The effect of aging on pensions

Hollanders, D.A.

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Proefschrift

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David Antonie Hollanders

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Promotor:	Prof.dr. A.C. Meijdam
Overige leden:	Prof.dr. A.L. Bovenberg
	Prof.dr. E.H.M. Ponds
	Prof.dr. W. Salverda
	Prof.dr. C.N. Teulings
	Prof.dr. H.A.A. Verbon

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Chapter 1

Introduction

The main topic of this thesis is the effect of aging on pension systems. As the population of many Western-European countries ages, this topic has gained wide attention in the popular press, the policy debate and the academic literature. Chapters 2, 3 and 4 analyze the effect of aging on intergenerational risk sharing, public pension expenditure, and the asset allocation of pension funds respectively. Chapter 5 shows how a pension fund can improve participants' welfare of by facilitating financial transactions between generations. Chapter 6 is more general and focuses on the politics of reforms of welfare programs, including pension reforms. Finally, the seventh chapter is unrelated to pensions; it analyzes the association between media coverage and consumer confidence.

Before discussing the content of the chapters, it is useful to first discuss the two central concepts of the title of this thesis, aging and pensions.

Pensions

The first concept that is central in this thesis is pension systems. A useful and often used ideal-type of how pension systems are organized is given by the three pillar system, see World Bank (1994). The three-pillar system also provides a good description of the Dutch pension system. The first pillar consists of a state-pension that provides a minimal pension for each citizen, such as the AOW in the Netherlands. The first pillar aims to avoid old age poverty and is usually financed by a Pay-As-You-Go system (PAYG). In a PAYG-system current benefits are financed by current contributions.

The second pillar consists of supplementary, occupational pensions, aimed at safeguarding the standard of living after retirement. It is organized by employers and unions and is typically carried out by pension funds. Most pension funds are financed by full funding, like the approximately 500 occupational pension funds in the Netherlands. When a pension-arrangement is fully funded, each participant saves for his or her own retirement.

Participation in the first and second pillar is often mandatory. This contrasts with the third pillar, which consists of private, voluntarily saving and retirement plans, usually provided by insurance companies. This thesis focuses on the first (Chapters 2 and 3) and second pillar (Chapters 4 and 5).

The three-pillar system is a useful ideal-type of pension systems, but in reality hybrid systems exist. For example, wage-related pension-schemes may be organized by the state and financed with PAYG, as is the case in Germany.

Aging

The second concept that is central in this thesis is aging. Aging is a generic term that refers to the population of a country or a society getting older. While aging is an unambiguous concept at the individual level, it is not a straightforward concept when applied to a group of people. Aging is determined by several factors. The two most important factors are life expectancy and the fertility rate. A higher life expectancy and a lower fertility rate are both associated with the aging of a society. A third factor that may influence aging of a society is migration, depending on the age of immigrants and emigrants.

The most widely used operationalization of aging is the dependency ratio, which is defined as the number of people that have reached the retirement age (usually the age of 65) relative to the number of people of working age. The dependency ratio thus indicates how many retired people are supported by the working age-population. The higher this ratio, the more a population is aging. The dependency ratio figures prominently in the policy debate and in the academic literature. (It is used here as the main operationalization of aging in Chapters 2 and 5.)

Table 1: dependency ratio in the Netherlands							
Year	1950	1960	1970	1980	1990	2000	2010
Dependency ratio (%)	14.0	16.8	18.8	20.1	20.8	21.9	25.1
Year (continued)	2020	2030	2040	2050	2060		
Dependency ratio (%), (projected)	33.9	43.2	49.3	46.7	46.0		

Aging in the Netherlands can be illustrated with the development of the dependency ratio. Table 1[1] shows for the Netherlands the (projected) dependency ratio, defined as 100 times the number of people who are 65 years or older divided by the number of people between 19 and 65 years of age. As can be seen, ever since 1950 the dependency ratio has been increasing in the Netherlands. In 1950 the dependency ratio was equal to 14, so 100 people of working age 'supported' 14 retirees. In 1980 the dependency ratio was 20.1 and in 2010 the dependency further increased to 25.1. It is projected to increase to 49.3 in 2040 (while decreasing somewhat to 46 in 2060). If the projections turn out to be accurate, in 2040 two people of working age will support almost one retiree.

Other operationalizations of aging may be useful as well. The literature on the political economy of Social Security for example stresses the importance of the age of the median voter. Theoretically, the median voter is pivotal in a democratic society as its support gives a policy proposal a majority. The older the median voter is, the more a government may be expected to spend on pension benefits. (Chapter 3 offers an empirical analysis of the political effect of aging and uses the age of the median voter as the main operationalization of aging.)

Aging is obviously a good development, as it means that people on average live longer. However, there are also worries that aging may negatively impact the economy in general and pension arrangements in particular. This thesis mainly focuses on the effect of aging on pensions.

Aging is first and foremost problematic for pension arrangements that are financed by PAYG, as is typical in the first pillar. If the dependency ratio increases, the number of people contributing decreases relative to the number of people receiving benefits. This may put pressure on the financial sustainability of PAYG-financed pension arrangements. In the Netherlands for example, the level of the contributions is fixed and any remaining gap between pension expenditures and contributions is financed out of general tax revenues. Van Ewijk et al. (2006) state that if current budgetary arrangements are maintained, as a result of aging the "gap between government expenditures and revenues is projected to increase by more than 3% of GDP between 2006 and 2040". An increase in productivity can mitigate the effect of aging if benefits are not linked to GDP, but with a steady decline of people of working age relative to the number of retirees, at a certain point either contributions need to increase or benefits need to decrease, or both.

Aging is however also problematic for a pension system that is financed by full funding, as is often the case in the second pillar. This holds true in particular for Defined-Benefit plans but also for Defined-Contribution plans. In a Defined-Benefit plan (DB), participants receive a guaranteed pension, based on the number of years during which participants contributed and on their wage during that period. In a DB plan the investment risk is thus borne by the pension fund (the sponsoring company and active participants). If the value of assets of the pension fund falls short of the value of liabilities, contributions -paid by the sponsoring company or active participants- need to be raised. (Conversely, contributions may be reduced if solvency of the pension fund increases.) This introduces a PAYG-element in a DB arrangement, which is therefore vulnerable to aging. If the investment return is low, contributions in an aging pension fund need to be raised by a large amount to restore solvency. This is all the more relevant since aging may negatively affect the return on capital. As there are fewer working people relative to the total number of people, the

[1] Source: data-base *Statline* from Statistics Netherlands ('Centraal Bureau voor de Statistiek', www.statline.cbs.nl).

capital-labor ratio may decrease, in turn depressing both capital returns and the level of production; see Adema et al. (2009).

In a DB plan risks are shared between participants and the sponsoring company and between generations, in a DC plan this is not the case. In Defined-Contribution plans the level of the contributions is fixed, and investment risks are therefore borne by the participants. Investment losses are thus not problematic from the perspective of the pension fund (though they are problematic for individual participants). The longevity risk is usually borne by the pension fund, as is also the case in DB plans. Sharing idiosyncratic longevity risk is indeed among the primary tasks of a pension fund. If there are enough participants, a pension fund can perform this task well by pooling the risks. Some participants will live longer than expected and receive benefits during a longer period, but other participants will live shorter than expected. An increase in the average longevity of participants is not problematic if it is anticipated and has been taken into account in determining the level of contributions. However, if there is an unexpected increase in the average longevity of participants, aging has a negative impact on the solvency of pension funds. Then, both in DB and DC plans, aging increases the period over which pension funds need to pay benefits to retired participants.

The distinction between DC and DB plans is a useful typology, but hybrid systems exist. In the Netherlands for example, many pension funds have a DB arrangement though indexation of the accrued rights depends on the financial condition of the pension fund, thus introducing a DC element.

There is now much political discussion and policy debate about how pension arrangements, both in the first pillar and the second pillar, should be reformed to meet the challenges of aging. In the first pillar, the three main options for reform are to lower benefits, increase contributions or extend the retirement age. In the second pillar these options are discussed as well to improve solvency of pension funds. Another important issue in the second pillar is how (investment) risks should be shared between the sponsoring company, retirees and active participants. Introducing more DC elements makes pension funds more robust to aging, but it does away with the advantages of risk sharing. Related issues are how much investment risk a pension fund should take and how changes in pension arrangements should be reflected in changes in pension fund governance to ensure the pension arrangement is carried out adequately.

The policy debate about pension reforms will be present for the foreseeable future and it cannot be predicted what the outcome of the political debate will be. This thesis seeks to contribute to the academic literature, but will hopefully also be informative for the policy debate on pension reforms. The chapters of the thesis are now discussed in more detail.

Chapter 2, entitled *Political economy of intergenerational risk sharing*, analyzes the political limits to intergenerational risk sharing.

It is well established that intergenerational risk sharing can be efficient from an ex-ante perspective, see for example Gordon and Varian (1988). Intergenerational risk sharing between non-overlapping generations can however not be implemented by markets. The reason is that ex-ante efficient risk sharing may lead to transfers that are disadvantageous for some generations ex post. In particular, a young generation might not voluntarily participate in risk sharing if that is not in their interest ex post because they have to bail out older generations. Just as it is difficult to insure a burning house, young participants do not want to insure an economic bust that has already taken place. The market cannot force future generations to participate and is thereby incomplete and inefficient from an ex ante point of view.

A feasible risk-sharing mechanism requires mandatory participation, which can only be enforced by the government. That is, only the government can pre-commit unborn generations to participate in a pension scheme that is ex-ante efficient. Although the government can implement intergenerational risk sharing, it is not a foregone conclusion that it actually will.

The objectives of a government are not (solely) determined by efficiency considerations but by political pressure as well. In a democracy, political decisions depend on electoral support. Politicians therefore have an incentive to redistribute towards cohorts that are both easier to influence and more numerous; a politician will receive more votes that way. Politicians therefore do not have the incentive to arrange ex ante optimal risk sharing.

This chapter analyzes if or to what extent ex-ante efficient risk sharing arises endogenously in a democratic political process. Using a probability voting model in the context of an overlapping-generations-model, both the ex-ante efficient transfers and the transfers resulting from the political process are characterized. The main result is that the political process generally does not lead to ex-ante efficiency. Source of the inef-

ficiency is that politicians have an electoral incentive to redistribute ex post to larger cohorts. The political process may however still lead to some risk sharing which from an ex-ante perspective is preferable to no risk sharing at all.

While there exists a well-established literature on the political economy of intergenerational transfers, see Galasso (2002), it is a relatively new development to analyze the political economy of intergenerational risk sharing. Notable exceptions are Rangel and Zeckhauser (1999) and D'Amato and Galasso (2010).

The **third chapter** -entitled *The greying of the median voter*- tests how an aging electorate influences public pension expenditure, using data for 30 OECD-countries between 1980-2005. Theoretically, there are two channels through which aging may positively influence pension expenditure. The first effect is that there are more retirees receiving benefits. Aging thus leads to higher total pension expenditure relative to GDP. A second, political effect of aging is that there are relatively more older voters, who can therefore exert more political influence. Median voter models predict that an older median voter leads to an increase of benefits per retiree, see for example Browning (1975) and Galasso (2006). Aging will then not only lead to higher expenditure relative to GDP but also relative to the number of retirees.

There is empirical support for the hypothesis that aging leads to more public pension expenditure relative to GDP. The dependency ratio (the number of retirees relative to the number of people in working age, 15-64) has a positive and significant effect on expenditure relative to GDP. This indicates that the popular concern that aging will lead to higher public pension expenditure and -ceteris paribus- to higher government deficits is justified. It may be added that an increase in expenditure is almost unavoidable as there are more people on the receiving end of Social Security and an increase could only be avoided by a relatively large decrease in benefits. Whether benefits should decrease or whether contributions should increase (or whether other public spending should be decreased), is a political decision. This chapter shows that the decision itself cannot be avoided, however. There is no empirical support for the stronger hypothesis made by median voter models. In fact the opposite is the case: an increase in the age of the median voter (proxied with the median age of the population) has a negative impact on benefits per retiree.

Some other studies investigated the relationship between aging and pension expenditure as well, reaching similar conclusions; for example Breyer and Craig (1997) and Tepe and Vanhuysse (2010). The novel contribution to this literature is that health care costs are evaluated as well. Older voters can be expected to press as much for higher health care spending as for higher pension benefits, because they make use of health care more often than younger voters do. A complete analysis thus considers both factors. A second contribution is that this chapter considers more recent data, more observations and an extended model-specification.

The **fourth chapter**, entitled *Demographic composition and risk of pension funds*, documents the effect of the demographic structure of Dutch pension funds on their strategic asset allocation, using a unique data set of pension fund investment plans for 2007. The main result is that an increase of the average age of active participants by one year is associated with a decrease in the equity exposure of pension funds equal to 0.5 percentage points. As equity is generally a risky asset class, older pension funds thus tend to decrease the risk level of their investment portfolio.

The negative relation between age and equity allocation is in line with an important outcome of the literature on optimal saving and investment over the life cycle, see Bovenberg et al. (2007). The proportion of financial capital invested in risky assets as stocks should decrease over the life-cycle, thereby increasing the fraction invested in safer bonds. The reason is that younger workers have more human capital than older workers. A young worker can diversify investment risk with his or her human capital. The optimal negative relationship between age and equity exposure is derived under the assumption that human capital is risk-free. This assumption is not realistic and an important question in the literature is whether and how that matters. If capital returns and wages are cointegrated, as Benzoni et al. (2007) proposes, it may be the case that young workers should take less rather than more equity risk than older workers. Whether the negative age-dependence of the equity allocation of Dutch pension funds is optimal, therefore remains an open question. The contribution of this chapter is the empirical observation that older pension funds take less equity risk. This is in line with other studies, see for example Alestalo and Puttonen (2006) and Gerber and Weber (2007). Other factors that have a positive effect on the equity exposure of pension funds are pension fund size, funding ratio, and average pension wealth of participants. Pension plan type and pension fund type have no significant impact.

The results of this chapter are furthermore relevant for the policy debate because of the nature of the Dutch pension contract. Dutch pension funds typically guarantee pension benefits to retirees in nominal terms with the ambition to index nominal pensions to inflation or wages. Indexation is conditional on the financial position of the pension fund, as indicated by the funding ratio. The funding ratio of a pension fund gives the value of the assets divided by the nominal liabilities. If the funding ratio exceeds 125, the pension fund indexes pension benefits of retirees and accrued pension rights of active participants. The best a retired or near-retired participant can hope for is an indexed pension. If the funding ratio is high, a retiree will prefer that the pension fund does not take further investment risk, as this may decrease the funding ratio, while retirees do not benefit when the funding ratio increases. Young participants may on the other hand benefit when the pension fund takes investment risk, as this may decrease future contributions if the funding ratio increases further.

