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Oliver Pamp

Political Preferences and the Aging of Populations

Political-Economy Explanations of Pension Reform

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Oliver Pamp
München, Germany

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Contents

List of Symbols

α ..... discount factor
β ..... parameter measuring altruism towards the old in terms of consumption or leisure
Δ ..... rate of change of a variable
δ ..... parameter measuring a party's common popularity
γ^i ..... preference for public policy good g
λ_i ..... Lagrange multiplier
$\mathscr{L}$ ..... Lagrangian
μ^i ..... ideology parameter measuring i's ideological bias
ω ..... wage growth rate
ϕ ..... relative political influence of workers
ρ ..... discount factor
σ ..... strategy of a player
τ ..... contribution rate to the pension system
ξ ..... redistribution (Bismarck) factor, relating contributions to benefits
A ..... productivity
a ..... output elasticity
c ..... consumption
D ..... government debt
d ..... density measure
g ..... public policy good
h ..... history of a game
i ..... internal rate of return of a PAYG pension system; index for a representative player
K ..... capital

L ..... labor
n ..... population growth rate
N^i ..... size of group i
r ..... real interest rate
s ..... saving rate
t ..... time index
U ..... utility/value function
u ..... utility
V^i ..... indirect utility function
W ..... Social welfare function / government objective function
w ..... wage rate
x ..... pension
J ..... set of political parties
S ..... implicit savings

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Executive Summary

Population aging and its profound consequences puts the sustainability of pension systems in industrialized Western democracies at risk. Almost all pensions systems in these countries are primarily based on a pay-as-you-go (PAYG) principle. Hence, changes in pension benefits or contribution rates are immediately felt by the participants of the system. Any change in a pension system will thus involve winners and losers. Pension reforms are obviously a very interesting and difficult to analyze policy field because they involve policy changes that don't constitute mere Pareto improvements nor do they easily allow the implementation of simple compensation schemes for the distributional losers of a reform. To model the impact of population aging on pension systems and their reform thus requires a profound understanding of voters' preferences and of the political environment in which such an endeavor is undertaken. This holds for any type of pension reform, regardless of whether the reform is parametric (i.e. changes in the contribution rate, benefit levels or eligibility rules) or non-parametric (partial or full transitions to prefunded systems).

Building on the current state of research on pension systems and their reform, this dissertation sets out to, first, review existing political economy models showing that pension policy is mainly a political problem. Second, it will prove that any pension reform is by and large a redistributional policy shift. Third and foremost, this dissertations develops a political economy model of a pension system that explicitly considers the political preferences of different age groups and also takes into account some of the underlying political incentives generated by the size of the pension system and the political environment. Hence, pension policy is examined not in isolation but in view of the fiscal trade-offs made with respect to

other public policy goods. The resulting simple overlapping-generations model allows for an easy derivation of the policy preferences of different age groups. This alone, however, would be insufficient when analyzing the prospects of a pension reform, since individual preferences need to be aggregated through an electoral process.

The existing political economy literature has mainly analyzed this aggregation process by assuming the existence of a direct democracy with popular referenda or by analyzing rather simple settings of representative democracy, without properly taking into account the impact of different types of electoral institutions. This dissertation sets out to address this very shortcoming. In the research tradition of modern political economy, it attempts to offer a theoretical analysis by focusing on voters' policy preferences and the way in which these preferences are aggregated through domestic electoral institutions. This focus allows to derive different scenarios for the feasibility and direction of pension reform. Finally, some hypotheses derived from the model are tentatively tested using cross-national survey data of 21 countries provided by the International Social Survey Programme.

Following the introductory chapter that puts this thesis into a theoretical and empirical context, **chapter 2** examines the premise that population aging has severe economic consequences and strains existing pension systems. This is empirically fleshed out by reviewing current demographic and economic long term projections provided, among others, by the United Nations and the European Commission. It is shown that aging has not only severe domestic and international macroeconomic consequences but also leads to strong imbalances in current pension systems. As a result, in many countries the present expected value of future benefits is by no means matched by the present expected value of future revenues.

Chapter 3 reviews the existing formal political economy literature on the existence and size of public pension systems, thereby also introducing the concept of overlapping-generation models and explaining the necessary notation. This review shows that pension systems can only be understood by looking at the politics involved. Assuming, as part of the literature does, that pension policy is decided in a direct democratic referendum represents a valuable first attempt in understanding the underlying political processes. These kinds of models show that coalition building might be important. The literature has suggested that retirees and older workers may conspire, and that an elaborated inter-generational punishment mechanism ensures sustainability of the system once it has been introduced. Alternatively, it has been proposed that intra-generational in-

equality leads poor workers to team up with pensioners to push for public pension provision. Another factor could be the existence of altruism that induces workers to consider the well-being of the old, which in turn affects their voting behavior.

The chapter then shows that although being a valuable first step, the explanatory power of these approaches is not fully satisfactory. Their Achilles' heel is the assumption of a direct democracy. Clearly, pension politics in Western countries takes place within the confines of a representative democracy. Some models have explored this possibility. In one approach, more than one party could wield influence by using the threat of a veto. Even more importantly, workers and retirees might influence policymaking beyond the individual act of voting. Hence, pensioners could be able to gain privileged access to a government through lobbying and campaigning. If their thus defined political power is greater than the power of workers, they may be able to push for intergenerational transfers against the will of the young. One possible explanation for the greater political leverage of the old could come from the fact that they are more 'single-minded' and thus ideologically more homogenous. Employing a probabilistic voting model suggests that in this case electoral competition will induce office-motivated political parties to favor the old in their electoral programmes. However, beyond these explanations, political modeling has not gone much further in examining the political rationale of public pension provision in a representative democracy. In particular, despite the use of probabilistic voting models, the possible impact of different electoral institutions has not been sufficiently analyzed in the literature.

Chapter 4 then clarifies what I mean by 'pension reform'. It turns out that any change to a pension scheme, be it parametric or non-parametric, is redistributional. Any reform will involve winners and loser and is therefore a politically very contested issue. As a result, discussions about whether to completely replace a PAYG system with a prefunded scheme are often misleading. Neither of these two systems Pareto-dominates the other. Transition from one to the other is always redistributional and both types of schemes can be reformed to deal with the consequences of aging.

Chapter 5 first develops a three-period overlapping-generations model to derive policy preferences of individuals with respect to a public PAYG pension scheme, taking the preferences for expenditures on other policy goods into account. The results of the model are that, (1), preferences for a big public PAYG system increase with age; and, (2), older workers policy preferences depend on population growth and on the size of the existing pension scheme. Based on these results, I then proceed to examine the po-

litical process. If voters' preferences are aggregated through a direct referendum, then the prevailing population growth rate is decisive, for it determines which age group contains the pivotal median voter. If the median was a young worker, the public scheme would be completely replaced by a prefunded system of individual saving. If retirees were in a majority, the PAYG scheme would be preserved and any fiscal imbalance in the system would be resolved through changes in the contribution rate. Finally, if the median voter was an old worker, then reform outcomes depend on the size of the existing pension scheme. If it is generous, old workers are in favor of keeping it. Depending on its prevailing size relative to what old workers consider as optimal, they may favor a reduction in its overall generosity in favor of more prefunding. If the existing PAYG system is small, old workers prefer its complete replacement with a prefunded system of private saving.

If policy preferences are aggregated within the framework of a representative democracy, then the electoral system becomes important. This is analyzed in the framework of a probabilistic voting model. Now the number of swing voters turns out to be the decisive variable. Under proportional representation, the group with the highest number of swing voters will find their policy preferences catered to by the parties vying for office. This need not be the case under majoritarian elections though. Here the number of swing voters in the swing district becomes crucial. Therefore, under certain conditions a pension reform to reduce the PAYG pillar and increase individual prefunding may be feasible under proportional representation but not under majoritarian elections. The latter therefore may allow smaller groups (i.e. groups with fewer politically important swing voters) to determine the pension policies that parties propose.

Chapter 6 explains that, due to data limitations, a thorough econometric test of the reform scenarios and the impact of electoral institutions is not feasible. This chapter does test the two hypotheses related to individual policy preferences, however. Employing logit and ordered-logit analyses of cross-national survey data of 21 countries show that, as hypothesized, age is positively associated with preferences for more public PAYG pension spending. Retirees are much more likely to favor large pension systems than young workers. As predicted by the model, old workers' preferences are more likely to be aligned with the interests of pensioners in countries with generous public schemes and, regardless of the existing size, when population growth is positive. In countries with negative population growth rates, the odds are much higher that old workers join young workers in preferring a smaller pension system. With respect to pension

reform, these results suggest that retirees are the most likely to oppose cuts in public pensions, whereas young workers are the most likely to favor such changes. The attitude of old workers ultimately depends on the degree of population aging and the size of the existing pension system. As a result, the main implications of the model are tentatively confirmed by the data.

Finally, **chapter 7** summarizes premises, hypotheses and results of the thesis. It also offers some thoughts on future avenues of research and future developments of pension systems in industrialized countries.

Zusammenfassung

Die Alterung der Gesellschaften in westlichen Industrieländern erhöht den Anpassungsdruck für die bestehenden umlagefinanzierten Rentensysteme. Da diese Form von Alterssicherungssystem die aktive mit der in Ruhestand befindlichen Generation verbindet, hat jede mögliche Reform unmittelbare verteilungspolitische Auswirkungen. Rentenreformen sind somit ein analytisch besonders interessantes Politikfeld, da sie keine Pareto-Verbesserung darstellen, sondern es immer verteilungspolitische Gewinner und Verlierer gibt. Dies gilt sowohl für parametrische wie auch nicht-parametrische Reformen.

Trotz eines recht gleichförmigen Anpassungdruckes auf die Alterssicherungssysteme westlicher Industrieländer können wir jedoch unterschiedliche Anpassungsreaktionen beobachten, denn Richtung, Ausmaß und politisch erfolgreiche Durchführung von Rentenreformen unterscheiden sich erheblich. Ziel dieser Dissertation ist es, aus der Perspektive der modernen Politischen Ökonomie einen Erklärungsbeitrag zu liefern, unter welchen Bedingungen Reformen eher möglich sind und welche Formen der Anpassung zu erwarten sind. Nach einer kurzen empirischen Illustration der ökonomischen und finanziellen Konsequenzen von gesellschaftlichen Alterungsprozessen, führt die Arbeit zunächst in die bestehende politik-ökonomische Literatur ein. Es zeigt sich in dieser Forschung deutlich, dass Politik eine entscheidende Rolle für die Erklärung von Existenz und Größe von Rentensystemen spielt. Es wird jedoch auch deutlich, dass der politische Aggregationsprozess individueller Wählerpräferenzen größtenteils vernachlässigt oder sehr vereinfacht dargestellt wird. Besonders der Einfluss von elektoralen Institutionen ist bisher nicht ausreichend gewürdigt worden.

In einem nächsten Schritt wird gezeigt, dass jede Art der Reform redistributiv ist und somit neben den Gewinnern immer auch Umverteilungsverlierer produzieren wird. Kern der Dissertation ist anschließend die Entwicklung eines dreistufigen Modells überlappender Generationen (OLG). Dieses erlaubt die formale Analyse individueller politischer Präferenzen. Es zeigt sich, dass politische Präferenzen für ein großzügiges umlagefinanziertes Rentensystem mit dem individuellen Lebensalter zunehmen. Als besonders interessant erweisen sich die Ergebnisse für ältere Arbeitnehmer. Deren Zustimmung oder Ablehnung eines staatlichen Umlagesystems hängen vom Grad der gesellschaftlichen Alterung und der Größe des bestehenden Rentensystems ab.

Nach der Analyse der Wählerpräferenzen wendet sich die Arbeit dem politischen Aggregationsprozess zu. Während in einer direkten Demokratie das Alter des Medianwählers ausschlaggebend ist, tritt in repräsentativen Demokratien die Zahl der Wechselwähler (swing voters) in den Vordergrund. Anhand eines probabilistischen Wahlmodells lässt sich zeigen, dass unter bestimmten Bedingungen die Art des Wahlsystems einen großen Einfluss auf die Realisierung von Rentenreformen haben kann. Eine vergleichende Analyse von Mehrheits– und Verhältniswahlsystemen ergibt, dass in bestimmten Konstellationen große, nicht-paramtetrische Reformen in Verhältniswahlsystemen wahrscheinlicher sein könnten.

Die Arbeit schließt mit einigen empirschen Überlegungen und Tests. Die theoretischen Vorhersagen bezüglich des politischen Aggregationsprozesses und dessen Auswirkungen auf Rentenreformen lassen sich nicht statistisch prüfen. Jedoch können die Hypothesen zu individuellen Reformpräferenzen anhand internationaler Surveydaten ökonometrisch getestet werden. Unter Verwendung von Umfragedaten aus 21 westlichen Industrieländern lassen sich die Hypothesen mit Hilfe von Logit- und ordinalen Logitschätzungen tentativ bestätigen. Lebensalter, Alterungsprozess und Größe eines bestehenden umlagefinanzierten Rentensystems haben einen statistisch belegbaren Einfluss auf individuelle Reformpräferenzen.

Chapter 1
Introduction

The beauty about social insurance is that it is actuarially unsound. A growing nation is the greatest Ponzi game ever contrived.

Paul A. Samuelson (1967)
(Economist)

Why should I care about future generations, what have they done for me?

Groucho Marx
(Marx brother)

1.1 Not quite a once upon a time...

It almost sounds like a fairy tale. Once upon a time, there was a people living happily together. They went forth and reproduced, one generation caring for the next, the young caring for the old. But as time went by, for a mysterious reason unknown to the people, ever fewer babies were born. Gradually it dawned upon the people that this could imperil their happily ever after, so they decided to send their wise folks (those who possessed no other really useful craft, a.k.a. political scientists and economists) to an ivory tower to think about a solution for this problem...

Yet unlike in a fairy tale, magic beans or the miraculous deeds of a wizard will not help. The aging of societies in western democracies represents a massive economic and societal challenge. It has been widely referred to as "looming disaster", "demographic crunch" or "population meltdown". Unlike other developments, however, it has been predicted, calculated, ex-

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pected. Demographers and statisticians have closely followed and documented the fall in fertility rates and the increases in longevity. Projections by national and international statistical offices on the future development of societies's age pyramids and dependency ratios abound. Hence, this phenomenon came neither overnight nor in disguise. It has been recognized by policy-makers, scientists, pundits and the public during the last two decades or so.

The consequences of population aging are primarily economic in nature. It leads to a shrinking work force, which in turn will affect productivity growth, aggregate GDP growth, government budgets, and the sustainability of systems of old age provision. Although there are studies by the European Commission, the OECD (Organisation for Economic Co-operation and Development) and other independent researchers estimating the impact on economic growth and productivity (see Bloom et al. (2011); Carone et al. (2005); Martins et al. (2005); McMorrow and Röger (2003)) much more attention has been paid to the consequences for pension systems and their fiscal implications. The focus on the latter aspects comes as no surprise. At an individual level, a pension scheme is a device to transfer current resources into the future. The aim is ensure sufficient consumption in old-age when, due to retirement, working income is no longer available. Hence such a system directly and substantially affects the well-being of retired individuals. What is more, the redistributional nature of changes in pension systems are much more obvious than in the case of growth and productivity related issues, even though the latter two also clearly involve distributional issues.

Almost all pensions systems in the industrialized world are to a large extent, but often not exclusively, based on a pay-as-you-go (PAYG) principle. This means that current workers pay current retirees' pension benefits through a tax that is levied on their working incomes. Hence, changes in pension benefits or contribution rates are immediately felt by the participants of the system. A reduction in the size of the working age population and a simultaneous increase in the number of pensioners makes it obvious that such a system will need to change the rate of contributions and/or benefit levels. Given that projected population changes are dramatic, with old-age dependency ratios[1] expected to rise by almost 30 % in the Euro-area and working age population expected to fall at the same time by almost 16% until the year 2050 (ECB (2006)), these changes have

[1] The dependency ratio is here defined as the ratio of people over the age of 64 to those of working age (15-64).

to be of a major scale. While there is quite some cross-country variation within western countries with Spain, Italy and Japan projected to have the highest dependency ratios by 2050 (0.68, 0.65 and 0.72 respectively) whereas the UK and U.S. will have the lowest (0.38 and 0.32 respectively), the trend is very much of the same direction everywhere.

Any change in a pension system of any industrialized country will thus involve winners and losers. Policy reforms that are not merely Pareto improvements or do not allow the implementation of a simple compensation scheme[2] for the losers, pose the most interesting and most difficult to analyze policy questions. If there were no redistributional issues involved, a classical normative economic analysis would compare the efficiency properties of different systems (or policy proposals for that matter) and would then suggest implementation of the most desirable one (with the Pareto criterion being one possible approach to determine "desirableness"). However, once matters of redistribution are involved, this approach is no longer valid. In this case, no Pareto improvements exist, the distributional issue becomes the core problem and questions of political decision making procedures come to the fore. Analyses of these kinds of problems are inherently "political" in the sense that one must examine the political environment to understand which solutions are feasible and which are not. A normative economic analysis is no longer sufficient. Now the analyst must consider the different voting coalitions that could form and the institutional structure of the decision making process, i.e. who may vote, how are representatives chosen, where lies the agenda-setting power, what is the quorum, does delegation of authority take place and so forth. As a response to the analytical intricacies, economics and political science alike have seen the rise of sub-fields explicitly dealing with these aspects, starting with the seminal contributions of Downs (1957) and Arrow (1963) and the establishment of "Social Choice" as a distinct field, accompanied and complemented by the study of "Public Choice" (for an overview see Mueller (2002)) up to what is currently being called "New Political Economy", "Political Economics" or "Formal Political Theory" (see Persson and Tabellini (2000); Drazen (2000); Austen-Smith and Banks (1998, 2005)).

This dissertation is an exercise in political economy analysis. Broadly speaking, political economy tries to explain political and economic out-

[2] Devising and implementing schemes for compensation turns out to be quite difficult from a theoretical perspective. As Dewatripont and Roland (1992) and Fernandez and Rodrik (1991) show, time-inconsistency problems and the unobservability of individual endowments casts a strong doubt on the political feasibility of compensation.

comes by examining the interaction of economic factors on the one hand and political incentives and constraints on the other. As such, this type of analysis is explicitly positive in nature and tries to account for deviations from normative, first-best solutions. As the author of one of the authoritative textbooks on modern political economy analysis put it:

> Political economy thus asks the question how political constraints may explain the choice of policies and thus economic outcomes that differ from optimal policies, and the outcomes those policies would imply (Drazen (2000): 7).

Whatever the precise definition, the core idea is that political outcomes are the result of two factors: preferences of the actors involved and the political and economic institutions through which these preferences are aggregated. Modeling the impact of population aging on pension systems and their reform thus requires a profound understanding of voters' preferences and of the political environment in which such an endeavor is undertaken. This holds true for any type of pension reform, regardless of whether the reform is parametric (i.e. changes in the contribution rate, benefit levels or eligibility rules) or non-parametric (partial or full transitions to prefunded systems). Any reform of a PAYG system of old-age provision has strong redistributional implications, there is no Pareto improvement possible, as has been argued before by Breyer (1990) and Sinn (2000).

1.2 So far, not so good

Quite a number of countries have implemented pension reforms during the last three decades. The first large-scale reform to receive international attention was clearly the Chilean Reform of 1981, which introduced a full transition from a PAYG to a prefunded system (see Diamond (1993); Mesa and Mesa-Lago (2006)). Interestingly, it was not a democratic government but the autocratic regime of General Pinochet that was able to implement such a major reform. This precedent was followed by reforms in other Latin American countries in the 1990s such as, among others, Bolivia, Argentina, Mexico and Peru. Other emerging market economies like some of the transition countries of Central and Eastern Europe also implemented sizeable reforms in the 1990s, the most prominent cases being Hungary, Lativa and Poland (see Müller (2001); Fox and Palmer (1999)). But broad pension reforms have also been introduced in a number of Western European countries. Especially Sweden, Italy and Germany are among the

most recent examples to introduce major changes (see Galasso (2006) and Immergut et al. (2007)).

Yet despite the common demographic pressures, we observe a strong variation across countries and time in the occurrence and size of pension reforms that cannot be explained by aging alone. Unfortunately, only few quantitative studies on the determinants of pension system size and pension reform exist, but these few do not find the age structure of the population to be the only important factor (see Breyer and Craig (1997); James and Brooks (2001); Brooks and Weaver (2005); Mulligan et al. (2002)). A plethora of further possible explanations has been offered which comes as no surprise given the importance of political factors in redistributional reforms. However, the analysis of the politics behind changes of systems of old-age provision has fallen short so far, even though it had spawned great scholarly interest in the past decade. Entering the search term "pension reform" in the Social Science Citation Index returns a whopping 415 entries (as of January 2013) - and these are articles in peer-reviewed journals only. This academic attention has not yet led to a coherent body of theoretical and empirical insights though, but rather to a patchwork of hypotheses. This is not due to a lack of empirical showcases, as shown above, but rather due to the intricate political nature of redistributional issues. Discussing a recently published book on pension politics in Europe, a reviewer came to the sobering conclusion:

> Judged by this volume, political scientists are still some way off from having a theory and analysis of pension politics and reform (...) (Toft (2008): 125).

This criticism could also be leveled to some extend against the economic literature. However, the economic approach of analyzing pension systems in the framework of overlapping generations models (OLG, in short) proved to be the first fruitful step in adding political structure to the analysis of pension systems. Starting with the seminal contribution of Browning (1975), these studies have explicitly modeled the pension system as the outcome of a majority voting process. Later on, repeated voting (e.g. Sjoblom (1985), Boldrin and Rustichini (2000)) and super-majority voting rules have been incorporated (e.g. Azariadis and Galasso (2002)). The role of the institutions of representative government and electoral competition have been less of a concern so far. This stands in contrast to the study of other policy fields. In the area of fiscal policy, for instance, which also provides a mechanism of intergenerational resource transfer via the accumulation of public debt, the influence of electoral institutions (see Austen-Smith (2000); Lizzeri and Persico (2001)), the dynamics of po-

litical competition (see Persson and Tabellini (1999, 2003)) and the impact of legislative bargaining (see Ferejohn and Krehbiel (1987); Persson et al. (2000); Grossman and Helpman (2008)) have been more extensively analyzed and empirically tested. These political models have contributed quite significantly to our understanding of fiscal policy and the evolution of deficits and debts. Yet, so far their insights have not been fully extended to the related field of pension policy and reform.

With respect to the political science literature, most of it has taken a different tack on pension reforms. Theoretical work has rather relied on broader narratives about the development of the welfare state as a whole. The pension system has been thus considered as a part of a certain welfare regime (see Esping-Andersen (1990) for the seminal contribution). Explanations have been based on the consequences of industrialization (see Wilensky (1975)), the political clout of left-wing parties and trade unions (see Huber and Stephens (2001)), the influence of the fragmentation of the political system by veto players (see Bonoli (2000)) or, with regard to reforms, the blame avoidance strategies by policy makers (see Myles and Pierson (2001)). However, a coherent and rigorous theoretical framework has not been developed so far. Most of the empirical literature, on the other hand, looks at case studies to shed light on the dynamics of pension reform (see for instance the volume by Immergut et al. (2007)). The lessons that can be drawn from these kind of studies are limited though. As Eichengreen has put it nicely in a different context:

> Case studies are useful for illustrating the practical applicability of abstract reasoning, but they are crude instruments for discriminating among alternative hypotheses and rating their relative explanatory power. (...) [T]he limited number of cases any one scholar has the energy to master offers limited degrees of freedom for systematic tests (Eichengreen (1998): 1012).

In addition, what is mostly missing in the political science literature is a formal analysis and derivation of political preferences for pension reform amongst voters. There is also a lack of analysis of how these preferences are shaped by demographic developments, economic incentives and the political environment. It is therefore to safe to say that our current knowledge about the political dynamics of pension system reform is sketchy at best.

1.3 Things to come

Building on the current state of research on pension systems and their reform, the following work sets out to, first, review existing political economy models and to show that pension policy is foremost a political problem; second, to prove that any pension reform is by and large a redistributional policy shift; and third, most importantly, to develop a political economy model of pension reform that explicitly derives the policy preferences of different age groups. The aim is to improve our understanding of the politics of pension reform in aging societies by explicitly taking into account some of the underlying political incentives generated by the size of the pension system and the political environment. Due to the difficulty of modeling a complete political decision-making process, especially with regard to redistributional issues, this dissertation will focus on the pre-electoral dimension of politics. The ultimate goal is to attempt a model-based explanation of whether and how voter preferences, aging dynamics and their interaction with a country's existing pension system shape the electoral prospect for pension reform. Given the inherent difficulty of such an endeavor, no additional attempt is made to develop a general model of the *whole* political process, which would entail an explanation of prelectoral politics and the process of government formation, legislative bargaining and policy formation. For the same reason, the economic environment of the model will be restricted to a partial equilibrium nature. The focus is on the political preferences involved and not on maximizing the number of economic parameters that can be endogenously derived.

Focusing on political preferences, aging processes and the electoral institutional environment is a natural starting point to discuss pension reforms and their feasibility. Since the seminal work of Downs (1957) the burgeoning fields of public choice and political economy have emphasized how political decisions are not primarily driven by economic efficiency concerns but rather by policy makers' concerns for re-election. Knowledge of voters' preferences, possible voting coalitions and the incentives provided by the political environment are therefore key to understand the dynamics of reform politics.

However, before looking into political economy models of pension systems, the stage needs to be set by examining more closely demographic trends and their economic repercussions in the western industrialized world, which will be the focus of this dissertation. For this end, Chapter 2 will explore existing projections of population growth and aging. These projections have been widely used to estimate medium to long-

term trends in productivity, economic growth, labor markets, fiscal policy and benefit and contribution levels of existing pension arrangements. These preliminaries will provide a taste for the problem at hand. It will become clear why pension reform is an pressing issue in most western countries, and why existing systems of old age provision are under pressure to change. The consequences of aging and their implications for the sustainability of pension systems will greatly affect the economic welfare of voters. Thus, pension politics is widely considered a highly salient issues with great electoral relevance.

Chapter 3 then reviews the existing political economy literature on the existence and size of pension systems. The basic set up for the review will be a simple OLG framework with a uniform notation to facilitate comparisons and the understanding of the different approaches. It will be shown that, for the most part, the literature models the political process as a direct-democratic process. Policy is determined simply by the median voter of a certain age or by some influential group that cannot be overruled. In contrast, a much smaller number of models add more political structure and models pension decision making in a representative democracy setting. The chapter elucidates the strengths and deficiencies of these political economy explanations and highlights what the model proposed in this dissertation will add to the discussion.

Having laid out the inherently political nature of pension policy, I will next turn to the issue of reform in Chapter 4. Although public policy discussions heavily emphasize the differences between PAYG and prefunded systems as well as the pros and cons of a transition from the former to the latter, it will be shown that the exact type of pension reform is of no importance really. The chapter will make clear why pension reform, whether parametric or non-parametric, is a redistributional issue. Hence, when developing a model of (redistributive) pension reform, we do not need to bother about whether we mean one type of reform or another. The underlying political incentives should be the same regardless of whether a switch to funding is considered or a parametric change of the public PAYG scheme.

Chapter 5 then proceeds to developing a simple model for deriving voters' pension policy preferences. Since this approach explicitly considers the impact of preferences for non-pension policies, pension policy is examined not in isolation but in view of the fiscal trade-offs made with respect to other public policy goods. To this end, a simple three generation OLG model is employed, which allows for an easy derivation of economic and political preferences of the different age groups. The analysis of the model

suggests that preferences for a generous pension system (not surprisingly) increase with age but also depend on the size of the existing system and the population growth rate. From these very basic results, it is then possible to formulate scenarios under which changes to a pension system are more or less likely. In particular, I will analyze the feasibility and direction of pension reform under different electoral institutions, comparing reform outcomes in a direct democracy on the one hand, with outcomes in a representative democracy on the other hand. It will be possible to explicitly distinguish and compare reform scenarios in majoritarian and proportional electoral systems. I will show that in certain scenarios and conditions, pension reform may be harder to achieve in a majoritarian system than under proportional representation.

The insights of the model are tentatively tested in Chapter 6. While it won't be possible to empirically check the model's implications with respect to the actual feasibility and direction of pension reforms, it is possible to test whether reported political preferences actually do conform with the model's predictions. Using cross-national survey data of 21 countries provided by the International Social Survey Programme, logit and ordered logit estimations lend some statistical support for the hypotheses derived from the model.

Chapter 7 summarizes premises, hypotheses and results of this dissertation. The most important insights are then contextualized with respect to the current literature. Finally, the dissertation closes with some thoughts on future avenues of research and future developments of pension systems in industrialized countries.

Chapter 2
Aging and its Consequences

2.1 The Dynamics of Population Aging

To understand why population aging strains pension systems and puts their reform on the political agenda, it is paramount to grasp the different dynamics and implications of this process. What is often not fully understood by the layman is that a fall in the population growth rate alone would not pose so much of a problem if the age structure remained the same, i.e. if the relation between young and old[1] would roughly stay constant. In this case, the relative size of the working age population to the non-working population (the retired and children) would not change. This, however, is not what we currently observe in the industrialized nations. Not only does the population growth rate decline there, but the populace also grows older. Hence, the relative number of working age people is steadily declining.

A useful indicator to describe the relative size of the work force is the old-age dependency ratio which measures the ratio of the population of retirement age (defined as those aged 65 or over) to the population of working age (defined as those aged 15-64).[2] It is widely used because it is easy to compute and straightforward to interpret. Table 2.1 shows the development of this indicator in selected OECD countries and provides future projections that have been estimated by the United Nations' Pop-

[1] Unless explicitly stated otherwise, in this dissertation "young" refers to those of working age while "old" denotes the retired population.

[2] This indicator is not be confused with the "Dependency Ratio" which includes in the numerator not only those aged 65 and over but also those under the age of 15.

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ulation Division (United Nations (2010)). In all countries exhibited in the table, the old-age dependency ratio was well below 20 in 1955, highlighting the existence of a relatively large work force compared to the number of people aged 65 and above. Most notable is the small ratio of 9 in Japan. Except for Ireland, these numbers steadily increased until the year 2010, exceeding 20 in almost all countries.

Table 2.1: Projected development of old-age dependency ratios in selected countries

	1955	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**
Austria	17	23	26	30	41	50	53
Belgium	17	26	27	32	39	44	44
Czech Republic	13	20	21	30	34	38	49
Denmark	15	22	25	31	37	42	41
Finland	11	22	26	37	44	44	45
France	18	25	26	33	39	43	43
Germany	16	24	31	36	48	56	57
Greece	11	25	28	32	37	47	55
Hungary	12	22	24	30	32	36	44
Ireland	18	17	17	23	28	34	41
Italy	13	27	31	36	44	57	62
Japan	9	25	35	48	53	63	70
Luxembourg	15	21	20	22	28	35	40
Netherlands	13	20	23	31	41	48	46
Poland	9	18	19	27	35	37	48
Portugal	12	24	27	32	40	52	64
Spain	12	25	25	29	37	50	62
Sweden	17	27	28	34	38	41	42
United Kingdom	17	24	25	29	34	39	40
USA	14	19	20	25	33	35	35

Note: Old-age dependency ratio is defined as the age ratio $\frac{65+}{15-64}$. The projections are based on the UN's "medium variant" scenario.
Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp)

Looking ahead until the year 2050, the UN's projections[3] predict an even more dramatic rise in old-age dependency ratios, which will almost more than double in most countries of the EU within the next 40 years. Japan and Portugal will suffer the most remarkable increases from 35 and 27 in 2010 to respectively 70 and 64 in the year 2050. But also other countries like Germany, Italy and Spain are reckoned to exhibit ratios above 50, implying that there will be less than two workers per retiree in 2050. Looking at the Czech Republic, Hungary and Poland, we find that these trends are prevalent also in the transition economies of Eastern Europe. Hence, these developments are not confined to the "old" Western countries but mark a general trend in the developed world.

It is worth pointing out that the old-age dependency ratio is actually understating the problem, however. For one, most countries provide ample opportunities to retire before the age of 65, thus increasing the size of the numerator. And second, the fact that not everyone aged between 15 and 64 is actually part of the labor force strongly reduces the denominator. Many pursue an education beyond the mere age of 15 and there is a significant number of people that are unemployed or voluntarily outside the labor force. As a result, the employment rate lies not at 100 per cent but significantly below that. In 2011, according to the OECD's Economic Outlook data (OECD (2012)), employment rates in the countries under consideration ranged from 55.6 per cent (Greece) to 74.9 per cent (Netherlands).[4] The picture is thus much bleaker than Table 2.1 conveys.

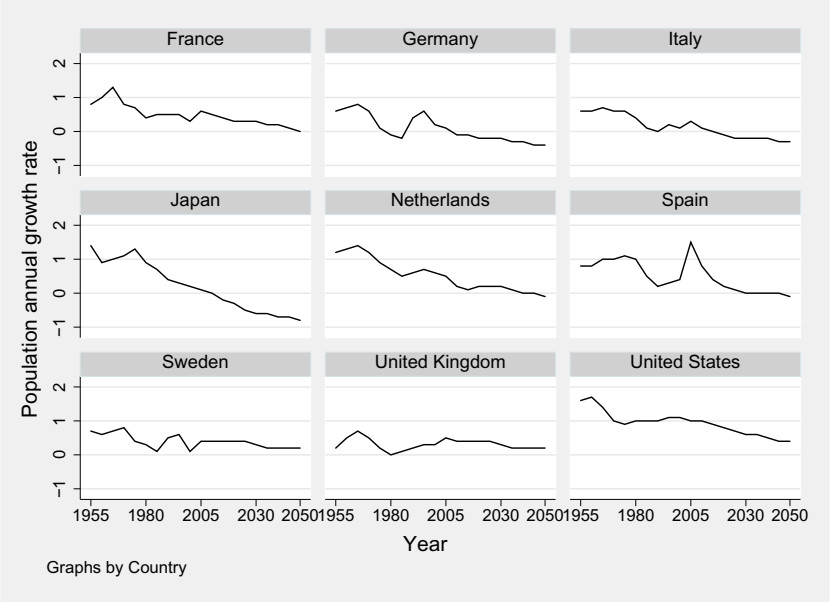
It is very clear, therefore, that population aging entails a dramatic relative reduction in the size of the active labor force vis-à-vis the retired. There are several dynamics that drive this decline. First of all, population growth rates are falling. However, up to now almost all countries considered here still had positive population growth rates (with the exception of Germany in the mid-eighties). This will change in the future, however. In most EU countries and Japan population growth will turn negative within the next 40 years. This trend is explicated in Figure 2.1 which displays the developments and projected trends in the five big EU countries along with Sweden, the Netherlands, Japan and the United States. Of these nations,

[3] All projections are based on the UN's "medium variant" scenario. The underlying assumptions vary for different country groups. For developed countries it is being assumed that fertility rates increase slightly to on average 1.79 in 2050, mortality rates continue to improve and the flow of immigration stays at current levels.

[4] Of course, many countries (especially Greece) suffered reductions in their employment rates since 2009 due to the global financial crisis and the subsequent economic downturn.

only Sweden, Britain and the U.S. will continue to have positive albeit low population growth rates.

Fig. 2.1: Long-term projections of population growth rates

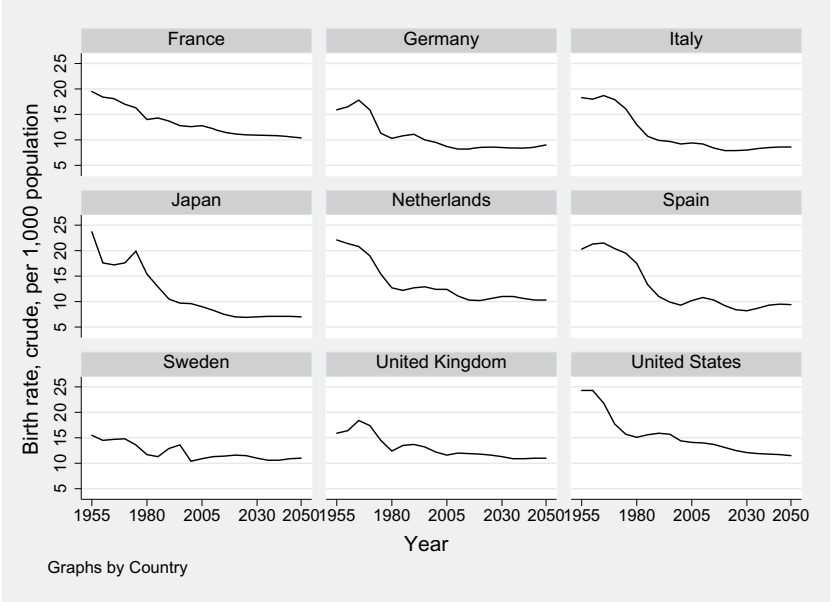


Note: Projections based on "medium variant" scenario.
Data Source: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp).

The culprit behind this downward shift are falling fertility rates. The average number of children of a woman until the end of her reproductive period is steadily declining. This can also be seen by looking at crude birth rates. Figure 2.2 graphs these for the same sample of countries as before. In 1955 all countries had birth rates well above 15 or even 20 (Japan, Netherlands, U.S.). By 2050, these will have fallen below 12 in most states (except France and the U.S.).

It should be noted that *some* part of the plunge in fertility rates will be a transitory phenomenon. The reason is that women nowadays tend to have children at a later age than women of previous generations. Table 2.2 underscores this development. Until 2050 the average childbearing

Fig. 2.2: Long-term projections of crude birth rate, per 1000 population



Note: Number of births in a given period divided by the person-years lived by the population over that period, per 1000 population; based on "medium variant" scenario.
Data Source: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp).

age of a women will have increased to above 30 in all countries under consideration. As a result, the current data reflects the coexistence of previous cohorts of women with earlier peaks of fertility and later cohorts that have their peaks at a higher age. This would suggest that taking *completed* fertility rates into account somewhat reduces the size of projected old-age dependency ratios. But as has been estimated by other studies such as Calmfors et al. (2005), there is only a minor impact of this qualification on projected population trends.

Concomitant to the decline in fertility is a steady increase in longevity which can mainly be attributed to improvements in public health provisions and medical innovation.[5] It is this rise in life expectancy that really aggravates the problem of falling fertility rates because it increases the rel-

[5] See Lichtenberg (2004) for an empirical study using U.S. time series data.

Table 2.2: Projected development of average childbearing age in selected countries (in years)

	1995-2000	2010-2015	2030-2035	2045-2050
France	29,23	29,91	30,50	30,50
Germany	28,05	29,84	30,50	30,50
Italy	29,52	30,65	31,24	31,39
Japan	29,02	29,63	30,22	30,53
Netherlands	30,19	30,56	30,50	30,50
Spain	29,92	30,41	30,50	30,50
Sweden	29,00	29,99	30,50	30,50
United Kingdom	27,82	29,17	30,50	30,50
United States	26,60	28,52	30,50	30,50

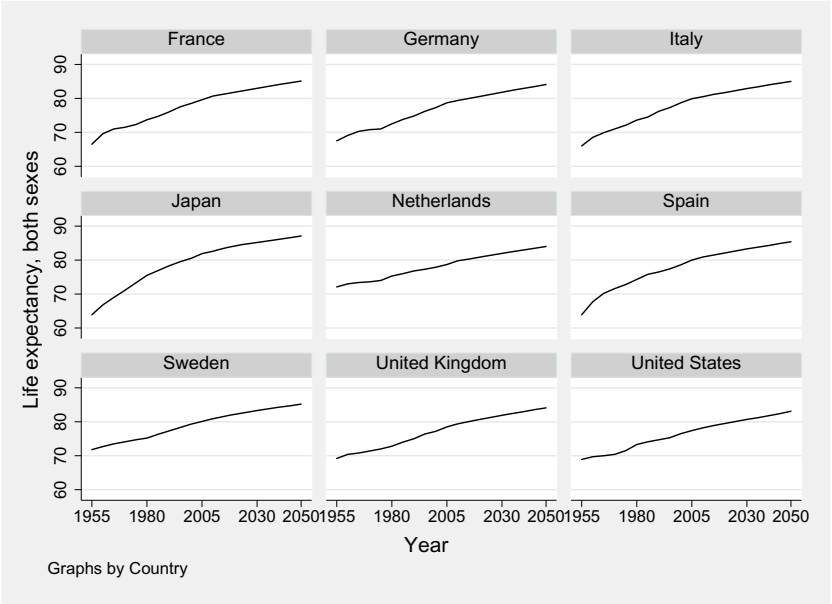
Note: Average childbearing age of a woman in years.
Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp)

ative size of the retired population vis-à-vis the young. On the other hand, of course, it prevents a stark fall in the overall population size, since to some extend it counteracts the fact that fewer people are being born. The increase in longevity has been quite steady in the past, raising average life expectancy from around 64-72 in 1955 to approximately 80 in 2005. Figure 2.3 again shows the UN's future projections based on the "medium variant" scenario. All countries are expected to continue to observe steady increases in longevity albeit at a somewhat decreasing pace. These estimates thus suggest diminishing returns to medical innovations and health care spending. Nevertheless, by the year 2050 projected life expectancy will hover around 85. In other words, given a retirement age of 65 people will spend on average 20 years in retirement, around 5 years more than in 2005.

In sum, falling fertility rates and rising longevity combine to lead to a "graying" of the population.[6] To give a final taste of this development and to convey its magnitude, figure 2.4 displays the past and future shares of people aged 65 and over. While in 1955 the share of elderly thus defined was still around or below 10 per cent, it is expected to increase to 25-30

[6] Of course, net migration also affects population aging. This is not discussed here, for immigration policy is driven by other factors than aging developments. Furthermore, immigrants tend, over time, to converge in their fertility rates and life expectancy towards those prevailing in the host nation.

