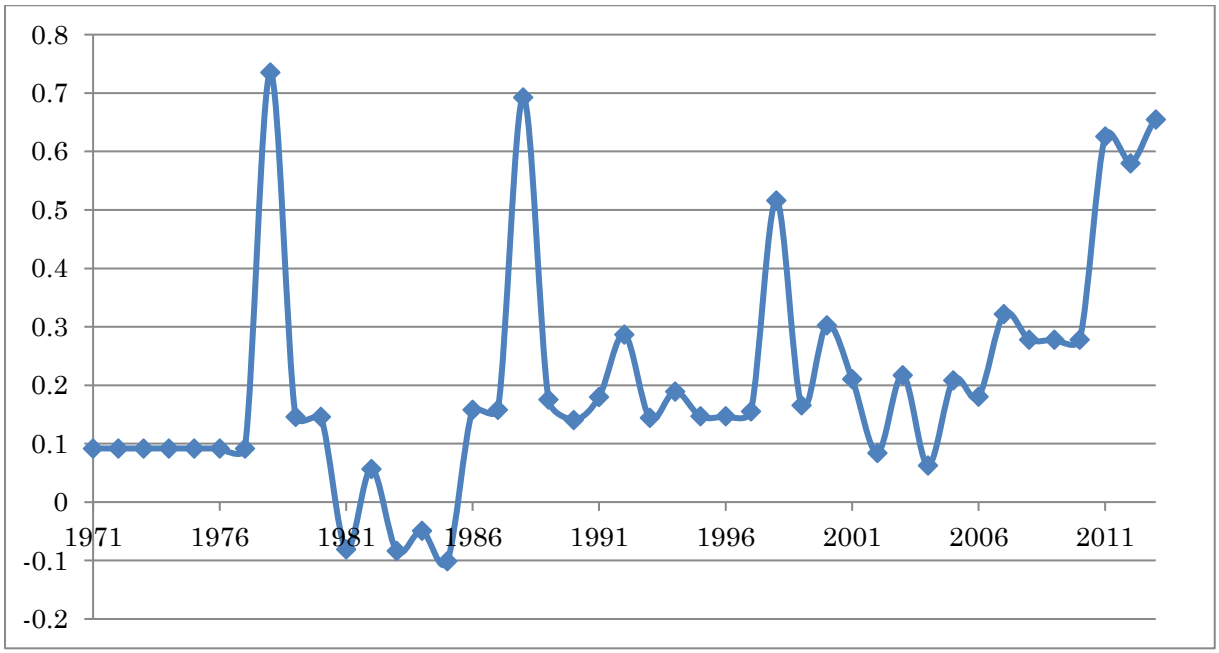
We have a series for the current estimated old-age dependency ratio. Figure 3.A.2 depicts the resulting series over our sample period.

Figure 3.A.2: Average 25-ahead projection of old-age dependency ratio



In our regressions, we include the change in this variable, i.e. $\Delta OAD_{it} = OAD_{it} - OAD_{it-1}$. Figure 3.A.3. depicts the yearly average of this variable.

Figure 3.A.3: Average change of the current estimated old-age dependency ratio

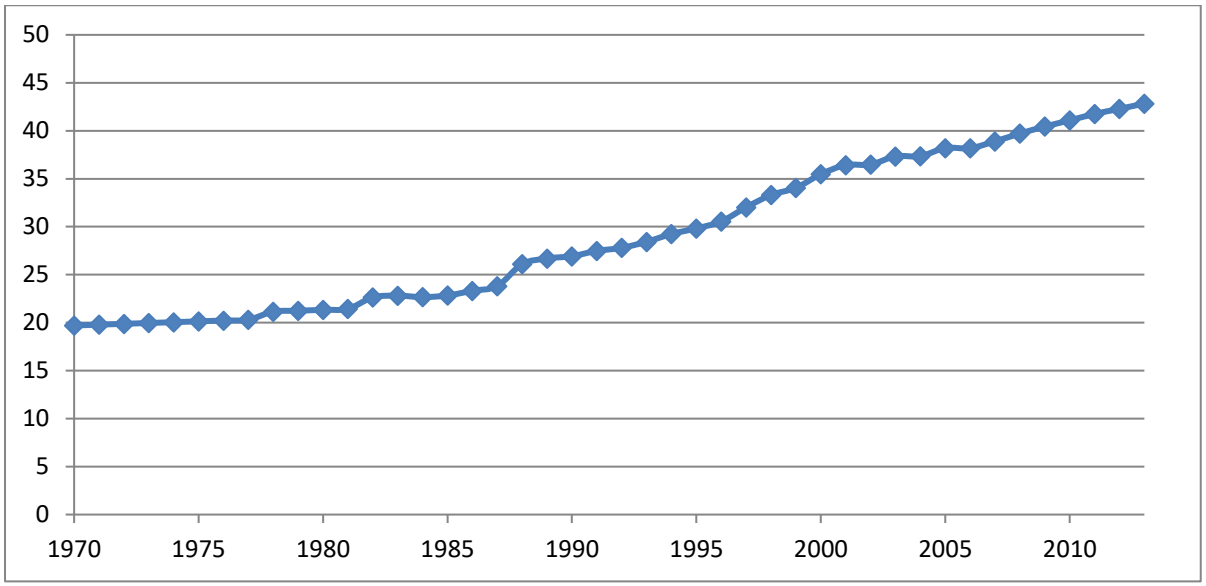


We construct the 25-year ahead forecast for the old-age dependency ratio as follows. As an example take again the 1990 edition of the UN-WPP. This edition reports a forecast of the old-age dependency ratio for 2015, hence we can directly take this number. Then, take the year 1991. Because we want to avoid the use of information that is not available, we construct the 25-year ahead forecast using only data from the 1990 edition. Hence, we linearly interpolate between the forecasted values for 2015 and 2020 from the 1990 edition. In 1992 we have a new edition of the UN-WPP that reports projections for 2015 and 2020. Hence, we obtain the projection for 2017 by interpolating from these two numbers. For other years, we proceed analogously.

The first two editions of the UN-WPP require extrapolations, for they only provide projections up to the year 2000. As already explained, the 1973 edition of the UN-WPP is used to estimate the current old-age dependency ratio for the years 1970 - 1977. To estimate the 25-year ahead forecast in 1977, we need to extrapolate from 2000 to 2002. Again, as already explained the 1978 edition is used to estimate current old-age dependency ratio for 1978 - 1981. To obtain the 25-year ahead forecast in 1981, we need to extrapolate from 2000 to 2006.

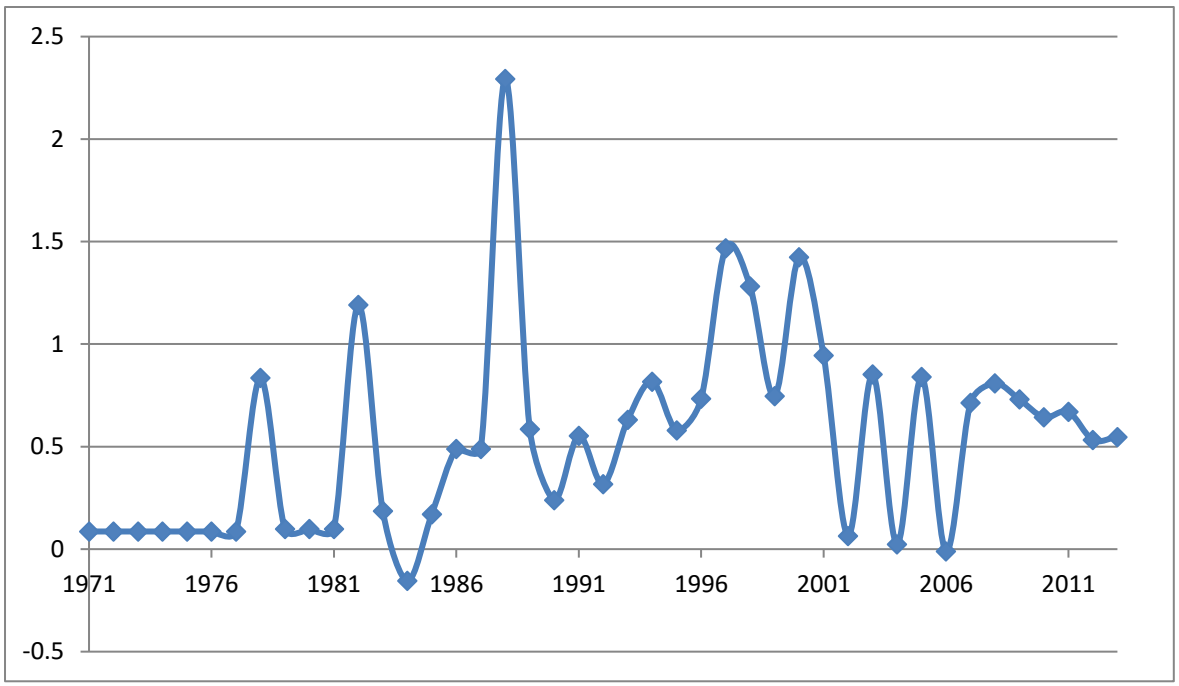
Eventually we thus have a series for the projected old-age dependency ratio for 25-years ahead. Figure 3.A.4 depicts the resulting series over our sample period.

Figure 3.A.4: Average 25-ahead projection of old-age dependency ratio



In our regressions, we include the change in this variable, i.e. $\Delta OAD25_{it} = OAD25_{it} - OAD25_{it-1}$. Figure 3.A.5. depicts the yearly average of this variable.

Figure 3.A.5: Average change in 25-ahead projection of old-age dependency ratio



3.A.4.2. Economic Variables

We extract the following economic variables.

- *Real GDP*: the real GDP data are obtained from the World Bank.
- *Openness of trade*: openness of trade is measured as the sum of exports and imports as a percentage of GDP. Data on imports and exports are obtained from the OECD National Accounts.
- *GDP deflator*: the GDP deflator measures the change of the price level of all domestically produced goods and services, and is obtained from the World Bank.
- *Unemployment rate*: the unemployment rate is measured as the number of unemployed as a percentage of the total labour force. It is obtained from the OECD Economic Outlook.
- *Yield on the public debt*: this is calculated as the average of the yield on short-term debt and on long-term debt. The yield on short term debt is the yield at which short-term (usually 3 month) government paper is issued or traded in the market. Data of this variable is obtained from the OECD Economic Outlook, the OECD Monthly Economic Indicator, and the European Commission AMECO database. The yield on long term debt is the yield at which long (usually 10-year) government bonds are issued or traded in the market. Data of this variable is obtained from the OECD Economic Outlook, the OECD Monthly Economic Indicator, European Commission AMECO, and IMF International Financial Statistics.
- *General government debt*: it is calculated as the central government's gross liabilities, reduced by the government's holding of equity and financial derivatives, and expressed in per cent of GDP. It is obtained from the OECD Economic Outlook.
- *Total receipts of the general government*: this variable measures the total income of the general government in per cent of GDP. The general government consists of four subsectors: the central government, the state government, the local government, and social security funds. These data are obtained from the OECD National Accounts.
- *Total disbursements of the general government*: this variable is expressed in per cent of GDP and is obtained from the OECD National Accounts.
- *General government deficit*: this variable is calculated as total receipts general government – total disbursements of the general government. Thus, this variable is expressed in per cent of GDP.
- *Government net lending*: this variable measures the amount of financial assets available for lending or the amount of borrowing needed to cover the difference between government expenditures and revenues. A positive value refers to net lending, while a

negative value refers to net borrowing. The data is obtained from the OECD National Accounts.

For Germany, for each variable we link the West-German time series for the period before the unification with the German time series after the reunification. For each variable, we inspect whether the unification causes a jump, but we find none.

3.A.4.3. Political Variables

All our political variables are obtained from Armingeon *et al.* (2015). This dataset contains annual data over the period 1960-2013 for a number of OECD countries on a set of political and institutional variables. Here we use:

- $CABINET\_INDEX_{it}$: This variable captures the government's average political orientation based on the seat shares of right-, centre-, and left-wing parties in the cabinet. Armingeon et al. (2015) provide the fraction (in percent) of cabinet posts of right-, centre- and left-wing parties, which they denote by gov_right, gov_cent1 and gov_left1. We create the variable $CABINET\_INDEX_{it}$ as follows: $CABINET\_INDEX_{it} = gov\_right1_{it} * 1 + gov\_cent1_{it} * 0 + gov\_left1_{it} * (-1)$.
- GOV_PARTY_{it}: This variable captures the cabinet composition (Schmidt-Index). It is measured as follows: (1) hegemony of right-wing (and centre) parties ($gov\_left1_{it} = 0$), (2) dominance of right-wing (and centre) parties ($gov\_left1_{it} < 33.3$), (3) balance of power between left-wing and right-wing ($33.3 < gov\_left1_{it} < 66.6$), (4) dominance of social-democratic and other left-wing parties ($gov\_left1_{it} > 66.6$), (5) hegemony of social-democratic and other left-wing parties ($gov\_left1_{it} = 100$).
- GOV_NEW_{it}: A dummy for a new ideological composition of cabinet. The dummy is zero if GOV_PARTY_{it} does not change and one if GOV_PARTY_{it} changes from previous to the current year.
- GOV_GAP_{it}: This variable captures the ideological gap between new and old cabinets and is calculated as the change in the value of GOV_PARTY_{it}, i.e. $GOV\_GAP_{it} = \Delta\, GOV\_PARTY_{it}$.
- GOV_TYPE_{it}: This variable ranges from 1 to 6, where 1 = single-party majority government, 2 = minimal winning coalition, 3 = surplus coalition, 4 = single-party

minority government, 5 = multi-party minority government, 6 = caretaker government, 7 = technocratic government.

- GOV_CHAN_{it} : Number of changes in government per year, where the termination of the government can be due to (a) elections, (b) voluntary resignation of the Prime Minister, (c) resignation of the Prime Minister due to health reasons, (d) dissension within the government (break-up of the coalition), (e) lack of parliamentary support, (f) intervention by the head of state, or (g) broadening of the coalition (inclusion of new parties).
- $PARLIAMENT\_INDEX_{it}$: This variable captures the parliament's average political orientation based on the seats of right-, centre-, and left-wing parties in parliament. Armingeon et al. (2015) provide the fraction (in per cent) of parliamentary seats of right-, centre- and left-wing government parties, which they denote by gov_right2, gov_cent2 and gov_left2 , respectively. We create $PARLIAMENT\_INDEX_{it}$ as follows: $PARLIAMENT\_INDEX_{it} = gov\_right2_{it} * 1 + gov\_cent2 * 0 + gov\_left2 * (-1)$.
- RAE_LEG_{it}: Index of electoral fractionalization of the party system according to the formula proposed by Rae (1968): $RAE\_LEG_{it} = 1 - \sum_{i=1}^{m} s_i^2$, where s_i is the share of voters for party i and m the number of parties (without the category "others"). The index can take values between 1 (indicating maximal fragmentation) and 0 (indicating minimal fragmentation).
- $D\_ELECTION_{it}$: This is a dummy that takes a value of 1 in an election year and 0, otherwise.

3.A.4.4. Crisis variables

We take our crisis variables from Laeven and Valencia (2012). They cover all systemic banking, currency and sovereign debt crises during the period 1970–2011. In addition, they provide data on sovereign debt restructuring, which we also recognize as a crisis if it takes place. A banking crisis occurs if a country's corporate and financial sector experiences multiple defaults and corporate and financial institutions face great difficulties repaying their outstanding loans in time. A currency crisis is defined as an episode in which there is a nominal depreciation of the currency of at least 30 percent, while in addition the currency must be at least 10 percent lower in value than the year before. A sovereign debt crisis is defined as an episode in which a sovereign debt default takes place. Sovereign debt restructuring takes place if debt is restructured.

We construct a dummy variable D_CRISIS_{it} that equals one (zero, otherwise) for a country-year combination if for this combination one or more of crises take place in the Laeven and Valencia (2012) dataset.

3.A.5. Computation of the mean marginal effects

This appendix provides a description of the calculation of the mean marginal effects. We illustrate the calculation of these mean marginal effects for the piecewise linear specification of $z_{it,r}$ in (2'). We denote the estimated values of the coefficients by $\hat{\alpha}_r^j$, respectively $\hat{\gamma}_r^j$, where the subscript denotes the regime and the superscript indicates the *j*-th element of the baseline variables (first is ΔOAD, etc.). The mean marginal effect associated with the *j*-th baseline variable in sub-period p (which could also be equal to the full sample period) is calculated as the first derivative of the probability with respect to that variable, evaluated at the mean value of all covariates:

$$\frac{\partial \Pr(y=1)}{\partial BASEVAR^j} | \bar{X}_p, \bar{D}_{y,p} = \left(\hat{\alpha}_r^j + \hat{\gamma}_r^j \bar{D}_{y,p}\right) \Pr\left(y=1 \middle| \bar{X}_p, \bar{D}_{y,p}\right) \left[1 - \Pr\left(y=1 \middle| \bar{X}_p, \bar{D}_{y,p}\right)\right],$$

where $\bar{X}_p$ is the vector of mean values over sub-period p (and over countries) of the baseline variables and $\bar{D}_{y,p}$ is the mean of the time dummy over the period under consideration. Hence, $\bar{D}_{y,p} = 0$ for the first sub-period and $\bar{D}_{y,p} = 1$ for the second sub-period. The mean of all covariates includes the mean value of the country specific intercepts, so

$$\Pr\left(y=1 \middle| \bar{X}_p, \bar{D}_{y,p}\right) = \frac{\exp(z)}{1+\exp(z)}, \text{ with } z = \frac{1}{n}\sum_i \hat{\alpha}_{0i,r} + \bar{D}_{y,p}\hat{\gamma}_{0,r} + \left(\hat{\alpha}_r + \bar{D}_{y,p}\hat{\gamma}_r\right)' \bar{X}_p$$

The mean marginal effect associated with the time dummy itself in sub-period *p* is calculated as:

$$\Pr\left(y=1 \middle| \bar{X}_p, D_y = 1\right) - \Pr\left(y=1 \middle| \bar{X}_p, D_y = 0\right).$$

Chapter 4

What drives pension reform measures? A comparative analysis between OECD and non-OECD countries.

4.1. Introduction

Over recent decades, the need to reform pension schemes has become a worldwide topic. Within the more developed countries the discussion revolves around the financially unsustainable aspect of the pension schemes, and in many developing countries the discussion dwells mainly on the inadequacy of such schemes. Indeed, many countries have already undertaken pension reforms of some kind. This paper focusses on the determinants of such reform measures and on whether the drivers of reform measures differ between developed and developing countries.

This paper makes several contributions to the literature. First, we construct a new dataset on pension reforms for a total of 151 countries over the period 1995-2013. We categorize the reform measures according to their type, of which "Generosity and adequacy", "Coverage", "Fiscal and financial sustainability" and "Work incentives" are the main ones.

A second contribution of this research is that we focus on a much larger group of countries and a broader range of pension reforms than earlier studies. Available research on pension reform measures focusses on the measures conducted in specific regions such as Latin America, and Central and Eastern Europe, or it only focusses on the shift from PAYG systems to fully funded systems (e.g. Brooks, 2007; and Orenstein, 2005, 2013). This research focusses on a broad array of pension reform measures, ranging from changes in the contribution rate to changes in the retirement age.

Our third contribution is that we empirically explore the determinants of pension reform measures by examining the effects of demographic, economic and budgetary data that were available at the time of reform. To this end, we employ a narrative approach. In

addition, we investigate the role for reforms of political factors and political institutions, such as the effects of elections, the colour of the government, the fractionalization of the political system, a presidential system versus a parliamentary system, and proportional representation in a democracy or not. Finally, we explore the effects of crises on the likelihood of reform measures.

We distinguish three possible reform regimes. A regime with reforms that only expand coverage or eligibility, hence make the system more generous, is referred to as "Expansionary only". A regime with reforms that only aim at increasing financial and fiscal sustainability or stimulating work incentives is classified as "Contractionary only". Finally, a regime in which expansionary and contractionary reforms are undertaken simultaneously is labelled as "Expanding and contracting".

We distinguish between OECD countries and Non-OECD countries. The reason is that the two groups of countries are in different stages of economic and demographic development. For the OECD, we observe over time a slightly upward trend in the overall number of pension reforms, in particular in the area of "Fiscal and financial sustainability" reforms and during the recent financial crisis. For the non-OECD country sample, it is a bit more difficult to detect clear trends. However, the data suggest that "Generosity and adequacy" reform measures have decreased during the recent crisis.

Indeed, our regression analysis yields different results for the OECD and Non-OECD. For the OECD sample the business cycle plays a more dominant role in explaining the occurrence of the "Expanding only" and "Contracting only" regimes. We do not find this for the Non-OECD sample. Further, for both country groups the business cycle helps to explain the occurrence of an "Expanding and contracting" regime. Further, for the OECD sample we do not find any evidence that the old-age dependency ratio drives reforms. Moreover, for the Non-OECD countries we find that an increase in the old-age dependency rate lowers the likelihood of a "Contracting only" reform. We can explain this rather surprising result by the fact that these countries generally still have underdeveloped pension systems, and therefore, an ageing population increases the need for the development of a proper system.

The remainder of this paper is organized as follows. Section 4.2 briefly summarizes the related literature on structural (pension) reforms. Section 4.3 describes the data. Section 4.4 presents the econometric methodology. Section 4.5 discusses the empirical results and the sensitivity analysis, while section 4.6 concludes.

4.2. Review of the literature on the determinants of reform measures

In this section, we review the related literature on the determinants of reform measures. This literature is still relatively small. It focuses mainly on the privatisation of pensions and the switch from PAYG to funded systems in the Latin-American countries in the nineteen eighties and nineties. The literature considers several major drivers of pension and structural reforms, and in the sequel, we address them one by one.

4.2.1. Demographic effects

Demographic changes affect the costs of social security. It is argued that population aging is an important reason for reforming pensions (Börsch-Supan, 2013). Due to increased longevity and lower fertility rates, future fiscal capacity no longer keeps up with the accumulation of pension entitlements. Natali and Rhodes (2007) argue that population ageing and increasing budgetary strains put pension reforms on the political agenda. When this happens, governments often engage in 'political exchange', meaning that a combination of reforms is implemented, with which the government wins over social partners. In the theoretical models featured in the literature the young generally prefer to limit the generosity of the pension system, while the elderly prefer to expand it (see, for example, Sinn and Uebelmesser, 2002). Indeed, Boeri and Tabellini (2012) point out that age is a significant determinant for individuals to prefer Pay-As-You-Go (PAYG) pension schemes. However, Hollanders and Koster (2011) fail to find empirical evidence that countries with older median voters have more generous pension systems. Further, for the U.S. and Western Europe, Razin *et al*. (2003) find a negative correlation between the dependency ratio and the level of social transfers.

4.2.2. Economic conditions

Macroeconomic factors also stimulate governments to engage in structural reforms. Poor economic conditions may undermine the perception that current social welfare arrangements are sustainable, and hence make it easier for governments to implement contractionary pension reforms. Similarly, favourable economic and budgetary situations may lead to expansionary pension reforms.

Aghion and Blanchard (1994) argue that favorable changes in economic conditions (e.g. a declining unemployment rate or increased GDP growth) provide reforming governments with room to compensate losers, hence making reforms more likely. However,

D'Amato and Galasso (2010) argue that under conditions that are particularly averse to the retired agents, office-seeking politicians are more likely to provide them with generous transfers. These transfers are less responsive to aggregate shocks, and therefore more persistent. Meanwhile, the young are in favour of a more generous and persistent pension system for they are implicitly guaranteed with higher benefits when they retire.

Further, Bonfiglioli and Gancia (2015) find empirical evidence that economic uncertainty promotes the implementation of structural reforms. Agnello et al. (2015) find that a large spending-driven consolidation measure raises the likelihood of financial reforms. They further find that higher levels of inflation, lower degrees of trade openness, weaker financial consolidations, and less competitive economies, increase the likelihood of financial reforms. Public indebtedness may also be a trigger for change. Haggard and Kaufman (1989) argue that higher debt leads to more unorthodox structural adjustments.

The determinants of privatization have been addressed in a relative substantial amount of studies and been applied to different sectors and regions. Roberts and Saeed (2012) examine the economic, political and institutional determents of privatization. They find that privatization is more likely to take place in countries displaying satisfactory economic conditions. Countries with high growth experience more privatization. This, they argue, challenges the hypothesis that crisis leads to reforms (as argued by e.g. Rodrik, 1996). By contrast, Weise (2014) shows that under poor economic conditions, namely during periods with high unemployment rates and high government interest rates, the likelihood of healthcare sector privatizations increases. Further, Campos and Norváth (2012) compose an index of structural reforms for 25 former communist countries for the timespan 1989-2001, and find that domestic growth and unemployment are determinants of external liberalization and privatization. Madrid (2002) argues that pension privatization in Latin America was largely driven by macroeconomic factors and increased with a country's capital shortage and the influence of international organizations.

The literature that explicitly focusses on the determinants of pension reforms is limited. James and Brooks (2001) find that large implicit pension debt (IPD) places pension reforms high on the political agenda. However, this large IPD also makes the transition to a FF-DC system more expensive, therewith constraining the degree of funding and privatization that can be attained. Overbye (2008) argues that high interest rates and prosperous economic forecasts make a shift towards Defined-Contributions (DC) schemes more popular.

4.2.3. Crisis

Drazen and Grilli (1993) postulated the so called "crisis-induced-reform hypotheses", which states that countries are induced to reform certain sectors when they are hit by a crisis. This is because, as Tommasi and Velasco (1996) argue, the economic situation needs to get rather bad to have policy makers realize they are dealing with a permanent problem, and that a major policy change is a required solution. In this sense a crisis either facilitates or causes economic reform. Rodrik (1996) argues that a crisis is an extreme case of policy failure, and that if policy has failed (or is perceived not to be working) a reform is the natural consequence. He states that this hypothesis is tautology. This is because it is non-falsifiable, for if a crisis episode has not been followed by a reform this is because the crisis has not yet become severe enough to change the perception of current policy and therefore induce a policy reform.

Drazen and Easterly (2001) find empirical evidence that is in line with the crisis-induce-reform hypothesis, but also find that the evidence is conditional on the type kind of crisis. They find that reforms are indeed triggered by an episode extremely high inflation or black-market premium[18]. They fail, however, to find evidence of reforms triggered by high current account deficits, high budget deficits or negative per-capita GDP growth. By analysing the determinants of financial reforms, Abiad and Mody (2005) find that crisis does trigger action. However, different types of crisis have different effects on financial liberalization. A balance-of-payment crisis raises the likelihood of further financial liberalization. A banking crisis, on the other hand, has the opposite effect. Other empirical evidence that suggests that crises facilitate the adoption of reforms are Pitlik and Wirth (2003), Duval and Elmeskov (2005) and Agnello *et al.* (2015). Campos *et al.* (2010) find that political crisis rather than economic crisis make structural reforms more likely.

Further, politicians may use a crisis episode as an excuse for implementing unpopular measures (Vis, 2015). Specifically, Kay (2014) argues that second-pillars private pensions are not insulated from contemporary politics. Based on several case studies she shows that private fully-funded defined-contribution pension pillars are subject to political force. In particular, in times of financial crises, political leaders have an incentive to seize the assets of such systems.

[18] The black-market premium is the difference between the of the currency on the black market and its official exchange rate to another currency.

4.2.4. Political and institutional effects

Political factors and institutional arrangements may also affect the propensity to reform. Reforms in a certain direction may be triggered by the ideology of the ruling government. There is a widespread perception that left-wing governments are more inclined to reduce inequality by increasing social security transfers, whereas right-wing governments are more inclined to reduce the size of the government and of social security, which would arguably foster the market economy (Alesina and Roubini, 1992).

Some argue that the worldwide shift towards neo-liberalism caused a global trend towards privatization in the 1990s (Bortolotti and Pinotti, 2003). According to Orenstein (2005, 2013), in the 1990s, this so called "neoliberal paradigm" sparked fire in Latin America and Eastern Europe, which caused many of these countries to put privatization of markets and of the social security system high on their political agendas. Arguably, dissemination of this paradigm was largely led by international organisations such as the World Bank, which promotes the implementation of private pensions (see World Bank, 1994, Brooks, 2007, and Orenstein, 2005, 2013). Brooks (2007) and Orenstein (2005, 2013) argue that this global paradigm shift has been the main driver of the world-wide shift from PAYG to a fully funded pension system.

However, empirical work on the effect of ideology on reform produces ambiguous results. Tavares (2004) analyses the determinants of fiscal adjustments and empirically shows that left-wing governments are more likely to implement right-wing policies than that right-wing governments are. Cukierman and Tommasi (1998) argue that right-wing (left-wing) governments find it harder to credibly signal that right-wing (left-wing) policies are beneficial. This is because it is believed (by the public and opposition) that governments are prone to become victims of their own ideology, making it tougher for them to credibly sell policy plans that are in line with their own ideology.

If elections are nearing, governments might use popular reforms to win over the public. An influential study by Kramer (1971) showed the existence of a political business cycle within US congress and found evidence of opportunistic pre-electoral manipulation. Further, if elections are approaching the government may refrain from legislating reforms that entail high costs, for this might harm their image. Finally, a government that expects not to be re-elected may decide to go ahead with unpopular reforms (Hollanders and Vis, 2011).

A newly elected government with a different perspective on "good governance" than its predecessor raises the likelihood of change. Indeed, Lora (2000) empirically investigates

the triggers of structural reforms in Latin America. He finds evidence that structural reforms are more likely to take place in the early years of a new government. This finding is confirmed by Haggard and Webb (1994).

In their analysis on the drivers of privatization, Robert and Saeed (2012) distinguish between developing, transition and advanced economies. For advanced countries they find that older governments are more likely to resort to privatization policies and that this process is facilitated by well-developed financial institutions. For transition economies, however, they find that privatizations are mostly initiated by new governments are associated. This is in line with the theoretical prediction of Shleifer and Vishny (1994).

Rodrik (2000) argues that policy changes significantly depend on the political regime. Autocratic regimes (such as dictatorships) face very little political opposition to reform, which makes a reform process much smoother on the one hand, while on the other hand the pressure for change is also smaller precisely because of the lack of opposition. Empirical research shows that the democratic regimes are more inclined to conduct more economic reform than autocratic regimes (see Haggard and Kaufman, 1992; and Fidrmuc, 2003).

In a proportional representative electoral system governments generally face stronger opposition than under a first-past-the-post electoral system (Persson, 2003). In a similar vein, Alesina and Drazen (1991) argue that reforms are less likely to take place in the presence of more political fragmentation, which allows small parties to use their veto power to block legislation.

4.3. The data

Our panel dataset consists of data on pension reform measures, demographic projections, macroeconomic and budgetary variables and political variables for 151 countries over the period 1995-2013. Our analysis distinguishes between OECD countries and Non-OECD countries. Table 4.1 lists the OECD countries. The other countries are listed by region Tables 4.2 – 4.5.

4.3.1. The pension reform measure data

The pension reform measure data is based on the dataset discussed in Chapter 2, however, for the purpose of making each chapter self-containing we start by providing a brief overview of its structure. We construct a dataset on pension reform measures for 151 countries for the period 1995-2013. A substantial amount of the input is obtained from the International Social

Security Association (ISSA, 2014) and the OECD (2008, 2012, 2013), all of which provide information on the legislation on pension reforms. Where needed, we have consulted a number of miscellaneous (mostly national) sources. In this subsection, we briefly delve into the content and construction of the dataset. However, for a more comprehensive description of the dataset we refer the reader to Chapter 2 which explains in detail the construction of the pension reform measures dataset and which describes the data in detail.

We date reform measures by the year in which they are officially legislated rather than the year in which they are implemented. The reason is that we want the explain which factors influence the reform decision, and, therefore, we want to measure those potential determining factors as close as possible to the moment the reform decision is taken. Moreover, the implementation date of a reform measure is often unclear, since reforms are of implemented in steps. We also often see that politicians and the media start discussing reform before it is actually legislated. For most observations, however, it is infeasible to determine the exact moment such discussion starts. Hence, to avoid assigning arbitrary dates to reforms, we assume that they are dated by their year of legislation.

Our analysis mainly focusses on reform measures that fall into one of the following four categories: (1) "Coverage", measures that *expand* the coverage, for example by extending coverage to the self-employed; (2) "Generosity and adequacy", measures that expand the generosity of the pension system, for example by allowing for early retirement or by raising the individual pension benefit; (3) "Financial and fiscal sustainability", measures that enhance the financial sustainability of the social security system, for example by raising the retirement age; (4) "Work incentives", measures that enhance work incentives, for example by introducing bonuses for working beyond the minimum retirement age. We have collected data on other types of reform as well. We discuss them briefly in Appendix 4.A.1., but we do not use them in our analysis. The majority of the observed reforms fall within the first pension pillar, while a minority of the reforms fall within the second pillar. In Appendix 4.A.1. we provide a few examples on the classification of such reforms.

We define two dummy variables, "Expanding" and "Contracting". The first dummy variable equals one if the sum of the "Coverage" and "Generosity and adequacy" measures for a particular country-year combination is at least one, and zero otherwise. The dummy variable for "Contracting" equals one if the sum of the "Financial and fiscal sustainability" and "Work incentives" measures is at least one, and zero otherwise.

Next, we define three different *reform regimes*, "Expanding only", "Contracting only", and "Expanding and Contracting". We construct a dummy variable for each regime. The

dummy for the "Expanding only" regime equals one if the dummy for "Expanding" is one *and* the dummy for "Contracting" is zero. The dummy for the "Contracting only" regime equals one if the dummy for "Expansion only" is zero *and* the dummy "Contraction" is one. The "Expanding and Contracting" regime dummy equals one if the dummies for both "Expanding" and "Contracting" are equal to one. This latter regime captures the case of the simultaneous adoption of expansionary and contractionary reform. A potential reason for this to happen is that the governments may buy off public or political resistance to a contractionary reform measures by adopting an expansionary measure elsewhere in the system. This conjecture is supported by the fact that the majority of these "Expanding and Contracting" regimes are documented in a single text piece in the ISSA (2014) documentation, implying that both types of measures are simultaneously made public.

Tables 4.1-4.5 records the number of reform measures per category in each country over our sample period. We dissect our sample of countries into five groups: "all OECD countries", "Africa", "Latin America (Non-OECD)", "Asia and Oceania (Non-OECD)", and "Europe (Non-OECD)". There is no overlap between these groups. The group of "all OECD countries" are all countries that are current members of the OECD. To interpret the tables, take Australia as an example: this country features a total of three reforms in the area of "Coverage" over the period 1995 - 2013.

There are substantial differences within regions. Take the OECD region as an example. In this group, the differences are most salient for "Financial and Fiscal Sustainability". We observe that Greece has conducted 17 of such reforms, and Iceland has not conducted any reform of this kind.

Figures 4.1-4.7 depict all pension reform measures in a certain year for the following self-explanatory country samples "All Countries", "All OECD Countries", "All Non-OECD Countries", "Africa", "Latin America (Non-OECD)", "Asia and Oceania (Non-OECD)", and "Europe (Non-OECD)". For the interpretation, take Figure 4.1 as example. Here, we see for 1995 a total of 14 "Coverage" reforms legislated in the "All Countries" sample. We detect some clear trends across time. For example, Figure 4.2**Figure 4.1**, which depicts all pension reforms for "All OECD Countries", shows that the number of legislated "Generosity and adequacy" measures is relatively high in the first half of the sample period and relatively low during the second half of the sample period. Further, the number of "Financial and fiscal sustainability" measures exhibits a positive time trend. However, the "All Non-OECD Countries" group has been rather inactive during the latter part of the sample (see Figure 4.3).

For the sub-groups of the Non-OECD countries we can hardly detect any trend. Only for "Europe (Non-OECD)", we observe an increase in the incidence of "Financial and fiscal sustainability" during the latter years of the recent financial crisis (see Figure 4.7).

Table 4.6 depicts the total number of reforms by category and area. For "All Countries", the total number of expansionary measures ("Coverage" plus "Generosity and Adequacy") is $271 + 416 = 687$, distributed over a total of 2869 (country-year) combinations. Note that a certain country-year combination can have multiple reforms of a specific type. For example, if a country reduces the retirement age and provides higher pension benefits within the same year, this counts as two reforms in the direction of "Generosity and Adequacy". The total number of contracting measures ("Financial and fiscal sustainability" plus "Work incentives") is $407 + 103 = 510$. Further, there are 311 country-year combinations of the "Expanding only" regime, 154 observations of the "Contracting only" regime and 142 observation of the "Expanding and contracting" regime. Given that the country groups differ in size, Table 4.7 repeats the information in Table 4.6 on a per country basis. We observe that the reform measure intensity per country is highest for the OECD countries, followed by Latin America and then followed by Europe non-OECD. Also, for each of the three reform regimes the chances of observing them are highest for the OECD countries, followed by the Latin American countries.

Next, we turn to Figures 4.8-4.14, which plot per country group the average frequency of each reform regime per country in a given year. To interpret the figures, take, for example, Figure 4.8, which shows that in 1995 the fraction of countries in the "Expanding only" reform regime is 0.119. Figure 4.8 suggests a decreasing trend in "Expanding only" reforms since the start of this century, and they suggest an increasing trend in "Contracting only" reforms in recent years. Figure 4.8, which plots the frequency of the different reform regimes in each sample year for "All OECD Countries", suggests that these trends are also present for this country group.