In 2007, the year of the study, the funding ratio of many pension funds exceeded 125; this chapter shows that if the age of their active participants increases, Dutch pension funds indeed take less risk, in line with preferences of older participants, induced by the pension contract. Whether pension funds should optimally adapt their investment risk more (or less), can again not be answered by this chapter. It does however show that pension funds adapt their investment strategy at least partly according to the interests of their participants.

The **fifth chapter**, entitled *Can pension funds improve welfare by lifting borrowing constraints?*, develops conditions under which a pension fund can improve the welfare of young, borrowing-constrained participants by letting them borrow from older participants. It further discusses the consequences that lifting participants' borrowing constraints has for the investment strategy, contribution policy and governance structure of the pension fund.

As mentioned before, the literature on optimal saving and investment over an individual's life cycle suggests that young workers should invest more in stock than older workers because of their larger human capital, again see Bovenberg et al. (2007). The optimal investment strategy of young workers may involve that they go short in bonds, that is, that they optimally borrow in order to invest in stock. This strategy is however unfeasible if the young are borrowing-constrained.

This chapter shows how in this case a pension fund may be able to improve the welfare of borrowing-constrained participants by letting them borrow from older participants who want to lend. The pension fund as a whole subsequently increases its stock exposure. It may even be optimal that the young borrow against human capital. In that case the pension fund needs to levy contributions ex post on younger participants to repay older participants in case stock return is low. The risk level of the pension fund ex-ante can therefore not be separated from the contribution policy ex post.

The pension fund is in a unique position to facilitate optimal borrowing against human capital when participation in a pension fund is mandatory. The young essentially face a commitment problem; they want to borrow against their human capital, promising to repay via contributions to the pension fund in case stock return is low. However, when the young indeed need to repay, they have an incentive to renege on their promise. Therefore insurance companies without mandatory participation cannot facilitate borrowing against human capital. A pension fund with mandatory participation may enforce the promise of the young to repay the old, when necessary, out of human capital. Mandatory participation thus acts as a commitment device for the young to repay their debt when they borrow against human capital.

If contributions cannot be raised automatically, however, for example due to resistance of young participants ex post, intergenerational conflicts may arise. Then the optimal investment policy can only be implemented by a proper governance structure. For example, if the board of the pension fund has discretionary power to decide over contributions, the old will want to be represented on the board to ensure that they are repaid in full. However, the young want to avoid that the old abuse their position to increase contributions arbitrarily, so the young will need to be represented adequately as well.

If governance cannot solve the commitment problem, the optimal solution cannot be implemented. A second-best solution is that the risk level is scaled back to a level such that the young do not borrow against human capital. With a risk immunization policy, the young can still borrow but only with their financial capital as collateral. While this risk immunization policy is second-best, it is welfare-enhancing compared to strictly separated accounts.

There is now much debate in the Netherlands whether benefits should be decreased and whether

contributions can further increase, see Goudzwaard et al. (2009). There is also discussion whether pension funds should decrease their investment risks and whether young and old participants should be represented (explicitly) in the pension fund board, see Frijns et al. (2009). This chapter shows that these issues are intrinsically intertwined and should be considered simultaneously; for example, if a pension fund cannot increase contributions, this affects the optimal investment risk.

The **sixth chapter**, entitled *Voters' commitment problem and reforms in welfare programs*, gives a theoretical explanation for why and when vote-seeking governments pursue unpopular welfare reforms that are likely to cost it votes.

Public opinion research shows that the cards are very much stacked in favor of the welfare state status quo. A majority of voters, including the median voter holding the median policy preference, value welfare programs such as public pensions and unemployment benefits and prefer to uphold the status quo rather than cutting back these programs, see Boeri et al. (2002). Consequently, vote-seeking political parties have the best chance of attaining their goal if they refrain from reforming these programs in the direction that the median voter dislikes.

Many governments in advanced democracies have however pursued reforms that are unpopular, such as increasing the pension age or cutting back benefits. When and why will a vote-seeking government pursue unpopular welfare reforms that are likely to cost votes? This question has arrived at the forefront of the comparative literature on the welfare state, but hasn't yet been answered satisfactorily; see Vis (2010). This chapter contributes to this scholarly debate by proposing a mechanism that simultaneously explains the occurrence and timing of welfare program reforms that are unpopular with the median voter.

Using a novel game-theoretical model, it is shown that a government enacts reforms that are unpopular with the median voter during bad economic times, but generally not during good ones. The key reason is that voters cannot commit to re-elect a government that does not reform during bad times. This voters' commitment problem stems from economic voting, that is voters' tendency to punish the government for a poor economic situation. The voters' commitment problem means that a vote-seeking government will consider reforms only if it will likely be voted out of office anyway because of economic hardship. A poor socio-economic state thus enables a government to act according to its own economic ideas or interests.

The central empirical implication of the model is that unpopular reforms are generally initiated during recessions, which is in line with the findings of for example Høj et al. (2006). This means that given the current credit-crisis, pension reforms may be expected the coming years. In the Netherlands for example, the minority government of Christian Democrats (CDA) and liberals (VVD) indeed plans to increase the retirement age from 65 years to 66 years in 2020 and to 67 year in 2025.

The **seventh** and last **chapter**, entitled *News and consumer confidence*, is not related to pensions. It addresses the question whether economic news coverage affects consumer confidence. Using a Vector AutoRegression-model (VAR), the empirical relationship between the real economy, consumer confidence and economic news coverage in national newspapers is studied for the Netherlands during the period 1990-2009. The main finding is that in this period, more negative news coverage (operationalized as the number of times terms like unemployment and inflation are mentioned in newspaper articles) significantly decreases consumer confidence.

This chapter contributes to the academic literature on the determinants of consumer confidence. Consumer confidence is first and foremost determined by real economic factors such as unemployment, economic growth, and the stock market. However, a second important factor identified by several authors is media coverage. This study confirms the importance of media coverage for consumer confidence. Moreover, by using computer-assisted content analysis of news-papers, a time series that is both longer and more recent than time series in most studies can be considered. This enables an analysis of whether there are structural breaks in the relationship between consumer confidence and media coverage.

There indeed seem to be structural breaks in the effect of media coverage on consumer confidence. In the period 1990-1999 (representing a full business-cycle) there is a substantial and significant effect. The last two years of the study, 2008-2009, also show a sizeable effect. In the intermediate period 2000-2007 there is however no effect. A possible explanation for the differences is that the dotcom-era was characterized more by debt-financed demand and asset and house bubbles, with positive media coverage stimulating both. During the credit-crisis this dynamic was reversed. This contrasts with the intermediate period that was more influenced by real world events as the discovery of accounting fraud and the attack of 9/11.

While this hypothesis about the causes of the structural breaks should be further developed and tested, the sizable effect in the most recent years does suggest that during the current credit crisis, news coverage influences consumer confidence to a considerable extent. Consumer confidence is in turn important for consumer spending and, thereby, for economic growth; see for example Acemoglu and Scott (1994). Journalists should therefore be aware of the consequences of overreporting negative economic developments, and a realistic but moderate tone in economic news coverage seems called for.

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Chapter 2

Political economy of intergenerational risk sharing

2.1 Introduction

[1]It is by now well established that intergenerational risk sharing can be efficient from an ex-ante perspective. This is discussed in Gordon and Varian (1988), Bohn (2003), Ball and Mankiw (2007), Beetsma and Bovenberg (2007), Matsen and Thogerson (2004) and Gollier (2008). However, intergenerational risk sharing between non-overlapping generations cannot be implemented by markets, see Rangel and Zeckhauser (1999). The reason is that ex-ante efficient risk sharing leads to transfers that may be disadvantageous for some generations ex post. In particular, a young generation might not voluntarily participate in risk sharing if it is not in their interest to have to 'bail out' the older generations. The market cannot force future generations to participate and is therefor incomplete and inefficient from an ex-ante point of view. A feasible risk-sharing mechanism requires mandatory participation, which can only be enforced by the government. That is, only the government can pre-commit unborn generations to participate in a pension scheme that is ex-ante efficient.

While the government is in a position to implement intergenerational risk sharing, it is not guaranteed that it actually will. This chapter's central observation is that the objectives of a government are not determined by efficiency considerations but by political pressure. In a democracy, political decisions depend on electoral support of voters. The central question of this chapter is whether ex-ante efficient risk sharing arises endogenously in a democratic society where a policy proposal needs the support of a majority of voters. This question is analyzed with a probabilistic voting model in the context of an overlapping generations model. The economic environment of the model is straightforward. Individuals live for two periods. In the first period, individuals work and receive a fixed wage. A fixed part of this wage is saved and invested in the capital market. In the second period, agents are retired and consume the accrued savings. The capital market consists of a risky asset and this introduces risk in this economy. As generations face unique and uncorrelated risks, risk sharing is welfare-enhancing. The government has a simple tax instrument available: it can tax the young when capital return is low and redistribute the proceeds to the retired generation in the form of pension benefits. This instrument is enough to share risks between generations.

This chapter determines the ex-ante efficient tax policy, that is, the tax policy a social planner would choose so as to maximize ex-ante utility of a steady state generation. It compares the ex-ante efficient taxation with taxation that results from the political process. The political environment is modeled with the probability voting model. Elections with two electoral candidates take place each period. Candidates are office-seeking and propose the tax rate that maximizes their chance of being elected. Voters base their vote on two things. First, voters take the tax policies of the candidates into account. Second, voters base their vote on the ideology of the candidate. This second aspect -ideology- differs between candidates. Ideology is

[1]A previous version was published as CentER discussion paper 2010-102 and Netspar discussion paper 01/2009-011.

a permanent feature of the candidate and cannot be changed. The importance that voters attach to ideology has a random element; this random element of the probability model results in a continuous mapping from candidates' tax proposals to the probability of being elected. This contrasts with a common approach of the median voter model which typically leads to a discontinuous mapping. As a result, the probability voting model is suited to analyze gradual policy responses to changes in the political-economic environment, such as aging. This chapter determines the tax rates that arise in the setting of probability voting and compares them with the efficient tax rates.

The main result is that the political process generally does not result in ex-ante efficient risk sharing. The ex-ante efficient tax rate and the tax rate that candidates propose generally differ. As the government is the only institution that may implement risk sharing, the message of this paper is that risk sharing is a good idea but that that it cannot be fully implemented due to innate and unavoidable political biases. The political process is biased because electoral candidates have an incentive to redistribute from smaller to larger cohorts and from ideological voters to non-ideological voters who are more easily persuaded to change their vote. Essentially, politicians are motivated by redistribution (to receive political support), not by efficiency. Thus, the institution that is in a position to implement insurance is likewise motivated by redistribution rather than efficiency. Aging typically increases the discrepancy between the efficient tax level and the tax level determined by electoral candidates. The reason is that aging increases the political clout of retirees, thereby motivating candidates to redistribute to this group at the expense of younger cohorts. The same applies to a scenario where the young form a large majority. However, some risk sharing may still arise in the political process. The reason is that politicians redistribute from voters with a high income to voters with a low income, as the latter are easier to convince. An ex-ante efficient tax policy also transfers from cohorts with a relatively high income to cohorts with a lower income. While the two tax policies differ due to the innate political biases, some risk sharing thus still arises.

This chapter focuses on the political sustainability of intergenerational risk sharing. In doing so, it abstracts from possible distortions of the risk-sharing mechanism. For example, if a young generation has to bail out the elderly, this may distort their labor supply decisions, see Sánchez-Marcos and Sánchez-Martin (2006) and Kruger and Kubler (2006). However, the aim of this chapter is not to determine the optimal tax as such, but to provide an analytical framework to assess whether whatever is optimal arises endogenously in the political process.

This chapter relates to the literature on the political economy of social security. Traditionally this literature has focused on the political sustainability of intergenerational transfers. Recently, some scholars expanded this literature by focusing on intergenerational risk sharing. This chapter adds to this latter development by applying the probability voting model in the context of intergenerational risk sharing. This chapter is among the first to do so, and gives a novel analysis of the influence of aging on the political sustainability of intergenerational risk sharing.

There is a well-developed and substantial literature on the political economy of social security, see Breyer (1994), Verbon (1993) and in particular Galasso and Profeta (2002) for overviews of the political economy of social security. A central question in the literature is how to understand the existence of pay-as-you-go financed social security. Social security involves intergenerational transfers; how can these be rationalized, as contributing working generations generally outnumber the benefitting retired generations? If intergenerational transfers do not influence future transfers, a majority of workers would vote against social security.

The literature explains social security in different ways. Four dominant approaches are discussed here. A seminal contribution to the first approach is Browning (1975), who applies a median voter model in the context of overlapping generations. Browning considers a three-period overlapping generations model, where people work in the first two periods and are retired in the third period. Working generations pay contributions, which are transferred to the retired generation in the form of pension benefits. Voting on social security takes place once. The elected government commits to the voted-upon pension policy which remains in effect forever after; there is thus full commitment.

Browning shows why a democracy may overspend on social security. When the median voter is middle-aged, (s)he will regard past contributions as sunk while all benefits still lie ahead. The median voter thus prefers an inefficiently high level of pension expenditure. By contrast, a young voter internalizes all benefits and all costs and prefers the efficient level of retirement contributions. Letting only the young vote would thus result in the efficient outcome. This is however not the case and overspending is the result.

This 'voting failure' occurs because younger voters anticipate getting older while older voters know they will never be young again. Several authors have further developed this argument; Persson and Tabellini (2000) introduces income as a second source of heterogeneity, Townley (1981) considers an arbitrary number of generations and Galasso (2006) analyzes a computational OLG-model. Other important contributions include Conesa and Krueger (1999), Cooley and Soares (1999), and Cooley and Soares (1996) who analyze social security in more realistic settings. This stream of the literature highlights the importance of the median voter's age for the size of Social Security. The central message is that an older median voter increases retirement spending beyond what is efficient.