Fig. 2.3: Long-term projections of life expectancy, both sexes

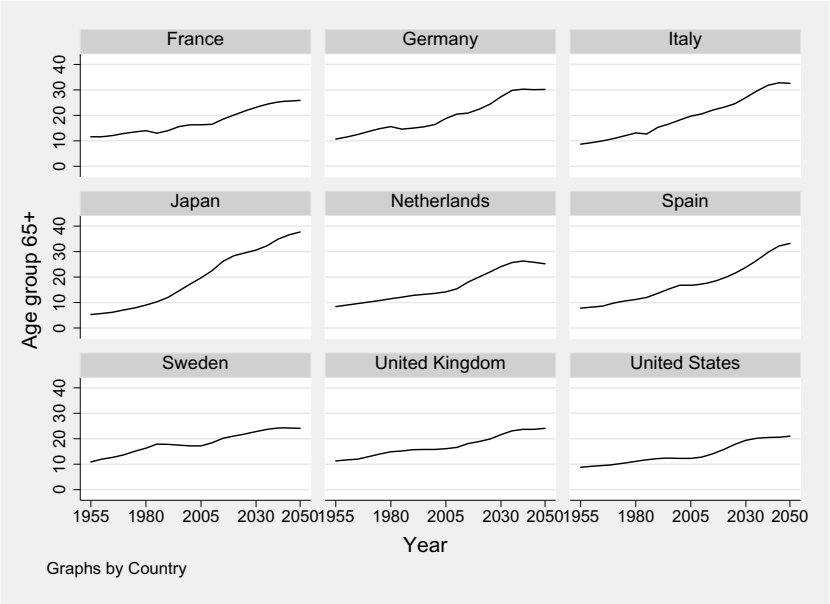


Note: Average number of years of life expected by individuals of a hypothetical cohort, subject during all their lives to the mortality rates of a given period; based on "medium variant" scenario.
Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp).

per cent of the whole population. Japan once again leads the pack with a whopping 38 per cent.

Of course, as with any long-term projections, results are dependent on the underlying assumptions and on past and current data. Furthermore, future policy measures that affect migration or the incentive to have children cannot appropriately be factored in. There is certainly a lot of truth in the often heard adage that predictions are uncertain, especially about the future. Maddaloni et al. (2006) illustrate these uncertainties by pointing out the recurrent significant revisions in Eurostats' population growth projections. Yet even with these caveats in mind, the qualitative results are beyond doubt for three reasons. First, the underlying factors such as fertility tend to change very slowly. Even if a sudden hike in fertility occurred, it would only gradually affect old-age-dependency ratios. Second, when comparing these UN projections with, for example, those of Euro-

Fig. 2.4: Long-term projections of share of population aged 65 or over



Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (http://esa.un.org/unpp).

stat, we find very similar results. Moreover, there are also other scenarios provided by the UN's Population Division that do take into account abrupt changes in the underlying variables: besides the "medium variant", there are also low, high and constant fertility scenarios. Third, projections of life-expectancy notoriously underestimate true trends which leads to regular upward revisions of earlier projections. In case of Great Britain, for instance, projections made in 2004 about the number of people aged 65 and over in the year 2050 were 65% higher than projections made in 1981 (OECD (2011): 85). No matter which prediction we look at, however, while the magnitudes may differ the general pattern and thus the qualitative conclusions remain robust. The aging of societies in industrialized countries is an ongoing process and it is expected to continue for the foreseeable future.

2.2 The Macroeconomic Consequences of Aging

Although this dissertation focuses on aging and its impact on pension systems, it is worthwhile to look at the broader economic picture. Aging affects not only the functioning of systems of old-age provision but has macroeconomic ramifications that require substantial adjustments in both the public and the private sector. These macroeconomic implications in turn directly affect the stability and sustainability of pension systems, while pension systems in turn affect macroeconomic variables like labor supply, private saving and capital accumulation. Hence, it is also the general equilibrium effects that make pension systems such an important policy field. Quite a number of studies have analyzed and estimated the effects of aging on per capita economic growth, financial market development, fiscal policy and the financial viability of pension systems. Some of the results will be reviewed in this section to convey an idea about the (expected) macroeconomic environment. It is some of these consequences of aging that explain why pension reform is considered such a salient policy issue among policy makers and in academia.

2.2.1 Aging and Economic Growth

A number of organizations have attempted to project the impact of population aging on per capita incomes and growth rates, among them the European Central Bank (ECB (2006)), the Economic Policy Committee of the ECOFIN Council[7] (Carone et al. (2006)), the European Economic Advisory Group at the CESifo institute (Calmfors et al. (2005)), the International Monetary Fund (Batini et al. (2006)) and the OECD (Martins et al. (2005)). These estimates have to be taken with even more caution than demographic projections, however. They are highly dependent on the underlying assumptions about future labor productivity growth, expected changes in labor force participation rates and labor utilization. Nevertheless, while the exact magnitudes involved may be doubtful, these projections can at least convey the qualitative nature of future developments.

[7] The Economic Policy Committee is a body composed of senior officials from central banks, national economics and finance ministries, whose task is to prepare the ECOFIN Council.

The channels by which aging affects economic growth can be easily sketched without having to get into the details and intricacies of standard growth theories.[8] Looking at a general production function, where Y denotes an economy's output, L labor input, K capital input and A productivity allows to identify these channels:

$$Y = AF(L,K) \tag{2.1}$$

Rewriting (2.1) in terms of growth rates yields

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + a_K \frac{\Delta K}{K} + a_L \frac{\Delta L}{L} \tag{2.2}$$

where Δ denotes the respective rates of change and a_K and a_L the respective output elasticities with regard to capital and labor. This growth accounting equation suggests that aging affects output growth directly via a reduction in labor input L. If the relative size of the working age population decreases and this is not fully compensated by an increased participation rate, per capita growth will fall. Empirically, this channel is expected to have the strongest adverse impact. Columns 1-4 of Table 2.3 present estimates carried out by Carone et al. (2006) who use the long-term projections conducted by the Economic Policy Committee's Working Group on Aging. These estimations show how employment growth, which is a measure of ΔL, will contribute to changes in GDP. For all countries under consideration[9] the impact of employment on economic growth falls rapidly between the period 2004-2010 and 2011-2030, going to around zero or becoming even slightly negative. Between 2031-2050 employment growth is weakest and thus exerts a sizeable negative effect on GDP growth for all states but Sweden. A slight improvement is discernable after 2040, however. The message from these numbers is unambiguous: employment growth will contribute less and less to GDP growth and will even retard it in most countries between 2031 and 2050.

In addition, aging not only affects the size of the work force but increases the share of older workers. If labor productivity is age-specific with older workers being less productive, then an aging work force will lead to lower overall labor productivity and thus lower economic growth. However, the question of how large this effect is and at what precise age

[8] For an overview of modern theories of economic growth see Barro and Sala-i Martin (2003) and Mankiw (1995).

[9] Note that projections for Japan and the U.S. were not carried out.

Table 2.3: Projected impact of aging on per capita growth

	2004-2010	2011-2030	2031-2040	2041-2050
France	0.8	0.1	-0.1	-0.1
Germany	0.8	-0.2	-0.6	-0.5
Italy	1.1	-0.2	-0.9	-0.6
Netherlands	0.6	-0.1	-0.1	0.1
Spain	1.9	0.1	-1.1	-1.1
Sweden	0.6	0.1	0	0.2
U.K.	0.7	0.0	-0.2	-0.2
EU-15	0.9	0.0	-0.5	-0.4
Japan				
USA				

Note: Contribution of employment growth to annual GDP growth rate, 2005-2050.
Data Sources: Carone et al. (2006)

productivity declines is still controversial and has not been empirically settled yet. In general, it is presumed that productivity decreases from a certain age on because of lower physical fitness, less perceptual speed and greater difficulty in acquiring new skills. This of course needs to be traded off with greater work experience. Surveying the literature, Skirbekk (2003) finds that productivity follows an inverted U-shape and starts decreasing around the age of 50. He points out the general difficulty in empirically testing these propositions, since there are likely to be selection[10] and identification problems. More recent econometric studies using macro-level data confirm the inverted U-shape relationship (see Feyrer (2007); Werding (2008)). In particular, Werding (2008) finds that workers' productivity peaks between the age 40 and 49. As with respect to the overall impact of aging on productivity, Börsch-Supan (2003) conducts estimations using German labor market data and combines them with age-specific productivity computations by Kotlikofff and Wise (1989). He concludes that its impact is rather small compared to the one arising from a shrinking work force. Other studies, looking at OECD countries in general, report somewhat larger adverse effects on aggregate productivity growth (see Krueger and Ludwig (2007); Werding (2008)).

[10] More productive workers have higher salaries and may decide to stay longer in the work force compared to less productive workers. This could lead to an upward bias in the estimates, suggesting that labor productivity may start declining well before the age of 50.

Another more indirect effect of a graying work force on economic growth comes via changes in aggregate savings. According to the standard life-cycle hypothesis (see Ando and Modigliani (1963)), household saving follows a hump-shaped curve. The peak of the curve reflects the position of middle aged income earners who save part of their income for old-age. The retired, on the other hand, tend to dissave, i.e. run down their accumulated wealth, to ensure sufficient consumption in old-age.[11] As a result, an aging population implies more pensioners (net-dissavers) and fewer prime-age workers (net-savers), thus lowering aggregate savings.[12] Lower savings may lead to lower investments, which in turn could reduce the capital stock K and thus induce a lower capital-labor ratio. Therefore, productivity growth could be smaller and so could be economic growth.[13] Although in principle foreign capital could fill the void, empirically saving and investment move pretty much in line in the long run (see Feldstein and Horioka (1980)). Numerous studies have tried to measure the impact of aging on private saving behavior. The vast majority of them finds a clear and robust link, yet the magnitude of the effect varies. The earlier literature has found quite a large impact, concluding that a 1 per cent increase in the old-age dependency ratio should, ceteris paribus, lead to a reduction in household savings of around 1 per cent (see Feldstein (1980); Masson and Tryon (1990)). More recent estimates come up with more modest but still significant results of below -0.5 per cent (see Masson et al. (1998); Loayza et al. (2000)). Note that a reduction in capital intensity due to fewer savings may potentially be offset by a substitution effect. A declining work force raises wages, thus inducing a substitution of capital for labor. This, and the fact that there are now fewer workers for a given capital stock, increases the capital-labor ratio and hence productivity. The net effect of population aging on capital intensity is therefore not as clear-cut as some have insinuated (e.g. Feldstein (2006)).

[11] Young workers are also considered to dissave. Given that they can expect earnings to increase with age, the consumption smoothing motive suggests borrowing against future incomes.

[12] It has been found that countries with very generous PAYG pension systems like Germany and Italy have a rather flat saving profile, seemingly contradicting the life-cycle hypothesis (see Börsch-Supan et al. (2001); Brugiavini and Padula (2001)). However, if one adds contributions to a PAYG system to private savings, the predicted hump-shaped profile can be observed again.

[13] It has to be noted, however, that the validity of this theoretically well established causal chain with respect to developed countries has been questioned by some on empirical grounds (see Aghion et al. (2006); Claus et al. (2001)).

Given these different transmission channels, estimating how aging affects future economic growth is not an exact science. Nevertheless, there are quite a number of studies presenting simulation results using either a growth accounting perspective (see ECB (2006); Calmfors et al. (2005)) or general equilibrium models (see Martins et al. (2005); Faruquee (2002)). Table 2.4 is based on the results of a growth accounting exercise carried out by the European Economic Advisory Group (Calmfors et al. (2005)). Assuming that productivity will grow by 2 per cent per annum and labor market participation rates remain at the levels of 2004, they calculate by what factor per capita output would grow between 2004 and 2050. Based on their results, I calculated the difference between the aging and the no-aging scenarios in percentage terms.

Table 2.4: Projected overall impact of aging on per capita growth (in %)

	2004-2050
France	-27.87
Germany	-30.33
Italy	-50.82
Netherlands	-26.64
Spain	-57.38
Sweden	-27.46
U.K.	-18.44
EU-15	-32.79
Japan	-60.66
USA	-17.21

Note: Total reduction in overall GDP per capita growth due to aging compared to non-aging scenario, in %, assuming a constant labor participation rate, 2004-2050.
Data Sources: Calmfors et al. (2005)

According to these estimates, gains in per capita output between 2004 an 2050 will be much lower due to population aging in all countries. The cross-country differences are striking. Countries like the U.S. and the U.K. that have a more favorable demographic outlook are expected to suffer a loss in average per capita output growth of 17 and 18 per cent respectively, compared to the hypothetical case where the demography remains stable. Fast aging countries like Japan, Italy and Spain are even projected to face a reduction in growth of more than 50 per cent over the whole period. Increasing labor participation rates to 80 per cent improves

the situation somewhat in all states but does not change the finding of lower output gains vis-à-vis a scenario without aging. Not all is doom and gloom though. A more recent study by Bloom et al. (2011) finds more modest negative effects pointing out that behavioral responses such as higher female labor force participation rates and policy reforms may mitigate some of the negative dynamics. Furthermore, others have suggested that economies could adapt to declining population numbers by switching from labor-oriented to human capital-oriented technologies (Elgin and Tumen (2012)). While the accuracy of all projections and their exact magnitudes should be taken with a grain of salt (as with all simulations), the general qualitative findings in all studies are very much the same: on aggregate, a graying population and a shrinking work force will clearly reduce economic growth in per capita terms.

2.2.2 The Impact of Aging on Financial Markets, Public Expenditures and Pension Systems

A changing demographic structure has direct implications for domestic and international financial markets, public expenditures and the fiscal balance of pension systems. The effects in these areas are of immediate relevance when considering the need and feasibility of changes to systems of old-age provision. They also indirectly affect economic growth; the magnitude of which is, however, very hard to estimate.

2.2.2.1 Financial Markets

Let's begin with financial markets. Most attention has been drawn to the so-called "asset meltdown hypothesis". The argument posits that particularly large cohorts just like the baby boomer generation drive up asset prices when they are in their prime working age. But at retirement they will all try to sell these assets to finance consumption, thus driving down their value if the following cohorts are smaller in size. As Siegel (1998) has put it:

> The words 'Sell? Sell to whom?' might haunt the baby boomers in the next century. Who are the buyers of the trillions of dollars of boomer assets? [The boomer generation] threatens to drown in financial assets. (Siegel (1998): 41)

This reasoning would imply that saving for old-age by investing in capital markets could be a bad idea in aging societies. That is why this argument is vitally important when discussing non-parametric pension reforms that involve funding. There is also an opposing view, which maintains that forward-looking, rational market participants anticipate the effects of aging. Asset prices thus reflect these expectations and therefore no meltdown will take place. These considerations have been formally analyzed by a number of authors (see Abel (2001, 2003); Brooks (2000, 2002)), confirming the general result of falling asset prices due to aging. Several studies have also empirically tested the validity of this proposition, yet the results are very mixed. Bakshi and Chen (1994) and Geanakopolos et al. (2004) have found evidence of a negative relationship between age structure and stock market returns in the case of the United States. Looking at U.S. data as well, Poterba (2001, 2004) on the other hand could not find any strong econometric evidence that asset returns react to demographic variables. He finds some evidence when considering the *level* of asset prices, yet does not consider it to be very robust (Poterba (2004): 30). Using a broader sample that also includes Japan, France and Germany and employing different scenarios for the period 2000-2050, Martins et al. (2005) also find little support for a future asset meltdown.

Reasons, beside the rationality argument, why the "asset meltdown hypothesis" may be indeed erroneous are, one, that only a minority of households is actually invested in stocks and bonds, and second, that it assumes a closed economy. With open capital markets the retiring baby boomers could sell their assets to foreign investors – which brings us directly to the impact of a graying population on international capital flows. As elucidated in the previous section, aging will change the saving and investment balance. This, in turn, will directly affect external balances and interest rates. If saving and investment behavior changes, then, with open capital markets, this should entail changes in current account balances. Given the above reasoning based on the life cycle hypothesis, we would expect societies with a higher old-age dependency ratio to have lower aggregate saving rates and, if not accompanied by a fall in desired investment rates, to experience higher net capital inflows than "younger" countries. The lower savings should increase expected returns and thus attract foreign investors. Several empirical studies have found evidence pointing in this direction (see Santis and Lührmann (2006); Higgins (1998)). Using cross-sectional and panel data, they find a significant negative relationship between the old-age dependency ratio and the current account balance. Simulating the impact of future demographic developments, Börsch-Supan

et al. (2004) project current account balances to turn negative and decrease below -2 per cent by 2050 for France, Germany and Italy. As a result, and this is often overlooked in public discussions, aging is not only a domestic issue but will lead to a global re-allocation of resources.

Reinforcing this global impact, aging could also affect equilibrium real interest rates. On the one hand, a declining labor force will increase the capital-labor ratio, thus leading to a fall in the profitability of investments which would put downward pressure on interest rates. On the other hand, if saving rates really decrease due to the demographic changes and desired investment rates remain stable, then a lack of funds for investment could very well bid up real interest rates. Simulations using calibrated general equilibrium models predict the former effect to outweigh the latter. These studies predict real interest rates to decline by 30-100 basis points until 2050 (see Miles (1999); Batini et al. (2006)) which is, of course, a rather modest impact.

2.2.2.2 Public Expenditures and Pension Systems

A shifting demography not only changes the size but also the structure of public expenditures, if no legislative changes are enacted. As the median age rises and the number of old people increases, public spending for old-age provision and health care as well as long-term care increase in importance. On the other hand, fewer young people and a shrinking labor force imply (potentially) less need for expenditures on education and unemployment benefits. However, it is widely expected that the former effects of increased spending pressures by far outweigh the latter reductions, an expectation that is clearly borne out by the empirical data.

The Ageing Working Group of the European Commission's Directorate-General for Economic and Financial Affairs (European Commission (2012)) has made projections of public expenditure paths for all EU countries. These estimates take 2010 as a base year, assume the state of 2011's domestic legislation to hold until 2060 and employ the Working Group's reference scenario of future demographic developments. Hence, the aforementioned caveats for such projection exercises apply here as well. Table 2.5 presents estimations of changes in expenditures for different budget items between 2010 and 2060.

Public pension spending is projected to rise in all countries under consideration except for Italy. The exact size of the changes depend on two factors: the generosity of benefit levels as currently legislated and the ex-

Table 2.5: Projected changes in public expenditures in selected countries (in % of GDP), 2010-2060

	Pension 2010-2060	Health & Long-term Care 2010-2060	Unemployment 2010-2060	Education 2010-2060
France	0.5	3.5	-0.6	-0.4
Germany	2.6	3.1	-0.3	-0.2
Italy	-0.9	1.5	-0.3	-0.5
Netherlands	3.6	5.1	-0.3	-0.1
Spain	3.6	2.0	-1.1	-0.5
Sweden	0.6	3.2	0.0	0.0
U.K.	1.5	1.8	0.0	0.0
EU-27	1.5	2.6	-0.3	-0.1
Japan[a]	3.0	2.4		
USA[b]	2.2	4.9		-1.0

Note: Overall changes in per cent of GDP from 2010 to 2060; [a] 2000 to 2050; [b]2005 to 2050
Data Sources: European Commission (2012); [a]OECD (2003); [b]Budget of the United States Government, Fiscal Year 2003, Analytical Perspectives.

pected change in old-age dependency ratios. This helps explain some of the astounding variety. Italy, although aging much faster than all of the other countries (except for Spain), is expected to have a decline in pension spending of -0.9 per cent until 2060. The reason is, of course, that Italy enacted a number of pension reforms that will drastically reduce benefit levels in the future (see Galasso (2006); Ferrera and Jessoula (2007)). The equally low prediction for Sweden can also be explained by the strong parametric and non-parametric pension reforms the country has put into force in 1998 (see Sunden (2006); Anderson and Immergut (2007)). Spain, on the other hand, combines a fast aging population with generous benefits. Without legislative changes, this is estimated to lead to a sizeable rise in expenditures for old-age provision of 3.6 per cent of GDP, a number that will only be matched by the Netherlands. Note that also countries with more favorable demographic outlooks like the U.S. and the U.K. face substantial increases of 1.5 and 2.2 per cent respectively. Looking at health and long-term care, we find in some countries even stronger increases in projected spending. This points to the fact that health and long-term care spending is not only strongly affected by aging itself but also by costly medical innovations that lead not only to better but also more expensive

treatments. In addition, some countries[14] have been notably slower in enacting changes to their health care system, even though projections on future health care expenditures are much bleaker than for future pension spending.

These steep increases are somewhat offset by reductions in other items. In particular, the graying of societies will lead to declining labor forces which should be accompanied by lower unemployment rates. Therefore, expenditures related to unemployment should decline, although the size of this effect is projected to be small in all countries, ranging from -0.6 to 0.0 per cent of GDP. A similar impact can be expected from lower spending on education. A lower fertility rate leads to fewer children being born and thus less public education needs to be provided. This expectation, however, could be reversed if governments aim to counter the effects of a shrinking working population by increases in per capita education spending to raise average skill levels and thus per worker productivity (European Commission (2006): 17). Regardless of the precise effect of educational spending, the overall impact of aging on public expenditure is sizeable and points to a strong upward pressure on government budgets. Of course, these higher outlays have to be financed somehow. While temporarily this could be done by selling off government assets or by increased government net borrowing[15], in the long run higher expenditures need to be matched by higher revenues.[16] As a result, taxes and/or social security contributions will invariably rise. This fiscal burden will thus negatively affect economic growth as it increases deadweight costs from taxation and distorts labor supply decisions (see Alesina and Perotti (1997); Daveri and Tabellini (2000)).

The size of the needed increases in social security contributions is quite substantial. Chand and Jaeger (1996) were one of the first to estimate future contribution rates given demographic projections and the state of pension legislation in the middle of the 1990s. Their predictions are quite dramatic. As Table 2.6 elucidates, all countries under consideration are

[14] Until the enactment of the Affordable Care Act in 2010, the U.S. was a prime example of a country that did little to reform its health care system.

[15] Of course, Eurozone member countries are severely constrained in their ability of deficit financing due to their commitment to the Stability and Growth Pact, which could also pose a serious obstacle to parametric pension reform (see Razin and Sadka (2003), Beetsma and Oksanen (2007)).

[16] Another option would be a concomitant reduction in other spending areas (e.g. defense, government consumption). However, given the large magnitudes involved here, this would require cuts of a size that seem not viable politically.

likely to witness a steep increase, with Germany and France expected to almost see a doubling of their contribution rates by 2050. Italy presents the most whopping estimate. However one should remember that the reforms of the last 15 years are of course not incorporated in these calculations.

Table 2.6: Projected contribution rates in selected countries in 2050, (in %)

		Chand and Jaeger (1996)	Galasso and Profeta (2004)
	2000	2050	2050
France	22.4	41.2	40.8
Germany	23.8	41.6	37.7
Italy	38	68.2	50
Spain	21.3		45.5
U.K.	14.5		33.2
Japan	8.7	12.7	
USA	9.7	15.9	21.6

Note: Social Security contribution rates in per cent; the projections by Galasso and Profeta (2004) are simulations that explicitly take into account political pressures due to an increase in the median age. Estimates for Netherlands and Sweden were not carried out.
Data Sources: Chand and Jaeger (1996); Galasso and Profeta (2004)

A more recent projection has been carried out by Galasso and Profeta (2004) who take the year 2000 as their base. More importantly, they also try to incorporate political pressures stemming from the aging of the electorate and how this will influence individual voting on the size and generosity of pension systems. Therefore, their results (see table 2.6) do not only reflect an interpolation of the current system given demographic trends but also take into account individual optimizing behavior and the possibility to change pension parameters through majority voting. Their predictions for Germany and France are surprisingly close to the results by Chand and Jaeger (1996), although somewhat smaller. The estimates are smaller for Italy (and still not incorporating the most recent reforms) but significantly higher for the United States. Spain and the U.K. are also predicted to witness severe increases. While the precision of all these projections can again be questioned on many grounds, their qualitative nature is unambiguous: given the demographic shift and current pension commitments, social security contributions have to rise markedly to ensure the future financial balance of systems of old-age provision.

In sum, aging has not only severe domestic and international macroeconomic consequences but also leads to strong imbalances in current pension systems. As a result, the present expected value of future benefits is by no means matched by the present expected value of future revenues. Re-balancing a simple PAYG system may be technically and economically easy — just change benefit levels, contribution rates and eligibility criteria — but politically it is a daunting task. As will become clear in the next chapters, systems of old-age provision are established, sustained and reformed through a political process. The strong distributional implications of any such system explain why *political* viability and sustainability are of such great importance and why pension systems can only be analyzed within a political context.

Chapter 3
It's Politics, Stupid! – Political-Economy Models of Pension Systems

The creation of public systems of old-age provision is, by historical standards, a fairly recent development. Pension systems were established around the beginning of the 20th century as part of a more general move towards systems of public insurance and welfare. The first compulsory public pension scheme was introduced in the German Kaiserreich by Chancellor Bismarck (for historical overviews see Fisch (2000); Haerendel (2001); Hohn (2004)). The so-called *Disability and Old Age Insurance Act* of 1889, a funded and earnings-related system, was element of a whole package of social reforms. It also included insurances against accidents and sickness, aimed at alleviating poverty and quelling the rising influence of socialist worker movements. Somewhat later in 1913, Sweden established the first universal pension system. The U.S., on the other hand, did not introduce a comprehensive system until the *Social Security Act* of 1935. Interestingly, even those schemes that were initially set up as funded systems soon, for various reasons like wars and high inflation, depleted their capital stocks and evolved into PAYG[1] systems.

There is a broad political science literature analyzing the reasons for the introduction of welfare state arrangements that points at the impact of urbanization, industrialization and the demise of the extended family (see Wilensky (1975)), the extension of voting rights (see Acemoglu and Robin-

[1] A PAYG system is a scheme where current workers pay current retirees' pension benefits through a tax that is levied on their working incomes. Hence no contributions are saved, no assets are accumulated. The revenues of the system are immediately transferred to the pensioners. In a prefunded system, on the other hand, contributions are invested in assets, and thus capital is being accumulated. Benefits for each retiree are therefore covered by a previously generated stock of funds.

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son (2000)) and the increasing strength of left parties and labor unions (see Korpi and Palme (2003)).

From a normative economic perspective, the need for a mandatory public system is usually justified by myopic individual saving behavior and imperfect financial markets (Diamond (2004)). With respect to the former argument, it is suggested that short-sighted individuals do not save sufficiently for their retirement. Some have suggested that individuals tend to revise their consumption plans in an inconsistent way by using a higher discount rate for the near future than the far future (see Angeletos et al. (2001)). All of this would call for a paternalistic government intervention.[2] The second argument in favor of a compulsory public pension programme posits that private financial markets do not provide sufficient possibilities for annuitization of pension benefits due to adverse selection problems. In addition, only few households actually do voluntary annuitization (Diamond (2004): 6). Yet saving for old age is supposed to ensure sufficient consumption possibilities after retirement, but without annuities an insurance against longevity is not possible. Thus, the danger of running out of funds when old arises. Hence, a mandatory government programme seems to be a suitable remedy.

While the economic rationales may or may not make sense, and while the general development of welfare states may provide insights into general trends and patterns, all of this hardly explains timing, size, scope and variety of pension systems. The political dimension still remains opaque. Thus, before descending into the dark abyss of analyzing political dynamics of pension reform, it is helpful to erect the giant on whose shoulders we need to stand for this endeavor. That is, first we have to understand and to model how a pension system is the intended result of a political process. The following review of the most prominent political economy models of pension policy-making forms the basis for the subsequent analysis of pensions preferences and reforms.[3] It also allows us to get acquainted with the logic of OLG models and introduces the necessary notation. Note that the aim here is not to provide an exhausting overview of the rather large literature but to highlight the most important issues in this area and to formalize them in a coherent framework.

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[2] Of course, this reasoning immediately begs the question of why short-sighted voters should elect a far-sighted government or become far-sighted once attaining a government position. See Homburg (1988) for a critique of this paternalistic position.

[3] Surveys of the positive pension literature that strongly differ in their emphasis and technical sophistication can also be found in Breyer (1994a); Mulligan and Sala-i Martin (1999b); Galasso and Profeta (2002); Walque (2005).

3.1 The Pension System as the Outcome of Majority Voting in a Direct Democracy

Samuelson (1958) and Aaron (1966) were among the first to explain why a voting majority would favor a PAYG pension system. Both maintained that overall welfare would be improved by a PAYG saving device in a dynamically inefficient economy where the rate of interest r is smaller than the population growth rate n. In such a situation the internal rate of return i of a PAYG is higher than the real return from capital accumulation. Since the internal rate of return from a PAYG scheme, where a fraction of every worker's income is transferred to pay pensions for the current retirees, is dependent on the product of the (working) population growth rate n (famously dubbed by Samuelson as "biological rate of interest") and the growth rate of wages ω, the following condition must hold:

$$1 + i = (1 + n)(1 + \omega) > 1 + r \tag{3.1}$$

As Aaron and Samuelson have shown, in such a situation *everyone* would be better off by contributing a given amount to such a scheme rather than to invest it in assets. As a result, the introduction of a PAYG scheme is a unanimous and undisputed decision by all voters. The notion of "dynamic inefficiency" has been criticized on theoretical and empirical grounds, however. Blackburn (1967) has pointed at its limited applicability once capital is properly considered, while Homburg (1991) shows the existence of an unproductive asset like land would also rule it out. On the empirical side, Abel et al. (1989) found that the U.S. and major OECD countries are dynamically efficient. Therefore, the assumption of dynamic inefficiency is usually disregarded, which of course implies that the political rationale behind pension systems cannot be based on a natural consensual view among all voters.

At this point, it is useful to introduce a common theoretical approach that helps structuring our analysis. Since political dynamics will get slightly more complicated once we allow for conflicting preferences between different generations, we need now a more rigorous framework. A useful way to model individual life-cycle behavior is by employing a so-called *overlapping generations model* (OLG). These type of models are dynamic general equilibrium frameworks, which have been popularized by Allais (1947); Samuelson (1958) and Diamond (1965). The idea is that in every

period t, there are three[4] generations alive: young workers, old workers and pensioners. For simplicity, childhood and time of education in young adulthood are left out. In the second period, $t+1$, the young workers will have become the old workers, the old workers of the period t will now be pensioners, while the pensioners of the previous period are no longer alive. In addition, a new generation of young workers will have been born. Then the next period starts and so on with an infinite horizon. Table 3.1 succinctly summarizes the basic logic. While clearly a strong simplification, reducing the number of cohorts alive at every point in time to three makes the analysis tractable and still offers rich insights.

Table 3.1: The basic structure of an OLG model

t	$t+1$	$t+2$
young workers $\Longrightarrow$	old workers $\Longrightarrow$	pensioners
old workers $\Longrightarrow$	pensioners $\Longrightarrow$	death
pensioners $\Longrightarrow$	death	
	young workers $\Longrightarrow$	old workers
		young workers

Note: OLG model with three generations.

3.1.1 Voting on Pensions as a One-Shot Game

This OLG framework can also be applied to the seminal contribution of Browning (1975), who analyzes majority voting on social security.[5] Browning in fact did not fully formalize his model. He starts out with a numerical

[4] The number of generations is a modeling decision. Later on we will encounter OLG models with only two (pensioners and workers) generations alive at each point in time. The literature also offers models with more than three generations, others like Boadway and Wildasin (1989) use a continuous-time approach.

[5] *Social security*, which is an American term, and *pension system* are used interchangeably throughout and denote, if not stated explicitly otherwise, a public, mandatory PAYG scheme.

example and then proceeds with a graphical exposition of the underlying model. Still, analyzing it from an OLG angle makes it more lucid and at the same time serves as a useful illustration that introduces the necessary notation for the subsequent discussions. This is the reason why I will take a little bit of time here to introduce it and analyze its implications. Furthermore, in contrast to Browning, I will introduce an imperfect capital market, which makes the model richer without changing the substantive results or complicating the analysis too much.[6]

Browning's aim was to show how majority voting leads to a PAYG system that is too large in a democracy. The economic environment in his model is rather sparse. Factor prices and labor supply are exogenous, and there are no capital markets. The latter assumption will be amended here without changing the conclusions, if we allow for imperfect capital markets that permit private saving but no borrowing. Further important assumptions are that voters perceive their decision to be binding for all future generations, i.e. it is a one-shot vote. Moreover, voters are not altruistic towards other generations and people of the same age group are homogenous, thus having the same preferences.

In every period t there are N_t^i individuals, where the superscript $i \in \{y,o,r\}$ denotes the generation of *young workers*, *old workers* or *retirees* respectively. Every generation N^i and the population as a whole grow with a constant rate n:

$$N_t^y = (1+n) \cdot N_{t-1}^y \tag{3.2}$$

All individuals share the same utility function, which is additive separable, strictly monotone, strictly concave and twice differentiable:

$$U_t = u[c_t^y] + u[c_{t+1}^o] + u[c_{t+2}^r] \tag{3.3}$$

Hence, utility in every period of life is only dependent on the level of personal consumption c. For simplicity, I abstract from a time preference rate at this point. Note also that I will not use the superscripts if it is sufficiently clear which generation we are talking about. Consumption during working age and after retirement is determined by

$$c_t^y = w \cdot (1-\tau_t) - s_t \tag{3.4}$$

$$c_{t+1}^o = w \cdot (1-\tau_{t+1}) - s_{t+1} \tag{3.5}$$

$$c_{t+2}^r = x_{t+2} + (1+r)^2 \cdot s_t + (1+r) \cdot s_{t+1} \tag{3.6}$$

[6] In essence, this means adding some of the elements of the approach by Boadway and Wildasin (1989) to Browning's model.

here w denotes the (exogenous and constant) wage rate, τ is the contribution rate to the public pension system, while s stands for the saving rate and x for the pension received in old-age. Hence, working-age individuals divide their income between consumption and saving, whereas the proceeds from workers' contributions will be transferred as a lump-sum to the current old. Note that savings can only be used for consumption after retirement, it therefore cannot be negative. Pensioners, on the other hand, derive their retirement consumption from the public pension x and the accumulated savings which earn an interest rate r.

The budget constraint of the public PAYG system is satisfied if

$$N_t^r \cdot x_t = N_t^y \cdot w \cdot \tau_t + N_t^o \cdot w \cdot \tau_t \tag{3.7}$$

which, bearing in mind (3.2), simplifies to

$$x_t = (1+n)^2 \cdot w \cdot \tau_t + (1+n) \cdot w \cdot \tau_t \tag{3.8}$$

Looking at the budget constraint and dividing both sides by w_t, it becomes immediately clear what drives relative pension levels[7] in a PAYG system: the growth of the working age population and the contribution rate. If the working population shrinks, contributions either have to rise or the pension level has to fall.[8]

Now a once-and-for-all decision is being taken through majority voting by all currently living generations, determining whether a PAYG scheme is introduced and of what size it should be. Given that population growth is assumed to be exogenous, the only choice variable of the voters is τ. Therefore, given the perception of irreversibility, everybody expects that $\tau_t = \tau_{t+1} = \tau_{t+2}...$ and so on indefinitely. The result of the vote depends on the preferences of the three generations and their relative sizes.

To derive the preferences of the young workers, we have to insert the constraints (3.4) - (3.6) and (3.8) into the utility function (3.3) yielding

$$\begin{aligned} U^y = {} & u_t[w \cdot (1-\tau_t) - s_t] + u_{t+1}[w \cdot (1-\tau_{t+1}) - s_{t+1}] \\ & + u_{t+2}[w \cdot \tau_t \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_t + (1+r) \cdot s_{t+1}] \end{aligned} \tag{3.9}$$

[7] The relative pension level is defined as $\frac{x_t}{w_t} = (1+n)^2 \cdot \tau_t + (1+n) \cdot \tau_t$.

[8] The statement that rising wages would increase the pension level, an argument sometimes made by politicians concerned about workers' salaries and pensions, is therefore flat out wrong. It is based on a confusion between the pension level and a system's internal rate of return.

Since the young would have to pay contributions over two periods before eventually receiving a pension, they are internalizing the full costs and benefits of a PAYG system. Hence, their choice of τ could be considered as socially 'optimal' from an intertemporal welfare perspective. In addition, the young also choose their optimal amount of private saving and thus their consumption in both working periods. A young worker's optimal contribution rate can thus be found by maximizing (3.9) with respect to τ, s_t, s_{t+1} given that we assumed $\tau, s_t, s_{t+1} \geq 0$. The resulting first-order conditions can be solved for the optimal saving and contribution rates. Rearranging and simplifying[9] yields the following inequality that has to be satisfied, if the young are to prefer a positive contribution rate

$$(1+n)^2 + (1+n) \geq (1+r)^2 + (1+r) \tag{3.10}$$

In other words, young workers would only support the introduction of a PAYG scheme, if the population growth rate exceeds the interest rate in which case the economy would be dynamically inefficient.[10] In such a situation, saving for old-age via a PAYG system is more profitable than private savings. Otherwise, $r > n$ and the preferred contribution rate by this group is $\tau = 0$. Hence, young workers vote against the introduction of a PAYG system.

Let's turn to the currently retired next before analyzing the preferences of old workers. Pensioners' saving decisions lie in the past and cannot be changed anymore, thus their utility for the first two periods is given. The relevant utility function is reduced to the retirement period:

$$U^r = u_t[w \cdot \tau_t \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_{t-2} + (1+r) \cdot s_{t-1}] \tag{3.11}$$

The only choice variable of the old is the contribution rate, which directly affects the pension they receive, but which of course cannot affect past periods' incomes. Given (3.11), we see that utility is strictly increasing in τ. The higher the contribution rate, the higher the pensions and therefore the higher is consumption for the retired. Therefore, pensioners would like the contribution rate to be as high as possible. In the extreme, given that labor supply is exogenous and thus inelastic in this model, they would prefer

[9] The first-order conditions and the derivation of solutions can be found in appendix A.1.

[10] This condition is of course identical with (3.1), except that we assumed no wage growth here.

$\tau = 1$, i.e. they would vote to transfer the complete income of young and old workers to themselves. The introduction of a PAYG scheme therefore represents a huge free lunch for this generation that has to be borne by subsequent generations.[11]

Finally we have to deduce the preferences of the old workers. At the time of the vote t, the first period utility has already been determined by their decision on s_{t-1}. Therefore, their utility over only two periods needs to be considered:

$$U^o = u_t[w \cdot (1-\tau_t) - s_t] + \\ u_{t+1}[w \cdot \tau_t \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_{t-1} + (1+r) \cdot s_t] \tag{3.12}$$

Old workers thus compare the relative utility from saving another period for retirement via private investments in capital markets with the establishment of a PAYG pension plan. Maximizing (3.12) with respect to τ and s_t yields the two first-order conditions. Substituting these into each other and simplifying gives us the condition under which an old worker would favor a positive contribution rate and thus the introduction of a PAYG scheme:

$$(1+n)^2 + (1+n) \geq (1+r) \tag{3.13}$$

This is a fairly weak condition which is easily satisfied. Even with no population growth at all (0 per cent per period), an interest rate of 100 per cent would not be enough to make an old worker strictly favor private saving over a PAYG system. The reasons for this strong preference are straightforward. First of all, savings of the previous period are a sunk cost and thus do not affect the current decision. Second, and most importantly, old workers only need to contribute one period to the PAYG pension system. Yet they will receive full benefits regardless, as if they had contributed their whole working life. This is a windfall that cannot be matched by returns on private savings under any reasonable assumptions. Of course, their windfall is smaller than the one received by the current retired but unlike the young workers, they still do not need to internalize the full costs of the system. In other words, the closer a worker is to retirement, the more profitable the introduction of a public pension system becomes. As a result, both old workers and retirees vote in favor of a PAYG scheme. Note,

[11] This free lunch of the initial generation is a major obstacle to changing an existing pension system and is key in understanding the redistributional nature of any pension reform (see chapter 4).

however, that the preferred τ of old workers is still smaller than the 100 per cent demanded by the retirees. While a higher τ increases pensions, it also reduces current income and thus consumption.

Given that the utility function is assumed to be strictly monotone and concave, preferences for τ are single-peaked between 0 and 100 per cent. Old workers would vote for a contribution rate at which the marginal utility gain of a pension increase is exactly offset by the marginal utility loss in current consumption. This contribution rate is determined by $\frac{\partial U^o}{\partial \tau} = 0$ (see A.19 in the Appendix), which after some rearranging reduces to the following condition:

$$\frac{u_t'[w \cdot (1-\tau_t^o) - s_t]}{u_{t+1}'[w \cdot \tau_t^o \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_{t-1} + (1+r) \cdot s_t]} = (1+n)^2 + (1+n) \qquad (3.14)$$

The left-hand side of the equation represents intertemporal consumption preferences between the current and the retirement period, where $u_t'[.]$ in the numerator denotes the negative impact of τ on utility derived from the working period, while $u_{t+1}'[.]$ in the denominator highlights the positive effect on the pension period's utility. We know from (3.1) that the population growth rates on the right-hand side determine the internal rate of return of a PAYG system. Therefore, an old worker's preferred τ^o is chosen to equalize the marginal rate of substitution with the pension system's rate of return.

In a similar way, we can use $\frac{\partial U^y}{\partial \tau} = 0$ to derive the condition for a young worker's favored τ^y:

$$\frac{u_t'[w \cdot (1-\tau_t^y) - s_t] + u_{t+1}'[w \cdot (1-\tau_t^y) - s_{t+1}]}{u_{t+2}'[w \cdot \tau_t^y \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_t + (1+r) \cdot s_{t+1}]} = (1+n)^2 + (1+n) \qquad (3.15)$$

which again equalizes the marginal rate of substitution with the pension systems' rate of return. However, τ affects utility now in both working periods. Comparing (3.14) and (3.15) therefore shows that young workers prefer a smaller τ than old workers, since for them the internal rate of return of the pension system is much smaller due to the longer time of contribution. Consequently, if we assume $s_t = s_{t+1}$, the numerator in (3.15) becomes twice as large as in (3.14), thus reflecting a greater relative dis-utility from τ during working life.