Figure 4.10 depicts the reform measure frequencies for "All Non-OECD Countries". average reform frequencies tend to be lower than for the "All OECD Countries" group. The "Expanding only" regime seems to exhibit a decreasing trend during recent years, while the opposite is the case for the "Contracting only" regime. The "Expanding and contracting"

regime suggests no trend. Hence, qualitatively we observe from similarity with the OECD countries, although at a lower level.

4.3.2. The demographic data

We use the projections of the old-age dependency ratio as estimated by the United Nations World Population Prospects (UN-WPP). The old-age dependency ratio is measured as the number of people of 65 and older divided by the number of people in the age group 15-64. Depending on the issue, projections are made for 1-, 5- or 10-year ahead intervals. From these issues, we obtain the 25 years ahead projected value for the old-age dependency ratio. In Appendix 4.A.2.1. we describe in detail how this variable is constructed.

4.3.3. The economic and budgetary data

Our set of economic and budgetary variables includes per-capita real GDP growth, government deficit, unemployment, openness of trade measured as imports plus exports as percentage of GDP, inflation as measured by the CPI index, and general government debt as a percentage of GDP. Most of the data is obtained from the OECD Economic Outlook (2014), the European Commission's Ameco dataset (2014), the IMF World Economic Outlook (2014), the IMF International Financial Statistics (2014) and the World Bank (2014). Appendix 4.A.2.2. provides a more thorough description of these economic and budgetary variables and their sources.

4.3.4. The crisis data

We take our crisis variables from Laeven and Valencia (2012). They cover all systemic banking, currency and sovereign debt crises during the period 1970–2011. We construct a dummy variable named "CRISIS", which equals one for a country-year combination if for that combination one or more crises took place, and zero, otherwise. Appendix 4.A.2.3. gives a more thorough description of this variable. Furthermore, in Appendix B.4 we provide an overview of the total number of crises observation.

4.3.5. The political and institutional data

Our political variables are obtained from the World Bank's Database on Political Institutions (World Bank, 2012). We use among others the composition of the cabinet, the composition of the parliament, the political orientation of the government and the parliament and electoral variables. We further use variables capturing the design of the political system, namely

whether there is a presidential or a parliamentary system, and whether there is proportional representation or first-past-the-post. Appendix 4.A.2.4. provide a more thorough description of these variables.

4.4. The regression framework

Using a logit regression framework, we uncover the main drivers of the occurrence of pension reform regime. To this end, we define the latent variable $Z_{it,r}$ for reform regime r ("Expanding only", "Contracting only" and "Expanding and contracting") as a linear function f_r of the explanatory variables:

$$Z_{it,r} = f_r(\alpha_i, AREA_i * BASEVAR_{it}, AREA_i * ADD_{it}, \\ (1 - AREA_i) * BASEVAR_{it}, (1 - AREA_i) * ADD_{it}), \quad (1)$$

where $BASEVAR_{it}$ is a vector of baseline variables;

$$BASEVAR_{it} = (OAD_{it}, GDP_{it}, DEF_{it}, UNE_{it})'$$

Here, OAD_{it} is the projected *change* in year t of the old-age dependency ratio 25 years ahead, GDP_{it} is the GDP growth rate of country i, DEF_{it} is the government's budget deficit as a share of GDP and UNE_{it} is the rate of unemployment. Further, α_i is a vector of country dummies, ADD_{it} is a vector of additional control variables and $AREA_i$ is a zero-one indicator whether country i belongs to a specific group of countries.[19] This can be the group of "All countries", the "OECD countries" and "Non-OECD countries". The motivation for this formulation is that when we distinguish between the two sub-samples we prefer to estimate the coefficients for the two country groups in a single regression, so that we can immediately test whether coefficients are significantly different for the two subsamples. The point estimates of the coefficients and their standard errors are unaffected by doing the estimation in a single regression. The explanatory variables will be measured in per cent or in percentage points and hence are stationary. They can reasonably be assumed to be stationary, even though in some cases it may be hard to reject non-stationarity due to the typically low power of these type of tests.

[19] We do not include time-fixed effects because these are highly correlated with the reform measures, as these are often implemented in clusters.

An increase in $Z_{it,r}$ raises the likelihood of ending up in reform regime r. Concretely, the probability for country i in period t of ending up in reform regime r is given by the logistic function $\left[1+\exp(-Z_{it,r})\right]^{-1}$. We conduct a separate logit estimations for each of the three reform regimes, so that the alternative to ending up in regime r is to end up in the regime of "No reform".

4.5. Results

In this section, we describe and interpret the results of our regression analysis. We distinguish the "No reform", "Expanding only", "Contracting only" and "Expanding and contracting" regimes. We further distinguish between "All countries", "OECD countries" and "Non-OECD countries". We start by discussing the results for the baseline regression and continue with several robustness checks by adding additional explanatory variables.

4.5.1. Baseline estimates

The estimates for the baseline regressions of the three regimes are provided in Table 4.8 Column (1) shows the results for "All countries". For the first regime, "Expanding only", we find that only the GDP growth is significant. The sign is positive, indicating that as GDP growth increases this also increases the likelihood of an expansionary reform measure. Column (2) shows the results when we allow the coefficients on the explanatory variables to differ for the OECD and the Non-OECD country groups. For the OECD sample we find that only GDP growth is statistically significant, with a coefficient that is larger than for the full country sample, while for the Non-OECD sample none of the variables turn out to be statistically significant. This suggests that the significance of GDP growth for the full country sample is largely driven by the OECD subsample. Table 4.18 shows the results of the Wald tests for the equality of the coefficients for the two sub-samples. We find that only GDP growth reports to have a significantly different effect on the two sub-samples.

Note that the estimates in Table 4.8 do not provide us with direct information about the magnitude of the coefficient. For this we need to calculate the mean marginal effects (MME). We evaluate these for each explanatory variable at the sub-sample average of all the explanatory variables. Appendix 4.A.3. describes the derivation of the MME. As we explain there, to calculate the MME for the OECD and non-OECD subsamples separately, we need to

estimate the model separately for each of these two country groups and evaluate the MME at the subsample averages of the explanatory variables.

Table 4.9 reports the MME for the "Expanding only" regime. For the full country sample based on the averages of the explanatory variables across the entire dataset we find that a one-percentage point increase of the GDP growth rate raises the likelihood of an expansionary reform by 0.6 percentage points. For the OECD subsample this effect is 1.5 percentage points and highly significant. For the non-OECD subsample this effect is 0.3 percentage point and insignificant. Suggesting that in the OECD, the business cycle plays a rather large role in determining expansionary reforms, and does not play a significant role in the non-OECD countries.

In the same table, we also find the results for the other two regimes. For the "All country" sample, presented in Column (1), we see that for the "Contracting only" regime both GDP growth and the unemployment rate are statistically significant. An increase in the GDP growth rate lowers the likelihood of a contractionary reform, while an increase in unemployment rate raises the likelihood. This suggests that the state of the economy is an important driver of such reforms. Both GDP growth and the unemployment rate are imperfectly correlated indicators of the state of the economy, with the unemployment rate usually trailing behind the GDP growth rate, implying that they may both enter as explanatory variables for the reform decision. As for their MME, reported in Table 4.9, we find that a one percentage point increase in GDP growth decreases the likelihood of an expansionary reform by 0.5 percentage points. Moreover, a one-percentage point increase of the unemployment rate increases the likelihood of an expansionary reform by 0.8 percentage points. In Column (2) of Table 4.8 we find that for the OECD country sample, GDP growth exerts a significantly negative effect on the likelihood of a "Contraction only" regime and unemployment a significantly positive effect. As for their MME (see Table 4.9), we find that a one-percentage point increase in GDP growth reduces the likelihood of a "Contraction only" regime by 1.2 percentage points, while a one percentage point increase in the unemployment rate raises the likelihood of a "Contraction only" regime by 1.1 percentage points. These findings suggest that contractionary reforms within the OECD countries are largely driven by the current state of the economy.

For the Non-OECD countries neither GDP growth, nor unemployment exerts a significant effect on the likelihood of a "Contraction only" regime. Yet the change in the 25-

year ahead projection of the OAD enters significantly with a negative sign, indicating that as the expected old-age dependency rate increases, the likelihood of "Contraction only" regime decreases. Looking at the MME, we find that a one-percent increase in the change in the projected old-age dependency rate, measured at the sample mean, reduces the likelihood of a "Contraction only" regime by 1.7 percentage points (see Table 4.9). This negative effect seems counterintuitive. However, we need to bear in mind that the majority of the non-OECD sample consists of countries with still underdeveloped pension systems, making it impracticable to 'cut' back on coverage and adequacy measures. We argue that as population aging increases the need for maintaining decent pension arrangements increases too. We find that governments of non-OECD countries generally do not extend the pension system, but certainly do *not* opt for contractionary measures. We again test whether the effects of the variables are different for the OECD and the non-OECD, and find that OAD, GDP and $UNEMPLOYMENT$ have a statistically significant different effect between the two subsamples (see Table 4.18 with the corresponding Wald-test statistics). Hence, we conclude that the determinants of contractionary reforms differ substantially between the two samples.

In the final panel of Table 4.8 we present the results for the "Expanding and contracting" regime. As mentioned earlier, the existence of this regime is often the result of governments that buy off public or political resistance to contractionary measures by simultaneously providing expansionary measures. Hence, it is expected that the driving forces behind the likelihood of this regime are somewhat similar to those for the "Contracting only" regime. This is indeed the case. For the full country sample, presented in column (1), we find that only the GDP growth rate is significant and has a negative sign, suggesting that as the GPD growth rate increases the likelihood of this regime decreases. As for its MME, we find that a one-percentage point increase of the GDP growth rate decreases the likelihood of an "Expanding and contracting" reform by 0.6 percentage points (see Table 4.9). The other variables are not significant. Next, we turn to the OECD country sample, where the only significant variable is the government deficit, which is another proxy for the state of the economy. It has a positive sign, implying that if the government deficit increases the likelihood of an "Expanding and contracting" regime also increases. As for its MME (presented in Table 4.9), we find that a one-percentage point increase in the government deficit increases the likelihood of an "Expanding and contracting" reform by 0.8 percentage points. The Wald-test results show that this variable has a different effect for the OECD than

for the non-OECD countries (see Table 4.26). As for the non-OECD, the only statistically significant variable is the GDP growth rate. The sign is negative, which indicates that an increase in the GDP growth rate decreases the likelihood of an "Expanding and contracting" regime. This is in line with what we would have expected. Looking at the MME in Table 4.9, we find that a one-percentage point increase of the GDP growth rate decreases the likelihood of an expansionary reform by 0.7 percentage points. These findings imply that the current state of the economy plays a role in determining the likelihood of an "Expanding and contracting" regime for both sub-samples.

Overall, for the OECD sample we find that the current state of the economy is a significant driver for the likelihood of each of the three reform regimes. The role of the state of the economy is less evident for the non-OECD sample, for which the current state of the economy only seems to drive the likelihood of the "Expanding and contracting" regime. Our results seem to contradict the argument by D'Amato and Galasso (2010) that during poor economic conditions retirees are more likely to get compensated for their incurred losses. Our findings suggest that retirees are more likely to benefit from reforms in prosperous economic conditions.

Furthermore, we find that the determinants of pension reform differ substantially between the two samples. This difference is especially pronounced for the "contracting only" regime, where we find that the business cycle is the main driver for the OECD sample, and demographic changes are the main driver for the Non-OECD sample. Moreover, it is remarkable that the expected change of the old age dependency ratio has no effect on the likelihood of reforms in the OECD sample for any regime, and that the business cycle has only a limited effect on the likelihood of reforms in the Non-OECD sample for which it effects the likelihood of a reform in the direction of expanding and contracting.

4.5.2. Robustness checks

Overall, we find that the reforms are largely driven by macroeconomic and budgetary variables, which especially holds true for the OECD sample. In this section we test the robustness of the baseline regression.

4.5.2.1. Averages of explanatory variables

Thus far, we have used macroeconomic and budgetary information of the year that pension reforms had been legislated. However, before the formal legislation a discussion about the

potential reform measure has usually taken place. Especially larger reforms can take years to materialize and, therefore, also be driven by circumstances that applied in the years before the legislation. Therefore, as our first robustness check, we use as explanatory variables averages of the baseline variables over current and preceding two years. In particular, our specification of $Z_{it,r}$ now becomes:

$$Z_{it,r} = f(\alpha_i, AREA_i * \sum_{j=0}^{2} BASEVAR_{i,t-j}, (1 - AREA_i) * \sum_{j=0}^{2} BASEVAR_{i,t-j}) \qquad (2)$$

Error! Reference source not found. Table 4.10 shows the baseline estimates for this s pecification. Column (1) provides the results for the "All country" sample, while Column (2) provides the results for the OECD and Non-OECD. For the "Expanding only" regime we see that the results reported for the baseline regression are rather robust. The only relevant change occurs for the non-OECD sample, where the estimate for GDP growth is now is statistically significant at the 10% level, indicating that the state of the economy also plays a role for this regime for this country sub-sample.

For "Contracting only" we find that for both the full country sample and the OECD sample, the significance of the negative GDP growth rate has increased to the one percent level. The effect of the government deficit is now statistical significant for the full sample and the Non-OECD sub-sample. The sign is positive, indicating that an increase of the government deficit, raises the likelihood of a contractionary reform. Further, the unemployment rate has lost its significance for both samples. This is likely explained by the fact that the unemployment rate is correlated with the lagged GDP growth rate, which is now captured in our three-year average of the GDP growth rate. The Wald test, presented in Table 4.19, still rejects the equality of the coefficients on GDP growth for the two country sub-samples, but does not, anymore, reject the equality of the coefficients for OAD and $UNEMPLOYMENT$.

Regarding the "Expanding and contracting", GDP growth continues to exert a significant negative effect both for the full sample and the non-OECD subsample. For the OECD sample deficit is not statistical significant anymore. Further, the Wald-test (see Table 4.19) no longer rejects the coefficients on the GDP being equal for the two country sub-samples.

Overall, these findings suggest that our obtained results under the baseline regression is robust to this variation. Most salient, we continue to conclude that the state of the economy continues to play a key role in determining the likelihood of the reform regimes.

4.5.2.2. Additional economic variables

In this subsection, we expand the baseline regressions with economic control variables, including one additional control variable at a time. The additional controls that we include are CPI inflation (*INFLATION*), openness of trade which is measured as imports plus exports as a percentage share of GDP (*OPEN*), and the general government debt ratio as a share of GDP (*DEBT*). The results are reported in Tables 4.11-4.13, for the "Expanding only", "Contracting only", and "Expanding and contracting" regime, respectively.

Inflation reports turns out to be significant only for the "Expanding only" and the "Contracting only" regimes and only for the OECD subsample but not for the Non-OECD sample. In both cases the coefficient on inflation is significantly negative. The Wald tests reported in Tables 4.20 and 4.21 show that the coefficient on inflation differs significantly for the two country subsamples for both the "Expanding only" and the "Contracting only" regimes. Furthermore, as for the robustness of the baseline regression, we find only some mentionable variation for the "Contracting only" regime for which the unemployment rate is not statistical significant anymore. However, for this regime, the business cycle continues to be the main driver for reforms through the GDP growth rate.

Openness of trade is significant for all regimes. We find that the likelihood of an "Expanding only" and an "Expanding and contracting" regime falls when openness of trade increases. Openness of trade may also capture elements of the state of the economy. In fact, in Appendix 4.A.5. we show that once we smooth out the business cycle by taking the averages of openness of trade over a number of years for each country, openness loses significance in explaining the "Expanding only" and "Contracting only" regimes. For the "Expanding and contracting" regime, however, we do find a slightly downward sloping trend. Our findings for openness for the full country sample for these two regimes are driven by the OECD subsample, for which the point estimates on the coefficient of openness are substantially larger, while the coefficient estimates for the non-OECD sample are insignificant. For the "Expanding and contracting" regime the results seem to be driven by the non-OECD sub-sample. The formal test for the equality of the coefficients for the two country sub-samples is not rejected for any of the regimes (see Tables 4.20-4.22), suggesting openness of trade does not affect the two subsets differently.

Finally, general government debt reports to be insignificant for all regimes. As for the robustness of the significance of the coefficient estimates of the baseline variables, for the "Expanding only" regime we find that for the Non-OECD sample, the rate of the government deficit is now statistical significant at the ten percent level. The sign is negative, indicating that as the deficit increases the likelihood of an expansionary reform decreases. Further, for the "Expanding and contracting" regime, we find that the estimate of deficit loses significance for the OECD countries, an effect that is likely explained by the relatively tight relationship between the two variables.

4.5.2.3. The role of a crisis

Following the discussion in Section 2, we investigate whether the presence of a financial crisis affects the likelihood that our reform regimes materialize. In this section, we extend the baseline regression with a dummy for a crisis. For details of the construction of this dummy variable we refer the reader to Appendix 4.A.2.3. where a detailed description is given. Further, note that we only have crisis data up to 2011. Hence, our sample period now ends in 2011 rather than 2013.

The results are provided in Table 4.14. We only find a statistical significant estimator for the "Contracting only" regime, where the crisis dummy is significant for the full country sample. The effect of the crisis dummy is positive, suggesting that the likelihood of a contractionary reform increases during crisis episodes. Not surprisingly, the crisis dummy partly takes over the role of other variables (GDP growth and unemployment) capturing the state of the economy, which both loses significance. For the "Expanding only" and the "Expanding and contracting" regimes we find that the crisis dummy is insignificant. For the "Expanding only" regime we find that the GDP growth rate continues to be statistical significant, however, now at the ten percent level. For the "Expanding and contracting" regime we observe that government deficit ceases to be statistical significant, presumably because the crisis dummy substitutes for other indicators of the state of the economy. Tables 4.20-4.22 report the results of the Wald tests, which in none of the cases reject the hypothesis that the coefficients for the two country subsamples are equal.

Our results for the role of crisis are only partially in line with the "crisis-induced-reform hypotheses" postulated by Drazen and Grilli (1993), who argue that crisis may trigger economic reform. Here, we find that a crisis raises the likelihood of a "Contraction only" regime. This is consistent with the common perception that a crisis provides an excuse for implementing unpopular measures, in line with the argument by Vis (2015).

4.5.2.4. Additional political variables

This subsection addresses the role of political variables in determining the likelihood of the reform regimes. This is done by expanding the baseline regression with one political variable at a time. We also check whether the coefficients on the baseline variables remain unaffected. The additional control variables we include are the number of years a chief executive has been in office (*YRS_OFFC*), a variable that captures the government's ideological leaning (*COLOUR*), a dummy for executive elections (*D_ELECTION*), the margin of majority, i.e. the fraction of seats in parliament held by the government (*MARGIN*), using the Herfindahl index of the government (*HERF_GOV*) and the Herfindahl index of the opposition (*HERF_OPP*) the fractionalization of the parties in respectively the government and opposition is measured. The political data are only available until the year 2012. Hence, the sample period for our regressions now ends in 2012.

Tables 4.15–4.17 report the results for these estimates. To conserve space we only present the outputs of the estimate of the political variables, hence not of the baseline variables. Therefore, each entry is derived from a separate regression.

The results for the "Expanding only" regime are shown in Table 4.15. For this regime none of the political variables are significant for the "All countries" sample and the "Non-OECD countries" sample. For the "OECD countries" sample we find the number of years the executive has been in office, YRS_OFFC, to be statistically significant with a negative sign, suggesting that as the chief executive has spent more years in office, the chance of an expansionary reform decreases. This suggests that if governments push for reforms they often attempt to do so early on in their terms. This is in line with the findings of Haggard and Webb (1994) and Lora (2000), who obtain evidence that structural reforms are more likely to take place in the initial years of a new government. Interestingly, we confirm this result only for the "Expanding only" regime. The inclination to expand pension provision shortly after taking up office may be a reflection of new governments trying to fulfil election promises. The fact that such expansion is more likely to take place early in the new government's term contradicts the theory of the political business cycle, which argues that favourable reforms are more likely to take place shortly as this enhances re-election chances (see Kramer, 1971). For the OECD also the margin of majority of the government reduces the likelihood of the "Expansion only" regime, as $MARGIN$ enters with a negative and significant sign, suggesting that the government needs to cater less to popular demands for expansion if its majority is more comfortable. The Wald tests reported in Table 4.23 reject the equality of the

coefficients on YRS_OFFC and $MARGIN$ for the two country subsamples, indicating these variables affect the two sub-samples differently.

The results for the "Contracting only" regime are reported in Table 4.16. We find that only the Herfindahl index of the opposition ($HERF\_OPP$) is statistically significant and only for the full country sample and for the OECD sample. The sign on its coefficient is positive in these cases, suggesting that if the opposition becomes more fragmented, the likelihood of a contractionary regime increases. This finding seems to contradict Alesina and Drazen (1991), who argue that reforms are less likely to take place in countries with more political fragmentations, for each party can use its veto power to block legislation. However, they do not distinguish between the fragmentation of the government and opposition, as we do in this analysis. The Wald test in Table 4.23 does not reject the equality of the coefficients between the two country samples, though.

Table 4.17 reports the results for the "Expanding and contracting" regime. We find that the margin of majority of the government $MARGIN$ is significant for the OECD sample. However, the Wald test reported in Table 4.23 shows that the coefficient of this variable does not differ between the two country subsamples. Furthermore, for the Non-OECD sample we find that the estimate of YRS_OFFC is statistical significant at the 10% level. The sign is negative, suggesting that as the chief executive has spent more years in office, the chance of an expansionary reform decreases. The Wald test reported in Table 4.23 shows that the coefficient of this variable does not differ between the two country subsamples.

4.5.2.5. The role of political institutional variables

In this subsection, we extend the baseline regression with one political institution variable at the time. The additional control variables are "$SYSTEM$", which contains coded information on different systems (presidential, assembly-elected presidential or parliamentary), "$PLURALITY$", which is a dummy variable that equals one if legislators are elected on the basis of a winner-takes-all (first-past-the-post) system, and "PR", which is a dummy variable that equals one if candidates are elected based on the percentage of votes received by their party (proportional representation). Because we only avail of political institutions data until 2012, the sample period for our regressions now ends in 2012.

The results are provided in Tables 4.15-4.17. Just as for the political variables, to conserve space we only present the outputs of the estimate of the institutional variables, hence not of the baseline variables. Therefore, each entry is derived from a separate regression. For the OECD subsample, we drop proportional representation dummy PR,

because it does not vary within this subsample. The only significant results are found for the "Contracting only" regime in reported in Table 4.16, where *PLURALITY* enters with a significant positive coefficient for the OECD sample, suggesting that using a first-past-the-post system raises the likelihood of a "Contracting only" regime.

The Wald test results are reported in Table 4.23. There are no results in which the equality of the coefficients for the OECD and the non-OECD country groups is rejected.

4.5.3. Summary of results and discussion

In our empirical analysis we have investigated the driving forces behind pension reform measures for a large set of countries, and two subsets; OECD countries and non-OECD countries. Further, we tested whether these driving forces differ the two subsets. Our analysis have led to some interesting results. In this section we discuss the most important results.

Our analyses indicates that the old age dependency ratio does not play a determining factor for any of the reform regimes within the OECD sample. For the non-OECD sample, however, we find empirical evidence that increases of the old age dependency ratio reduces the likelihood of a contractionary reform. This negative effect seems counterintuitive. However, we need to bear in mind that the majority of the non-OECD sample consists of countries with still underdeveloped pension systems, making it impracticable or infeasible to 'cut' back on coverage and adequacy measures. We argue that as population aging increases the need for maintaining decent pension arrangements increases too. However, we find that governments generally do not extend the pension system as a result of an increased old age dependency ration, but certainly do *not* opt for contractionary measures. This indicates that an aging population does not trigger the extension of pension arrangements, but does give notion to the importance of already existing arrangements.

As for the business cycle variables, we find that for the "Expanding only" and "Contracting only" regimes, the business cycle plays a key role in the OECD, but does not play a role in the Non-OECD sample. For the "Expanding and contracting" regime, the business cycle plays a role for both sets of countries, although affect the likelihood of a reform through different channels. This leads us to conclude that the business cycle plays a substantial role in determining the likelihood of reforms for OECD countries, but plays only a limited role for non-OECD countries. A possible reason for this is that pension arrangements in OECD countries are relatively much larger, measured as a percentage share of GDP. Therefore, in times of economic downturn, the policy maker can substantially reduce the government's expenditure by cutting back on pension arrangements. In non-OECD countries

this is often not the case, because of the still rather underdeveloped pension systems there is not much to 'cut' back on.

From our analysis it is clear that reform measures in OECD countries are largely driven by the business cycle. However, for the non-OECD countries, we do not find a clear mechanism that affects the likelihood of reform measures. Considering that in this analysis we have crossed out many of the usual suspects, it is potentially more likely that the country set should be divided up even further in terms of development or region. It would also be interesting to conduct country specific research on the drivers of such reform measures. This, perhaps, provides more insight into the institutional setting that fosters such systems into existance.

4.6. Conclusion

In this paper, we have investigated which factors determine the likelihood of pension reform measures, and whether the driving forces differ between OECD and non-OECD countries. We have used a unique and comprehensive dataset on pension reform measures for a total of 151 countries for the period from 1995 till 2013. We dissect reform regimes into three types: "Expanding only", "Contracting only, and "Expanding and contracting". We have deployed logit regressions that link reform measure decisions to an array of factors. We investigated the role of demographic, economic, budgetary, political, political institutional and crisis variables. We attempted to explain the reform decision using only information that was available at the time the reform decision was made. To this end we have used a "narrative" approach of the type that has become quite popular for research on the effects of changes in fiscal policy. Our analysis focussed the sample of "All countries" and the split of the full country sample into "OECD countries" and "non-OECD countries".

Our empirical analysis has addressed several hypotheses about the potential driving forces of pension reform measures that were put forward in the literature review in Section 2. Surprisingly, we found only limited evidence for the role of the old-age dependency ratio. For the Non-OECD countries, we found that a larger projected increase in the old-age dependency ratio reduces the likelihood of a contractionary reform. Hence, even though expected expenses increase due to population aging, cutting back on benefits or shrinking coverage is not a measure policy makers in non-OECD countries generally opt for. We argued that this is a plausible result. We need to bear in mind that the majority of the non-OECD sample consists of countries with still rather underdeveloped pension systems. Hence,

it is likely that as population aging increases the need for the development of adequate pension arrangements increases, too. Further, we need to realize that with underdeveloped pension systems there is little to cut back on, often making it infeasible to do so. Moreover, for the OECD countries we did not find any statistically significant evidence on the role of the old-age dependency ratio.

We found substantial evidence for the role of the current state of the economy on the likelihood of reform measures. For the "All countries" and the "OECD countries" sample we find evidence that during periods of high economic growth, the likelihood of the "Expanding only" regime increases and the likelihood of "Contracting only" regime decreases. For the "Non-OECD countries" sample the evidence in this direction is weaker, although we find that the "Expanding and contracting" regime becomes more likely if GDP growth increases. For the OECD country sample, we also find that higher unemployment makes "Contracting only" more likely, while a higher deficit makes "Expanding and contracting". In the end, these findings are all a reflection of the role of the state of the economy determining the entry into a reform regime. The state of the economy manifests itself in different ways, implying that the importance of the independent variables that capture the state varies from across the various regressions. We also observe that the current state of the economy has a considerably larger role in determining pension reform decisions in OECD countries than in non-OECD countries.

Our main results are robust for the various robustness checks that we carried out, including the averaging of our independent variables over some years, the inclusion of additional economic political or political institutional variables and the introduction of a crisis dummy, with the latter sometimes taking over the role of the variables capturing the state of the economy.

4.T. Tables

Table 4.1 : Number of reforms by country and type - All OECD Countries				
Country	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives
Australia	2	6	6	7
Austria	2	4	2	2
Belgium	2	7	3	3
Canada	1	4	3	1
Chile	3	4	0	1
Czech Republic	2	2	7	3
Denmark	3	5	11	4
Estonia	4	4	5	1
Finland	2	5	5	4
France	7	10	10	6
Germany	1	7	7	1
Greece	3	7	17	5
Hungary	3	2	8	2
Iceland	1	0	0	0
Ireland	5	7	7	3
Israel	1	2	1	0
Italy	2	2	9	3
Japan	6	8	10	0
Korea, Republic of	4	3	2	0
Luxembourg	3	8	8	2
Mexico	8	8	0	2
Netherlands, the	0	0	4	1
New Zealand	3	0	4	0
Norway	1	2	2	2
Poland	3	3	5	1
Portugal	3	2	8	4
Slovakia	5	4	3	0
Slovenia	4	0	5	1
Spain	1	13	7	7
Sweden	1	4	2	4
Switzerland	3	2	8	2
Turkey	3	6	8	0
United Kingdom	4	9	6	2
United States	1	6	4	0

Note: the set of OECD countries are all current (2016) OECD countries.

Table 4.2: Number of reforms by country and type - Africa				
Country	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives
Algeria	0	2	0	0
Benin	2	1	3	0
Botswana	1	0	0	0
Burkina Faso	0	2	2	0
Burundi	0	1	2	0
Cabo Verde	0	2	1	0
Congo	0	1	4	0
Congo, Democratic Republic	2	0	0	0
Côte d'Ivoire	0	0	4	0
Djibouti	0	0	0	0
Egypt	1	3	2	0
Ethiopia	2	4	1	1
Gambia	0	1	0	0
Ghana	1	1	0	0
Kenya	2	4	2	1
Lesotho	1	0	0	0
Malawi	1	0	0	0
Mali	1	0	8	0
Mauritania	0	0	1	0
Mauritius	1	5	3	0
Morocco	1	2	2	0
Mozambique	0	3	0	0
Namibia	1	0	0	0
Niger	0	1	0	0
Nigeria	3	1	3	0
Rwanda	1	2	3	0
Senegal	1	1	1	0
Seychelles	2	4	1	0
Sierra Leone	1	1	0	0
South Africa	1	7	1	0
Swaziland	0	1	1	0
Tanzania, United Republic of	1	0	0	0
Togo	0	0	2	0
Tunisia	5	4	2	0
Uganda	0	1	0	0
Zambia	1	1	0	0
Zimbabwe	0	4	4	0

Table 4.3: Number of reforms by country and type – Latin America (Non-OECD)				
Country	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives
Argentina	2	10	5	1
Bahamas, The	1	0	0	1
Barbados	0	8	2	0
Belize	1	0	0	0
Bolivia	6	12	1	0
Brazil	5	7	12	5
Colombia	2	2	5	0
Costa Rica	0	2	5	0
Cuba	0	2	1	2
Dominica	0	1	1	2
Dominican Republic	2	1	0	0
Ecuador	0	4	1	0
El Salvador	3	1	3	1
Grenada	1	1	1	0
Guatemala	1	1	2	0
Guyana	0	0	1	0
Jamaica	0	1	1	0
Nicaragua	0	0	2	0
Panama	3	3	4	0
Peru	4	6	3	0
St. Kitts and Nevis	1	4	0	0
St. Lucia	0	0	3	0
St. Vincent and the Grenadines	1	3	5	0
Suriname	1	1	0	0
Trinidad and Tobago	3	6	4	0
Uruguay	8	3	1	0
Venezuela, RB	1	0	0	0

Table 4.4: Number of reforms by country and type – Asia and Oceania (Non-OECD)				
Country	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives
Bahrain, The Kingdom of	1	3	0	0
Bangladesh	1	0	0	0
Brunei Darussalam	1	0	1	0
Cambodia	1	0	0	0
China	5	7	2	1
Fiji	1	1	0	0
French Polynesia	1	0	1	0
Hong Kong	5	5	3	0
India	8	7	3	0
Indonesia	3	0	0	0
Iran, Islamic Rep.	6	6	5	1
Jordan	3	2	3	2
Lao PDR	1	0	1	0
Lebanon	1	1	0	0
Malaysia	1	7	5	1
Maldives	2	1	0	0
Marshall Islands	0	2	2	0
Micronesia, Fed. Sts.	1	1	4	0
Mongolia	0	2	4	0
Oman	1	3	1	0
Pakistan	5	6	1	0
Papua New Guinea	1	0	1	0
Philippines	3	9	2	0
Qatar	1	0	0	0
Samoa	0	0	0	0
Saudi Arabia	2	2	2	0
Singapore	0	3	4	0
Sri Lanka	2	0	0	0
Syrian Arab Republic	2	0	1	0
Taiwan	4	2	3	0
Thailand	5	4	2	0
United Arab Emirates	1	0	0	0
Vanuatu	0	0	0	0
Vietnam	0	1	0	0
Yemen, Rep.	1	0	0	0

Table 4.5: Number of reforms by country and type – Europe (Non-OECD)				
Country	1. Coverage	2. Generosity and Adequacy	3. Financial and fiscal sustainability	4. Work incentives
Albania	3	3	1	0
Andorra	1	2	3	1
Armenia	1	0	1	0
Belarus	0	4	2	1
Bulgaria	1	3	9	2
Croatia	3	2	1	1
Cyprus	1	5	0	0
Latvia	1	7	11	2
Liechtenstein	0	1	1	0
Lithuania	1	0	5	1
Macedonia, FYR	1	0	0	0
Malta	0	1	3	0
Moldova	0	0	2	1
Monaco	0	2	4	0
Romania	3	7	5	1
Russian Federation	7	4	2	0
Serbia	1	0	0	0
Ukraine	1	5	3	0

Table 4.6: Number of reforms by reform regime and area

	All Countries (151)	OECD (34)	Africa (37)	Europe (Non-OECD) (18)	Asia and Oceania (35)	Latin America (17)
Coverage (1)	271	97	33	25	70	46
Generosity and adequacy (2)	416	156	60	46	75	79
Expanding (1+2)	687	253	93	71	145	125
"Expanding only" regime	311	100	50	32	77	52
Financial and fiscal sustainability (3)	407	187	53	53	51	63
Work incentives (4)	103	74	2	10	5	12
Contracting (3+4)	510	261	55	63	56	75
"Contracting only" regime	154	87	17	18	16	16
"Expanding and Contracting" regime	142	56	18	15	25	28
Total (1+2+3+4)	1197	514	148	134	201	200

Table 4.7: Average number of reforms by reform regime and area

	All Countries (151)	OECD (34)	Africa (37)	Europe (Non-OECD) (18)	Asia and Oceania (35)	Latin America (17)
Coverage (1)	1,79	2,85	0,89	1,39	2,00	2,71
Generosity and adequacy (2)	2,75	4,59	1,62	2,56	2,14	4,65
Expanding (1+2)	4,55	7,44	2,51	3,94	4,14	7,35
"Expanding only" regime	2,06	2,94	1,35	1,78	2,20	3,06
Financial and fiscal sustainability (3)	2,70	5,50	1,43	2,94	1,46	3,71
Work incentives (4)	0,68	2,18	0,05	0,56	0,14	0,71
Contracting (3+4)	3,38	7,68	1,49	3,50	1,60	4,41
"Contracting only" regime	1,02	2,56	0,46	1,00	0,46	0,94
"Expanding and Contracting" regime	0,94	1,65	0,49	0,83	0,71	1,65
Total (1+2+3+4)	7,93	15,12	4,00	7,44	5,74	11,76

Table 4.8: Baseline regressions

Regime	Variables	(1) All Countries	(2) OECD	(2) Non-OECD
Expanding Only	*OAD*	-0.043	-0.033	-0,044
		(-0.81)	(-0.36)	(-0,67)
	GDP	0.054**	0.126***	0,033
		(2.37)	(2.64)	(1,28)
	DEF	-0.032	0.026	-0,043
		(-1.36)	(0.53)	(-1,55)
	UNE	-0.008	-0.091	0,027
		(-0.25)	(-1.51)	(0,69)
	Log likelihood	751.4		-748.4
	N	2046		2046
	LR Chi2(k)	170.79		176.77
	prob>chi2	0.000		0.000
Contracting Only	*OAD*	-0.071	0.091	-0.277**
		(-0.97)	(0.93)	(-2.33)
	GDP	-0.064**	-0.113***	-0.07
		(-2.11)	(-2.64)	(-0.15)
	DEF	0.045	0.038	0.056
		(1.30)	(0.81)	(1.02)
	UNE	0.091**	0.120**	-0.096
		(2.04)	(2.27)	(-0.87)
	Log likelihood	-378.2		-370.1
	N	1152		1152
	LR Chi2(k)	59.78		74.21
	prob>chi2	0.626		0.283
Expanding and Contracting	*OAD*	0.036	0.033	0,054
		(0.42)	(0.29)	(0,42)
	GDP	-0.077***	0.004	-0,103***
		(-2.80)	(0.08)	(-3,21)
	DEF	0.014	0.097*	-0,015
		(0.47)	(1.76)	(-0,43)
	UNE	0.027	0.018	0,029
		(0.64)	(0.30)	(0,44)
	Log likelihood	-406.2		-404.0
	N	1416		1416
	LR Chi2(k)	46.99		51.44
	prob>chi2	0.998		0.979

Notes: figures between parentheses are t-values. Further, *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. The number of observations differs because some countries have zero variation within regimes (e.g. no entries for the "Expanding and contracting" regime). Subsequently, these countries are dropped from the regression for that regime.