A second stream of the literature considers social security in the presence of repeated voting, see Sjoblom (1985) and Boldrin and Rustichini (2000). Elections take place each period and the political process is again characterized by the median voter model. Intergenerational transfers are sustainable also when young voters form a majority. The motivation to contribute to retirees is that future generations will also contribute if (and only if) current working generations contributed to current retirees. This may be seen as a social contract between generations that continues as long as all generations participate but that breaks down once one generation stops participating. This shows the importance of trust *in* the system for the continuation *of* the system.

A third approach is given by Breyer and Stolte (2001), which postulates that (near) retireed generations form a majority, holding all political power. Young generations respond to taxation by adjusting their labor supply. The retired generation therefore does not set a contribution rate of 100% but maximizes instead a Laffer curve that gives total tax revenues as a function of the tax rate. Breyer and Stolte predict that the 'burden' of aging is shared between retirees and working generations, that is, aging leads to both higher contributions and lower individual benefits. A fourth mechanism in the literature is altruism, with young generations voluntarily contributing to the old, see Hansson and Stuart (1989), Veall (1986) and Tabellini (2000).

A relatively new development in the political literature is to analyze the political sustainability of intergenerational risk sharing. Part of the recent political literature focuses on the question whether political institutions can support intergenerational risk sharing. Rangel and Zeckhauser (1999) and Demange (2005) analyze political support for intergenerational risk sharing using a median voter model. A limitation of the median voter model is that there is typically a discontinuous mapping from model parameters to policy outcomes, leading to somewhat unsatisfying results; a simple OLG-model may for example predict a taxation of 100% if the median voter belongs to the retired generation. And when the median voter model is applied in the context of repeated elections, generally a wide range of equilibria can be rationalized, hindering a precise prediction of the tax rate.

This chapter proposes that a probabilistic voting model is better suited to analyze the political limits of risk sharing and the effect of aging upon that. There are several applications of the probability voting model to analyze social security, see Meijdam and Verbon (1996) and Gonzales-Eiras and Niepelt (2007). These studies do not however consider risk sharing. To my knowledge, there is just one other paper that uses a similar approach and is thus closest to this one, namely D'Amato and Galasso (2010) who also analyze intergenerational risk sharing with a probability voting model in the context of a two-period OLG-model. However, aside from several modeling differences, there are two important differences between this study and D'Amato and Galasso. First, they use a different welfare concept. Here the focus is on ex-ante efficiency, in line with the literature on risk sharing. The question is to what extent a political process skewed towards redistribution still generates ex-ante efficiency. D'Amato and Galasso instead use a Social Welfare Function (SWF) as the normative benchmark. Their SWF includes utility of the first generation that receives a windfall gain when the system is first introduced. Ex-ante utility does not consider the welfare gain for the first retired generation. Although this is a real gain for the first generation, the welfare criterion of a maximized SWF combines risk sharing and redistribution to the first generation. Their normative benchmark then includes redistribution, whereas this type of redistribution is viewed here as an inefficiency.

The second difference is that in D'Amato and Galasso (2010), the government is a Stackelberg leader vis-à-vis future governments, exploiting that future governments will 'bail out' the currently young generation if they have lower savings. This gives an opportunity to increase taxation for the younger generation, without losing electoral support. Higher taxes reduce savings of the young, but the young anticipate that lower savings will be partly compensated by higher future benefits, provided by future politicians. Their source of inefficiency is this 'exploiting' behavior of current governments, while in this chapter the source

of the political inefficiency lies in the tendency of politicians to redistribute to larger cohorts for electoral reasons. This difference affects the prediction of the effect of aging on Social Security. D'Amato and Galasso predict that aging makes politicians *less* likely to overspend on Social Security, as a lower rate of return on intergenerational transfers decreases the scope to exploit future generations. This study instead argues that aging makes politicians generally *more* likely to increase the tax level beyond what is efficient, as aging increases the political dominance of the elderly.

The rest of the chapter is organized as follows. The second section introduces the model, determines and compares the efficient taxation and the politically determined tax levels, and relates the model to the median voter model. The third section considers an extension with endogenous savings, while the fourth section concludes.

2.2 The model

2.2.1 Set-up of the model

Consider an overlapping generations model of a small, open economy. In each period there are two generations, a young generation and an old generation. Each generation lives for two periods. In the first period a generation works and is referred to as young. In the second period a generation is retired and is referred to as old. There is constant geometric population growth n: $N_t = (1+n)N_{t-1}$, where N_t is the number of young agents in period t and $n > -1$. The young can save on a capital market. Savings are fixed (the next section considers an extension with endogenous savings). Capital return is the only risk factor in this economy and it is assumed exogenous which is a reasonable assumption for a small, open economy. There are two states of the economy, one state (state L) in which gross capital return is low, and another state (state H) in which it is high.[2] There is a government that in state L can levy a lump-sum tax on the young and redistribute the proceeds to the older generation. This simple tax instrument is enough to enable intergenerational risk sharing. Before characterizing first-best and second-best taxation, the model is described in more detail.

The capital market

The capital market consists of one risky asset. The gross return of this asset at time t is denoted r_t. The gross return of the asset is Bernoulli distributed. With probability λ gross return is equal to r^L and with complementary probability $1-\lambda$ the return is equal to r^H, where $0 < \lambda < 1$. The returns are uncorrelated across time. Note that it is ruled out that one of the two states occurs with probability zero, as this would eliminate the risk element in the model. The following relation holds: $0 < r^L < 1 < r^H$. Introducing notation, the state of the economy at time t is denoted ω_t, with $\omega_t \in \Omega = \{L, H\}$. When $r_t = r^L$ the economy is in state L: $\omega_t = L$. When $r_t = r^H$ the economy is in state H: $\omega_t = H$. Denote one particular element of Ω by ω and denote the successor of ω by ω^+.

A simple tax instrument

There is a government that can levy a non-negative lump-sum wage tax, denoted as $\tau_t \geqq 0$. The proceeds of taxation in the low state are redistributed as pension benefits to the old. The government runs a balanced budget, so taxes of the young are used to finance benefits for the old. Total taxation equals $N_t\tau_t$, while there are N_{t-1} retirees. Retirees at time t receive from the government $(1+n)\tau_t$. No government debt is possible.

Institutional arrangements are assumed such that when the economy is in state H taxation is zero, that is, $\tau_t = 0$ if $\omega_t = H$. This assumption implies that no transfer -either from or to the retired generation- is made when capital return is high. The tax instrument is thus only used to compensate or 'bail out' the

[2] Alternatively, state H could be interpreted as the normal state of affairs and state L as a state in which a disaster (World War; credit-crisis) occurs, resulting in a period with low capital return.

elderly when they are unlucky. The tax instrument is however not used to redistribute capital gains of the old to the young.

This assumption allows focusing on risk sharing in the simplest way possible, as this assumption does not rule out the possibility of intergenerational risk sharing. The risk that capital return is low remains. This risk is uncorrelated across periods. Therefore intergenerational risk sharing can be welfare-enhancing. Risk is shared when the young transfer to the old when capital return is indeed low; the young in turn receive a transfer when the return on their investment is low as well. The essence is that the tax-instrument -understood as a quasi-asset- is not available on the capital market. The pay-offs of the tax instrument (only effective in state L) and asset return are negatively correlated. Therefore, the tax instrument is welfare-enhancing by diversifying risk. It is however important to note that what is called first-best in the remainder is second-best from a more general perspective, which would consider less restrictive forms of taxation.

Individuals

Individuals of each generation live for two periods: youth (first period) and old age (second period). The young inelastically supply one unit of labor, for which they receive a strictly positive, constant wage $w > 0$. Consumption in the first period (young) of an agent born at time t is denoted by c_t^y; consumption in the second period (old) of an agent born at time t is denoted by c_t^o.

It is assumed that young generations have fixed savings equal to $\overline{s} \geqq 0$. These savings are invested on the capital market. Fixed savings can be understood as mandatory contributions to a pension fund. Consumption by the generation young at time t is given by: $c_t^y = w - \tau_t - \overline{s}$, that is, wages are divided into taxes, young-aged consumption and savings. Savings are strictly smaller than wages: $\overline{s} < w$. This ensures that without taxation, consumption by the young is strictly positive; in all cases with taxation, consumption of agents is strictly positive as well.

Older generations leave no bequests, so second-period consumption of an agent born at time t is given by: $c_t^o = \overline{s} r_{t+1} + (1+n)\tau_{t+1}$.

Agents born at time t have a time-separable life-time utility function with felicity functions exhibiting constant relative risk aversion (CRRA):

$$V(c_t^y, c_t^o) = u(c_t^y) + u(c_t^o) = \begin{cases} \frac{(c_t^y)^{1-\sigma}}{1-\sigma} + \frac{(c_t^o)^{1-\sigma}}{1-\sigma} & \text{if } \sigma > 0 \text{ and } \sigma \neq 1 \\ \ln(c_t^y) + \ln(c_t^o) & \text{if } \sigma = 1 \end{cases} \tag{2.1}$$

Both in the first and in the second period, consumption is essentially determined by the tax level, as savings are fixed. Life-time utility of an agent born at time t can therefore alternatively be given as a function of the tax levels at time t and time $t+1$. This alternative expression will indeed turn out to be convenient. First, define the following functions which give first-period and second period consumption respectively as a function of the relevant tax-level: $c^y(\tau_t) \equiv w - \tau_t - \overline{s}$ and $c^o(\tau_{t+1}) \equiv \overline{s} r_t + (1+n)\tau_{t+1}$. By substituting these functions in $V(c_t^y, c_t^o)$, life-time utility of an agent born at time t is also given by the following function:

$$\widetilde{V}(\tau_t, \tau_{t+1}) \equiv u(c^y(\tau_t)) + u(c^o(\tau_{t+1})) \equiv \begin{cases} \frac{(w-\tau_t-\overline{s})^{1-\sigma}}{1-\sigma} + \frac{(\overline{s} r_t + (1+n)\tau_{t+1})^{1-\sigma}}{1-\sigma} & \text{if } \sigma > 0 \text{ and } \sigma \neq 1 \\ \ln(w - \tau_t - \overline{s}) + \ln(\overline{s} r_t + (1+n)\tau_{t+1}) & \text{if } \sigma = 1 \end{cases}$$

The functions $V(c_t^y, c_t^o)$ and $\widetilde{V}(\tau_t, \tau_{t+1})$ are equivalent in the sense that for any pair of tax-levels τ_t and τ_{t+1}, the two functions give exactly the same utility.

2.2.2 First-best taxation: optimal intergenerational risk sharing

Each generation faces unique and uncorrelated investment risk. Therefore intergenerational risk sharing can improve welfare. When capital return is low, the younger generation supports the older generation. When the young are old themselves they receive benefits when the return on their investment is low. Such risk

sharing can be achieved by the simple tax instrument of levying taxes on the young in case of state L. What would be an efficient tax policy here?[3]

It is important to be precise about what efficiency refers to here. Unless stated otherwise, ex-ante efficiency is used as the welfare concept. Ex-ante efficiency evaluates expected utility of individuals prior to birth, when individuals do not know in what state of nature they are born. A policy may affect utility positively in one state of nature but negatively in another one. A tax policy is defined to be ex-ante efficient if it maximizes the expected utility of an unborn individual. But how to determine expected utility of an unborn?

Now, an individual born at time t can encounter two states of the economy ($\omega_t = H$ or $\omega_t = L$) in the first period and again two states of the economy in the second period ($\omega_{t+1} = H$ or $\omega_{t+1} = L$). This gives four possible states of nature that an individual can be born into. In state L, the social planner can levy a tax on the young, denoted by τ^L. The tax policy used by the social planner then takes the following form:

$$\tau_t = \begin{cases} \tau^L & \text{if } \omega_t = L \\ 0 & \text{if } \omega_t = H \end{cases} \tag{2.2}$$

Table 1 shows the four possible states of nature an individual can be born into, the probabilities of occurrence and the life-time utility of an individual born into that state of nature.

Table 1

ω_t	ω_{t+1}	$P[\omega_t = \omega, \omega_{t+1} = \omega^+]$	$\widehat{V}(\tau_t, \tau_{t+1})$
L	L	λ^2	$u(w - \overline{s} - \tau^L) + u(\overline{s}r^L + (1+n)\tau^L)$
L	H	$\lambda(1-\lambda)$	$u(w - \overline{s} - \tau^L) + u(\overline{s}r^H)$
H	L	$(1-\lambda)\lambda$	$u(w - \overline{s}) + u(\overline{s}r^L + (1+n)\tau^L)$
H	H	$(1-\lambda)^2$	$u(w - \overline{s}) + u(\overline{s}r^H)$

Here the function $u(.)$ is as defined in 2.1. Ex-ante utility of an individual is equal to the expected life-time utility at birth. Life-time utility of a steady-state generation is denoted by $\widehat{V}$ and its expectation by $E[\widehat{V}]$. Suppressing time-subscripts and using the expressions in table 1 and expression 2.2, expected life-time utility is now given by:

$$\begin{aligned} E[\widehat{V}(\tau^L)] = \lambda^2[u(w - \overline{s} - \tau^L) + u(\overline{s}r^L + (1+n)\tau^L)] + \lambda(1-\lambda)[u(w - \overline{s} - \tau^L) + u(\overline{s}r^H)] + \\ (1-\lambda)\lambda[u(w - \overline{s}) + u(\overline{s}r^L + (1+n)\tau^L)] + (1-\lambda)^2[u(w - \overline{s}) + u(\overline{s}r^H)] \end{aligned} \tag{2.3}$$

The social planner chooses the tax-rate τ^L, so as to maximize expected life-time utility, given by $E[\widehat{V}(\tau^L)]$. This gives the first-best tax level in state L, which will be denoted by τ^{fb}. The first order condition (FOC)

[3] This would not be the case in a risk-free environment. In the current model the rate of return on intergenerational transfers equals $1 + n$. In a risk-free environment $1 + n$ should be compared with the risk-free interest rate, denoted by, say, r. When $r > (<) 1 + n$, the economy is dynamically (in)efficient. When the economy is dynamically efficient a social planner should implement a funded system; otherwise it should implement a Pay-as-you-go system. This is the so called Aaron condition.