In sum, the preference ordering of the three generations is therefore

$$\tau^r = 1 > \tau^o > \tau^y \qquad (3.16)$$

Now the question arises, which generation will be politically successful in implementing its preferred size of the pension system. Since the Browning-model presumes a direct majority vote, the outcome depends on the relative sizes of the three groups and the identity of the median voter.[12]

If the retired are at least 50 per cent of the population, i.e. $N_t^r > \frac{N_t^y + N_t^o + N_t^r}{2}$, they will put in place a scheme which transfers the complete income of the working population to the pensioners. To be in a majority population growth must be negative. Calculating the precise growth rate for $N^r > 0.5$ yields

$$\begin{aligned} N^r &> (1+n) \cdot N^o + (1+n)^2 \cdot N^y \\ n &< -0.382 \end{aligned} \tag{3.17}$$

Hence, the population must shrink by more than -38.2 % per period. This may seem a lot at the first glance, but bear in mind that a period spans a whole generation in a OLG model. If we presume that a generation comprises around 25 years, then this would imply an annual population growth of -1.5 %, which in principle is not that far off. If the young hold a majority, then they will either reject the introduction of a PAYG system or, if the economy is dynamically inefficient, they will vote for a smaller system, i.e. a smaller contribution rate, than preferred by the old workers. Rearranging (3.17) to $N^y > \frac{N^r + N^o \cdot (1+n)}{(1+n)^2}$ gives us the necessary population growth rate of 68.1% per period or 2.5 % per year.

Looking at the actual data of industrialized countries since WWII, we find that population growth falls squarely between these two polar values. So far, growth has not gone below an annual rate of -1% nor exceeded $+1.5$% except for Israel and Canada which have witnessed a higher rate in some years due to a massive influx of immigrants. Hence, neither of these two cases seem empirically relevant. Therefore, it must be the case that either old workers have an absolute majority or, empirically most relevant, no generation alone is sufficient to reach a majority. Even if old workers do not make up 50% of the population, their position between the young and the retired ensures that their policy preference will be implemented. Given that the issue at stake is uni-dimensional and preferences are single-peaked, they thus represent the median voter whose vote is decisive. A

[12] The median voter in a one-dimensional issue space, $\tau \in [0,1]$, with single-peaked preferences is the median of the voter distribution. His vote is decisive as he garners a majority against all other alternatives (see the seminal work by Black (1958)).

PAYG system will therefore be introduced with τ being higher than 0 and higher than preferred by young workers, but smaller than 1.[13]

The decisive variable in this analysis, the population growth rate, therefore affects the preferred contribution rate. In an aging society n goes down and exerts two countervailing effects on τ. First, an income effect puts upward pressure on the contribution rate because a shrinking working age population reduces pensions and thus retirement consumption, making an off-setting increase in contributions necessary. Second, there is a substitution effect that reduces the contribution rate, for with smaller population growth the internal rate of return of the pension system becomes smaller (see 3.1), thus raising the utility of private saving and current consumption.

This analysis, although it was less formalized in the original paper, led Browning (1975) to conclude that under reasonable population growth assumptions, majority voting will lead to: first, the introduction of a mandatory public pension system; and, second, *"an overexpansion in the size of a social insurance system because of the short run effects of a change in the tax rate, which are concentrated increasingly on those who are older when a change is made"* (Browning (1975): 387). He reckons that the optimal size of such a system corresponds to the size preferred by young workers, for only they internalize all costs and benefits and thus prefer a contribution rate that maximizes overall life-time utility.

Note that there is a kind of time-inconsistency problem lurking: workers when young clearly oppose the introduction of a PAYG pension scheme if the economy is dynamically efficient, or favor a smaller size than all other generations. Postponing the vote for one period, if possible, would not help though. The current young would change their mind once they have become old workers themselves, since they then only consider the one period contribution period and the corresponding higher rate of return to a PAYG system.

The crucial assumption underlying this result is voters' perception that their decision is forever binding and cannot be revoked by future generations. If, in contrast, there was a vote in every period, a PAYG scheme would not be established. The reason is that no worker contributing to the system could be certain to receive a pension upon reaching retirement, since a new vote could undo the former decision. Also, the decision on the contribution rate in period t has no bearing on future periods' utility because contributions may change after every vote. Thus the utility func-

[13] In other words, τ^o is the Condorcet winner.

tions of young and old workers at the time of the vote are reduced to

$$U_t^y = u_t[w \cdot (1 - \tau_t) - s_t] \tag{3.18}$$

$$U_t^o = u_t[w \cdot (1 - \tau_t) - s_t] \tag{3.19}$$

For both groups of workers, deciding on τ can only affect the current period's utility, which is decreasing in τ. Hence, all workers prefer a contribution rate of zero and consequently oppose the introduction of a public pension system. If, on the other hand, the decision is believed to be permanent but there is a new 'surprise-vote', then the original logic of the model would still hold. Again old workers would be pivotal and the PAYG system would remain in place at their preferred size.

The illusion that pension policy is decided by a forever binding, once-and-for-all vote is the greatest weakness of the Browning model. It is hard to empirically justify this modeling choice, for in democracies every decision can be undone by a new vote. Additional criticism has been leveled against the assumptions of a direct democracy framework and the fact that, in principle, there is no sensible limit regarding the contribution rate. If the retired had a majority they would implement a tax rate of 1. Mitigating effects such as the contribution rate's adverse impact on labor supply and thus on benefit levels (e.g. Breyer (1994b)) are not considered.[14] Despite these drawbacks Browning's approach nevertheless represents a break-through, as it was the first systematic attempt to model the introduction of a public pension system as a genuine political process. It also succeeds in giving an account of why a PAYG scheme could be introduced even though the immediate beneficiaries (i.e. pensioners) are in a minority, and why such a system could be larger than is socially optimal.

However, even a casual look at pension politics in Western democracies reveals that it is not a one-shot game. Changes are being proposed and voted on quite frequently. Therefore, assuming that voters think their decision would be final and binding presupposes an unreasonable amount of myopia on their part. But as we saw above, dropping this assumption immediately leads to the conclusion that neither the young nor the old workers would be in favor of introducing a PAYG scheme, let alone maintaining it. It seems indeed a major puzzle why any democratic society would introduce a transfer scheme, the costs of which are fully front-loaded for the

[14] Note that the original model formulation by Browning received further criticism for not allowing alternative private saving devices. However, as the preceding modeling has shown, introducing (albeit imperfect) capital markets does not change the conclusions.

working majority and whose benefits materialize in the future only under the condition that subsequent generations actually honor the commitments imposed on them. It follows that there must be additional factors sustaining a public pension system.

3.1.2 *Pension Politics as a Repeated Voting Game*

Discarding the possibility of altruism towards the elderly for the moment, the question arises whether there exists a mechanism that induces self-interested individuals to introduce and maintain a pension system, even if the vote is repeated every period. Two closely related solutions have been proposed in the literature that offer a simple explanation. Both solutions are based on an idea by Hammond (1975), who was the first to suggest that there might be a social contract between generations. The young promise to transfer income to pensioners and can expect in turn to be similarly treated when they retire. This contract is enforced either by a punishment mechanism or solely by reputation. The former approach has been first formalized by Sjoblom (1985), more recent modeling in this vein has been done by Bellettini and Ceroni (1999); Boldrin and Rustichini (2000) and Azariadis and Galasso (2002). On the other hand, reputation as a mechanism to uphold the social contract has been modeled by Cooley and Soares (1999). All these models have in common that they employ an extensive, perfect information game to formalize the social contract. From this analysis, a PAYG pension system emerges as a *subgame perfect equilibrium*[15], which is maintained by successive generations.

This idea is fairly simple. The number of generations simultaneously alive can be reduced to two: workers and pensioners. The basic set-up remains the same as above. Life-time utility for every individual is given by

$$U = u_t[w \cdot (1-\tau_t) - s_t] + u_{t+1}[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t] \tag{3.20}$$

[15] A subgame perfect equilibrium, which was first developed by Selten (1975), is a profile of strategies that generates a Nash equilibrium in every subgame. A more formal definition is provided in Appendix C. See Osborne (2004); McCarty and Meirowitz (2007) for introductions and applications.

The difference to the Browning model is that $\tau_t \neq \tau_{t+1}$ because their will be a vote in every period. Hence, every agent[16], in calculating her optimal decisions, has to form expectations about the outcome of next period's vote. This can be modeled by defining a best-response function which relates a current decision to decisions made by earlier generations in the past. Remember that we do not longer distinguish between old and young workers. Under any reasonable population growth assumption, it is safe to say that the workers are in a majority. Thus, their vote is decisive and the representative agent of this generation could also be conceptualized as a dictator.

At time t, a worker decides about her preferred contribution rate, $\tau_t^y \in [0,1]$ depending on past sequence of τ until $t-1$. This sequence is given by the history h_t:

$$h_t = (\tau_1, \tau_2 ... \tau_{t-1}) \in [0,1] \tag{3.21}$$

The best response function of the young generation σ_t^y, i.e. its strategy, is then a mapping from h_t into the space of possible contribution rates:

$$\sigma_t^y : h_t \rightarrow [0,1] \tag{3.22}$$

This allows to implement a trigger mechanism that punishes or rewards past workers for their behavior and thus allows current workers to form a belief about the behavior of the next generation. Let us define τ^* as a positive contribution rate and thus as the existence of a public pension scheme of a particular size. The strategy profile $(\sigma_t^{y*}, \sigma_t^{r*})_{t=0}^{\infty}$ that constitutes a subgame perfect equilibrium can be defined by

$$\sigma_t^{y*} = \begin{cases} \tau^* & if \quad \tau_{t-1} \geq \tau_{t-1}^* \\ 0 & otherwise \end{cases} \tag{3.23}$$

The strategy mandates that workers at time t reward current retirees with a pension level corresponding to τ^*, if the old in turn had provided a pension at $t-1$ to their parent generation. If current retirees did not pay a pension while they were young, then workers at time t will also set $\tau_t = 0$. In other words, the PAYG system will break down. This is a grim trigger type of strategy. Once one generation deviates and does not provide a pensions to their old, all subsequent generations will do the same according to this rule. Note that if we assume the following preference ordering

[16] Again all agents of the same generation are homogenous and share the same preferences. Thus, we can talk as if there was a representative agent in every generation.

$$u[\tau_t = 0, \tau_{t+1} = \tau^*] > u[\tau_t = \tau^*, \tau_{t+1} = \tau^*] > u[\tau_t = 0, \tau_{t+1} = 0]$$
$$> u[\tau_t = \tau^*, \tau_{t+1} = 0] \tag{3.24}$$

then this strategy will lead every generation to maintain the public pension scheme, for the best every generation can achieve is $u(\tau_t = \tau^*, \tau_{t+1} = \tau^*]$. An attempt of a worker generation to shirk their contributions will inevitably lead to $u[\tau_t = 0, \tau_{t+1} = 0]$, since the next generation of workers has no incentive to reinstate the system again. Thus, it is established that $(\sigma_t^{y*}, \sigma_t^{r*})_{t=0}^{\infty}$ indeed constitutes a subgame perfect equilibrium.

This reputation mechanism, which is in a similar vein as in Cooley and Soares (1999) has the unfortunate implication that once a generation deviates, the "nuclear" option goes into force and the payment of pensions is not chosen by subsequent generations, precluding the re-introduction of the system. Therefore, it does not represent a renegotiation proof equilibrium. A more elegant trigger strategy would only punish the defector generation. In other words, the worker at time t should be able to distinguish whether the workers at $t-1$ have shirked their obligation or simply punished the workers of $t-2$ for not fulfilling their pension promise.

Given a sequence h, this distinction can be formalized by defining

$$n[\tau(t)] \equiv t - max[T \in \{1, 2, ..., t-1\} : \tau_T \geq \tau^*] \tag{3.25}$$

where $n[\tau(t)]$ is a counter T that indicates the number of periods that have passed since the last pension of at least τ^* has been paid by a generation of workers. Therefore, the corresponding subgame perfect equilibrium strategy changes to

$$\sigma_t^{y*} = \begin{cases} \tau^* & if \quad n[\tau(t-1)] \text{ is even} \\ 0 & if \quad n[\tau(t-1)] \text{ is uneven} \end{cases} \tag{3.26}$$

If the previous generation of workers have honored their commitments, that is $\tau_{t-1} \geq \tau^*$, then $n[\tau(t)] = 0$. If they have not done so, however, but the previous workers of $t-2$ have made the contributions of at least τ^*, then $n[\tau(t)] = 1$ and worker generation t should punish them by not paying any pensions. Finally, if $n[\tau(t)] = 2$, then workers at $t-1$ have not contributed τ^*, but neither have workers of generation $t-2$. Hence, workers at $t-1$ have acted according to (3.26) and punished their parents for not paying a pension to their parents. As a result, generation t should contribute the full

amount of τ^*. This logic can be extended to any number of prior periods to ascertain whether punishment or reward is justified.[17]

Note that in the case of $n[\tau(t)] = 1$, it is in the perfect interest of workers at t to carry out the punishment. No additional outside enforcement or incentive is needed. The reason is that even if generation t sets $\tau = 0$, they can still expect from the next generation of workers to receive a pension at $t+1$, for they have abided by the rule and punished the defectors. This earns them the best possible utility of $u[\tau_t = 0, \tau_{t+1} = \tau^*]$. In contrast, not punishing worker generation $t-1$ would result only in $u[\tau_t = \tau^*, \tau_{t+1} = \tau^*]$, for they have transferred τ^* unnecessarily. Therefore, with this best response function in place, no worker generation has an incentive to deviate, making (3.26) a subgame perfect equilibrium.

While this approach represents a very interesting application of an extensive form game, it is also somewhat unsatisfactory. For one, it allows for multiple equilibria because it makes no prediction about the precise size of τ^*. Indeed, many contribution rates could be sustained as an equilibrium. Second, an infinite number of trigger mechanisms could be envisioned[18]. It is therefore not clear what the "true" best response function could look like. Finally, some empirical experiments have been conducted to test these ideas (see van der Heijden et al. (1998)). The results hardly provide any evidence for rewards and punishments. The authors point out that there seems "*almost no (cor)relation between the transfers of present and past generations*" (van der Heijden et al. (1998): 1383) and that other factors must also be at work. As the next subsection shows, majority voting combined with altruism or intra-generational heterogeneity could potentially offer a more forceful explanation of why public pension systems are politically sustained.

[17] For example, $n[\tau(t)] = 4$ suggests that workers should honor their pension commitment because workers at $t-1$ have punished generation $t-2$ who should have paid pension to $t-3$ who punished $t-4$ for not contributing τ^* to $t-5$ which actually paid pensions to $t-6$.

[18] Following Sjoblom (1985), for instance, one could propose a response function of the type:

$$\sigma_t^{y*} = \begin{cases} \tau^* & \text{if} \quad n[\tau(t-1)] \text{ is even} \\ \tau^*/2 & \text{if} \quad n[\tau(t-1)] \text{ is uneven} \end{cases}$$

3.1.3 *Repeated Voting with Altruism and Intra-generational Inequality*

That altruism may affect the feasibility of inter-generational transfers of resources has been first suggested by Barro (1974), who maintained that altruistic relationships between current and subsequent generations (i.e. altruism running from the old to the young) would neutralize the wealth effects of government debt. With respect to public pensions, this would imply that a public PAYG system does not constitute a burden that reduces aggregate saving as claimed by Feldstein (1974), because it is completely analogous to government debt. From this perspective, of course, introducing a public pension system makes no sense whatsoever. This conclusion changes, however, if we assume that altruism runs from the young (i.e. the workers) to the retired. If this was the case, repeated voting could lead to a politically sustainable PAYG scheme.

This idea was first suggested by Veall (1986) and later extended by Hansson and Stuart (1989). The latter showed that a PAYG system could arise as an equilibrium even under unanimity rule. We can use once more a simplified two-period OLG model to formalize the idea of altruism. Staying within the confines of Veall's approach, however, we now employ a specific functional form of a representative individual's lifetime utility and introduce explicit time preferences:

$$U_t = \alpha \cdot \log(c_t^y) + \beta \cdot \log(c_t^r) + \rho \cdot \log(c_{t+1}^r) \tag{3.27}$$

where α, β and ρ are discount factors. Altruistic feelings towards the elderly are expressed by the second term $log(c_t^r)$, which underlines that consumption of the retired enters positively into a worker's utility function. This can be very simply justified by the fact that the young do not like their parent generation to be poor and suffering. A ceteris paribus increase in the old's consumption therefore also raises the well being of the young. The *log* indicates the logarithmic form of the utility function, which has the convenient technical property that income and substitution effects cancel each other out. The representative individual's and the pension system's budget constraints are the same as implied in (3.20):

$$c_t^y = w \cdot (1 - \tau_t) - s_t \tag{3.28}$$

$$c_{t+1}^r = x_{t+1} + (1+r) \cdot s_t \tag{3.29}$$

$$c_t^r = x_t + (1+r) \cdot s_{t-1} \tag{3.30}$$

$$x_{t,\,t+1}^r = (1+n) \cdot \tau_{t,\,t+1} \cdot w \tag{3.31}$$

Inserting these constraints into the utility function (3.27) gives the full optimization problem, which unlike the problems above, implies not only an intertemporal trade-off between current and old-age consumption but also between a worker's own consumption and those of the retirees:

$$\begin{aligned} U_t = {} & \alpha \cdot \log(w \cdot (1 - \tau_t) - s_t) + \beta \cdot \log((1+n) \cdot \tau_t \cdot w + (1+r) \cdot s_{t-1}) + \\ & \rho \cdot \log((1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t) \end{aligned} \tag{3.32}$$

Key here are the relative sizes of the three discount factors. In the extreme, i.e. if β approaches 1 and α as well as ρ approach 0, a worker is willing to forego almost all of her current consumption in favor of the retired. Of course, such an extreme form of altruism does not seem to be a sensible assumption. Workers probably are not ready to starve themselves to death to increase consumption of the old. One of the few existing empirical studies that tried to estimate the role of altruism has been conducted by van der Heijden et al. (1997). They held a survey among a representative sample of the Dutch population and found that, first, altruism from workers to pensioners is stronger than vice versa; and second, the point estimates suggested that workers' elasticity of altruism is about 0.2 of the elasticity of their income (van der Heijden et al. (1997): 516). Hence, it is empirically reasonable to follow Veall (1986) in modestly assuming that 'charity-begins-at-home' so that

$$\alpha > \frac{\rho}{(1+r)} > \beta \tag{3.33}$$

where the first inequality represents a worker's time preference for consumption and the second inequality indicates that at the same per capita income level of workers and pensioners, an additional unit of income by a worker will yield a higher utility if it is saved rather than given to the retirees.

To understand why and under what conditions a PAYG pension system could be politically sustainable, we need to maximize equation (3.32) with

respect to the two choice variables s_t and τ_t.[19] Given that there are once again non-negativity constraints for s and τ, we have to use the Kuhn-Tucker theorem in establishing the first-order conditions.[20] For a pension system to come into existence (i.e. $\tau > 0$), it must hold that $\frac{\partial U_t}{\partial \tau_t} = 0$. Setting for simplicity $s_t > 0$ so that $\frac{\partial U_t}{\partial s_t} = 0$, we can solve for the equilibrium contribution rate $\tau_t^\star$ using the two first order conditions, which yields

$$\tau_t^\star = \frac{(1+n)(1+r)\cdot w\cdot \beta + (1+n)^2\cdot \beta \cdot w\cdot \tau_{t+1} - (1+r)^2(\alpha+\rho)\cdot s_{t-1}}{(1+n)(1+r)(\alpha+\beta+\rho)\cdot w} \quad (3.34)$$

Assuming steady-state values for population growth and the interest rate, this somewhat convoluted expression reveals that the optimal contribution rate and thus the optimal size of the public pension system increases with a worker's income and falls with the saving rate of the parent generation. In other words, the more the previous generation has saved for old-age, the less are current workers inclined to contribute to the consumption of these retirees.

The question of course is, whether a pension system constitutes a subgame perfect equilibrium given repeated voting in every period, and given that there is no explicit punishment mechanism as in the previous model. Would it still be beneficial to a generation of workers at time t to have a positive contribution rate, even if the next generation at $t+1$ might not pay them any pensions at all? The answer can be found by setting $\tau_{t+1} = 0$ in equation (3.34). Simplifying and rearranging results in the condition for which a positive contribution rate is beneficial, even if $\tau_{t+1} = 0$:

$$\frac{\beta}{(\alpha+\rho)}\cdot(1+n)\cdot w > (1+r)\cdot s_{t-1} \quad (3.35)$$

In plain words, if this inequality is fulfilled, workers will vote for introducing or maintaining a pension scheme even if they expect to receive no pension themselves in the next period. This is all the more likely, the higher working income w, the greater the altruism towards the elderly (expressed as the ratio $\frac{\beta}{(\alpha+\rho)}$), the greater the relative number of workers $(1+n)$, and finally, the fewer savings the old have accumulated during their working

[19] Since I only care about pension system here, I will refrain from deriving the optimal saving rate.

[20] FOCs and explicit derivation of the following solutions can be found in appendix A.2.

lives. As a result, altruism can lead to the introduction of a public pension system even if there is a possibility that the next generation might abolish it again.

Note that two Nash equilibria are possible. One where no pension scheme exists and all generations save for their own retirement, and another one with a positive pension level. In order to determine which is more plausible in the long run and thus subgame perfect, we should take another look at (3.35). It implies that a generation can elicit higher pension transfers during their retirement by reducing their own savings. Therefore, it might be rational to 'undersave' in order to receive a higher pension. If no pension scheme exist at time t, workers could exploit this opportunity by reducing their saving to force the next (altruistically inclined) generation to introduce a pension scheme, from which generation t benefits without having contributed a pension to their parent generation. As shown above, this system is stable even it will be subject to a vote in subsequent periods. As a result, workers at time t act as Stackelberg[21]-leaders. The pension system thus constitutes a subgame perfect equilibrium. In the extreme, this Stackelberg behavior drives down savings to zero, since this would elicit the highest pension transfer because for $s_{t-1} = 0$,

$$\tau_t^\star = \frac{(1+n)(1+r)\cdot w\cdot \beta + (1+n)^2\cdot \beta \cdot w\cdot \tau_{t+1}}{(1+n)(1+r)(\alpha+\beta+\rho)\cdot w} \tag{3.36}$$

which is higher than for $s_{t-1} > 0$ in (3.35). The extent of this undersaving of course would be contained if the interest rate is sufficiently large compared to the population growth rate, for these two determine the relative attractiveness of saving and PAYG transfers. Similarly, the PAYG equilibrium is stable unless r changes dramatically relative to n.

In sum, introducing altruism may help explain the introduction and political sustainability of public pension systems even under repeated voting. Moreover, it also offers an explanation of why pension systems that started out fully funded have often been converted into PAYG schemes[22] and why the latter are more common than the former. Often triggered by an external shock such as a war or hyperinflation which reduced savings,

[21] The term 'Stackelberg' derives from the well known model of duopoly competition in which the first-mover has an advantage that ensures a higher payoff for him (see Osborne (2004)).

[22] Notable examples are the American social security and the German social insurance systems. Both were initially devised as prefunded schemes but have gradually been transformed into PAYG.

one generation acted as the above mentioned Stackelberg-leader and thus induced the transformation of a system of private savings into a PAYG arrangement. As also Veall (1986) concluded, a prefunded pension system is therefore much more vulnerable than a PAYG scheme because there is always the temptation for a generation to shirk their contributions by not saving themselves and thus running down the capital stock to pay for current pensioners, and to rely on PAYG transfers when retiring themselves.

While this is quite an elegant game-theoretic model with some sharp predictions, there are also some severe problems with this approach. First of all, altruism is probably strongest towards one's own parents, hence intra-family transfers would be a more natural solution than a public system that benefits all retirees. Veall (1986) and Hansson and Stuart (1989) try to solve this problem by arguing that introduction of a social security system improves intertemporal allocation and therefore economic efficiency by preventing the saving rate from going all the way down to zero, yet then we are back at the politically uninteresting presumption that two generations simply agree on a Pareto-optimal system. Second, an explanation that rests heavily on altruism would run into empirical difficulties once applied to the analysis of cross-country differences. While altruism is most likely an important factor, it should be safe to assume the altruism factor β to be constant across countries. Otherwise, one runs into complicated cultural and psychological reasonings that are impossible to falsify empirically and probably are also erroneous.[23] So maybe there is another, more straightforward factor at work that has the advantage of offering sufficient and easily detectable variation and does not boil down to a constant.

As it turns out, income inequality could be this missing link. Almost every existing PAYG pension system not only transfers resources from the young to the retired but also introduces some degree of intra-generational redistribution. This second dimension might explain why we find plenty of support for such a system even among the young. The redistribution stems from the fact that contributions and benefits are usually not perfectly proportional. In the extreme case of a total Beveridgean[24] system, contributions are progressively increasing with wages, while benefits are lump-sum. The amount of redistribution in the U.S. social security system

[23] Are for example the British less altruistic than, say, the Japanese?

[24] Named after William Henry Beveridge, the British social reformer whose 'Beveridge Report' in 1942 formed the basis for the British as well as, later on, the Scandinavian welfare states. The guiding principles of this kind of welfare state are universal access and egalitarian redistribution (for an overview see Esping-Andersen (1990)).

for instance, which is considered to be of a Beveridgean bent, has been found to be quite substantial (for estimations of the degree of redistribution see Boskin et al. (1987); Cubeddu (2000); Galasso (2001)). Empirical studies have found redistributional elements even in the case of the German system (see Börsch-Supan and Reil-Held (2001)), which is of a Bismarckian type where benefits reflect contributions much more closely.

The impact of income inequality on intra-generational redistribution has been first formally analyzed by Romer (1975); Roberts (1977); Meltzer and Richard (1981, 1983). Their prediction was that in a context of majority voting, redistribution increases with a rising mean to median income ratio and so does redistributive government taxation, since the median income earner is pivotal and evaluates her relative income position in her voting decision. This idea has been introduced in the analysis of public pension systems by Tabellini (1990, 2000). Related models have been proposed, among others, by Casamatta et al. (2000); Conde-Ruiz and Galasso (2005); Cremer et al. (2007); Hassler et al. (2007) and Bossi and Gumus (2012). The basic novelty in these models is that individuals do not only differ in terms of age (workers v.s pensioners) but also with respect to their income.

The previously developed OLG framework can be easily amended to allow for this second type of heterogeneity. Note that it is perfectly possible to employ a model with weak altruism as in Tabellini (2000). However, to keep things simple and to carry home the point as clearly as possible, I will abstract now from any notions of altruism. In the vein of Casamatta et al. (2000), we can model the impact of intra-generational heterogeneity by using a two-generation version of the initial Browning model.

Utility is given once again by an additive separable, strictly monotone, strictly concave and twice differentiable function

$$U_t = u[c_t^y] + \rho \cdot u[c_{t+1}^r] \tag{3.37}$$

with ρ being the discount factor to measure preference for old-age consumption. The budget constraints are straightforward:

$$c_t^y = w \cdot (1 - \tau_t) - s_t \tag{3.38}$$

$$c_{t+1}^r = x_{t+1} + (1 + r) \cdot s_t \tag{3.39}$$

As before, savings are constrained to be non-negative. The pension benefit x is related to a worker's income and also has a redistributional element. Pensions are thus given by

$$x_{t+1} = (1+n) \cdot \tau_{t+1} \cdot (\xi \cdot w + (1-\xi) \cdot \bar{w}) \tag{3.40}$$

with $\xi \in [0,1]$ being a 'redistribution factor'[25] that measures to what extent pension benefits are actually related to contributions and to what extent they are redistributional. The higher ξ the less intra-generational redistribution takes place, while $\xi = 0$ indicates a perfect Beveridgean system where benefits are lump-sum. Accordingly, $\bar{w}$ denotes the economy-wide average wage.

Inserting the budget constraints into the utility function (3.37) establishes the optimization problem of a given individual:

$$U_t = u_t[w \cdot (1-\tau_t) - s_t] + \rho \cdot u_{t+1}[(1+n) \cdot \tau_{t+1} \cdot (\xi \cdot w + (1-\xi) \cdot \bar{w}) + (1+r) \cdot s_t] \tag{3.41}$$

To further simplify matters, we go back to the assumption of a once-and-for-all vote, thus $\tau_t = \tau_{t+1}$. From the retirees' perspective, only the second term in (3.41) is relevant, since working-age consumption and saving decision lie in the past. Hence, their preferred contribution rate, as in the Browning model, is $\tau^r = 1$ because it maximizes their utility accruing from the pension benefits $x = (1+n) \cdot \tau \cdot (\xi \cdot w + (1-\xi) \cdot \bar{w})$.

For a given worker, preferences depend on income w. From (3.41) we find that a worker will vote in favor of a positive contribution rate and thus for the introduction of a PAYG pension scheme, if

$$1 + r < (1+n) \cdot (\xi + (1-\xi) \cdot \frac{\bar{w}}{w}) \tag{3.42}$$

In case condition (3.42) holds, it is more profitable for a worker to set private saving s to zero and introduce a PAYG system to ensure consumption in old-age. If the reverse holds, then a worker will reject a public pension system and will prefer private savings instead. Taking α as given and assuming steady-state values for r and n, the condition shows that a worker's wage relative to the average income is decisive in determining whether or not she prefers to introduce a public pension system. We can thus derive the critical wage $\hat{w}$ that makes a worker just indifferent between private saving and a PAYG system:

$$\hat{w} = \frac{(1+n)(\xi - 1) \cdot \bar{w}}{\xi - 1 + \xi \cdot n - r} \tag{3.43}$$

[25] Casamatta et al. (2000) call it 'Bismarck factor'.

If for a worker i income is lower than that, i.e. $w_i < \hat{w}$, then she prefers a PAYG scheme over private saving. In the opposite case of $w_i > \hat{w}$, private saving is being chosen instead. Note that even the very poor would not join the retirees in demanding the maximum of $\tau = 1$, since they also want to consume while young.

Preferences for pensioners and workers are single-peaked[26], therefore the median voter theorem can be applied once again. Pensioners will favor a $\tau = 1$, while workers with an income of less than $\hat{w}$ will prefer a contribution rate, $0 < \tau < 1$, that is increasing in their income.[27] These two groups are opposed by workers earning more than $\hat{w}$, who reject a PAYG system altogether. The size of τ depends on the relative sizes of these three groups and therefore on the distribution of incomes. The median voter earns an income w^m, which satisfies

$$N^r + N^r(1+n)\int_{w^m}^{\hat{w}} f(w)dw = \frac{N^r + N^r(1+n)}{2} \tag{3.44}$$

where N^r denotes the number of retirees and $N^r + N^r(1+n)$ the total population. If equality (3.44) holds, one half of the population prefers a higher and one half a lower contribution rate. Consequently, if the number of workers earning less than the critical wage $\hat{w}$ plus the number of pensioners is $N^r + N^r(1+n)\int_{w^-}^{\hat{w}} f(w)dw \geq \frac{N^r+N^r(1+n)}{2}$, the median voter will be in favor of a PAYG system. If, on the other hand, $N^r + N^r(1+n)\int_{w^-}^{\hat{w}} f(w)dw < \frac{N^r+N^r(1+n)}{2}$, the median opposes a positive τ. As can be seen from (3.44) therefore, a winning coalition advocating a PAYG scheme consists of pensioners and workers with income below the critical value.

Note that the number of workers joining retirees in pushing for a public pension system does not only depend on the wage distribution but also on the relative profitability of private saving. The higher r is relative to n, the more workers will reject a PAYG scheme.[28] However, the main variable of interest is clearly the degree of income inequality, for this model predicts that a rise thereof will lead to the introduction or an increase in size of a PAYG system. The reason is that as income heterogeneity increases, the

[26] This is the case because pensioners' preferences are strictly increasing with τ, thus having a maximum at 1, and workers' utility function are strictly concave.

[27] As long as $w_i < \hat{w}$, preferred contributions increase with income ($\frac{\partial \tau}{\partial w_i} > 0 \; \forall \; w < \hat{w}$) because the profitability of the PAYG system rises with income and we assume a low intertemporal substitution.

[28] For more on comparative statics and the impact of deadweight losses due to taxation see Casamatta et al. (2000).

number of workers joining a coalition with the old goes up. Unlike models that center on the impact of inter-generational altruism, this reasoning can be easily tested using income data. Running cross-country regressions, Tabellini (2000) found a positive and significant relationship between pension spending and inequality, although it has to be noted that his number of observations was only between 11 and 40, and inequality, captured as the fraction of pre-tax income by the top 5 per cent of the wage ladder, is only a poor measure. Breyer and Craig (1997) using panel data and basing their inequality variable on the Gini coefficient find only weak evidence, the coefficients are of the right sign but not quite significant at conventional levels. The general empirical literature on the determinants of government spending does not offer clear evidence, either. Lindert (1996) and Moene and Wallerstein (2003) find a negative, albeit insignificant coefficient, whereas Shelton (2006) finds a positive and modestly significant impact. In sum, although these models are intuitively quite appealing, the empirical evidence in their favor is mixed at best.

Regardless of whether we look at coalitions of retirees and older workers, trigger mechanisms, the possible role of altruism or income inequality forging a coalition of retirees and poor workers, we have analyzed pension politics so far by assuming majority voting in a direct democracy. This of course is a simplification.[29] Pension politics in almost all democratic countries takes place in an institutionalized setting, where voters do not decide issues directly, but rather elect representatives through an electoral process. These representatives in parliament and government then decide on policies, and these policies may or may not coincide with electoral platforms of these representatives. The only study I am aware of that systematically tries to analyze under what conditions the direct- and representative democracy models arrive at different conclusions is the one by Cukierman and Spiegel (2000). They find that direct democracy models are a good approximation of a representative institutional context, if there is two-party competition with a strong tendency of policy platform convergence. This holds in particular, "*when the polarization between parties is*

[29] Prima facie, simplifying assumptions are of course no need to worry and indeed the bedrock of any meaningful model. Whether highly 'unrealistic' assumptions are a valid criterion for discarding a theory has been a contested issue in the theory of science. For instance, Friedman (1953) maintains that assumptions are considered to be *as if* conjectures, hence proving them wrong is not a valid criterion for judging a theory: *"(...) the only relevant test of validity of a hypothesis is comparison of its predictions with experience"* (Friedman (1953): 8). This position has been challenged among others by Hausman (1984), who argues that assumptions are testable and falsification of these cannot be disregarded when judging a theory (Hausman (1984): 217).

not too large, when the party leaders are sufficiently office motivated, or when the political system is characterized by strong symmetries" (Cukierman and Spiegel (2000): 3). Absent these rather tight conditions, however, the two classes of models will come up with diverging policy explanations and predictions. As result, introducing elements of representative democracy could potentially change some of the insights we have gained so far and thus warrants a closer inspection.

3.2 The Pension System in a Representative Democracy

Examining the political rationale of public pension systems in a representative systems adds several layers of institutional detail, which makes the analysis more involved. Not only does the decision making process from voters to policy outcome get more complicated, we also need to introduce a third group of actors: politicians. If politicians were perfect representatives of voters' preferences, then this would not be a big deal. But if they have diverting preferences such as caring for the spoils of office (i.e. office motivation) or an ideological bias, matters get more tricky. In addition, the act of voting may no longer be the only channel of influence of the electorate, since lobbying and campaign contributions might induce representatives to deviate from their constituents' preferences.

In general the literature using models of representative democracy to explain the political rationale of public pension systems is still rather small compared to the considerable number of studies employing the assumption of direct democracy. To be sure, there is quite an extensive literature that develops formal models of political competition and decision making in a representative context – often with a view on matters of redistribution. In fact, this research has become so vast that it would be impossible to provide even a shallow overview here. There are plenty of approaches based on the spatial model of political competition (for overviews see Enelow and Hinich (1984, 1990); Osborne (1995)). Many have tried to incorporate the ideology of parties (e.g. Lindbeck and Weibull (1987); Dixit and Londregan (1998)) or to create complete models that trace political outcomes from the choice of citizens as candidates to final policies (e.g. Besley and Coate (1997); Osborne and Slivinski (1996)). A major focus has also been put on the influence of lobbying by interest groups (e.g. Denzau and Munger (1986); Baron (1989b, 2006); Grossman and Helpman (1996)) and the dynamics as well as the institutions of legislative decision making

(e.g. Austen-Smith and Banks (1988); Austen-Smith (2000); Baron (1989a); Grossman and Helpman (2008)). Yet despite all this existing research and compared to the literature on redistribution, there are conspicuously few attempts by scholars of pension politics to make inroads into this literature to explain occurrence, size and sustainability of PAYG pension systems.

3.2.1 Veto Voting in a Representative Democracy

One of the first attempts was made by Hansson and Stuart (1989). They introduced the simple idea that elected politicians would not make any changes to a public pension system or even introduce it, if either workers or pensioners vetoed it. Azariadis and Galasso (2002) have taken up this approach and analyzed how in an environment of repeated voting, a veto right of retirees might change the outcome compared to simple majority voting. The underlying notion is that no government can afford to change pension legislation against the will of the old, even if they are outvoted by the young. This might be due to pensioners' effectiveness as organized interest group. It has been suggested that retirees are a particularly successful interest group because of their 'single-mindedness', i.e. their focus one just one issue: pensions (see Mulligan and Hunter (2003); Canegrati (2006)). Of course, simply introducing the possibility of a veto does not really change a lot compared to a direct democracy environment. However, the model of Azariadis and Galasso (2002) can be easily re-conceptualized to make it more akin to a representative democracy setting. For the sake of consistency, I choose once again a model set-up which is similar to the previous ones. Thus it is a two-period OLG model with the utility function and budget constraints being

$$\begin{aligned} U_t &= u[c_t^y] + \rho \cdot u[c_{t+1}^r] \\ c_t^y &= w \cdot (1 - \tau_t) - s_t \\ c_{t+1}^r &= (1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t \end{aligned} \tag{3.45}$$

We abstract here from the previously raised issues of altruism and income inequality but assume that decisions are made in every period and are therefore reversible. As in the models of repeated voting, we therefore define the history of past contributions h as $h_t = (\tau_1, \tau_2 ... \tau_{t-1}) \in [0,1]$ and look for a strategy profile $(\sigma_t^{W*}, \sigma_t^{R*})_{t=0}^{\infty}$ that constitutes a subgame perfect equilibrium. Next, let us assume that workers vote only for party W and

pensioners for party R. Both parties are committed to the cause of their respective constituencies and have no incentive to cater to the other societal group. Since under any reasonable population growth assumption workers are in the majority, party W will win any election, hence electoral competition itself is of no interest here.

As W holds a majority, it can propose the size of τ in every period. However, let's assume that R's approval is needed. That is, while R cannot propose a τ, it may veto proposals by W. The reason could be that a qualified majority for a change in pension legislation is needed which party W alone does not have; or alternatively, that R holds a majority in a second chamber which needs to approve any decisions by the first chamber. As a result, the strategies σ_t^i of W and R respectively are

$$\sigma_t^W : h_t \to [0,1] \tag{3.46}$$

$$\sigma_t^R : h_t \times \sigma_t^W \to \{\mathscr{Y}, \mathscr{N}\} \tag{3.47}$$

that is, given the history of contribution rates, party W proposes a new τ and R decides, whether to approve ($\mathscr{Y}$) or veto ($\mathscr{N}$) this proposal. Since the utility for party R's constituency is increasing in τ, its behavior is easy to characterize. It will approve any increase in τ and veto any reduction:

$$\sigma_t^{R*} = \begin{cases} \mathscr{Y} & \text{if } \tau_t \geq \tau_{t-1} \\ \mathscr{N} & \text{if } \tau_t < \tau_{t-1} \end{cases} \tag{3.48}$$

A (rational) strategy of party W has to take this into account when proposing a change to τ. This implies of course that once in place, a public pension system can never be abolished again, since the party representing the retired would veto any such attempt. As in the model of repeated voting above, it would be in the interest of the workers to have a trigger mechanism in place to punish a previous generation that shirked its pension obligations[30]. However, veto power by party R makes this no longer necessary, for abandoning the pension promise against the will of the retirees is no longer politically feasible. Hence, the problem of which trigger mechanism to choose and how to coordinate around it disappears in this representative democracy setting. Still, party R as the agenda-setter can decide

[30] For example the one explicated above:

$$\sigma_t^{W*} = \begin{cases} \tau^* & \text{if} \quad n[\tau(t-1)] \text{ is even} \\ 0 & \text{if} \quad n[\tau(t-1)] \text{ is uneven} \end{cases}$$

whether or not to introduce a public pension scheme in the first place and of what size it should be.

The optimal contribution rate (i.e. pension scheme size) τ^* is obtained by solving the workers' optimization problem given by (3.45). As we have seen before, this depends on time preferences as well as the interest- and population growth rates. For a pension system to get started, $1+n > 1+r$ must hold. In other words, the economy must be dynamically inefficient. However, once the system is in place, dynamic inefficiency is no longer a necessary condition because party R can now block any reduction in the pension level. Even if later generations of workers are faced with a situation where private saving would be a superior saving vehicle (i.e. $1+n < 1+r$), they are stuck with the system. Party W' best response can therefore be described by

$$\sigma_t^{W*} = \begin{cases} \tau^* & if \quad 1+r \leq 1+n \\ \tau_{t-1} & otherwise \end{cases} \tag{3.49}$$

Party W knows the preferences of R and can therefore perfectly anticipate its reaction to a proposal. If the status quo is no public pension system, then $\tau_{t-1} = 0$ and W will not propose any changes in case that $1+r > 1+n$. If, however, the opposite condition holds, W will either propose to introduce a public pension scheme or, if it already exists, increase its size depending on r and n, for both of which it will get support by the pensioners' party. Given the veto power of R, it will never propose a reduction in τ however, even if it would prefer to do so.