Table 4.9: Mean Marginal Effects

Regime	Variables	All Countries	OECD	Non-OECD
Expanding Only	*OAD*	-0.004	-0.004	-0.004
		(-0.81)	(-0.36)	(-0.67)
	GDP	0.006**	0.015***	0.003
		(2.38)	(2.70)	(1.28)
	DEF	-0.003	0.003	-0.004
		(-1.36)	(0.53)	(-1.56)
	UNE	-0.001	-0.011	0.003
		(-0.25)	(-1.52)	(0.70)
Contracting Only	*OAD*	-0.006	0.010	-0.017***
		(-0.98)	(0.94)	(-2.32)
	GDP	-0.005**	-0.012***	-0.000
		(-2.12)	(-2.67)	(-0.15)
	DEF	0.004	0.004	0.004
		(1.31)	(0.82)	(1.03)
	UNE	0.008**	0.013**	-0.006
		(2.05)	(2.29)	(-0.88)
Expanding and Contracting	*OAD*	0.003	0.003	0.003
		(0.42)	(0.29)	(0.42)
	GDP	-0.006***	0.000	-0.007***
		(-2.84)	(0.08)	(-3.31)
	DEF	0.001	0.008*	-0.001
		(0.47)	(1.78)	(-0.43)
	UNE	0.002	0.002	0.002
		(0.64)	(0.30)	(0.44)

Notes: figures between parentheses are t-values. Further, *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level.

Table 4.10: Baseline regressions - three year averages

		(1)	(2)	
Regime	Variables	All Countries	OECD	Non-OECD
Expanding Only	*OAD*	0.094	0,137	0,080
		(0.86)	(0,74)	(0,59)
	GDP	0.095***	0,171**	0,071*
		(2.66)	(2,33)	(1,72)
	DEF	-0.024	-0,034	-0,014
		(-0.72)	(-0,50)	(-0,35)
	UNE	0.029	0,003	0,047
		(0.73)	(0,04)	(0,94)
	Log likelihood	-651.60	-651,25	
	N	1748	1748	
	LR Chi2(k)	143.85	146,53	
	prob>chi2	0.012	0,016	
Contracting Only	*OAD*	-0.216	0,025	-0,430**
		(-1.59)	(0,13)	(-2,07)
	GDP	-0.222***	-0,360***	-0,052
		(-4.14)	(-4,73)	(-0,63)
	DEF	0.107**	0,051	0,208**
		(2.05)	(0,76)	(2,15)
	UNE	0.015	-0,005	-0,066
		(0.25)	(-0,07)	(-0,45)
	Log likelihood	-319.59	-313,75	
	N	975	975	
	LR Chi2(k)	76.32	88,00	
	prob>chi2	0.089	0,030	
Expanding and Contracting	*OAD*	-0.062	0,022	-0,139
		(-0.40)	(0,11)	(-0,58)
	GDP	-0.106**	0,004	-0,147***
		(-2.34)	(0,05)	(-2,63)
	DEF	-0.001	0,113	-0,048
		(-0.02)	(1,49)	(-0,91)
	UNE	0.042	0,015	0,058
		(0.79)	(0,19)	(0,71)
	Log likelihood	-362.9	-360,9	
	N	1211	1211	
	LR Chi2(k)	43.38	47,37	
	prob>chi2	0.999	0,998	

Notes: see Table 4.8.

Table 4.11: Expanding only - Adding economic variables

	(1)	(2)	
Variables	All Countries	OECD	Non-OECD
OAD	-0.043	-0.024	-0.044
	(-0.82)	(-0.26)	(-0.69)
GDP	0.055**	0.137***	0.035
	(2.39)	(2.84)	(1.31)
DEF	-0.033	0.041	-0.043
	(-1.37)	(0.83)	(-1.56)
UNE	-0.008	-0.111*	0.028
	(-0.24)	(-1.77)	(0.71)
INFLATION	0.001	-0.079*	0.001
	(0.55)	(-1.76)	(0.61)
Log likelihood	-750.99		-745.53
N	2043		2043
LR Chi2(k)	170.69		181.60
prob>chi2	0.001		0.000
OAD	-0.050	-0.052	-0.055
	(-0.91)	(-0.56)	(-0.79)
GDP	0.053**	0.112**	0.030
	(2.28)	(2.34)	(1.12)
DEF	-0.045*	0.010	-0.054*
	(-1.81)	(0.20)	(-1.87)
UNE	-0.002	-0.087	0.034
	(-0.06)	(-1.42)	(0.87)
OPEN	-0.009**	-0.018**	-0.003
	(-1.95)	(-2.17)	(-0.53)
Log likelihood	-737.12		-733.01
N	1977		1977
LR Chi2(k)	170.73		178.83
prob>chi2	0.000		0.000
OAD	-0.043	-0.033	-0.042
	(-0.80)	(-0.36)	(-0.64)
GDP	0.059**	0.125***	0.039
	(2.52)	(2.63)	(1.48)
DEF	-0.037	0.032	-0.049*
	(-1.53)	(0.63)	(-1.75)
UNE	-0.016	-0.080	0.018
	(-0.48)	(-1.22)	(0.43)
DEBT	0.004	-0.004	0.006
	(1.03)	(-0.44)	(1.38)
Log likelihood	-743.00		739.5
N	2031		2031
LR Chi2(k)	172.19		179.23
prob>chi2	0.000		0.000

Notes: see Table 4.8.

Table 4.12: Contracting only - Adding economic variables

	(1)	(2)	
Variables	All Countries	OECD	Non-OECD
OAD	-0.072	0.122	-0.277**
	(-0.98)	(1.22)	(-2.33)
GDP	-0.067**	-0.100**	-0.008
	(-2.19)	(-2.28)	(-0.16)
DEF	0.045	0.051	0.055
	(1.28)	(1.04)	(1.00)
UNE	0.090**	0.085	-0.096
	(2.02)	(1.55)	(-0.86)
INFLATION	-0.004	-0.143**	0.000
	(-0.58)	(-2.03)	(-0.03)
Log likelihood	-377.84	-366.95	
N	1151	1151	
LR Chi2(k)	60.18	81.97	
prob>chi2	0.646	0.155	
OAD	-0.071	0.103	-0.319**
	(-0.94)	(1.05)	(-2.42)
GDP	-0.071**	-0.105**	-0.021
	(-2.32)	(-2.41)	(-0.43)
DEF	0.046	0.048	0.046
	(1.31)	(1.01)	(0.84)
UNE	0.092**	0.113**	-0.066
	(2.05)	(2.13)	(-0.61)
OPEN	0.005	0.012	-0.003
	(0.87)	(1.37)	(-0.27)
Log likelihood	-371.59	-364.22	
N	1123	1123	
LR Chi2(k)	61.76	76.50	
prob>chi2	0.556	0.250	
OAD	-0.074	0.090	-0.290**
	(-1.01)	(0.93)	(-2.38)
GDP	-0.064**	-0.115***	-0.008
	(-2.11)	(-2.67)	(-0.16)
DEF	0.043	0.044	0.049
	(1.20)	(0.91)	(0.87)
UNE	0.086*	0.137**	-0.112
	(1.81)	(2.22)	(-0.99)
DEBT	0.002	-0.005	0.005
	(0.27)	(-0.54)	(0.72)
Log likelihood	-377.63	-369.93	
N	1145	1145	
LR Chi2(k)	59.15	74.56	
prob>chi2	0.681	0.000	

Notes: see Table 4.8.

Table 4.13: Expanding and contracting - Adding economic variables

	(1)	(2)	
Variables	All Countries	OECD	Non-OECD
OAD	0.035	0.032	0.051
	(0.41)	(0.28)	(0.40)
GDP	-0.080***	0.004	-0.110***
	(-2.87)	(0.07)	(-3.33)
DEF	0.013	0.096*	-0.016
	(0.46)	(1.73)	(-0.45)
UNE	0.026	0.022	0.029
	(0.61)	(0.37)	(0.42)
INFLATION	-0.002	0.008	-0.003
	(-0.60)	(0.38)	(-0.73)
Log likelihood	-405.91		-403.41
N	1416		1416
LR Chi2(k)	47.56		52.57
prob>chi2	0.998		0.997
OAD	0.038	0.029	0.074
	(0.44)	(0.26)	(0.54)
GDP	-0.069**	-0.003	-0.089**
	(-2.45)	(-0.05)	(-2.61)
DEF	0.004	0.093*	-0.032
	(0.14)	(1.68)	(-0.86)
UNE	0.032	0.022	0.021
	(0.73)	(0.37)	(0.31)
OPEN	-0.014**	-0.009	-0.019*
	(-2.00)	(-0.93)	(-1.74)
Log likelihood	-395.66		-393.37
N	1357		1357
LR Chi2(k)	47.55		52.12
prob>chi2	0.997		0.996
OAD	0.056	0.033	0.095
	(0.66)	(0.29)	(0.74)
GDP	-0.065**	0.010	-0.091***
	(-2.33)	(0.19)	(-2.82)
DEF	0.017	0.073	-0.009
	(0.51)	(1.27)	(-0.23)
UNE	0.004	-0.026	0.018
	(0.09)	(-0.39)	(0.25)
DEBT	0.007	0.015	0.003
	(1.26)	(1.46)	(0.53)
Log likelihood	-401.33		-399.06
N	1390		1390
LR Chi2(k)	47.16		51.69
prob>chi2	0.998		0.000

Notes: see Table 4.8.

Table 4.14: Expanding and contracting - Adding Crisis

Regime	Variables	(1) All Countries	(2) OECD	(2) Non-OECD
Expanding Only	*OAD*	-0.064	-0.019	-0.081
		(-1.11)	(-0.20)	(-1.14)
	GDP	0.041*	0.086*	0.030
		(1.71)	(1.73)	(1.12)
	DEF	-0.025	0.044	-0.036
		(-1.01)	(0.84)	(-1.27)
	UNE	0.008	-0.064	0.028
		(0.23)	(-0.96)	(0.64)
	CRISIS	-0.248	-0.608	0.024
		(-0.98)	(-1.48)	(0.07)
	Log likelihood	-700.30		-697.88
	N	1811		1811
	LR Chi2(k)	155.72		160.57
	prob>chi2	0.005		0.006
Contracting Only	*OAD*	-0.033	0.059	-0.202
		(-0.37)	(0.56)	(-1.30)
	GDP	-0.032	-0.071	0.004
		(-0.93)	(-1.46)	(0.08)
	DEF	0.057	0.047	0.057
		(1.52)	(0.85)	(1.03)
	UNE	0.057	0.129*	-0.115
		(0.99)	(1.75)	(-1.01)
	CRISIS	0.693**	0.568	0.734
		(2.34)	(1.58)	(1.23)
	Log likelihood	-310.65		-306.87
	N	930		930
	LR Chi2(k)	46.70		54.26
	prob>chi2	0.877		0.802
Expanding and Contracting	*OAD*	0.046	0.061	0.037
		(0.46)	(0.49)	(0.23)
	GDP	-0.076**	-0.023	-0.092***
		(-2.61)	(-0.38)	(-2.74)
	DEF	0.009	0.085	-0.012
		(0.29)	(1.31)	(-0.34)
	UNE	0.075	0.096	0.024
		(1.49)	(1.28)	(0.33)
	CRISIS	-0.087	-0.350	0.149
		(-0.28)	(-0.74)	(0.32)
	Log likelihood	-371.21		-369.34
	N	1234		1234
	LR Chi2(k)	40.37		44.11
	prob>chi2	1.000		0.000

Notes: see Table 4.8.

Table 4.15: Expanding only - Political and institutional variables

Regime	Variables	All Countries	OECD	Non-OECD
Political variables	*YRS_OFFC*	-0.027	-0.118**	0.011
		(-1.53)	(-2.28)	(-0.62)
	COLOUR	0.092	0.072	0.113
		(0.77)	(0.47)	(0.57)
	D_ELECTION	-0.324	-0.168	-0.379
		(-1.33)	(-0.37)	(-1.30)
	MARGIN	0.141	-3.795**	0.064
		(0.23)	(-2.02)	(0.98)
	HERF_GOV	0.210	-0.070	0.307
		(0.49)	(-0.08)	(-0.62)
	HERF_OPP	0.352	-0.864	0.852
		(0.74)	(-0.99)	(1.48)
Institutional variables	*SYSTEM*	0.010	6.173	-0.159
		(0.02)	(0.02)	(-0.37)
	PLURALITY	-0.605	-13.415	-0.568
		(-1.08)	(-0.02)	(-0.17)
	PR	-0.190		-0.152
		(-0.23)		(-0.18)

Notes; see Table 4.8. Further. each entry is derived from a separate equation: the baseline regression plus one political/institutional variable. Thus. a column does not represent one regression. The reason for doing this is to conserve space. Furthermore. the result for *PR* is omitted for the OECD due to no variation of this variable for this sample.

Table 4.16: Contracting only - Political and institutional variables

Regime	Variables	All Countries	OECD	Non-OECD
Political variables	*YRS_OFFC*	-0.030	-0.023	-0.042
		(-0.83)	(-0.44)	(-0.85)
	COLOUR	-0.087	-0.072	-0.249
		(-0.57)	(0.44)	(-0.53)
	D_ELECTION	-0.013	-0.657	0.446
		(-0.04)	(-1.13)	(0.92)
	MARGIN	0.785	1.083	0.650
		(0.65)	(0.57)	(0.40)
	HERF_GOV	-0.370	-0.016	-0.618
		(-0.56)	(-0.02)	(-0.59)
	HERF_OPP	1.841**	1.956	1.790
		(2.43)	(2.11)	(1.30)
Institutional variables	*SYSTEM*	0.748	5.877	0.457
		(1.03)	(0.02)	(0.51)
	PLURALITY	0.003	2.970**	-12.485
		(0.00)	(2.01)	(-0.03)
	PR	-0.805		-1.365
		(-0.48)		(-0.89)

Notes; see Table 4.8. Further. each entry is derived from a separate equation: the baseline regression plus one political/institutional variable. Thus. a column does not represent one regression. The reason for doing this is to conserve space. Furthermore. the result for *PR* is omitted for the OECD due to no variation of this variable for this sample.

Table 4.17: Expanding and contracting - Political and institutional variables

Regime	Variables	All Countries	OECD	Non-OECD
Political variables	*YRS_OFFC*	-0.039	0.019	-0.058*
		(-1.53)	(0.35)	(-1.91)
	COLOUR	0.064	0.090	-0.011
		(0.41)	(0.47)	(0.04)
	D_ELECTION	-0.260	-0.452	-0.190
		(-0.73)	(-0.68)	(-0.45)
	MARGIN	1.523	4.465*	0.960
		(1.62)	(1.87)	(0.92)
	HERF_GOV	-0.103	1.364	-0.880
		(-0.17)	(1.26)	(-1.14)
	HERF_OPP	-0.348	-1.209	0.316
		(0.49)	(-1.04)	(0.34)
Institutional variables	*SYSTEM*	-0.915		-0.971
		(-1.50)		(-1.57)
	PLURALITY	1.466*	1.198	1.650*
		(1.85)	(0.75)	(1.76)
	PR	-0.647		-0.479
		(-0.62)		(-0.46)

Notes; see Table 4.8. Further, each entry is derived from a separate equation: the baseline regression plus one political/institutional variable. Thus, a column does not represent one regression. As previously explained, the reason for not reporting the outputs of the baseline variables is to conserve space. Furthermore, the result for *PR* is omitted for the OECD sample in this regime due to no variation of this variable for this sample. Also, because the subset is smaller (because some countries have zero entries in the direction of expanding and contracting), coincidentally $SYSTEM$ also has no variation and is hence omitted.

Table 4.18: Wald test for difference OECD and Non-OECD – baseline regression

Independent variables	Expanding Only	Contracting Only	Expanding and Contracting
OAD	0.01	5.75**	0.02
GDP	2.91*	2.76*	2.78*
DEF	1.50	0.06	2.96*
UNE	2.70	3.10*	0.02

Notes: see Table 4.8

Table 4.19: Wald test for difference OECD and Non-OECD – baseline regression – 3 year averages

Independent variables	Expanding Only	Contracting Only	Expanding and Contracting
OAD	0.06	2.69	0.26
GDP	1.41	7.40***	2.15
DEF	0.07	1.78	3.03*
UNE	0.23	0.14	0.15

Notes: see Table 4.8

Table 4.20: Wald test for difference OECD and Non-OECD – Expanding Only

	Baseline regression +			
Independent variables	*INFLATION*	*OPEN*	*DEBT*	*CRISIS*
OAD	0.03	0.00	0.01	0.26
GDP	3.47*	2.22	2.48	0.96
DEF	2.19	1.24	1.95	1.81
UNE	3.52*	2.76*	1.59	1.34
INFLATION	3.20*			
OPEN		2.30		
DEBT			0.97	
CRISIS				1.41

Notes: see Table 4.8

Table 4.21: Wald test for difference OECD and Non-OECD – Contracting Only

	Baseline regression +			
Independent variables	*INFLATION*	*OPEN*	*DEBT*	*CRISIS*
OAD	6.61**	6.58**	5.94**	1.93
GDP	2.01	1.70	2.79*	1.14
DEF	0.00	0.00	0.00	0.02
UNE	2.12	2.20	3.71*	3.24*
INFLATION	4.09**			
OPEN		1.26		
DEBT			0.74	
CRISIS				0.06

Notes: see Table 4.8

Table 4.22: Wald test for difference OECD and Non-OECD – Expanding and Contracting

	Baseline regression +			
Independent variables	*INFLATION*	*OPEN*	*DEBT*	*CRISIS*
OAD	0.01	0.07	0.13	0.01
GDP	3.08*	1.75	2.45	1.02
DEF	2.90	3.50*	1.38	1.73
UNE	0.00	0.00	0.20	0.46
INFLATION	0.29			
OPEN		0.50		
DEBT			0.92	
CRISIS				0.57

Notes: see Table 4.8

Table 4.23: Wald test for difference OECD and Non-OECD - Political and institutional variables

	Expanding only	Contracting only	Expanding and contracting
YRS_OFFC	3.75*	0.07	1.49
COLOUR	0.03	0.13	0.05
D_ELECTION	0.15	2.11	0.11
MARGIN	4.96**	0.03	1.81
HERF_GOV	0.14	0.19	2.86*
HERF_OPP	2.69	0.01	1.04
SYSTEM	0.00	0.00	2.48
PLURALITY	0.00	0.00	0.06
PR	0.03	0.79	0.21

Notes; see Table 4.8. Further, each entry is derived from a separate equation: the baseline regression plus one political/institutional variable. Thus, a column does not represent one regression. As previously explained, the reason for not reporting the outputs of the baseline variables is to conserve space.

4.F. Figures

Figure 4.1: All Pension Reforms – All Countries

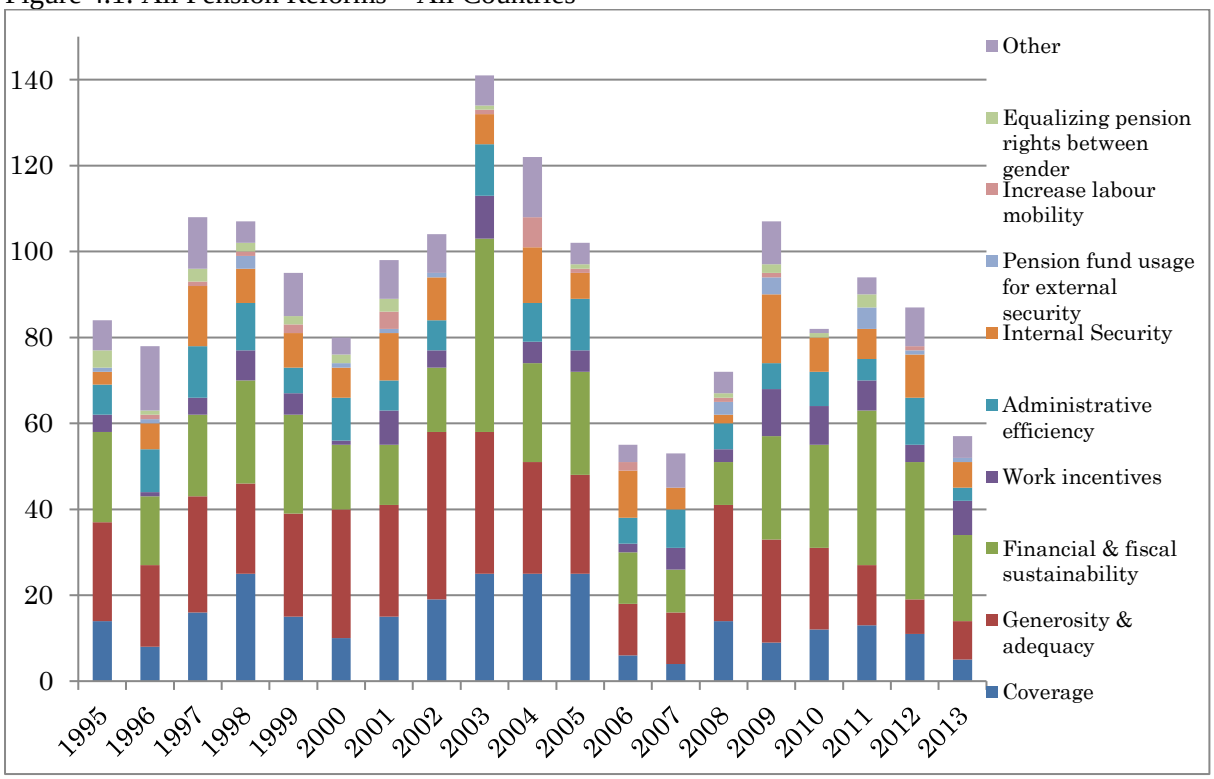


Figure 4.1: All Pension Reforms – All OECD Countries

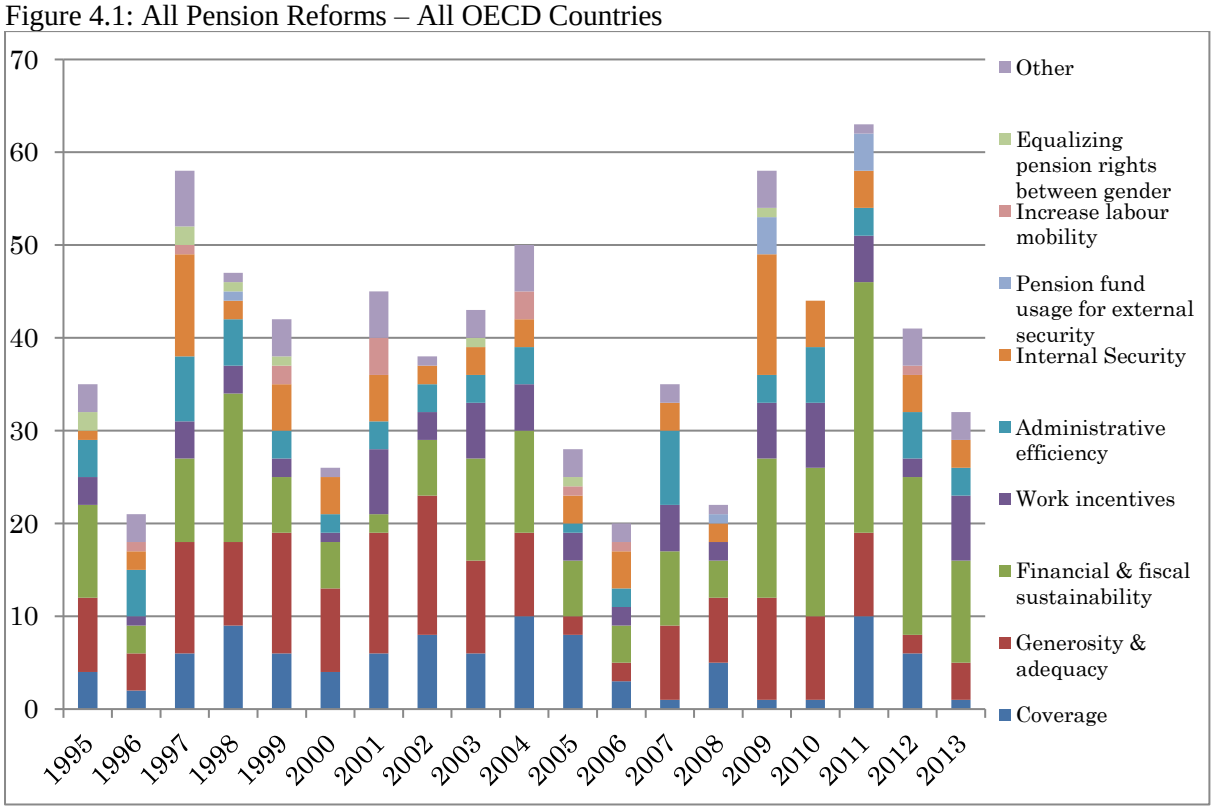


Figure 4.2: All Pension Reforms – All Non-OECD Countries

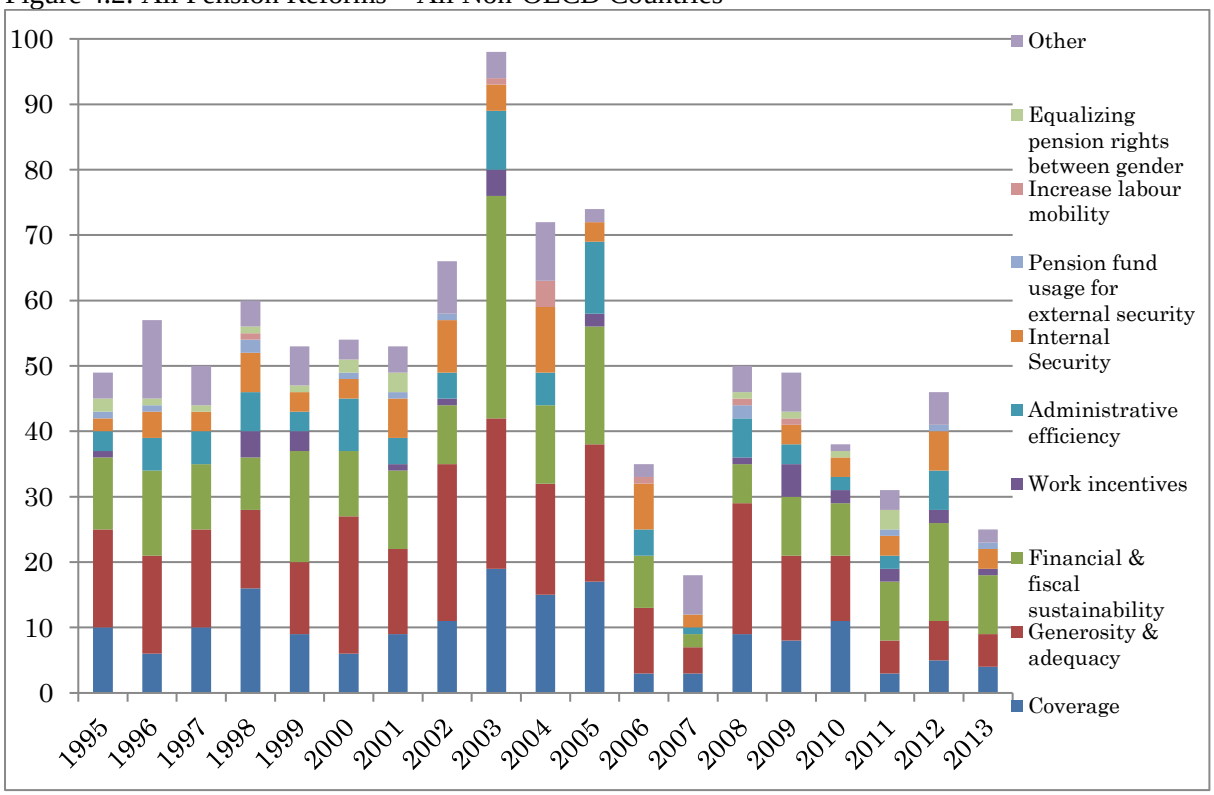


Figure 4.3: All Pension Reforms – Africa

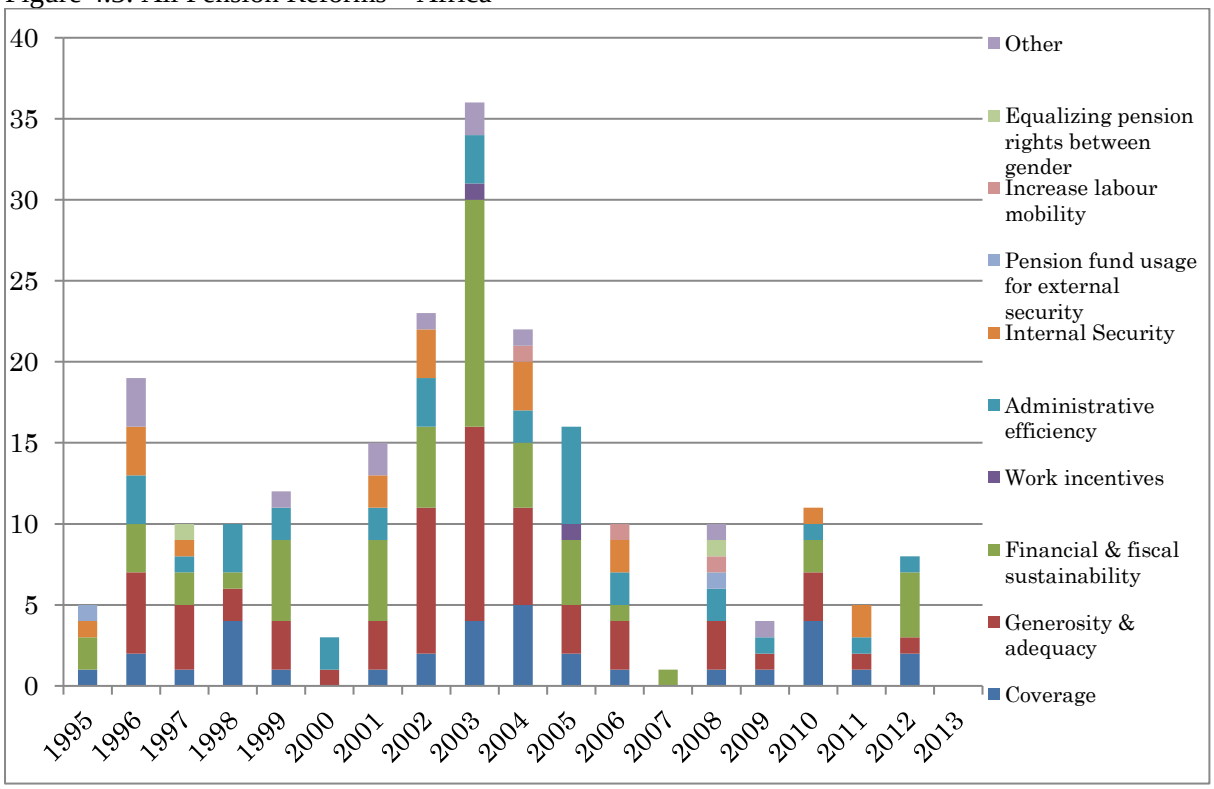


Figure 4.4: All Pension Reforms – Latin America (Non-OECD)

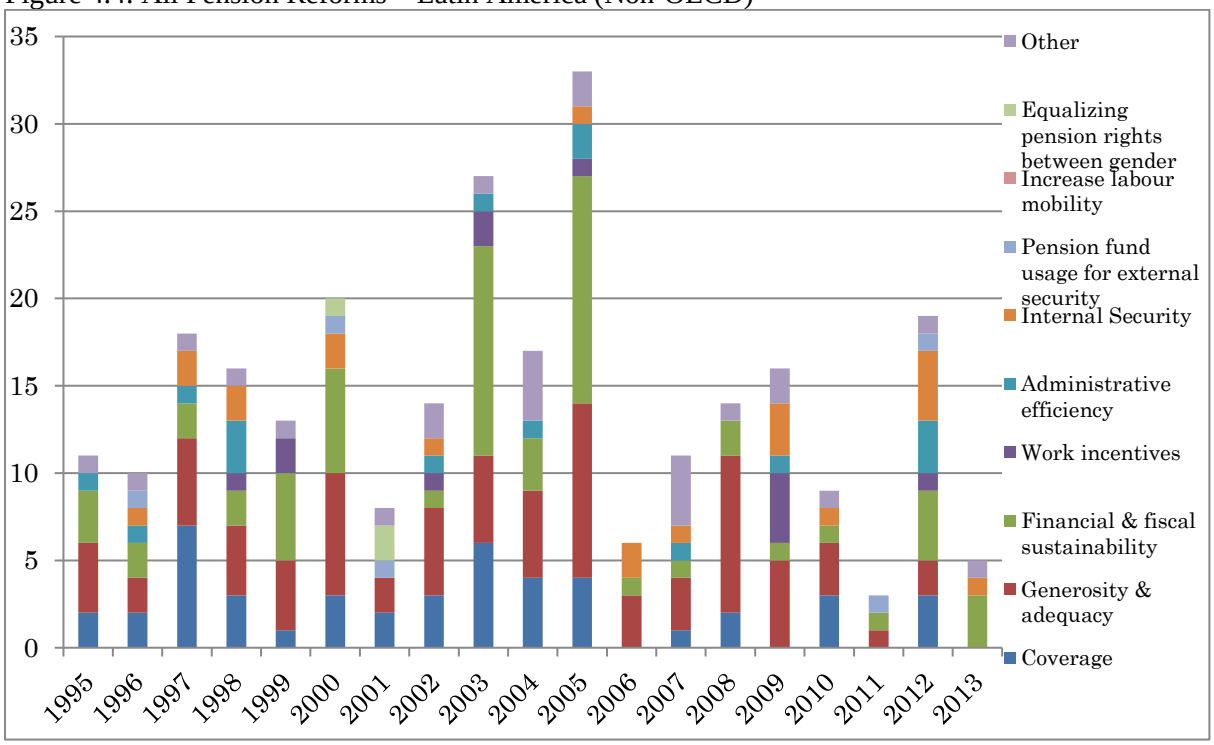


Figure 4.5: All Pension Reforms – Asia and Oceania (Non-OECD)

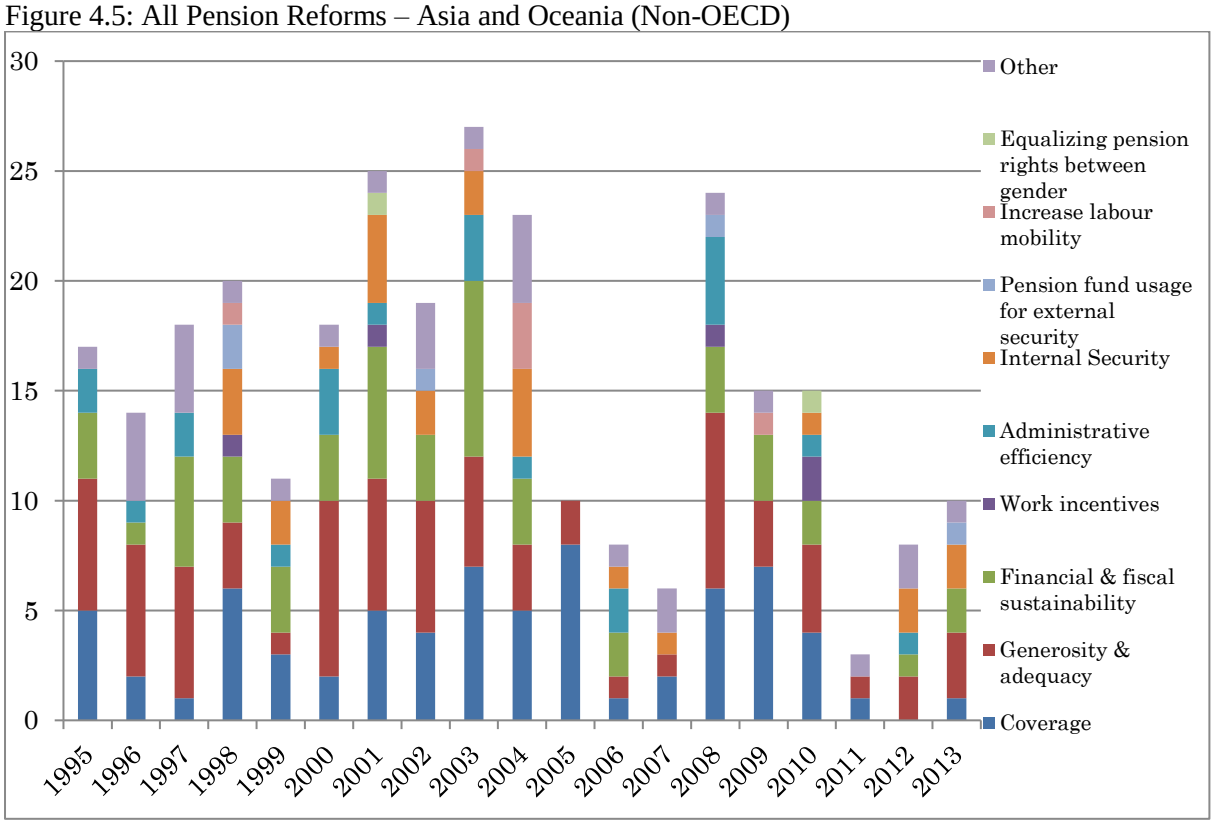


Figure 4.6: All Pension Reforms – Europe (Non-OECD)