When there is investment risk, the Aaron condition cannot be applied. If the expected capital return exceeds population growth, intergenerational transfers may still be welfare-enhancing. The argument for intergenerational risk sharing does not depend on dynamic efficiency. What is essential is that the tax instrument, understood as a quasi-asset, is not spanned by the market portfolio and can therefore be welfare-improving by a usual diversification argument. Here, the pay-offs of the tax instrument are negatively correlated with capital returns.

is $\frac{\partial E[\widetilde{V}]}{\partial \tau^L} = 0$. It can be shown[4] that this is equivalent to: $\frac{\partial u(w-\overline{s}-\tau^L)}{\partial \tau^L} = -\frac{\partial u(\overline{s}r^L+(1+n)\tau^L)}{\partial \tau^L}$. Using the expression for $u(.)$ given by 2.1, the FOC becomes:

$$(w - \overline{s} - \tau^L)^{-\sigma} = (1+n)(\overline{s}r^L + (1+n)\tau^L)^{-\sigma}$$

Solving this equation[5] gives the first-best taxation:

$$\tau^L = \frac{w - \overline{s}[1 + (1+n)^{-\frac{1}{\sigma}} r^L]}{1 + (1+n)^{\frac{\sigma-1}{\sigma}}} := \tau^{fb} \tag{2.4}$$

What is the intuition for this expression? The first-best tax level increases when wages increase or when savings or capital return in the low state decrease. Higher income for young and a lower income for retirees increase the ability and the need respectively to insure retirees against low capital return. The effect of population growth is ambiguous; if there are relatively many young workers, this increases the 'rate of return' on intergenerational transfers. However, the same income can be ensured to the old by a lower contribution of the young, which will consume the remaining. This income effect and risk-sharing effect work in opposite directions and the net effect on the first-best taxation depends on the particular values of the parameters involved.

The expression for τ^{fb} can be negative if for example (fixed) savings and capital return in the low state are very high. A negative value of τ^{fb} implies that when the retired generation is hurt by low return on it's savings, it is efficient to implement backward transfers from the old generation to the young generation. Such a situation is neither empirically relevant nor theoretically interesting and is not the situation this paper seeks to investigate. It is ruled out here by imposing the following condition:

$$r^L \leqq (1+n)^{\frac{1}{\sigma}} \frac{w-\overline{s}}{\overline{s}}$$

This condition ensures that the nominator in expression 2.4 is non-negative. That is, the capital return in the low state is sufficiently low to render intergenerational transfers potentially welfare enhancing.

2.2.3 Second-best taxation: political redistribution

Politicians are not social planners offering risk sharing with the goal of maximizing ex-ante utility of voters. Instead, this chapter assumes that politicians redistribute from one generation to another to increase their electoral prospects. The consequences for risk sharing are analyzed in this section. What tax rate would

[4] The FOC is $\frac{\partial E[\widetilde{V}]}{\partial \tau^L} = 0$.
To solve the FOC, it is convenient to simplify the maximand in several ways. First, all (additive) parts in the maximand are omitted in which τ^L does not enter; this does not affect the solution of the FOC. This gives:

$\frac{\partial E[\widetilde{V}]}{\partial \tau^L} = 0 \Leftrightarrow \frac{\partial}{\partial \tau^L}[\lambda^2[u(w-\overline{s}-\tau^L) + u(\overline{s}r^L + (1+n)\tau^L)] + \lambda(1-\lambda)u(w-\overline{s}-\tau^L) + (1-\lambda)\lambda u(\overline{s}r^L + (1+n)\tau^L)] = 0$

$\Leftrightarrow \frac{\partial}{\partial \tau^L}[u(w-\overline{s}-\tau^L) + u(\overline{s}r^L + (1+n)\tau^L)] = 0.$

In the last step, the FOC was divided by λ and rearranged, which again does not affect the FOC. Now, the FOC is: $\frac{\partial u(w-\overline{s}-\tau^L)}{\partial \tau^L} = -\frac{\partial u(\overline{s}r^L+(1+n)\tau^L)}{\partial \tau^L}$.

[5] $(w - \overline{s} - \tau^L)^{-\sigma} = (1+n)(\overline{s}r^L + (1+n)\tau^L)^{-\sigma} \Rightarrow w - \overline{s} - \tau^L = (1+n)^{-\frac{1}{\sigma}}(\overline{s}r^L + (1+n)\tau^L) \Rightarrow$
$w - \overline{s} - (1+n)^{-\frac{1}{\sigma}}\overline{s}r^L = (1+n)^{\frac{\sigma-1}{\sigma}}\tau^L + \tau^L \Rightarrow w - \overline{s}[1 + (1+n)^{-\frac{1}{\sigma}} r^L] = \tau^L[(1+n)^{\frac{\sigma-1}{\sigma}} + 1] \Rightarrow$
$\tau^L = \frac{w-\overline{s}[1+(1+n)^{-\frac{1}{\sigma}} r^L]}{1+(1+n)^{\frac{\sigma-1}{\sigma}}}$

politicians set and are these efficient? This depends on the preferences of politicians and voters and the institutions that map those preferences in policy outcomes. So, it depends on the political process.

The political process is characterized here with a probabilistic voting model. In the model two candidates run for office in majoritarian elections. Elections take place each period. Before the election both candidates announce a tax policy. This announced tax policy is binding and cannot be withdrawn by the winning candidate. The candidate who gains the most votes, wins the election. The winning candidate forms the government and his announced policy is implemented.

In their role as voters individuals base their voting decision on two things. First, voters consider the tax policies of the candidates, as the tax rate directly influences their consumption and thereby their utility. Voters also consider a second aspect, called ideology. This second aspect –ideology- differs between candidates. Ideology is a permanent feature of the candidate and cannot be changed. What is crucial is that voters differ in how important ideology is for them. Non-ideological voters will only consider the tax policy, while ideological voters will vote for a certain candidate irrespective of the tax policy he proposes. This gives candidates the incentive to cater their policy towards non-ideological voters, who are more easily swayed.

Now, elections take place after the state of the economy (L or H) is revealed. Remember that it is assumed that the government cannot levy a tax in state H. If state H occurs, taxation is zero and the candidates have no policy to announce (formally, it is assumed that both have a probability of $\frac{1}{2}$ of being elected in this case). If state L occurs, the candidates announce their tax policies. As state L is the interesting case, this case is analyzed further.

It is shown in the appendix (based on Persson and Tabellini (2000)) that in equilibrium, both candidates announce exactly the same policy and that this policy is the tax rate that maximizes the following function:

$$W(\tau_t) = \phi(1+n)W^y(\tau_t) + W^o(\tau_t) \tag{2.5}$$

Here $W^y(.)$ and $W^o(.)$ are defined as:

$$W^y(\tau_t) \equiv u(c^y(\tau_t)) = u(w - \overline{s} - \tau_t) \tag{2.6}$$

$$W^o(\tau_t) \equiv u(c^o(\tau_t)) = u(\overline{s}r^L + (1+n)\tau_t) \tag{2.7}$$

The functions $W^y(.)$ and $W^o(.)$ denote utility of the young and the old respectively in time-period t as a function of the tax level at time t. The parameter ϕ captures the inclination of young voters to vote ideologically. A value $\phi > 1$ indicates that young voters are relatively less inclined to vote ideologically. Therefore they are more responsive to policy changes than older voters and thus more important to politicians.

The function $W(.)$ is called the political target function and it is derived formally in the appendix. The political target function takes utility of both the young and older generation into account. The function however also shows a demographic bias and an ideological bias in the political process. Electoral candidates bias their announced tax policy towards the policy that is preferred by the group that is larger, as this group simply has more voters. For example, when the old outnumber the young ($n < 0$), the policy is biased towards the interests of the old in the sense that their utility weighs more than that of young voters. This is the demographic bias in the political process. Electoral candidates also bias their announced tax policy towards the policy that is preferred by the group that votes less ideologically. For example, if $\phi > 1$ young voters are on average less ideological than older voters. Then, the tax policy is biased in their favor, in the sense that their utility carries greater weight than that of the old in the political target function. The reason is that the young are easier to persuade by a policy change to vote for another candidate.

It remains to solve for the equilibrium policy, that is, the policy that results from the political process. This tax policy will be denoted by τ^{sb}. Suppressing time-subscripts, this second-best tax rate follows from the following procedure:

$$\max_{\tau} W(\tau) = (1+n)\phi W^y(\tau) + W^o(\tau)$$

The FOC is $\frac{\partial W(\tau)}{\partial \tau} = (1+n)\phi\frac{\partial W^y(\tau)}{\partial \tau} + \frac{\partial W^o(\tau)}{\partial \tau} = 0$. Using the equations in 2.6 the FOC is equal to $(1+n)\phi\frac{\partial u(w-\overline{s}-\tau)}{\partial \tau} = -\frac{\partial u(\overline{s}r^L+(1+n)\tau)}{\partial \tau}$. Further using the expression for $u(.)$ given by 2.1, the FOC becomes:

$$\phi(1+n)(w-\overline{s}-\tau)^{-\sigma} = (1+n)(\overline{s}r^L+(1+n)\tau)^{-\sigma}$$

Solving this equation[6] gives the following solution:

$$\tau = \frac{w-\overline{s}[\phi^{\frac{1}{\sigma}}r^L+1]}{\phi^{\frac{1}{\sigma}}(1+n)+1} := \tau^{sb} \tag{2.8}$$

This expression gives the tax policy announced by the two candidates and implemented by the winning candidate. This tax policy is the second-best tax level and is denoted by τ^{sb}. It increases when wages increase or when savings decrease, as poorer voters are more easily swayed by a transfer. The net effect of population growth is unambiguously negative. An increase in n leads to more political clout for the young. This effect dominates the lower rate of return, given by $1+n$, of transfers from young to old.

This expression for τ^{sb} can be negative if, for example, (fixed) savings and capital return in the low state are very high. A negative value of τ^{sb} implies that when the retired generation is hurt by a low return on their savings, it is politically opportune to implement backward transfers from the old generation to the young generation. Such a situation is again not the situation this paper seeks to investigate, though it could in principle be allowed. It is however ruled out here by the imposing the following condition:

$$r^L \leqq \phi^{-\frac{1}{\sigma}}\frac{w-\overline{s}}{\overline{s}}$$

This condition ensures that the nominator in expression 2.8 is non-negative. That is, the capital return in the low state is sufficiently low to avoid that candidates redistribute from older voters to younger voters in case capital return is low.

Is the second-best tax rate, τ^{sb}, preferable from an ex-ante perspective to no risk sharing at all? This is the case iff $E[\widehat{V}(\tau^{sb})] > E[\widehat{V}(0)]$. Using expression 2.2 it readily follows that $E[\widehat{V}(\tau^{sb})] > E[\widehat{V}(0)]$ is equivalent to the following relation:

$$u(w-\overline{s}-\tau^{sb}) + u(\overline{s}r^L+(1+n)\tau^{sb}) > u(w-\overline{s}) + u(\overline{s}r^L) \tag{2.9a}$$

Whether condition 2.9a is met, depends on the particular parameter values. It is possible that the second-best tax rate is preferable to the third-best tax rate, but it is also possible that no risk sharing at all, that is zero taxation in state L and in state H, is preferable from an ex-ante perspective.

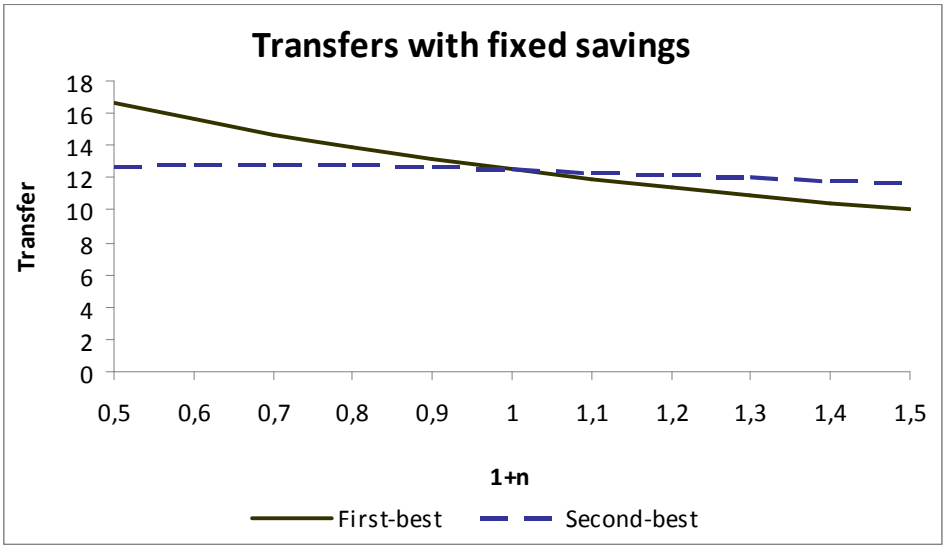
[6] $\phi(1+n)(w-\overline{s}-\tau)^{-\sigma} = (1+n)(\overline{s}r^L+(1+n)\tau)^{-\sigma} \Rightarrow$
$\phi^{-\frac{1}{\sigma}}(w-\overline{s}-\tau) = (\overline{s}r^L+(1+n)\tau) \Rightarrow \phi^{-\frac{1}{\sigma}}(w-\overline{s}) - \overline{s}r^L = \tau((1+n)+\phi^{-\frac{1}{\sigma}}) \Rightarrow$
$\phi^{-\frac{1}{\sigma}}w - \overline{s}(\phi^{-\frac{1}{\sigma}}+r^L) = \tau((1+n)+\phi^{-\frac{1}{\sigma}}) \Rightarrow$
$\tau = \frac{\phi^{-\frac{1}{\sigma}}w-\overline{s}(r^L+\phi^{-\frac{1}{\sigma}})}{(1+n)+\phi^{-\frac{1}{\sigma}}} = \frac{w-\overline{s}[\phi^{\frac{1}{\sigma}}r^L+1]}{\phi^{\frac{1}{\sigma}}(1+n)+1}$

2.2.4 Numerical illustration

The ex-ante efficient transfers and the transfers that result in the political process are illustrated in Graph 1. The graph gives transfers as a function of $1+n$ (the relative size of the group of young voters) for the parameter values given in Table 2. These values are not calibrated and are for illustrative purposes only. The graph shows that first-best and second-best taxation coincide in the special case when $n = 0$ and both groups are of equal size. Otherwise the first-best and second best taxation differ and the difference increases when population growth (n) moves away from 0.

For the parameter values in Table 2, condition 2.9a is met for all $-0.5 \leqq n \leqq 0.5$. This illustrates that from an ex-ante perspective, second-best taxation may be preferable to no taxation (and thus no risk sharing) at all.