The exact size of τ^* depends on the rate of substitution between current and future consumption as well as the exogenously given values of r and n. Azariadis and Galasso (2002) show that in this context of repeated voting with veto power, there exist a golden rule contribution rate τ^{gr} that constitutes a fixed-point[31] and thus a stationary equilibrium. The way I have formulated the problem, however, implies a second fixed point at $\tau = 0$, where no PAYG pension scheme is proposed by W. Hence, as is proven by Azariadis and Galasso (2002), we can observe a convergence of all equilibria to the golden rule contribution rate. Of course, there can be contributions levels that imply a higher utility than is associated with τ^{gr}, but such a situation cannot be stable. Imagine the status quo is $\tau_t = 0$, then party W may propose a pension scheme size $\tau^\star$ with $0 < \tau^\star < \tau^{gr}$. This confers an indirect utility $u[0, \tau^\star]$, which is higher than the utility from $u[\tau^{gr}, \tau^{gr}]$. Of course, in the next period, party W representing the next gen-

[31] For an introduction to fixed point theorems see Agarwal et al. (2001)or Border (1985).

eration of workers will propose to increase the contribution from $\tau^\star$ to the golden rule level (as before, party R eagerly supports this move), since $u[\tau^{gr}, \tau^{gr}] > u[\tau^\star, \tau^\star]$

This model is an interesting first step in adding political structure. It is able to explain why PAYG schemes have been introduced in an environment of repeated elections and why it is being sustained in many countries, even after the rate of population growth deteriorated. It is also able to reduce the number of feasible equilibria. Yet, it is still a far cry from depicting a truly representative democracy. Electoral competition does not take place and the two parties perfectly coincide with the two societal groups. Parties only care about their respective constituencies and do not adjust their programs to increase their chances of winning elections. From an analytical point of view, not that much has been gained therefore.

3.2.2 Power and Influence

A viable alternative approach would be to make the government more of an actor in its own right. The government is thus not merely a representative of one group but cares about the plight of both workers and pensioners. In other words, it maximizes a pre-defined social welfare function; yet it is also responsive to the competing influences of retirees and workers. Verbon (1986); Verbon and Verhoeven (1992) have proposed models in this vein that make pension policy a decision of a government that balances the interests and influences of both groups. Influence can be thought of as a much broader concept than what we have considered so far. It may include not only the votes that one societal group can mobilize but also lobbying power or direct access to government decision making. This approach can therefore account for the fact that voting is not the only channel of political influence and some groups of voters are more favored by the political process than others. In a related model, Grossman and Helpman (1998) include also the possibility of making campaign contributions to influence government policies.

The spirit of the models by Verbon (1986) and Verbon and Verhoeven (1992) can be easily captured in the given framework of a two-period OLG model. The optimization problem of a representative individual is the same as before, with utility function and budget constraints being given above in equations (3.45). Maximizing with respect to s_t and rearranging yields the condition (known from the Browning model in a slightly differ-

ent form)[32]

$$(1+r) = \frac{u'[w \cdot (1-\tau_t) - s_t]}{\rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]} \tag{3.50}$$

that is, the marginal rate of intertemporal substitution equals the interest rate. Individuals save to the point where the marginal dis-utility in period t from an additional unit of saving equals marginal utility from saving in $t+1$.

What is new now is the explicit formulation of an objective function W that the government maximizes

$$W_t = \phi \cdot u[c_t^w, c_{t+1}^w] + (1-\phi) \cdot u[c_t^r] \tag{3.51}$$

where ϕ denotes the relative political influence of the workers, and $(1-\phi)$ the political clout of pensioners. If both groups exert equal power (e.g. $\phi = 0.5$), then the government attaches equal weight to the utility of each group. The government, however, puts more emphasis on workers' utility, if they are able to yield more influence ($\phi > 0.5$); whereas with $\phi < 0.5$, the opposite holds. Combining the policy function with (3.45) gives

$$\begin{aligned} W_t = {} & \phi \cdot (u[w \cdot (1-\tau_t) - s_t] + \rho \cdot u[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]) \\ & + (1-\phi) \cdot u[(1+n) \cdot \tau_t \cdot w + (1+r) \cdot s_{t-1}] \end{aligned} \tag{3.52}$$

Let's suppose that at time t, the government ponders whether to introduce a public pension system or to uphold it, if it already exists. It balances the utility of workers and pensioners depending on their relative political influence. However, since the government cannot credibly commit to uphold the system also in the next period because political power may shift, τ_{t+1} is uncertain and could well be zero. This changes (3.52) to

$$\begin{aligned} W_t = {} & \phi \cdot (u[w \cdot (1-\tau_t) - s_t] + \rho \cdot u[(1+r) \cdot s_t]) \\ & + (1-\phi) \cdot u[(1+n) \cdot \tau_t \cdot w + (1+r) \cdot s_{t-1}] \end{aligned} \tag{3.53}$$

By establishing the first-order condition with respect to τ_t and bearing in mind the result in (3.50), which can be rearranged to yield $u'(w \cdot (1-\tau_t) - s_t) = (1+r) \cdot \rho \cdot u'((1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t)$, we can solve for the condition under which a public pension scheme is introduced or maintained by the government:

[32] The explicit derivation of the following FOCs and results are to be found in Appendix A.3

$$1-\phi \geq \frac{\phi \cdot (1+r) \cdot \rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]}{(1+n) \cdot u'[(1+n) \cdot \tau_t \cdot w + (1+r) s_{t-1}]} \tag{3.54}$$

The political feasibility of a public pension system hinges therefore not only on its rate of return compared to private savings, but also on the relative political power of the old $(1-\phi)$. Recall that the government maximizes a function that incorporates the utility of both groups, weighted by their political power. Expression (3.54) defines the critical value of the retiree's influence and clearly show that this value must increase with the interest rate. This makes intuitive sense, since an increasing interest rate makes private saving more attractive for the workers and raises their utility. This must be off-set by a stronger weight on the pensioners' utility, which is analogous to a bigger political influence. The opposite effect can be observed with respect to the population growth rate. The higher $(1+n)$, the more profitable is a PAYG scheme. Hence, the pensioners need to exert less power to convince the government to introduce/maintain a public system. Finally, time preferences are also decisive. The more future utility is discounted (i.e. the lower ρ is), the less power by the retirees is needed to convince the government to act according to their preferences. The reason is that the positive utility from private saving is reduced the more future consumption is disregarded, which reduces the utility the government derives from satisfying the workers.[33]

As a result, it all comes down to relative political power of workers and pensioners. Of course, the government not only decides whether a PAYG scheme should be in place, but it also determines the optimal size of the system.[34] Deriving the government's choice of the contribution rate from the first order condition of the objective function, we find that

$$1+n = \frac{\phi \cdot u'[w \cdot (1-\tau_t) - s_t]}{(1-\phi) \cdot u'[(1+n) \cdot w \cdot \tau_t + (1+r) \cdot s_{t-1}]} \tag{3.55}$$

[33] The analysis for the perspective of the workers is analogous. If private saving is more profitable than a PAYG scheme from their perspective, their political power must at least be

$$\phi \geq \frac{(1-\phi) \cdot (1+n) \cdot u'[(1+n) \cdot \tau_t \cdot w + (1+r) s_{t-1}]}{(1+r) \cdot \rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]}$$

The interpretation of the impact of $(1+n)$, $(1+r)$ and ρ is quite obviously the reverse of the one given for the retirees.

[34] 'Optimal' here does not refer to the social optimum, but to the optimal size given the objective function.

The right-hand side of this expression represents the marginal rate of substitution between the utility of the workers and the pensioners, weighted by their respective political power. An increase in τ_t reduces the marginal utility of the workers in period t, while at the same time it raises retirees' utility. A government will therefore increase the size of the pension system up to the point where the inter-generational rate of substitution equals the population growth rate which can be considered as the workers' price of consumption relative to pensioners' consumption.[35] It therefore raises τ_t until the (power-weighted) marginal dis-utility experienced by the young exactly equals the (power-weighted) marginal utility gain by the old.

A fall in the population growth rate would therefore lead to three effects. First, a substitution effect induces the government to reduce the contribution rate because the utility of the workers' gets comparably more "valuable". Second, an income effect puts upward pressure on τ_t because a falling population growth rate reduces the profitability of the pension system and thus reduces the utility of pensioners. Third, if the political influence of both groups is to some extend related to their cohort size, then a smaller population growth should increase the power of the pensioners, thus inducing the government to increase the size of the system. Which of these effects dominates cannot be determined analytically, but is an empirical matter.

So far I have been silent on how political power could be explicitly determined. As just mentioned, making it a function of the relative cohort size of workers and retirees is intuitively appealing. It also has the advantage that it allows to make comparative statics statements on how aging may affect the power distribution. However, other factors can easily be imagined. Maybe relative influence is also determined by the income share (see Weizsäcker (1990)) or size of the capital stock that both groups have dominion over, or their relative 'single-mindedness' (see Rhodebeck (1993); Mulligan and Sala-i Martin (1999a)). Alternatively, the institutional set-up of the political system might influence which groups have more access to government decision making. As a result, a much more precise definition of a 'power function' would be desirable.

Another approach is to expand the original idea of Verbon (1986) and to make power endogenous. We can re-interpret the problem by defining ϕ^w and ϕ^r as the 'political investments' workers and pensioners need to make to induce the government to set policy in line with their preferences. They both could now actively try to influence the weight the government puts

[35] As we have learned above, $(1+n)$ is also the internal rate of return of a PAYG system.

on their respective preferences. Political power becomes the result of the strategic interaction between the two groups and is thus being endogenized. These investments could take the form of time and money spent lobbying, or promised campaign contributions for the government parties. This would imply[36] that a rising interest rate would, from the perspective of the pensioners, necessitate an increase in their political investment. The opposite effect would occur if population growth accelerated. Finally, an increase of in the political investment of the young would also induce pensioners to raise ϕ^r.[37] Note that Grossman and Helpman (1998) develop a related model where lobbies of pensioners and workers offer campaign contribution schedules to short-lived governments, which also have an objective function and cannot commit to future policies. Due to their rather restrictive assumptions regarding the economic environment (e.g. the young do not consume during their working period, labor supply is inelastic), they arrive at rather stark conclusions, however. If only the old lobby the government, then the complete income of workers is being transferred to them, driving the economy's capital stock to zero. On the other hand, if both groups are able to make contributions to the policy makers, they bid each other up to the point where all resources of the economy go to the politicians without any net gain to any of the two groups.

In sum, the pension policy of a representative government, according to these models, is determined by economic efficiency considerations emanating from exogenous population growth and interest rates, and by the government's political considerations that are driven by the relative influence (political investments/contributions) of workers and retirees.[38] The strength of this approach is that it implicitly accounts for a lot of political factors, its weakness is that it cannot spell them out explicitly. The political influence factor ϕ could subsume all kinds of interest group behavior (lobbying, campaign contributions, privileged access etc.) but could also stand

[36] To see that, we only need to slightly adjust expression (3.54) by replacing ϕ and $(1-\phi)$. Hence, (3.54) would simply change to

$$\phi^r \geq \frac{\phi^w \cdot (1+r) \cdot \rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]}{(1+n) \cdot u'[(1+n) \cdot \tau_t \cdot w + (1+r) s_{t-1}]}$$

[37] The interpretation for ϕ^w is analogous again.

[38] Of course, the role of political influence and lobbying may not be restricted to different age groups. Kemmerling and Neugart (2009) model the political influence of financial firms and the size of the domestic financial markets to explain the switch towards mandatory defined-contribution pension schemes.

for electoral influence. The objective government function may represent responsiveness to interest groups, but also to voter sentiments. Thus a re-election motive is implicit here as well.

3.2.3 *Electoral Competition and Probabilistic Voting*

What this model lacks, however, is an explicit treatment of electoral competition and how parties behave strategically to maximize their chances of winning elections by proposing platforms that center around pension policy. In a representative democracy, the need for parties and candidates to get (re-)elected is a major determinant of policy outcomes. Of course, there is always the possibility that parties and candidates renege on their campaign promises and implement different policies once elected. However, empirical studies have shown that, by and large, parties actually do fulfill their pledges (see Klingemann et al. (1994)). Modeling electoral competition could therefore shed light on the political rationale of public pension provision. Intuitively, one might conjecture that the resulting policy should be similar as in a direct democracy, since in both cases the preferences of the same median voter should be pivotal. Yet this need not be the case as policy platforms may include more than one issue and/or ideology. In addition, personal traits of candidates/parties may also influence voting behavior.

Of course, such a multi-dimensional issue space makes policy analysis and predictions much more complicated. As Plott (1967) has shown, a voting equilibrium in a multi-dimensional issue space does only exist under very extreme assumptions about the distribution of voter preferences. The solution to this analytical dilemma is to either presume some sort of agenda-setting rule, to add more institutional detail and follow the notion of structure-induced equilibrium as proposed by Shepsle (1979), or to employ a probabilistic voting model.

There are not many pension models that have analyzed electoral competition. The few that do exist use probabilistic voting models[39] to arrive at equilibrium solutions. Mulligan and Sala-i Martin (2003) suggest a two-

[39] In probabilistic voting models (as opposed to deterministic models in the Downsian tradition) candidates/parties cannot predict with certainty how voters will respond to policy proposals or where exactly they are located in the policy space. For a seminal example see Lindbeck and Weibull (1987), for an overview and in depth elaboration see Coughlin (1992).

dimensional model that tries to simultaneously explain the existence of PAYG schemes and the fact that most pension systems mandate retirement before the old can collect pension benefits. It is shown that pensioners have more influence in the political contest. This influence is due to their stronger 'single-mindedness' which in turn is a function of the amount of leisure time they enjoy. Leisure, in turn, is affected by distortionary taxation and the preferences of workers for the old's leisure, which can be considered as a form of altruism. The basic idea of the authors is that voters do not care so much about other people's consumption but about their social behavior (i.e. how much do others need to work /how much leisure do they enjoy). As a result, a stronger workers' preference for old-age leisure increases pensioners political influence (because of greater single-mindedness) and therefore the size of pensions that competing political parties/candidates will promise to the retirees. In a representative democracy, the electoral contest may therefore favor the old, even though they are in a minority compared to workers and would lose a in directly held referendum.

To explore in more detail how this, at first glance, contra-intuitive result may come about, I will outline a related probabilistic voting model suggested by Profeta (2002b). Once again, the basic set-up is a two period OLG model with additive separable, strictly monotone, strictly concave and twice differentiable utility functions. What is different now is that individuals also have to decide how much leisure l^i they would like to enjoy, that is, labor supply decisions are made endogenous here. To simplify things somewhat, I will (unlike in Profeta (2002b)) abstract from private savings. Note that introducing non-negative savings and steady-state interest rates would not change any of the results.[40] The main novelty, however, is that there are now two types of transfers. One of those transfers, T^i, is intra-generational, that is, it redistributes income between workers and between pensioners and is financed by a distortionary wage tax ν^i. The other one is a lump-sum inter-generational transfer, τ^i, between the two age groups which is zero-sum. In other words, if for example $\tau^r > 0$, then it must be that $\tau^w < 0$. Introducing two separate tax-transfer systems is actually a very reasonable assumption. Most PAYG systems are not (at least primarily) financed by wage taxes but by distinct wage contributions, although these are, contrary to the assumption made here, usu-

[40] All of the model's derivations and results are explicated in appendix (A.4) To see that savings do not change any results, the reader is invited to plug (accumulated) savings into the consumption functions (as in the previous models) and to conduct the corresponding derivations.

ally not lump-sum. The revenues from wage taxation finance the bulk of the government budget, which, besides the usual non-redistributive spending (e.g. public goods like defense, government consumption, investment), also include social expenditures benefitting workers (like education, health, social assistance, family subsidies etc.). Ignoring the former group of spending items because we are interested in redistribution here, it makes sense to consider revenues from taxes on workers' income as intra-generational redistribution.

Of course, assuming also an intra-generational system that taxes the wage income of the old and redistributes the proceeds among them seems at first to be very far from what we observe in reality. There is no special redistributive tax levied on pensioners in their old age. However, as Mulligan and Sala-i Martin (1999b) have pointed out, pension benefits are a declining function of elderly wages, but do not depend on asset income. In other words, with respect to their pension entitlements, the old are punished for continuing to receive working income. This could be considered a (implicit) special tax on their income that effectively punishes them for not completely retiring. The reduction in pension benefits for those people that still work are then used to prop up the pensions of those who have completely retired from working and therefore earn a higher PAYG pension. Therefore, φ^r represents the implicit tax inherent in most defined-benefit PAYG systems.

The old's utility is given by

$$U_t^r[c^r, l^r] = c_t^r + \varphi^r \cdot \log(l^r) \tag{3.56}$$

$$c_t^r = w \cdot (1 - \nu_t^r)(1 - l_t^r) + \tau_t + T_t^r \tag{3.57}$$

where φ^r measures the preference for leisure. Consumption therefore depends on the (steady state) wage, the amount of work, the tax rate and the sizes of intra- and inter-generational transfers.

The young's utility is given by

$$U_t^w[c^w, l^w] = c_t^w + \varphi^w \cdot \log(l^w) + \beta^w \cdot \log(l_t^r) + \rho \cdot (c_{t+1}^w + \varphi_{t+1}^w \cdot \log(l_{t+1}^w)) \tag{3.58}$$

$$c_t^w + \rho \cdot c_{t+1}^w = w \cdot (1 - \nu_t^w)(1 - l_t^w) + \tau_t^w + T_t^w + \rho \cdot (w \cdot (1 - \nu_{t+1}^w) + \tau_{t+1}^w + T_{t+1}^w) \tag{3.59}$$

where φ^w denotes the young's preference for their own leisure, β^w is their taste for the old's leisure, while ρ is the already known time discount factor. Note that τ_t^w is introduced with a positive sign because unlike in the previous approaches, this model allows the possibility that inter-generational redistribution runs from pensioners to the young.

The budget constraints for the two transfer systems are

$$T_t^i = \nu^i \cdot w \cdot (1 - l^i) \tag{3.60}$$

$$\begin{aligned} \tau_t^i &= (1+n^r) \cdot \tau_t^r + (1+n^w) \cdot \tau_t^w + \alpha \cdot |(1+n^r) \cdot \tau_t^r||(1+n^w) \cdot \tau_t^w| \\ &= 0 \end{aligned} \tag{3.61}$$

The parameter α measures the efficiency loss or, alternatively, the political costs of inter-generational redistribution given the overall size of the system $|(1+n^r) \cdot \tau_t^r||(1+n^w) \cdot \tau_t^w)|$.

The probabilistic voting model introduced by Profeta (2002b) is closely related to the one suggested by Persson and Tabellini (2000). Electoral competition takes place between two parties L and R. The only issues that matter to the electorate are the two transfer systems and the distributional consequences they entail. Election programmes and thus implemented public policy are represented by the n-tuple $\mathbf{q} = (\nu^w, \nu^r, \tau^w, \tau^r)$. The first two elements determine, in conjunction with the individual labor-leisure decision, the size of the intra-generational net transfer that an individual expects to get, while the latter two elements determine the inter-generational redistribution (taking the cost parameter α as given). Parties do not cooperate and try to choose $\mathbf{q}$ so as to maximize the number of votes their receive (or, alternatively, the probability of winning the election).

What makes probabilistic voting models interesting is that they allow the introduction of ideological biases and / or popularity shocks. In the model proposed by Profeta (2002b), voter k belonging to an age group i (old or young), votes for party L if

$$V^i(q^L) + \delta + \mu^k > V^i(q^R) \tag{3.62}$$

where V^i is an indirect utility function which is obtained by solving the individual's optimization problem with respect to c^i and l^i and inserting the results into (3.56) and (3.58) respectively (see appendix (A.4)). The term δ is a popularity measure or popularity shock. It is conceptualized as a random variable, which is uniformly distributed on $(-\frac{1}{2d_\delta}, \frac{1}{2d_\delta})$, has a mean of zero and cannot be controlled by the competing parties. It is

being realized after all policy platforms have been chosen and therefore captures all the imponderables of electoral competitions where scandals may be revealed or foreign policy events (war, terrorist attack) intervene. On the other hand, μ^k is the idiosyncratic ideological bias that an individual k possesses. Introducing ideology allows the possibility that voters care also about other things, not explicitly accounted for in the model. Again we assume zero mean and a uniform distribution on $(-\frac{1}{2d^i_{\mu^k}}, \frac{1}{2d^i_{\mu^k}})$. Note that the density parameter d^i is group-specific, hence the ideological diversity among the young and the old may differ. As result, expression (3.62) means that a given voter will vote for party L, if the utility she derives from the electoral platform plus the ideological leaning and popularity of that party is greater than the utility from the proposed policy of R. Note that the sign of the ideology parameter is very important. If it is positive, a voter is attached to party L on ideological grounds. Therefore, party L could offer less utility from its electoral platform than party R but could still retain her vote, if this difference is compensated by the utility derived from ideological attachment.

The bedrock assumption in this model is that the degree of ideological homogeneity among the young and the old depends on the amount of leisure they enjoy. The more leisure a group has, the stronger aligned are its members' preferences, i.e. $\frac{\partial d^i_\mu}{\partial l^i} > 0$. The intuition behind this assumption is related to the idea of single-mindedness[41] introduced before. People that do not work or work less (e.g. retirees) share a strong common interest in securing a transfer income, from which they depend all the more, the less they receive working income. Few other issues exist that divide them. Hence, they can rally around a single issue. Workers, on the other hand, may differ in more dimensions like industry type (export vs. import sector), income (high vs. low) or job security (safe vs. precarious). Therefore they may be more heterogenous in their political leanings.

Both parties face the following maximization problem

$$\max_{q^j} \sum_{i=w,r} (1+n^i) \cdot d^i \cdot (V^i(q^j) - V^i(q^{-j})) \tag{3.63}$$

which is subject to the budget constraints (3.60) and (3.61) of the two transfer systems. When proposing an intergenerational transfer, party j must consider how many votes it loses in one group, and how many it

[41] For empirical evidence that the old are indeed more single-minded see Rhodebeck (1993); Canegrati (2007).

gains in the other. This does not only depend on the overall size of each group, but also the distributions of ideological biases. Due to ideology some voters in group i may still vote for party j, even if j proposes to reduce transfers. Hence, groups that are ideologically more homogenous (i.e. groups with a higher density) are more 'valuable', as catering to their needs promises a gain in votes that is higher than the loss in the ideologically more dispersed group.

The parties now solve a two-dimensional problem, as they not only propose an inter-generational transfer but also a wage tax and a corresponding intra-generational redistribution. The latter will in turn determine how much the young and the old choose to work, and consequently whether the old will stop working completely. Since it is not my primordial concern here to analyze why pension schemes induce retirement, I will focus on the former dimension which explains the existence and political sustainability of a public pension system. Note that both parties solve a symmetric problem. Thus, electoral competition will lead them to offer identical policy platforms.

To analyze whether electoral competition in a representative democracy will lead to a pension transfer from workers to the old, we need to solve the individual optimization problems of workers and the old with respect to l_t^i and c_t^i, insert these into the indirect utility functions of both groups, plug these into the parties' policy function and maximize (see appendix (A.4)).

Given the assumption that the pensioners are more homogenous (i.e. more single-minded) so that $d^r > d^w$, the following condition results from the first-order conditions:

$$\frac{d^r}{d^w} = \frac{1 - \alpha \cdot \tau_t^w \cdot (1 + n^w)}{1 - \alpha \cdot \tau_t^r \cdot (1 + (1 + n^r))} > 0 \tag{3.64}$$

For this to be the case, the term $(\alpha \cdot \tau_t^w \cdot (1 + n^w))$ needs to be negative. Since α and $(1 + n^w)$ are both assumed to be positive, τ_t^w has to be negative, that is, inter-generational transfers to the workers are negative. As inter-generational transfers are zero-sum, any losses by one group are the gains of the other (hence, $\tau_t^w \cdot \tau_t^r < 0$). As a result, τ_t^r must be positive and condition (3.64) is fulfilled. From this it follows that electoral competition will lead to the proposal (by both parties) of an inter-generational transfer from the young to the old (i.e. the introduction and/or maintenance of a PAYG pension system).

This outcome depends crucially on the higher ideological cohesiveness of the old, which is in turn a result of their greater single-mindedness.

If workers were ideologically more homogenous than the old, electoral competition would lead to the opposite result, with workers receiving a transfer from pensioners. The model, therefore, offers an explanation why pensioners are politically so potent in a representative democracy, even though they are clearly outnumbered by the workers. It also underlines the importance of electoral competition and its potentially great impact on public policy choice.

3.3 The Bottom-Line: Politics Matter But are Hard to Model

The previous sections of this chapter have explicated that public pension provision is driven by a genuine political process. Simply looking at Pareto-efficiency does not explain much, for it predicts that only under the extreme condition of dynamic inefficiency can a PAYG scheme occur. Assuming that pension policy is decided in a direct democratic referendum represents a valuable first attempt in understanding the underlying political processes. These kinds of models show that coalition building might be important. It has been suggested that retirees and older workers may conspire, and that an elaborated inter-generational punishment mechanism ensures sustainability of the system once it has been introduced. Alternatively, it has been proposed that intra-generational inequality leads poor workers to team up with pensioners to push for public pension provision. Another factor could be the existence of altruism that induces workers to consider the well-being of the old, which in turn affects their voting behavior.

Although being a valuable first step, the explanatory power of these approaches is not fully satisfactory. Their Achilles' heel is the assumption of a direct democracy. Clearly, pension politics in Western countries takes place within the confines of a representative democracy. Hence, the voting outcome may depend on the electoral rules. In addition, more than one party could wield influence by using the threat of a veto as exemplified in the first model of the second section. Even more importantly, workers and retirees might influence policy-making beyond the individual act of voting. Hence, pensioners could be able to gain privileged access to a government through lobbying and campaigning. If their thus defined political power is greater than the power of workers, they may be able to push for intergenerational transfers against the will of the young. One possible explanation for the greater political leverage of the old could come from the

fact that they are more 'single-minded' and thus ideologically more homogenous. Employing a probabilistic voting model suggests that in this case electoral competition will induce office-motivated political parties to favor the old in their electoral programmes.

However, beyond what I have outlined here, political modeling has not gone much further in examining the political rationale of public pension provision in a representative democracy. In particular, despite the use of probabilistic voting models, the possible impact of different electoral institutions has not been analyzed in the literature. Models that offer more institutional details about governments' formation and decision-making processes are desireable but would be exponentially more complicated and risk compromising analytical clarity. However, we do know from the existing literature on fiscal policy decision-making that the institutions of electoral competition and legislative bargaining may have a big impact on actual policy outcomes (see Lizzeri and Persico (2001); Persson and Tabellini (2000, 2003).

All the political economy models reviewed so far try to explain the political rationale for establishing and sustaining a public pension system. They can therefore be used to derive explanations for pension reforms by highlighting the conditions under which systems of old-age provision are no longer sustainable and thus likely to be amended or even fully abandoned. However, these explanations are still a long way from explaining the stylized facts about cross-country differences in timing and scope of pension reforms.[42] Why were there more sweeping changes to pension systems in, say, Germany, Italy and Sweden than in the U.S.? It is not fully convincing to simply consider the above mentioned variables and to argue that in some countries the degree of altruism changed, or that income inequality fell, or the social enforcement mechanisms collapsed or the 'single-mindedness' or political influence of the old changed. Aside, from the fact that some of these concepts (e.g. political influence, altruism etc.) are very hard to measure empirically, what we do observe runs counter to what we would expect. For one, income inequality increased

[42] The less formalized comparative welfare state literature, in contrast, has been more concerned with analyzing the political obstacles to pension reform. Bonoli (2000), for instance, has emphasized the role institutional veto players have in blocking policy changes. From this perspective, the institutional structure of a political system is the decisive variable. Others have focussed on the negative electoral consequences of any type of pension reform (Pierson (1994); Myles and Pierson (2001)). They argue that policy-makers only dare to reform pensions if they can avoid political blame or are able to share responsibility with other political players.

throughout the industrialized world[43] in the last four decades (see Brandolini and Smeeding (2009); OECD (2008)) which, according to some of the previously discussed models, should increase the political support and generosity of existing pension systems. Also, there are number of studies that show preferences for income redistribution and the welfare state are much less pronounced in the U.S. than in European countries (see Andress and Heien (2001); Alesina et al. (2004); Alesina and Angeletos (2005)). This, according to the arguments relating to inequality and altruism, should make Germany, Italy and Sweden less likely to engage in reform than the United States. It becomes clear, therefore, that political-economy models, while very valuable in illuminating certain theoretical mechanisms at work, are a far cry away from being able to fully account for specific pension reform outcomes. As a result, the specific context, like the size of the existing public pension system, the degree of aging, other policies, and the structure of political institutions, should be considered when analyzing pension policy making. However, this comes at the cost of reduced analytical clarity.

Since the aim of this dissertation is to analyze political preferences for pension reform in an electoral context during times of aging, I will need to spend some time on the concept of 'pension reform'. Explicating reform options and shedding light on its redistributional nature provides the background against which it will be possible to explain political dynamics.

[43] From the mid-1980s to the mid-2000s the average increase in the Gini coefficient for equivalised household disposable income was around 7 per cent in the 24 OECD countries for which income data was available (OECD (2008): 26).

Chapter 4
Reforming the Beast – The Nature of Pension Reform

One of the main premises of this dissertation is that reform of a PAYG pension system is a purely redistributional issue. It therefore always entails winners and losers who cannot be compensated for their losses. This is quite important, as the underlying political dynamic in this case is quite different as compared to a policy shift that is efficient according to the Pareto or Kaldor-Hicks principle. In the latter case, the political problem is 'merely' how to distribute the gains, no one is made worse off.

The assertion of the redistributional nature of pension reform may strike a layperson to be at odds with what is apparently the received wisdom in public debates on that topic. Especially with respect to the question of whether to privatize and prefund existing PAYG schemes, it is a widely held belief that such a reform could amount to a free lunch.[1] Redistributional outcomes, however, cannot be explained by economic and demographic factors alone. Models are needed that add more political structure to the analysis in order to account for the occurrence (or non-occurrence) of pension reforms across space and time. The neglecting of political fac-

[1] This view is nicely exemplified in the proposed bill (S. 2782 and H.R. 4851) of 2005, co-authored by American Senator John E. Sununu (R-NH) and Representative Paul Ryan (R-WI), which aimed to reform the American social security system. In essence, the plan purports to leave everyone better off by creating individual accounts and paying for the estimated 7 trillion $ in transition costs by some magic intra-budget transfers and additional future economic growth. That there could be a free lunch to be had was obviously also underlying the thinking of former Republican presidential candidate and editor of *Forbes* business magazine, Steve Forbes, who compared the 2.2 per cent return on Social Security with the past 9-10 per cent earned on stock markets and concluded that the advantages of reform towards a private and prefunded system *"are overpowering"* (Forbes (1996)).

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tors may help explain why quantitative empirical studies so far have been rather unsuccessful in explaining pension reforms.[2] The aim of this chapter is therefore two-fold: first, to discuss available parametric and non-parametric reform options for public PAYG-based pension systems, and second, to show that pension reforms are redistributional in nature.

4.1 Should it Stay or Should it Go: Options for Reforming PAYG Pension Systems

Two ideal types of pension systems have been considered so far: on the one hand, there are PAYG schemes where pensions are transfers paid from current workers to current retirees, and on the other hand, there are prefunded systems that finance pensions out of the personally accumulated savings of each retiree. When talking about mandatory public provision so far, I was exclusively referring to the former type, while the latter was conceptualized as private saving efforts of individuals. In the real world, we observe much more variety, however. Prefunded systems can be mandatory or public (for instance, in the form of public trust funds), privatized or government-run. PAYG schemes also come in several forms. In most countries, there exists a basic pension safety net that is flat rate and / or mean-tested and often financed not from earmarked payroll contributions but from general tax revenues. In categorizing different sources of old age income, the OECD has called these the first tier in a multi-tier pension scheme (OECD (2007)). The bulk of pension income is generated through earnings-related PAYG schemes that make up the second tier. In such a system, payroll taxes levied on workers are used to finance pensions that are related in some way to a retiree's past wage contributions. Pension benefits are regularly re-valued by indexing them to annual inflation, changes to average net- or gross working income or a combination of these factors. The relationship between past contributions and current retirement income[3] can take several forms. Most common are defined-benefit systems (DB), where the generosity of one's pension depends on

[2] See James and Brooks (2001) for an attempt to test the impact of different political and economic variables on reform outcomes using probit and OLS estimates of cross-section data of 105 countries.

[3] It has to be reiterated here that in a PAYG system, the relationship between past contributions and earned pensions is artificial. Pensions solely depend on the willingness of workers to make the necessary transfers.

the number of years contributed to the system and to some degree on the level of working income received.[4] This type of benefit formula is not only used by PAYG systems, but also by public, prefunded schemes. In such a system, workers do not bear any individual investment risk or face the danger of running out of funds when old, since these risks are pooled across the whole population. Individual prefunded schemes, on the other hand, are usually of a defined-contribution (DC) type. Here, every worker contributes to his or her own personal account which is invested in assets that earn a rate of return. The size of the contributions made and their earned return then determine retirement income. Finally, it is also possible to combine PAYG schemes with defined-contribution principles. These schemes are so-called notional defined-contribution (NDC), where every worker accumulates pension claims in a personal account. However, unlike in a prefunded system, the rate of return is not determined by market interest rates but by some notional factor that is usually tied to some macroeconomic variable. As the name implies, rate of return and individual accumulations are merely notional, as pensions are still paid by current workers and are not actually accumulated in a real account.

To convey a taste of the existing variety, table 4.1 provides an overview of existing pension arrangements in OECD countries and the contribution of each tier to overall pension wealth. As can be clearly seen, public PAYG systems on a DB basis are still the dominant form of retirement income in almost all countries except for the UK and Ireland where public benefits are mainly a basic retirement income. Note that first tier pensions are also PAYG, even though they are often financed out of the general government budget. They are, however, much more redistributive than the second tier earnings-related DB schemes because they pay out only a lump sum pension regardless of prior income levels.

In terms of pension income, the public PAYG systems are still the most important components in many OECD countries for average income earners.[5] However, as can be seen in table 4.2, private schemes have surpassed the public pillar in some countries. In Australia, Denmark and the Netherlands most old-age income is generated through mandatory private prefunded systems, while the U.K. and Ireland stand out in that most retirement income comes from voluntary prefunded schemes (which are also quite sizeable in Canada and the United States.).

[4] Note that some countries such as Germany, France and Norway use a point system to translate a worker's earnings history into a pension income.

[5] Note that looking at low or high incomes changes this picture somewhat and reveals a slightly more complicated picture (OECD (2011): 121)

Table 4.1: Pension systems in selected OECD countries; contribution of components to weighted average pension wealth (in %), 2011

	First tier	**Second tier**		
	Public (flat)	Public	Private	
		ER, DB, NDC	DB	DC
Australia	40.6			59.4
Austria	0	100.0		
Belgium	6.4	93.6		
Canada	57.8	42.2		
Denmark	44.6			55.5
Finland	2.3	97.7		
France	0	100		
Germany	3.7	96.3		
Greece	0	100		
Ireland	100			
Italy	0.1	100		
Japan	44.6	55.4		
Luxembourg	15.8	84.3		
Netherlands	41.4		58.6	
Norway	3.7	85.4		10.9
Portugal	11.1	88.9		
Spain	0.7	99.3		
Sweden	5.6	48.0		46.4
Switzerland	0.2	69.3	30.5	
United Kingdom	89.3	10.8		
United States		100.0		

Note: Pension wealth is the present value of the flow of pension benefits (taking into account paid taxes and social security contributions), measured and expressed as a multiple of gross annual individual earnings. The first tier comprises of basic, minimum and resource-rested pensions. ER= earnings-related, DB = defined-benefit, DC = defined-contribution, NDC = notional defined-contribution.
Source: OECD (2011)

Despite the variety of organizing principles (defined-benefit vs. defined-contributions, public vs. private, payroll contributions vs. general revenues, mandatory vs. voluntary etc.), the only important distinction is really whether pensions are PAYG or prefunded. As will be shown below, even this distinction is at a fundamental macroeconomic level of no importance, as reforming either system or even transforming one system into another is always a purely redistributional move.

Table 4.2: Gross pension replacement rates from public and private pension schemes, in % of individual earning, 2011

	Public	Mandatory private	Voluntary DC	Total mandatory
Australia	11,8	35,4		47,3
Austria	76,6			76,6
Belgium	42		15,6	42
Canada	38,9		30,8	38,9
Denmark	28,9	50,7		79,7
Finland	57,8			57,8
France	49,1			49,1
Germany	42		16,9	42
Greece	95,7			95,7
Ireland	29		37,6	29
Italy	64,5			64,5
Japan	34,5			34,5
Luxembourg	87,4			87,4
Netherlands	29,2	58,9		88,1
Norway	46,1	7	12	53,1
Portugal	53,9			53,9
Spain	81,2			81,2
Sweden	31,1	22,7		53,8
Switzerland	34,5	23,4		57,9
United Kingdom	31,9		36,7	31,9
United States	39,4		38,8	39,4

Note: Replacement rates are calculated for an average income earner.
Source: OECD (2011)

4.1.1 Parametric Reforms

It is very easy to show that all parametric reforms of PAYG pension systems are purely redistributional. Let's suppose in line with chapter 2 that demographic aging makes a given scheme unsustainable and leads to an implicit pension debt, i.e. the present discounted value of all future pension benefits exceeds the present discounted value of future revenues. One immediate reform measure would be to raise the contribution rate. This obviously leaves workers worse off, since it lowers their current consumption while keeping the level of retirement benefits stable. Another way to address the imbalance would be to cut pension benefits, which, of course,

would make pensioners worse off. This could be done by directly lowering pension income or by reducing the annual growth in pensions. A number of countries have pursued the latter strategy by changing indexation from gross wage to net wage growth (e.g. Germany in 1992) or, alternatively, from some measure of average wage growth to price inflation (e.g. Italy) or a combination of both (e.g. Finland). A move to adjusting pensions in line with inflation is particularly effective as it preserves the purchasing power of pensions but de-couples them from general income growth. A third option, which is often proposed, is to increase the retirement age, thus leaving contribution rates and monthly benefits unchanged. However, raising the retirement age reduces the number of years a person receives a pension and increases the number of years it has to pay contributions. In essence, such a move therefore constitutes a combination of both, an increase in the overall size of life-time contributions and an overall reduction in aggregate pension benefits.

These three measures are all redistributive, since they all entail that at least one group is incurring a loss just to prevent the other from being made worse off.[6] Of course, more parametric reform options exist such as changing the valorization rule for past earnings, reducing early retirement incentives or relating benefits to demographic projections, but these are in essence merely reductions in the overall size of pension benefits and thus, again, clearly redistributional.

Finally, transfers from the general budget to the PAYG system seem, at first glance, a very attractive option to restore solvency without needing to change the contribution rate or the generosity of pension benefits. It would appear that this leaves neither pensioners nor workers worse off and would therefore satisfy the Pareto criterion. Yet again, this conclusion does not withstand closer scrutiny. If the increased budget transfer is financed by raising taxes, then whoever has to bear the additional tax burden is made worse off. If the additional funds are raised by increasing the budget deficit, then the implicit pension debt is merely turned into explicit government debt. From an intertemporal perspective, this debt (including interest) needs to be repaid in the future. Of course, it is possible to delay debt repayment into the far future, where current workers and retirees are no longer alive. This, however, would worsen the welfare of some future generation, leading in essence to an inter-generational redistribution. Funding the budget transfer by cutting government spending

[6] Note that if only benefits are cut and contributions remain unchanged, workers are also made worse off. The reason is that the present discounted value of their future pension income is also lower, thus reducing their life-time consumption.

in some other area would avoid this burden on future generations, but it would represent an opportunity cost, which is ultimately borne by those who would have benefitted from that spending. As a result, transfers from the general government budget are also redistributional in nature, even though winners and losers may be harder to identify.

4.1.2 Non-parametric Reforms

Policy discussions in many OECD countries have moved beyond parametric changes, contemplating non-parametric reforms such as the transition from PAYG systems to prefunded schemes.[7] The essence of such a move is to replace some or all of the PAYG system with retirement income generated from a capital stock that has been accumulated during a retiree's working life. As a result, pension income is no longer a transfer from current workers.[8] What often muddles public discussions about pension prefunding is that is often considered synonymous with privatization or introduction of individual retirement accounts.[9] However, prefunded schemes come in very different flavors. They can be mandatory (e.g. the prefunded occupational pensions in the Netherlands) or voluntary (e.g. the "Riester-Rente" in Germany), they may be invested in private individual retirement accounts (e.g. Sweden's premium pension) or in a government-run trust fund (e.g. Canada), investment can be made in a diversified portfolio or in government bonds only. Whatever the precise path chosen, the desirability of a shift to a prefunded system seems self-evident when comparing the relatively low rates of return of a mature PAYG system with the higher returns that can be obtained by investing in financial assets[10]. This has led some to argue that under certain con-

[7] The (failed) attempt of the Bush-administration in 2005 to introduce personal retirement accounts in the U.S. is one example. The (successful) reform in Sweden in 1999 is another.

[8] This decoupling from current workers is, of course, fictional on a macroeconomic level. Even with a large stock of accumulated assets in stocks and bonds,the retirement income still depends on workers willingness to work and pay taxes. Otherwise, stocks and bonds would not be worth anything.

[9] See Feldstein (1997, 2005) for an in depth description of individual retirement accounts.

[10] Boldrin et al. (1999) estimated internal rates of return for selected European countries and compared them with average returns on different assets. The calculation of PAYG

ditions such a transition could raise overall welfare (see Feldstein (1995b, 1997))[11], while even others consider this to constitute a free lunch (see Ferrara (1997)). However, as will be shown next, transition to a partially or fully prefunded system is again merely a redistributional policy shift.