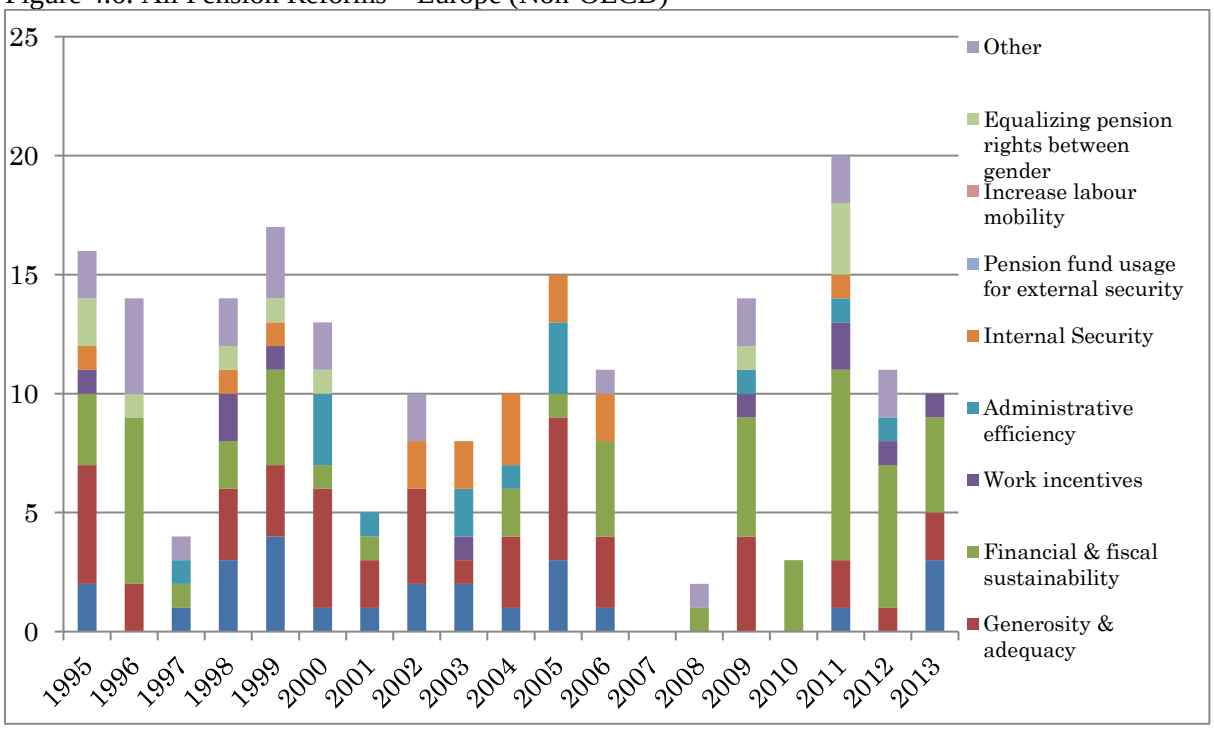


Figure 4.7: Average Pension Reforms – All Countries (151 countries)

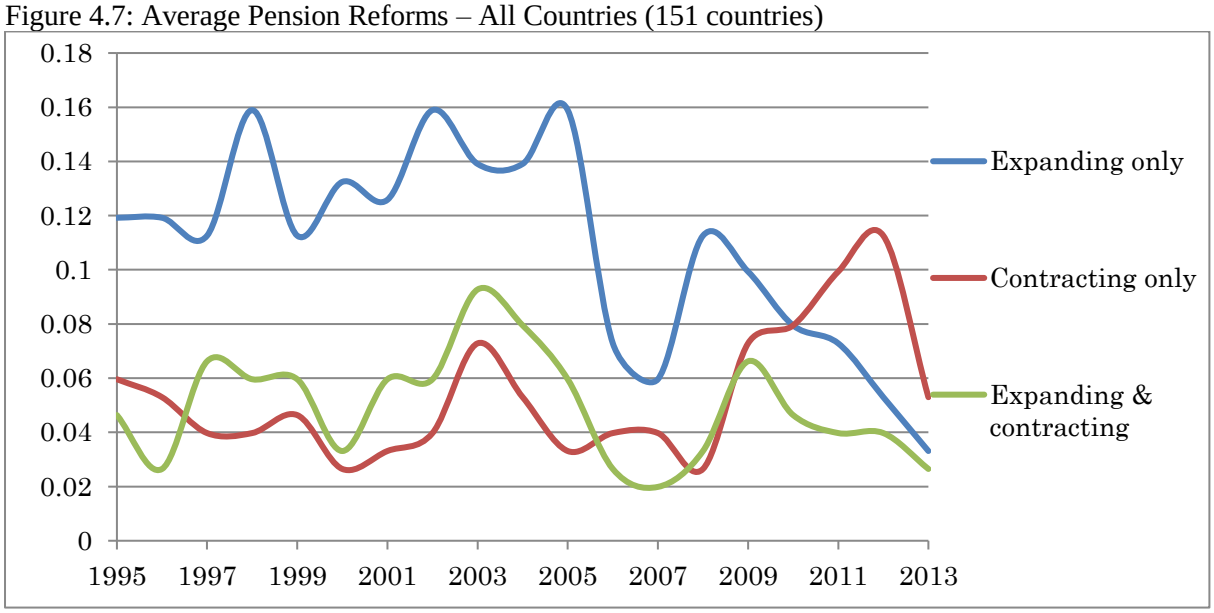


Figure 4.8: Average Pension Reforms – All OECD Countries (34 countries)

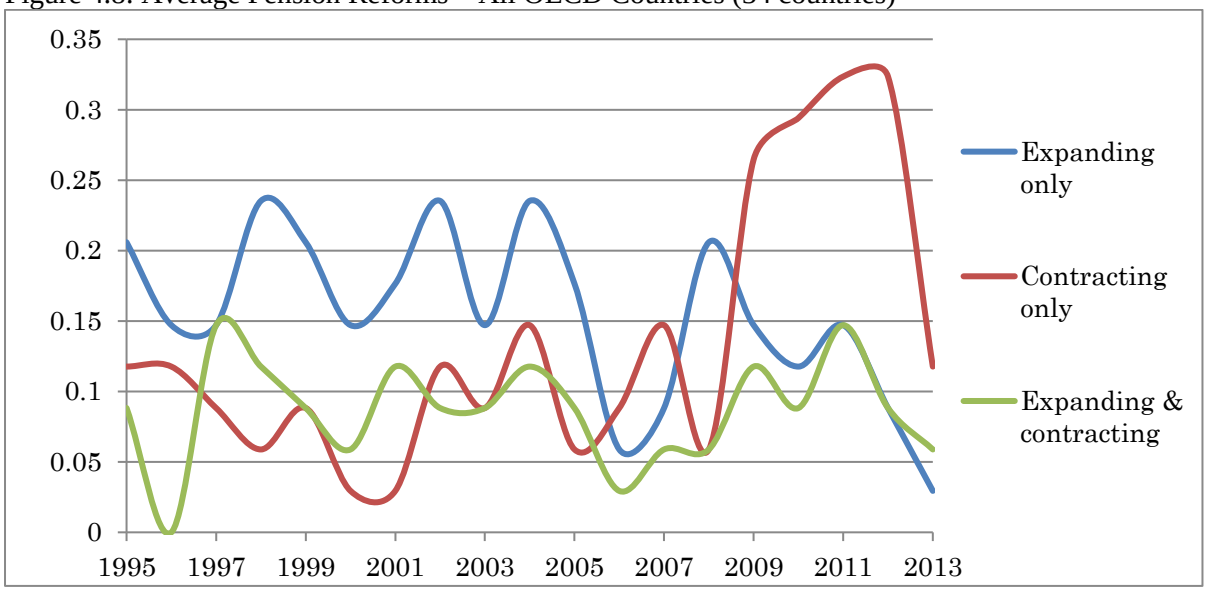


Figure 4.9: Average Pension Reforms – All Non-OECD Countries (117 countries)

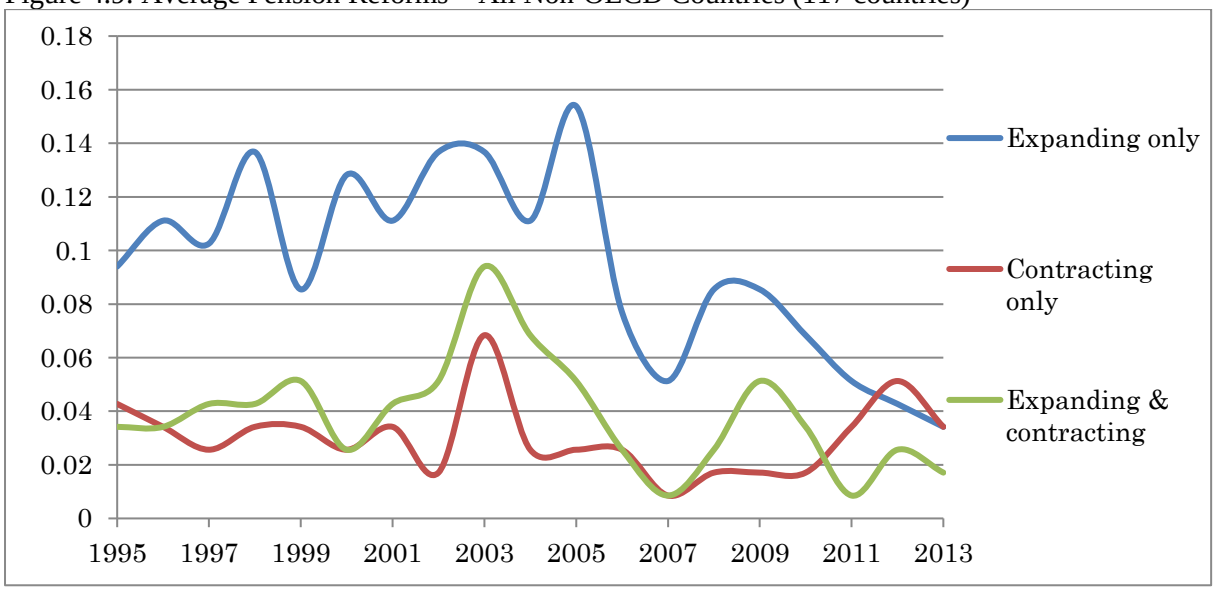


Figure 4.10: Average Pension Reforms – Africa (37 countries)

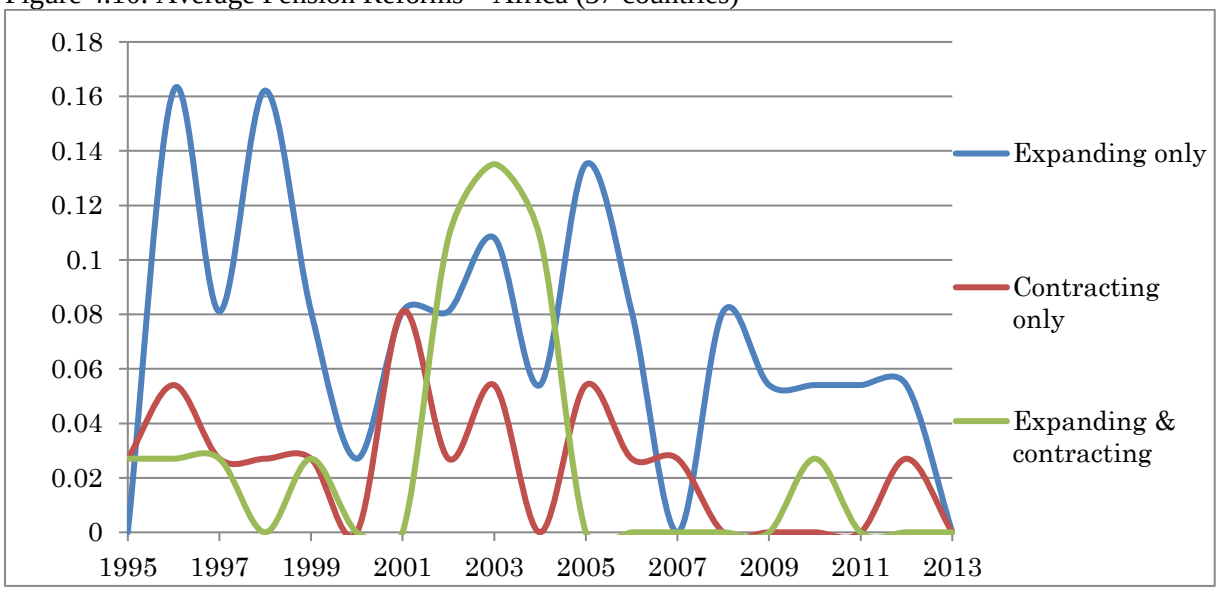


Figure 4.11: Average Pension Reforms – Latin America (Non-OECD) (17 countries)

Figure 4.12: Average Pension Reforms – Asia and Oceania (Non-OECD) (35 countries)

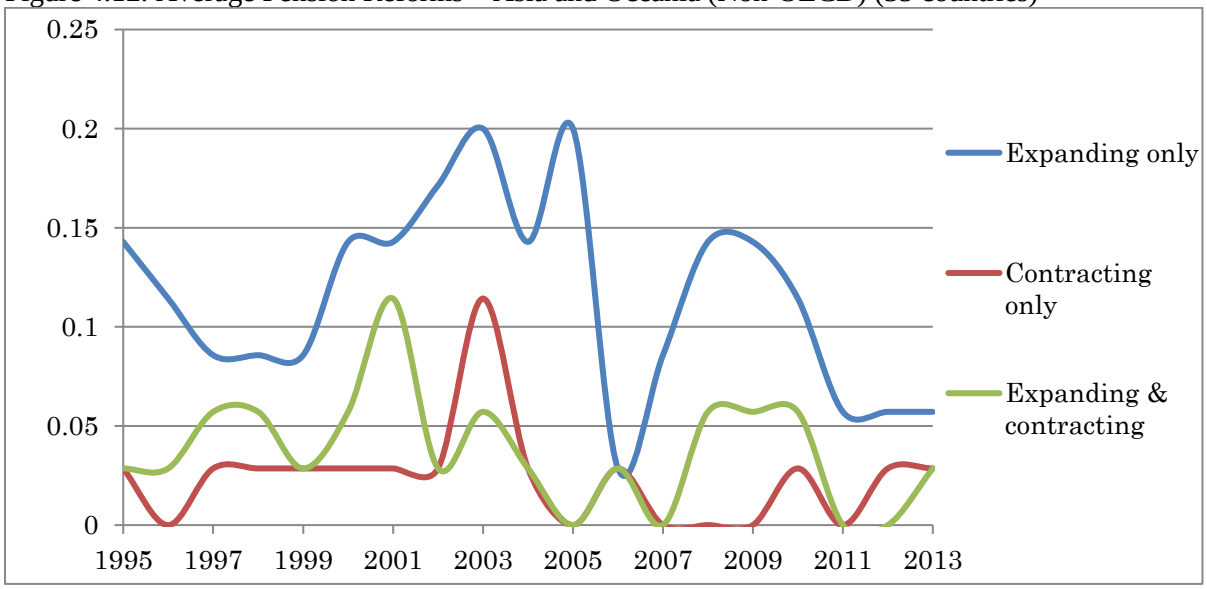
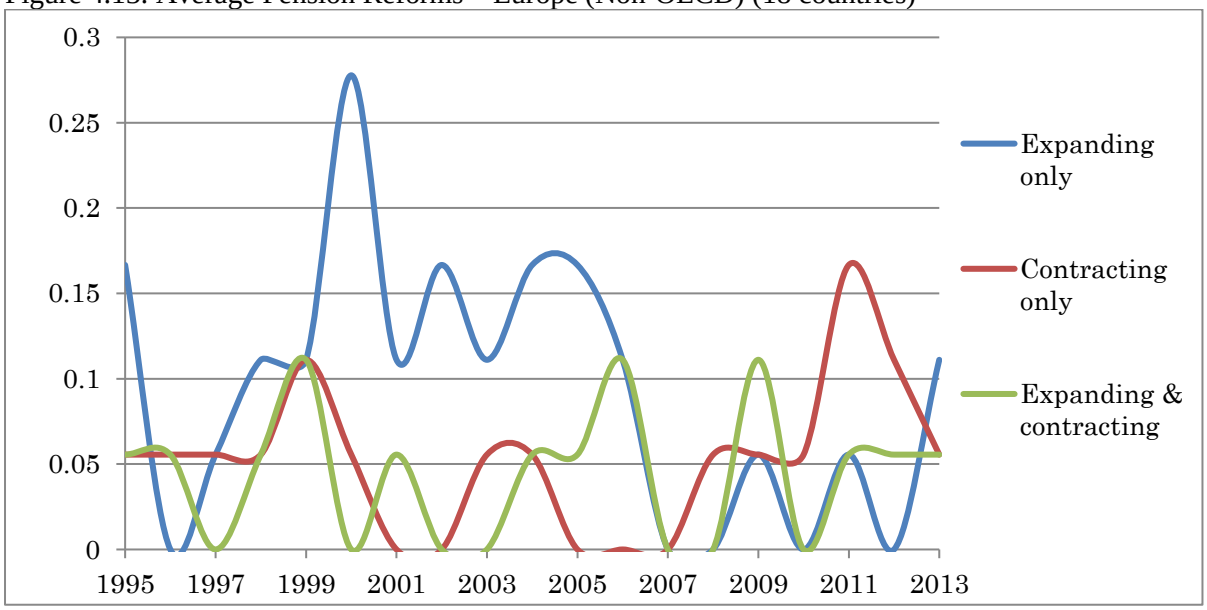


Figure 4.13: Average Pension Reforms – Europe (Non-OECD) (18 countries)



4.A. Appendices

4.A.1. Details on the collection of the reform data

A substantial amount of the input is obtained from the International Social Security Association (ISSA, 2014), several issues of the OECD Pension Outlook (2008, 2012) and the OECD Pensions at a Glance 2013 (2013), which all provides well-documented information on press releases and social security reforms. In addition, we make use of a considerable number of academic sources which provide information on the legislation of old-age social security reforms.

As the reform date we always take the year in which the reform has officially been legislated, and, therefore, not the year of its implementation. The main reason for this is that in our research we want to focus on what triggers pension reforms. This requires us to focus on the information that is available at the moment the reform decision is made.

In addition, the implementation date frequently cannot be uniquely determined. This is because reforms are often implemented in a number of steps. This is often the case for an increase in the statutory retirement age, which may take place in a large number of steps possibly covering a period of decades.

Reforms can be institutional, such as the privatization of the first pillar or a shift from a PAYG system to a NDC system, or reforms can be incremental, such as a change in the statutory retirement age or a change in the benefit or contribution level. The far majority of the reforms fall into the latter category. To avoid subjective judgments, we give each reform the same weight in our dataset although we know that some reforms are more substantial than others.

Below we provide a number of examples of the classification of reforms starting from the formulation in the original sources.

Bangladesh (1998):

ISSA (2014) writes “On 31 May 1998, a new old-age pension scheme was introduced in Bangladesh. This scheme will pay monthly benefits equal to around 10 per cent of average income to people aged over 57. This is likely to affect around 400,000 people. Previously, only public employees were covered by a special pension scheme.”

We classify this reform as “Coverage”

Algeria 2011:

ISSA (2014) writes "The Algerian national guaranteed minimum wage (salaire national minimum garanti (SNMG)) was increased from DZD15,000 to DZD18,000 per month on 1 January 2012."
We classify this reform as "Generosity and Adequacy".

Portugal 2005:
ISSA (2014) writes "According to the new measures the retirement age for the civil service (60 years old) will be gradually increased, by 6 months a year, until it reaches 65 years in 2015."
We classify this reform as "Financial and fiscal sustainability".

Switzerland 2009:
OECD (2012) writes "Minimum rate of return on mandatory private pensions cut from 2.75% to 2% in 2009 and to 1.5% from 2012."
We classify this reform as "Financial and fiscal sustainability".

Greece 2013:
OECD (2012) writes "A reduction in monthly pensions greater than €1,000 (US$1,299) by 5 per cent to 15 per cent (depending on income)."
We classify this reform as "Financial and fiscal sustainability".

Belgium 2005:
ISSA (2014) writes "All those who continue to work after reaching 62 will receive a supplementary pension bonus: the financial rewards will increase with the number of years worked."
We classify this reform as "Work incentives".

4.A.2. Details on the (construction of the) variables

4.A.2.1. Demographic variables

Here we define the old-age dependency (OAD) ratio as the number of people of 65 and older divided by the number of people in the age category 15-64, times 100.

We use the projections of the old-age dependency ratio as estimated by the United Nations World Population Prospects (UN-WPP). The years in which a new edition of the UN-WPP was published are 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010 and 2012. Depending on the issue, projections are only made for 1-, 5- or 10-year ahead intervals.

To clarify, the 25-year ahead forecast of the old age dependency ratio means that in the year 1995 we use the forecasted value of the OAD ratio of the year 2020. We do not want to use information that is not available in the year 1995, hence we only use information that was available in 1995. For this year, the most recent issue of the UN-WPP is 1994, and hence, we only use information available in this issue. The value for the year 2020 can readily be taken from this publication.

If we take the year 1996 we use the 1996 edition. For this year we want the forecasted value of the OAD ratio for the year 2021. Both the year 1996 and 2021 are not readily presented in this publication because forecasts are given at five-year intervals. In order to obtain the OAD ratios of 1996 and 2021 we linearly interpolate the OAD between its value for 1995 and its projection for 2000, and between the projections for 2020 and 2025, respectively. This way we obtain the real-time estimate of the OAD ratio of 1996 and the projected value of the OAD ratio of 2021.

By not using information that has not yet been published we avoid using information that is not yet available. Figure 4.A.1 depict the average 25-year ahead projections $OAD25_t$ of the old-age dependency ratios for the OECD and the non-OECD countries. Figure 4.A.2 reports the first difference of that variable, for both country groups. That variable is labelled as OAD_t, and is the variable included in the regressions.

Figure 4.A.1: Average 25-ahead projection of old-age dependency ratio

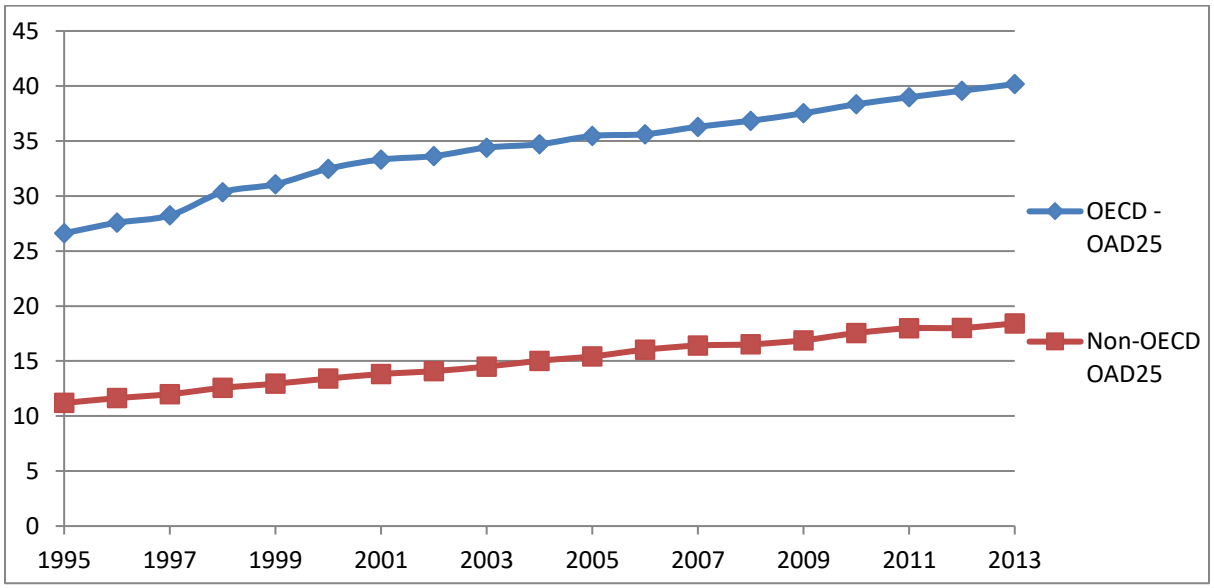
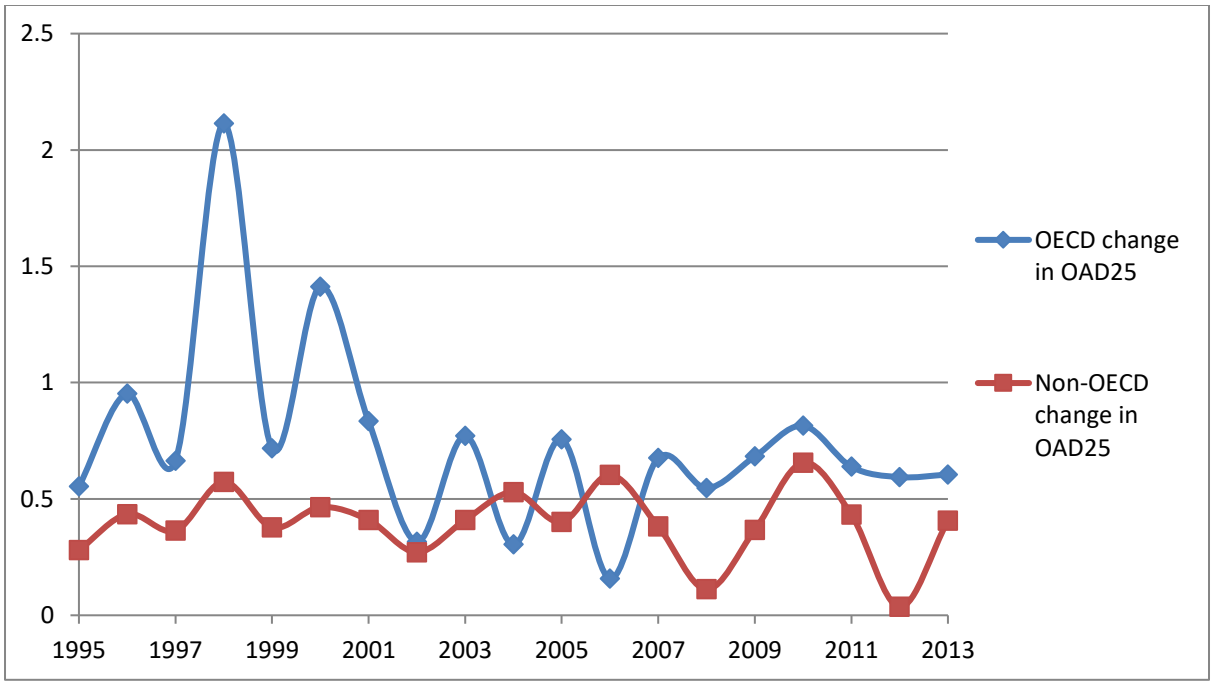


Figure 4.A.2: Average change in 25-ahead projection of old-age dependency ratio



4.A.2.2. Economic variables

GROWTH: Annual percentage growth rate of GDP per capita based on constant prices, in local currency. Data is obtained from the World Bank, IMF World Economic Outlook, Penn World Tables 8.1, and the ERS International Macroeconomic Data Set.

DEF: the general government deficit measures the total disbursements of the general government minus the total income of the general government, expressed in percentage of GDP. The data is obtained from the World Bank, IMF World Economic Outlook, OECD Economic Outlook, various editions of the Asian Development Bank: Key indicators of developing Asian and Pacific Countries, and various editions of the African Economic outlook.

UNE: the unemployment rate is measured as the number of unemployed as a percentage of the total labour force. Data is obtained from the World Bank, IMF World Economic Outlook, IMF International Financial Statistics, and Oxford Economics data.

OPEN: openness of trade is measured as the sum of exports and imports as a percentage of GDP. Data on imports and exports are obtained from the World Bank.

DEBT: general government debt is calculated as general governments gross liabilities, reduced by the government's holding of equity and financial derivatives, and expressed as a percentage of GDP. It is obtained from the Historical Public Debt Database (Horton et al. 2010), IMF World Economic Outlook, and Reinhart and Rogoff (2010).

CPI: Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. Data is obtained from the World Bank, IMF World Economic Outlook, Oxford Economics Data, and the ERS International Macroeconomic Data Set.

4.A.2.3. Crisis variables

We take our crisis variables from Laeven and Valencia (2012). They cover all systemic banking, currency and sovereign debt crises during the period 1970–2011. In addition, they provide data on sovereign debt restructuring, which we also recognize as a crisis if it takes place. A banking crisis occurs if a country's corporate and financial sector experiences multiple defaults and corporate and financial institutions face great difficulties repaying their outstanding loans in time. A currency crisis is defined as an episode in which there is a nominal depreciation of the currency of at least 30 percent, while in additional the currency must be at least 10 percent lower in value than the year before. A sovereign debt crisis is defined as an episode in which a sovereign debt default takes place. Sovereign debt restructuring takes place if debt is restructured.

We construct a dummy variable $CRISIS$ that equals one (zero, otherwise) for a country-year combination if for this combination one or more of crises took place in the Laeven and Valencia (2012) dataset.

4.A.2.4. Political and institutional variables

YRS_OFFC: How many years has the chief executive been in office?

COLOUR: Right = 1, Center = 2, Left = 3. No information = 0; No executive (NA).

D_ELECTION: this dummy is 1 if there is an executive election, 0 otherwise.

MARGIN: Margin of Majority. This is the fraction of seats held by the government. It is calculated by dividing the number of government seats (*NUMGOV*) by total (government plus opposition plus non-aligned) seats.

HERF_GOV: Herfindahl Index Government.

HERF_OPP: Herfindahl Index Opposition. Calculated in the same manner as the Herfindahl Government. Equals NA if there is no parliament. If there are any opposition parties where seats are unknown (cell is blank), the Herfindahl is also blank, or there are no parties in the legislature, the observation is reported as NA (non-available).

SYSTEM: Parliamentary = 2, Assembly-elected president = 1 and Presidential = 0.

PLURALITY: Dummy which takes a value of 1 in the case of plurality and 0, otherwise. In "plural" systems, legislators are elected using a winner-take-all / first past the post rule. The dummy is 1 if there is competition for the seats in a one-party state, blank if it is unclear whether there is competition for seats in a one-party state and "NA" if there is no competition for seats in a one-party state or if legislators are appointed.

PR: Dummy which takes a value of 1 in the case of proportional representation and 0, otherwise. The dummy is 1 if candidates are elected based on the percent of votes received by their party and/or if our sources specifically call the system "proportional representation". It is 0 otherwise, except if LIEC is 4 or lower, in which case "NA" is reported.

4.A.3. Mean Marginal Effects

The probability that a reform takes place is given by

$$\mathrm{P}[y_{i,t} = 1] = \frac{1}{1 + e^{-(L)}}$$

where $L = \alpha_i + \sum_{j=1}^{J} \beta_j OECD_i x_{j,i,t} + \sum_{j=1}^{J} \gamma_j (1 - OECD_i) x_{j,i,t}$. Further, α_i is a country-specific constant, while β_j and γ_j are vectors of parameters for the continuous explanatory variables. Subscript j indexes our continuous variables and runs from 1 to a maximum of J, subscript i refers to a specific country and subscript t subscript refers to a year.

The mean of $x_{j,i,t}$ is

$$\bar{x}_j = \frac{1}{Q_j} \sum_{i=1}^{n} \sum_{t=1}^{T} x_{j,i,t}$$

$$Q_j = \sum_{i=1}^{n} \sum_{t=1}^{T} \mathbb{1}_{\{x_{j,i,t} \neq \cdot\}}$$

where n stands for the number of countries within the sample, T stands for the number of years of the sample and "·" denotes a missing observation. Hence, Q_j is equal to the total number of non-missing observations. The MME of $x_{j,i,t}$ is

$$\left.\frac{\partial P[y_{i,t}=1]}{\partial x_{j,i,t}}\right|_{x_{i,t}=\bar{x}} = \hat{\beta}_1\,\overline{OECD}P[y_{i,t}=1|\bar{x}]P[y_{i,t}=0|\bar{x}] + \hat{\gamma}_1\,(1-\overline{OECD})P[y_{i,t}=1|\bar{x}]P[y_{i,t}=0|\bar{x}]$$

where $\overline{OECD}$ is the number of OECD countries as a share of the total number of countries. However, this is not the MME we are interested in, as it does not yield different MME for the OECD sample and Non-OECD sample. We are interested in comparing the MME for each subsample. Estimating the coefficients for the two subsamples in a single regression prevents us from doing so. Hence, in order to derive the subsample specific MME, we first need run the regressions separately for each subsample (which yields exactly the same coefficient estimates and standard errors). Hence, using

$$L = \alpha_i + \sum_{j=1}^{J} \beta_j x_{j,i,t}$$

the MME of $x_{j,i,t}$ in the OECD sample is:

$$\left.\frac{\partial P[y_{i,t}=1]}{\partial x_{j,i,t}}\right|_{x_{i,t}=\bar{x}} = \hat{\beta}_j\,P[y_{i,t}=1|\bar{x}]P[y_{i,t}=0|\bar{x}]$$

where the mean values of all the continuous explanatory variables are calculated across the OECD subsample observations only. We similarly calculate the MME of variables for the non-OECD subsample.

4.A.4. Wald test results

We use the Wald test to test the significance of the second-period coefficients one by one. Under the null hypothesis that the coefficient of a variable are equal for the OECD and the non-OECD subsample, the Wald test statistic is given by

$$\frac{\left(\hat{\theta}-\theta_0\right)^2}{Var\left(\hat{\theta}\right)},$$

where $\hat{\theta}$ is the maximum likelihood parameter estimate under the unrestricted model and θ_0 the parameter value under the null hypothesis. Under the null hypothesis the Wald test

statistic converges to a χ^2 with degree of freedom parameter equal to one. In our case, $\hat{\theta} = \hat{\beta} - \hat{\gamma}$ and $\theta_0 = 0$, where $\hat{\beta}$ is the OECD parameter estimate of some explanatory variable and $\hat{\gamma}$ is the non-OECD estimate of the same parameter.

4.A.5. Testing effect of openness of trade

In Tables 11-13 we found that openness of trade ($OPEN$) is statistically significant for the "Expanding only" and "Expanding and contracting" regime. To explore whether this is because $OPEN$ captures business cycle elements or whether this is because countries that on average are more open are more inclined to enter a specific reform regime, we calculate the average of $OPEN$ for each country over our sample period, thereby smoothing out the business cycle, and see whether $OPEN$ is related to the number of times a country is in one of the reform regimes. The ensuing figures, Figure 4.A.3 – 4.A.8, regress countries' average values of $OPEN$ on the number of times a regime occurs for each country. In none of the cases the regression slope is significant. This suggests that openness affects reform, because it captures certain elements of the business cycle.