Table 2: parameter values in base-line scenario		
Wage	w	100
Fixed savings	$\overline{s}$	50
Capital return in state L	r^L	0.5
Capital return in state H	r^H	2
Probability of state L	λ	0.5
Coefficient of relative risk aversion	σ	4
Relative ideological bias of the young	ϕ	1



Graph 1

2.2.5 Comparison between the first-best and second-best tax

The first-best and second-best transfers generally differ, as illustrated in Graph 1. However, they coincide in a special but meaningful case when $\phi = \frac{1}{1+n}$. The equivalence was illustrated above and it follows when substituting $\phi = \frac{1}{1+n}$ in the expression for $\tau^{sb} = \frac{w-\overline{s}[\phi^{\frac{1}{\sigma}} r^L+1]}{\phi^{\frac{1}{\sigma}}(1+n)+1} = \frac{w-\overline{s}[(1+n)^{-\frac{1}{\sigma}} r^L+1]}{(1+n)^{-\frac{1}{\sigma}}(1+n)+1} = \frac{w-\overline{s}[(1+n)^{-\frac{1}{\sigma}} r^L+1]}{(1+n)^{\frac{\sigma-1}{\sigma}}+1} = \tau^{fb}$.

What is the intuition for this? Electoral candidates bias their announced tax policy towards the policy that is preferred by the group that is larger. For example, when the old outnumber the young ($n < 0$), the second-best transfer is biased towards the interests of the old. This is the demographic bias in the political process. Electoral candidates also bias their announced tax policy towards the policy that is preferred by the group that votes less ideologically (and is thus easier to influence). So, when the young vote less ideologically than the old ($\phi > 1$), the second-best transfer is biased in favor of the young. This is the ideological bias in the political process. As a result of the combined effect of these biases, the political process will generally be biased towards the interests of one of the two electoral groups (either old or young). Therefore the second-best tax differs from the first-best tax. But when $\phi = \frac{1}{1+n}$ the demographic bias and the ideological bias exactly cancel each other out. In that special case the first-best and second-best transfers are equal and the political process is efficient.

Ex-ante efficiency abstracts from the implementation of the tax policy. However, implementing the ex-ante efficient transfers would come with a windfall gain for either the young or the old generation. If the economy is in state L at the time of implementation, the generation that is old at that time receives a windfall gain. If the economy is in state H, the young generation receives a windfall gain, as the young do not contribute but do receive a benefit in the next period if state L occurs (a positive probability of a positive transfer is a gain in utility terms for the young generation). This windfall gain is a real gain but it is not considered by the ex-ante criterion.

Here the distinction with the concept of a Social Welfare Function (SWF) becomes relevant. Ex-ante utility assesses utility of an individual prior to birth, assuming the tax policy is implemented. The tax policy that maximizes expected life-time utility of an unborn individual is ex-ante efficient. An SWF on the other hand maximizes utility of current and future generations, thereby including the windfall gain in the first period. The welfare concept of an SWF then essentially combines risk sharing and redistribution to the first generation (for which good reasons may or may not exist). This chapter wishes to solely focus on risk sharing. Under a reparameterization the political target function coincides with an SWF, so the difference between first-best and second-best tax levels can alternatively be interpreted as the difference between the tax that is ex-ante efficient and the tax that maximizes an SWF.[7]

2.2.6 Relation to the median voter model

The probability voting model can be seen as an extension of the median voter model. The probability voting model reduces to the median voter model if all voters vote non-ideologically and only care about economic interests.[8] In that case all young voters find zero taxation ($\tau = 0$) optimal. The reason is that current taxation does not influence future taxation, so young voters do not need to consider reputation. All old voters find full taxation, that is $\tau = 1$, optimal.

Which policy would the candidates announce? This now solely depends on whether the old voters form a majority or whether the young voters form a majority. If $n > 0$, the young form a majority and both

[7] With the tax-level indicated by τ and implementing a transfer scheme in state L, the SWF equals: $u(\overline{s}r^L + (1+n)\tau) + (1+n)\rho\{u(w-\overline{s}-\tau)$
$+\lambda u(\overline{s}r^L + \tau(1+n)) + (1-\lambda)u(\overline{s}r^H))\}+$
$(1+n)^2\rho^2\{\lambda u(w-\overline{s}-\tau) + (1-\lambda)u(w-\overline{s})+$
$+\lambda u(\overline{s}r^L + \tau(1+n)) + (1-\lambda)u(\overline{s}r^H))\} + ...$ Here ρ is the discount rate with which the social planner weighs utility of future generations. The maximand can be simplified without affecting the outcome by omitting parts that do not contain τ:
$u(\overline{s}r^L + (1+n)\tau) + (1+n)\rho u(w-\overline{s}-\tau)$
$+\lambda(1+n)\rho u(\overline{s}r^L + \tau(1+n)) + (1+n)^2\rho^2\lambda u(w-\overline{s}-\tau)$
$+(1+n)^2\rho^2\lambda u(\overline{s}r^L + \tau(1+n)) + ...$
This function is maximized w.r.t. taxation τ. Note that only a sequence of states L is considered. Taxes in state H equal zero, so they need not be considered explicitly. If -after at least one state H- state L occurs, exactly the same maximization problem occurs. If the risk sharing device is implemented in state H -instead of state L-, essentially also the same maximization problem occurs, as only the transfer at the time of implementation given by $u(\overline{s}r^L + (1+n)\tau) + (1+n)\rho u(w-\overline{s}-\tau)$ needs to be omitted then, not altering the problem essentially.

With $\rho = \phi$ the SWF exactly equals a sequence of political target functions. The difference is that the political target functions are maximized each period w.r.t. τ. However, if the optimizing values of the social planner would be proposed, no candidate could improve on that solution. Hence it is also the outcome of the political process.

[8] In terms of the probability voting model as described in the appendix, this means that $\delta = 0$ and that $\mu^{ij} = 0$ for all voters i in both groups j.

candidates announce zero taxation. The probability that either candidate wins equals $\frac{1}{2}$. If for example candidate A would announce another policy $\tau_A > 0$, he would lose the elections (given that candidate B announces zero taxation $\tau_B = 0$). Although all old voters would vote for candidate A, all young voters, who form a majority, would vote for candidate B. Candidate A would therefore lose the elections. As a similar reasoning holds for candidate B, $\tau_A = \tau_B = 0$ forms an equilibrium. This equilibrium is also unique. To see this, note that if, for example, candidate B announces a non-zero tax $\tau_B > 0$, a best reaction for candidate A is to propose lower taxation, $\tau_A < \tau_B$, thereby assuring the support of all young voters. A best reaction for candidate B in turn is to undercut τ_A. This mutual undercutting leads to an equilibrium where both candidates propose zero taxation.

With a complete analogous reasoning, both candidates will set a policy $\tau_A = \tau_B = 1$ if older voters form a majority ($n < 0$). If $n = 0$, every combination of τ_A and τ_B forms an equilibrium. The candidate with the lowest tax-policy will get all votes of young voters, whereas the candidate with the highest tax policy will get all votes of older voters. This leads to a probability for both candidates to win the elections equal to $\frac{1}{2}$. If $\tau_A = \tau_B$, both candidates again have a probability of winning the elections equal to $\frac{1}{2}$. Irrespective of what policy the other candidate announces, the announcement of every policy leads to a probability of winning equal to $\frac{1}{2}$. Therefore every tax policy is a best reaction to every tax policy and every combination of τ_A and τ_B forms an equilibrium.

These outcomes demonstrate the drawback of the median voter model. A disadvantage of the median voter model is that outcomes are sensitive to changes in the value of model parameters. That is, in a model with two or three generations, a very small change in the demographic structure can lead to implausibly large effects on policy outcomes if it changes the cohort that the median voter belongs to. Here, the political process results in one of two extreme equilibria (either $\tau = 0$ or $\tau = 1$), with a sharp and discontinuous shift between these two when $n = 0$.

2.2.7 Is it efficient to let only the young vote? The role of commitment and reputation

As discussed in the introduction, an important and intuitively appealing result in the literature is that with full commitment and in the absence of risk it is efficient to let only young voters vote, see Browning (1975). In the current set-up, this is not the case. If only young voters voted, zero taxation would result. The reason is that in the model here, current taxation does not influence future taxation. This assumption is strong but not unreasonable as one time period represents 30 years. It also allows to focus in the simplest way possible on the main issue of risk sharing. However, what would change if future taxation is influenced by current taxation? And would it then be efficient to let only the young vote?

Full commitment

The most extreme way in which future taxation depends on current taxation is full commitment. With full commitment, elections take place once and the chosen transfer policy remains in effect forever after. In this setting, older voters would still prefer full taxation. Young voters however no longer want zero taxation. The reason is that the chosen policy not only negatively affects their utility in the first period in life, but may positively affect their utility in the second period of life if state L occurs.

Which tax policy would young voters prefer? This depends on the state of the economy in the period that elections take place. If elections take place when the economy is in state H, young voters would want full taxation, as they do not have to pay themselves (taxation is zero in state H) but do have a positive probability of receiving benefits in state L once they are old. Consider instead the more interesting case that the economy is in state L. The preferred tax rate results from the following procedure:

$$\max_{\tau} \qquad u(w - \overline{s} - \tau) + \lambda u(\overline{s} r^L + (1+n)\tau) + (1-\lambda) u(\overline{s} r^H)$$

Omitting from the maximand the part which does not contain τ, the following maximization procedure is equivalent, that is, it gives the same optimizing value:

$$\max_{\tau} \qquad u(w-\overline{s}-\tau)+\lambda u(\overline{s}r^L+(1+n)\tau) \tag{2.10}$$

This expression resembles the expression that is maximized by the social planner, with however one difference, that is parameter λ. The young take into account that there is a probability of λ that they will receive a transfer in the low state, while they know with certainty that they have to pay taxes (as they are in state L).

Why is the ex-ante efficient utility different? A social planner takes into account that ex-ante the probability that a generation pays a transfer *also* equals λ. Therefore the policy preferred by the young differs from the ex-ante efficient policy. Intuitively, young voters do not internalize the interests of unborn voters, as unborn voters do not know for sure that they have to pay taxes. The tax policy preferred by the young, denoted by τ^y, is the tax that solves maximization problem 2.10. It can be shown that the solution is given by[9]:

$$\tau^y = \frac{w-\overline{s}[1+(1+n)^{-\frac{1}{\sigma}}\lambda^{-\frac{1}{\sigma}}r^L]}{1+(1+n)^{\frac{\sigma-1}{\sigma}}\lambda^{-\frac{1}{\sigma}}}$$

By inspection it can be seen that $\tau^y < \tau^{fb}$. Since electoral candidates would announce the policy preferred by the young (as only the young vote), τ^y would be the equilibrium outcome. So, in this setting, letting only young voters vote would not be ex-ante efficient. The only exception would be when $\lambda = 1$, which is essentially the case described by Browning (1975). However, this case would rule out any risk and would thus make risk sharing redundant.

While analytically useful, full commitment is a strong assumption. It is ipso facto incorrect, as pension policies have been changed. An alternative and more realistic assumption is to have repeated elections (as in the probability voting model here). In this environment reputation becomes relevant if young voters can condition their vote on previous electoral outcomes. Such conditional voting calls for an expansion of the action space of (young) voters, see Sjoblom (1985) and Boldrin and Rustichini (2000). Generally a whole range of equilibria can be sustained by a proper set of reaction functions. Suppose that in each time-period a representative agent of the young generation could decide on a transfer to the old, so abstract from any political process for now. Consider for example the following strategy for the representative agent, young at time t:

$$\tau_t = \begin{cases} \widetilde{\tau} & \text{if } \omega_t = L \text{ and } \tau_i = \widetilde{\tau}\ \forall\ i < t \text{ in which } \omega_i = L \\ 0 & \text{otherwise} \end{cases}$$

Here, young generations only contribute $\widetilde{\tau}$ if state L occurs and if all young generations to date did likewise by contributing $\widetilde{\tau}$ when state L occured. If all other (young) generations have this strategy, is it a best response for a generation young at time t? If it did not contribute $\widetilde{\tau}$, it would receive 0 in the next period in state L, irrespective of the height of the transfer. So if a young generation deviates it can best deviate to a transfer of zero. This provides utility as if the generation operates in autarky, not transfering anything and receiving nothing. So the strategy is a best-response iff:

$$u(w-\overline{s}-\widetilde{\tau})+\lambda u(\overline{s}r^L+(1+n)\widetilde{\tau})+(1-\lambda)u(\overline{s}r^H) \geqq u(w-\overline{s})+\lambda u(\overline{s}r^L)+(1-\lambda)u(\overline{s}r^H) \Leftrightarrow$$
$$u(w-\overline{s}-\widetilde{\tau})+\lambda u(\overline{s}r^L+(1+n)\widetilde{\tau}) \geqq u(w-\overline{s})+\lambda u(\overline{s}r^L)$$

[9] The FOC is: $\frac{\partial u(w-\overline{s}-\tau)}{\partial \tau}+\lambda\frac{\partial u(\overline{s}r^L+(1+n)\tau)}{\partial \tau}=0$.
Using the expression for $u(x)=\frac{x^{1-\sigma}}{1-\sigma}$, this becomes: $(w-\overline{s}-\tau)^{-\sigma}=(1+n)\lambda(\overline{s}r^L+(1+n)\tau)^{-\sigma} \Rightarrow$
$w-\overline{s}-\tau=(1+n)^{-\frac{1}{\sigma}}\lambda^{-\frac{1}{\sigma}}(\overline{s}r^L+(1+n)\tau) \Rightarrow$
$w-\overline{s}-(1+n)^{-\frac{1}{\sigma}}\lambda^{-\frac{1}{\sigma}}\overline{s}r^L=(1+n)^{\frac{\sigma-1}{\sigma}}\lambda^{-\frac{1}{\sigma}}\tau+\tau \Rightarrow$
$w-\overline{s}[1+(1+n)^{-\frac{1}{\sigma}}\lambda^{-\frac{1}{\sigma}}r^L]=\tau[(1+n)^{\frac{\sigma-1}{\sigma}}\lambda^{-\frac{1}{\sigma}}+1] \Rightarrow$
$\tau=\frac{w-\overline{s}[1+(1+n)^{-\frac{1}{\sigma}}\lambda^{-\frac{1}{\sigma}}r^L]}{1+(1+n)^{\frac{\sigma-1}{\sigma}}\lambda^{-\frac{1}{\sigma}}}$

Any $\widetilde{\tau}$ that meets this condition is sustainable as an equilibrium. In particular note that by construction τ^y maximizes the left-hand expression and is thus sustainable as an equilibrium. Whether the ex-ante efficient transfer, τ^{fb}, is sustainable depends on whether it meets the condition. Even if so, it is one possible equilibrium among many and there is no reason a priori to assume it will be the equilibrium outcome. So letting young voters vote would again be more efficient than letting old voters vote (who want full taxation) but the ex-ante efficient tax will not typically result. This abstracts from the political process, but in a median voter model set-up the electoral candidates would, as before, announce and implement exactly the tax preferred by the young (given that only the young vote); see Sjoblom (1985) and Rangel and Zeckhauser (1999) for a formal treatment.