4.2 It's Redistributional, Stupid!

The relative efficiency of a move from a PAYG to a prefunded system has been the subject of some intensive theoretical debates. Breyer (1989) maintained that a prefunded system could not Pareto-dominate a PAYG scheme. The reason is that under a PAYG arrangement, the first generation receives a pension without having to make any contributions themselves. A transition to a prefunded system would need to honor the commitments made to the introductory generation and leave any later generation better, or at least not worse, off. Breyer shows that this is not possible. Homburg (1990), on the other hand, maintains that a Pareto-improving transition is possible, if contributions are not considered to be lump sum (as Breyer (1989) did) but flat-rate. Yet, others like Brunner (1996) and Fenge (1995) claim that with or without proportionality of contributions, in neither case can a conversion from a PAYG system into a prefunded scheme be a Pareto-improvement. Others have nevertheless argued that devising a Pareto-improving transition is feasible (see Belan et al. (1998); Feldstein and Samwick (1998)). Yet, this requires some positive growth externality effects that are not necessarily an issue of pension reform and do not necessarily materialize when funding is introduced. Hence, many have concluded that from a present discounted value perspective, a transition to a prefunded system cannot make anybody better off without making someone else worse off (see Breyer (2001); Geanakopolos et al. (1998); Sinn

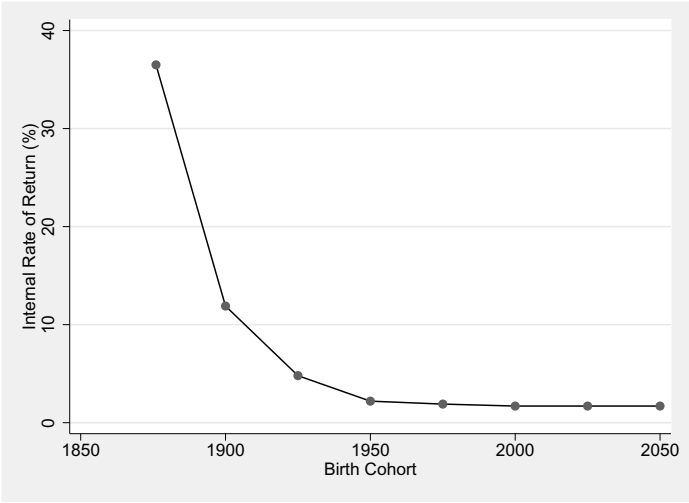
rates of return was based on the assumption of 35 years of contribution and 20 years of retirement. They found, for instance, that in Germany and France, the public PAYG scheme yielded a 2.0 and 3.3 per cent return respectively. Returns on long term bonds offered 4.0 and 5.6 per cent respectively between 1981 and 1990. In the same period, the average annual return on investing in equities was 11.3 and 11.1 per cent. However, when considering the period 1991-1996, the returns obtained by investing in the stock markets were negative with -0.3 and -0.1 per cent respectively. This already hints at the greater volatility and thus greater risk of equity investments.

[11] Note that even Feldstein does not claim that such a policy would be Pareto-improving, only that the overall gains exceed the losses (Feldstein (1997): 6).

(2000)). The validity of this claim will be briefly shown next, first intuitively, and then somewhat more formally.

The Pareto efficiency of a PAYG system rests ultimately on the first generation of pensioners. When a PAYG scheme is introduced, current retirees receive a pension without having contributed themselves to the system. Their rate of return is therefore infinite. Note that the next age cohorts (people in their fifties or forties, for instance) also get a very favorable deal, since they will receive a full pension income, while having only to contribute 10 or 20 years of their working lives. Only those generations that enter the workforce at the introduction of the system (and all later generation for that matter) have to internalize the full cost of the system. Hence, any PAYG scheme faces declining internal rates of return, with earlier generations faring considerably better than later ones. This fact is empirically illustrated for the American social security system in figure 4.1, which shows the development of inflation-adjusted returns for different birth cohorts.

Fig. 4.1: Internal rates of return of the American Social Security system for selected birth cohorts, %



Note: Internal rates of return are inflation-adjusted. Numbers from 2000 on are projections.
Data Source: Leimer (1995).

These "gifts" for the early generations are one reason why the rates of return to a PAYG are lower than the interest rates on long term government bonds. The costs for the initial pensions are simply spread across all future generations. An attempt to transform such a scheme into a prefunded system would face two obstacles: first, it would need to pay off immediately these early "gifts", and, second, it would need to deal with the transition burden. The transition burden arises because current workers would not only need to pay contributions to finance current pensions but also need to accumulate savings for their own retirement when a prefunded system is being established. As it turns out, there is no way to deal with this transition burden that would constitute a Pareto-improvement. Raising additional taxes to cover these costs would make current workers worse off. Cutting current pension benefits would reduce the welfare of retirees. Both of these options clearly entail a stark inter-generational redistribution. The solution most often proposed is to cover the transition costs by means of debt-financing. This, in essence, would turn the implicit debt of the pension system into explicit government debt and may suggest to offer a Pareto-superior solution. Existing pension claims could be covered through debt-financing, while workers should benefit from higher future pension income because interest rates, say on government bonds, are higher than the returns from the PAYG system. However, a simple example will show that workers are no better off than under the previous arrangement.

Suppose there is a PAYG scheme to which workers contribute a certain fraction of their income, which is then used to finance current pensions. All other income is used for current consumption. The by now well-known utility function and budget constraints[12] are the following:

$$\begin{aligned} U &= c_t + x_{t+1} \\ c_t &= w \cdot (1 - \tau_t) \\ x_{t+1} &= w \cdot \tau_t \end{aligned} \tag{4.1}$$

To keep matters simple, let's assume that working income is the same for everybody and is 1000 EUR. Furthermore, assume that there is no population growth, no additional private savings and the contribution rate is 0.15, i.e. 15 per cent. Income in each period and lifetime utility are therefore

[12] See chapter 3.1.1 for an explanation of the formal notation.

$$\begin{aligned} c_t &= 1000\ \text{EUR} \cdot (1 - 0.15) = 850\ \text{EUR} \\ x_{t+1} &= 1000\ \text{EUR} \cdot 0.15 = 150\ \text{EUR} \\ U &= 850\ \text{EUR} + 150\ \text{EUR} = 1000\ \text{EUR} \end{aligned} \tag{4.2}$$

Hence, every retiree receives a pension of 150 EUR and a lifetime income (equivalent to utility) of 1000 EUR. Now a prefunded system is introduced in the hope of raising future pensioners' income. This is a mandatory individual account system that invests the proceeds of the contribution rate in safe government bonds that offer a rate of return of 5 per cent. At the same time, the government borrows money to pay for the existing pension claims of the PAYG scheme. Obviously, this debt carries with it an interest rate of 5 per cent and needs to be serviced by the workers. This changes the first period's consumption constraint to

$$c_t = w \cdot (1 - \tau_t) - D \cdot r \tag{4.3}$$

where D denotes the borrowing (per retiree) and r is the interest rate. Income in each period and lifetime utility would now change to

$$\begin{aligned} c_t &= 1000\ \text{EUR} \cdot (1 - 0.15) - 150\ \text{EUR} \cdot 0.05 = 842.5\ \text{EUR} \\ x_{t+1} &= 150\ \text{EUR} \cdot (1 + 0.05) = 157.5\ \text{EUR} \\ U &= 842.5\ \text{EUR} + 157.5\ \text{EUR} = 1000\ \text{EUR} \end{aligned} \tag{4.4}$$

Pensions are indeed higher in the prefunded system, but note that debt servicing increases the tax burden on the workers exactly to such an extent that overall lifetime income (utility) is the same as under a PAYG arrangement. If we put the responsibility for servicing the debt on the retirees, then we would find that pension income now becomes $x_t = 150\ \text{EUR} \cdot (1 + 0.05) - 150\ \text{EUR} \cdot 0.05 = 150\ \text{EUR}$. In other words, the transition burden exactly offsets the higher return from prefunding. The higher rate of return in a prefunded system is therefore elusive.[13] This result underlines that nothing is gained in welfare terms by a transition. It only converts the implicit pension debt that exists because of the "gifts" that were made to the early generations into explicit government debt.

[13] This example shows that letting workers service the debt represents an intergenerational redistribution in favor of the old, while letting retirees pay for the debt leaves the welfare of both groups unchanged. From a policy perspective, this would suggest that the interest burden of a debt financed transition to a prefunded system should be put on those generations of pensioners that receive their pensions from the prefunded system.

Note that this proposition can be proven in general terms without having to resort to arbitrary numerical examples. To be Pareto-superior, a reform to a prefunded systems needs to satisfy

$$U^{paygo} < U^{funded} \tag{4.5}$$

where the superscripts mark the lifetime utility under PAYG or prefunded scheme, respectively. Using (4.1) and (4.3), this expression becomes

$$w \cdot (1 - \tau_t) + w \cdot \tau_t < w \cdot (1 - \tau_t) - D \cdot r + (1 + r) \cdot w \cdot \tau_t \tag{4.6}$$

where $D = w \cdot \tau_t$. Given that w and τ are kept constant, it is easy to verify by solving for r that this statement is always false. There does not exist an interest rate r that would make the right-hand side greater than the left-hand side. However, if we replace the inequality- by an equality-sign, we find that any interest rate r would satisfy such an equation. In other words, no matter how high the interest rate is, lifetime utilities under both systems remain the same.

It is tempting to presume that establishing a prefunded scheme that invests in stocks instead of bonds would circumvent this problem. After all, stocks earn on average a much higher return than government bonds.[14] Hence, stock returns would exceed necessary interest payments on government debt. This line of reasoning, however, ignores the fact that equity investments exhibit much larger volatility in their rate of return profile and are therefore riskier. When calculating lifetime income and utility, the inherent risks need to be adjusted for. In a well-functioning financial market, higher returns on equities simply reflect the higher risks associated with them. If one subtracts the risk premium, returns should be basically the same. If this was not the case, governments could make huge arbitrage profits by issuing bonds and investing the proceeds in the stock market. Therefore, in *expected* utility terms, there is again nothing to be gained by a transition from a PAYG to a prefunded system.[15]

Sinn (2000) has arrived at a similar conclusion by focusing on the equivalence of implicit and explicit pension debt. He underlines that in present

[14] To give but one example, the average annual return on stocks in the U.S. was 16.5 per cent between 1990-1996, while long term government bonds only yielded 4.3 per cent in the same period (Boldrin et al. (1999): 311).

[15] Of course, there are valid arguments for prefunding part of a pension system. However, these arguments emphasize mainly improved diversification (Sinn (2000)), especially if there are many households with only constrained access to capital markets (Geanakoplos et al. (1998)).

value terms, the sum of all contributions/taxes must match the sum of all pensions. His formalization makes clear how the cost of the "gift" to the first generation of pensioners in a PAYG system is transmitted to all subsequent generations. Implicit in any contribution to a public pension arrangement is an implicit saving S_t, which is the amount of income an individual would need to invest in financial assets to achieve the same level of pension benefits as with the PAYG scheme. If the actual contribution rate τ_t exceeds S_t, then the resulting residual can be considered an implicit tax T_t. The contribution rate therefore consist of two parts:

$$\tau_t = T_t + S_t \tag{4.7}$$

This entails that implicit saving is defined by

$$S_t = \frac{x_{t+1}}{1 + r_{t+1}} = \frac{\tau_{t+1}}{1 + r_{t+1}} \tag{4.8}$$

where x_{t+1} is the expected pension and r the rate of interest earned in the capital market. Since τ_t determines pension income, implicit saving is the contribution divided by the market interest rate.

Now, the overall implicit pension debt of the system is simply the first generation's pension x_0, which, of course, is $x_0 = \tau_t = T_t + S_t$. Hence, taking population size of the workers N^w explicitly into account

$$D_t = N_t^w \cdot T_t + N_t^w \cdot S_t \tag{4.9}$$

Combining the right-hand side of the second equation in (4.8) with (4.7) and inserting into (4.9) yields

$$D_t = N_t^w \cdot T_t + \frac{N_t^w \cdot T_{t+1}}{1 + r_{t+1}} + \frac{N_t^w \cdot S_{t+1}}{1 + r_{t+1}} \tag{4.10}$$

As this relationship holds for subsequent periods as well, and since the term S_k can be replaced according to (4.8) with $k+1$ ad infinitum, we arrive at the present discounted value of implicit pension debt:

$$D_t = \sum_{k=t}^{\infty} \rho_k \cdot T_k \cdot N_k^w \tag{4.11}$$

where $\rho_k = \prod_{j=t+1}^{j=k} \frac{1}{1+r_k}$ (given $k > t$) is the discount factor. As has been shown above, the implicit pension debt exist because of the "gift" that has

been made to the first generation. The implicit tax T is the part of the debt that any subsequent generation has to bear and the present discounted value of all future T constitutes the size of this inter-generational burden. Note that while this debt is covered in present value terms, it can never be repaid, since it is rolled over from one generation to the next and grows with the generosity of the PAYG scheme,[16]

It is easy to show now that a debt-financed transition to a prefunded system does not reduce the overall debt burden. Since explicit government debt D^e_{t+1} at any point in time t is defined by previously existing debt minus repayments through explicit taxes T^e times the interest rate, i.e. $D^e_{t+1} = (1+r_{t+1}) \cdot (D^e_t - N^w_t \cdot T^e_t)$, we have the suspiciously familiar relationship

$$D^e_t = N^w_t \cdot T^e_t + \frac{D^e_{t+1}}{(1+r_{t+1})} \tag{4.12}$$

Summing this term over an infinite number of future periods yields

$$D^e_t = \sum_{k=t}^{\infty} \rho_k \cdot T^e_k \cdot N^w_k \tag{4.13}$$

Comparing this term with (4.11) we see that $D_t = D^e_t$. Hence a transition from a PAYG system to a prefunded one leaves the overall pension burden unchanged. It merely converts the implicit pension debt into explicit government debt and changes the financing mode from PAYG-contributions to general taxes. Despite this equivalence, however, the macroeconomic policy consequences may not be the same at all. Explicit government debt needs to be issued and taken up by financial markets. It therefore directly adds to a country's debt stock and affects its solvency and financing conditions much more than implicit debt, which only needs to be covered in the future and which could be reduced by changing a pension system's parameters. This suggests that making the implicit pension debt explicit may come at an additional cost that needs to be considered when pondering the welfare effects of a non-parametric pension reform.

[16] It may appear somewhat hard to understand that the debt burden does not decrease but rises with the pension system's generosity. But it suffices to remember that in any period t, $D_t = N^w_t \cdot x_t$.

Detour: Prefunding and Economic Growth

Beyond the previous discussion, an economic argument could be made that, in the long run, a transition to a prefunded system may be Kaldor-Hicks-efficient because it raises economic growth and thus overall welfare.[17] As Feldstein (1974) has shown in the context of the American social security system, PAYG schemes depress national saving which implies a lower aggregate capital stock. This in turn results in a lower level of national income. While Leimer and Lesnoy (1982) showed that Feldstein's econometric results overestimated the deleterious effect of a PAYG system on national saving, the general economic argument has been, in principle, accepted. On the basis of this argument, Feldstein has repeatedly argued in favor of partial transition to prefunded retirement accounts (Feldstein (1995a, 2001, 2005)). The underlying idea is, of course, that such a move would significantly raise national saving, thus leading to a bigger capital stock and higher national income.[18] There are, however, two qualifications that have to be made to this argument. First, prefunding may not necessarily lead to higher aggregate saving if it simply crowds out existing saving. In other words, at the introduction of a mandatory prefunded system, households may simply reduce other forms of savings, leaving the national aggregate virtually unchanged. Therefore, prefunding only increases the saving rate if it forces people to save more than they intended. Second, a debt-financed transition to prefunding leaves national saving unchanged, since, as shown above, only the form of debt has been changed.

The empirical evidence on the link between prefunding, private saving and growth is mixed. While Bailliu and Reisen (1998) find statistical evidence that the level of prefunded pension assets increases private saving in OECD and non-OECD countries, Bosworth and Burtless (2004) arrive at the conclusion that pension saving is merely a substitute for other forms of saving in OECD countries. With respect to the impact on economic growth, the empirical picture is similarly unclear. Davis and Hu (2008) find econometric evidence that prefunding increases economic growth, yet a very recent analysis of OECD and non-OECD countries by Zandberg

[17] Hence, with the right compensation scheme, the design of which is not a trivial matter, no one needs to be worse off.

[18] This theoretical link may not hold for small, open economies, however. As Van Groezen et al. (2007) show, these economies may even be worse off from an increase in saving and capital accumulation.

and Spierdijk (2013) has not found any effects of the degree of prefunding on short-run economic growth, while the results for long-run growth have been mixed. Therefore, while economic theory suggest a way in which reform towards prefunding may raise overall economic welfare, the empirical record is far from clear. In any event, as the failed attempt to introduce individual retirement account in the U.S. in 2005 has clearly shown, the immediate redistributional concerns seem politically more salient than arguments pointing towards possible future economic growth effects.

In sum, any change to a pension scheme, be it parametric or non-parametric, is redistributional (at least in the immediate sense).[19] What the previous analysis points out is that there is no free lunch to be had. Any reform will involve winners and loser and is therefore a politically very contested issue. This shall not be taken to mean that changing a country's system of old-age provision is never sensible. Quite to the contrary, population aging heavily redistributes a pension system's financial burden between current and future generations. Making profound policy changes is thus warranted on equity and fairness grounds that are subject to political debate.[20] It is not the aim of this dissertation, however, to enter this discussion and come forth with a pension proposal that satisfies certain normative criteria advocated by the author. The intention is merely to model part of the political rationale behind such pension reform, no matter what the distributional outcome is.

[19] Note that Breyer (1989) shows that mixed systems consisting of both PAYG and prefunded pension provision are not pareto-superior either.

[20] Just to give but two examples, Diamond and Orszag (2005) advocate, in the context of the American Social Security system, to keep the PAYG scheme and restore its financial balance by a combination of gradual benefit reductions and revenue increases, thus spreading the adjustment costs across current and future generations. Sinn (2000), on the other hand, argues in favor of partial prefunding. He advocates putting the transition costs of this reform on those current worker generations that failed to produce enough offspring. As these generations saved money on child rearing and education compared to previous generations, so the argument goes, it is fair to let them bear additional costs.

Chapter 5
Pension Preferences and Reform – A Political-Economy Model

5.1 The Point of Departure

This dissertation has emphasized two things so far. First, existence and sustainability of a pension system is not merely an economic efficiency question but rather a highly political issue. Theoretical explanations therefore need to explicitly model political factors. Second, any pension reform is a purely redistributional policy shift that entails a different political rationale than Pareto-improving policy changes do.

The point of departure for what follows is that the existence of a public PAYG pension scheme can be considered a political equilibrium. Population aging and its consequences as outlined in chapter 2 represent an exogenous perturbation of this equilibrium. The way a political system reacts to this shock and enacts political change depends on two essential factors: one, on voters' preferences, and two, the constitutional structure, i.e. the rules of the game, of a country. Preferences and electoral institutions shape, which issues are considered important, the way political competition is conducted, which preferences will be decisive and which will be filtered out, how many parties can enter the legislative body, the stability and size (number of coalition partners) of governments, and, ultimately, what kind of policies will be implemented.

With respect to the first factor, in a democratic society we can expect that the size and shape of a public pension system reflects the preferences of a majority of voters (mediated through the political system). Hence, analyzing individual preferences is key for understanding societal decisions on old-age provision for retirees. A major assumption in many public de-

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bates is that the age of an individual matters most in determining his or her preferences for public pensions. This is what underlies the notion of "generational conflict", the perception that preferences regarding size and shape of a pension system follow generational lines. The assumption often made is that younger people prefer a smaller public pension system than retirees or older workers. Some maintain that these conflicting generational interests are key for understanding feasibility, timing and structure of pension reforms (see, for instance, Sinn and Übelmesser (2001)).[1] This naturally begs the question: Does age play an really an important role? The model proposed below will formally derive how individual age interacts with the aging process and the size of the existing pension system to shape the policy preferences of different societal groups.

With respect to the second factor, the importance of the electoral system[2] for the political process and policy outcomes has been well established in a large theoretical and empirical literature. While electoral systems differ in a number of dimensions such as district magnitude, effective thresholds, list type, malapportionment and ballot structure, the most important aspect is the electoral formula,[3] which determines how votes are transformed into parliamentary seats. The central property is the degree of proportionality, that is, how closely related are vote shares and seat shares. One can, in a very stylized fashion, distinguish between proportional and majoritarian systems. Highly proportional electoral formulas exhibit a ratio of vote share to seat share of close or even equal to one. Majoritarian systems of a first-past-the-post type, on the other hand, have a ratio of zero if a party's vote share is below the winning threshold in a given district, and a ratio above one if the vote share lies above the threshold.

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[1] Taking this view as given, Sinn and Übelmesser (2001) look at population growth projections for Germany and estimate the number of years until the pivotal median voter belongs to an age group that opposes any pension reform. They come to the conclusion that after 2023, reducing the public pension pillar will become infeasible because "the country will be characterized by a gerontocratic system where the old decide over the young" (p. 17).

[2] A useful definition of what constitutes an electoral system is suggested in Morelli (2004): *"The electoral system determines a mapping from the election results (i.e. distributions of votes) to a distribution of seats in a parliament, which then determines the policy by majority rule"* (830).

[3] The electoral formula determines how votes are translated into parliamentary seats. Broadly, one can distinguish between highest average methods such as d'Hondt, Sainte-Laguë and their modified versions, and the largest remainder approach that uses quotas such as the Hare- or Droop quota. For overviews, see Norris (1997); Lijphart (1999) and Myerson (1999).

Duverger (1954) was the first to observe that majoritarian formulas like plurality vote tend to produce systems with only two competitive parties. This finding has even been labeled a *Law* by Riker (1982) and theoretically been elaborated by, among many others, Palfrey (1989) and Morelli (2004). Its impact on the number of parties also entails that systems of proportional representation are more likely than majoritarian systems to exhibit coalition or even minority governments, although this correlation is far from being a perfect one (see Norris (1997); Lijphart (1999)). Iversen and Soskice (2006) even argue that the ideological composition of governments is affected by electoral institutions, with proportional systems favoring center left-coalitions, while center-right governments dominate under plurality voting. Furthermore, a number empirical studies have clearly shown that voter turnout is significantly higher in proportional systems (see Blais and Carty (1990); Jackman (1987)). The findings of a recent paper by Fisher et al. (2008) even suggest that plurality systems discourage voters with less political knowledge from going to the polls.

Electoral systems also affect the nature of parties' campaign platforms, that is, how close these are to the position of the median voter and whether different parties converge or diverge in their programmes (see Cox (1987, 1990)). In general, systems of greater disproportionality such as plurality voting have been associated with a less accurate representation of the electorate's preferences. In their empirical analysis, Powell and Vanberg (2000) arrive at the conclusion that proportional representation outperforms majoritarian systems in terms of proportionality and the closeness of the correspondence between a parliament's median and the median voter in the general electorate. Yet, the model by Austen-Smith and Banks (1988) cautions against such a clear-cut normative conclusion. They have shown that strategic voting on part of the electorate could severely reduce the degree of representativeness of governments and policies in proportional systems.[4]

Finally, given the profound effect on party competition, party structure, platforms and government formation, it comes as no surprise that electoral institutions should also systematically shape policy outcomes. With respect to fiscal policy, it has been shown theoretically and empirically that countries with majoritarian electoral rules spend less on public goods and have smaller governments than countries operating under proportional

[4] Evaluations of electoral system can also be made based on normative grounds, such as the effectiveness and accountability of the government, the degree of fairness to small parties and therefore the inclusiveness with respect to minority preferences (see Norris (1997)).

representation (see Lizzeri and Persico (2001); Milesi-Ferretti et al. (2002); Persson and Tabellini (1999, 2003)). Some have also argued that the latter system is more likely to suffer from high government indebtedness, since it usually leads to coalition governments, which are prone to common pool dilemmas (see Hallerberg and Hagen (1997)). There indeed exist numerous empirical studies that investigate the impact of the number of coalition partners and legislative parties on the size of government deficits and debts (see Roubini and Sachs (1989); Grilli et al. (1991); Haan et al. (1999); Perotti and Kontopoulos (2002)) or on fiscal retrenchment decisions (see Mulas-Granados (2003); Mierau et al. (2007); Pamp (2008)). Furthermore, it has also been emphasized that proportional systems are associated with less income inequality (see Verardi (2005)) and more redistributional spending (see Austen-Smith (2000); Iversen and Soskice (2006)). Other policy areas have also been investigated. Myerson (1993) and Persson and Tabellini (1999) respectively have examined the relationship between electoral rules on the one hand, and corruption as well as political rents on the other. Finally, in analyzing labor market institutions, Neugart (2005) has developed a model explaining why unemployment benefits (net replacement rates) are higher in countries employing proportional representation.

In sum, it is well established that elections and the electoral process shape the fundamental properties of representative democracies. They have a profound impact not only on the policy-making process itself, but also on the nature of the policies that are enacted. Understanding electoral competition in terms of voters' preferences and the institutional environment is therefore key in understanding how policies are devised. This does not mean that post-electoral politics, i.e. legislative bargaining and coalition formation, are unimportant. Quite to the contrary: many policies can only be understood in light of these post-electoral dynamics – a case in point being pork-barrel spending and the 'common-pool-problem'.[5] However, the impact of post-election institutions is empirically less well established than the impact of the voting process itself. While Persson and Tabellini (2003) find statistically significant differences in policy outcomes

[5] The 'common-pool-problem' results when there is more than one decision maker involved in setting the budget. These decision makers represent different constituencies they care about and hence compete for their preferred public goods. In doing so, they fail to internalize the costs of their choices on current and future expenditures in terms of higher taxes needed for debt service and payments, which results in a deficit bias (see Weingast et al. (1981); Persson and Tabellini (2006); Hallerberg and Hagen (1997); Tornell and Lane (1998); Velasco (1999, 2000); Krogstrup and Wyplosz (2006)).

between presidential and parliamentary regimes, a recent empirical study by Blume et al. (2009) came to different conclusions. Using a broader country sample and more recent data, they found that while differences in electoral systems exert a discernible and significant influence on public policy, differences in post-electoral institutions (i.e. differences between presidential and parliamentary regimes) do not. Hence their conclusion is that *"it is the details of the electoral systems that matter most"* (Blume et al. (2009): 218)

Ultimately though, the question of which dimension is more decisive in shaping public policy depends on the issue under consideration. Very salient issues (highly ideological, redistributive character) that strongly influence voters' electoral preferences are likely to be established before the elections by candidates and parties and are not subject to coalition bargaining. They are the breaking point that every party brings to the bargaining table. These promises are rarely broken and thus are decided in the electoral competition process. In fact, the few empirical studies that do exist suggest that electoral promises, contrary to the public's perceptions, are by and large actually kept by parties and candidates (see Klingemann et al. (1994); Walgrave et al. (2006)). Hence, the question of whether we should model pre- or post electoral politics depends on the salience of the policy field in question.

Unfortunately, there are, as far as I am aware of, no empirical studies that measure and compare the salience of different policy fields. Postulating that pension policy is a highly salient issue that is appropriately analyzed in terms of voters' preferences and political elections is therefore an assumption. However, while there are no direct measures of salience, there are surveys that reflect voters' perceptions of issues, which in turn could indirectly hint at their salience. That voters care strongly about their old-age provision has been shown in a Eurobarometer poll in 2001[6], which found that more than 90 per cent of the persons asked in EU-15 countries agreed that a guaranteed minimum pension should be a basic social right for every citizen (European Commission (2004): 52). This indicates a strong attachment on part of the voters to their public pension system. That pension reform is perceived to be a pressing issue has been shown in an opinion poll conducted by Boeri et al. (2001). They found that more than two thirds of the respondents in France, Germany and Italy expect the public pension system to be in a crisis. Even 70 per cent in these countries expect a major reform in the future that will decrease the system's

[6] Around the turn of the 21st century, pension reforms where extremely high on the political agenda in many European countries.

generosity. As a result of these findings, the assumption that pension policy is a highly salient issue is therefore not a feeble one.

Given the importance of preferences and electoral considerations in the area of pension reform, the aim of this chapter is to develop a three-period overlapping generations (OLG) model, where policy preferences are formally derived from individual optimizing behavior based on first-order preferences. Unlike many other political-economy models, this one does not look at pension systems in isolation but also explicitly considers the fact that resources not spent on pensions could be spent on other items. In addition, the model allows to analyze the impact of different population growth rates and the generosity of an existing pension scheme on policy preferences. The results of the model are then used to look at the effects direct referenda, as well as majoritarian and proportional electoral systems could have in filtering these preferences through the electoral process. Taken together, derivation of policy preferences and consideration of electoral institutions allow me to formulate political scenarios under which changes to a pension system are more or less likely.

5.2 The Basic Model

The model proposed in this chapter is a three-period-OLG where at each point in time a generation of young workers, old workers and retirees are alive. It is assumed that a mandatory public pension system is already in place and that people also have the option to privately save for their retirement. The model allows the analysis of agents' economic choices and optimizing behavior and, therefore, makes it possible to explicitly derive policy preferences with respect to pension systems.

At this point, it is useful to delineate the term 'policy preference', which refers to the voting choices individuals would make, if they had the chance to cast their vote on pension policy. Policy preferences are derived from first-order preferences about individual consumption. These first-order preferences are, of course, assumptions we make about individual goals and tastes. These are the standard assumptions also made in the models explicated in chapter 3, most notably, the assumption that individuals aim to maximize their life-time consumption. Of course, as with any model, if we change the basic assumptions about these preferences, model predictions about policy preferences would change as well. Assuming that individuals are concerned with their own consumption does not rule out

intergenerational altruism or concern for income inequality, as some of the models in chapter 3 have shown. But since pension policy is about the distribution of working and retirement income, it makes sense to make the assumption that individuals are motivated by concerns for their own life-time consumption.[7] However, as the following model will show, additional policy concerns can also be analytically accommodated.

5.2.1 Assumptions and General Form Solutions

The (general form) utility function of a representative individual is given by

$$U_t^i(c_t, c_{t+1}, c_{t+2}) = u_t[c_t + \gamma^y \cdot g] + \rho \cdot u_{t+1}[c_{t+1} + \gamma^o \cdot g] + \rho^2 \cdot u_{t+2}[c_{t+2} + \gamma^r \cdot g] \tag{5.1}$$

with the subscripts indicating the model period and the superscripts denoting the age of an individual i, where $i \in \{y, o, r\}$ stands for a young worker, an old worker, or a retiree, respectively. Hence, as in the Browning model, agents work two periods of their life and then spend one period in retirement. At each point in time, there are thus young and old workers as well as retirees. As individuals make plans over lifetime consumption, future utility is discounted by a common factor ρ, with $0 < \rho \leq 1$, which captures time preferences. The standard assumptions about the general properties of the utility function are as in the models of the previous chapters: $u(0) = 0$, $u' > 0$ and $u'' < 0$. Utility in each period of life is derived not only from private consumption c but also from the provision of a public policy good g. This public policy term can be very broadly interpreted. It may represent public services such as education or unemployment insurance, but it could also refer to more intangible policies such as securing intragenerational equity (although income inequality is not explicitly introduced in the model) or the sustainability of general public finances.[8] Furthermore, g may also stand for policies that have future benefits such

[7] There is, of course, a large theoretical and empirical literature on whether individuals vote based on their economic self-interest. However, it is beyond the scope of this dissertation to discuss this huge body of research. For an early review see Feldman (1984). Regardless of whether people actually vote according to their 'pocket book', there is ample evidence that policy makers believe that they do (Tufte (1978).

[8] It would also be possible to conceptualize g to represent the government's budget deficit. Then g would enter the utility function with a negative sign.

as productive investments in research and development, infrastructure or preserving the environment. I am trying to be deliberately broad here: the idea is simply that voters are not only interested in maximizing private consumption but also have a demand for public policies that are not directly tied to personal consumption, but may have current intangible advantages or future benefits. These future benefits are not explicitly factored into future consumption, but people are aware that their future welfare may be affected by them.

This set-up introduces not only a multidimensional issue space but makes the political decision problem more interesting. The majority of pension policy models assume that the contribution rate is the only issue that voters are concerned with. Introducing the public policy term accounts for the fact that elections are rarely about pension policy alone.

The parameter γ^i, with $\gamma^i > 0$, measures the relative value that a given voter attaches to this policy good. It is assumed here that γ^i depends on an agent's generation, and every member of a generation has the same evaluation of the public policy. This necessitates some strong assumptions about the relative size of this parameter for every age group. The easiest decision is to assign the lowest γ-value to the retirees. This corresponds with the already mentioned postulation of the 'single mindedness' of pensioners, which maintains that the old are mainly concerned with their pension income and act as a group very cohesively in terms of their voting behavior. There are a few empirical studies that seem to lend support to this notion. Canegrati (2007) has tested whether age is significant in determining political preferences. Using British survey data, he found that political preferences are indeed strongly correlated with age. Campbell (2003), on the other hand, examined participatory reactions to perceived policy threats using U.S. data. The empirical results suggest that "senior citizens reacted most strongly to threats to age-related programs, with reaction falling off monotonically as age decreases" (Campbell (2003): 40). The use of the single-mindedness hypothesis as a guide to the political behavior of the old in a number of theoretical papers (e.g., Mulligan and Sala-i Martin (1999a, 2003) and Profeta (2000, 2002a)) seems therefore not to be too far-fetched. Hence, it makes sense to assume that retirees place a relatively low weight on the public policy good compared to the pension policy.[9]

[9] Note that a low preference for g should not be confused with the preference for a small government or less government interventions. It simply states that pension policy is considered more important and these old voters are happy to trade-off the policy good

Having established that pensioners have a lower γ-value than workers, we still need to determine whether young or old workers place greater emphasis on the public policy good. Given that income and therefore private consumption tend to increase with age, we may conjecture that older workers place a lower value on public policy because they are less in need of public services and stand to gain less from future benefits (if g is interpreted to stand for sustainability). Even though the public policy good is very vaguely defined here, I assume that $\gamma^y > \gamma^o$. Unfortunately, there are not many studies, that I am aware of, that investigate this proposition empirically. Hewitt (1985) used U.S. data to derive demand curves for different public policies. He found that with increasing age, the demand for a diverse set of public policies, such as welfare, space exploration, education, foreign aid, and urban improvement, decreased. The only exception is defense spending, where the coefficient of the age-variable was positive. The negative correlation between age and the valuation of public goods has also been corroborated by Brookshire et al. (1982), who conducted surveys in the Los Angeles metropolitan area on people's willingness to contribute to public measures to reduce air pollution. Hence, their is some, at least tentative, evidence supporting the notion that younger workers should have a higher valuation for g than older ones. As a result, we can summarize our assumption about the three age groups' relative preferences for the public policy good as follows:

$$\gamma^y > \gamma^o > \gamma^r \tag{5.2}$$

We are now in a position to analyze the individual economic decisions of the model's agents. Lifetime utility, given by equation (5.1), is maximized subject to the following constraints:

$$c_t = w \cdot (1 - \tau_t) - s_t \tag{5.3}$$
$$c_{t+1} = w \cdot (1 - \tau_{t+1}) + (1 + r) \cdot s_t - s_{t+1} \tag{5.4}$$
$$c_{t+2} = x_{t+2} + (1 + r) \cdot s_{t+1} \tag{5.5}$$
$$x_{t+2} + g = (1 + n)^2 \cdot w \cdot \tau_{t+2} + (1 + n) \cdot w \cdot \tau_{t+2} \tag{5.6}$$
$$s_t, s_{t+1} \geq 0 \tag{5.7}$$
$$\tau_t = \tau_{t+1} \geq 0 \tag{5.8}$$

for higher public pension provision. Thus, this model makes no prediction about the overall preferred size of government.

These conditions are fairly standard and resemble to some extent the ones in the formalization of the Browning model in chapter 3. Hence, equations (5.3) and (5.4) indicate that during working life, individuals receive an income w which, after (non-distortionary)[10] contributions to the pension system and the public policy good $(1 - \tau)$ have been subtracted, they can either consume (c) or save (s). Wages are exogenously given at their steady-state value and are the same for both young and old workers.[11] Note that capital markets are assumed to be imperfect, since savings are constrained to be non-negative, which means that individuals cannot borrow against future income. Unlike in the formalization of the Browning model, however, agents may draw on their savings during their working life. In other words, an old worker may consume the savings accumulated during the first working period.

As is described by (5.5), pensioners receive their income from the savings they have accumulated plus the interest r they earn on them and the public pension x. Note that they do not need to pay any taxes and therefore neither contribute to the pension system nor to the public policy good. The budget constraint of the public pension system, equation (5.6), reflects the fact that the size of the pension system, and thus its generosity, depends on the number of workers (young and old) and the contribution rate levied on their income. It also depends (negatively) on the preferred size of the public policy good, which uses up financial resources that could otherwise be spent on pensions. Of course, in most countries the pension system is managed in a separate budget financed by social security contributions, whereas other government expenditures are funded though general taxation. However, this distinction is more virtual than real for two reasons: First, from an accounting perspective a pension fund belongs to the general government budget. Hence, deficits in the pension system are directly added to the overall government balance. From a macroeconomic perspective, it does not matter whether there is a joint budget or several nominally separated budgets.[12] Therefore, aging populations do not simply pose a burden on the sustainability of a pension system but on public finances in general. Second, nothing prevents a government from moving funds be-

[10] This property entails that the contribution rate does not affect labor supply and thus does not affect aggregate income and individual wages.

[11] Given this assumption, we could normalize w to one and drop this variable altogether. For interpretational reasons, however, I prefer to keep it as an explicit variable.

[12] Of course, financing the pension budget from flat-rate contributions may engender certain labor supply reactions that are different from the incentives generated through progressive taxation, which funds the general budget.

tween the general budget and the pension system. A case in point is the German system: since social security contributions are insufficient to fund current pension benefits, the system needs annual transfers from the federal budget ("Bundeszuschuss"). In the year 2011, this transfer amounted to around 25 per cent (DRV (2011): 7)[13] of overall pension expenditures. For these reasons, it is therefore not an undue simplification to use only one budget and one contribution rate in this model.[14]

Since this is a partial equilibrium model with no corporate sector, wages and interest rates are exogenously given and assumed to be at their steady state values. Note also that there is no explicit intra-generational heterogeneity, which is why w is the same for all workers. Furthermore, population growth n is not affected by pension policy and therefore also exogenous to the model.[15]

Finally, constraint (5.8) reflects the assumption that agents consider a pension reform to be binding for future generations. While admittedly unsatisfactory, this assumption is necessary to keep the model analytically tractable. In addition, as Bütler (2000) has argued, major pension reforms, as opposed to automatic parametric changes, are low-frequency events. This suggests that policy changes are made with the expectation that future generations will feel bound by it. A summary of all model assumptions can be found in Table 5.1.

Having elucidated the economic dimension of the model, we are in a position to make some statements about economic choices. Given (5.1), agents choose their consumption and private savings to maximize lifetime utility. Solving the resulting constrained optimization problem with

[13] This transfer is coming from the general budget as well as from a dedicated green tax ("Öko-Steuer").

[14] It would be quite easy to separate the pension system and the budget of the public policy good. This would simply necessitate to introduce a second tax rate, say l, which would change constraint (5.3) into $c_t = w \cdot (1-\tau)(1-l) - s_t$. The policy good g would then have its own budget constraint: $g = (1+n)^2 \cdot w \cdot (1-\tau) \cdot l + (1+n) \cdot w \cdot (1-\tau) \cdot l$.

[15] Note that in the long run, however, it does seem to be the case that population growth is endogenous, reacting, among other things, to changes in pension system parameters. Barro and Becker (1989) and Boldrin and Jones (2002) have devised theoretical models relating pension system characteristics to fertility. On the empirical side, using cross-sectional and panel data, Boldrin et al. (2005) have found that an increase in the pension system size can account for a drop in total fertility rates of between 0.7 and 1.6 children. However, given that these are trends unfolding over the long term and are not well established yet, it makes sense to assume that individuals do not consider the impact on population growth when making decisions on pension systems. The fact that most projections of population growth do not explicitly account for pension policy is testimony to this fact.

Table 5.1: Summary of model assumptions

Category	Assumption
Time structure	3-period OLG
Capital markets	imperfect, no borrowing
Labor supply	exogenous, at steady-state values
Interest rates	exogenous
Population growth	exogenous & negative
Wage rate	exogenous, at steady-state value
Intragenerational income / wealth distribution	homogeneous
Intergenerational altruism	No
Generational preferences for public policy good	$\gamma^y > \gamma^o > \gamma^r$
Voter perception of voting game	one-shot, once-and-for-all decision
Democracy type	representative

respect to the optimal saving rate yields[16] the optimality conditions for a representative young worker:

$$\begin{aligned} &u_t'[w\cdot(1-\tau)-s_t+\gamma_y\cdot g]= \\ &(1+r)\cdot\rho\cdot u_{t+1}'[w\cdot(1-\tau)+(1+r)\cdot s_t-s_{t+1}+\gamma_o\cdot g]= \\ &(1+r)\cdot\rho^2\cdot u_{t+2}'[(1+n)\cdot w\cdot\tau+(1+n)^2 w\cdot\tau-g+(1+r)\cdot s_{t+1}+\gamma_r\cdot g] \end{aligned} \tag{5.9}$$

Hence, young workers set their savings to equalize the marginal utility from consumption today with the marginal utility of future consumption, which is weighted by the discount factor and the returns earned on savings. Doing so, they also take present and future valuations of the public policy good into account. From the perspective of an old worker in period t, the reasoning is analogous, albeit for only two periods obviously. The corresponding condition therefore reads

$$\begin{aligned} &u_t'[w(1-\tau)+(1+r)\cdot s_{t-1}-s_{t+1}+\gamma_o\cdot g]= \\ &(1+r)\cdot\rho\cdot u_{t+1}'[(1+n)\cdot w\cdot\tau+(1+n)^2 w\cdot\tau-g+(1+r)\cdot s_t+\gamma_r\cdot g] \end{aligned} \tag{5.10}$$

[16] All formal derivations and results of this chapter are explicated in Appendix B.1.

where s_{t-1} constitutes a past decision that therefore cannot be altered in period t. These results give us the conditions under which a young and an old worker respectively would prefer a public pension system over private saving. These calculations have already been done in chapter 3.1.1[17]. The relative size of each generation depends again on n. For retirees to be in a majority, population growth must be negative. Calculating the precise growth rate for $N^r > 0.5$ yields $N^r > (1+n) \cdot N^o + (1+n)^2 \cdot N^y$, which results in $n < -0.382$. Assuming, as before, a generational span of 25 years, this implies an annual population growth of -1.5 %. For the young to form a majority, on the other hand, the necessary population growth rate must be at least 2.5 % per year.