Figure 4.A.3: Average openness of trade versus "Expanding only" – All Countries

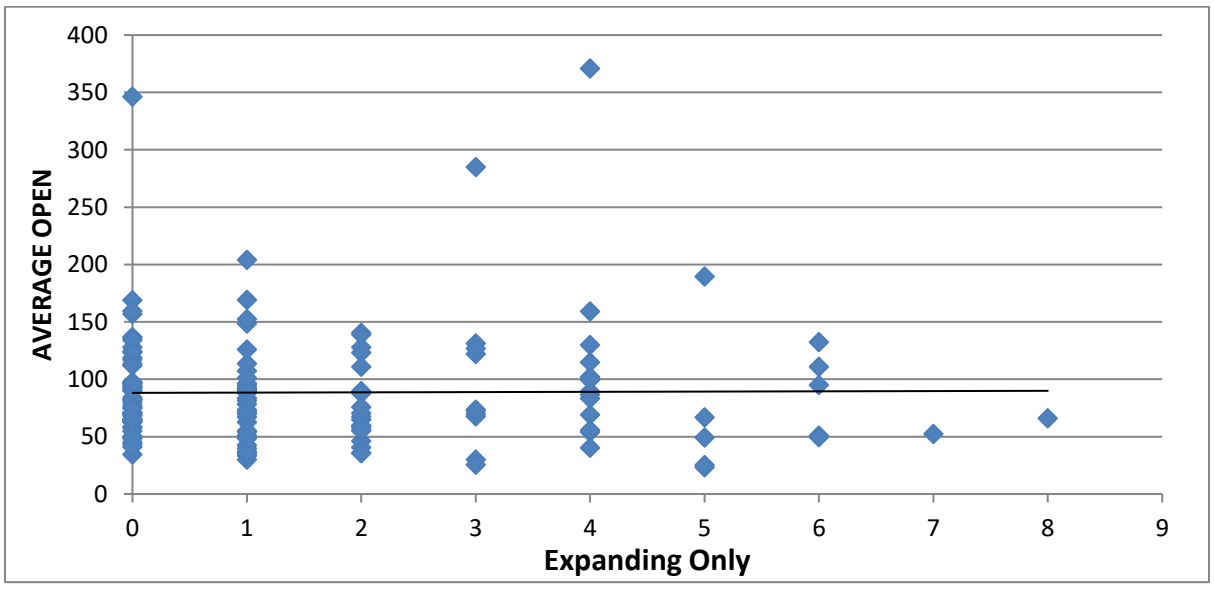


Figure 4.A.4: Average openness of trade against "Expanding only" – OECD Countries

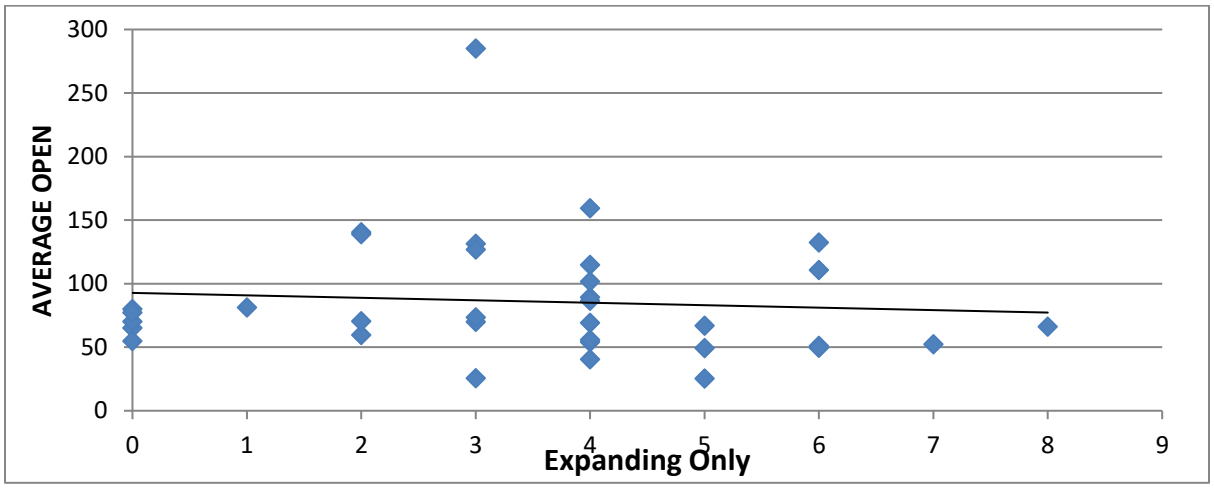


Figure 4.A.5: Average openness of trade against "Contracting only" – All Countries

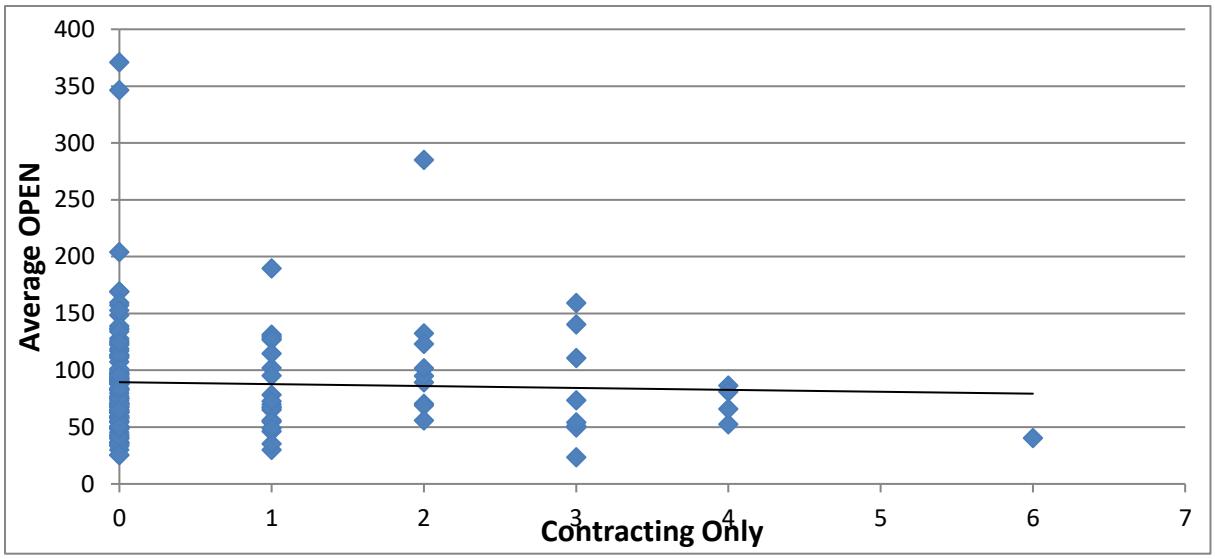


Figure 4.A.6: Average openness of trade against "Contracting only" – OECD Countries

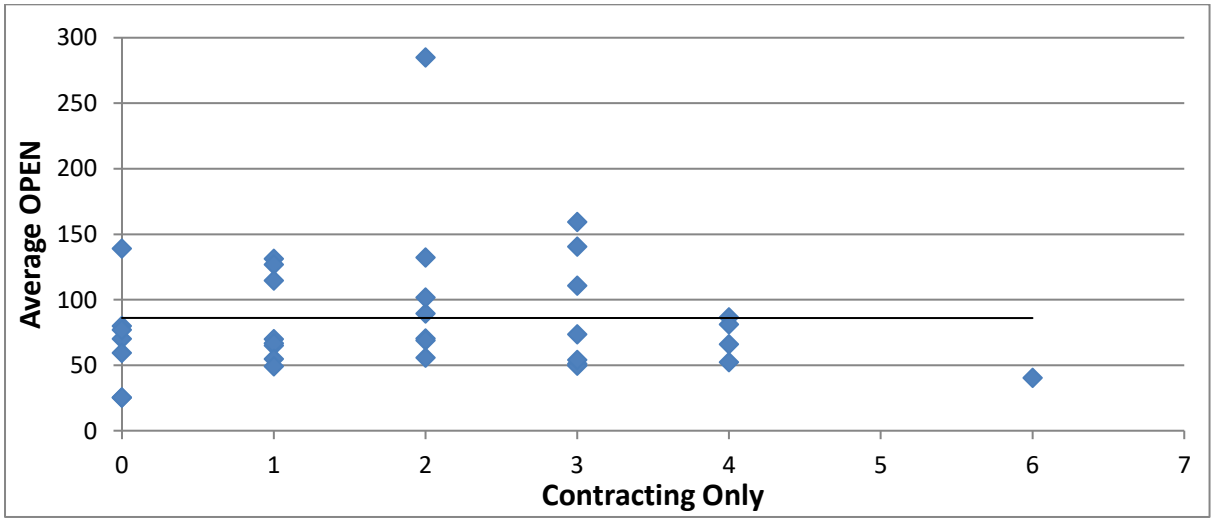


Figure 4.A.7: Average openness of trade against "Expanding and contracting" – All Countries

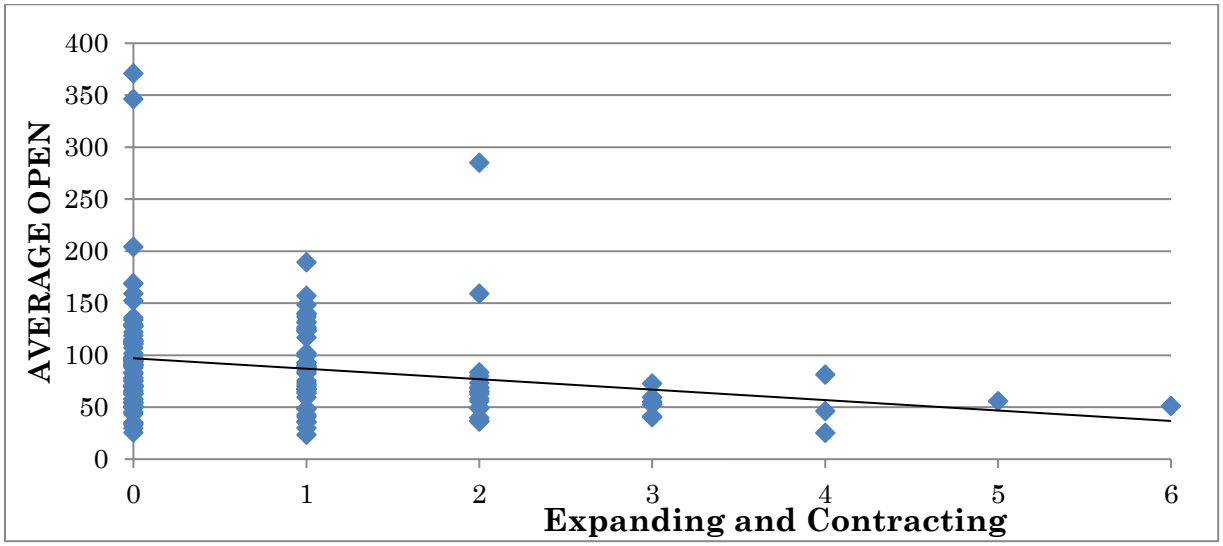
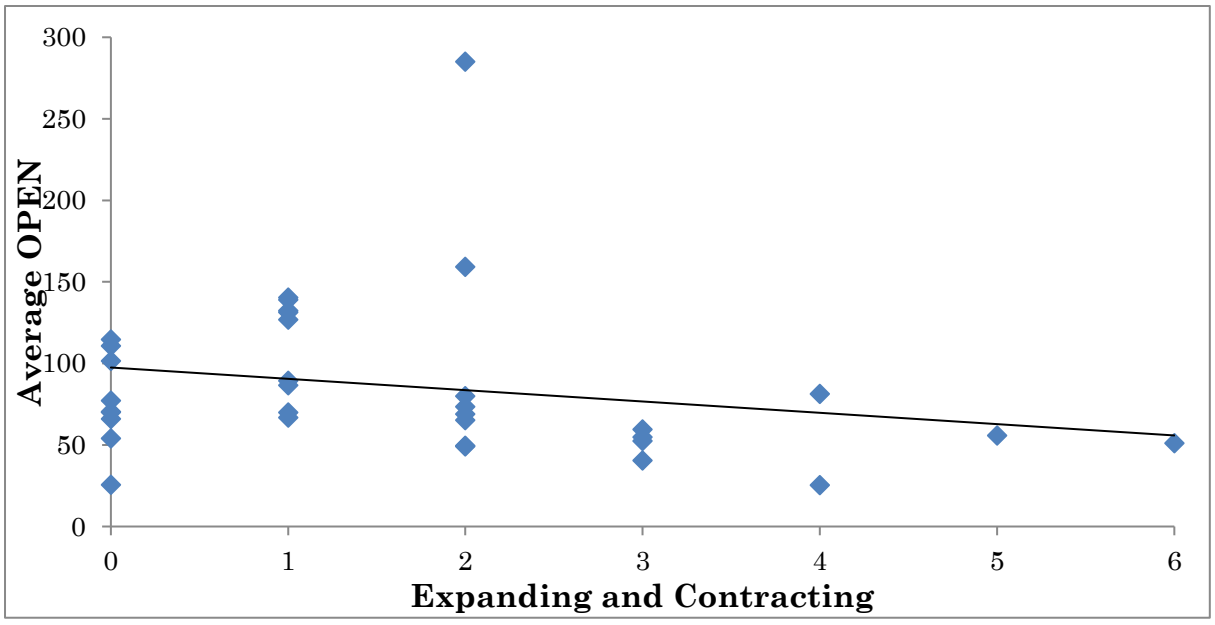


Figure 4.A.8: Average openness of trade against "Expanding and contracting" – OECD Countries



Chapter 5

The effects of pension arrangements and their reforms on voluntary household savings

1.1. Introduction

This research empirically investigates the effects of pension arrangements and the legislation of pension reform measures on voluntary household savings, using a unique and comprehensive dataset of narratively identified pension reforms that covers 19 OECD countries over the period from 1970 to 2013. Changes in pension arrangements are measured in two ways: through the contemporaneous changes of the pension arrangements and through the legislation of pension reforms which are expected to change the system in the future. The contemporaneous changes of pension systems are measured through the replacement rate of mandatory pensions and through the statutory retirement age. Further, we distinguish between several kinds of pension reform measures, namely, changes in contributions, pension coverage, generosity and retirement age, as well as financial and fiscal sustainability measures and reforms that increase work incentives. Subsequently, we categorize each reform type according their expected effect on voluntary household savings. The different effects are either purely positive, negative, or ambiguous. Further, we control for a broad range of economic and demographic variables.

The contributions of this paper are the following. First, we employ a new and unique dataset of pension reform measures with broad coverage in terms of countries and time span. Second, to the best of our knowledge, there exists only a limited amount of empirical work on the effects of pension reforms on household savings. Moreover, the available research is limited to the use of micro-level datasets. Attanasio and Rohwedder (2003) investigate the effects of three major U.K. pension reforms on pension saving and discretionary private savings. They

find that an increase in the earnings-related tier of the pension system affects private savings negatively, while an increase in the flat tier of the system has a statistically insignificant effect. Attanasio and Brugiavini (2003) investigate the effects of the Italian pension reforms of 1992 on the savings of individuals belonging to different cohorts. These reforms are shown to negatively affect the Italian pension wealth. They find evidence that individual savings increase as a result of a reduction in pension wealth. Dolls *et al.* (2016) explore the effect of a German policy change in 2004, in which the government started sending out annual information letters to pension scheme participants. They found that increased knowledge about the individual mandatory pension raised voluntary pension savings. To the best of our knowledge, no macro level panel-data research has been conducted in which the effects of pension reforms on household savings have been addressed. Also, no real distinction has so far been made in terms of the nature of the reforms and their effect on savings. This paper tries to address these gaps. Finally, in contrast to other works, we do not focus on private savings, the sum of total household and corporate savings, or on total household savings, which includes the change in net equity of pension funds (hence, includes mandatory savings through pension funds), but we focus on the effects of pension reform measures on voluntary household savings. In this light, besides the effects of pension reforms, specifically of interest is the effect of the replacement rate and the statutory retirement age on voluntary household savings. Thus far, the effect of the pension replacement rate has been regressed on aggregate national savings (e.g. Bloom *et al*., 2007) and on total household savings (e.g. De Frietas and Martins, 2014), but not, to our knowledge, on voluntary household savings. Furthermore, at the best of our knowledge, there is no panel data analysis that investigates the effects of the statutory retirement age on voluntary household savings.

Our findings are the following, we find that the replacement rate of mandatory pensions has a negative effect on the voluntary household savings rate. The statutory retirement age, however, reports to have no statistical significant effect. Further, we find that not all pension reforms have a significant effect on voluntary household savings. We find some evidence that reforms that are expected to positively affect the voluntary household savings rate, indeed do so. This finding is, however, not very robust against variations in the regression specification. Furthermore, there is mild evidence that the other two reform regimes seem to have a nonlinear effect on household savings, however, we detect that these results are driven by two outliers. After elimination of these outliers their does not appear to be a significant nonlinear relationship between any of the reform regimes. Finally, the joint effect of reforms with an

expected negative effect and two of its lags are jointly significant and indeed have a negative effect on voluntary household savings.

The remainder of the paper is organized as follow. Section 5.2 discusses the conceptual relationship between pension reforms and voluntary household savings, as well as the related literature on the main determinants of household savings. Section 5.3 discusses the data, while Section 5.4 presents the empirical framework. Section 5.5 presents the empirical results and discusses them. Finally, Section 5.6 concludes the main body of this paper.

5.2. How ageing and pension arrangements affect voluntary household savings: theoretical and empirical review

This section discusses the concept of voluntary household savings, how it is measured and how we expect it to be affected by pension arrangements and population ageing. This is followed by a brief review of existing empirical work on how pensions and ageing affect voluntary household savings.

It is important to understand what each measure of savings consist of. In Figure 5.1 we present an overview of the different measures of savings which are generally used in the literature. Starting on the left-hand-side of Figure 5.1 we find “national savings”, which is the sum of “private savings” and “public savings”. In turn, “private savings” consists of “corporate savings” and “household savings”, of which the latter measure consists of a voluntary and a mandatory part. The mandatory savings is the part which is saved under a mandatory pension plan. Most of the literature focuses on national savings, private savings, or household savings. In our research, we solely focus on the voluntary household savings part. In Section 5.2.1 we discuss the theoretical and empirical literature that explains the behaviour of voluntary household savings as a result pension arrangements and pension reforms. However, due to the limited available empirical literature on pension reforms and the demographic determinants of voluntary household savings, we also discuss the empirical literature that covers total household, private, and national savings. In Section 5.2.2 we discuss the theoretical and empirical literature on the effects of demographics on the voluntary household savings rate.

5.2.1. Pension determinants of voluntary savings

The theoretical literature on the effects of pension arrangements on savings primarily relies on the overlapping-generation (OLG) model. Under standard assumptions, the model predicts that the introduction of increased coverage of an unfunded PAYG system reduces aggregate savings. The driving assumption of this model is that agents smooth consumption over their lifetime. Due to the promised pension benefit at old age, current workers need to set aside less voluntary savings, which is needed for their old-aged consumption, hence, aggregate savings decreases. Using the life cycle model, Feldstein (1974) shows that increased social security wealth (which, as he argues, proxies the size of the social security system) leads to a reduction in private savings.

Different pension arrangements will have different effects on voluntary household savings has theoretically no effect on overall household savings, hence an increased contribution to the funded arrangement causes a one-for-one crowding out of voluntary household savings. In the case of a pay-as-you-go pension system, all savings are voluntary. Compared to a fully funded system, total individual savings are lower, while voluntary savings are likely to be higher (assuming the pension arrangements are of comparable magnitude).

There is a large body of literature which empirically investigates the effects of pension arrangements on savings. Among one of the first to explore this issue is Feldstein (1974), who empirically investigates the effect of public pension wealth on household savings. His findings indicate a negative effect of social security wealth on household savings. Moreover, Bailliu and Reisen (1998) conduct a cross-country analysis and empirically test whether the stock of funded pensions assets contribute to higher aggregate savings and find statistical evidence that it does. However, Euwals (2000) does not find a significant effect of pension wealth on household savings. Moreover, a cross-country data analysis by the IMF (1995) reveals little correlation between the size of the pension system (measured in pension wealth) and the private saving rate.

Arguable, higher pension wealth does not necessarily proxy the size of the pension scheme. Take for example a PAYG system, which does not require any assets holdings as the transfers made from workers to retirees can be direct. In such a scenario, social security wealth can be relatively minor, even though the effects of the pension scheme can be considerable. Arguable, a better measure for the scope of the social security scheme is to proxy it by its coverage. Using microdata for the U.S., Munnell (1976) investigates the

impact of social security and pension coverage on private savings. She finds that both types of coverage have a negative effect on private savings. However, social security coverage has a significantly more pronounced effect. She argues that as social security is not funded, it has an unambiguously negative effect on private savings.

However, in contrast to what life-cycle theory implies, increased pension coverage does not always negative effects household savings. In a study on developing countries, the implementation of social security schemes was found to have a positive effect on private savings (Edwards, 1995). The author argues that the implementation of such schemes brings about awareness of the need for proper old-age benefit, triggering people to increase their savings.

A good proxy for the generosity and adequacy of the social security scheme is the replacement rate. The replacement rate is the individual's retirement income paid out by a pension program as a share of the individual's pre-retirement income. Therefore, as the replacement rate of mandatory pension schemes increases, the paid-out pension benefit increases, which substitutes retirement savings. Indeed, empirical studies show that higher pension replacement rates reduce both national savings (Bloom *et al*., 2007) and total household savings (De Freitas and Martins, 2014). To our knowledge, the effect of the replacement rate on voluntary household savings has not yet been addressed.

A prominent feature of social security schemes is their ability to share financial risks within and across cohorts, which in turn affects household's precautionary savings motives. The progressivity of the replacement rate implies the level of risk sharing and insurance of the pension system. Zero progressivity implies that replacement rates are constant across different levels of lifetime earnings. However, if an individual's replacement rate decreases as a result of an increase of the individual's lifetime earnings, then the pension system is progressive. High progressivity implies that the pension system offers insurance against idiosyncratic shocks. Therefore, if individuals, for whatever reason, suddenly earn less, their future pension benefits will not drastically decrease because they are now faced with a higher replacement rate on their lifetime earnings. High progressivity ensures pension benefits are roughly equal between low and high earners. Therefore, agents covered by a strongly progressive pension system have less incentive to accumulate precautionary savings.

Within a PAYG pension systems we can distinguish between two extreme types of pension benefits: a flat benefit (FB) system that pays the same amount of benefits regardless

the amount of contributions (non-zero progressivity), and a notional defined contribution (NDC) pension system, in which benefits are directly related to the amount of contributions (zero progressivity). Using a two-period OLG model, Ciurila (forthcoming) studies the theoretical consequences of a pension system that moves towards no progressivity like the NDC system and concludes that it has two effects on the steady state level of savings. First, because the switch increases the work incentives of the elderly, therewith increasing the income of the elderly, they need to save less when young in order to maintain their old-aged consumption at an equivalent level. Second, because there is less insurance against shocks agents increase their labour supply. Therewith, agents increase their precautionary savings.

Because of their inter- and intra-generational effects, it is argued that social security reforms are among the most complex of all types of structural reforms. In addition, nearly all inhabitants are stakeholders of the system. Hence, not surprisingly, social security reforms tend to cause political tensions. They also affect public finances, and current and future labour and capital markets. Voluntary household savings are expected to be affected by various kinds of social security reforms. We first discuss a few of the theoretical consequences of the more prominent reforms. After this, we discuss the available empirical literature on the effects of pension reforms on savings.

Increased longevity imposes financial burdens on pension systems. In response, many governments opt to increase the statutory retirement age. Changes in the retirement age are expected to affect voluntary household savings. If people are forced to remain longer in the labour force as a result of an increased statutory retirement age, they are expected to save less for two reasons. One, they are employed longer and will therefore contribute more to the pension system. These contributions crowd out voluntary savings. Second, they expect to spend fewer years in retirement, and hence need less old-age savings to smooth their lifetime consumption. During the 1970s and early 1980s there where relatively many OECD countries that decreased the statutory retirement age. One expects that this raised voluntary household savings. Furthermore, increased (decreased) old-age pension benefits reduce (raise) the need for old-age savings, and hence, is expected to decrease (increase) voluntary household savings.

Among the most thoroughly studied social security reforms there was the scaling back of existing PAYG pension arrangements during the 1990s. There arrangements were often fully or partially replaced by mandatory fully-funded (FF) systems (see for example, Arrau and Schmidt-Hebbel, 1993; Kotlikoff et al., 1997). Such shifts increased mandatory savings,

and hence had a positive effect on total private savings. Further, they reduced (or eliminated) the security of old-age income, triggering people to increase their precautionary voluntary savings. Indeed, Schmidt-Hebbel (1999) provides empirical evidence that Chile's radical 1981 pension reform has contributed to higher savings. However, Samwick (2000) empirically analyses the effect of switches from PAYG systems to FF systems on national savings and finds little evidence that countries that have implemented defined-contribution reforms have higher saving rate trends after the reform.

Besides the empirical studies that focus on the shift from PAYG to FF, the empirical literature on the savings effects of pension reforms is limited. Moreover, among the available empirical studies on the effects of pension reforms on household savings the work is limited to the use of micro-level datasets. Dolls et al. (2016) empirically tests whether increased knowledge about the state of the pension system and the individual's pension affects personal savings. They explore the effect of a German policy change in 2004 that led the government sending annual information letters to pension scheme participants. This policy reform did not affect the level of pensions, but only raised knowledge about mandatory pension payments. They found that the increased knowledge about the individual mandatory pension increased the voluntary pension savings.

Further, using household data, Attanasio and Rohwedder (2003) investigate the impact of reforms that affected the public pension wealth in the U.K and estimated their effects on private savings. Using a difference-in-difference estimator they investigate the effects of three major U.K. pension reforms on pension savings and discretionary private savings. They find that wealth increases in the earnings-related tier of the pension scheme has a negative effect on private savings, and wealth increases of the flat-tier of the scheme has a statistical insignificant effect. Further, Attanasio and Brugiavini (2003) investigate the substitutability between private wealth and pension wealth. They employ a dataset covering Italian households. They use a difference-in-difference estimator to exploit the effects of the Italian pension reforms of 1992 on the savings of individuals belonging to different cohorts. This reform is especially interesting because it did not change the institutional nature of the pension scheme; instead it substantially changed the pension wealth of a large majority of Italian households. They find evidence that individual savings increased as a result of a reduction in pension wealth.

5.2.2. Demographic determinants of voluntary savings

As people expect to live longer they need to be assured of adequate old-age income. As replacement rates are generally below 100%, households are required to resort to personal voluntary savings during retirement. Hence, if the retirement age remains constant, an increase in life expectancy induces people to increase their personal savings. An alternative is to stay in the labour force after reaching the statutory retirement age. This reduces the need to increase saving for two reasons. One, working more years enables workers to contribute more to the pension scheme, which generally results in higher benefits. Second, postponing retirement results in a reduced number of years spend in retirement, decreasing the need for personal old-age savings. Lee *et al.* (2000) investigates the determinants of Taiwan's savings boom and concludes that one of the main reasons is the increased longevity prospects and the country's fixed retirement age. They argue that as people expect to spend more of their remaining years in retirement they increase their personal savings during their lifespan. Empirical studies have shown that increased longevity results in higher savings (Li *et al.*, 2007; Bloom et al., 2007; de Freitas and Martins, 2014; Börsch-Supan *et al.*, 2014). Further, Bloom et al. (2007) find that increased longevity raises the aggregate savings rate in countries with universal pension coverage and retirement incentives.

5.3. Data

In this section we explain the data which in the succeeding section will be used to empirically estimate the effects of certain variables on voluntary household savings. Our panel dataset consists of data on household savings, economic and budgetary variables, demographic variables, the replacement rate of mandatory pensions, and pension reforms for 19 OECD countries over the period 1970-2013. In Appendix 5.A.1., we list our sample countries. Further, Table 5.4 provides the descriptive statistics, which suggest that there are no outliers or other peculiarities.

5.3.1. The household saving data

As our saving variable, we take voluntary net household savings. This variable is defined as the net household disposable income minus household consumption expenditure and it is measured as a percentage of net household disposable income. Moreover, net household disposable income is gross disposable income minus the consumption of fixed capital (the depreciation of fixed assets). It is important to note that net household disposable income

does not contain the change in net equity of households in pension funds. Therefore, we are explicitly dealing with voluntary household savings. Further note that because households can be indebted, net voluntary household savings can be negative. Most of the available data on household savings incorporate the change in the net equity of households in pension funds.

Optimally, we would use the share of the voluntary household savings that is specifically aimed for old-age retirement, as this in the specific part of savings which is expected to be affected by pension arrangement and pension reforms. Understand that the voluntary household savings variable as defined in the previous paragraph also includes the share of savings aimed for other purposes than old-age retirement (e.g. savings aimed for the purchase of a new car or washing machine, education, etc.), and this variable is therefore not optimal. However, to our knowledge, such specific data is not available for a large group of countries and a large time span, and we argue that the overall voluntary household savings variable is the best suited proxy for voluntary old-age retirement savings.

Our data is obtained from the UN System of National Accounts (2016), The World Bank (2016), the OECD National Accounts (2016), and Oxford Economics (2016). In Appendix 5.A.2.3. we discuss our savings variables more extensively.

5.3.2. The pension data

We distinguish between two different types of pension data; pension system data and pension reform data. In the former we refer to variables that capture the contemporaneous effect of pensions on households. In the latter, we refer to the legislation of pension reforms.

5.3.2.1. Pension arrangement data

As pension arrangement variables, we use the replacement rate of mandatory pensions and the statutory retirement age [20]. We expect that these two variables capture the contemporaneous effect of pension systems on household savings motives. The replacement rate captures the adequacy of the granted pension benefits, and the statutory retirement age captures the expected time spend in retirement.

The replacement rate is the percentage of a worker's pre-retirement income that is paid as retirement benefits under a public mandatory pension program. We expect the

[20] Arguable, a better measure than the statutory retirement age is the actual retirement age, which is the age at which people on average actually retire. Note that this can deviate from the statutory retirement age because some people either retire earlier or later. However, to our knowledge, no widespread data is available on the actual retirement age.

replacement rate to have a negative effect on the voluntary household savings rate. If the replacement rate increases, the system becomes more generous and the incentive for old-age savings decreases. Data is obtained from the Comparative Welfare Entitlement Dataset (2014) and the OECD (2013).

The statutory retirement age is the age at which workers are entitled to receive superannuation and other old-age benefits. The statutory retirement age differs between countries and in many countries the age is also different depending on gender. The statutory retirement age is generally higher for men than it is for women. We take the un-weighted average of the statutory retirement age for males and females. If the statutory retirement age increases, households are expected to spend less years in retirement and will hence need less voluntary savings.[21] Moreover, in one of the robustness checks we take a variation of this variable. There, we apply the expected statutory retirement age in 20 years' time. Arguable, this variable has a stronger effect on the saving motives of household as this is approximately the retirement age the average household faces. Information is obtained from the pension reform dataset discussed in Chapter 2 and SSA (2017). For more information about these pension system variables we refer the reader to Appendix 5.A.2.4..

5.3.2.2. The pension reform measures data

In this subsection, we briefly discus the content and construction of the dataset. However, for a more comprehensive description of the dataset we refer the reader to Chapter 2, which explains the construction of this dataset in more detail.

We construct a dataset on pension reform measures for 19 OECD countries for the period 1970-2013. A considerable amount of input is obtained from the International Social Security Association (ISSA, 2014), the OECD (2008, 2012, 2013), and the International Labor Organization (ILO, 2014), all of which provide information on the legislation on pension reforms. Where needed, we have consulted a number of miscellaneous sources.

We date reform measures by the year in which they are officially legislated rather than the year in which they are implemented. We chose the legislation date because the

[21] Note that even though in some countries people are free to exit the labour force whenever they please, the statutory retirement age is in most countries the age at which people do choose to retire. In other countries, remaining in the labour force after the statutory retirement age is not always optional. In some countries (e.g. the Netherlands) the labour contract is automatically terminated upon reaching the statutory retirement age. It is possible to continue working after having reached that specific age, but only with a new contract agreed upon by both the employer and the employee. Therefore, overall, changes in the statutory retirement age do affect the actual average statutory retirement age. Hence, we expect that changes in the statutory retirement age have an effect on voluntary household savings.

implementation date of a reform is often unclear, since many reforms are implemented in steps. Also, in many instances, discussion about a reform started in a year before its year of legislation. However, it is difficult, if not impossible, to date the earliest discussion about a reform.

We divide reforms into seven categories: (1) “Coverage”, reform measures that expand the coverage, for example by broadening the eligibility for a pension; (2) “Increased benefits”, reform measures that increase the generosity and adequacy of the pension system; (3) “Reduction retirement age”, reform measures that reduce either the voluntary or the mandatory retirement age; (4) “Decreased benefits”, reform measures that enhance the financial sustainability of the pension arrangement, for example through decreases of the basic pension or decreases of the indexation rate; (5) “Increase retirement age”, reform measures that increase either the voluntary or the mandatory retirement age; (6) “Increase contribution rate”, reform measures that increase mandatory contributions; (7) “Work incentives”, reform measures that enhance work incentives, for example by introducing bonuses for maintaining work activities after the minimum retirement age. For a more detailed description of each reform type we refer the reader to Appendix 5.A.2.5..

All of these reform types are expected to either have a positive or a negative effect on voluntary households’ savings. The categories “Reduction retirement age” and “Decreased benefits” are expected to have a positive effect on voluntary household savings. The categories “Coverage”, “Increased benefits”, “Increase retirement age”, “Increase contribution rate”, and “Work incentives” are expected to have a negative effect on voluntary household savings.

To get more specific, we expect reform measures that increase the coverage of the pension system, “Coverage”, to have a negative effect on household savings because as workers are covered and entitled to an old-age pension there is less need to save, as they are ensured of an old-age income.

The second type of reform measures, measures that increase the benefits of the pension systems, “Increased benefits”, are also expected to have a negative effect on household savings. We expect that if, for example, basic pension benefits increase, the need for old-age savings decreases as one is entitled to more income once enters retirement.

The third type of reform measures are those that reduce either the voluntary or the mandatory retirement age, “Reduction retirement age”, and are expected to have a positive effect on voluntary household savings. As people retire earlier, we expect such savings to

increase because in order to smooth consumption they need more savings to cover for an expected longer amount of time to be spent in retirement.[22]

The fourth type of reform measures are those that increase the financial and fiscal soundness of the system, "Decreased benefits", and are expected to have a positive effect on voluntary household savings. Measures that fall under this category are decreases of the basic pension, decreases of the indexation rate and the elimination of tax-favoured or additional benefits. All of which are expected to have positive effect on voluntary household savings, because as total old-age income decreases due to such policies, individuals must increase their savings if they want to smooth consumption.

The fifth type of reform measures are those that increase the voluntary or mandatory retirement age, "Increase retirement age", and are expected to have a negative effect on voluntary household savings. If people are forced to remain in the labour force longer as a result of an increased statutory retirement age, they are expected to decrease their savings. Because they expect to spend fewer years in retirement they need less old-age savings in order to smooth their lifetime consumption.[23]

We expect that the sixth type of reform measures, "Increase contribution rate", has a negative effect on voluntary household savings because they reduce the remaining disposable income available for consumption or voluntary savings. In fact, contribution rate increases are often linked to increases in pension benefits, in which case the expected effects on voluntary household savings are expected to be even more negative, because higher benefits reduce the need for retirement savings. Our data on this type of reform does not provide us with information whether such reforms simultaneously (i.e., whether they are part of the same reform act) affect the benefit level or not.

The seventh and final type of reform measures, "Work incentives", are expected to have a negative effect on voluntary household savings. Such reform incentivizes workers to remain in the labour force after the statutory retirement age by providing more benefits to those that choose to do so (e.g. by providing tax benefits for post-retirement labour income). These kinds of reforms are expected to have a negative effect on voluntary household savings because if people remain in the labour force longer, they need less savings for their retirement years.

[22] Idem.
[23] Idem.

Aggregating across the sample years, Table 5.1 depicts the number of each type of reform measure by country. There are substantial differences among the countries. France, for example, has legislated a total of 46 reforms that fall within the mentioned categories over the time period 1970-2013. On the other hand, over the same time period, Austria has legislated a mere 11 pension reforms. Also note that the type of reform activities differs significantly among countries. France, for example, has legislated relatively many reforms that can be labelled as generous (increases of benefits and a reduction of retirement age). The United States, on the other hand, has legislated relatively many reform measures that reduce the benefit level of the pension scheme. Figure 5.2 provides a comprehensive overview of the annual number of reform measures in each category. In the year 1970 a total of 4 reforms where legislated, 3 of which increased the coverage of the system, while 1 decreased the benefits of the system. Note that the figure does not clarify how many countries legislated reforms in a given year. For 1970 it could be that three different countries legislated reform measures that increase the coverage of the pension system. It could, however, also be that only one country legislated three different reform measures which all positively affected the coverage of the pension system. From the figure, we observe that as time progresses, increasingly more reforms are legislated. Note the reform categories “Reduction of benefits”, “Increased retirement age”, “Increased contribution rate”, and “Work incentives” have become relatively more popular as we move towards the end of the sample period.

We create two dummy variables termed “Positive” and “Negative”. The dummy variable “Positive” is one if the sum of “Reduction retirement age” and “Decreased benefits” reforms is at least one for a particular country-year combination, and zero otherwise. The dummy variable “Negative” is one if the sum of “Coverage”, “Increased benefits”, “Increase retirement age”, “Increase contribution rate”, and “Work incentives” is at least one for a particular country-year combination, and zero otherwise.

Next, we define three reform *regimes*. The first is “Positive only is captured by a dummy equal to one if the “Positive” dummy is one and the “Negative” dummy is zero, and zero otherwise. The second regime is “Negative only”, which is captured by a dummy equal to one if the “Positive” dummy is zero and the “Negative” dummy is one, and zero otherwise. Third, and finally, there is a regime labelled as “Both”, which is a dummy equal to one if both the “Positive” and the “Negative” dummies equal one, and zero otherwise.

In Table 5.2 we show that the popularity of the reforms has shifted over the sample period. We find that reforms that are expected to have a negative effect on voluntary household savings have been legislated relatively infrequently in the first half of the sample, 1970-1991, and substantially more frequently in the second half of the sample, 1992-2013. Take, for example, the reforms that either increase the voluntary or the mandatory retirement age. For the first half of the sample we report merely 4 such reforms, whereas for the second half of the sample we find 43 such reforms. This is not surprising, as this is one of the more obvious reforms in response to the continuously increasing life expectancy. The total number of reform measures expected to have a positive effect on voluntary household savings is $35 + 89 = 124$, distributed over 79 country-year combinations. The total number of reform measures expected to have a negative effect on voluntary household savings is $87 + 112 + 40 + 20 + 50 = 309$ distributed over 258 country-year combinations. Over the entire sample there are 39 country-year combinations in which only "Positive only" reforms have been legislated, 218 country-year combinations in which "Negative only" reforms have been legislated, and 40 country-year combinations in which both positive and negative reform measures have been legislated.

Figure 5.3 provides a more comprehensive overview of the frequency of the three reform regimes. The figure depicts a somewhat stable, if not slightly decreasing trend of the "Positive only" reform regime. Moreover, the "Negative only" reform regime has an upward trend and becomes more dominant towards the end of the sample.

5.3.3. The economic data

Our set of economic and budgetary variables comprises per-capita real GDP growth, inflation as measured by the consumer price index, the unemployment rate, the government deficit, the consumer confidence index (CCI), import plus export as percentage share of GDP, and the short-term interest rate. These variables are mostly taken from the OECD Economic Outlook, the OECD National Accounts, the European Commission's Ameco dataset, the IMF World Economic Outlook and the World Bank. In Appendix 5.A.2.1. we provide a more precise description of these economic variables. We also include the consumer confidence index, CCI_{it}, as a measure of uncertainty, whereas Loayza *et al.* (2000) proxy uncertainty with inflation. We would expect the CCI_{it} to negatively influence household savings, as an increase of the CCI_{it} decreases the need for precautionary savings.