2.3 Extension: endogenous savings

An important assumption in the previous section is that savings are fixed. These fixed savings can be understood as mandatory contributions to a pension scheme that cannot be altered or supplemented by individuals. The assumption is strong, but it is reasonable to abstract from saving decisions given that the focus here is on intergenerational risk sharing. From a practical point of view, it allows for simple, analytical solutions.

Nonetheless, the assumption of fixed savings is restrictive and the question is whether the conclusions are robust to changes in the way saving decisions are modelled. Fixed savings make it impossible for the young to react to higher taxation by lowering their savings; with endogenous savings, higher taxation indeed leads to lower savings. And because taxation affects savings in this setting, tax policies spill over to future periods. A high tax results in low savings, which induces a high transfer in the next period as the then old are relatively poor. It then becomes relevant whether electoral candidates and voters take future taxation as given (Nash assumption) or exploit their first-mover advantage vis-à-vis future generations by increasing taxation, anticipating that the disadvantaged young -who save less because of the higher tax- will be partly compensated in the next period (Stackelberg assumption). Here, the Nash-approach is taken to model saving decisions.

2.3.1 The model

This section considers an extension of the model. Savings are now no longer fixed but are endogenous. Individuals maximize their utility with respect to savings. This has several repercussions in particular for the political process. Further behavioral assumptions have to be made about individuals and candidates. First, it is assumed here that candidates and individuals take each other's actions as given. Second, it is assumed that both voters and candidates take taxation in the next period as given. These assumptions are discussed in more detail below. Otherwise, the set-up of the model is similar to the set-up in the preceding section. Before turning to the first-best and second-best solution, the extended model is discussed.

Individuals

As before, individuals born at time t have a time-separable utility function with felicity functions exhibiting constant relative risk aversion (CRRA):

$$V(c_t^y, c_t^o) = u(c_t^y) + u(c_t^o)$$

Here, the expression for $u(.)$ is given by 2.1. Consumption in the first and second period of an agent born at time t is denoted by c_t^y and c_t^o respectively. Savings at time t are denoted by s_t. The budget equations are now:

$$c_t^y = w - s_t - \tau_t \tag{2.11}$$
$$c_t^o = s_t r_{t+1} + \tau_{t+1}$$

As before, older generations leave no bequests.[10] Substituting the budget constraints directly in $V(c_t^y, c_t^o)$, life-time utility can alternatively be defined as a function of savings and taxes. That is, given future taxation τ_{t+1}, the function $W^y(.)$ can be redefined:

$$W^y(s_t, \tau_t, \tau_{t+1}) \equiv u(w - s_t - \tau_t) + u(s_t r_{t+1} + (1+n)\tau_{t+1})$$

The young do not control taxation and take taxes in the current period (τ_t) and in the next period (τ_{t+1}) as given. The young then maximize expected life-time utility, given by $E[W^y(s_t, \tau_t, \tau_{t+1})]$, with respect to savings, while taking taxes in the current period (τ_t) as given and given their expectations of future taxation (τ_{t+1}). How these expectations are formed is addressed below. Note that maximizing the (expected) value of $V(c_t^y, c_t^o)$ with respect to c_t^y and c_t^o, subject to equation 2.11, is equivalent to maximizing the (expected) value of $W^y(s_t, \tau_t, \tau_{t+1})$ with respect to savings s_t, in both cases taking taxes in the current period (τ_t) as given and given their expectations of future taxation (τ_{t+1}).

2.3.2 First-best: optimal intergenerational risk sharing

A social planner maximizes ex-ante utility with respect to taxation and savings. The social planner should now condition on the state in more periods. Why would this increase efficiency compared to conditioning on the state in the current period? Suppose that at time $t-1$ state L occurs, so that individuals young at time $t-1$ have to transfer a tax to the old. Suppose that at time t again state L occurs, so the individuals young at time $t-1$ and old at time t face low return on their savings. The generation born at time $t-1$ is essentially hit twice by state L; first in the first period when they were young and had to transfer a tax, and again when they are old. This risk could be shared by a higher transfer from young to old if the old faced state L twice in their life. The tax may thus depend on both the state at time t and $t-1$. In fact, it may depend on the entire history of the economy in current and previous periods. On how many periods does the social planner optimally condition? In principle, it is optimal that the social planner conditions on both the current and all previous periods. However, after a number of periods, the optimal tax-policy converges, that is, ex-ante utility does not increase when more periods are considered. How to determine optimal taxation and savings and the number of periods after which convergence occurs?

The solution procedure as described in Van Hemert (2005) is used. Let Z^k denote the set of all possible k-histories in k subsequent periods. As there are two possible states of the world in each period, there are 2^k elements in Z^k. Consider maximizing utility of a generation, conditioning on the last k periods only. Denoting two particular k-histories by z and z^+, ex-ante utility is maximized by maximizing V^k, which gives the expected life-time utility of a steady state generation when conditioning on the last k periods:

$$V^k \equiv \sum_{h \in H^k} \sum_{h^+ \in H^k} P[z_t = z, z_{t+1} = z^+] \times$$
$$[u(w - \tau(z) - s(z)) + u((1+n)\tau(z^+) + s(z)R(z^+))]$$

Here, $R(z)$, $s(z)$, and $\tau(z)$ denote the interest rate, savings and taxes respectively that occur in the particular k-history z. Optimal taxes and savings follow from maximizing V^k with respect to $\tau(z)$ and

[10] Note that individuals cannot off-set taxation (nor do they want to) by adjusting savings. Endogenous savings does not make taxation redundant and is thus a real extension. The reason is that the pay-offs of the tax policy (which has a pay-off in state L and not in state H) cannot be replicated in the capital market. In fact, the pay-offs of the tax instrument and capital returns are negatively correlated. The tax policy, understood as a quasi-asset, is not spanned by the market portfolio, which consists of one risky asset. This is why the tax instrument can be welfare-enhancing by diversifying investment risk.

$s(z)$ for all $z \in Z^k$. The maximization procedure takes ever more periods into account until convergence. Convergence occurs if $V^k \approx V^{k+1}$ and conditioning on more periods does not increase ex-ante utility and is thus redundant.

As an example, consider taxes contingent on the state of the economy in the last two periods. Introducing notation, define the 2-period history at time t as follows: $z_t = (\omega_{t-1}, \omega_t)$ where as before $\omega_{t-1}, \omega_t \in \Omega = \{L, H\}$. Let Z^2 denote the set of all possible 2-histories, so $Z^2 = \{(L,L), (L,H), (H,L), (H,H)\}$, where the last entry denotes the last time period. Denote one particular element of Z^2 by z and its successor by z^+.

An agent born at time t encounters one 2-period history in the first period of life, denoted by z_t, and encounters a 2-period history in the second period, denoted by z_{t+1}. Table 3 summarizes the eight possibilities for z_t and z_{t+1} and the resulting life-time utility. $P[z_t = z, z_{t+1} = z^+]$ denotes the probability that $z_t = z$ and $z_{t+1} = z^+$.

Table 3

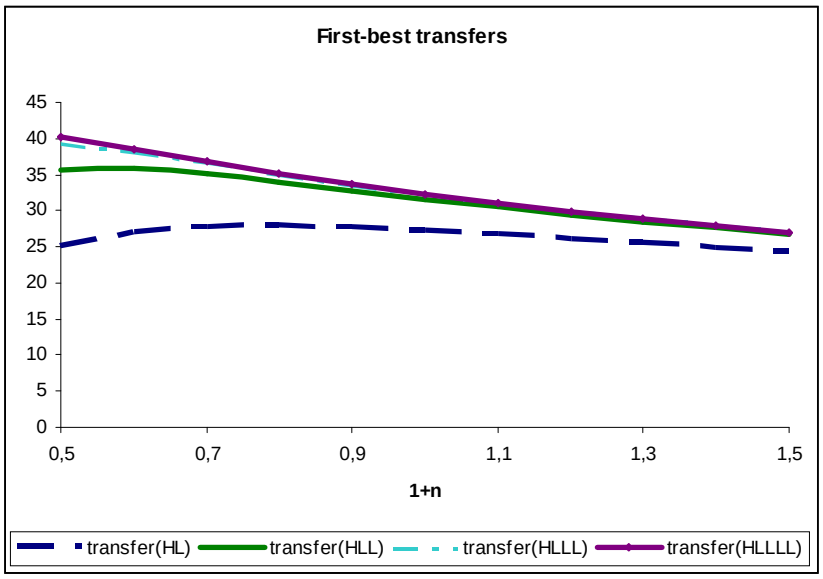
z_t	z_{t+1}	$P[z_t = z, z_{t+1} = z^+]$	Life-time utility
(L,L)	(L,L)	λ^3	$u(w - s^{LL} - \tau^{LL}) + u(s^{LL}r^L + (1+n)\tau^{LL})$
(L,L)	(L,H)	$\lambda^2(1-\lambda)$	$u(w - s^{LL} - \tau^{LL}) + u(s^{LL}r^H)$
(L,H)	(H,L)	$\lambda^2(1-\lambda)$	$u(w - s^H) + u(s^H r^L + (1+n)\tau^{HL})$
(L,H)	(H,H)	$\lambda(1-\lambda)^2$	$u(w - s^H) + u(s^H r^H)$
(H,L)	(L,L)	$\lambda^2(1-\lambda)$	$u(w - s^{HL} - \tau^{HL}) + u(s^{HL}r^L + (1+n)\tau^{HL})$
(H,L)	(L,H)	$\lambda(1-\lambda)^2$	$u(w - s^{HL} - \tau^{HL}) + u(s^{HL}r^H)$
(H,H)	(H,L)	$\lambda(1-\lambda)^2$	$u(w - s^H) + u(s^H r^L + (1+n)\tau^{HL})$
(H,H)	(H,H)	$(1-\lambda)^3$	$u(w - s^H) + u(s^H r^L)$

Ex-ante utility of an agent is now equal to the expected life-time utility of an unborn agent. This is given by multiplying the probabilities in column 3 with the appropriate life-time utilities, given in column 4, and summing the results. This sum is maximized with respect to history-contingent transfers (τ^{LL} and τ^{HL}) and history-contingent savings (s^{LL}, s^{HL} and s^H).[11] Note that savings of a young generation coincide when $z_t = (L,H)$ and $z_t = (H,H)$. The reason is that each young generation in state H faces the same conditions, irrespective of the previous states. This can be seen by inspection of Table 3. It also follows intuitively as the contemporaneous taxation for both is equal (it is zero in state H) and taxation in the next period does not depend on the states prior to the current state given that the current state is H. Every time state H occurs, the tax-policy is effectively reset.

Numerical illustration

An illustration for optimal savings and transfers is given in Graphs 2 and 3. Optimal savings and transfers are solved numerically for exactly the same parameter values as in Table 2 with the obvious difference that the value of $\overline{s}$ does not enter here. Graph 2 shows the ex-ante efficient transfers for different histories as a function of population growth. Graph 3 does the same for savings. Both savings and taxation are given in percentages of the wage.

[11] Note that the social planner conditions on one period in the case that savings are fixed, discussed in sub-section 2.2.2. Conditioning on more than one period is redundant, that is, all taxes in histories that end with state L are equal. This can be seen by inspection when substituting fixed savings $\overline{s}$ in Table 3. The intuition is that utility in the second period of life is not affected by history via savings (since savings are fixed), but it is only determined by the state in that period. The optimal tax in the second period of life therefore only depends on the state in that period.

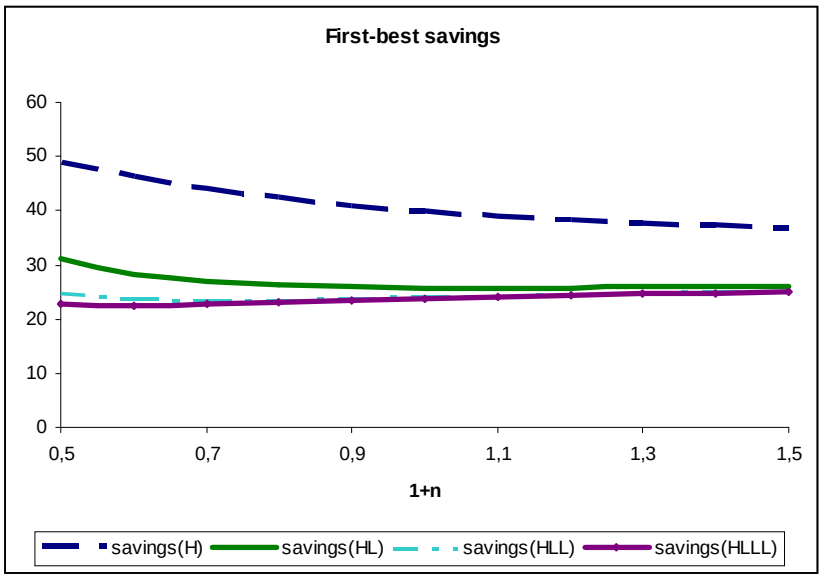


Graph 2

The graphs illustrate several features of the optimal solution. First, the size of the optimal transfer depends on the number of times state L preceded. The tax rate increases when more states L preceded. This implies that the loss of a low return on capital in state L is spread over the two living generations but also over future generations. In case state L occurs, the young generation contributes to the old generation, thereby the loss is spread over the two living generations. However, the young generation itself receives a higher transfer in case the return on its own savings is also low when they are old, so the loss for the living young generation is partly compensated by an extra contribution of the next young generation in case state L occurs. Thereby, the original loss is also partly spread over unborn generations. This illustrates the principle of optimal risk sharing to spread losses over current and future (unborn) generations, see Ball and Mankiw (2007). However, contrary to the optimality result of Ball and Mankiw, here a loss (or gain) does not translate into a proportional decrease (or increase) in consumption of all current and future generations.