5.2.2 *Logarithmic Utility, Optimizing Behavior and Pension Policy Preferences*

To allow for explicit solutions, let's be more specific about the concrete functional form. I employ a logarithmic utility function, since it has the convenient property that income and substitution effects cancel each other out. Hence, when doing comparative statics we do not have to make guesses as to which effect dominates. An individual's utility function thus reads:

$$U_t^i(c_t, c_{t+1}, c_{t+2}) = \log(c_t + \gamma^y \cdot g) + \rho \cdot \log(c_{t+1} + \gamma^o \cdot g) + \rho^2 \cdot \log(c_{t+2} + \gamma^r \cdot g) \tag{5.11}$$

Using this function, we can derive each generation's preferences with respect to the public pension system. To do this, we first need to analyze optimizing behavior of each generation. Young workers' optimal decisions are found by maximizing (5.11) using constraints (5.3)-(5.8). The resulting Lagrangian $\mathscr{L}$ is

[17] As explained in chapter 3.1.1, to do this we simply need to maximize equation (5.1) with respect to τ. Given that we assume $\tau, s_t, s_{t+1} \geq 0$, we can solve and simplify the resulting system of equations to arrive at $(1+n)^2 + (1+n) \geq (1+r)^2 + (1+r)$ for the young worker and $(1+n)^2 + (1+n) \geq (1+r)$ for the old worker. Hence, preferences for public pension provision depend on the relative sizes of the population growth rate and the rate of interest.

$$\begin{aligned}\mathscr{L} = &\log(c_t + \gamma^y \cdot g) + \rho \cdot log(c_{t+1} + \gamma^o \cdot g) + \rho^2 \cdot \log(c_{t+2} + \gamma^r \cdot g) - \\ &\lambda_1 \cdot (c_{t+2} - x_{t+2} - (1+r)(w \cdot (1-\tau) - c_{t+1} + (1+r)(w \cdot (1-\tau) - c_t))) \\ &-\lambda_2 \cdot (-x_{t+2} + c_{t+2}) \end{aligned} \tag{5.12}$$

where λ_1 and λ_2 are the Lagrange multipliers. Differentiating yields the following Kuhn-Tucker-conditions:

$$\begin{aligned}\frac{\partial \mathscr{L}}{\partial c_t} &= \frac{1}{c_t + \gamma^y \cdot g} - (1+r)(1+r) \cdot \lambda_1 = 0 \\ \frac{\partial \mathscr{L}}{\partial c_{t+1}} &= \frac{\rho}{c_{t+1} + \gamma^o \cdot g} - (1+r) \cdot \lambda_1 = 0 \\ \frac{\partial \mathscr{L}}{\partial c_{t+2}} &= \frac{\rho^2}{c_{t+2} + \gamma^r \cdot g} - \lambda_1 + \lambda_2 = 0 \\ \frac{\partial \mathscr{L}}{\partial \lambda_1} &= x_{t+2} + (1+r)(w \cdot (1-\tau) + (1+r)(w \cdot (1-\tau) - c_t) - c_{t+1}) - c_{t+2} \\ &= 0 \\ \frac{\partial \mathscr{L}}{\partial \lambda_2} &= -x_{t+2} + c_{t+2} \geq 0 \\ \lambda_2 \cdot \frac{\partial \mathscr{L}}{\partial \lambda_2} &= \lambda_2 \cdot (-x_{t+2} + c_{t+2}) = 0 \end{aligned} \tag{5.13}$$

Using these conditions as well as the constraints, we can solve explicitly for young workers' saving decisions. Note that the aim of the model is not to explain the introduction of a public pension system but its reform and therefore presupposes that a PAYG pension scheme already exists. How it was introduced shall be therefore of no concern here.

There are two possible states of the world. The pension system in place can be either generous (h), or small (l). Hence, the set of states of the world reads

$$\Omega = \{l\ , h\} \tag{5.14}$$

where $x^l < w \cdot (1-\tau)$ and $x^h \geq w \cdot (1-\tau)$, which means that in a country with a small system the pension benefit x^l is lower than the level of income that was available during a working age period. Under a generous pension scheme x^h, on the other hand, benefits equal or even exceed working age consumption. Given the Kuhn-Tucker-condition $\frac{\partial \mathscr{L}}{\partial \lambda_2} = -x_{t+2} + c_{t+2} \geq 0$,

this difference in system size also affects agents' optimal saving behavior. Solving the optimization problem for a young worker who faces a small pension scheme yields the results explicated in Table 5.2.

Although these expressions look somewhat convoluted, their interpretation is fairly straightforward. A fully rational agent will smooth her consumption over all three periods. This can be thought of as a worker entering the labor market at time t and making a complete plan about her current and future consumption. What makes matters look a little more complicated are two additional factors. One, future consumption is discounted by the factor ρ, which biases consumption towards the present and, second, savings earn a positive interest rate that increases future consumption possibilities. The first row indicates the optimal level of a young worker's first-period consumption. To facilitate interpretation, let's for the moment set the interest rate to zero and the discount factor to unity and re-do the optimization. We now would get the much simpler expression

$$c_t^y = \frac{2 \cdot (w - w \cdot \tau) + x + 2 \cdot \gamma^y \cdot g + \gamma^o \cdot g + \gamma^r \cdot g}{3} \tag{5.15}$$

In this case, an agent simply adds up the net income of the first two periods' plus her retirement income and each period's public policy good. This sum is then divided by the number of periods the agent lives because she wants to enjoy the same amount in every phase of her life due to her consumption smoothing motive. As a result, in this simplified version, c_{t+1}^y and c_{t+2}^y would be equal to $\frac{2 \cdot (w - w \cdot \tau) + x + \gamma^y \cdot g + 2 \cdot \gamma^o \cdot g + \gamma^r \cdot g}{3}$ and $\frac{2 \cdot (w - w \cdot \tau) + x + \gamma^y \cdot g + \gamma^o \cdot g + 2 \cdot \gamma^r \cdot g}{3}$ respectively.

Going back now to the full model with interest rates and discount factors, we find the very same logic at work. In essence, the numerator consists again of the wage income of the two working periods, plus the pension received during old-age, plus the utility received from the public policy good in every period, minus all the taxes paid. This sum, however, is weighted by an individuals' relative patience and the interest rate, which may prevent an agent from consuming exactly the same amount in every period. For instance, if impatience rises, i.e. , if ρ becomes smaller, then the denominator will shrink, implying a rise in period one consumption at the expense of later periods. The expressions for the optimal level of consumption during the later working stage (c_{t+1}) and retirement (c_{t+2}) are essentially the same but, since they lie in the future, are discounted by ρ and ρ^2, respectively.

Table 5.2: Optimal saving and consumption of a young worker under a small public pension system

	$x^J_{t+2} < w \cdot (1-\tau)$
c^y_t	$\frac{(1+r)\cdot w+(1+r)^2\cdot w+x_{t+2}-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau}{(1+r)(1+\rho+\rho^2)}+$ $\frac{((1+r)\cdot\gamma^o+\gamma^r-(1+r)^2\cdot\rho\cdot(1+\rho)\cdot\gamma^y)\cdot g}{(1+r)(1+\rho+\rho^2)}$
c^y_{t+1}	$\frac{\rho((1+r)\cdot w+(1+r)^2\cdot w+x_{t+2}-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau)}{(1+r)(1+\rho+\rho^2)}+$ $\frac{\rho\cdot(1+r)^2\cdot\gamma^y\cdot g+\rho\cdot\gamma^r\cdot g-(1+r)(1+\rho)^2\cdot\gamma^o\cdot g}{(1+r)(1+\rho+\rho^2)}$
c^y_{t+2}	$\frac{\rho^2((1+r)\cdot w+(1+r)^2\cdot w+x_{t+2}-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau)}{1+\rho+\rho^2}+$ $\frac{((1+r)\cdot\rho^2\cdot\gamma^o-(1+\rho)\cdot\gamma^r+(1+r)^2\cdot\rho^2\cdot\gamma^y)\cdot g}{1+\rho+\rho^2}$
s^y_t	$w-w\cdot\tau-\frac{(1+r)\cdot w+(1+r)^2\cdot w+x_{t+2}-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau}{(1+r)^2(1+\rho+\rho^2)}+$ $\frac{((1+r)\cdot\gamma^o+\gamma^r-(1+r)^2\cdot\rho\cdot\gamma^y-(1+r)^2\cdot\rho^2\cdot\gamma^y)\cdot g}{(1+r)^2(1+\rho+\rho^2)}$
s^y_{t+1}	$\frac{\rho^2((1+r)\cdot w+(1+r)^2\cdot w-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau)-x_{t+2}-\rho\cdot x_{t+2}}{(1+r)(1+\rho+\rho^2)}+$ $\frac{((1+r)\cdot\rho^2\cdot\gamma^o-\gamma^r-\rho\cdot\gamma^r+(1+r)^2\cdot\rho^2\cdot\gamma^y)\cdot g}{(1+r)(1+\rho+\rho^2)}$
λ_1	$\frac{1+\rho+\rho^2}{(1+r)\cdot w+(1+r)^2\cdot w+x_{t+2}-(1+r)\cdot w\cdot\tau-(1+r)^2\cdot w\cdot\tau}+$ $\frac{1+\rho+\rho^2}{(1+r)\cdot\gamma^o\cdot g+\gamma^r\cdot g+(1+r)^2\cdot\gamma^y\cdot g}$
λ_2	0

Since this is the low state l, where $x^l < w \cdot (1-\tau)$, an agent will strive to save some income to increase consumption after retiring from work. Hence, savings will be positive in both working periods. As the entries for s_t and s_{t+1} in Table 5.2 show, optimal saving depends not only on the interest rate, but it also decreases with the contribution rate and the size of the pension, i.e., the higher the pension benefit, the less need there is for private saving.[18] Finally, the Lagrangian multipliers λ_1 and λ_2 can be interpreted as shadow prices[19] for consumption and the pension. Note that the shadow price for the pension (λ_2) is zero because x is so low that an individual is not affected by the impossibility to borrow against it.

Next, let's look at Table 5.3, which highlights the solutions for the case of a generous pension system h, where $x^h \geq w \cdot (1-\tau)$. If the pension level is strictly greater than net wage income, consumption smoothing is no longer possible. In contrast to the first case, an agent only sums net income and policy goods over the two working periods. In other words, she disregards her retirement income when planning working life consumption. This can again be clearly gauged from setting the interest rate to zero and the discount factor to one. The corresponding results would then be $c_t^y = \frac{2\cdot(w-w\cdot\tau)+\gamma^o\cdot g-\gamma^y\cdot g}{2}$ and $c_{t+1}^y = \frac{2\cdot(w-w\cdot\tau)-\gamma^o\cdot g+\gamma^y\cdot g}{2}$, respectively. The reason is that consumption smoothing would actually demand borrowing against future pension income. Since we assumed imperfect capital markets, this is not possible. Hence, an individual can only smooth over the first two periods. Because the pension level is higher than net income during each of the first two periods, an agent may only have positive savings in the first period in order to ensure consumption smoothing with respect to the next period. However, an old worker will not save, as pensions are higher than current consumption and she would even prefer to dis-save, which is ruled out here. This also explains why consumption in retirement exactly equals income from the public pension system. Finally, there now exists a shadow price of the pension, since the impossibility to borrow is binding in this case.

One might be tempted to presume that from Tables 5.2 and 5.3 we can also infer the optimal decisions of individuals who are old workers or are already retired. However, this is fallacious because agents base their de-

[18] To see this more clearly, we could again set r to zero and ρ to unity. The resulting conditions would be $s_t^y = \frac{w-w\cdot\tau-x+2\cdot\gamma^y\cdot g-\gamma^o\cdot g-\gamma^r\cdot g}{3}$ and $s_{t+1}^y = \frac{2\cdot(w-w\cdot\tau-x)+\gamma^y\cdot g+\gamma^o\cdot g-2\cdot\gamma^r\cdot g}{3}$. Here the negative relationship between τ and x on the one hand, and saving on the other, becomes more obvious.

[19] The shadow price is the change in the solution if the corresponding constraint is relaxed by one unit.

Table 5.3: Optimal saving and consumption of a young worker under a generous public pension system

	$x^h_{t+2} \geq w \cdot (1-\tau)$
c^y_t	$\frac{w+(1+r)\cdot w - w\cdot\tau-(1+r)\cdot w\cdot\tau+\gamma^o\cdot g-(1+r)\cdot\rho\cdot\gamma^y\cdot g}{(1+r)(1+\rho)}$
c^y_{t+1}	$\frac{w\cdot\rho+(1+r)\cdot\rho\cdot w-\rho\cdot\tau\cdot w-(1+r)\cdot\rho\cdot w\cdot\tau-\gamma^o\cdot g+(1+r)\cdot\rho\cdot\gamma^y\cdot g}{1+\rho}$
c^y_{t+2}	x_{t+2}
s^y_t	$\frac{-w+(1+r)\cdot\rho\cdot w+w\cdot\tau-(1+r)\cdot\rho\cdot w\cdot\tau-\gamma^o\cdot g+(1+r)\cdot\rho\cdot\gamma^y\cdot g}{(1+r)(1+\rho)}$
s^y_{t+1}	0
λ_1	$\frac{1+\rho}{(1+r)(w+(1+r)\cdot w-w\cdot\tau-(1+r)\cdot w\cdot\tau+\gamma^o\cdot g+(1+r)\cdot\gamma^y\cdot g)}$
λ_2	$\frac{1+\rho}{(1+r)(w+(1+r)\cdot w-w\cdot\tau-(1+r)\cdot w\cdot\tau+\gamma^o\cdot g+(1+r)\cdot\gamma^y\cdot g)}-\frac{\rho^2}{x_{t+2}+\gamma^y\cdot g}$

cisions not only on expected values but adjust their plans, if changes in key exogenous variables occur. If the size of x deviates from its expected value, individuals will adjust their saving decisions accordingly. Hence, while the model assumes rational lifetime planning by the agents, it does not rule out that they amend their plans in the wake of unexpected external changes.

Deriving the optimal decisions of old workers implies maximizing over two periods, taking the previous period's decisions as given (see Appendix B.1.2). The results for the low pension case are shown in Table 5.4. The interpretation is analogous to Table 5.2, except there are only two periods left to consider. Again, agents smooth consumption, taking relative patience and interest rates into account. Savings are therefore strictly positive (unless ρ is zero, which we have ruled out). In the case of a generous pension system (see Table 5.5), all income and savings are consumed in the

first period. As x_{t+1} is too high from an intertemporal maximization point of view, savings are zero and the shadow price of the pension is positive.

Table 5.4: Optimal saving and consumption of an old worker under a small public pension system

	$x^l_{t+1} < w \cdot (1-\tau)$
c^o_t	$\frac{(1+r)\cdot w + x_{t+1} - (1+r)\cdot w\cdot\tau + (1+r)^2\cdot s_{t-1} - (1+r)\cdot\rho\cdot\gamma^o\cdot g + \gamma^r\cdot g}{(1+r)(1+\rho)}$
c^o_{t+1}	$\frac{\rho((1+r)\cdot w + x_{t+1} - (1+r)\cdot w\cdot\tau) + (1+r)^2\cdot\rho\cdot s_{t-1} + (1+r)\cdot\rho\cdot\gamma^o\cdot g - \gamma^r\cdot g}{1+\rho}$
s^o_t	$\frac{\rho\cdot((1+r)\cdot w - (1+r)\cdot w\cdot\tau) - x_{t+1} + (1+r)^2\cdot\rho\cdot s_{t-1} + (1+r)\cdot\rho\cdot\gamma^o\cdot g - \gamma^r\cdot g}{(1+r)(1+\rho)}$
λ_1	$\frac{1+\rho}{(1+r)\cdot w + x_{t+1} - (1+r)\cdot w\cdot\tau + (1+r)^2\cdot s_{t-1} + (1+r)\cdot\gamma^o\cdot g + \gamma^r\cdot g}$
λ_2	0

Finally, determining the optimal decisions of retirees is straightforward, as no saving decisions need to be made. Optimal consumption is determined by the budget constraint $c_t = x_t + (1+r)\cdot s_{t-1}$. Overall income is therefore given by current pension income plus accumulated savings. As all crucial economic decisions lie in the past, the only possible way for a retiree to raise her old-age consumption is by increasing the size of the public pension system, i.e. τ, which of course cannot be changed unilaterally by a single person but is determined via the political process. In a democracy, a sufficient number of voters with similar political preferences have to coalesce around a proposal or party/candidate, where "sufficiency" depends on the electoral system and the rules of the political game. To understand the outcome of the political process, we need to understand the preferences of workers and pensioners with respect to the size of τ.

To derive the preferences of the workers, we need to establish their indirect utility functions (V^i). This is done by inserting the values from Tables 5.2 and 5.3 into the utility function (5.11). To keep the interpretation as simple as possible, interest rates and discount factor are again set to zero

Table 5.5: Optimal saving and consumption of an old worker under a generous public pension system

	$x^h_{t+1} \geq w \cdot (1-\tau)$
c^o_t	$w - w \cdot \tau + (1-r) \cdot s_{t-1}$
c^o_{t+1}	x_{t+1}
s^o_t	0
λ_1	$\frac{1}{(1+r)(w-w\cdot\tau+(1+r)\cdot s_{t-1}+\gamma^o\cdot g)}$
λ_2	$\frac{\rho}{x_{t+1}+\gamma^r\cdot g} - \frac{1}{(1+r)(w-w\cdot\tau+(1+r)\cdot s_{t-1}+\gamma^o\cdot g)}$

and unity respectively. We get the following function for a young worker:

$$V^y = \begin{cases} \log(\frac{2\cdot(w-w\cdot\tau)+x_{t+2}+2\cdot\gamma^y\cdot g+\gamma^o\cdot g+\gamma^r\cdot g}{3}) + \log(\frac{2\cdot(w-w\cdot\tau)+x_{t+2}+\gamma^y\cdot g+2\cdot\gamma^o\cdot g+\gamma^r\cdot g}{3}) + \\ \log(\frac{2\cdot(w-w\cdot\tau)+x_{t+2}+\gamma^y\cdot g+\gamma^o\cdot g+2\cdot\gamma^r\cdot g}{3}) \\ \qquad\qquad if \quad \tau < \frac{w-x_{t+2}}{w} \\ \log(\frac{2\cdot(w-w\cdot\tau)+\gamma^o\cdot g-\gamma^y\cdot g}{2}) + \log(\frac{2\cdot(w-w\cdot\tau)-\gamma^o\cdot g+\gamma^y\cdot g}{2}) + \log(x_{t+2}) \\ \qquad\qquad if \quad \tau \geq \frac{w-x_{t+2}}{w} \end{cases} \tag{5.16}$$

Note that the budget-condition $x^h_{t+2} \gtreqless w \cdot (1-\tau)$ has been re-arranged with respect to τ. Thus, the equation neatly shows that utility is a step function that depends on the size of the pension scheme. For a contribution rate below the threshold, a different utility function is applied, since, as we have seen above, different saving decisions are made depending on the size of the pension system. Hence, a young worker will prefer a contribution rate that maximizes this expression. Utility of an old worker is derived in a similar fashion and reads

$$V^o = \begin{cases} \log\left(\frac{(w-w\cdot\tau)+x_{t+1}+s_{t-1}-\gamma^o\cdot g+\gamma^r\cdot g}{2}\right)+\log\left(\frac{(w-w\cdot\tau)+x_{t+1}+s_{t-1}+\gamma^o\cdot g-\gamma^r\cdot g}{2}\right) \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{if} \quad \tau < \frac{w+s_{t-1}-x_{t+1}}{w} \\ \log(w-w\cdot\tau+s_{t-1})+\log(x_{t+1}) \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{if} \quad \tau \geq \frac{w+s_{t-1}-x_{t+1}}{w} \end{cases} \tag{5.17}$$

Finally, deriving the preferences of a retiree regarding the size of τ is straightforward. Recalling that the budget constraint of the pension scheme is (5.6), we can easily re-write utility to

$$V_t^r(c_t) = \log((1+n)^2\cdot w\cdot\tau_t+(1+n)\cdot w\cdot\tau_t+(1+r)\cdot s_{t-1}+\gamma^r\cdot g-g) \tag{5.18}$$

Given that a pensioner has no taxable working income and past saving decisions cannot be changed, the only way to increase old-age consumption is to increase τ. Hence, it is easy to see that she would prefer a contribution rate of one.

With the aid of these three indirect utility functions, we can now establish the policy preferences of each generation. Note that these are directly derived from the optimizing behavior of individuals. In contrast to the valuation factor γ^i above, their ordering is more than "just" an assumption. The order of preferences with respect to τ^i for the three generations can therefore be summarized in the following proposition.

Proposition 5.1 (Political Preference Ordering). *Given the economic environment described by equations (5.11) and (5.3)-(5.8), the preferences of young workers (y), old workers (o) and retirees (r) with respect to the public pension system are qualitatively described by the following ordering:*

$$\tau^y \leq \tau^o \leq \tau^r$$

5.2.3 Some Numerical Simulations

That this is indeed the case can be graphically shown by plotting the indirect utility function of each generation against different contribution rates. To do this, we simply need to replace x with the budget constraint (5.6) and solve for different values of τ. This necessitates full parameterization. Note, however, that inserting different values for w, g, s_{t-1}, γ^i changes the results quantitatively, but does not change the preference ordering itself; that is, the qualitative claims of Proposition 5.1 remain valid. The same

holds with respect to the interest rate and discount factor, which I continue to set to zero and unity, respectively, to make the interpretations less tedious. The steady state common wage rate w shall be normalized to one, the public policy good takes on a value of 0.5, while the valuation factors γ^i are in accordance with the assumptions made with respect to their ordering. For a young worker it shall therefore be 0.75, for an old worker 0.5, and for a retiree $\gamma^r = 0.25$. In order to compute the function (5.17), we also need to assign a value to s_{t-1}. Since the average private saving rate in Germany was at 10.2 per cent between 1998 and 2008[20], we set $s_{t-1} = 0.1$. Finally, we need to determine population growth, which is negative in an aging society. Again, we refer to Germany to make matters concrete. United Nations projections predict an average annual population growth of -0.24 per cent for Germany between 2010 and 2050. This implies a population growth rate in our generational model of $n = -0.06$ (assuming that a generation spans 25 years).

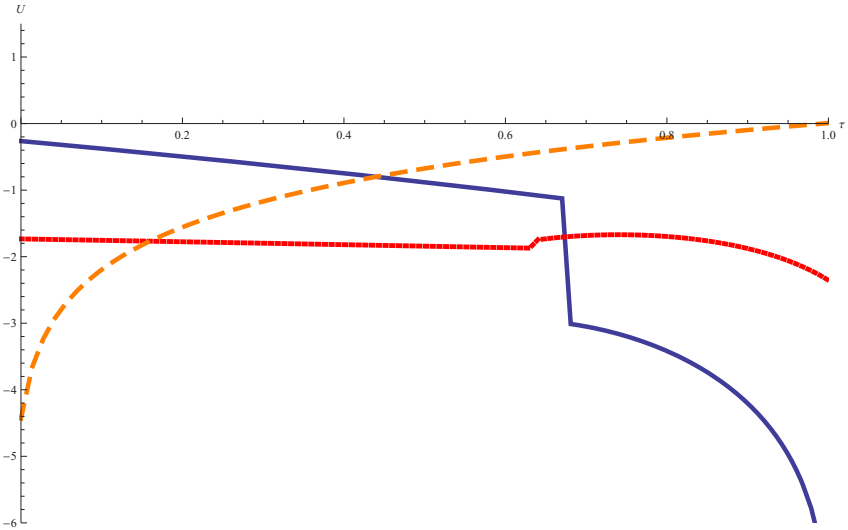
Figure 5.1 plots the utility of each generation as a function of the prevailing contribution rate. Naturally, since the lines of the young (solid) and the old workers (dotted) represent step functions, they have clearly visible edges. Such an edge is discernible for the young workers' utility function at the threshold value of $\tau = 0.63$. It clearly emerges that for a young worker lifetime utility decreases with the contribution rate. In a small system (i.e., where $x^l_{t+2} < w \cdot (1-\tau)$) utility decreases at a slower rate than in a generous system. However, regardless of the size of the existing scheme, a young worker always prefers $\tau = 0$, if $n = -0.06$. In fact, as it turns out, this preference is true for any negative population growth rate.

Turning next to an old worker's preferences, we find her utility gradually decreasing for a small pension system. In a generous system there is a unique maximum at around 0.73. Thus, old workers' preferences depend on the size of the existing system. With a small pension scheme, they prefer its abolition, while in a generous system they prefer a sizeable contribution rate. Finally, for retirees (dashed) utility is monotonically increasing in τ. Hence, their most preferred contribution rate is $\tau = 1$.

Note that the preference ordering is not dependent on the precise magnitude of population growth. Figure 5.2 shows the results for two different growth rates. Panel (a) depicts a scenario where the population shrinks by -38.2 per cent over a generation or -1.52 per cent per annum. As we have seen in Chapter 3.1.1, this represents a lower bound. Any growth below

[20] I use saving numbers from years before the onset of the global financial crisis at the end of 2008!

Fig. 5.1: Utility of young worker (solid), old worker (dotted) and retiree (dashed) given different contribution rates, n=-0.06

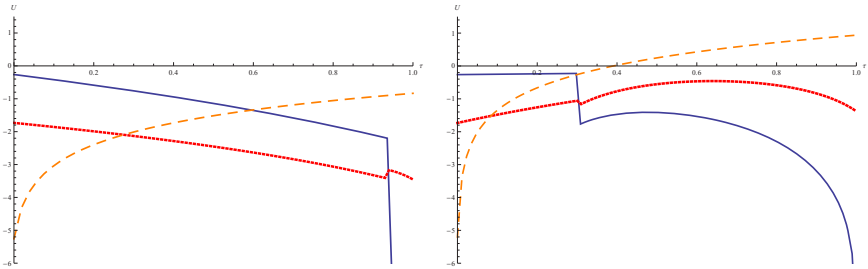


Note: $n = -0.06$, $g = 0.5$, $s_{t-1} = 0.1$, $w = 1$, $\gamma^y = 0.75$, $\gamma^o = 0.5$, $\gamma^r = 0.25$.

that number would make pensioners a majority of the population. Panel (b), on the other hand, shows the results for a very high population growth rate of 2.45 per cent per year, where any growth rate above that rate would make young workers a majority of the population.

Inspection of both figures reveals a pattern in line with our proposition. For the left panel, we again find that retirees prefer a contribution rate of one. The function of young workers is now decreasing at a much faster rate, but their maximum still lies at $\tau = 0$. An old worker, on the other hand, is now clearly better off with no public system. The picture changes somewhat when considering the case of a high population growth rate in the panel on the right-hand side. Since this would make the pension scheme much more profitable, even a young worker is now in favor of a positive contribution rate of $\tau = 0.38$. However, her preferred contribution rate is still smaller than the one demanded by the other two groups. Retirees still favor a maximum contribution, while old workers prefer a τ of about 0.63. Note that this is smaller than in the moderate negative population growth scenario with a generous system, because the PAYG pension

Fig. 5.2: Utility of young worker (solid), old worker (dotted) and retiree (dashed) given different contribution rates



(a) n=-0.382 (b) n=0.618

scheme now offers a much higher rate of return; hence a lower τ suffices to ensure optimal consumption smoothing.

The preferred contribution rates of old workers and pensioners may appear unreasonably high under all population growth scenarios. Most real-world pensioners probably would not favor to completely tax away workers' income, and old workers probably would not choose to be taxed, even under negative population growth, by 60 to 70 per cent. One factor that is missing in the model are explicit labor supply decisions by workers. The model assumes labor decisions to be exogenous (see Table 5.1) and inelastic. If workers reacted to increasing contribution rates by providing less labor, thus reducing the tax base, pensioners would find a τ of 1 no longer optimal. They would rather choose a lower contribution rate to ensure that workers continue to work and thus be able to contribute to the pension system. Regarding the preferences of old workers, two additional comments are in order. First, I have set the interest rate to zero in these plots. A positive interest rate would make private savings more attractive relative to the PAYG pension system. Thus preferred contribution rates decrease with rising interest rates as agents substitute from the pension scheme to savings in order to achieve consumption smoothing and lifetime utility maximization. Second, contribution rates can also be explained by the high value we assumed for g.[21] For lower values, old workers prefer a smaller τ. This can easily be calculated by plugging in

[21] Remember that τ is not only financing the pension system but also the public policy good that increases an individual's utility.

different smaller values of the public policy good. While, as shown in figure 5.1, the utility function peaks at $\tau = 0.73$ given $g = 0.5$, a lower public policy good size of 0.25 corresponds with a τ of 0.62. In the absence of a policy good, i.e., $g = 0$, the preferred contribution rate would be 0.55.

All these qualifications, however, do not affect the actual ordering of preferences. While this simplified model set-up, which abstracts from labor supply decisions, does not allow for empirical predictions of *absolute* contribution rates preferred by different age groups, it nevertheless captures *relative* policy preferences. As a result the model allows to posit two hypotheses:

Hypothesis 5.2.1. *Preferences for sustaining a big public pension system increase with age.*

This hypothesis implies that as societies grow older, the number of voters who oppose pension reforms, which reduce the public system, will rise, thus making such a pension reform politically less likely. However, the model also shows that population growth and the size of the pension system are important as well.

Hypothesis 5.2.2. *Policy preferences of old workers depend on population growth, and on the size of the existing pension scheme.*

For moderate population growth rates, we can expect old workers' preferences to be especially sensitive. They should be more opposed to a rising contribution rate in a small pension scheme than in a generous system. Or, to look at it from a pension reform perspective, they should be more in favor of reducing the public pension system while living under a small system than under a more generous system.

At this point, a reader may wonder whether the second hypothesis does really imply that old workers are fully aware of the prevailing and future population growth rates. One may readily assume that they are aware of the generosity of the existing pensions system vis-a-vis private saving, but knowledge of population growth figures seems more of a stretch. As with most of these types of rational political-economy models, certain variables of a model often reflect more indirect and complicated empirical processes. Therefore, one need not make the heroic assumption that old workers care or inform themselves about fertility rates and U.N. population projections. But in aging societies, the problem of declining population growth rates should surface in public discussions about budgets and the sustainability of the public pension system. Old workers in such countries should be more exposed to policy debates about the need to retrench

public schemes of old-age provision because of demographic pressures. This should convey the necessary information about declining population numbers and the concomitant consequences for pensions without requiring individuals to know precise population growth projections.

5.3 Voting on Pension Reform in a Democracy

The political preferences have now been sufficiently modeled. Having derived individual economic decisions and preferences with respect to the pension system, it is time to analyze the aggregation of these preferences into political outcomes and consider the consequences for possible pension reforms.

5.3.1 Pension Reform Scenarios in a Direct Democracy

If pension policy were decided by referendum, i.e., if there were direct democracy, determining the political outcome would be fairly easy. As policy preferences within groups are homogenous, all we would need to know is which generation is in a majority, or, if no group alone secures a majority, which one represents the median voter. As a result, it is easy to predict under which scenarios a pension reform, parametric or non-parametric, is possible.[22] We have already calculated the necessary population growth rates[23] in Chapter 3.1.1.

If $n < -0.382$ (-1.5 per cent per year assuming a generational length of 25 years), that is if the population is shrinking heavily, retirees will form a majority and implement the most generous pension system possible, with $\tau = 1$. As has been discussed before, however, we would expect τ to be smaller than one once labor supply decisions are taken into account. In any case, a successful pension reform could never be aimed at reducing the size of the public system. The majority of retirees would ensure that no reform reduced their pension benefits. Any financial pressure on

[22] At this point it is important to remember that the status quo is the existence of a PAYG pension scheme.

[23] Recall that these can be derived using the conditions $N^r > (1+n) \cdot N^o + (1+n)^2 \cdot N^y$ and $N^y > \frac{N^r + N^o \cdot (1+n)}{(1+n)^2}$, respectively.

the pension system due to population aging and a shrinking labor force would be relieved through rising contribution rates.[24] Hence, young and old workers would shoulder the financial burden. They would be the redistributional losers of a reform.

Young workers, on the other hand, would be in total command if $n > 0.618$. Of course, in such a society with strong population growth, there would be no aging pressures on the pension system. Two types of reform are feasible in this scenario. One, if the economy is dynamically inefficient,[25] the young would approve of any reform that ensures the continued existence of the public PAYG scheme. However, if the economy is dynamically efficient, which implies that returns to private saving are higher than returns from contributions to a PAYG plan, the young will vote for any proposal that abolishes the existing public system in favor of a individual prefunded scheme, which allows for individual saving decisions.[26]

If population growth lies between these two polar values, old workers will be decisive, since they represent the policy preferences of the median voter. Let us consider the most interesting case: a negative population growth rate, as assumed in figure 5.1, of -0.24 per cent per year, which is the U.N.'s projection for Germany between 2010 and 2050. It is an interesting scenario because it is low enough to put public PAYG systems under financial pressure, and at the same time, ensure that the median voter is an old worker.

As the previous model has demonstrated, feasibility and direction of a pension reform in this situation depend on the size of the existing public PAYG scheme. If the public pension system is small (i.e. pension benefits are below net working income: $x^h \geq w \cdot (1-\tau)$), old workers will form a voting coalition with young workers. Both groups would vote for a reform proposal that completely abolishes the public PAYG system in favor of a individual prefunded system. Any attempts to balance the existing system by increasing the contribution rate would be rejected by young and old

[24] The model does not allow the possibility of running up deficits. But if deficits were possible, retirees could also let future generations pay for current pension deficits through reduced benefits, which may be achieved by benefit cuts or higher retirement ages for future generations.

[25] I.e. $1+i = (1+n)(1+\omega) > 1+r$, see chapter 3.1

[26] Note that this system could be completely privatized but need not be. A publicly administered and regulated prefunding scheme that allows people to have individual saving accounts is feasible as well.

workers. Both groups would clearly be better off by saving individually for old-age than contributing to a PAYG plan.

This prediction is completely reversed if the existing PAYG pension scheme is a generous one (i.e. pension benefits are above net working income: $x^h > w \cdot (1-\tau)$). Now it is no longer in the interest of the old workers to support a transition from the public PAYG scheme to an individual prefunded one. The reason is that to save one period before retirement will generate a lower pension income than sticking with the current system. However, while old workers support sustaining the public system, they favor a smaller pension size than current retirees. The exact size depends on the time preferences, valuation of the public policy good, and how strong population growth declines.[27] If from an old workers' perspective the system was too big, they would vote in favor of reducing its size. Of course, the pensioners would vote against it, but young workers will join the coalition. Any reduction of the PAYG scheme is clearly in their interest. If the system was too small, old workers would vote for an increase in contribution rates, which is clearly opposed by the young. However, old workers would form a voting coalition with pensioners, since they favor any increase of the existing public plan.

In sum, unless the population is growing dramatically and thus making young workers a majority, we would not expect a complete abolition of an existing PAYG scheme in a direct democracy if the existing public scheme is generous. Rather, we may expect a reduction in the existing public pension system in favor of more individual saving but not a complete abolition. Of course, this type of reform outcome is exactly what we can observe in a number of countries that have undertaken changes to their systems of old-age provision. However, in most countries, voting occurs in the framework of a representative democracy, where voter preferences are aggregated through the electoral system. Reform scenarios in such an institutional setting are explored next.

[27] Simplifying by neglecting the discount factor and abstracting from particular parameterizations, the preferred contribution rate is $\tau = \frac{2+g+3\cdot n+n^2+2\cdot s+3\cdot n\cdot s+n^2\cdot s}{2\cdot(2+3\cdot n+n^2)}$.

5.3.2 *Pension Reform Scenarios in a Representative Democracy with a Majoritarian or Proportional Electoral System*

Considering reform scenarios in a representative democracy is a little more involved. The political institutional setting is more complicated and we need to consider the incentives parties face because any reform must now be part of an electoral programme, since voters can no longer directly vote on pension policy. To be able to draw any conclusions on the feasibility and direction of pension reform, one needs to clearly define the prevailing electoral institutions and make assumptions about party behavior. As the comparative political science literature amply demonstrates, there are a lot of different voting systems in the world that differ in many institutional dimensions.[28] In what follows, however, I will abstract from many of these details because otherwise predictions about pension policy would be impossible to make. In fact, this section will draw on existing probabilistic voting models as developed and applied by, for instance, Lindbeck and Weibull (1987) and Persson and Tabellini (1999, 2000), to provide an analytical framework for thinking about pre-electoral dynamics and voting in a representative democracy. Note that a version of this approach has already been presented in chapter 3.2.3 in the context of the model by Profeta (2002b). However, she only analyzes the existence of public pension systems, not their reform. In addition, her model does not distinguish between majoritarian and proportional electoral systems.

The analytical advantage of a probabilistic voting framework is that it ensures existence of political (Nash-) equilibria even in a multidimensional issue space. The problem with a deterministic voting model is that once voters decide on more than one issue at a time, an equilibrium may not exist (McKelvey (1976)). This means no matter which position a party/candidate adopts, the other party/candidate can always come up with an alternative that garners a majority. In fact, as has been shown by Plott (1967), only very particular symmetric preference configurations result in a Nash equilibrium. In contrast, assuming probabilistic voting behavior, i.e., introducing enough voter heterogeneity and thus uncertainty about voters' choices, significantly increases the likelihood of a Nash equilibrium with two (see Coughlin and Nitzan (1981); Enelow and Hinich (1989); Coughlin (1992)) or more parties (see Lin et al. (1999)) in a multidimensional context. Probabilistic models ensure existence of equilibria

[28] For a seminal overview see Lijphart (1999).

because they yield payoff functions that are smooth in policy choices. Deterministic models, on the other hand, have discontinuous payoff functions, since incremental changes in a policy proposal may lead to changes in voter choices from one candidate to the other.[29]

The analysis here will be restricted to the assumption of a two-party competition model. While this seems like a sensible assumption for a system with majoritarian elections, it is less suited for a system operating under proportional representation. As has been outlined at the beginning of this chapter, strategic voting considerations tend to lead to two-party systems under majoritarian voting, while a high degree of proportionality in the electoral institutional set-up is usually associated with multiparty systems (see e.g. Duverger (1954), Cox (1997) and Lijphart (1999)). There are two reasons for this simplification. First, in most systems with proportional voting, competing parties can be separated into two coalitional blocs that are structured along the left-right dimension, at least with respect to economic issues, thus ruling out certain coalitions a priori. For instance, Persson et al. (2007) have modeled electoral competition of four parties under proportional representation, allowing for the possibilities of coalition governments, but restricting the possible number of coalitional formations to two. This makes sense as they are concerned with analyzing public spending as common pool problems. However, in the case of pension policy, common pool dynamics are not a major concern. Focusing on two parties or reinterpreting two coalition blocs as if they were two parties is therefore appropriate. Second, restriction to two parties is analytically more convenient, since the strategic considerations in a multiparty environment with a multidimensional issue space get analytically much more complicated.[30] While these ad-hoc reasonings may be intuitive and agreeable, they shall not distract from the fact that the assumption of an exogenously fixed two-party system is not fully satisfactory.

To keep matters simple, electoral systems are considered in a stylized fashion. I abstract from subtleties such as voting thresholds, malappor-

[29] In a probabilistic model, a shift in a proposed policy may not engender a switch in a voter's choice because there may be other factors (ideology, exogenous events, informational restrictions, inability to properly identify policy shift etc.) that may prevent her from doing so. Also, it is very unlikely that candidates and parties possess sufficient information to perfectly predict the behavior of each and every voter in response to a platform change. Given these uncertainties, it makes sense to describe voters' choice behavior in probabilistic terms.

[30] It gets even more complicated if one tries to endogenously derive the number of parties.

tionment and ballot structure. Here the fundamental differences between the two systems are the number of electoral districts and the voting rule. The analysis assumes that there is only one voting district under proportional representation (as is the case in the Netherlands, for instance), where parliamentary seats are allocated in proportion to the votes received. To win the election, a party needs to win more than 50 per cent of all the votes cast. A majoritarian system, on the other hand, shall have electoral districts that employ a winner-takes-all voting rule. All available seats are allocated to the party/candidate that wins a relative majority in that district. Winning the overall election thus requires winning a plurality of districts.

Thus, the election game in a representative democracy can be conceptualized as follows: Before elections take place, party j, with $J = \{L, R\}$, announces a policy vector $\mathbf{q^j}$ to the public, which represents the programme it wants to enact once elected. Given the budget constraint (5.6), the policy vector is $\mathbf{q}^j = [\tau, g]$. Hence, the issues at stake in the election are the size of the public PAYG pension scheme[31] and the size of the public policy good. Both parties select their platforms simultaneously; they do not, however, cooperate or coordinate their proposals. In vying for public office, parties behave opportunistically, i.e., they have no particular ideological leaning or a particularly valued policy preference.[32] Thus, they receive no utility from the policy being implemented. Their sole intent is to choose a platform $\mathbf{q^j}$, which maximizes their chances of winning the election. When choosing their programmes, parties are perfectly informed about voters' preferences for τ and their relative valuations of the public policy good. Note that these policy announcements are perfectly credible, that is, voters hold the (correct) belief that parties keep their electoral promises.

In keeping with the probabilistic voting literature, we can assume the election outcome to be uncertain. After policy programmes have been announced, a random shock δ occurs, which may affect the relative popu-

[31] Remember, choosing the size of the pension system implies a decision not only about the size of pension benefits and contribution levels but also about the relative importance of a public PAYG scheme vs. a private prefunded scheme (i.e. private saving). Given a desired level of consumption in old-age, a reduction of the former entails an increase in the latter.