5.3.4. The demographic data

We control for demographic variables, in particular longevity and the old-age dependency ratio.

According to the literature, longevity is an important determinant of household savings (see for example, De Freitas and Martins, 2014; and Börsch-Supan *et al.*, 2014). To our knowledge, all the available studies that analyse the effect of longevity on savings use the average total expected lifespan. In our study, we capture longevity by including the expected remaining years of life at the age of 65. We argue that this measure for longevity better fits our empirical problem for it proxies how many years people currently expect to spend in retirement. Compared to the life expectancy of new-born cohorts, it is a more precise indicator of the need for resources during retirement.

We use the projections of the old-age dependency ratio as estimated by the United Nations World Population Prospects (UN-WPP), but we obtain them from the World Bank (2016). The OAD ratio is measured as the number of people of 65 and older divided by the number of people in the age group 15-64. In Appendix 5.A.2.2. we provide a more thorough explanation of this variable.

5.4. The empirical model

We start by estimating the following first-order autoregressive panel data model

$$Y_{it} = c_i + \tau_t + \alpha Y_{i,t-1} + \beta' X_{it} + \eta' REFORMS_{it} + v_{it} \quad (1)$$

where Y_{it} is the voluntary household savings rate as a percentage of disposable income for country i at time t; c_i is a country-fixed effect; τ_t is a time-fixed effect, X_{it} is a vector of control variables; $REFORMS_{it}$ is a vector of specific pension arrangement variables or reform regimes; and v_{it} is a mean-zero error term. Further, α, β, and η are (vectors of) coefficients. Because macroeconomic variables have a tendency to be persistent, we include the first lag of the dependent variable as an explanatory variable.

Among the control variables, X_{it}, we have GDP_{it}, $UNEMPLOYMENT_{it}$, $DEFICIT_{it}$, $INTEREST_{it}$, CCI_{it}, $INFLATION_{it}$, $LIFE65_{it}$, OAD_{it}, RR_{it}, and RET_AGE_{it}. Here, GDP_{it}, is growth of the gross domestic product in country i in period t, $UNEMPLOYMENT_{it}$ is the

unemployment rate, $DEFICIT_{it}$ is the government deficit as a percentage of GDP, $INTEREST_{it}$ is the interest rate on government bonds, CCI_{it} is the consumer confidence index, $INFLATION_{it}$ is the inflation rate, $LIFE65_{it}$ is remaining life expectancy at the age of 65, OAD_{it} is the old age dependency ratio, RR_{it} is the replacement rate of mandatory pensions, RET_AGE_{it} is the statutory retirement age. Furthermore, $REFORMS_{it}$ is a $3x1$ vector that contains the three regime dummies $Positive\_Only_{it}$, $Negative\_Only_{it}$, and $Both_{it}$. Moreover, Table 5.3 provides a list with a short description of all the variables and their abbreviations. Further, in Table 5.5 we present the expected sign—negative, ambiguous, or positive (respectively; $-$, 0 or $+$)—of each variable and make references to previously conducted empirical research that covers this variable.

Fixed-effects dynamic panel data models estimates are prone to a Nickell bias (Nickell, 1981). This bias is particularly serious in dynamic panel data models with a small time-span (T) and relatively many individual units (N). For models with a relative large T and small N this bias is small. Considering that our panel has a time-span of 44 and a country-span of 19, we can reasonably neglect this bias.

We estimate the model in equation (1) with the LSDV estimator. We apply the Breusch-Pagan test and find clear evidence of heteroskedasticity in the residuals. Further, we test for autocorrelation in the residuals using the Cumby-Huizinga test for autocorrelation (Cumby and Huizinga, 1992). This test reports no autocorrelation for our model. The reason of applying this test is that it can be applied to unbalanced panels. Other tests for autocorrelation in panel data that are widely used, such as the Wooldridge test and the Arellano-Bond test are not designed for unbalanced panels. Moreover, the Arellano-Bond test requires a panel with fixed T and large N. In our analysis, we control for both heteroskedasticity and autocorrelation as will be explained in the succeeding section.

Furthermore, cross sectional or "spatial" dependence is likely to play a role for many panel data sets that are not randomly sampled. Considering we are using a panel of OECD countries—a group of rather similar countries—it can be expected that common unobserved shocks or other factors such as business-cycle fluctuations and demographic changes affect all the countries simultaneously and, hence, result in cross-sectional dependence of the error term, $v_{i,t}$. We test for cross-sectional dependence using Pesaran's test for cross-sectional independence (Pesaran, 2004). We apply this test, because it can handle unbalance panels. We find sufficient statistical evidence that our model presented in equation (1) still suffers

cross-sectional dependence in the residuals. In our analysis, we control for cross-sectional dependence as will be explained in the following section.

Furthermore, we find evidence of a feedback effect from voluntary household savings (HH_SAV_{it}) to the business cycle variables (GDP_{it}, $UNEMPLOYMENT_{it}$, $DEFICIT_{it}$, $INTEREST_{it}$, and CCI_{it}). This implies that the model in equation (1) contains endogeneity. In our analysis, we control for endogeneity as will be explained in the following section.

To sum up, the model in equation (1) suffers from the following factors that violate the validity of the OLS estimator and, hence, yield inconsistent estimators; heteroskedasticity, cross-sectional dependence, and endogeneity.

5.4.1. Estimation Methodology

For our analysis, we apply two different estimation techniques: the Least-Squares-Dummy-Variable estimator (LSDV), the Instrumental Variable – 2-Stage-Least-Squares estimator (IV-2SLS). The LSDV potentially reports biased and unreliable results due to ignored endogeneity, we report the estimates nonetheless but take into account they may be biased and unreliable. The IV-2SLS estimation technique accounts for endogeneity and, therefore, provides reliable results.

5.4.1.1. The LSDV regressor

We start by estimating the model in equation (1) with fixed-effect OLS, also known as least-squares-dummy-variables (LSDV). We account for the heteroskedasticity and cross-sectional dependence by applying Driscoll-Kraay standard errors (Driscoll and Kraay, 1998). These standard errors are computed by taking cross-sectional averages of the regressors and residuals and then use these to compute the heteroskedasticity and autocorrelation consistent (HAC) standard errors. Driscoll-Kraay standard errors are robust for models with large time-dimensions which contain general forms of heteroskedasticiy, autocorrelation, and cross-sectional and temporal dependence. Hence, they are suitable for our panel dataset.

5.4.1.2. IV-2SLS regressor

However, due to endogeneity as a result of potential feedback from voluntary household savings to the business cycle variables, LSDV estimates will still be inconsistent. Therefore, as a second regression method we control for both CCE and for endogeneity. Again, we control for heteroskedasticity and CCE by applying Driscoll-Kraay standard errors. In order to correct for potential contemporaneous feedback effects, we utilize the IV-2SLS estimator.

The instruments we use are business-cycle variables of the previous periods. We find that the business-cycle variables are reasonably correlated across time-periods, making them potentially useful instruments. Moreover, because the feedback effect from the contemporaneous voluntary household savings rate has no effect on the business-cycle variables of the previous period, they are not correlated with the contemporaneous error term, and hence, are valid instruments. Nonetheless, we conduct several tests to check the validity of the instruments.

With the Kleibergen-Paap LM statistic of under-identification, we test whether the instrumental variables are correlated with the endogenous regressors, and hence, we test whether the relevance requirement is met. We apply this test because it is robust against the violation of the IID assumption, and hence, is able to cope with heteroskedastic errors. The instruments meet the relevance condition if $Cov(Z_{it}, X_{it}) \neq 0$, where Z_{it} is the instrument vector and X_{it} is the enogenous business cycle variable. The test essentially tests the rank of the covariance matrix, of which the null hypothesis states that the model is underidentified, against the alternative that the model is identified. If fully identified, the correlation matrix is of full rank, indicating that the relevance condition is met for all instruments. However, even if we reject underidentification, it may still be the case that our regression model is only weakly identified because the excluded instruments are only weakly correlated with the endogenous regressors. In this case the estimators can perform poorly. We apply the Anderson-Rubin Wald F Statistics to test whether the used instruments are weak.

We can test for the exogeneity of the instruments if we have an overidentified model, that is, when we have more instruments than endogenous variables. If this is the case, we check for the exogeneity of the instruments by using the Hansen *J*-statistic for overidentifying restrictions to test the validity of all the instruments. This test compares the estimates using different instruments, and if the results are significantly different it concludes that more of the instruments are unsuitable. The instruments meet the exogeneity condition if $Cov(Z_{it}, v_{it})$=0. The results of the Hansen J-statistics may not be informative if the used instruments are weak. The Anderson-Rubin Wald F Statistics informs us whether we are dealing with weak instruments.

5.5. Results

This section describes and interprets the results of our regression analysis. Equation (1) is estimated for 18 OECD countries over the time 1970-2013. However, for some countries data is missing for some variables for the beginning of the sample. As mentioned in the previous section, we apply two methods: LSDV and IV-2SLS, both with Driscoll-Kraay standard error. We first discuss the results of the LSDV estimator, then turn to the results of the IV-2SLS estimator which is our baseline estimator. We then apply several robustness checks to our baseline estimator. We do so by applying different regressions specifications and changes to the sample period.

5.5.1. LSDV estimates

Column (1) in Table 5.6, provides the LSDV estimates. We find significant evidence that the business cycle affects voluntary household savings. Perhaps the most clear-cut proxy of the business cycle is GDP growth, which reports to have a negative and statistical significant effect on the saving rate. The negative sign of the coefficient may come a bit as a surprise, as higher growth generally coincides with higher levels of income of the (working) population, which in turn allows them to save more. Our results suggests that this is not the case, and instead, during periods of low growth (economic contraction) households increase their precautionary savings.

Further, we find statistical evidence that government deficit positively affects voluntary household savings. This is in line with the Ricardian equivalence theory; as current government deficit increases, households expect to pay more taxes in the future, and therefore increase their current savings.

Furthermore, the coefficient of the consumer confidence index is statistically significant. The sign is positive, which implies that as consumers gain more confidence about the current and future state of the economy, they increase their savings. This result is contrary to our expectations, as we expect that an increase of consumer confidence would lead to a declining need for precautionary savings.

Of the included demographic variables, the old age dependency ratio is statistically significant. The sign is negative, which is in line with expectations. Note that our dependent variable is the ratio of aggregate voluntary savings over aggregate disposable income. Therefore, it also takes into account the voluntary savings and disposable income of the elderly. This group saves relatively little, and as this group increases relative to the younger

population, we expect that the aggregate savings over disposable income ratio decreases. This turns out to be the case. Our results are in line with previous empirical finings (e.g. Bloom et al., 2007; Masson *et al*., 2010; de Freitas and Martins, 2014; and Grigoli *et al.*, 2014).

Surprisingly, the expected remaining years of life at the age of 65 does not have a statistical significant effect. The insignificance of the sign can be the result of an array of reasons. We will mention a few. In countries in which the replacement rates are high, households do not need to have personal savings to smooth consumption. Due to the high replacement rates they are already guaranteed to sufficient income which will be paid out until death, and hence, longevity is irrelevant. Further, for the sample for which the replacement rate is well below 100%, longevity expectations are expected to affect voluntary household savings. Furthermore, the insignificance of the variable is perhaps the case because a share of the households are myopic.

As for our pension variables, we first discuss the findings of the replacement rate and the statutory retirement age, and then the findings of our reform dummies.

The replacement rate reports to be have a negative effect and is statistically significant at the 1% level. The replacement rate is the share of an individual's retirement income paid out by a pension program as percentage share of the individual's pre-retirement income. Therefore, if expected pension benefits are high and close to pre-retirement earnings, households need less voluntary savings to compensate for the fall income at retirement. These results are in line with those from other empirical studies, in which evidence is provided that increases in the pension replacement rate reduce both national savings (Bloom *et al*., 2007) and household savings (De Freitas and Martins, 2014). Further, in line with expectations, the coefficient of the statutory retirement age has a negative sign. This indicates that as the statutory retirement age increases the need for savings decreases. However, the finding of the statutory retirement age is not statistically significant.

Let us now turn to the pension reform variables. Only one of the three dummy variables report to be statistically significant. The reform dummy that captures the reforms that are expected to have a positive effect on household savings has, indeed, a positive sign, and is statistical significant at the 10% level. The coefficient is 0.558, indicating that during a period in which only a reform is legislated which is expected to positively affect the household savings rate, this rate increases with 0.56%. The estimates of the coefficients of the reform regime dummies that capture either reforms that are expected to have a negative

effect on household savings or combinations of reforms that are expected to have positive and negative effects on voluntary household savings.

5.5.2. IV-2SLS estimates

In this section, we discuss the results of the IV-2SLS estimator. The results are presented in Column (2)-(4) of Table 5.6. Column (2) provides the estimation results of a regression *without* the pension reform variables, and Column (3) provides the results of a regression *without* the contemporaneous pension arrangement variables. Column (4) provides the results a regression with both sets of variables included, which is the same specification as presented in the previous section. Arguably, the estimation results presented in Column (1) and (4) are wrongly specified due to the possibility that the pension system variables are highly correlated with the pension reform variables. E.g. a reform that increases the benefit level results in a higher replacement rate, and a reform that increases the statutory retirement age affects the statutory retirement age. However, reforms are rarely implemented within the same year as they are legislated, and this does therefore not pose a problem. We show this by regressing the pension system and pension reform variables independent from each other. Comparing the result of these regression specification with the results that includes both sets of variables (comparing the results of Column (2) and (3) with Column (4)) we find that the results are not significantly affected by including both sets of variables. Therefore, the inclusion of both sets of variables does not yield biased results. In the remainder of this section we only discuss the results of the regression specification that includes both sets of variables, which are presented in Column (4) of Table 5.6.

Further, the results presented in the previous section are potentially unreliable due to endogeneity. We have found evidence of a feedback effect from voluntary household savings rate to the business cycle variables GDP_{it}, $UNEMPLOYMENT_{it}$, $DEFICIT_{it}$, $INTEREST_{it}$, and CCI_{it}. We deal with this problem by conducting a IV-2SLS regression. As instruments we use the lagged levels of the business cycle variables and of the sum of imports and exports as share of GDP, $OPEN_{i,t-1}$. To be more specific, as instruments we use $GDP_{i,t-1}$, $UNEMPLOYMENT_{i,t-1}$, $DEFICIT_{i,t-1}$, $INTEREST_{i,t-1}$, $CCI_{i,t-1}$, and $OPEN_{i,t-1}$. We expect that these lagged business cycle variables predict the current business cycle variables quite accurately. Moreover, because we use the lagged business cycle variables as instruments, we expect them to be uncorrelated with the current error term. We test the validity of our instruments using several tests. First, we test whether our instruments are

correlated with the endogenous variables using the Kleibergen-Paap LM under-identification statistics. We find clear evidence to reject the null hypothesis at the 1% level, which indicates that the covariance matrix is of full rank, suggesting correlation between the instruments and all endogenous variables. Second, we apply the Hansen J test for overidentification. We find *insufficient* evidence to reject the null hypothesis, and we therefore conclude that the used instruments are valid. Third, using the Anderson-Rubin Wald F Statistics we test whether the instruments are weak. We find sufficient evidence to reject the null hypothesis that states weakness of the instruments, and hence conclude that the used instruments are not weak.

The estimation results are presented in Column (4) of Table 5.6. Comparing our results with the LSDV estimates we find that most of the coefficients and t-values have remained roughly the same. The main difference with the LSDV estimates is that the coefficient estimate of $DEFICIT_{it}$ is no longer statistically significant. This indicates that the results of the LSDV regressor where indeed biased due to endogeneity.

As for the results of the pension arrangement variables, the coefficient on the replacement rate of mandatory pensions is still negative and statistical significant at the 1% level. It is -0.053. Therefore, if the replacement rate increases by one percentage point, the voluntary household savings rate falls by 0.053% . Al though none of the existing literature look explicitly at voluntary household savings, it is interesting to compare our results to previous findings of studies using different measures of savings. Bloom *et al.* (2007) find that a one percentage point increase of the pension replacement rate of PAYG schemes reduces the national savings rate with approximately a tenth of a percent point of GDP. De Freitas and Martins (2014), for their dynamic panel GMM estimates, find that a one percentage point increase of the replacement rate reduces total household savings as percentage of disposable income by approximately half of a percentage point. Further, the coefficient of the statutory retirement age is statistical insignificant.

Let us now turn to the pension reform variables. Still, only the reform dummy that captures the reforms that are expected to have a positive effect on the household savings rate is statistically significant at the 10% level. The coefficient estimate remains roughly the same. The coefficient now measures 0.638, indicating that during a period in which only a reform is legislated which is expected to positively affect the household savings rate, the

household savings rate increases with 0.638%. The other two dummy variables that capture pension reforms remain statistically insignificant.

5.5.3. Robustness checks

We apply several robustness checks to our findings of the IV-2SLS estimator, which we henceforth refer to as our baseline regression. We check the robustness of our results by making changes to our regression specification in six different ways. We first substitute one of the business cycle variables. Second, we run a regression by taking the first difference of the demographic variables. Third, we delete the recent financial crisis episode, i.e. the period 2008-2013, from our sample. Fourth, we replace the contemporaneous statutory retirement age with the expected retirement age in 20 year time. Fifth, we check for nonlinear effects of pension reforms on household savings by interacting the pension reform dummies with the replacement rate. Finally, we extent the regression specification with lags of each reform regime and test for the joint significance of the regimes.

For the first robustness check we start by running a regression by substituting one of the business cycle variables. We substitute the government deficit, $DEFICIT_{it}$, for the change in government debt as percentage of GDP, $\Delta DEBT_{it}$. The reasons for not including both variables simultaneously in the regression is that they are likely correlated with each other, and hence, result into multicollinearity. Moreover, as in the case of the $DEFICIT_{it}$, we find that there is a feedback effect from voluntary household savings to $\Delta DEBT_{it}$. For this regression specification, we use a different instrument set than for the baseline regression. Instead of using $DEFICIT_{i,t-1}$ we now use $\Delta DEBT_{i,t-1}$. The used instruments are $GDP_{i,t-1}$, $UNEMPLOYMENT_{i,t-1}$, $\Delta DEBT_{i,t-1}$, $INTEREST_{i,t-1}$, $CCI_{i,t-1}$, and $OPEN_{i,t-1}$.

The regression estimates for this specification are presented in Column (1) of Table 5.7. First of all, we find that the used instruments satisfy all the criteria, and hence are considered as valid. As for the results, we find that they are in line with the IV-2SLS results of the baseline regression. We find that GDP_{it}, CCI_{it}, and OAD_{it} remain statistically significant. Their coefficients change only slightly. Similarly, the findings of RR_{it} and $Positive\_Only_{it}$ remain robust against variations of the business cycle variable.

Second, we replace the demographic variables, $LIFE\_65_{it}$ and OAD_{it}, with their first differences. We apply the same instrument set as used for the baseline IV-2SLS estimation. The results are reported in Column (2) of Table 5.7. Compared with the baseline regression, we observe some differences. The coefficient estimates of business cycle related variables, RR_{it} and $Positive\_Only_{it}$ remain roughly the same. However, ΔOAD_{it} is not statistically significant.

As a third robustness check we delete the recent financial crisis episode from our sample (2008-2013). The results of this specification are presented in Column (3) of Table 5.7. By comparing these findings to the estimation results of the baseline regression, we find that some of the results differ with the results of the baseline regression. For the business cycle related variables, the main noticeable difference is that $DEFICIT_{it}$ is now of statistical significance at the 5% level and has a negative sign. The RR_{it} remains to be statistical significant at the 1% level, and its coefficient continues to be roughly the same as in the baseline regression. Further, $Positive\_Only_{it}$ is not statistically significant anymore.

As a fourth robustness check we replace the contemporaneous statutory retirement age with the expected statutory retirement age in 20 years' time. Arguable, this variable has a stronger effect on the saving motives of household as this is approximately the retirement age the average household faces. The results are presented in Column (4) of Table 5.7. We find that the estimates of the baseline specification are robust against this variation. Further, we find that the expected statutory retirement age in 20 year has a stronger effect than the contemporaneous statutory retirement age. This result, however, is not significant at the 10% level.

As a fifth robustness check we test whether the effects of pension reforms are dependent on the level of pension benefit, and hence, have a nonlinear effect. The level of pension benefit is measured using the replacement rate for mandatory pensions, RR_{it}. We expect that reforms have a stronger effect on voluntary household savings if the replacement rate is relatively low. We argue that as replacement rates are low, the need for voluntary household savings is already high, and from the household's savings perspective, reforms that affect present or future expected benefit levels are expected to have a more sizeable effect. Specifically, we estimate

$$Y_{i,t} = c_i + \tau_t + \alpha Y_{i,t-1} + \beta' X_{i,t} + \eta' REFORM_{it} + \rho' REFORM_{it} * RR_{it} + v_{i,t} \quad (2)$$

The model presented in equation (2) extends the model in equation (1) with a set of interaction terms. Where ρ is the corresponding vector of coefficients, and $REFORM_{it} * RR_{it}$ are the interaction terms between the different reform dummies and the replacement rate. We expect that the coefficient of the interaction term between $Positive\_Only_{it}$ and RR_{it} to have a negative sign, and the coefficient of the interaction term between $Negative\_Only_{it}$ and RR_{it} to have a positive sign. Again, we apply the same instrument set to our IV-2SLS regression as used in the baseline setup.

The results are presented in Column (5) of Table 5.7. We find that the business cycle related variables and the demographic variables are robust to the inclusion of these interaction terms. Moreover, the RR_{it} remains statistical significant at the 1% level and its coefficient remains to be approximately -0.06.

As for the pension reform dummies, $Positive\_Only_{it}$ is not statistical significant anymore, and therefore not robust to this regression specification. Further, $Negative\_Only_{it}$ and $Both_{it}$ are statistically significant at the 5% level. The coefficient of this dummy variable are respectively -1.779 and 2.778. As for the coefficients of the interaction terms, $Negative\_Only_{it} * RR_{it}$ and $Both_{it} * RR_{it}$ are both statistically significant at the 5% level. The size of the coefficients of these interaction terms are respectively 0.026 and -0.035. Therefore, the full effect of the legislation of a reform with an expected negative effect on household savings is $-1.779 + 0.026 * RR_{it}$. This indicates that as the replacement rate increases, the effect of such a reform becomes less negative. The full effect of the legislation of a reform that simultaneously has an expected positive as negative effect on household savings is $2.778 - 0.035 * RR_{it}$, indicating that the effect of such a reform becomes less positive as the replacement rate increases. We test the joint significance of $Negative\_Only_{it}$ and $Negative\_Only_{it} * RR_{it}$ and find that they are jointly significant at the 5% level. We also test the joint significance of $Both_{it}$ and $Both_{it} * RR_{it}$ and find that they are jointly significant at the 10% level.

However, we find that these results are mainly driven by a few observations, namely by Spain and Sweden. Both these countries had, for a large part of their sample, a relative very high replacement rate (measuring higher than 100%). From Figure 5.4 (which is a histogram of the replacement rate) we can infer that a replacement rate that exceeds 100% is

beyond the normal distribution. The fact that these observations are outliers is confirmed by the box-plot of the replacement rate illustrated in Figure 5.5. The upper and lower line of the box-plot correspond to, respectively, the lower and upper adjacent values. Observations that fall outside the adjacent lines are "outside values" and can hence be labelled as outliers. A few of these outliers coincide with reforms that fall under the "Negative only" and "Both" regimes. We find that these observations put significant weight on the coefficient and the t-values of the interaction terms. After dropping Spain and Sweden from the sample the results are not statistically significant anymore. We therefore conclude that the estimation results of the interaction terms are largely driven by outliers and are therefore not robust. Column (2) of Table 5.9 reports the estimation results for this regression, without the inclusion of Spain and Sweden.

Moreover, dropping Spain and Sweden from the sample does not significantly alter the results of the baseline regression, and we therefore argue that we can keep these countries in the sample as used in the baseline regression. The results for the baseline regression, but without Spain and Sweden in the sample, are reported in Column (1) of Table 5.9. These results are in line with the baseline results presented in Column (4) of Table 5.6.

As a final robustness check we test whether the reform regimes have a lagged effect on the voluntary household savings rate. We test this by including one or two lags of the reform regime in the regression specification and, subsequently, test the joint significance of each reform regime dummy and its lags. The used regression specification looks as follows;

$$Y_{i,t} = c_i + \tau_t + \alpha Y_{i,t-1} + \beta' X_{i,t} + \eta' \sum_{n=0}^{N} REFORMS_{i,t-n} + v_{i,t} \quad (3)$$

The model presented in equation (3) extends the regression specification presented in equation (1) with lagged variables of the reform regime dummy variables.

The results are presented in Table 5.8, in which the first column of results include only one additional lag of each reform regime dummy, and the second column of results include two additional lags of each reform regime dummy. We find that all estimation results of the baseline regression remain robust to this change of the regression specification.

In the same table we also provide the F-test results with which we test for the joint significance of each reform regime and its lags. We find that the inclusion of one additional lag does not yield any joint significance of any of the reform regimes. When we include two

lags, however, we find joint significance at the 10% level of the reform regime with an expected negative effect on voluntary household savings. In line with expectations, the sign of the coefficients are negative, which implies that the legislation of such a reform regime has a negative effect on voluntary household savings.

We conduct several robustness checks to the regression specification with the inclusion of two additional lags of each reform regime. The results are reported in Column (3)-(5) of Table 5.8. In Column (3) we report the results of the regression in which we have substituted the government deficit, $DEFICIT_{it}$, for the change in government debt as percentage of GDP, $\Delta DEBT_{it}$. We find that the F-test results with which we test for the joint significance of each reform regime and its lags are robust to this variation. We find that the reform regime with an expected negative effect on voluntary household savings remains statistical significant at the 10% level. A second robustness test is reported in Column (4), in which we replace $LIFE_{it}$ and OAD_{it} with its first differences; $\Delta LIFE_{it}$ and ΔOAD_{it}. Similarly, the F-test results report to be robust to this change of regression specification. In fact, the joint significant of the negative reform dummy and its two lags is now statistical significant at the 5% level. As a final robustness check we delete the recent financial crisis episode from our sample (2008-2013). The results of this test are presented in Column (5). We find that the F-test results are not robust to this change of the sample period. Now, none of the F-test results report to be statistically significant. These results allow us to conclude that the joint significant effect of reform regime with an expected negative effect on voluntary household savings indeed has a negative effect, which is robust to several different regression specification but not the changes in the sample period.

5.5.4. Summary and discussion

Our empirical analysis provides robust evidence that the replacement rate of mandatory pensions has a negative effect on voluntary household savings. This is in line with expectations, because a higher replacement rate reduces the need for voluntary savings. On average, we find that a 1% increase of the replace rate reduces voluntary household savings with 0.05%. This effect seems to be small. There are several potential reasons for this. One, it could be that only a small part of voluntary household savings is saved for retirement. Therefore, if only a small part of voluntary household savings is put aside for retirement, the effects of changes in retirement benefits will potentially only effect that part. For future research it might be interesting to apply data of the voluntary households savings specifically aimed for old-age retirement.

Another reason for why the effect of the replacement rate on voluntary household savings seems to be small might be because households only limitedly take account of their future's pension benefits. Therefore, as the expected benefit levels changes, in either direction, they only slightly react to this. The reason for this minor reaction is unclear. One of the reason may be that not all households are properly informed about their future pensions or the change in the replacement rate. This could either be due to institutional malfunction (e.g. improper information distribution) or a sheer disinterest of households about their future pensions. Indeed, a survey study shows that workers' information regarding pension offering is often missing or incorrect (Mitchell, 1988). For future research, it might be interesting to test whether short-sightedness of households or improved pension information provision affects the relationship between the replacement rate and voluntary household savings.

As for the effects of pension reforms, we find some evidence that reforms with an expected positive effect on voluntary household savings do indeed have a positive effect on the household savings ratio. These findings are, however, not robust to all other regression specifications. The reason that pension reforms have such little to no effect on the contemporaneous voluntary household savings rate is unknown. There could be an array of reasons. Perhaps this is the case because households are not well-enough informed about the economic implications about such reforms, or it could be the case that households are short-sighted about economic implications.

Another possibility, is that households do react to reforms, but not immediately in the year that reforms are legislated. Our replacement rate and statutory retirement rate variables pick up much of the implemented changes (which are often the result of reforms). However, the implementations phase can be years after the legislation date. This makes it that there is a gap between the year of legislation and the year(s) of implementation. It could very well be the case that household change their voluntary savings profile to the legislation of reforms before they are implemented, but in the years succeeding the year of legislation. This is not picked up in the baseline regression of our analysis. However, in the final robustness check we to test for this by including two additional lags of each reform regime dummy. We find the reform regime with an expected negative effect on voluntary household savings indeed has a negative effect. We do not find a joint significant effect of the other reform regimes. This indicates that the effect of a reform with an expected negative effect on voluntary household savings is picked up in the years succeeding the legislation date. This finding is robust to different regression specification, but not to changes of the sample period.

As a final note on potential future research, it might be interesting to analyse the effects of pension arrangement and pension reforms on the saving profiles of specific cohorts and specific income groups. It can be expected that the effects of certain pension reform measures have a more substantial effect on older cohorts than it has on younger cohorts. This is because the younger cohorts anticipate they can smooth the effect out over a longer period of time. E.g. an anticipated decrease of future pension benefits, perhaps increases the saving profiles of the young, but smooth it out over a long period of time. The elderly, on the other hand, do not have the luxury of time, and therefore resort to a more radical change in their current savings profile. As for specific income groups, it seems plausible to assume that people whom are richer in financial wealth are less dependent of their promised future pension benefit because many of such people have built up a substantial third pillar. Therefore, it is expected that the effects of certain pension reforms are more likely to effect the poor than the rich. An analysis as this would require specific data on the saving profiles of specific cohorts and specific age groups.

5.6. Conclusion

In this paper, we empirically investigated the effects of pension systems and their reforms on voluntary household savings. Changes in pension systems are measured in two ways; through the contemporaneous changes and through the legislation of pension reforms which are expected to change the system in the future. The contemporaneous changes are measured through the replacement rate of mandatory pensions and the statutory retirement age. As for the pension reforms, we apply a unique and comprehensive dataset of narratively identified pension reforms that covers 19 OECD countries over the period from 1970 to 2013. We distinguish among several kinds of pension reforms, namely changes in contributions, pension coverage, generosity and retirement age, as well as financial and fiscal sustainability measures and reforms that increase work incentives. Subsequently, we categorize these reforms according their expected effect on voluntary household savings. As a result we create three dummy variables with each having a different expected effect on voluntary household savings. The effects are either positive, negative, or ambiguous. Further, we control for a broad range of economic and demographic variables, and the replacement rate of mandatory pension.

In our baseline regression, we control for some potential effects that might bias our results. We control for serial correlation by including a lag of the dependent variable as a regressor. We account for heteroscedasticity and cross-correlated effect by applying Driscoll-

Kraay standard errors. Further, we control for the potential endogeneity that might result from a feedback effect from our dependent variable to some of our control variables, by applying instrumental variables in the form of the 2-stage-least-squares method. Our baseline regression estimates suggest that the replacement rate has a negative effect on voluntary savings, and that reforms that are expected to positively affect voluntary household savings indeed do so.

We apply several robustness checks to our findings. We change the regression specification in six different ways. Namely, (1) changes in business cycle related variables, (2) changes in demographic variables, (3) dropping the crisis dummy from the regression and dropping the time period 2008-2013 from our sample, (4) we replace the contemporaneous retirement age with the expected retirement age in 20 year time, (5) including interaction terms between the set of pension reforms and the replacement rate, (6) inclusion of lags of the reform regime dummies.

The findings for the replacement rate are robust to all the estimated variation of the regression specification, and we therefore conclude that this finding is extremely robust. Further, the estimation results for the reforms that are expected to positively affect voluntary household savings are not robust to all variations in our regression specification.

As for any the findings of the robustness checks, there is mild evidence that the other two reform regimes seem to have a nonlinear effect on household savings, however, we detect that these results are driven by two outliers. After elimination of these outliers their does not appear to be a significant nonlinear relationship between any of the reform regimes. Further, the joint effect of reforms with an expected negative effect and two of its lags are jointly significant and indeed have a negative effect on voluntary household savings. We find the reform regime with an expected negative effect on voluntary household savings indeed has a negative effect. We do not find a joint significant effect of the other reform regimes. This indicates that the effect of a reform with an expected negative effect on voluntary household savings is picked up in the years succeeding the legislation date. This finding is robust to different regression specification, but not to changes of the sample period.

5.T. Tables

Table 5.1: Number of reform measures by country and type – aggregated over 1970-2013

	Coverage	Increase of benefits	Reduction retirement age	Decrease of benefits	Increased retirement age	Increased contribution rate	Work incentives	Total
Australia	10	6	0	6	2	0	5	29
Austria	2	5	0	2	1	0	2	11
Belgium	6	12	2	0	3	0	3	24
Canada	6	8	2	1	0	3	1	20
Denmark	7	4	4	5	5	1	4	26
Finland	6	8	2	3	3	0	4	23
France	10	13	8	8	2	2	6	46
Germany	4	13	4	9	3	0	2	32
Italy	3	4	1	8	5	1	3	24
Ireland	8	4	0	12	3	1	6	32
Japan	10	16	0	9	3	1	0	39
Netherlands, the	2	1	6	5	2	0	2	17
New Zealand	5	1	0	7	1	1	2	16
Portugal	5	9	3	6	4	2	4	30
Spain	5	14	4	3	0	0	7	29
Sweden	2	7	1	5	1	0	4	19
Switzerland	7	6	0	9	2	2	2	28
United Kingdom	6	9	0	6	2	2	2	26
United States	5	12	0	14	1	4	1	35

Table 5.2: Number of reform measures and reform-dummies by type, period and reform regime			
	1970-2013	1970-1991	1992-2013
Coverage	87	41	46
Increased benefits	112	50	62
Reduction retirement age	35	25	10
Decreased benefits	89	27	62
Increased retirement age	40	4	36
Increased contribution rate	20	6	14
Work incentives	50	7	43
Positive effects on savings	79	36	43
Negative effects on savings	258	102	156
Positive only	39	23	16
Negative only	218	89	129
Both	40	13	27

Table 5.3: List of variables and their description

HH_SAV_{it}	Voluntary household savings rate as percentage of disposable income
GDP_{it}	Real GDP growth in percentages
UNE_{it}	Unemployment rate as percentage share of the labour force
$INFLATION_{it}$	The inflation rate based on the Consumer Price Index (CPI)
$INTEREST_{it}$	The interest rate on short term (3-month) treasury bonds
CCI_{it}	Consumer Confidence Index
$DEFICIT_{it}$	Government deficit as a percentage of GDP
$OPEN_{it}$	Openness of trade, measured as the sum of exports and imports, as a percentage of GDP
$LIFE65_{it}$	Remaining life expectancy at the age of 65, measured in years
OAD_{it}	Old age dependency ratio
RR_{it}	Replacement rate of mandatory pensions, measured as a percentage share of pre-retirement income
$REFORM_{it}$	Vector containing dummies for the three pension reform regimes or dummies for specific types of reforms.
➢ $Increase\_Reforms_{it}$	Reforms that are expected to increase household savings
➢ $Decrease\_Reforms_{it}$	Reforms that are expected to decrease household savings
• $Coverage_{it}$	Extension of the coverage of the pension scheme
• $Increase\_Benefits_{it}$	Increased generosity and/or adequacy measure
• $Reduction\_Retirement\_Age_{it}$	This indicates a reduction of either the voluntary or the mandatory retirement age
• $Decreased\_Benefits_{it}$	Measures that enhance the pension scheme's financial and fiscal sustainability
• $Increased\_Retirement\_Age_{it}$	This indicates an increase of either the voluntary or the mandatory retirement age
• $Increases\_Contribution\_Rate_{it}$	An increase of the mandatory contribution rate
• $Work\_Incentives_{it}$	These are measures that increase the incentives of the old-age population to remain in the labour force

Table 5.4: Descriptive statistics

Variable	Observations	Mean	Standard Deviation	Minimum value	Maximum Value
HH_SAV_{it}	741	7.91	7.43	-16.75	24.88
GDP_{it}	836	7.90	2.35	-8.71	13.62
$UNEMPLOYMENT_{it}$	836	6.52	3.66	0.00	26.10
$INFLATION_{it}$	836	6.60	11.53	-4.50	105.20
CCI_{it}	674	99.94	1.33	94.41	104.85
$DEFICIT_{it}$	836	2.84	3.96	-41.31	32.43
$INTEREST_{it}$	836	7.78	2.54	0.65	29.74
$DEBT_{it}$	836	55.69	32.02	1.74	243.20
$LIFE\_65_{it}$	828	17.03	1.86	12.85	21.55
OAD_{it}	836	21.10	4.22	10.21	40.37
RR_{it}	759	65.28	14.09	18.8	111.10
RET_AGE_{it}	836	63.79	2.16	57.5	70
$RET\_AGE\_20Y_{it}$	836	64.06	2.12	57.5	70

Notes: HH_SAV_{it} is the household savings rate taken as a percentage of disposable income. GDP_{it} is the GDP growth rate. $UNEMPLOYMENT_{it}$ is unemployment in percent of the labour force. $INFLATION_{it}$ is inflation measured as the annual change in the price level in percent. CCI_{it} is consumer confidence and has a long-term average of 100. $DEFICIT_{it}$ is given in percentage of GDP. $INTEREST_{it}$ is the interest rate paid on short-term treasury paper. $DEBT_{it}$ is government debt in percent of GDP. $LIFE\_65_{it}$ is the remaining life expectancy in years at 65. OAD_{it} is the old-age dependency ratio, which is the total population aged 65 and over as share of the total population aged 15-64. RR_{it} is the replacement rate of the mandatory retirement income in percent of pre-retirement income. RET_AGE_{it} is the statutory retirement age. $RET\_AGE\_20Y_{it}$ is the expected retirement age in 20 years' time.