A second feature is that taxation does not necessarily increase with population growth, possibly counter-intuitively. On the one hand, a high implicit rate of return induces higher contributions; on the other hand, the insurance for the elderly can be accomplished by lower contributions, exactly because of the higher rate of return. This in turn leaves more scope in the first period for consumption or for savings.

Third, note that even when population growth is extremely low, some risk sharing is efficient. For example, when $1 + n = 0.5$ the rate of return of intergenerational transfers is extremely low compared with the expected return on capital. The expected rate of return equals 1.25 as $r^L = 0.5$, $r^H = 0.5$ and $\lambda = 2$ and $E[r_t] = \lambda r^L + (1 - \lambda) r^H$. The reason that risk sharing is efficient is that agents are risk averse and the tax instrument decreases investment risk.



Graph 3

2.3.3 Second-best: political redistribution

As before, the political process involves both individuals in their role as voters and electoral candidates. These are now discussed in turn.

Voters

The young maximize life-time utility with respect to savings. The young are assumed to take *current* taxation, τ_t, as given, whereas the electoral candidates take the savings rate of voters, that is young individuals, as given. An alternative approach is to assume that either voters or candidates are the Stackelberg-leader. For example, young voters move first and choose their savings and the candidates move next by announcing the tax rate given the savings decision of young voters. However, it can also be argued that the government moves first and voters decide on their saving decision next. As there is no natural Stackelberg leader here, the Nash approach with both voters and candidates simultaneously deciding seems most appropriate.

The young also take *future* taxation as given, which is a reasonable assumption. Higher *aggregate* savings lead to lower benefits the next period, as the government does not take into account whether low income of the old resulted from low *returns* on savings or from low *savings* itself. However *individual* savings have a negligible effect on aggregate savings, and without coordination individuals will therefore not take into account the effect of current savings on future benefits.

What tax level do individuals expect in the next period? Individuals are assumed to have rational expectations about the tax rate. If state H occurs the next period they know the tax level will be zero. However, they have to form a conjecture about the tax level were state L to occur. The conjectured tax level is equal to the actual tax level. As will turn out below, the tax level in state L depends on the number of states L that occurred previously. Denote the consecutive number of states L at time t, including time t itself, by l_t. That is, if the economy is in state H at time t $l_t = 0$; if the economy is in state L at time t but was in state H at time $t-1$, then $l_t = 1$. If the economy was in state L at time t and $t-1$ but in state H at time $t-2$, then $l_t = 2$. Formally the variable is defined as:

$$l_t = \begin{cases} j & \text{if } \omega_i = L \ \forall \ t-j < i \leqq t \text{ and } \omega_{t-j} = H \\ 0 & \text{if } \omega_t = H \end{cases}$$

Individuals have knowledge of l_t and take it into account when forming expectations. The expectation at time t given l_t about the tax level at time $t+1$ if the economy is in state L at time $t+1$ is denoted $\widehat{\tau}_{t+1|l_t}$. Maximizing expected life-time utility taking τ_t as given, a worker at time t solves the following problem:

$$\max_{s_t} E[W^y(s_t, \tau_t, \tau_{t+1})] \Rightarrow$$
$$\max_{s_t} u(w - s_t - \tau_t) + \lambda u(s_t r_{t+1} + (1+n)\widehat{\tau}_{t+1|l_t}) + u(1-\lambda)(s_t r^H)$$

The political process

As before, the political process is characterized by the probability voting model. Also as before, electoral candidates at time t maximize a political target function with respect to taxes τ_t. Taking s_t (savings of the young) as given, this target function is:

$$W(\tau_t, s_t) = \phi(1+n)E[W^y(s_t, \tau_t, \tau_{t+1})] + W^o(\tau_t)$$

Here $W^o(\tau_t)$ gives the utility of the old given their previous savings and is defined as follows: $W^o(\tau_t) \equiv u(s_{t-1}r_t + \tau_t)$. Electoral candidates take s_t as given. Electoral candidates also take future taxation as given. This Nash assumption is discussed below as well as the alternative Stackelberg assumption, where electoral candidates recognize and exploit that a higher taxation at time t will -via lower savings by the young- result in higher taxation at time $t+1$, which partly compensates the voters young at time t.

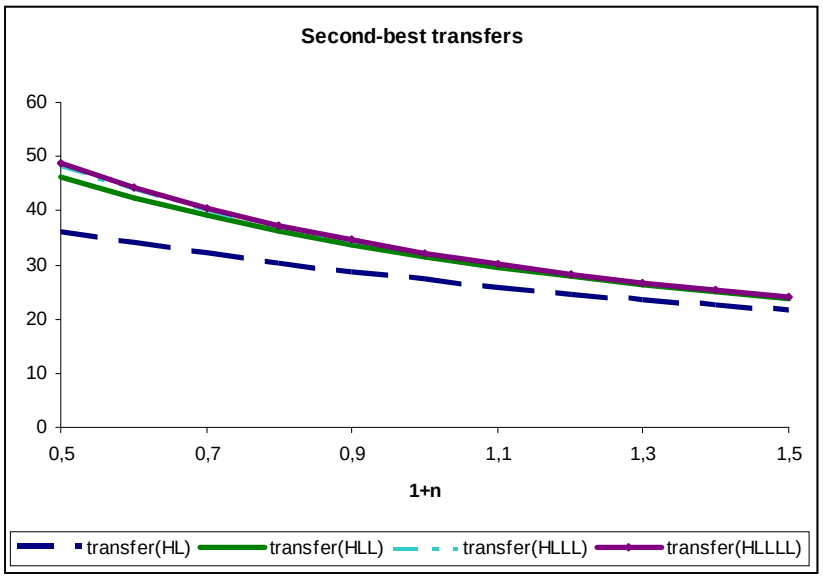
How to determine taxes (set by the candidates) and savings (decided by individuals) simultaneously? Taxes and savings at time t can be determined by maximizing the political target function with respect to both s_t and τ_t simultaneously. That is:

$$\max_{\tau_t, s_t} \phi(1+n)E[W^y(s_t, \tau_t, \tau_{t+1})] + W^o(\tau_t) \Rightarrow \tag{2.12}$$
$$\max_{\tau_t, s_t} \phi(1+n)\{u(w - s_t - \tau_t) + \lambda u(s_t r^L + (1+n)\widehat{\tau}_{t+1|l_t}) +$$
$$(1-\lambda)u(s_t r^H)\} + u(s_{t-1}r_t + (1+n)\tau_t)$$

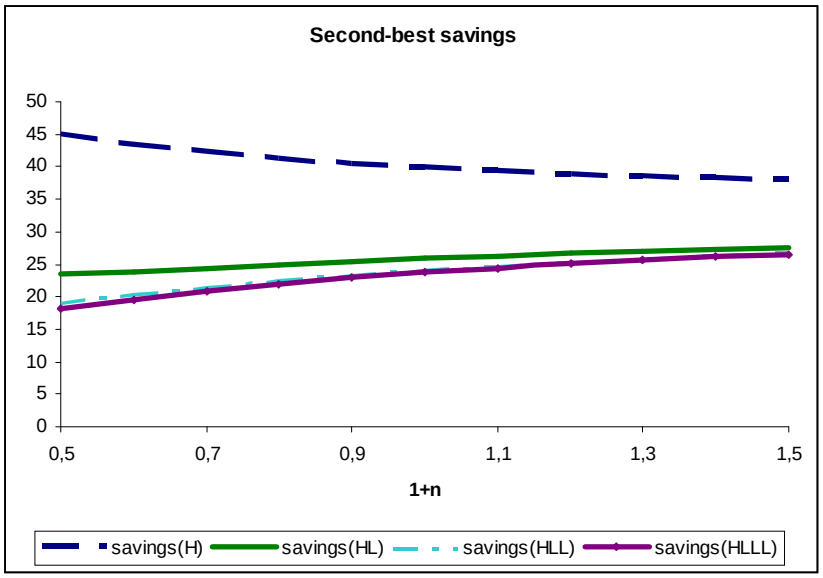
To see this, note the following. Given the savings that result from this procedure, the electoral candidates can do no better as the political target function is maximized. However, given the maximizing value of taxation, τ_t, maximizing the political target function coincides with maximizing expected life-time utility of the younger cohort (since life-time utility of the young cohort enters additively in the political target function). Solving maximization problem 2.12 gives both the equilibrium taxes and savings. The maximization problem is solved numerically for different values of l_t which represent different histories. The appendix discusses the solution procedure.

Numerical illustration

An illustration for savings and tax-levels that result from the political process is considered in Graphs 2 and 3. These graphs result from solving the problem numerically for exactly the same parameter values as in Table 2 with the obvious difference that the value of $\overline{s}$ does not enter. Graph 4 shows the tax-levels in different histories as a function of population growth. Graph 5 does the same for savings.



Graph 4



Graph 5

The graphs illustrate several features of the political process. First, taxation decreases in population growth. This is the net result of two opposing effects of population growth on contributions. Lower population growth decreases the rate of return of intergenerational transfers, thereby making it less attractive to redistribute from the working generation to the older generation. However, lower population growth also increases the political clout of the elderly, which has an upward effect on taxation. The political effect dominates and lower population growth thus results in higher taxation.

Second, taxation increases in the number of previous periods that L occurred. In state L capital return is low; this hurts the retirees whereas the working generation is not hit directly. As poorer voters are more easily swayed, this results in redistribution from young to old in state L. Young generations save less as a result. When state L occurs a second time in a row, workers have saved less and face low returns. This makes them worse off than the generation that was first hit by low returns. This in turn induces an

even higher transfer from the young generation that is working then. Together this leads to higher taxation every time an extra period in state L occurs. This resembles the contingent optimal taxation that likewise increases in the number of preceding market lows. While the direction of first-best and second-best transfers is the same, the sizes differ.

2.3.4 Discussion

An important assumption is that electoral candidates and voters do not take into account that current taxes influence future taxation. Candidates and voters instead take future taxes as given. This Nash assumption is restrictive, as there is a connection between contemporaneous and future taxes. This link results from the effect of taxation on private savings. Savings are crowded out by taxes and workers therefore have lower savings for retirement. This in turn induces the next government to redistribute to these retirees. Higher current taxes thereby lead to higher future benefits for current workers. Young voters are thus partly compensated for high taxes by higher future benefits.

An alternative for the Nash assumption is the Stackelberg approach considered by D'Amato and Galasso (2010). They propose that governments explicitly take the effect of current taxes on future benefits into account. Politicians exploit their first-mover advantage by increasing taxes at the expense of savings, resulting in higher taxes in the future. D'Amato and Galasso predict that aging decreases overspending on intergenerational transfers, as a lower rate of return of intergenerational transfers decreases the scope to exploit future generations. This chapter instead argues that aging may lead to higher taxation, due to the increased political clout of the elderly. This political-demographic effect dominates here and aging typically increases the discrepancy between the optimal transfer and the politically feasible one. The assumption about the behavior of candidates thus matters for the qualitative outcomes of the model.

The Nash assumption can be motivated by considering that one period represents 30 years. While voters and electoral candidates hold rational expectations about future taxation, it is still difficult to conceive how changes in current tax policy will influence future tax policies over such a long time period, as economic circumstances, demographic developments and political coalitions change substantially, constantly and in unpredictable ways. Which approach is more realistic, is in the end an empirical question. The Nash assumption is restrictive as candidates do not consider the reaction of future governments whatsoever. The Stackelberg approach is problematic as well, as the opposite extreme is assumed: governments know exactly and take fully into account the behavior of future governments. As one period in a two-period OLG model represents 30 years, this is a strong assumption. In reality it will probably be a mixed case.

An analytical advantage of the Nash assumption is that it allows to focus exclusively on the distortionary effect of aging on the political sustainability of intergenerational risk sharing, whereas the Stackelberg-approach combines the inefficiency resulting from aging with the inefficiency resulting from the first-mover advantage of contemporaneous candidates (where the two partly cancel each other out).

2.4 Conclusion

Intergenerational risk sharing has the potential to improve welfare, but cannot be implemented by markets. The government is in a unique position to implement optimal intergenerational risk sharing by pre-committing unborn generations. However, the government is not driven by efficiency considerations but by political motives. In a democracy, policies need electoral support to be implemented. This chapter has investigated whether ex-ante efficient intergenerational risk sharing can be generated by political institutions if these are primarily driven by redistributional motives.

The message of this chapter is that politics generally does not lead to ex-ante efficient risk sharing. The political process has an innate tendency to redistribute towards larger cohorts or towards voters who are easier to influence. Due to these biases, politics cannot deliver efficient outcomes. Aging may increase the discrepancy between efficient taxes and taxes determined in the political process. As Bovenberg (2008)

states, "the danger facing aging societies is that older voters block the needed reforms. In that case, a conflict arises between the political power of older generations (who depend on public transfers and are risk averse) and the economic power of the younger, working generations (who control the major resource that fuel the modern knowledge-intensive economy -namely, human capital and entrepreneurship). In other words, politics collides with economics." Indeed, concern is warranted, as aging may increase the difference between first- and second-best outcomes. The good news, however, is that from an ex-ante perspective, politics may still deliver better outcomes than a situation without any transfers.

Social Security in many countries developed in the 1930s-1950s; for example the USA implemented PAYG-financed social security in 1937 when many retirees suffered in the Depression, see also Perotti and Schwienbacher (2008). The resulting decrease in retirement savings was an important motive for social security. Although this chapter does not predict a specific moment when social security is implemented, timing and motivation coincide with an implication of the model that intergenerational transfers are used when retirees have suffered a severe financial set-back.

The conclusions hold for a wide range of population growth rates and are robust to changes in risk aversion (not shown here) and endogenous savings. The current set-up is nonetheless limited in several ways. It does not address labor market distortions and general-equilibrium effects, thereby overestimating the gains of risk sharing. However, by modelling only two generations the potential gain from risk sharing between more generations is underestimated. By abstracting from risk factors such as longevity, inflation and productivity, the gains from risk sharing are further underestimated. The model also does not take economic growth into account, underestimating the return on intergenerational transfers.

These limitations are recognized but they are not essential for the central message. If politics hinders risk-sharing in the relatively simple set-up here, then risk sharing in a more complex environment can certainly not be taken for granted. The aim of this chapter is also not to calibrate the optimal tax level, but to provide an analytical framework to consider whether whatever is optimal will arise endogenously in the political process. The bad news is that democracy may not lead to efficiency and aging may make things worse. The good news is that political institutions have the potential to generate some risk sharing and are thus preferable to a situation without intergenerational risk sharing.