[32] Pure opportunistic behavior is, of course, a strong assumption. However, it should be noted that even if parties had ideological convictions, as long as they value winning elections at all in order to implement their policy preferences, they face the strategic incentives and behavior as explained below. Only if we assume parties to be purely ideological, that is, if they are willing to forego the chance of winning an election in favor of ideological purity, do the following conclusions become less tenable.

larity of both parties. This shock could be, for example, a party financing scandal, an international crisis or a terrorist attack. Realization of such an unforeseeable event could potentially make one party more attractive in the eyes of all voters; e.g., the party not implicated with dubious financing methods, the party with a better foreign policy reputation or the one known to be tough on national security. Introducing this kind of exogenous event does not only add realism to the model, since it captures the imponderables of political competition, but makes the election outcome also inherently uncertain. In game theoretic terms, parties do not know the state of the world when proposing their electoral platforms; that is they act under incomplete information. Note that the event δ is a random variable, which is uniformly distributed on $(-\frac{1}{2d_\delta}, \frac{1}{2d_\delta})$, with the expected value being zero and the density being d_δ. The higher the density parameter, the smaller the range of possible realization of the exogenous event, and the less uncertain is therefore the electoral outcome.

Finally, elections take place and the winning party implements its policy proposal. Voters belong to one of the three generations and vote prospectively, i.e., they disregard parties' past behavior and base their decision solely on promised future policies. It is also important to point out that there are no abstentions and all voters are perfectly informed about each party's platform as well as the realization of δ.

Unlike the parties, voters are not only "issue-driven" but also have ideological biases. Although all voters within an age group share homogenous preferences with respect to τ, there are within-group differences in terms of individual ideological predispositions. Retirees, for example, agree on the preferred size of τ and g but differ in strength and size of their a priori ideological attachments. This moderates an extreme version of the single-mindedness assumption and renders voting behavior more 'realistic'. Note that the ideological leanings of an individual k of age group i, denoted by $\mu^{k,i}$, are exogenously given and do not change until a generation moves into the next age group. They are drawn from an uniform distribution on $(-\frac{1}{2d_\mu^i}, \frac{1}{2d_\mu^i})$ with zero mean[33] and density parameter d_μ^i. This implies that the higher an age group's ideological density, the more

[33] Alternatively, one could also assume that generations differ in their average ideology $\bar{\mu}^i$. Ideological distributions would then change to $(-\frac{1}{2d_\mu^i} + \bar{\mu}^i, \frac{1}{2d_\mu^i} + \bar{\mu}^i)$. This approach, however, would necessitate additional assumptions about the average ideology of each age group, which raises questions like whether retirees are on average more attracted towards, say, party L, compared to young or old workers. To make such a case, we would need to give programmatic/ideological content to our two generic parties. Since

homogenous they are in their political preferences and the less individual variance exists. Note that I assume that the degree of ideological heterogeneity within groups differs across generations. Hence, young workers have a different ideological density than old workers or pensioners. It is important to emphasize that $\mu^{k,i}$ may also represent other types of heterogeneity. It could very well capture different propensities to vote among individuals, thus incorporating the fact that different age groups tend to differ in abstention rates. Alternatively, heterogeneity may also refer to the different levels of information that individual voters' possess and their willingness or ability to get informed about the issues. Age groups with a high density parameter are accordingly more likely to react to changes in policy platforms because they contain more voters that are better informed and able to discern changes in party programmes.

Sticking to the first interpretation of heterogeneity, parties are aware of the ideological distribution from which voters of each age cohort are drawn, but do not know ideological positions of individual voters. The implementation of the winning party's programme is taken for granted and not subject to further analysis.[34] The election game as a whole is succinctly summarized in Figure 5.3.

Fig. 5.3: Election game

Given this sequence of events and the assumptions made, we can now describe individual voting behavior, as it is commonly analyzed in the probabilistic voting literature. Voter k of age group i will vote for party L if

$$V^k(\mathbf{q}^L) + \delta + \mu^{k,i} > V^k(\mathbf{q}^R) \tag{5.19}$$

it is good scientific practice to keep matters simple and to shed unnecessary assumptions, it makes sense to work with a common zero mean assumption.

[34] Modeling the legislative process as well would necessitate a model of post-electoral politics that encompasses coalition formation and legislative bargaining. Such a complete model is well beyond the scope of this dissertation. Simple modeling attempts that cover electoral competition (including candidate choice) and policy making in the legislative arena have been proposed by Osborne and Slivinski (1996); Besley and Coate (1997, 1998).

where a voter's indirect utility V^k depends on the policy package $\mathbf{q^j}$ chosen by party j. In forming a decision, voter k also considers general popularity δ and her individual ideological leaning $\mu^{k,i}$ towards or against party L. If both δ and $\mu^{k,i}$ were negative, party L would be a priori less attractive than R. To compensate for this negative bias, L needs to offer a policy bundle that delivers a higher indirect utility for k than party R does. If the opposite was the case, that is, if popularity and ideological attachment were positive, thus favoring L, then L could offer a worse policy than R and would still be very likely to get the vote of k. Put differently, a voter will vote for party L as long as her ideological bias towards L outweighs the relative indirect utility advantage that she would get if R's policy was implemented (always taking the popularity shock into account):

$$\mu^{k,i} > V^k(\mathbf{q}^R) - V^k(\mathbf{q}^L) - \delta \tag{5.20}$$

With respect to individual ideology, young and old workers, as well as pensioners systematically differ in their heterogeneity. The fundamental assumption being made here is that

$$d^i_\mu = d^i_\mu(\gamma^i) \quad \text{with} \quad \frac{\partial d^i_\mu}{\partial \gamma^i} < 0 \tag{5.21}$$

Hence, within-group ideological density d^i_μ is a negative function of the valuation γ^i of the public policy good. In other words, the more an age-group cares about other public policies besides the pension issue, the more ideologically heterogenous it is. The reasoning behind this assumption is that a lower γ^i indicates a greater degree of "single-mindedness" and thus implies less interest in other policies that may create ideological divisions. Thus, we can expect that age groups (young workers, for instance), which not only care about the organization of intergenerational transfers but also put great emphasis on other policy goods, exhibit a stronger ideological variance. Retirees, on the other hand, care mainly about the generosity of the public pension scheme, which may provide an ideological focal point, thus reducing heterogeneity. In addition, labor market cleavages (although not explicitly modeled here) also increase heterogeneity among workers. The reason is that unlike pensioners, workers differ along a number of dimensions (e.g., employed vs. unemployed, manufacturing vs. service sector, sectoral competition for state subsidies, import vs. export oriented industries etc.), which should increase ideological heterogeneity. As a result, voters' ideological variance should decrease with age. While this

reasoning may be intuitive, there are, to the best of my knowledge, no direct empirical studies that thoroughly investigate these claims. There are, however, studies that seem to indicate a greater single-mindedness among the elderly (see Rhodebeck (1993); Canegrati (2007)) and thus suggests less heterogeneity within this age group.

Given the assumptions made in (5.2) about the relative sizes of γ^i, it follows that

$$d_\mu^y < d_\mu^o < d_\mu^r \tag{5.22}$$

The implication here is that ideological heterogeneity is highest among young workers, and lowest among retirees. This ordering would also make a great deal of sense if, as suggested above, $\mu^{i,k}$ captured vote propensities. It has long been found in empirical studies that voter participation increases with age and that younger voters are more likely to abstain than older ones (see Nie et al. (1974); Becker (2002); Gimpel et al. (2004); Goerres (2007)).

Given the distributions of ideological biases, it is easy to identify a generation's swing voter for every given pair of policy proposals. Taking popularity δ[35] into account, swing voters are indifferent between both parties' proposals given their own ideological bias. Hence, k is a swing voter if her bias is

$$\mu_{swing}^{i,k} = V^k(\mathbf{q}^R) - V^k(\mathbf{q}^L) - \delta \tag{5.23}$$

Age group i voters with $\mu^{i,k} < \mu_{swing}^{i,k}$ will be in favor of party R, while those with $\mu^{i,k} > \mu_{swing}^{i,k}$ will favor L. Identification of the swing voter is important because it is the one who will respond to a marginal change in parties' policy platforms. The higher ideological density d_μ^i, the more swing voters a generation has. Hence, the share of votes, denoted π, that party R receives from generation i, after the popularity shock δ is realized, is given by

$$\pi^{R,i} = d_\mu^i \cdot (\mu_{swing}^{i,k} + \frac{1}{2d_\mu^i}) \tag{5.24}$$

In other words, all swing voters and voters with an ideology below $\mu_{swing}^{i,k}$ cast their votes in favor of R.

[35] An additional assumption about the distribution of popularity shocks has to be made. In order to avoid the 'awkward' result of corner solutions with respect to vote shares, d_δ has to be sufficiently close to zero (relative to the distributions of μ^i) implying a high electoral uncertainty to ensure that there are no districts where one of the parties receives no votes at all.

The aggregate vote share of party R is then obtained by inserting (5.23) into (5.24) and summing over all three generations (taking their relative sizes $\hat{n}_i = \frac{\hat{n}_i}{N}$, with $\sum_{i=\{y,o,r\}} \hat{n}_i = 1$ into account)[36]. Slightly re-arranging terms gives

$$\pi^R = \frac{1}{2} + \sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu \cdot (V^k(\mathbf{q}^R) - V^k(\mathbf{q}^L)) - \sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu \cdot \delta \tag{5.25}$$

Thus, when contemplating a marginal change in its policy platform that may affect age groups differently, parties have to consider the relative sizes of these generations and their ideological density (i.e. their number of swing voters). This is the general vote function that R maximizes. Party L's vote share function is symmetric with $1 - \pi^R$. Expression (5.25) underlines the fact that the policy bundle necessary to maximize the vote share ultimately depends on the exogenous popularity shock. If a scandal negatively affects voters' perception of R, then this party has to compensate by offering policies that increase the relative utility advantage over L's platform for a sufficient number of swing voters.

The necessary amount of compensation that ensures a simply majority of votes for R can be found by solving for δ:

$$\delta < \frac{\sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu \cdot (V^k(\mathbf{q}^R) - V^k(\mathbf{q}^L)}{\sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu} = \underline{\delta} \tag{5.26}$$

Hence, as long as $\delta < \underline{\delta}$, party R will win a majority for sure. The problem, however, is that the popularity shock is not realized before the platforms have been announced. This makes the outcome of the election a random event. Party R has no way of knowing *ex ante* the right *ex post* platform. All it can do is to maximize the probability of winning. As winning a majority of votes depends on whether $\delta < \underline{\delta}$, we have

$$Pr(\pi^R > 0.5) = Pr(\delta^R < \underline{\delta}) \tag{5.27}$$

By the distributional assumptions about δ it follows that

$$Pr(\delta < \underline{\delta}) = d_\delta \cdot (\underline{\delta} + \frac{1}{2d_\delta}) \tag{5.28}$$

[36] Note the difference between n and $\hat{n}_i$: the former denotes the population growth rate, the latter captures the population share of generation i.

Inserting (5.26) into (5.28) and re-arranging yields

$$Pr(\pi^R > 0.5) = \frac{1}{2} + \frac{d_\delta}{\sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu} \Big(\sum_{i=\{y,o,r\}} \hat{n}_i \cdot d^i_\mu \cdot (V^k(\mathbf{q}^R) - V^k(\mathbf{q}^L)) \Big) \quad (5.29)$$

which is the function that party R maximizes. When devising its policy platform, party R therefore needs to take into account the electoral response of each generation, its size and its ideological heterogeneity. Party L faces, of course, a symmetric decision problem. As a result, both parties will converge on the same programmes and therefore propose the same pension policy and provision of g. Expression 5.29 describes the strategic incentives a party faces when proportional representation is the electoral law of the land. As mentioned before, proportional representation is modeled here as a country-wide single district system. To win the election, party j needs to obtain more than 50 per cent of the votes, that is, $\pi^j > 0.5$. Now, what does this mean for direction and feasibility of a pension reform?

5.3.2.1 Proportional Representation

Let's focus here on the most realistic and analytically interesting scenario that we have discussed so far: an aging population, where neither young workers nor retirees are in a majority and the median voter is an old worker. Thus, the assumption is $-0.382 < n < 0$. As the probabilistic voting model above makes clear, electoral competition is not geared towards the median voter. Instead, parties offer programmes that target the generation with the most swing voters. This, in turn, depends on the ideological density of a group and its size ($\hat{n}_i \cdot d^i_\mu$). Given the assumption $d^y_\mu < d^o_\mu < d^r_\mu$, young voters have the lowest ideological density. Due to population aging, we can safely assume that their size is not big enough to compensate for this heterogeneity. As a result, the number of swing voters they offer is smaller than in the other two groups. Therefore, parties will offer pension policy programmes that are either geared towards old workers or retirees.

If retirees have the most swing voters, then the resulting pension policy programmes by the parties would be similar to the case of a direct democracy, where pensioners are in a absolute majority. In this scenario, no party would propose a reform that reduces the existing public PAYG pillar. Any imbalance in the pension system would be remedied by increasing contribution rates levied on the working population. Since both parties want

to maximize their probability of winning the election, no other pension reform than the one that pleases the pensioners will be proposed.

In contrast, old workers have the highest number of swing voters, if their higher ideological heterogeneity (i.e. lower d_{μ}^{i}) is compensated by the fact that they have a bigger population share than pensioners. Under this scenario, the size of the existing pension system becomes crucial again, since old workers' policy preferences ultimately depend on the profitability of a move away from the existing system towards more private saving. As a result, if the public pension scheme is small, both parties will propose electoral programmes that promise a transition from PAYG to prefunding, i.e. to private saving devices. If, on the other hand, the existing pension pillar is generous, old workers will oppose a complete abolition of the existing public system. A reform will reduce the overall size of the PAYG system in favor of more private saving, if old workers consider current scheme too large. If, on the other hand, old workers find the current contribution rate below their preferred optimum, they will favor an increase the overall size of the system. Since both parties want to maximize their chances of winning the election, they will offer electoral programmes that please the wishes of the old workers.

In sum, under proportional representation we arrive at somewhat similar reform scenarios than in the case of a direct democracy. However, the rationale is different now, as the median voter is no longer the decisive entity. Also, pensioners have the chance to find their policy preferences to rule supreme even if they don't have a majority in numbers. In case they are ideological much more homogenous than old workers, they could have the most swing voters, which would determine parties pension policy programmes. The question, of course, arises, whether it makes any difference if we have a majoritarian electoral system instead of proportional representation.

5.3.2.2 Majoritarian Electoral Systems

Majoritarian systems, as defined here, use a winner-take-all electoral rule, implying that a party wins all seats in a district it carries. This means that a party may not need to win a plurality of all votes, but only a plurality of electoral districts. In fact, in a majoritarian system a party may win an election with only 25 per cent of the popular vote by winning 50 per cent of the vote in half the districts.

Let's focus again on the scenario of a moderately shrinking population, where neither young workers nor pensioners are in a majority and the median voter is an old worker. To analyze the incentives of parties and the electoral programmes they converge on, we need to think about the distribution of age groups across voting districts. Following Persson and Tabellini (2000), it is easiest to imagine that a country consist merely of three electoral districts of equal sizes. Winning an election therefore requires winning a plurality in two districts. Let's for the sake of simplicity further assume that each party wins one electoral district for sure, thus focussing electoral competition on the decisive district.[37] This is something we frequently observe in these type of systems, with U.S.-presidential elections focusing on a handful of swing states being the prime example.

Let's first consider the case where each district has the same distribution of age groups. As a result, each district constitutes a microcosm of the country as a whole. In this situation, electoral competition leads to the same pension reform proposals as under proportional representation. Once more, the group with the highest number of swing voters would be most attractive for both parties, whose policy programmes would reflect this group's policy preferences. Things change, however, if district distribution changes.

In the most extreme case, where each group lives in a separate district (thus relaxing the equal district size assumption for a moment), the group that happens to live in the swing district is the one that parties will cater to in their electoral programmes. If districts have a more mixed make up, then the group with the highest number of swing voters in the swing district will decide the election. As a result, parties will tailor their pension policy accordingly. Therefore, if the young workers are in this comfortable position, they will be offered an abolition of the PAYG scheme by both parties. Note, however, that given the low ideological density of the young, this would require a fairly homogenous swing district with a very large share of young workers. More likely, therefore, is a scenario where old workers or pensioners offer the most swing voters in the swing district. Their policy preferences are then reflected in the electoral programmes. In case thaz old workers have the most swing voters, direction of a pension reform will, as in the case of proportional representation, depend on the size of the existing PAYG system. If, on the other hand, pensioners were

[37] Note that this is indeed a simplifying assumption within the framework that I have explicated above. To ensure an equilibrium where both paries focus on the marginal district, would actually require to assume different average ideological leanings $\bar{\mu}^{k,i}$ by the three age groups. For a formal proof see Persson and Tabellini (1999): 711.

decisive in the swing district, no reform which reduces the PAYG pillar would be offered. In a majoritarian system, it is therefore entirely possible for parties to cater to the interests of the pensioners and offer no pension reform that reduces the public system, even though nationwide old workers may offer more swing votes. As a result, a situation which leads to reform proposals to shrink the PAYG pillar under proportional representation, may under majoritarian elections lead to no reform programmes at all, or even a rise in the contribution rate to the existing scheme.

5.3.2.3 Summary of the Results

This chapter has analyzed the two ingredients of a political economy analysis: one, formal derivation of voters' policy preferences based on voters' first-order preferences for personal consumption and other public policies; second, the aggregation of these policy preferences through the electoral process and its institutional environment. The model and the subsequent reform scenarios in a probabilistic voting framework have yielded a number of insights that shall be briefly summarized again here. First of all, young workers prefer ending the public PAYG scheme in favor of a prefunded system. Retirees, on the other hand, are in general opposed to any reduction of the existing public systems. From their perspective, any fiscal imbalance of the pension system should be remedied by increasing the contribution rate levied on workers. Finally, preferences of old worker depend on the size of the existing pension scheme. If it is generous, they are in favor of keeping it. Depending on its precise size relative to what old workers consider as optimal, they may favor a reduction in its overall size in favor of more prefunding. If the existing PAYG system is small, old workers prefer its complete replacement with a prefunded system of private saving.

If these preferences are aggregated through a direct referendum, then the prevailing population growth rate is decisive, for it determines which age group contains the pivotal median voter. If policy preferences are aggregated within the framework of a representative democracy, then the electoral system becomes important. Now, the number of swing voters becomes the decisive variable. Under proportional representation, the group with the highest number of swing voters will find their policy preferences catered to by the parties vying for office. This need not be the case under majoritarian elections. Here the number of swing voters in the swing district becomes crucial. Therefore, in certain conditions a pension reform to

reduce the PAYG pillar and increase individual prefunding may be feasible under proportional representation but not under majoritarian elections. The latter therefore allows smaller groups (i.e. groups with fewer politically important swing voters) to determine policies that parties propose.

Given these insight, it is possible to posit the conditions for three, albeit crude, policy predictions:

1. A reduction of an existing PAYG pension system is least likely, if there is very strong negative population growth (i.e. large share of retirees), the existing public scheme is generous and there is a majoritarian electoral system in place.
2. A partial transition of an existing PAYG pension system is most likely, if the population is moderately shrinking, the existing public scheme is generous but higher than old workers would prefer, and if voting takes place under proportional representation.
3. A complete abolition of an existing PAYG pension system is most likely, if the population grows strongly, thus making young workers a majority, and pension policy is decided by referendum; or, alternatively, if the population is moderately shrinking, the existing public scheme is small, and voting takes place either under proportional representation or in a direct referendum.

Note that these predictions depend on the more complicated conditions as laid out througout this chapter! These predictions are made here for illustrative purposes, and because one could argue that brevity is the soul of wit.

Chapter 6
The Empirical World: Non-Evidence and Econometric Evidence

6.1 Non-Evidence and the Curse of Limited Data

The empirical predictions about feasibility and direction of pension reform, as developed in the previous chapter, depend on a number of crucial variables: the population growth rate, size of the existing system, ideological density of different age groups, and the electoral rules that exist in a country. Unfortunately, econometric testing of the influence of these different factors on pension reform turns out to be elusive. While one may point at ideological density as a very hard to measure concept, the actual culprit is the limited number of observations that would be available for such an exercise. Ideally, using time-series cross-sectional data would be optimal, since quite a number of the Western democracies that have been analyzed in this dissertation carried out several pension reform over the last three decades.

Using longitudinal data, however, would only make sense, if we had sufficient amount of variation in all independent variables of interest. Unfortunately, electoral systems have been constant in most countries under investigation (with Italy's recent electoral reform of 2005 being one of the few exceptions). A constant (or nearly constant) independent variable would, of course, correlate (almost) perfectly with the fixed effects in a time-series cross section model, thus making the effect of this variable indistinguishable from other country characteristics that are meant to be captured by the fixed effects parameters (Plümper et al. (2005); Choi (2013)). Even if the electoral variable offered some time variation for some countries, the problem remains that a slow changing independent variable

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still determines the time rate at which observations can be sensibly related (Kittel (2008)). If it changed only once in a decade, then having yearly observation for all other variables will not be of much use. As a result, the only possible route would be to abandon time-series cross-sectional data and go with a vanilla cross-section estimation. This is, however, where the small-N-problem rears its ugly head. Since we are dealing with less then 30 countries here, such an estimation would be rather dubious.

As a result of these obstacles, this dissertation will not attempt to test the predictions for pension reform empirically. One could of course try to engage in a number of thorough comparative case studies that go beyond anecdotal evidence.[1] This, however, would open another can of methodological worms and, in addition, would also be beyond the scope of this thesis.

All is not lost though. It is possible to statistically test the hypotheses derived from the model in chapter 5.2. The model explicitly derived the factors that are predicted to influence individual pension reform preferences, which in turn are crucial for predicting pension reform under different electoral institutions. The hypotheses are:

Hypothesis 6.1.1. *Preferences for sustaining a big public pension system increase with age.*

Hypothesis 6.1.2. *Policy preferences of old workers depend on population growth, and on the size of the existing pension scheme.*

[1] It is easy to think of confirming cases, such as the Rieser-Reform in Germany (moderately shrinking population, mixed electoral system though). Also, one could mention the United States and the failed reform proposal by the Bush administration in 2005, which proposed to reduce the size of the PAYG system by partial transition to prefunding (a.k.a. personal retirement accounts). Here we have a country with a majoritarian electoral system, and a vital swing state, Florida, with a very large population of retirees. Of course, finding confirming evidence does not represent a scientific empirical test, we are looking to falsify our hypotheses (Popper (1935)).

6.2 Predictions about Policy Preferences: A Look at Cross-National Survey Data

6.2.1 Existing Empirical Studies

Unfortunately, the number of empirical studies in the political economy research tradition that actually test the determinants of pension policy preferences in general is limited. However, there are a few that relate to the first hypothesis and the impact individual age may play. Some have analyzed this issue at the aggregate level. Breyer and Craig (1997), for instance, find that median voter age is positively associated with pension system size in a panel of OECD countries. Profeta (2002a) looks at a large cross-section of countries and finds that both system size and length of retirement increase with the share of the elderly in the population.

Of course, macro-level data only shed light on aggregate outcomes and are therefore too coarse to allow inferences about individual preferences. It cannot rule out the possibility that in older societies people of all ages prefer bigger pensions systems. Micro-level data are therefore clearly preferable. Boeri et al. (2001) use survey data and find that being old (above 54) increases the odds of being in favor of staying within a public PAYG system. Unfortunately, this study covers only 4 European countries and does not directly address the question of overall pension system generosity. In contrast, a study by van der Heijden et al. (1997) stands out because in line with standard OLG models, it analyzes age by distinguishing between young, middle-aged and old individuals. However, these authors are mainly interested in examining individual intergenerational altruism. They look at a survey data collected for the Netherlands and find that young and middle-aged individuals seem more altruistic than old people.

Some more empirical research has been conducted by sociologists. Many of these studies, however, are rather broad investigations of individuals' attitudes towards welfare state policies (e.g., Blekesaune and Quadagno (2003)) that use age only as a control variable without providing much theoretical grounding. The overall evidence has been rather mixed, casting doubt on a specific age effect. Only more recently, two papers have explicitly analyzed the impact of population aging on preference formation. While Busemeyer et al. (2009) analyze cross-national ISSP survey data from 1996, Wilkoszewski (2009) looks at surveys from Germany. Both find strong age effects for different kinds of intergenerational

spending programmes. However, neither of these papers' empirical tests are grounded in formal political economy models of preference formation.

6.2.2 Data and Estimation

The two hypotheses of the model are being tested using a cross-national survey conducted by the International Social Survey Programme (ISSP)[2] in 2006/2007. The name of the data set is "Role of Government IV" and it comprises 35 industrialized countries. Since OECD pension data was not available for all of them, data from 21 countries[3] were finally used in the empirical analysis.

There are two dependent variables that try to capture preferences for pension system size.[4] These, while being originally ordinal, are recoded into dummy variables that are based on several survey questions. The first one indicates whether respondents would prefer the government to spend less on pensions. It's based on question Q6f in the ISSP data set, where answers range from "*much more*" to "*much less*".[5] The second dummy variable indicates whether an individual agrees that taxes for low, middle and high income earners are too high (Q12a-c). Answers range from "*strongly agree*" to "*strongly disagree*".[6] Given the budget constraint of the model above, preferences for taxes τ and pensions x should be consistent. In other words, people who prefer a higher public PAYG scheme should also be more prone to say that taxes are not too high. Note that given the phrasing of the questions, preferences for certain levels of contributions or pension spending are also preferences over pension reform. If a person favors less spending, then he or she also prefers a reduction in the size of the public pension pillar.

Turning to the independent variables, I am, of course, mainly interested in the impact of a respondent's age as well as the prevailing population growth rate and the size of the existing public pension in a country on pol-

[2] For more information see http://www.issp.org/index.shtm.

[3] Australia, Canada, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Japan, South Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK, USA

[4] Definitions and sources of variables can be found in appendix D.

[5] The dummy is coded "1" if a respondent were of the opinion that government should spend *much less*, *less* or *the same* on retirement.

[6] The dummy is coded "1" if a respondent thinks that taxes are *much too high* or *too high*.

icy preferences. The variable "age", which measures the self-proclaimed age of a person, seems to be the natural choice. However, there are some pitfalls. In many countries, age and labor market status are not perfectly correlated. Some people retire very early, others continue working well beyond the age of 65. In addition, retirement ages differ across countries. To get around these difficulties and in order to stay true to the structure and theoretical reasoning of the model, three dummy variables have been created: "young worker" indicates if a person is in the labor market[7] and of the age 40 or younger; "old worker" is assigned to those that are inside the labor market and above the age of 40; finally the status "retiree" is assigned to people that are officially retired.

As for the other two important factors, first, the population growth rate "n", which is the estimated average for the years 2005-2010 in a given county, should reflect public perceptions about population aging. Second, the generosity of the existing pension system "Ω" is also being considered. To that end, let's slightly change the definition of a generous pension system to make it more compatible with the empirical data. The countries in the sample fall into two groups of almost identical size: those where the replacement rate exceeds 50 % of working income and those where it remains below that threshold. Hence, $x^h \geq \frac{w \cdot (1-\tau)}{2}$. In other words a generous system offers a pension that is at least half the working income. Hence, a country has a generous scheme, $\Omega = h$, if the pension system's gross replacement rate for a median earner is above 50 per cent, otherwise $\Omega = l$. Both of these factors, n and Ω, should shape individual considerations regarding the optimality of public pensions and private savings.

Finally, a number of control variables are being introduced into the various specifications. First and foremost, "income" captures, unsurprisingly, a person's income. Since income in the ISSP data is measured in national currencies, I follow Corneo and Gruner (2002) in standardizing it by calculating $ln(\frac{y_i}{\bar{y}})$, where y_i stands for an individual's income. This variable is important because it not only captures important economic differences between the respondents, but it also is a proxy for private saving.[8] Additional controls are: "male", which indicates whether a respondent is a male

[7] This includes everybody who is employed, unemployed and in college or vocational training. People considering themselves outside the labor force, helping family members, on housewife,-man duties or being disabled have been dropped from the data set.

[8] Unfortunately, the survey does not cover questions on private savings. But it is well known that private saving increases with income, thus making the income variable a suitable proxy.

or female; "education yrs", which captures a person's years in school; and finally, "household size", which counts the number of persons living in a household together with the respondent.

The estimation approach is to fit the following latent variable model using a logistic regression

$$y_i^* = \alpha + \beta \mathbf{x_i} + \gamma \mathbf{z_i} + \delta \mathbf{w_k} + \varepsilon \tag{6.1}$$

where $\mathbf{x_i}$ represents the age-related variables (for person i), $\mathbf{z_i}$ is a vector of controls, w_k represents a country dummy (for country k), and ε is the error term, where $Var(\varepsilon) = \pi^2/3$. The latent variable y_i^* is linked to the observed binary variable y_i by

$$y_i = \begin{cases} 1 & if \quad y_i^* > 0 \\ 0 & if \quad y_i^* \leq 0 \end{cases} \tag{6.2}$$

6.2.3 Results

Table 6.1 presents the results with respect to the impact of age on preferences for pension system size. The estimations were conducted for the whole sample as well as for two sub-samples, containing either only countries with generous pension schemes or only those with small systems. Comparing the results for the left and right-hand sides of the table reveals that they are consistent for the most part. Respondents who feel that pension spending should not be lowered were also more likely to oppose the view that taxes are too high. As expected, increasing age reduces the likelihood that a person would prefer lower public pension expenditures. Similarly, the older a person, the less likely he or she is to view taxes as being too high. Hence, the basic theoretical argument about the impact of age on preferences seems to be strongly confirmed. Note also that increasing income (and thus higher private saving) increases the odds that a person prefers less pension spending and lower taxation.

Looking at our three model generations in detail further refines these findings. Taking young workers as the reference category, we see that the coefficients for old workers and retirees have the expected negative signs and are highly significant. Both groups are far more likely to support a given level of taxation and higher public pensions than young workers. The model implies that while both of these generations prefer a bigger system than the young, pensioners should favor a scheme that is always

Table 6.1: Logit results for the impact of age on preferences for smaller public pensions system

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var	**Gov. should spend less on pensions**				**Taxes are too high**			
Sample	full	full	$\Omega = h$	$\Omega = l$	full	full	$\Omega = h$	$\Omega = l$
age	-0.0123***				-0.0108***			
	(0.00349)				(0.00172)			
old worker		-0.357***	-0.479***	-0.242*		-0.190***	-0.259***	-0.145*
		(0.0896)	(0.110)	(0.132)		(0.0533)	(0.0544)	(0.0743)
retiree		-0.517***	-0.779***	-0.287		-0.408***	-0.403***	-0.442***
		(0.135)	(0.167)	(0.177)		(0.0813)	(0.145)	(0.0960)
male	0.169***	0.160***	0.304***	0.0290	0.0973	0.0854	0.153	0.0290
	(0.0552)	(0.0557)	(0.0781)	(0.0561)	(0.0655)	(0.0670)	(0.118)	(0.0748)
income	0.310***	0.316***	0.182**	0.443***	0.149*	0.142*	0.376***	-0.0172
	(0.0502)	(0.0538)	(0.0750)	(0.0359)	(0.0791)	(0.0799)	(0.131)	(0.0758)
education years	0.00655**	0.00715**	0.00545	0.00951**	-0.00352	-0.00243	0.000637	-0.0125*
	(0.00288)	(0.00285)	(0.00341)	(0.00382)	(0.00293)	(0.00307)	(0.00326)	(0.00671)
household size	0.00852	0.0161	0.0558**	-0.0168	0.00219	0.0137	-0.0539**	0.0646***
	(0.0188)	(0.0190)	(0.0275)	(0.0175)	(0.0236)	(0.0239)	(0.0258)	(0.0207)
country dummies	(...)	(...)	(...)	(...)	(...)	(...)	(...)	(...)
Obs.	20245	20292	10633	9659	20245	20292	10633	9659
LR	2911.94***	2929.59***	1763.22***	895.7***	1078.56***	1068.91***	515.55***	515.64***
R^2	0.202	0.203	0.232	0.133	0.151	0.149	0.167	0.126

Notes: Robust Standard errors in parentheses clustered by country. R^2 is McKelvey and Zavoina's R^2. $\Omega = h$ includes: Denmark, Finland, Hungary, South Korea, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland. $\Omega = l$ includes: Australia, Canada, Czech Republic, France, Germany, Ireland, Japan, New Zealand, Poland, UK, USA.

bigger than what old workers prefer. Comparing coefficient sizes gives us some probabilistic evidence for that. In percentage terms, the odds of an old worker to favor a smaller pensions system are 30% lower than for a young worker, while for a retiree the odds are even more than 40% lower. This also implies that these two groups are much more likely to oppose a reform that reduces the size of the public pillar.

Turning next to the two sub-samples, I investigate the prediction of the model that preferences of old workers may depend on the size of the existing pension scheme. And indeed, coefficient sizes and significance lev-

els are clearly lower for small pension systems.[9] Comparing coefficients and calculating the odds in percentage terms, it emerges that with respect to pension spending, an old worker in a small system is 17 % less likely to oppose cuts than an old worker living under a generous scheme. This conforms with a scenario like the one depicted in figure 5.1, where an old worker prefers a much bigger system than a young worker under a generous scheme, but is opposed to public pensions in a small system. As a result, they are more likely to oppose fundamental pension reform involving retrenchment in a generous pension system.

Table 6.2: Logit results for the impact of age on preferences with different population growth rates

	(1)	(2)	(3)	(4)
Dep. Var	**Gov. should spend less on pensions**			
Sample	$\Omega = h, l$	$\Omega = h, l$	$\Omega = h$	$\Omega = h$
pop. growth	$n > 0$	$n < 0$	$n < 0$	$n > 0$
old worker	-0.417***	-0.00103	-0.430	-0.481***
	(0.0910)	(0.262)	(0.320)	(0.121)
retiree	-0.476***	-0.647*	-1.489***	-0.667***
	(0.148)	(0.378)	(0.354)	(0.167)
male	0.162***	0.155	0.556***	0.268***
	(0.0608)	(0.151)	(0.0982)	(0.0828)
income	0.330***	0.292**	-0.0171	0.219**
	(0.0593)	(0.141)	(0.0621)	(0.0889)
education yrs	0.00904**	0.00351	0.000340	0.00680
	(0.00407)	(0.00330)	(0.000700)	(0.00447)
household size	0.0292	-0.0520*	-0.0228	0.0640**
	(0.0205)	(0.0284)	(0.0395)	(0.0312)
country dummies	(...)	(...)	(...)	(...)
Observations	16596	3696	1821	8812
LR	2196.051***	714.730***	158.612***	1285.242***
R^2	0.180	0.273	0.199	0.194

Notes: Robust Standard errors in parentheses clustered by country. R^2 is McKelvey and Zavoina's R^2. $\Omega = h$ includes: Denmark, Finland, Hungary, South Korea, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland. $\Omega = l$ includes: Australia, Canada, Czech Republic, France, Germany, Ireland, Japan, New Zealand, Poland, UK, USA.

[9] Interestingly, a similar effect can be discerned for retirees with respect to the pension spending variable. However, with respect to taxation, system size does not seem to matter for pensioners. Clearly, the theoretical model supports the latter finding, but is at odds with the former.

This gives a first indication that old workers' preferences may indeed be a function of system size. But as the model showed, the impact should also be dependent on the population growth rate. For positive growth rates, old workers' preferences should be more aligned with pensioners as they will tend to prefer a high contribution rate and thus a big system. For negative population growth, on the other hand, their preferences will be closer to those of young workers, favoring a significantly smaller pension system (or even no public scheme at all). These predictions are confirmed by the empirical results explicated in table 6.2. In countries with a positive population growth rate (not distinguishing between big and small pension systems in the first two specifications) both old workers and retirees are significantly less likely to favor a reduction in the size of the public pension scheme. However, in countries with negative population growth, there is no statistically significant difference between young and old workers' preferences.

Finally, specification 3 in table 6.2 shows that in generous systems with rapidly aging societies, old workers are no different from young workers in favoring less pension spending. This finding is ambiguous because it does not allow a clear evaluation of one of the model's implications. The model predicts that under a generous system, old workers are against a complete abolition of the public pension system but may either favor a reduction in size or no reduction at all. The fact that the estimate finds no statistically significant difference between young and old workers, could therefore either mean that old workers do prefer an abolition of the public system to the same extend as young workers, thus falsifying the model's prediction. Or it could mean that old workers prefer to keep the public pillar but find it's current size too large, thus confirming the model's prediction. Since the dependent variable only asks about pension spending and not about a complete replacement of the public old-age scheme with a private prefunding system, it cannot discriminate between these two possible preferences of old workers.

Under positive population growth (column (4)), on the other hand, old worker side with pensioners and are thus more likely to support a high spending regime. Retirees, however, are much more prone to oppose pension cuts no matter what the existing scheme is or how fast a society is aging. These findings, again, conform with the predictions of the model and are illustrated in figure 5.2. To couch it in terms of pension reform, retirees will always oppose a reform involving a reduction in the public pillar. Old workers' support for reform, on the other hand, will depend on population growth and the size of the existing system.

In sum, the main implications of the model are tentatively confirmed by the data. In general, age is positively associated with preferences for more pension spending and higher taxation. Retirees are much more likely to favor large pension systems than young workers. As predicted by the model, old workers' preferences are more likely to be aligned with the interests of pensioners in countries with generous public schemes and, regardless of the existing size, when population growth is positive. In countries with negative population growth rates, the odds are much higher that old workers join young workers in preferring a smaller pension system. Note that these findings turn out to be fairly robust. Using the dependent variables in their original ordinal form and fitting an ordered logit regression does not change the results qualitatively[10]; neither does using probit estimation instead of logit.

The empirical analysis presented here is far from fully conclusive, of course. A more convincing empirical test would take the temporal dynamics of changes in public pension systems and population aging into account. Thus, empirical tests should ideally employ also time-series cross-section data. This would allow to exploit the information from changing population growth rates or pension system sizes. Collecting and analyzing such long-run data would be a fruitful enterprise.

[10] Results of an ordered logit estimation can be found in appendix D.1.

Chapter 7
Grand Finale: Summary and Concluding Remarks

The basic premise of this this dissertation has been that population aging puts public PAYG pension systems under heavy strain in Western democracies. Given these common pressures, observing a lot of cross-country variation in the feasibility and direction of pension reform presents an empirical puzzle that demands theoretical explanation. In the research tradition of modern political economy, this thesis attempted to offer a (albeit partial) theoretical analysis by focusing on voters' policy preferences and the way in which these preferences are aggregated through domestic electoral institutions. Considering economic incentives of individuals and political incentives of political actors (a.k.a. political parties) was at the heart of the analysis.

The discussion proceeded in four steps. First, the premise that population aging has severe economic consequences and strains pension systems was empirically fleshed out by reviewing existing demographic and economic long term projections. Second, I reviewed the existing formal political economy literature on the existence and size of public pension systems, thereby also introducing the concept of overlapping-generation models and explaining the necessary notation. This review showed that pension systems can only be understood by looking at the politics involved. This chapter also highlighted the fact that, so far, the role of different types of electoral institutions has not been sufficiently analyzed in the literature. The third step was to clarify what I mean by 'pension reform'. It turned out that regardless of the details of a change in an existing pension scheme, it is always a redistributional move that involves winners and losers. As a result, discussions about whether to completely replace a PAYG system with a prefunded scheme are often misleading. Neither of these two sys-

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tems Pareto-dominates the other. Transition from one to the other is always redistributional and both types of schemes can be reformed to deal with aging processes.[1]

Finally, the fourth step was to develop a three-period OLG model to derive policy preferences of individuals with respect to a public pension scheme, taking the preferences for expenditures on other policy goods into account. The results of the model are that, (1), preferences for a big public PAYG system increase with age; and, (2), older workers policy preferences depend on population growth and on the size of the existing pension scheme. Based on these results, I then proceeded to examine the political process of preference aggregation. It turned out that in a direct democracy, the age of the median voter is key. If the median was a young worker, the public scheme would be completely replaced by a prefunded system of individual saving. If retirees were in a majority, the PAYG scheme would be preserved and any fiscal imbalance in the system would be resolved through changes in the contribution rate. Finally, if the median voter was an old worker, then the PAYG system would be preserved in case it is generous in its benefits. If it only provided small old-age benefits, then it would be abolished in favor of a prefunded scheme.

These result were then compared to those in a representative democracy, where elections are conducted in a majoritarian or proportional system. This was done in the framework of a probabilistic voting model. It was shown that under these electoral conditions, the median voter is no longer necessarily pivotal. Important is rather the number of swing voters an age group contains. In a system of proportional representation, expected reform scenarios are somewhat similar to the case of direct democracy. However, retirees have a higher chance to find their policy preferences being implemented, even if they don't have a majority in numbers. This could happen in case they are ideologically much more homogenous than old workers. This implies that they would have the most swing voters, which would determine parties pension policy programmes. It was then shown that, in contrast, under majoritarian elections the number of swing voters in the swing district becomes crucial. Therefore, in certain conditions a pension reform that reduces the PAYG pillar and increases individual prefunding may be feasible under proportional representation but not under majoritarian elections. This could happen if old workers

[1] This is not to say that there couldn't be additional arguments that justify a certain type of policy change. Transition to a prefunded scheme could still be justified on the grounds of it having beneficial macroeconomic effects or a partial transition may be beneficial due to increased diversification of pension income.

have more swing voters than retirees nationwide, but do have fewer in the decisive swing district.

Given these theoretical results, I finally ventured on the thin ice of gross simplification to come up with three broad predictions:

1. A reduction of an existing PAYG pension system is least likely, if there is very strong negative population growth (i.e. large share of retirees), the existing public scheme is generous and there is a majoritarian electoral system in place.
2. A partial transition of an existing PAYG pension system is most likely, if the population is moderately shrinking, the existing public scheme is generous but higher than old workers would prefer, and if voting takes place under proportional representation.
3. A complete abolition of an existing PAYG pension system is most likely, if the population grows strongly, thus making young workers a majority, and pension policy is decided by referendum; or, alternatively, if the population is moderately shrinking, the existing public scheme is small, and voting takes place either under proportional representation or in a direct referendum.