Table 5.5: Determinants of savings in previous empirical studies

Variable category	Specific variables	Expected sign	Empirical findings
Economic variables	GDP growth	+	+(1, 2, 3, 4, 5, 8, 10, 15, 16)
	Unemployment	-	+(6, 7), -(19)
	Inflation	+, -	+(8, 9, 15, 16), -(20)
	Consumer confidence index	-	
	Real Interest Rate	+, 0, -	+(7, 15, 17), 0(10), -(18)
	Government deficit	+	
	Government debt	+	
Demographic variables	Longevity	+	+(11, 12, 13, 14)
	Old age dependency ratio	-, 0	-(12, 13, 15, 16, 18), 0(10)
Pension variables	Replacement rate	-	-(12, 13)
	(Expected) retirement age	-	
	Reforms		
	- Coverage	-	
	- Increased benefits	-	
	- Decreased retirement age	+	
	- Decreased benefits	+	
	- Increased retirement age	-	
	- Increased contributions	-	
	- Work incentives	-	

Note: Each number in the fourth and final column is a reference to a previously conducted empirical study. They are: 1 - Modigliani (1970); 2 - Deaton and Paxson (2000); 3 - Bosworth (1993); 4 - Carroll and Weil (1993); 5 - Dayal-Gulati and Thimann (1997); 6 - Kessler *et al.*, (1993); 7 - Mody *et al*. (2012); 8 - Loyaza et al., (2000); 9 - Hüfner and Koske, (2010); 10 – Bailliu and Reisen (1998); 11 – Li et al., (2007); 12 - Bloom et al., (2007); 13- de Freitas and Martins, (2014); 14- Börsch-Supan et al. (2014); 15 – Masson et al. (2010); 16 - Grigoli et al. (2014); 17 – Hondroyiannis (2006); 18 – De Mello et al. (2004); 19 – Arent (2012); 20 – Muradoglu and Taskin (1996)

Table 5.6: Panel data estimation results. Dependent variable: voluntary household savings as percentage of disposable income. Sample period: 1970-2013, 19 OECD countries.

	LSDV – Driscoll-Kraay	IV-2SLS – Driscoll-Kraay		
Independent variables	(1)	(2)	(3)	(4)
$HH\_SAV_{i,t-1}$	0.780***	0.799***	0.835***	0.801***
	(22.68)	(24.19)	(24.95)	(24.27)
GDP_{it}	-0.179***	-0.579***	-0.517***	-0.561***
	(-2.74)	(-3.31)	(-2.90)	(-3.34)
$UNEMPLOYMENT_{it}$	-0.036	0.005	-0.023	0.010
	(-0.87)	(0.09)	(-0.38)	(0.18)
$INFLATION_{it}$	-0.013	-0.012	-0.004	-0.011
	(-1.26)	(-1.06)	(-0.49)	(-0.98)
$DEFICIT_{it}$	0.101***	0.018	-0.012	-0.001
	(3.63)	(0.42)	(-0.31)	(-0.02)
CCI_{it}	0.214***	0.403***	0.340**	0.371***
	(3.52)	(3.03)	(2.48)	(2.82)
$INTEREST_{it}$	-0.117	0.111	0.127	0.113
	(-1.39)	(1.40)	(1.59)	(1.39)
$LIFE\_65_{it}$	0.260	0.234	0.109	0.195
	(0.96)	(0.80)	(0.39)	(0.67)
OAD_{it}	-0.128***	-0.111**	-0.106***	-0.111***
	(-3.88)	(-2.55)	(-2.77)	(-2.41)
RR_{it}	-0.047***	-0.054***		-0.053***
	(-4.78)	(-5.17)		(-5.27)
RET_AGE_{it}	-0.134	-0.086		-0.107
	(-1.12)	(-0.70)		(-0.87)
$Positive\_Only_{it}$	0.558*		0.632*	0.638*
	(1.77)		(1.65)	(1.78)
$Negative\_Only_{it}$	0.026		-0.054	-0.064
	(0.27)		(-0.47)	(-0.59)
$Both_{it}$	0.163		0.312	0.291
	(0.53)		(1.03)	(1.00)
Number of observations	611	600	600	600
R-squared	0.77	0.74	0.74	0.74
Kleibergen-Paap rk LM statistic – p-value		0.0248	0.0255	0.0254
Hansen J test – p-value		0.3834	0.4600	0.3704
Anderson-Rubin Wald test – p-value		0.0141	0.0578	0.0273

Notes: (i) Figures between parentheses are t-values. (ii) Further, *** denotes significance at the 1% level, ** denotes significance at the 5% level, and * denotes significance at the 10% level. (iii) We set the Kernel-Bartlett bandwidth to 3. (iv) The Kleibergen-Paap rk LM underidentification statistic tests whether the instrumental variables are correlated with the endogenous regressors ($Cov(Z_{it}, X_{it}) \neq 0$). The null states that the model is underidentified, and the alternative states the model is identified. With the Hansen J test for overidentification we test whether the instruments meet the exogeneity requirement, ($Cov(Z_{it}, u_{it}) = 0$). The null states that the instruments are valid, against the alternative, which states that the instruments are invalid. With the Anderson-Rubin Wald F statistic we test whether the instruments are weak. The null states that the instruments are weak, against the alternative that they are not.

Table 5.7: Various robustness checks. Panel data estimation results. Dependent variable: voluntary household savings as percentage of disposable income. Sample period: 1970-2013, 19 OECD countries.

Independent variables	(1)	(2)	(3)	(4)	(5)
$HH\_SAV_{i,t-1}$	0.815***	0.821***	0.769***	0.799***	0.793***
	(27.18)	(25.80)	(23.39)	(24.05)	(24.33)
GDP_{it}	-0.542***	-0.586**	-0.540***	-0.547***	-0.599***
	(-3.84)	(-3.47)	(-2.82)	(-3.12)	(-3.67)
$UNEMPLOYMENT_{it}$	0.027	-0.004	0.085	0.006	0.017
	(0.46)	(-0.07)	(1.36)	(0.10)	(0.33)
$INFLATION_{it}$	-0.009	-0.012	0.000	-0.012	-0.011
	(-0.80)	(-1.00)	(0.02)	(-1.05)	(-0.92)
$DEFICIT_{it}$		-0.005	-0.071**	0.004	0.013
		(-0.12)	(-2.19)	(0.10)	(0.26)
CCI_{it}	0.374***	0.370***	0.403**	0.363**	0.477***
	(2.86)	(2.74)	(2.16)	(2.77)	(3.91)
$INTEREST_{it}$	0.060	0.107	0.154	0.112	0.118
	(0.93)	(1.31)	(1.48)	(1.37)	(1.46)
$\Delta DEBT_{it}$	-0.036				
	(-0.78)				
$LIFE\_65_{it}$	-0.078		0.531*	0.261	0.234
	(-0.33)		(1.86)	(0.86)	(0.78)
OAD_{it}	-0.098**		-0.151***	-0.095***	-0.110**
	(-2.32)		(-2.80)	(-2.07)	(-2.57)
$\Delta LIFE\_65_{it}$		-0.322			
		(-0.67)			
ΔOAD_{it}		0.093			
		(0.23)			
RR_{it}	-0.059***	-0.049***	-0.059***	-0.053***	-0.060***
	(-5.89)	(-4.75)	(-6.07)	(-5.20)	(-5.47)
RET_AGE_{it}	-0.059	-0.168	-0.153		-0.115
	(-0.49)	(-1.58)	(-0.88)		(-0.91)
$RET\_AGE\_20Y_{it}$				-0.144	
				(-1.63)	
$Positive\_Only_{it}$	0.646*	0.654*	0.635	0.633*	1.442
	(1.70)	(1.73)	(1.52)	(1.82)	(0.80)
$Negative\_Only_{it}$	-0.058	-0.078	-0.081	-0.053	-1.779**
	(-0.44)	(-0.63)	(-0.63)	(-0.45)	(-2.24)
$Both_{it}$	0.276	0.285	0.169	0.272	2.778**
	(0.94)	(0.94)	(0.44)	(0.91)	(1.95)
$Positive\_Only_{it} * RR_{it}$					-0.013
					(-0.48)
$Negative\_Only_{it} * RR_{it}$					0.026**
					(2.22)
$Both_{it} * RR_{it}$					-0.035**
					(-2.01)
Number of observations	592	600	488	600	600
R-squared	0.76	0.74	0.72	0.74	0.74
Kleibergen-Paap rk LM statistic – p-value	0.0434	0.0247	0.0424	0.0275	0.0727
Hansen J test – p-value	0.1429	0.3106	0.9984	0.2776	0.4740
Anderson-Rubin Wald	0.0780	0.0395	0.0074	0.0434	0.0369

test – p-value

Notes: see Table 5.6. In Column (1) we replace DEF_{it} with $\Delta DEBT_{it}$. In Column (2) we replace $LIFE_{it}$ and OAD_{it} with its first differences; $\Delta LIFE_{it}$ and ΔOAD_{it}. In Column (3) we drop the crisis period 2008-2013 from the sample. In Column (4) we replace the contemporaneous statutory retirement age with the expected retirement age in 20 year time, $RET\_AGE\_20Y_{it}$. In Column (5) we interact the reform dummies with the replacement rate.

Table 5.8: Various robustness checks. Panel data estimation results. Dependent variable: voluntary household savings as percentage of disposable income. Sample period: 1970-2013, 19 OECD countries.

Independent variables	(1)	(2)	(3)	(4)	(5)
$HH\_SAV_{i,t-1}$	0.804***	0.816***	0.820***	0.831***	0.789***
	(25.22)	(29.83)	(28.98)	(31.53)	(28.33)
GDP_{it}	-0.555***	-0.458***	-0.530***	-0.492***	-0.398**
	(-3.34)	(-2.96)	(-3.67)	(-3.15)	(-1.96)
$UNEMPLOYMENT_{it}$	0.008	0.013	0.027	-0.013	0.087
	(0.14)	(0.23)	(0.47)	(-0.22)	(1.50)
$INFLATION_{it}$	-0.12	-0.011	-0.010	-0.012	-0.001
	(-1.05)	(-1.01)	(-0.85)	(-1.07)	(-0.05)
$DEFICIT_{it}$	0.006	-0.012		-0.012	-0.087**
	(0.15)	(-0.26)		(-0.24)	(-2.53)
CCI_{it}	0.375***	0.365***	0.382***	0.380**	0.333*
	(2.78)	(2.56)	(2.74)	(2.53)	(1.70)
$INTEREST_{it}$	0.106	0.053	0.052	0.049	0.106
	(1.38)	(0.88)	(0.84)	(0.80)	(1.15)
$\Delta DEBT_{it}$			-0.032		
			(-0.68)		
$LIFE\_65_{it}$	-0.225	-0.051	-0.052		0.150
	(-0.77)	(-0.21)	(-0.22)		(0.60)
OAD_{it}	-0.108**	-0.091**	-0.094**		-0.118**
	(-2.40)	(-2.30)	(-2.24)		(-2.18)
$\Delta LIFE\_65_{it}$				-0.327	
				(-0.57)	
ΔOAD_{it}				0.085	
				(0.23)	
RR_{it}	-0.0529***	-0.058***	-0.058***	-0.059***	-0.065***
	(-5.46)	(-6.39)	(-5.92)	(-5.91)	(-6.78)
RET_AGE_{it}	-0.106	-0.083	-0.065	-0.144	-0.100
	(-0.84)	(-0.66)	(-0.51)	(-1.25)	(-0.57)
$Positive\_Only_{it}$	0.617*	0.639*	0.644*	0.623*	0.633
	(1.75)	(1.81)	(1.73)	(1.68)	(1.60)
$Negative\_Only_{it}$	-0.086	-0.079	-0.085	-0.094	-0.075
	(-0.80)	(-0.72)	(-0.71)	(-0.83)	(-0.58)
$Both_{it}$	0.248	0.243	0.244	0.230	0.164
	(0.88)	(0.85)	(0.88)	(0.77)	(0.43)
$Positive\_Only_{i,t-1}$	-0.264	-0.198	-0.226	-0.241	-0.218
	(-0.80)	(-0.59)	(-0.69)	(-0.69)	(-0.56)
$Negative\_Only_{i,t-1}$	-0.187	-0.133	-0.145	-0.144	0.091
	(-1.04)	(-0.68)	(-0.73)	(-0.74)	(0.54)
$Both_{i,t-1}$	-0.411	-0.428	-0.424	-0.460*	-0.211
	(1.59)	(-1.62)	(-1.62)	(-1.67)	(-0.73)
$Positive\_Only_{i,t-2}$		0.099	0.066	0.059	0.239
		(0.30)	(0.20)	(0.18)	(0.59)
$Negative\_Only_{i,t-2}$		-0.194	-0.214	-0.223	-0.107
		(-1.48)	(-1.63)	(-1.55)	(-0.80)
$Both_{i,t-2}$		-0.211	-0.193	-0.216	0.104
		(-0.87)	(-0.76)	(-0.85)	(0.46)
F-test for joint significance of certain reform regimes					
$\sum_{n=0}^{N} Positive\_Only_{i,t-n}$	0.77	1.43	1.07	0.86	1.37

$\sum_{n=0}^{N} Negative\_Only_{i,t-n}$	2.19	3.06*	3.11*	4.11**	0.23
$\sum_{n=0}^{N} Both_{i,t-n}$	0.16	0.66	0.60	0.74	0.01
Number of observations	600	592	592	592	480
R-squared	0.74	0.77	0.76	0.76	0.75
Kleibergen-Paap rk LM statistic – p-value	0.0265	0.0305	0.0516	0.0305	0.0661
Hansen J test – p-value	0.3671	0.2678	0.1476	0.2194	0.6659
Anderson-Rubin Wald test – p-value	0.0061	0.0658	0.0257	0.0570	0.0206

Notes: see Table 5.6. Further, in Column (1) we include one additional lag of each reform regime. In Column (2) we include two additional lag of each reform regime. Further, Column 3-5 reports robustness checks to the findings of baseline regression with the inclusion of two additional lags of each reform regime. In Column (3) we replace DEF_{it} with $\Delta DEBT_{it}$. In Column (4) we replace $LIFE_{it}$ and OAD_{it} with its first differences; $\Delta LIFE_{it}$ and ΔOAD_{it}. In Column (5) we drop the crisis period 2008-2013 from the sample. Furthermore, we conduct a F-test to test for the joint significance of each reform regime and its included lags. The null hypothesis of this test states that there is no joint effect of the reform regimes on household savings, against the alternative that there is a joint effect.

Table 5.9: Panel data estimation results. Dependent variable: voluntary household savings as percentage of disposable income. Sample period: 1970-2013, 17 OECD countries.

Independent variables	(1)	(2)
$HH\_SAV_{i,t-1}$	0.812***	0.802***
	(27.14)	(25.37)
GDP_{it}	-0.578***	-0.629***
	(-2.96)	(-3.20)
$UNEMPLOYMENT_{it}$	0.014	0.020
	(0.23)	(0.33)
$INFLATION_{it}$	-0.011	-0.011
	(-1.00)	(-0.94)
$DEFICIT_{it}$	-0.002	0.021
	(-0.05)	(0.45)
CCI_{it}	0.331**	0.480***
	(1.94)	(2.92)
$INTEREST_{it}$	0.081	0.089
	(0.85)	(0.95)
$LIFE\_65_{it}$	0.224	0.245
	(0.75)	(0.79)
OAD_{it}	-0.112**	-0.110**
	(-2.31)	(-2.42)
RR_{it}	-0.058**	-0.062***
	(-3.74)	(-4.18)
RET_AGE_{it}	-0.112	-0.108
	(-0.95)	(-0.85)
$Positive\_Only_{it}$	0.602*	1.601
	(1.68)	(0.88)
$Negative\_Only_{it}$	-0.189	-1.460
	(-1.50)	(-1.52)
$Both_{it}$	0.415	2.487
	(1.11)	(1.37)
$Positive\_Only_{it} * RR_{it}$		-0.0156
		(-0.59)
$Negative\_Only_{it} * RR_{it}$		0.020
		(1.33)
$Both_{it} * RR_{it}$		-0.032
		(-1.18)
Number of observations	557	557
R-squared	0.75	0.74
Kleibergen-Paap rk LM statistic – p-value	0.0400	0.1003
Hansen J test – p-value	0.4509	0.3710
Anderson-Rubin Wald test – p-value	0.1492	0.1060

Notes: see Table 6. The observations for Spain and Sweden are eliminated from the sample, leaving a panel of 17 countries. Column (1) reports the results of the baseline regression. In Column (2) we interact the reform dummies with the replacement rate.

5.F. Figures

Figure 5.14. Splitting national savings into (sub) components

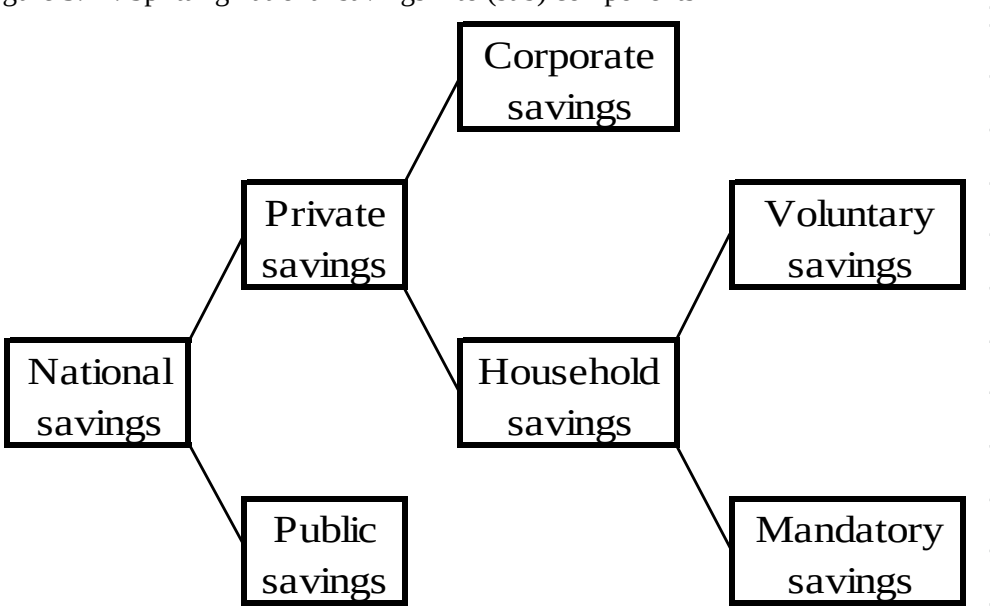


Figure 5.215. Pension reforms divided into different reform types

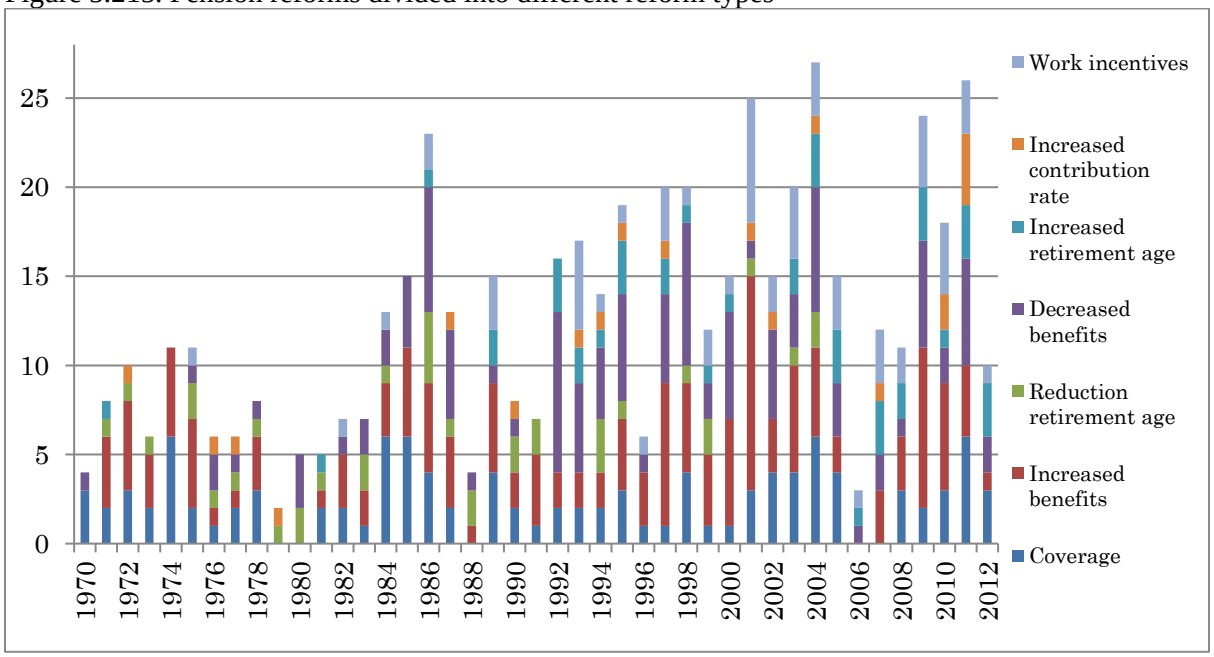


Figure 5.3: Pension reforms divided into different reform regimes

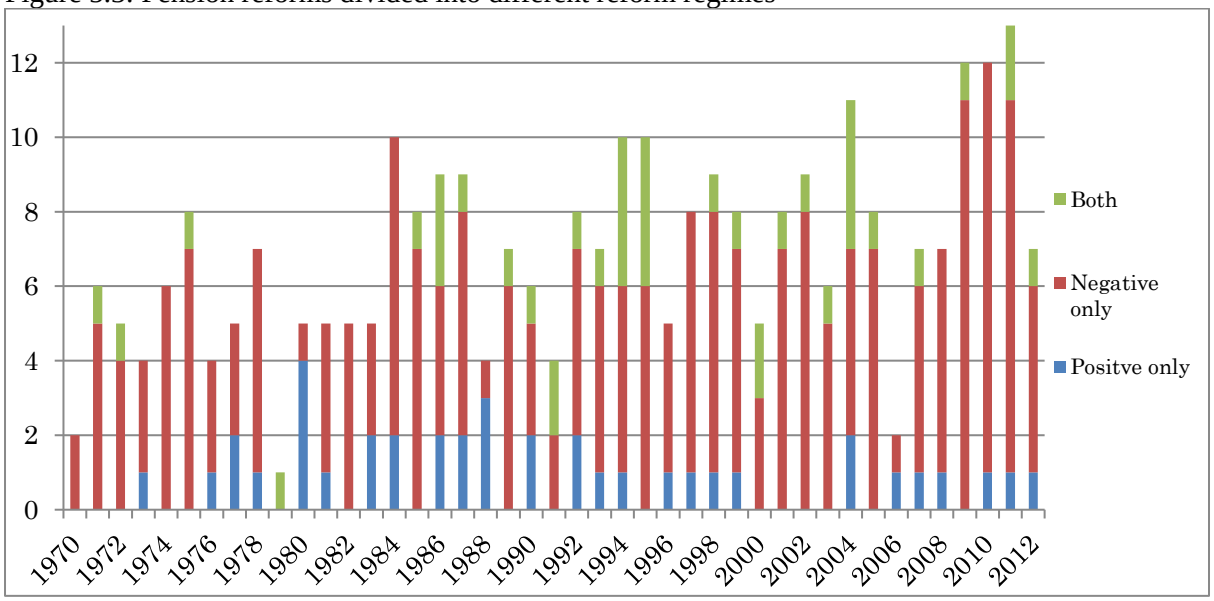


Figure 5.4: Histogram – replacement rate

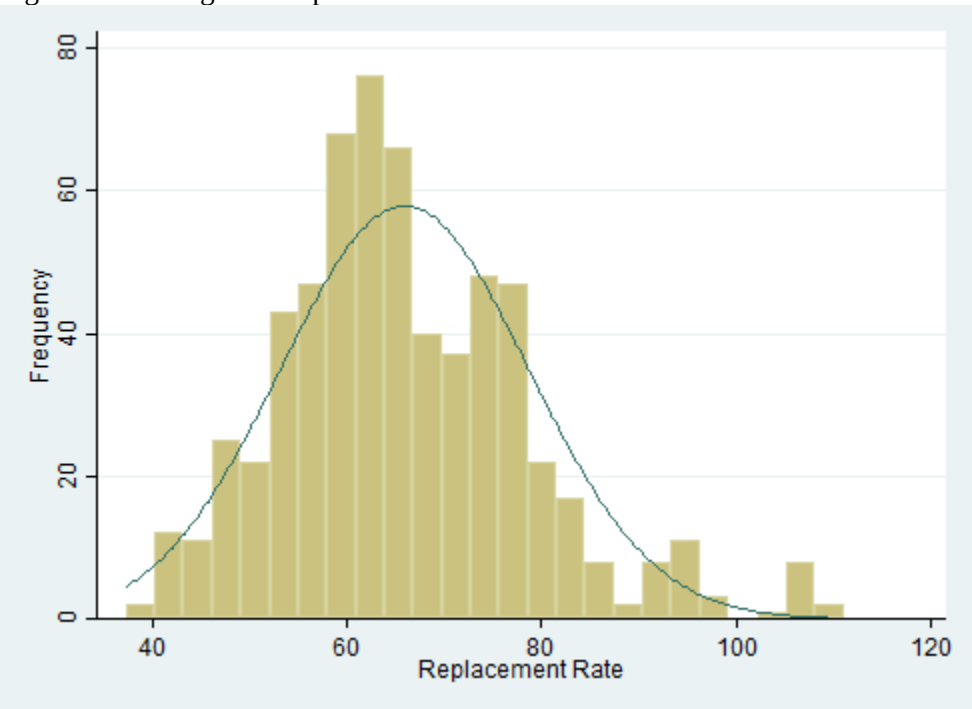
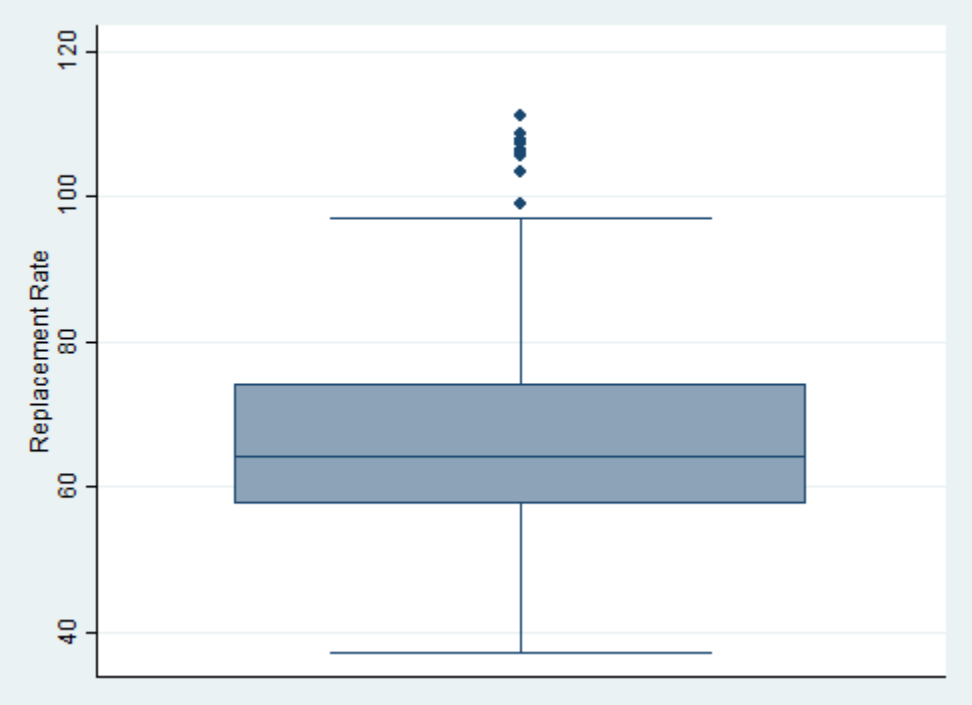


Figure 5.5: Box plot – replacement rate



5.A. Appendices

5.A.1. List of OECD countries included in the dataset

The following countries are included in our dataset:

Australia	Japan
Austria	The Netherlands
Belgium	New Zealand
Canada	Portugal
Denmark	Spain
Finland	Sweden
France	Switzerland
Germany	United Kingdom
Italy	United States
Ireland	

5.A.2. Data description

5.A.2.1. Economic variables

GDP: Annual percentage growth rate of GDP per capita based on constant prices, local currency. Data is obtained from the World Bank (2014).

UNEMPLOYMENT: the unemployment rate is measured as the number of unemployed as a percentage of the total labor force. Data is obtained from the World Bank (2014).

INFLATION: Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. Data is obtained from the World Bank (2014).

INTEREST: The long term interest rate is the rate at which long (usually 10-year) government bonds are issued or traded in the market. Data of this variable is obtained from the OECD Economic Outlook (2014) and Eurostat (2014).

CCI: This indicator measures consumer confidence. The indices have been standardized and centered around 100 points to make them comparable across countries.

The CCI is defined as the degree of optimism consumers have in the state of the economy. It is based both on their current situation and on their expectations for the immediate future. The index is based on questionnaires sent out to a random sample of the population. They consist of questions about the current and expected future personal and general economic situation. Although the specific questions may differ among countries, the general format looks as follows:

- Expected change in the household's financial situation over the year;
- Expected change in the general economic situation over the next year;
- Expected change in unemployment rate over the next year;
- Expected change in the household's savings rate over the next year.

Each question has five possible answers: a lot better, a little better, the same, a little worse and a lot worse. The answers are balanced and weighed to create an index.

Data is obtained from the OECD Main Economic Indicators (OECD MEI, 2016). Data is missing for Australia for the years 1970-1974; Austria, 1970-1976; Belgium, 1970-1972; Canada, 1970-1979; Denmark, 1970-1973; Finland, 1970-1988; France, 1970-1972; Germany, 1970-1972; Italy, 1970-1972; Ireland, 1970-1973; Japan, 1970-1982; the Netherlands, 1970-1972; New Zealand, 1970-1988; Portugal, 1970-1986; Spain, 1970-1986; Sweden, 1970-1995; Switzerland, 1970-1972; United Kingdom, 1970-1973.

DEFICIT: this variable is calculated as total receipts general government minus total disbursement of the general government as a percentage of GDP. Data is obtained from the OECD National Accounts (2014).

OPEN: openness of trade is measured as the sum of exports and imports as a percentage of GDP. Data on imports and exports are obtained from the OECD National Accounts (2014).

DEBT: it is calculated as the central governments gross liabilities, reduced by the government's holding of equity and financial derivatives, and expressed as a percentage of GDP. It is obtained from the OECD Economic Outlook (2014).

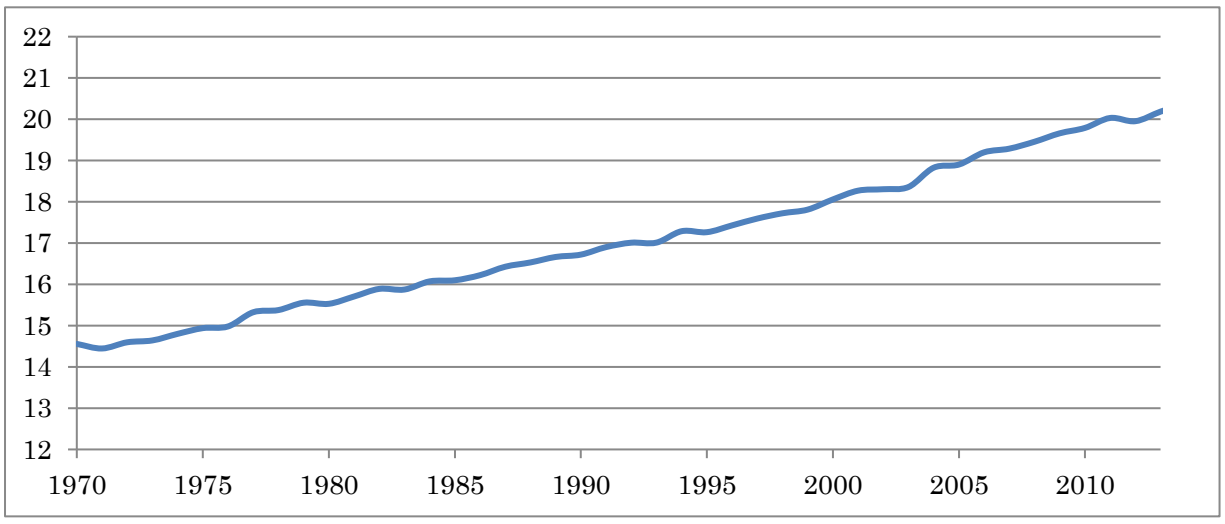
5.A.2.2. Demographic variables

LIFE_65: This variable captures the expected remaining years a 65-year-old person has left to live. We take the un-weighted average for males and females. Data is obtained from the Comparative Welfare Entitlements Dataset (2014) and the OECD (2013). The data are combined where needed and appropriate.

The average life expectancy at the age of 65 is depicted in Figure 5.A.1. For each year, the average is taking over all the countries for which we have data for that year. Data is missing for Canada for the year 2013; Finland, 1970; Italy, 1970; and Spain,1970-1974.

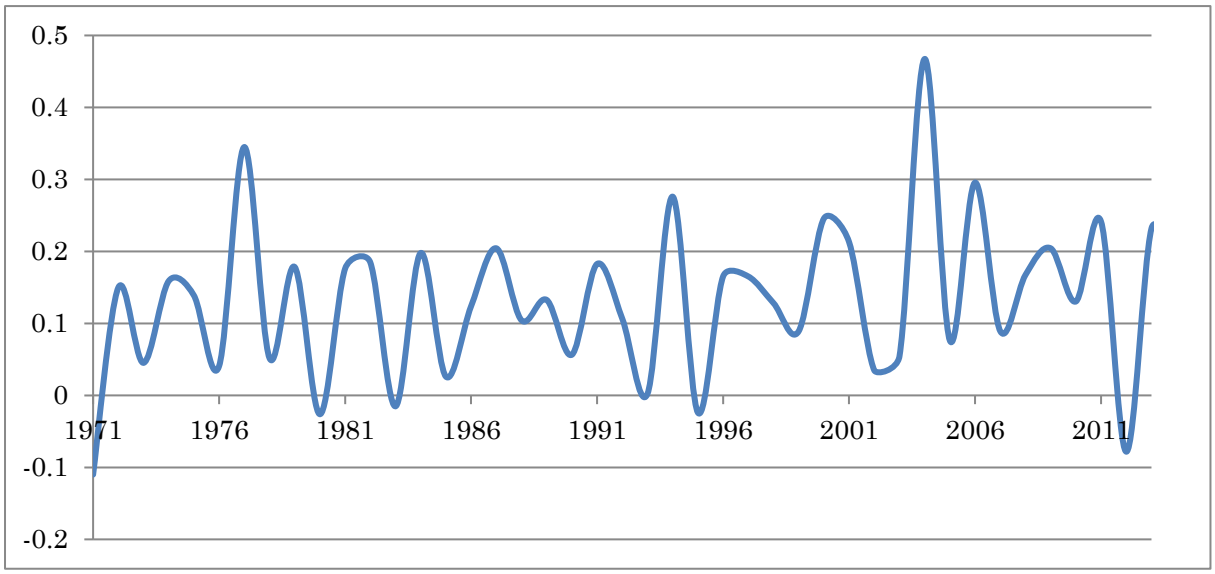
Clearly, the variable features a trend. In 1970 the expected average remaining number of years of life at the age of 65 was about 14.5. This has steadily increased to roughly 20 years in 2013.