While data limitations prevented a thorough econometric test of these reform predictions, it was possible to test the two hypotheses about individual policy preferences. Logit and ordered-logit analyses of cross-national survey data of 21 countries showed that, as predicted by the model, age is positively associated with preferences for a bigger public pension system. As predicted by the model, old workers' preferences are more likely to be aligned with the interests of pensioners in countries with generous public schemes and, regardless of the existing size, when population growth is positive. In countries with negative population growth rates, the odds are much higher that old workers join young workers in preferring a smaller pension system. With respect to pension reform, these results suggest that retirees are the most likely to oppose cuts in public pensions, whereas young workers are the most likely to favor such changes. The attitude of old workers ultimately depends on the degree of population aging and the size of the existing pension system. As a result, the main implications of the model were tentatively confirmed by the data.

Note that these predictions and estimates do not rule out the possibility that other factors such as intergenerational altruism may play an important role. Given the nature of the questions underlying the dependent variables, the survey data could not discern whether young workers

would really favor a complete abolition of the public pension system or just a reduction. Similarly, feelings of intergenerational fairness may prevent pensioners from demanding the maximum system size predicted by the model. The empirical analysis could only provide probabilistic evidence. This evidence, however, seems to confirm the qualitative ordering of preferences proposed by the model and highlights the conditions under which the preferences of some age groups may change.

Taking a step back and looking at this dissertation's overall aim of explaining pension reform, it becomes clear a lot of more work needs to be done. Looking at voters' preferences, electoral institutions and the resulting political incentives of parties in a representative democracy is only the beginning. Ideally, one would like to also incorporate post electoral politics in models of legislative bargaining. One needs also to be humble enough, however, to recognize that even with such a more complete model, it would still be hard to really provide a complete theoretical account of domestic pension reform. Many idiosyncratic, country-specific conditions stand in the way of developing satisfying parsimonious models.

On the empirical front, things are not any easier. As chapter 6.1 has argued, a comprehensive econometric analysis of the factors that may explain pension reform is, at the current stage, hard to conduct if some of the independent variables are constant or change only very rarely. On a positive note, however, the econometric tests in this dissertation do indicate that rational choice models can indeed tell us quite a bit about individual preferences. They also allow researcher to identify the conditions under which preferences may vary.

Finally, after digesting this dissertation, one may query whether we should expect more pension reforms in Western democracies (and thus more data points for the empirical researcher). Due to the onset of the global financial and economic crisis in 2008, pension policy has currently dropped somewhat down the agenda in the publics' and policy makers' minds compared to the time around the turn of the millennium. However, since population aging is a continuing trend in Western democracies, attention will soon very likely return to this issue. Once the more short term issues of economic and financial stabilization have been dealt with, the issue of long term stabilization of public pension system will move further atop national political agendas again, especially in countries which have not really dealt with this issue in the past and have suffered from high fiscal deficits after the begin of the financial crisis. Whether a budgetary crisis is conducive to pension reform is, however, far from clear.

One could argue that big pension reforms are only possible in situations of fiscal health, especially if the reform involves a debt-financed partial or full transition to prefunding.[2] But whether the recent economic upheavals will speed up or slow down the process of adjustment of national systems of old-age provision and whether parametric or non-parametric reforms will become more likely remains to be seen. What is safe to say, though, is that it will remain a strongly contested political issue that political parties and candidates alike will tread carefully, if they want to be successful at the polls. As a result, it is and will be susceptible to political economy analysis.

[2] This idea was clearly embraced by Eichengreen and Wyplosz (1998) when they criticized that the Eurozone's fiscal criteria, as enshrined in the Stability and Growth Pact, are too strict because they could prevent any pension reform that needed debt financing of the transition burden.

Appendix A
Political Economy Theories of Pension Systems

A.1 Formalization of the Browning Model, Chapter 3.1.1

The young workers' optimization problem

$$\max_{(s_t, s_{t-1}, \tau)} U_t^y = u[c_t] + u[c_{t+1}] + u[c_{t+2}] \tag{A.1}$$

$$s.t.$$

$$c_t = w \cdot (1 - \tau_t) - s_t \tag{A.2}$$

$$c_{t+1} = w \cdot (1 - \tau_{t+1}) - s_{t+1} \tag{A.3}$$

$$c_{t+2} = x_{t+2} + (1+r)^2 \cdot s_t + (1+r) \cdot s_{t+1} \tag{A.4}$$

$$x_t = (1+n)^2 \cdot w \cdot \tau_t + (1+n) \cdot w \cdot \tau_t \tag{A.5}$$

$$s_t, s_{t+1} \geq 0 \tag{A.6}$$

$$\tau_t = \tau_{t+1} \geq 0 \tag{A.7}$$

Inserting (A.2)-(A.5) into (A.1) and using the Kuhn-Tucker-Theorem because (A.6) and (A.7) are non-binding, we can establish the first-order conditions (FOC):

$$\frac{\partial U_t^y}{\partial s_t} = -u_t'[w(1-\tau) - s_t] + (1+r)^2 \cdot u_{t+2}'[w \cdot \tau_t \cdot ((1+n)^2 + (1+n)) + (1+r)^2 \cdot s_t + (1+r) \cdot s_{t+1}] \leq 0$$

$$(if\ s_t > 0,\ then\ \frac{\partial U}{\partial s_t} = 0) \tag{A.8}$$

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$$\begin{aligned}\frac{\partial U_t^y}{\partial s_{t+1}} &= -u'_{t+1}[w(1-\tau)-s_{t+1}]+(1+r)\cdot u'_{t+2}[w\cdot\tau_t\cdot((1+n)^2+(1+n))\\ &\quad +(1+r)^2\cdot s_t+(1+r)\cdot s_{t+1}]\leq 0\\ &\quad (\textit{if } s_{t+1}>0, \textit{ then } \frac{\partial U}{\partial s_{t+1}}=0) \qquad \text{(A.9)}\\ \frac{\partial U_t^y}{\partial \tau} &= -w\cdot u'_t[w(1-\tau)-s_t]-w\cdot u'_{t+1}[w(1-\tau)-s_{t+1}]+\\ &\quad w\cdot((1+n)^2+(1+n))\cdot u'_{t+2}[w\cdot\tau_t\cdot((1+n)^2+(1+n))\\ &\quad +(1+r)^2\cdot s_t+(1+r)\cdot s_{t+1}]\leq 0\\ &\quad (\textit{if } \tau>0, \textit{ then } \frac{\partial U}{\partial \tau}=0) \qquad \text{(A.10)}\end{aligned}$$

Substituting A.8 and A.9 into A.10 and rearranging yields the condition for τ to be positive:

$$\begin{aligned}w\cdot((1+n)^2+(1+n))\cdot u'_{t+2}[w\cdot\tau_t\cdot((1+n)^2+(1+n))+\\ (1+r)^2\cdot s_t+(1+r)\cdot s_{t+1}]\\ \geq\\ (1+r)^2\cdot w\cdot u'_{t+2}[w\cdot\tau_t\cdot((1+n)^2+(1+n))+\\ (1+r)^2\cdot s_t+(1+r)\cdot s_{t+1}]+\\ (1+r)\cdot w\cdot u'_{t+2}[w\cdot\tau_t\cdot((1+n)^2+(1+n))+\\ (1+r)^2\cdot s_t+(1+r)\cdot s_{t+1}]\end{aligned} \qquad \text{(A.11)}$$

Dividing both sides of the inequality A.11 by $(w\cdot u'_{t+2}[.])$ simplifies it to

$$(1+n)^2+(1+n)\geq(1+r)^2+(1+r) \qquad \text{(A.12)}$$

The old workers' optimization problem

$$\begin{aligned}\max_{(s_t,\tau)} U_t^o &= u[c_t]+u[c_{t+1}] && \text{(A.13)}\\ s.t.&\\ c_t &= w\cdot(1-\tau_t)-s_t && \text{(A.14)}\\ c_{t+1} &= x_{t+1}+(1+r)^2\cdot s_{t-1}+(1+r)\cdot s_t && \text{(A.15)}\\ x_t &= (1+n)^2\cdot w\cdot\tau_t+(1+n)\cdot w\cdot\tau_t && \text{(A.16)}\\ s_t &\geq 0 && \text{(A.17)}\\ \tau_t &\geq 0 && \text{(A.18)}\end{aligned}$$

The FOC are:

$$\begin{aligned}\frac{\partial U_t^o}{\partial s_t} = & -u_t'[w\cdot(1-\tau)-s_t]+(1+r)\cdot u_{t+1}'[w\cdot\tau_t\cdot((1+n)^2+(1+n))+\\ & (1+r)^2\cdot s_{t-1}+(1+r)\cdot s_t]\leq 0\\ & (\textit{if } s_t>0, \textit{ then } \frac{\partial U}{\partial s_t}=0)\end{aligned} \tag{A.19}$$

$$\begin{aligned}\frac{\partial U_t^o}{\partial \tau} = & -w\cdot u_t'[w\cdot(1-\tau)-s_t]+w\cdot((1+n)^2+(1+n))\cdot\\ & u_{t+1}'[w\cdot\tau_t\cdot((1+n)^2+(1+n))+(1+r)^2\cdot s_{t-1}+(1+r)\cdot s_t]\leq 0\\ & (\textit{if } \tau>0, \textit{ then } \frac{\partial U}{\partial \tau}=0)\end{aligned} \tag{A.20}$$

Substituting A.19 and A.20 into each other results in the following condition:

$$\begin{aligned}& w\cdot((1+n)^2+(1+n))\cdot u_{t+1}'[w\cdot\tau_t\cdot((1+n)^2+(1+n))+\\ & \qquad (1+r)^2\cdot s_{t-1}+(1+r)\cdot s_t]\\ & \qquad\qquad \geq\\ & (1+r)\cdot w\cdot u_{t+1}'[w\cdot\tau_t\cdot((1+n)^2+(1+n))+(1+r)^2\cdot s_{t-1}+(1+r)\cdot s_t]\end{aligned} \tag{A.21}$$

Dividing both sides of the inequality A.21 by $(w\cdot u_{t+1}'[.])$ simplifies it to

$$(1+n)^2+(1+n)\geq(1+r) \tag{A.22}$$

A.2 Solution of the Model with Altruism, Chapter 3.1.3

The optimization problem of a representative worker

$$\max_{(s_t,\tau)} U_t = \alpha \cdot ln(c_t^y) + \beta \cdot ln(c_t^r) + \rho \cdot ln(c_{t+1}^r) \tag{A.23}$$

s.t.

$$c_t^y = w \cdot (1-\tau_t) - s_t \tag{A.24}$$

$$c_{t+1}^r = x_{t+1} + (1+r) \cdot s_t \tag{A.25}$$

$$c_t^r = x_t + (1+r) \cdot s_{t-1} \tag{A.26}$$

$$x_{t,\,t+1}^r = (1+n) \cdot \tau_{t,\,t+1} \cdot w \tag{A.27}$$

$$s_t, s_{t+1} \geq 0 \tag{A.28}$$

$$\tau_t, \tau_{t+1} \geq 0 \tag{A.29}$$

Inserting (A.24)-(A.27) into (A.23) and using the Kuhn-Tucker-Theorem because (A.33) and (A.29) are non-binding, we can establish the FOC:

$$\frac{\partial U_t}{\partial s_t} = -\frac{\alpha}{w \cdot (1-\tau_t) - s_t} + \frac{(1+r) \cdot \rho}{(1+n) \cdot w \cdot \tau_{t+1} + (1+r) \cdot s_t} \leq 0$$

$$(if\ s_t > 0,\ then\ \frac{\partial U}{\partial s_t} = 0) \tag{A.30}$$

$$\frac{\partial U_t}{\partial \tau_t} = -\frac{w \cdot \alpha}{w \cdot (1-\tau_t) - s_t} + \frac{(1+n) \cdot \beta \cdot w}{(1+n) \cdot w \cdot \tau_t + (1+r) \cdot s_{t-1}} \leq 0$$

$$(if\ \tau_t > 0,\ then\ \frac{\partial U}{\partial \tau_t} = 0) \tag{A.31}$$

Solving this system of equations for the optimal contribution rate, $\tau_t^\star$, yields

$$\tau_t^\star = \frac{(1+n)(1+r) \cdot w \cdot \beta + (1+n)^2 \cdot \beta \cdot w \cdot \tau_{t+1} - (1+r)^2(\alpha+\rho) \cdot s_{t-1}}{(1+n)(1+r)(\alpha+\beta+\rho) \cdot w} \tag{A.32}$$

To find the condition under which $\tau_t^\star$ remains positive even if the pension system is abolished in the next period, we have to set $\tau_{t+1} = 0$ in (A.32). This produces

$$\tau_t^\star = \frac{\beta}{\alpha+\beta+\rho} - \frac{(1+r)(\alpha+\rho) - s_{t-1}}{(1+n)(\alpha+\beta+\rho) \cdot w} \tag{A.33}$$

which is equivalent to

$$\tau_t^\star = \frac{\beta \cdot (1+n) \cdot w}{(1+n)(\alpha+\beta+\rho) \cdot w} - \frac{(1+r)(\alpha+\rho) - s_{t-1}}{(1+n)(\alpha+\beta+\rho) \cdot w} \tag{A.34}$$

Hence the condition for $\tau_t > 0$ if $\tau_{t+1} = 0$ can be written as

$$\frac{\beta}{(\alpha+\rho)} \cdot (1+n) \cdot w > (1+r) \cdot s_{t-1} \tag{A.35}$$

A.3 Solution of the Representative Democracy Model, Chapter 3.2.2

The economic optimization problem is

$$\max_{(s_t,\tau)} U_t = u[c_t^y] + \rho \cdot u[c_{t+1}^r] \tag{A.36}$$

$$s.t.$$

$$c_t^y = w \cdot (1-\tau_t) - s_t \tag{A.37}$$

$$c_{t+1}^r = (1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t \tag{A.38}$$

$$s \geq 0 \tag{A.39}$$

$$\tau \geq 0 \tag{A.40}$$

Inserting (A.37)and(A.38) into (A.36) and using the Kuhn-Tucker-Theorem because (A.39) and (A.40) are non-binding, we can establish the FOC:

$$\frac{\partial U_t}{\partial s_t} = -u'[w \cdot (1-\tau_t) - s_t] + (1+r) \cdot \rho \cdot u'[(1+n) \cdot \tau_{1+t} \cdot w + (1+r)s_t] \leq 0$$

$$(\textit{if } s_t > 0, \textit{ then } \frac{\partial U_t}{\partial s_t} = 0) \tag{A.41}$$

Solving with respect to $(1+r)$ gives

$$(1+r) = \frac{u'[w \cdot (1-\tau_t) - s_t]}{\rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]} \tag{A.42}$$

Note that multiplying both sides of this equation with $\rho \cdot u'[(1+n) \cdot \tau_{t+1} \cdot w + (1+r) \cdot s_t]$ rearranges it to

$$u'[w\cdot(1-\tau_t)-s_t]=(1+r)\cdot\rho\cdot u'[(1+n)\cdot\tau_{t+1}\cdot w+(1+r)\cdot s_t] \tag{A.43}$$

The government function is

$$W_t=\phi\cdot u[c_t^w,c_{t+1}^w]+(1-\phi)\cdot u[c_t^r] \tag{A.44}$$

Inserting (A.37) and (A.38) expands the government function to

$$\begin{aligned}W_t\;=\;&\phi\cdot(u[w\cdot(1-\tau_t)-s_t]+\rho\cdot u[(1+n)\cdot\tau_{t+1}\cdot w+(1+r)\cdot s_t])\\&+(1-\phi)\cdot u[(1+n)\cdot\tau_t\cdot w+(1+r)\cdot s_{t-1}]\end{aligned} \tag{A.45}$$

If we assume that the government's decision is non-binding and thus reversible, so that $\tau_t\neq\tau_{t+1}$ and, given uncertainty, $\tau_{t+1}=0$, (A.45) reduces to

$$\begin{aligned}W_t\;=\;&\phi\cdot(u[w\cdot(1-\tau_t)-s_t]+\rho\cdot u[(1+r)\cdot s_t])\\&+(1-\phi)\cdot u[(1+n)\cdot\tau_t\cdot w+(1+r)\cdot s_{t-1}]\end{aligned} \tag{A.46}$$

Maximizing this function with respect to τ_t yields the following FOC:

$$\begin{aligned}\frac{\partial U_t}{\partial\tau_t}\;=\;&(1+n)\cdot w\cdot(1-\phi)\cdot u'[(1+n)\cdot\tau_t\cdot w+(1+r)s_{t-1}]\\&-w\cdot\phi\cdot u'[w\cdot(1-\tau_t)-s_t]\leq 0\\&(\textit{if }\tau_t>0,\textit{ then }\frac{\partial U_t}{\partial\tau_t}=0)\end{aligned} \tag{A.47}$$

Given equation (A.43), we can re-write (A.47) accordingly. Rearranging and simplifying thus gives

$$1-\phi\geq\frac{\phi\cdot(1+r)\cdot\rho\cdot u'[(1+n)\cdot\tau_{t+1}\cdot w+(1+r)\cdot s_t]}{(1+n)\cdot u'[(1+n)\cdot\tau_t\cdot w+(1+r)s_{t-1}]} \tag{A.48}$$

Rearranging the FOC in (A.47), we derive the government's optimal contribution level

$$1+n=\frac{\phi\cdot u'[w\cdot(1-\tau_t)-s_t]}{(1-\phi)\cdot u'[(1+n)\cdot w\cdot\tau_t+(1+r)\cdot s_{t-1}]} \tag{A.49}$$

A.4 Solution of the Probabilistic Voting Model, Chapter 3.2.3

The old's optimization problem is

$$\max_{(c_t^r, l_t^r)} U_t^r[c^r, l^r] = c_t^r + \varphi^r \cdot log(l^r) \tag{A.50}$$

$$s.t.$$

$$c_t^r = w \cdot (1 - \nu_t^r)(1 - l_t^r) + \tau_t + T_t^r \tag{A.51}$$

Differentiating with respect to l_t^r yields the following FOC:

$$\frac{\partial U_t}{\partial l_t^r} = -w(1 - \nu_t^r) + \frac{\varphi^r}{l_t^r} = 0 \tag{A.52}$$

Solving for l_t^r and then solving for c_t^r gives the optimal choices of the old regarding l_t^r and c_t^r:

$$l_t^r = \frac{\varphi^r}{w(1 - \nu_t^r)} \tag{A.53}$$

$$c_t^r = w \cdot (1 - \nu_t^r) - \varphi^r + \tau_t^r + T_t^r \tag{A.54}$$

The young's optimization problem is

$$\max_{(c_t^w, l_t^w)} \quad U_t^w[c^w, l^w] = c_t^w + \varphi^w \cdot log(l^w) + \beta^w \cdot log(l_t^r) + \rho \cdot (c_{t+1}^w + \varphi_{t+1}^w \cdot log(l_{t+1}^w)) \tag{A.55}$$

$$s.t.$$

$$c_t^w + \rho \cdot c_{t+1}^w = w \cdot (1 - \nu_t^w)(1 - l_t^w) + \tau_t^w + T_t^w + \rho \cdot (w \cdot (1 - \nu_{t+1}^w) + \tau_{t+1}^w + T_{t+1}^w) \tag{A.56}$$

Differentiating with respect to l_t^w yields the following FOC:

$$\frac{\partial U_t}{\partial l_t^w} = -w \cdot (1 - \nu_t^w) + \frac{\varphi_y^w}{l_t^y} = 0 \tag{A.57}$$

Solving for l_t^w and then solving for c_t^w gives the optimal choices of the workers regarding l_t^w and c_t^w:

$$l_t^w = \frac{\varphi_t^w}{w \cdot (1 - \nu_t^w)} \tag{A.58}$$

$$c_t^w = w \cdot (1 - \nu_t^w) - \varphi_t^w + \tau_t^w + T_t^w + \rho \cdot (w \cdot (1 - \nu_{t+1}^w) - \varphi_t^w + \tau_{t+1}^w + T_{t+1}^w) - \rho \cdot c_{t+1}^w \quad \text{(A.59)}$$

Given the budget constraint of the intragenerational transfer, $T^i = \nu^i \cdot w \cdot (1 - l^i) = \nu^i \cdot w - \frac{\nu^i \cdot \varphi^i}{1 - \nu^i}$, the indirect utility functions of workers and pensioners respectively can be obtained by plugging (A.53) and (A.54) into (A.51), as well as (A.58) and (A.59) into (A.55):

$$V_t^r = w \cdot (1 - \nu_t^r) - \varphi_t^r + \tau_t^r + (\nu^r \cdot w - \frac{\nu_t^r \cdot \varphi_t^r}{(1 - \nu_t^r)}) + \varphi_t^r \cdot log(\varphi_t^r) - \beta_t^w \cdot log(w) - \beta_t^w \cdot log(1 - \nu_t^r) \quad \text{(A.60)}$$

$$\begin{aligned} V_t^w = {} & w \cdot (1 - \nu_t^w) - \varphi_t^w + \tau_t^w + (\nu^w \cdot w - \frac{\nu_t^w \cdot \varphi_t^w}{1 - \nu_t^w}) + \\ & \beta_t^w \cdot log(\varphi_t^r) - \varphi_t^r \cdot log(w) - \varphi_t^r \cdot log(1 - \nu_t^r) + \\ & \rho(w \cdot (1 - \nu_{t+1}^w) - \varphi_{t+1}^w + \tau_{t+1}^w + (\nu_{t+1}^w \cdot w - \frac{\nu_{t+1}^w \cdot \varphi_{t+1}^w}{(1 - \nu_{t+1}^w)}) + \\ & \varphi_{t+1}^w \cdot log(\varphi_{t+1}^w) - \varphi_{t+1}^w \cdot log(w) - \varphi_{t+1}^w \cdot log(1 - \nu_{t+1}^w) \end{aligned} \quad \text{(A.61)}$$

The optimization problem of party j, where $j \in \{L, R\}$ is:

$$\max_{q^j} \sum_{i=w,r} (1 + n^i) \cdot d^i \cdot (V^i(q^j) - V^i(q^{-j})) \quad \text{(A.62)}$$

s.t.

$$\begin{aligned} \tau_t^i &= (1 + n^r)_t \cdot \tau_t^r + (1 + n^w) \cdot \tau_t^w + \alpha \cdot ((1 + n^r) \cdot \tau_t^r)((1 + n^w) \cdot \tau_t^w)) = 0 \\ T^i &= \nu^i \cdot w \cdot (1 - l^i) = \nu^i \cdot w - \frac{\nu^i \cdot \varphi^i}{1 - \nu^i} \end{aligned} \quad \text{(A.63)}$$

Differentiating with respect to τ_t^w and τ_t^r returns the FOCs. For the sake of completeness I also list FOCs of the second group of choice variables ν_t^y, ν_t^r, although they are not relevant for the explication in the text.

$$\frac{\partial V_t^r}{\partial v_t^r} = (1+n^r)\cdot d^r\cdot(-\frac{v_t^r\cdot\varphi_t^r}{(1-v_t^r)^2}) = 0 \tag{A.64}$$

$$\frac{\partial V_t^w}{\partial v_t^w} = (1+n^w)\cdot d^w\cdot(\frac{\varphi_t^r}{1-v_t^w} - \frac{\varphi_t^w}{1-v_t^w} - \frac{v_t^w\cdot\varphi_t^w}{(1-v_t^w)^2}) = 0 \tag{A.65}$$

$$\frac{\partial V_t^r}{\partial \tau_t^r} = (1+n^r)\cdot d^r - \lambda\cdot((1+n^r)+\alpha\cdot(1+n^r)\cdot(1+n^w)\cdot\tau_t^w) = 0 \tag{A.66}$$

$$\frac{\partial V_t^w}{\partial \tau_t^w} = (1+n^w)\cdot d^w - \lambda\cdot((1+n^w)+\alpha\cdot(1+n^r)\cdot(1+n^w)\cdot\tau_t^r) = 0 \tag{A.67}$$

where λ denotes the Lagrangian.
To show that retirees get a positive intergenerational transfer from workers (i.e. $\tau_t^w < 0$ and $\tau_t^r > 0$), we rearrange and reduce (A.66) and (A.67):

$$d^r = \lambda\cdot(1-\alpha\cdot\tau_t^w\cdot(1+n^w)) \tag{A.68}$$

$$d^w = \lambda\cdot(1-\alpha\cdot\tau_t^r\cdot(1+(1+n^r))) \tag{A.69}$$

Given the assumption that the pensioners are more homogenous (i.e. more single-minded) so that $d^r > d^w$, it must follow from the above conditions that

$$\frac{d^r}{d^w} = \frac{1-\alpha\cdot\tau_t^w\cdot(1+n^w)}{1-\alpha\cdot\tau_t^r\cdot(1+(1+n^r))} > 0 \tag{A.70}$$

For this to be the case, the term $(\alpha\cdot\tau_t^w\cdot(1+n^w))$ needs to be negative. Since α and $(1+n^w)$ are both assumed to be positive, τ_t^w has to be negative, that is, inter-generational transfers to the workers are negative. As intergenerational transfers are zero-sum, any losses by one group are the gains of the other. Hence, $\tau_t^w\cdot\tau_t^r < 0$. As result, τ_t^r must be positive and therefore condition (A.70) is fulfilled.

Appendix B
Pension Preferences and Reform – An Political-Economy Model

B.1 Solution of the Political Economy Model, Chapter 5.2

B.1.1 Economic Decisions in the General Form Model

A representative young individual faces the following optimization problem:

$$\max_{(s_t, s_{t+1})} U_t^i(c_t, c_{t+1}, c_{t+2}) = u_t[c_t + \gamma^y \cdot g] + \rho \cdot u_{t+1}[c_{t+1} + \gamma^o \cdot g] + \rho^2 \cdot u_{t+2}[c_{t+2} + \gamma^r \cdot g] \quad \text{(B.1)}$$

$$s.t.$$

$$c_t = w \cdot (1 - \tau_t) - s_t \quad \text{(B.2)}$$

$$c_{t+1} = w \cdot (1 - \tau_{t+1}) + (1 + r) \cdot s_t - s_{t+1} \quad \text{(B.3)}$$

$$c_{t+2} = x_{t+2} + (1 + r) \cdot s_{t+1} \quad \text{(B.4)}$$

$$x_{t+2} + g = (1 + n)^2 \cdot w \cdot \tau_{t+2} + (1 + n) \cdot w \cdot \tau_{t+2} \quad \text{(B.5)}$$

$$s_t, s_{t+1} \geq 0 \quad \text{(B.6)}$$

$$\tau_t = \tau_{t+1} \geq 0 \quad \text{(B.7)}$$

Inserting (B.2)-(B.4) into (B.1) yields a constraint optimization problem, since (B.6) and (B.7) are non-binding. The resulting FOC are:

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$$\frac{\partial U^y}{\partial s_t} = -u_t'[w\cdot(1-\tau)-s_t+\gamma_y\cdot g]+ \\ (1+r)\cdot\rho\cdot u_{t+1}'[w\cdot(1-\tau)+(1+r)\cdot s_t-s_{t+1}+\gamma_o\cdot g]\leq 0 \\ (\textit{if } s_t>0, \textit{ then } \frac{\partial U}{\partial s_t}=0) \tag{B.8}$$

$$\frac{\partial U^y}{\partial s_{t+1}} = -\rho\cdot u_{t+1}'[w\cdot(1-\tau)+(1+r)\cdot s_t-s_{t+1}+\gamma_o\cdot g]+ \\ (1+r)\cdot\rho^2\cdot u_{t+2}'[(1+n)\cdot w\cdot\tau+(1+n)^2\cdot w\cdot\tau-g+(1+r)\cdot s_{1+t}+\gamma_r\cdot g] \\ (\textit{if } s_{t+1}>0, \textit{ then } \frac{\partial U}{\partial s_{t+1}}=0) \tag{B.9}$$

Rearranging both conditions gives

$$u_t'[w(1-\tau)-s_t+\gamma_y\cdot g]=(1+r)\cdot\rho\cdot u_{t+1}'[w(1-\tau)+(1+r)s_t-s_{t+1}+\gamma_o\cdot g] \tag{B.10}$$

$$\rho\cdot u_{t+1}'[w(1-\tau)+(1+r)\cdot s_t-s_{t+1}+\gamma_o\cdot g]= \\ (1+r)\cdot\rho^2\cdot u_{t+2}'[(1+n)\cdot w\cdot\tau+(1+n)^2 w\cdot\tau-g+(1+r)\cdot s_{t+1}+\gamma_r\cdot g] \tag{B.11}$$

An old worker has to allocate consumption and savings over only two periods. The FOC is therefore:

$$\frac{\partial U^o}{\partial s_t} = -u_t'[w\cdot(1-\tau)+(1+r)\cdot s_{t-1}-s_t+\gamma_o\cdot g] \\ (1+r)\cdot\rho\cdot u_{t+1}'[(1+n)\cdot w\cdot\tau+(1+n)^2 w\cdot\tau-g+(1+r)\cdot s_t+\gamma_r\cdot g] \\ (\textit{if } s_t>0, \textit{ then } \frac{\partial U}{\partial s_t}=0) \tag{B.12}$$

Rearranging gives

$$u_t'[w\cdot(1-\tau)+(1+r)\cdot s_{t-1}-s_{t+1}+\gamma_o\cdot g]= \\ (1+r)\cdot\rho\cdot u_{t+1}'[(1+n)\cdot w\cdot\tau+(1+n)^2 w\cdot\tau-g+(1+r)\cdot s_t+\gamma_r\cdot g] \tag{B.13}$$

B.1.2 Economic Decisions in the Model with Logarithmic Utility

A representative **young worker** faces the following optimization problem:

$$\begin{aligned}
\underset{(c_t,c_{t+1},c_{t+2})}{max}\ U_t^y(c_t,c_{t+1},c_{t+2}) &= log(c_t+\gamma^y\cdot g)+\rho\cdot log(c_{t+1}+\gamma^o\cdot g)+ \\
&\quad \rho^2\cdot log(c_{t+2}+\gamma^r\cdot g) && \text{(B.14)}\\
s.t.& \\
c_t &= w\cdot(1-\tau_t)-s_t && \text{(B.15)}\\
c_{t+1} &= w\cdot(1-\tau_{t+1})+(1+r)\cdot s_t-s_{t+1} && \text{(B.16)}\\
c_{t+2} &= x_{t+2}+(1+r)\cdot s_{t+1} && \text{(B.17)}\\
s_t,s_{t+1} &\geq 0 && \text{(B.18)}\\
\tau_t=\tau_{t+1} &\geq 0 && \text{(B.19)}
\end{aligned}$$

The number of constraints can be reduced to two:

$$\begin{aligned}
c_{t+2} &= x_{t+2}+(1+r)(w\cdot(1-\tau)-c_{t+1}+(1+r)(w\cdot(1-\tau)-c_t)) && \text{(B.20)}\\
c_{t+2} &\geq x_{t+2} && \text{(B.21)}
\end{aligned}$$

The resulting Lagrangian $\mathscr{L}$ consist thus of the utility function and two constraints:

$$\begin{aligned}
\mathscr{L} &= log(c_t+\gamma^y\cdot g)+\rho\cdot log(c_{t+1}+\gamma^o\cdot g)+\rho^2\cdot log(c_{t+2}+\gamma^r\cdot g)- \\
&\quad \lambda_1\cdot(c_{t+2}-x_{t+2}-(1+r)(w\cdot(1-\tau)-c_{t+1}+(1+r)(w\cdot(1-\tau)-c_t))) \\
&\quad -\lambda_2\cdot(-x_{t+2}+c_{t+2}) && \text{(B.22)}
\end{aligned}$$

Differentiating yields the following Kuhn-Tucker-conditions:

$$\begin{aligned}
\frac{\partial \mathscr{L}}{\partial c_t} &= \frac{1}{c_t + \gamma^y \cdot g} - (1+r)(1+r) \cdot \lambda_1 = 0 \\
\frac{\partial \mathscr{L}}{\partial c_{t+1}} &= \frac{\rho}{c_{t+1} + \gamma^o \cdot g} - (1+r) \cdot \lambda_1 = 0 \\
\frac{\partial \mathscr{L}}{\partial c_{t+2}} &= \frac{\rho^2}{c_{t+2} + \gamma^r \cdot g} - \lambda_1 + \lambda_2 = 0 \\
\frac{\partial \mathscr{L}}{\partial \lambda_1} &= x_{t+2} + (1+r)(w \cdot (1-\tau) + (1+r)(w \cdot (1-\tau) - c_t) - c_{t+1}) - c_{t+2} = 0 \\
\frac{\partial \mathscr{L}}{\partial \lambda_2} &= -x + c_{t+2} \geq 0 \\
\lambda_2 \cdot \frac{\partial \mathscr{L}}{\partial \lambda_2} &= \lambda_2 \cdot (-x + c_{t+2}) = 0
\end{aligned} \tag{B.23}$$

Combining (B.15)-(B.19) with (B.23), we can find the solutions for the given maximization problem. The solutions are explicated in Tables 5.2 and 5.3 of Chapter 5.2.

A representative **old worker** faces the following optimization problem:

$$\begin{aligned}
\max_{(c_t, c_{t+1})} U_t^o(c_t, c_{t+1}) &= log(c_{t-1} + \gamma^y \cdot g) + log(c_t + \gamma^o \cdot g) + \\
&\quad \rho \cdot log(c_{t+1} + \gamma^r \cdot g) && \text{(B.24)} \\
s.t. & \\
c_t &= w \cdot (1-\tau_t) + (1+r) \cdot s_{t-1} - s_t && \text{(B.25)} \\
c_{t+1} &= x_{t+1} + (1+r) \cdot s_t && \text{(B.26)} \\
s_{t-1}, s_t &\geq 0 && \text{(B.27)} \\
\tau_t &\geq 0 && \text{(B.28)}
\end{aligned}$$

Again, the number of constraints can be reduced to two:

$$\begin{aligned}
c_{t+1} &= x_{t+1} + (1+r)(w \cdot (1-\tau) + (1+r) \cdot s_{t-1} - c_t) && \text{(B.29)} \\
c_{t+1} &\geq x_{t+1}
\end{aligned}$$

The resulting Lagrangian $\mathscr{L}$ is

$$\begin{aligned}\mathscr{L} = & log(c_t + \gamma^o \cdot g) + \rho \cdot log(c_{t+1} + \gamma^r \cdot g) - \\ & \lambda_1 \cdot (c_{t+1} - x_{t+1} - (1+r)(w \cdot (1-\tau) + (1+r) \cdot s_{t-1} - c_t) \\ & -\lambda_2 \cdot (-x_{t+1} + c_{t+1})\end{aligned} \tag{B.30}$$

Differentiating yields the following Kuhn-Tucker-conditions:

$$\begin{aligned}\frac{\partial \mathscr{L}}{\partial c_t} &= \frac{1}{c_t + \gamma^o \cdot g} - (1+r) \cdot \lambda_1 = 0 \\ \frac{\partial \mathscr{L}}{\partial c_{t+1}} &= \frac{\rho}{c_{t+1} + \gamma^r \cdot g} - \lambda_1 - \lambda_2 = 0 \\ \frac{\partial \mathscr{L}}{\partial \lambda_1} &= x_{t+1} - c_{t+1} + (1+r)(w \cdot (1-\tau) - c_t + (1+r) \cdot s_{t-1} = 0 \\ \frac{\partial \mathscr{L}}{\partial \lambda_2} &= -x + c_{t+1} \geq 0 \\ \lambda_2 \frac{\partial \mathscr{L}}{\partial \lambda_2} &= \lambda_2 \cdot (-x + c_{t+1}) = 0\end{aligned} \tag{B.31}$$

Combining (B.25)-(B.19) with (B.31), we can find the solutions for the given maximization problem. The solutions are explicated in Tables 5.4 and 5.4 of Chapter 5.2.

A representative **retirees** faces the following optimization problem:

$$\begin{aligned}\max_{(c_t)} U_t^i(c_{t-2}, c_{t-1}, c_t) = & log(c_{t-2} + \gamma^y \cdot g) + log(c_{t-1} + \gamma^o \cdot g) + \\ & log(c_t + \gamma^r \cdot g) \qquad \text{(B.32)} \\ s.t. & \\ c_t = & x_t + (1+r) \cdot s_{t-1} \qquad \text{(B.33)} \\ & \qquad \text{(B.34)}\end{aligned}$$

The solution for optimal retirement consumption is trivially determined by the budget constraint.

Appendix C
Definitions, Propositions and Hypotheses of the Dissertation

Definition 1 (Nash Equilibrium). *A strategy profile* $(s_1^*, s_2^* ..., s_n^*) \in S$ *is a Nash equilibrium, if for every player i*

$$u_i(s_i^*, s_{-i}^*) \geq u_i(s_i^{**}, s_{-i}^*) \qquad \forall\, s_i^{**} \in S \quad \& \quad \forall\, i \in N$$

Definition 2 (Subgame Perfect Equilibrium). *An extensive form game with perfect information is a subgame perfect equilibrium, if for every player i*

$$u_i(H_h(s^*)) \geq u_i(H_h(r_i, s_{-i}^*)) \qquad \forall\, r_i$$

where s^* *is a strategy profile,* r_i *is player i's strategy and* $H_h(s)$ *is a terminal history consisting of h followed by the sequence of of actions generated by s after history h.*

Proposition 1 (Political Preference Ordering). *Given the economic environment described by equations (5.11) and (5.3)-(5.8), the preferences of young workers (y), old workers (o) and retirees (r) with respect to the public pension system are qualitatively described by the following ordering:*

$$\tau^y > \tau^o > \tau^r$$

Hypothesis 1. *Preferences for sustaining a big public pension system increase with age.*

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Hypothesis 2. *Policy preferences of old workers depend on population growth, and on the size of the existing pension scheme.*

Appendix D
Statistical Appendix to Chapter 6

Table D.1: Description of variables and data sources

Variable	Source	Description
	Dependent Variables	
Gov. should spend less on pensions (logit)	ISSP / Role of Government IV Q6f: Government should spend money: Retirement	1=spend less/ same; 0=spend more
Gov. should spend less on pensions (ordered logit)	ISSP / Role of Government IV Q6f: Government should spend money: Retirement	1=spend much more 2=spend more 3= spend the same as now 4=spend less 5=spend much less
Taxes are too high	ISSP / Role of Government IV Q12a: Taxes for high incomes Q12b: Taxes for middle incomes Q12c: Taxes for low incomes	1=too high for all groups 0=about right/too low for all groups
	Independent Variables	
age	ISSP / Role of Government IV	respondent's age
young worker	ISSP / Role of Government IV	1=worker under age 41
old worker	ISSP / Role of Government IV	1=worker above age 40
retiree	ISSP / Role of Government IV	1=retired; 0=employed
male	ISSP / Role of Government IV	1=male; 0=female
income	ISSP / Role of Government IV	respondent's income; $ln(\frac{y_i}{\bar{y}})$
education years	ISSP / Role of Government IV	years of schooling
household size	ISSP / Role of Government IV	no. of persons in household
n	U.N. World Population Prospects United Nations (2010)	estimated population growth rate 2005-2010
Ω	OECD (2007)	1=h= if replacement rate ≥ 50 0=l= if replacement rate < 50

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Table D.2: Summary statistics

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Gov. should spend less on pensions (logit)	25611	.3763227	.484472	0	1
Gov. should spend less on pensions (ordered logit)	25611	2.166559	.8319411	1	5
Taxes are too high	25611	.1326774	.3392323	0	1
male	25580	.5109461	.4998899	0	1
income	21282	-.188157	.7165936	-6.313.053	3.530.229
young worker	25611	.3541837	.4782746	0	1
old worker	25611	.4002187	.4899521	0	1
retiree	25611	.2455976	.4304494	0	1
education yrs	24557	1.648.337	1.799.063	1	96
household size	25219	2.745.668	1.407.506	1	34
n	25611	.5633447	.453469	-.21	1.83
Ω	25611	.5245402	.4994072	0	1

D.1 Additional results - Ordered-Logit Estimations

Table D.3: Ordered logit results for the impact of age on pension preferences with different population growth rates

	(1)	(2)	(3)	(4)
Dep. Var	**Gov. should spend less on pensions**			
Sample	$\Omega = h, l$	$\Omega = h, l$	$\Omega = h$	$\Omega = h$
pop. growth	$n > 0$	$n < 0$	$n < 0$	$n > 0$
old worker	-0.246***	-0.0893	-0.376	-0.233**
	(0.0851)	(0.173)	(0.396)	(0.112)
retiree	-0.443***	-0.941***	-1.339***	-0.561***
	(0.124)	(0.283)	(0.508)	(0.179)
male	0.179***	0.270***	0.330**	0.236**
	(0.0601)	(0.0709)	(0.150)	(0.100)
income	0.370***	0.365**	0.115	0.304***
	(0.0569)	(0.168)	(0.134)	(0.102)
education yrs	0.00881*	0.000241	0.00205	0.00763
	(0.00521)	(0.00120)	(0.00329)	(0.00573)
household size	0.00266	-0.135*	-0.0452	-0.0214
	(0.0244)	(0.0768)	(0.0363)	(0.0403)
country dummies	(...)	(...)	(...)	(...)
cut1	-1.450	-1.498	-0.878	-1.463
cut2	0.504	0.229	1.430	0.629
cut3	3.364	2.717	4.042	3.576
cut4	5.208	3.947	5.715	5.539
Observations	16,152	3,578	1,795	8,579
LR	686.74***	272.479***	192.104***	337.657***
R^2	0.045	0.077	0.112	0.042

Notes: Robust Standard errors in parentheses clustered by country. R^2 is McKelvey and Zavoina's R^2. $\Omega = h$ includes: Denmark, Finland, Hungary, South Korea, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland. $\Omega = l$ includes: Australia, Canada, Czech Republic, France, Germany, Ireland, Japan, New Zealand, Poland, UK, USA.

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