Figure 5.A.1: Average life expectancy at age 65



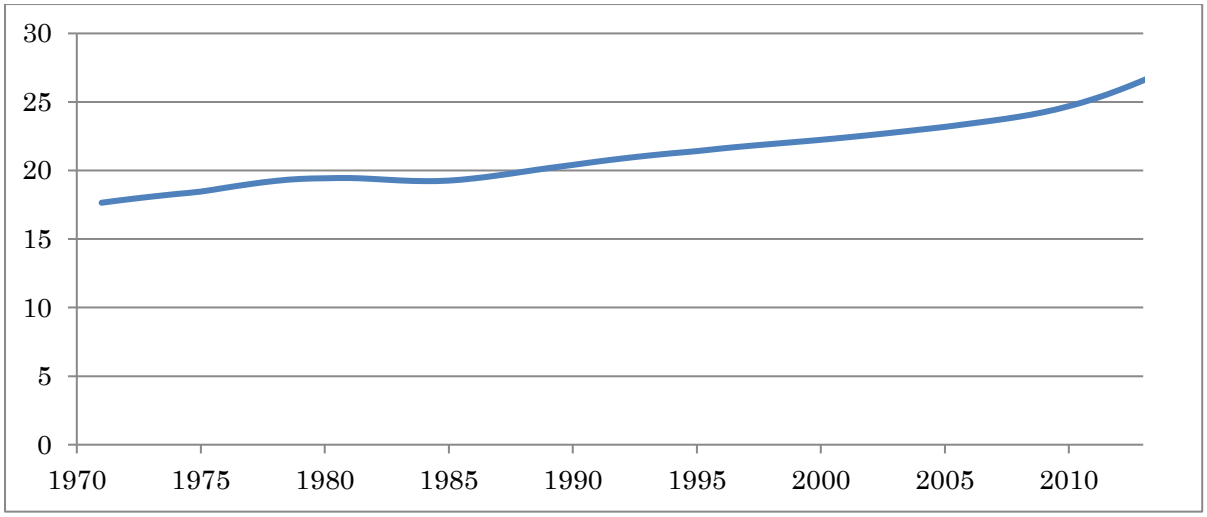
By taking the first difference of the variable we can eliminate the trend. Figure 5.A.2 we present the year-to-year change in the average life expectancy at the age of 65.

Figure 5.A.2: First difference of the average life expectancy at 65



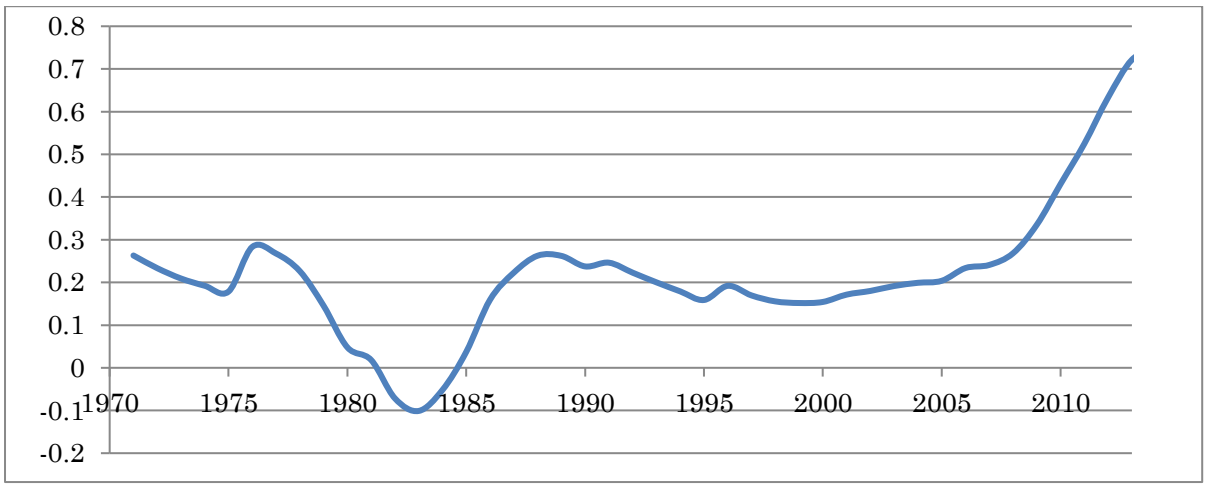
OAD: we define the old-age dependency ratio as the number of people of 65 and older divided by the number of people in the age category 15-64, times 100. The average OAD is depicted in Figure 5.A.3. For each year, the average is taking over all the countries for which the OAD is available for that given year. Data is obtained from the United Nations Population Division's World Population Prospects.

Figure 5.A.3: Average *Old Age Dependency ratio (OAD)*



The average old-age dependency ratio clearly exhibits a trend. In Figure 5.A.4 we present the year-to-year change in the average OAD.

Figure 5.A.4: Average of the first difference of the old age dependency ratio *(ΔOAD)*



5.A.2.3. Savings variable

HH_SAV: voluntary household savings is defined as the subtraction of household consumption expenditure from net household disposable income. This variable is measured as a percentage of net household disposable income. Further, net household disposable income is gross disposable income minus the consumption of fixed capital.

Our sources for this variable are the UN System of National Accounts (UN SNA), the World Bank, The OECD National Accounts, Oxford Economics and the world saving database (Loayza *et al.*, 1998).

The UN SNA has several systems (the 1968-, 1993-, 2008-systems) from which we have calculated the saving rate by subtracting household final consumption expenditure and the consumption of fixed capital from disposable income and taking the remainder as a percentage of disposable income. Each UN SNA system has several series (which are small adjustments to pervious series). The data coverage differs among series, although in most cases there is still much overlap. If an older series reports to be more complete than a newer series, and the series do not complement each other (e.g. the series follow a differed trend), we take the series that is most complete. Where needed and appropriate, we combine the different systems and series. In this case we take the most recent series of the most recent system as the baseline, and, if needed and appropriate, extend that series with the second last series, etc. Different series are only combined if the overlapping data observations follow a similar trend.

Now we give an example how such series are combined.

Suppose we have two different series that both cover data on variable X. The two series are series A and series B, of which series A covers the years 1-6, and series B covers the years 3-10. The overlapping years are the years 3-6 and we find that these years follow a similar trend, hence allowing us to complement the data from series B with the data from series A

To combine the data of these two sources we proceed as follows;

- For year 3 we take the ratio of series B with respect to series A: $X_{B,3}/X_{A,3}$.
- We adjust the values of variable X for years 1 and 2 from series A, by taking the product of these values and the calculated ratio.
    - Thus, for years 1 and 2, respectively, we find the following values: $\left(\frac{X_{B,3}}{X_{A,3}}\right)X_{A,1}$ and $(\frac{X_{B,3}}{X_{A,3}})X_{A,2}$.
- As a result, we end up with one combined series that covers the years 1-10, of which year one = $\left(\frac{X_{B,3}}{X_{A,3}}\right)X_{A,1}$, year two =$(\frac{X_{B,3}}{X_{A,3}})X_{A,2}$, year three =$X_{B,3}$, year four = $X_{B,4}$, …, year ten = $X_{B,10}$.

We obtain household final consumption expenditure data from the World Bank (2016) and household net disposable income data from the OECD National Accounts (2016). With these two series we calculate household voluntary savings as percentage of disposable income.

We also use the voluntary household savings data from the world saving database (Loayza *et al.*, 1998). By combining this with the household final consumption expenditure data from the World Bank (2016) we calculate again the net household savings data as a percentage of disposable income.

Furthermore, from Oxford economics (2016) we have also obtained a series on net household savings as percentage of disposable income.

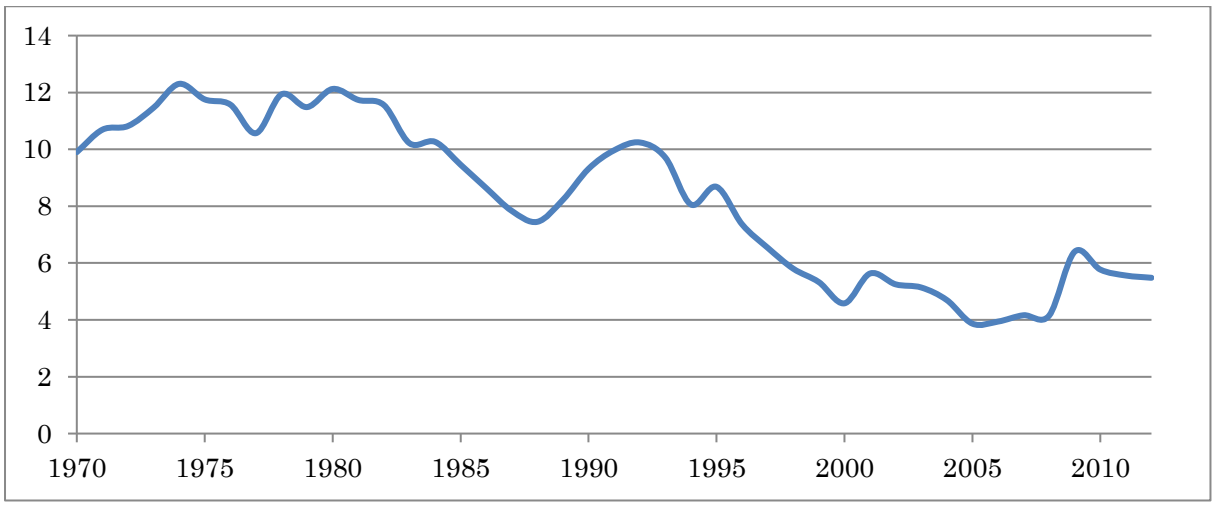
These series show much overlap with the UN SNA account series. Where needed and appropriate, we complement the UN SNA data with these series on net household savings. The different data sources are only combined if the overlapping data observations follows a similar trend. Combining these sources is done in a similar way is the different UN SNA series are combined as explained above.

As a result, we have obtained a total of 741 observations, covering a total of 19 OECD countries from 1970 till 2013. Data is missing for Denmark for the years 1970-1980; Finland, 1970-1974; France, 1970-1977; Germany, 1970-1979; Ireland, 1970-1999; New Zealand, 1970-1985; and Portugal, 1970-1994.

Figure 5.A.5 presents average net household savings as a percentage of disposable income. Note that for each year we take the average over the countries, only including the countries

for which we have data for that year. There seems to be a downward trend in average net household savings. In 1970, its average value is 9.9%, while in 2013 its value has shrunk to 5.5%.

Figure 5.A.5: Average voluntary household savings as percentage of disposable income

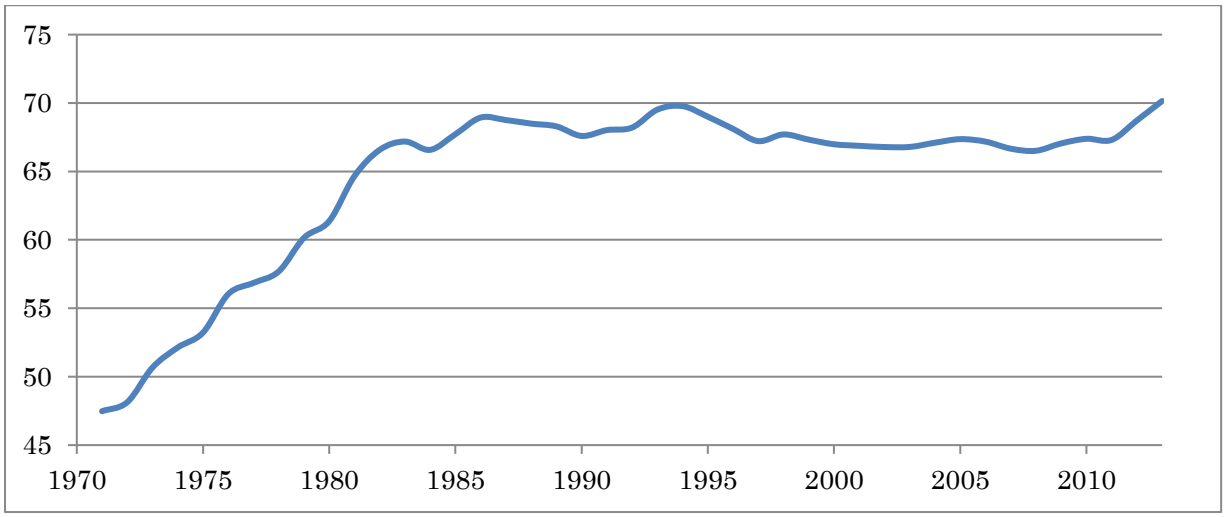


5.A.2.4. Pension arrangement variables

RR: Replacement rate, mandatory public pensions. This variable captures the percentage of a worker's pre-retirement income that is paid as retirement benefits under a public mandatory pension program. Data is obtained from the Comparative Welfare Entitlement Dataset (2014) and the OECD (2013).

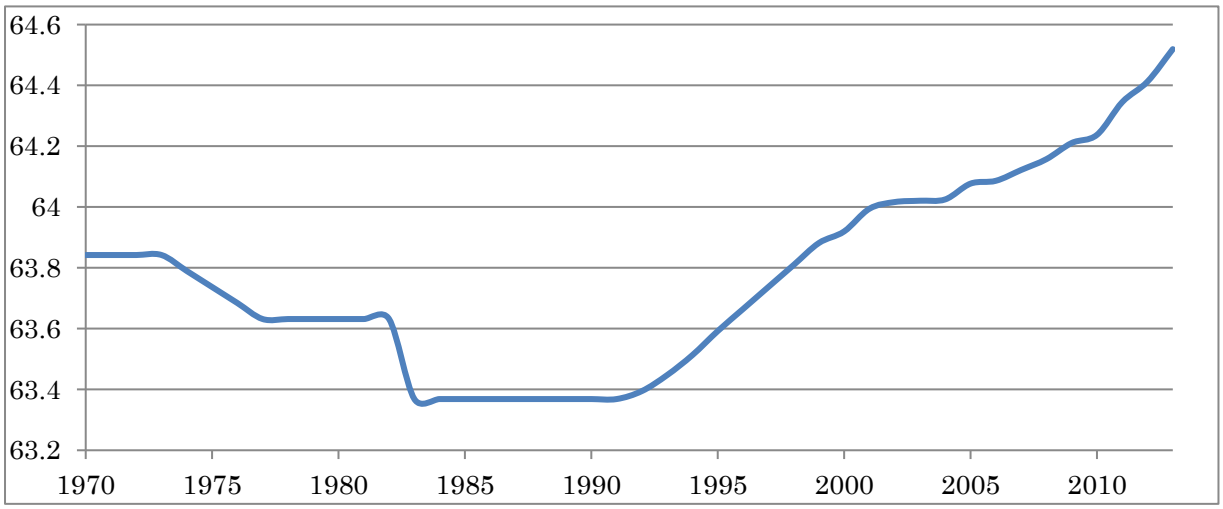
Figure 5.A.6 presents the average replacement rate of mandatory pensions. Data is missing for Australia for the year 1970; Austria, 1970-1972; Belgium,1970; Canada, 1970; Denmark, 1970; Finland, 1970-1975; France, 1970-1973; Germany, 1970; Ireland, 1970; Italy, 1970-1974; Japan, 1970; the Netherlands, 1970-1974; New Zealand, 1970; and Portugal, 1970-1994; Spain, 1970-1971; Sweden, 1970; Switzerland, 1970-1973; United Kingdom, 1970; United States, 1970.

Figure 5.A.6: Average replacement rate of mandatory pensions



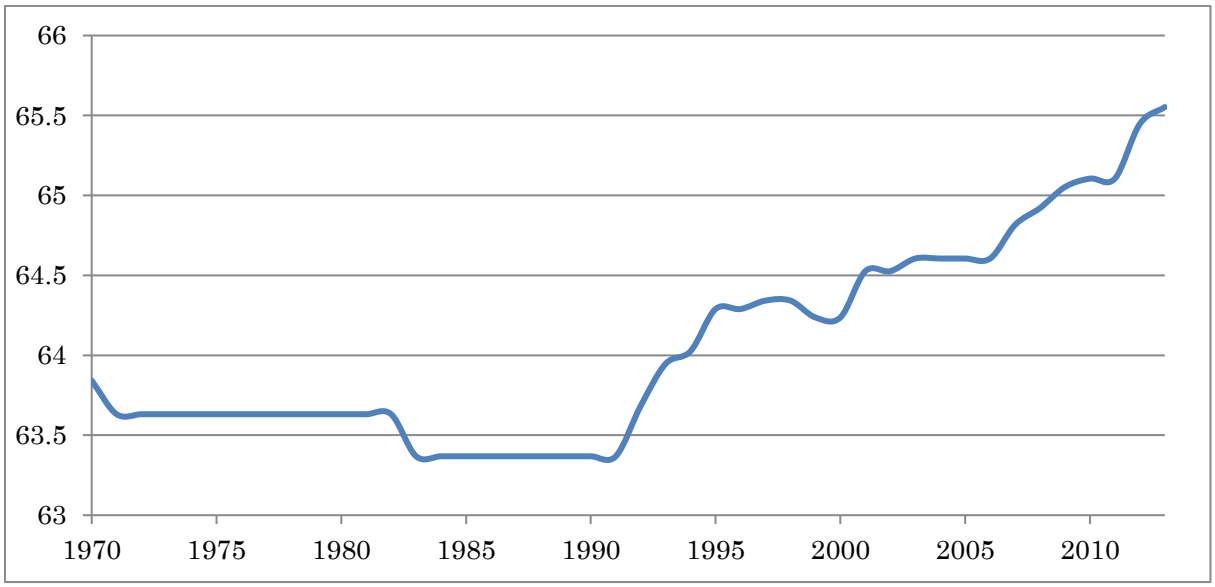
RET_AGE: The statutory retirement age is the age at which workers are entitled to receive superannuation or other old-age benefits. The statutory retirement age differs between countries and in many countries the age is also different depending on gender. The statutory retirement age is generally higher for man than it is for woman. We take the un-weighted average of the statutory retirement age for males and females. Information is obtained from the pension reform dataset discussed in Chapter 2 and SSA (2017). Figure 5.A.7 presents the average of the statutory retirement age over time. We see that in 1970 the average statutory retirement age was approximately 64, decreased during the 1980s, and increased since the early nineties. In 2013 the average statutory retirement age was 64.5.

Figure 5.A.7: Average statutory retirement age



RET_AGE_20Y: This is the expected statutory retirement age in 20 years' time. We take the un-weighted average of the statutory retirement age for males and females. Information is obtained from the pension reform dataset discussed in Chapter 2 and SSA (2017). Figure 5.A.8 presents the average of the statutory retirement age over time. We see that in 1970 the average statutory retirement age was approximately 64, decreased during the 1980s, and increased since the early nineties. In 2013 the average statutory retirement age was 65.5. Although this variable follows a similar trend as the contemporaneous statutory retirement age, we do see that, after the nineties, this trend increases faster. Moreover, this variable contains more jumps than RET_AGE. This is because the legislation of reforms, which is often implemented in steps, is often completed within 20 years' time. Therefore, at the moment of the announcement we see a jump to the anticipated retirement age.

Figure 5.A.8: Average expected statutory retirement age in 20 years' time



5.A.2.5. Pension reform data

A considerable amount of input is obtained from the International Social Security Association (ISSA, 2014), the OECD (2008, 2012, 2013), and the International Labor Organization (ILO, 2014), all of which provide information on the legislation on pension reforms. Where needed, we have consulted some miscellaneous other sources. Each reform is categorized into at least one of the following seven categories: (1) "Coverage"; (2) "Increased benefits"; (3) "Reduction retirement age"; (4) "Decrease benefits"; (5) "Increase retirement age"; (6) "Increase contribution rate"; and (7) "Work incentives". Most categories have several sub-

categories. These sub-categories make it clear which reform falls into which main category. Next, we present a detailed description of each category and its sub-categories:

1. Coverage: measures to enhance pension coverage. These are a means to fight old-age poverty by ensuring that more elderly people are entitled to a pension income. These measures comprise:

5.2. Extended mandatory participation: the introduction or extension of mandatory occupational pensions.

5.3. Extended voluntary participation: these measures include, for example, automatic enrolment in voluntary schemes, or providing more opportunities for access to pension schemes for groups that are not covered by pension funds automatically.

5.4. Increase family coverage: For example, widows who did not make pension contributions themselves are entitled to their deceased husband's pension.

6. *Increased Benefits*: Expansionary measures to guarantee sufficient old-age pension income. Unlike coverage, which focuses on the share of the population being targeted, adequacy focuses on whether the received pensions cover subsistence income, or more.

2.1. Increased benefits: raising the benefit level is the most direct way of ensuring sufficient pension income at old age.

2.2. Increased/more secure basic pension: this refers to an increase in the most basic pension benefit. In general, this refers to first-pillar payments.

2.3. Increased indexation rate: many pension schemes provide for indexation of existing pension entitlements so as to compensate for price or wage increases.

2.4. Provide addition benefits: this refers to the introduction of additional benefit schemes besides the existing ones.

2.5. Tax favorable policies: measures that make the tax-treatment of pensions more favorable for any of the three pension pillars. For example, a reduction of taxes on occupational pension benefits or a tax reduction on long-term private savings that before a certain age can only be withdrawn at the cost of a tax reduction.

3. *Decrease retirement age*: reducing the pension age allows the worker to retire earlier and still receive an adequate pension. We distinguish between reducing the statutory and the voluntary retirement age.

3.1. Decrease statutory retirement age: a decrease of the official retirement age as set by the law.

3.2. Decrease optional retirement age: individuals get the option to retire earlier, assuming they have the means for it.

4. *Decreased benefits*: measures to increase the long-run financial and fiscal stability of the pension system as a whole.
   4.1. Decreased benefits: reduced pension expenditures raise financial sustainability.
      4.1.1. Decreased basic pension
      4.1.2. Decreased indexation rate
   4.2. Elimination of other old-age benefits: this comprises the elimination of all additional old-age benefits. An example is the elimination of a lump-sum payment granted upon retirement.
   4.3. Tax increasing policies: this includes all pension-related increases in taxes. An example is an increase in the tax on occupational pension benefits.
5. *Increase in statutory retirement age:* all reforms that raise the official retirement age. This reduces the amount of benefits paid and increases the amount of contributions into the scheme. Note the distinction with changing the optional retirement age. The latter falls under the header of work incentives.
6. *Increased contribution rate*: by increasing the contribution rate, but keeping the benefits and other parameters constant, the system becomes more sustainable.
7. *Work incentives*: measures aimed at stimulating the labor supply, mainly focused on older individuals. An example are measures to discourage early retirement.
   7.1. Financial benefit after certain age: financial incentives are provided for people who continue to work beyond a certain age.
   7.2. Possibility to put pension on hold: Especially in DC schemes, retirement income depends on the value of the accumulated portfolio of pension savings. Providing the opportunity to put the pension on hold might incentivize the employee to work longer.
   7.3. Increasing the optional retirement age: Individuals are discouraged from retiring early.
   7.4. Tightening access or imposing a financial penalty for early retirement: these measures make it more (financially) burdensome or even impossible to access early retirement. For example, early withdrawals of second-pillar pensions can be made less attractive by imposing a penalty.

Chapter 6

Summary

In recent decades, economic and demographic changes have put pressure on social security systems all over the world. Indeed, the financial sustainability of pension arrangements and the resulting need for reform are high on the agendas of national policymakers as well as of international organizations. As a result, many countries have legislated and/or implemented measures to enhance the sustainability of their pension system. This dissertation discusses and investigates several topics on pension reforms. More specifically; it reviews the trends and facts of pension reforms; it investigates the main political, macroeconomic and demographic drivers of pension reforms, it explores whether these drivers differ between OECD and non-OECD countries, and it investigates the consequences of such reforms on voluntary household savings.

Chapter 2 presents and discusses a new and comprehensive dataset of pension reforms for an extended period of time and a broad set of countries. The reforms include the substantial, institutional reforms as well as the smaller, incremental reforms. We gathered data on institutional reforms for all countries for the time span 1980–2013. For the incremental pension reforms, we gathered data for 151 countries, most of them covering the period 1995–2013. For the first 24 OECD members, we have data on both institutional and incremental reforms over the period 1970–2013. We detect several trends in both the institutional and the incremental reforms. The most evident trend has been the adoption of fully-funded (FF) DC schemes. During the period 1980–2013, a total of 38 countries added a private second pillar, either as a supplement to or a substitute for the first pillar. The most salient incremental reform trends took place in the OECD. In the years preceding the millennium shift, 1995–1999, there were a substantial number of reforms expanding pension

arrangements. However, from our data it seems that the recent global economic and financial crisis has given a boost to reforms aimed at reducing the generosity of pension arrangements. For the non-OECD countries in our dataset, trends are not so clearly visible.

Chapter 3 explores the determinants of those reforms in OECD countries based on information on the state of the economy, demography and political landscape available at the moment these reforms are legislated. We distinguish three reform regimes: a regime characterized by reforms that expand pension arrangements through coverage and eligibility, a regime characterized by contractionary reforms aimed at increasing financial and fiscal sustainability and stimulating work incentives, and a regime that combines the aforementioned expansionary and contractionary reforms in the same year. These regimes are, respectively, labelled as "Expanding only", "Contracting only", and "Expanding and contracting". Our empirical results are the following. First, we find only limited or no effect of projected future changes in the demographic composition of the population on reforms. Second, there is substantial evidence that the current state of the economy, broadly defined, affects reform measures: when the current state is good, there are more expanding reform measures, and vice versa. As pension reforms are primarily aimed at the longer run, the limited role of projected demographic changes and the substantial role of the current state of the economy is remarkable. Third, the supranational European budgetary constraints do not seem to play any role. Fourth, political variables play only a limited role. Finally, we find no evidence that the presence of a crisis affects the likelihood of ending up in one of the reform regimes. We construct a simple theoretical framework that can simultaneously explain why the cyclical state of the economy can trigger adjustments in pension generosity, while projected changes in the old-age dependency ratio cannot. These dynamics can be explained by a government which cares about the income position of the elderly, and, at a fixed cost, is willing to adjust pension pay-outs if that current pension pay-out deviates too far from the optimal one. The current optimal pension pay-out depends on the current old age dependency ratio and the current state of the economy. If the current optimal pension pay-out drifts further from the actual one, the incentive for the government to take reform measures strengthens. However, this incentive is countered for two reasons. One, waiting an extra period before reforming provides more information about the future old-age dependency ratio, allowing for a more appropriate reform decision. Second, postponing the reform decision reduced the discounted reform cost. By means of realistic calibration, the model predicts that the current state of the economy plays the main role in determining the incentive to reform, while the effect of changes in the future old-age dependency ratio play no role.

Chapter 4 investigates whether the driving forces of pension reforms differ between OECD and non-OECD countries. Reforms are categorized in a similar way as in Chapter 3. We conclude that the reform drivers do indeed differ between the two groups of countries. For the OECD country sample, we find no statistically significant evidence of a role of the old-age dependency ratio, whereas for the Non-OECD countries we find that a larger projected increase of this ratio reduces the likelihood of contractionary reform measures. Although this finding seems counterintuitive, it can perhaps be explained by the fact that many of such countries still have rather underdeveloped pension arrangements, making it impracticable and infeasible to cut back on such systems. Further, we find substantial evidence for the role of the current state of the economy for reform measures. For the "All countries" and the "OECD countries" sample we find evidence that during periods of high economic growth, the likelihood of the "Expanding only" regime increases and the likelihood of "Contracting only" regime decreases. For the "Non-OECD countries" sample the evidence in this direction is weaker, although we find that reforms in the "Expanding and contracting" regime becomes more likely if GDP growth increases. For the OECD country sample, we also find that higher unemployment makes reforms in the direction of "Contracting only" more likely, while a higher deficit enhances the likelihood of the "Expanding and contracting" regime. In the end, these findings are all a reflection of the role of the state of the economy. The state of the economy manifests itself in different ways, implying that the importance of using different variables to capture the state of the economy varies across the various regressions. We also observe that the current state of the economy has a considerably larger role in determining pension reform decisions in OECD countries than in non-OECD countries. This may well be the result of the fact that pension arrangements in the non-OECD are in build-up transitional phase.

Chapter 5 empirically investigates the effects of pension systems and pension reform measures on voluntary household savings. For this analysis, we conduct a panel analysis that covers 19 OECD countries over the period from 1970 to 2013. We distinguish between contemporaneous pension arrangements and pension reform measures. Contemporaneous pension arrangements are measured through the contemporaneous replacement rate and the statutory retirement age. Pension reforms are measured by their legislation date and are expected to change the system in the future. We distinguish between different types of reform measures, according their expected effect (positive, ambiguous, or negative) on voluntary household savings. Our empirical analysis provides robust evidence that the replacement rate of mandatory pensions has a negative effect on voluntary household savings. Further, we find

no statistical significant evidence that the statutory retirement age has an effect on voluntary household savings. As for the effects of pension reform measures, we find some evidence that reform measures with an expected positive effect on voluntary household savings do indeed have a positive effect on the household savings ratio. These findings are, however, not robust to all other regression specifications.

Chapter 7

Samenvatting (Summary in Dutch)

Tijdens afgelopen decennia hebben economische en demografische veranderingen de sociale zekerheidsstelsels over de hele wereld onder druk gezet. De financiële houdbaarheid van pensioenregelingen en de daaruit voortkomende hervormingsbehoefte staan inderdaad hoog op de agenda's van nationale beleidsmakers en internationale organisaties. Als gevolg daarvan hebben veel landen wetgeving en/of maatregelen getroffen om de houdbaarheid van hun pensioenstelsel te verbeteren. Dit proefschrift onderzoekt diverse onderwerpen over pensioenhervormingen. In het bijzonder, het bestudeert de tendensen en feiten van pensioenhervormingen. Het onderzoekt wat de belangrijkste politieke, macro-economische, en demografische factoren zijn die pensioenhervormingen teweegbrengen, en of deze factoren verschillen tussen OESO en niet-OESO-landen. Verder bestudeert het de consequenties van dergelijke hervormingen op vrijwillige huishoudelijke besparingen.

Hoofdstuk 2 presenteert en bespreekt een nieuwe en uitgebreide dataset van pensioenhervormingen over een lange tijdsperiode en een grote reeks landen. De hervormingen omvatten de substantiële institutionele hervormingen en de kleinere incrementele hervormingen. We hebben gegevens verzameld over institutionele hervormingen voor alle landen voor de periode 1980-2013. Voor de incrementele pensioenhervormingen hebben we gegevens verzameld voor 151 landen, waarvan de meeste de periode 1995-2013 betreffen. Voor de eerste 24 OESO-leden hebben we gegevens over zowel institutionele als incrementele hervormingen voor de periode 1970-2013. We zien verschillende trends in zowel de institutionele als de incrementele hervormingen. De meest evidente trend is de doorvoering van een kapitaal-gedekte (fully-funded ofwel FF) DC-regeling. In de periode 1980-2013 hebben in totaal 38 landen een tweede pijler opgezet, hetzij

als aanvulling op of als vervanging voor de eerste pijler. De belangrijkste trend in toenemende generositeit vonden plaats in de OESO. In de jaren voorafgaand aan de millenniumverschuiving, 1995-1999, was er een aanzienlijk aantal landen die hun pensioenregelingen hebben uitgebreid. Uit onze data blijkt echter dat de recente wereldwijde economische en financiële crisis er toe heeft geleid dat de generositeit van de pensioenregelingen is verminderd door middel van hervormingen. Voor de niet-OESO-landen in onze dataset zijn dergelijke trends niet zo duidelijk zichtbaar.

Hoofdstuk 3 onderzoekt de determinanten van deze hervormingen in OESO-landen op basis van informatie over de conjuncturele situatie van de economie, de demografie en het politieke landschap die beschikbaar was op het moment van een hervorming. We onderscheiden tussen drie hervormingsregimes: een regime dat wordt gekenmerkt door hervormingen die de pensioenregelingen genereuzer maken door verhoging van de uitkeringen, verlaging van de pensioenleeftijd of de eisen voor deelname versoepelen, een regime dat wordt gekenmerkt door beperkende hervormingen gericht op het verhogen van de financiële en fiscale houdbaarheid en vergroting van de arbeidsdeelname door bijvoorbeeld verhoging van de pensioenleeftijd, en een regime dat maatregelen die de generositeit vergroten combineert met andere maatregelen die de generositeit verkleinen. Deze zijn, respectievelijk, gelabeld als “Expanding only”, “Contracting only”, en “Expanding and contracting”. We vinden de volgende resultaten: we vinden slechts beperkt bewijs van een effect van een hogere verwachte toekomstige afhankelijkheidsratio op de kans op pensioenhervormingen. Ten tweede, er is aanzienlijk bewijs dat de huidige conjuncturele situatie effect heeft op dergelijke hervormingen: tijdens een hoogconjunctuur zijn er aanzienlijk meer hervormingen die het systeem of genereuzer maken, en visa versa. Aangezien pensioenhervormingen voornamelijk gericht zijn op de langere termijn, is de beperkte rol van de verwachte vergrijzing en de aanzienlijke rol van de huidige conjunctuur opmerkelijk. Ten derde lijken de Europese budgettaire regels geen rol te spelen. Ten vierde, politieke variabelen spelen slechts een beperkte rol. Ten slotte we vinden geen bewijs dat een crisis effect de kans op een hervorming beinvloedt. Verder presenteren we een simpel theoretisch model dat kan verklaren waarom de stand van de conjunctuur de kans op pensioenhervormingen kan beïnvloeden, terwijl, dat tegelijkertijd niet het geval is voor veranderingen in de geprojecteerde ouderdomsafhankelijkheidsverhouding. Deze dynamiek kan worden verklaard door een overheid die zich bezighoudt met de inkomenspositie van de ouderen, en, tegen vaste kosten, bereid is de pensioenuitkering aan te passen indien de huidige pensioenuitkering niet in overeenstemming is met de optimale pensioenuitkering. De

huidige optimale pensioenuitkering hangt af van de huidige ouderdomsafhankelijkheids-verhouding en de huidige staat van de economie. Als de huidige optimale pensioenuitkering verschilt van de huidige pensioenuitkering, impliceert dit dat de huidige pensioenregeling suboptimaal is. Dit motiveert de zittende regering om te hervormen, maar deze regering is tegelijkertijd gemotiveerd om een hervorming uit te stellen om twee redenen. Eén, wachten tot de volgende periode levert meer informatie op over de toekomstige ouderdoms-afhankelijkheidsverhouding, waardoor de overheid een geschikter niveau voor de uitkering kan vaststellen. Twee, uitstel resulteert in een verlaging van de verdisconteerde hervormingskosten. Op basis van een realistische kalibratie voorspelt het model dat de huidige conjunctuur de belangrijkste factor is die bepaalt of een hervorming plaatsvindt, en dat de rol van de ouderdomsafhankelijkheidsverhouding verwaarloosbaar is.

Hoofdstuk 4 onderzoekt of de factoren die pensioenhervormingen teweeg brengen verschillen tussen OESO en niet-OESO-landen. Hervormingen worden op een vergelijkbare manier gecategoriseerd als in hoofdstuk 3. Wij concluderen dat de factoren inderdaad verschillen tussen de twee landengroepen. Voor OESO-landen vinden we geen statistisch significant bewijs over de rol van de ouderdomsafhankelijkheidsverhouding, terwijl, voor de niet-OESO-landen, een toename van deze verhouding de kans op beperkende hervormings-maatregelingen juist vermindert. Verder vinden we bewijs dat de conjunctuur effect heeft op de kans op hervorming maatregelingen. Voor de "Alle landen" en de "OESO-landen" groepen blijkt dat tijdens een periode van hoge economische groei de kans op het “Expanding only” regime toeneemt en de kans dat het “Contracting only” regime afneemt. Er is echter maar zwak bewijs hiervoor bij de "niet-OESO" landen, hoewel we vaststellen dat de kans op een "Expanding and contracting" regime groter wordt als de groei van het BBP toeneemt. Voor de groep van OECD landen vinden we ook dat hogere werkloosheid de kans op hervorming in de richting van “Contracting only” vergroot, en we vinden dat een hoger overheidstekort de kans op “Expanding and contracting” vergroot. Uiteindelijk zijn deze bevindingen allemaal een weerspiegeling van de conjunctuur. De conjunctuur heeft op verschillende manieren effect op de kans van hervormingen. Dit impliceert dat het effect van de onafhankelijke variabelen die de conjunctuur weerspiegelen verschillen over de verschillende regressies. We merken ook op dat de huidige conjunctuur een aanzienlijk belangrijkere factor is achter besluiten om pensioenvoorzieningen te hervormen in de OESO-landen dan in niet-OESO-landen. Wellicht komt dit doordat pensioenstelsel in vele niet-OESO-landen nog in de opbouwende/transitie fase zit.

Hoofdstuk 5 onderzoekt wat de effecten zijn van pensioenregelingen en hun hervormingen op vrijwillige huishoudelijke besparingen (dus naast het eventuele verplichte pensioenbesparingen). Voor dit analyse maken wij gebruik van een unieke en uitgebreide dataset op narratieve basis geïdentificeerde pensioenhervormingen voor 19 OESO-landen over de periode 1970-2013. Wij maken onderscheid tussen veranderingen in pensioenstelsels en wijzigingen in pensioenregelingen. Deze laatste worden gemeten via wijzigingen van de vervangingsratio en de wettelijke pensioenleeftijd. Pensioenhervormingen worden gemeten op basis van het moment dat ze in de wet worden opgenomen, en zullen naar verwachting het systeem in de toekomst veranderen. We onderscheiden verschillende soorten hervormingsmaatregelen, die worden gecategoriseerd in hervormingsregimes volgens hun verwachte effect op de vrijwillige huishoudelijke besparingen (positief, dubbelzinnig of negatief). We vinden sterk bewijs dat het vervangingspercentage van verplichte pensioenen een negatief effect heeft op de vrijwillige huishoudelijke besparingen. Verder vinden we geen statistisch significant bewijs dat de wettelijke pensioenleeftijd een effect heeft op de vrijwillige huishoudelijke besparingen. Wat betreft het effect van pensioenhervormingen, vinden we mild bewijs dat hervormingsmaatregelingen met een verwachte positief effect op de vrijwillige huishoudelijke besparingen deze inderdaad stimuleren. Dit effect blijkt echter niet robuust te zijn over de verschillende specificaties van het empirische model.

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