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2.5 Appendix: Existence of a unique solution

2.5.1 Derivation of equation 2.5

Based on Persson and Tabellini (2000), this appendix shows that in the probability voting model, discussed in sub-section 2.2.3., in equilibrium both candidates announce exactly the same policy and that this policy is the tax rate that maximizes the following function:

$$W(\tau_t) = \phi(1+n)W^y(\tau_t) + W^o(\tau_t).$$

In order to derive this function, the players in the game are discussed in turn.

Electoral candidates

There are two candidates running for office, candidate A and candidate B. Before elections take place, candidates A and B announce the tax rates τ_A and τ_B that they would implement after elections. This is a binding promise, which cannot be withdrawn after elections. Both candidates are office-seeking. They thus set the tax rate that maximizes the probability of being elected. The candidate with the most votes wins. Denote with π_A the vote share of candidate A where $0 \leqq \pi_A \leqq 1$. Then the probability that candidate A wins, denoted p_A, equals: $p_A = P[\pi_A \geqq \frac{1}{2}]$. The expressions for candidate B are defined completely analogously, with the obvious relation $p_A + p_B = 1$. The probability that a candidate wins depends on the tax he himself announces, the tax rate the other candidate announces, and the voting decision of voters. These are now discussed in turn.

Voters

The electorate consists of two distinct groups, the young and the old. For ease of reference, index these groups $j = y, o$. The share of young and old voters in the electorate is denoted by α^j. These shares equal $\alpha^y = \frac{1+n}{2+n}$ and $\alpha^o = \frac{1}{2+n}$.

Voters base their voting decision on two considerations:

(1) The tax policy announced by the two candidates. This policy influences the consumption of voters directly and thereby their utility.

(2) A personal characteristic of the candidates, called ideology.

The second aspect –ideology- differs between candidates. Ideology is a permanent feature of the candidate and cannot be changed. (The term ideology is used here, but the permanent characteristic could also be thought of as party loyalty, habit formation of voters or the candidate's charisma.) What is crucial is that voters differ in how important ideology is for them. Non-ideological voters will only consider the tax policy, while ideological voters will vote for a certain candidate irrespective of the tax policy he proposed. This gives candidates the incentive to cater their policy towards non-ideological voters, who are easy to sway. Recall that $W^y(\tau_t) = u(c^y(\tau_t))$ and $W^o(\tau_t) = u(c^o(\tau_t))$ and that $c^y(\tau_t) \equiv w - \tau_t - \overline{s}$ and $c^o(\tau_{t+1}) \equiv \overline{s}r_t + (1+n)\tau_{t+1}$. The functions $W^y(.)$ and $W^o(.)$ denote utility of the young and the old respectively at time t as a function of the tax-level at time t.

Now, voter i in group j prefers candidate A iff:

$$W^j(\tau_A) > W^j(\tau_B) + \mu^{ij} + \delta \qquad j = y, o$$

Here μ^{ij} is a voter-specific parameter that can take on both positive and negative values. A positive value implies that a voter has an ideological bias towards candidate B. A negative value on the other hand implies that voters have an ideological preference for candidate A. Voters that are ideologically neutral have a value equal to zero ($\mu^{ij} = 0$).

The parameter μ^{ij} has a group-specific uniform distribution on the domain $[-\frac{1}{2\phi^j}, \frac{1}{2\phi^j}]$. The density is thus ϕ^j and both groups (young and old) have members inherently biased towards both candidates.

The parameter δ measures the average popularity of candidate B in the population as a whole. It can also be positive or negative and it is uniformly distributed on the domain $[-\frac{1}{2\psi}, \frac{1}{2\psi}]$.

Elections

Timing of events in elections is as follows:

(1) The two candidates simultaneously announce their policies. When doing so, they are aware of the distribution of μ^{ij} and δ, but not of their realizations.

(2) The value of δ is realized.

(3) Elections are held, in which voters choose between the two candidates.

(4) The announced policy of the winning candidate is implemented.

Which policy will the candidates choose? To see this, consider the "swing voter" in group j. This is the voter that, given his ideological bias and given the policies of the candidates, is indifferent between candidate A and candidate B. Now define:

$$\mu^j \equiv W^j(\tau_A) - W^j(\tau_B) - \delta$$

All voters i in group j with $\mu^{ij} < \mu^j$ vote for candidate A, whereas all voters with $\mu^{ij} > \mu^j$ vote for candidate B. If $\mu^{ij} = \mu^j$, a voter votes for candidate A with probability $\frac{1}{2}$ (and also with probability $\frac{1}{2}$ for candidate B).

Recall that α^j equals the share of group j of the total population. The vote share of candidate A equals:[12]

$$\pi_A = \textstyle\sum_j \alpha^j \phi^j (\mu^j + \frac{1}{2\phi^j})$$

The probability with which candidate A wins is now equal to[13]:

$$p_A = \tfrac{1}{2} + \tfrac{\psi}{\zeta}[\textstyle\sum_j \alpha^j \phi^j [W^j(\tau_A) - W^j(\tau_B)]]$$

where $\zeta \equiv \sum_j \alpha^j \phi^j$, the average density across groups. Candidate A maximizes p_A with respect to τ_A.

Equilibrium

The expression for p_A can be rearranged to get:

$$p_A = \tfrac{1}{2} + \tfrac{\psi}{\zeta}[\alpha^y \phi^y W^y(\tau_A) + \alpha^o \phi^o W^o(\tau_A)] - \tfrac{\psi}{\zeta}[\alpha^y \phi^y W^y(\tau_B) + \alpha^o \phi^o W^o(\tau_B)]$$

Again, candidate A maximizes p_A with respect to τ_A. Disregarding the parts that cannot be influenced by τ_A, maximizing p_A is equivalent to maximizing $\widehat{p_A} \equiv \alpha^y \phi^y W^y(\tau_A) + \alpha^o \phi^o W^o(\tau_A)$ with respect to τ_A. Using the expressions for α^y, this is in turn equivalent to maximizing $\widehat{p_A} = \frac{1+n}{2+n}\phi^y W^y(\tau_A) + \frac{1}{2+n}\phi^o W^o(\tau_A)$.

Finally, multiplying $\widehat{p_A}$ with $2+n$ and defining $\phi \equiv \frac{\phi^y}{\phi^o}$ leads to the function:

$$W(\tau_A) \equiv (1+n)\phi W^y(\tau_A) + u(\overline{s}r^L + (1+n)W^o(\tau_A)$$

Maximizing the function $W(\tau_A)$ and maximizing p_A is completely equivalent for candidate A in the sense that exactly the same optimizing value for τ_A results. Now $W(\tau_A)$ is called the political target function. But which tax policy does candidate B announce? The unique equilibrium has both candidates converging on the same tax policy. This follows from the observation that the two politicians face the same optimization problem. This can be seen formally by interchanging subscripts A and B in the above. Intuitively both candidates have similar preferences (they are both office-seeking) and have the same "technology to convert tax money into (expected) votes" (Persson and Tabellini (2000)). Therefore, in equilibrium both candidates maximize the same political target function. Note that $\phi > 1$ indicates that young voters vote less ideologically then older voters. A value $\phi > 1$ implies that $\phi^y > \phi^o$ and that $\frac{1}{\phi^y} < \frac{1}{\phi^o}$. This in turn means that the density of μ^{iy} has a smaller domain than μ^{io} and that it is thus more concentrated around 0, which is the value of non-ideological voters.

[12] To see this, note that $P[\mu^{ij} \leqq \mu^j] = \phi^j(\mu^j + \frac{1}{2\phi^j})$. This follows from the uniform distribution of μ^{ij} on $[-\frac{1}{2\phi^j}, \frac{1}{2\phi^j}]$. This probability multiplied by the share of group j in the total population gives the number of votes for candidate A coming from group j.

[13] $p_A = P[\pi_A \geqq \frac{1}{2}] = P[\sum_j \alpha^j \phi^j (\mu^j + \frac{1}{2\phi^j}) \geqq \frac{1}{2}] =$
$P[\sum_j \alpha^j \phi^j (W^j(\tau_A) - W^j(\tau_B) - \delta + \frac{1}{2\phi^j}) \geqq \frac{1}{2}] =$
$P[\sum_j \alpha^j \phi^j (W^j(\tau_A) - W^j(\tau_B)) - \sum_j \alpha^j \phi^j \delta +$
$\sum_j \alpha^j \phi^j \frac{1}{2\phi^j} \geqq \frac{1}{2}] = P[\phi\delta \leqq -\frac{1}{2} + \sum_j \alpha^j \phi^j (W^j(\tau_A) - W^j(\tau_B)) + \frac{1}{2}] =$
$P[\phi\delta \leqq \sum_j \alpha^j \phi^j (W^j(\tau_A) - W^j(\tau_B))] = \frac{1}{2} + \frac{\psi}{\phi} \sum_j \alpha^j \phi^j (W^J(\tau_A) - W^J(\tau_B))$, where the last equality follows from the uniform distribution of δ.

2.5.2 Discussion of solution of equation 2.12

The objective is to solve the following maximization problem:

$$\max_{\tau_t, s_t} \phi(1+n)E[W^y(s_t, \tau_t, \tau_{t+1})] + W^o(\tau_t) \Rightarrow$$
$$\max_{\tau_t, s_t}\{\phi(1+n)[u(w - s_t - \tau_t) + \lambda u(s_t r^L + (1+n)\widehat{\tau}_{t+1|l_t}) +$$
$$(1-\lambda)u(s_t r^H)^{1-\sigma}] + u(s_{t-1}r_t + (1+n)\tau_t)$$

A complicating point in solving this equation is that the optimal values of savings and taxation depend on savings a period earlier, s_{t-1}, and on current (rational) expectations of taxes a period later, $\widehat{\tau}_{t+1|l_t}$, which in turn coincides with actual taxes. In the beginning of each iteration the relevant state-contingent taxes that result are used as the new values for $\widehat{\tau}_{t+1|l_t}$ until convergence is reached; that is, until $\widehat{\tau}_{t+1|l_t}$, which is the expected tax in the next period given that state L preceded l_t times, is equal to the tax-level when indeed state L preceded l_t times.

Now, the optimization problem is solved numerically by the following procedure:

1a) In the first iteration take some initial values for $\widehat{\tau}_{t+1|l_t}$

1b) Otherwise update $\widehat{\tau}_{t+1|l_t}$ by taking as its value the tax level in the previous iteration when state L preceded l_t times, so $\widehat{\tau}_{t+1|l_t=l} := \tau^{l+1}$; τ^{l+1} is as defined below.

2) Calculate s_t in state H (so when $l_t = 0$) given $\widehat{\tau}_{t+1|l_t=0}$. Denote the maximizing value of s_t when $l_t = 0$ by s^0. Note that the value of s_{t-1} here does not influence the tax rate in state H (the tax rate is zero) and therefore also does not influence the savings rate of the generation young at time t.

3) Calculate s_t and τ_t if state L occurs next ($l_t = 1$), so given $\widehat{\tau}_{t+1|l_t=1}$ and given $s_{t-1} = s^0$. Denote the maximizing value of s_t and τ_t when $l_t = 1$ by s^1 and τ^1 respectively.

4) Repeat step 3) for increasing values of l_t until convergence occurs, that is until $\exists\ i$ such that $\tau^i \approx \tau^{i+1}$ and $s^i \approx s^{i+1}$.

5) Denote for all $l \leqq i$ the difference between the expected tax rate and the realized tax rate by $d_l \equiv \widehat{\tau}_{t+1|l_t=l} - \tau^{l+1}$.

6) Repeat steps 1) through 5) until $d_l \approx 0$ for all $l \leqq i$, that is, until expected tax levels are equal to the realized values (ensuring that expectations are rational).

This procedure gives the equilibrium taxes and savings for different values of l_t, that is, for a different number of times state L preceded at time t. As l_t summarizes all relevant information at time t, this characterizes the political process in each relevant history.

Note that at each time t, s_{t-1} and $\widehat{\tau}_{t+1|l_t}$ are given and that there exists a unique solution at each time t by the theorem of Weierstrass and strict concavity of the political target function.

Chapter 3

The greying of the median voter

3.1 Introduction

[1] Aging has called the sustainability of public finance into question. This has become more pressing with deficits of most countries ballooning after the nationalization of private bank debts. There are two distinct ways in which aging may positively influence pension expenditure.

The first effect is that there are more retirees on the receiving end of Social Security. As a result, aging naturally leads to higher total pension expenditure relative to GDP. This upward effect of aging on pension expenditures relative to GDP can only be counterbalanced by a considerable decrease of benefits per retiree.

A second effect of aging is that there are more older voters; retirees thus have more political clout. Median voter models argue that this effect is crucial and predict that an older median voter will successfully push for increasing generosity of pensions, see Galasso (2006) and Persson and Tabellini (2000). In this view, aging not only leads to higher spending relative to GDP but also relative to the number of retirees. This would lead to a substantial increase in pension expenditure.

This chapter assesses the empirical support for both propositions using OECD data from 30 countries between 1980 and 2005. It evaluates the demographic impact on retirement spending relative to GDP and relative to the number of retirees. Additionally the association between aging and health care costs is considered. Aging is frequently assumed to be positively associated with health care costs, as elderly are relatively often in need of health care.

Only public spending is taken into account here, disregarding savings via pension funds, insurance companies and banks. The focus is solely on the presence or absence of political pressure to increase pensions theorized to arise from an older electorate. As governments can influence public spending directly, public pension spending should be first and foremost affected if such political pressure exists. Demographic composition of the electorate is operationalized by the median age of the population, while robustness checks are carried out for the dependency ratio as an alternative operationalization.

There is some empirical support for the proposition that aging leads to more pension expenditure as a share of GDP. In the baseline regression an increase of the median age does not lead to an increase in pension expenditure as a share of GDP. However, aging has a positive and significant effect when time effects are discarded or when aging is operationalized with the dependency ratio instead of the age of the median voter. There is no support for the stronger claim made by median voter models. In fact the exact opposite is the case: aging influences the generosity of individual benefits negatively and significantly in the baseline regression. In some alternative specifications the effect is insignificant and still negative.

The impact of an older median voter on health care costs is comparable to the effect on pension expenditure. Generally no significant effect of aging is found. All estimates result from a fixed effect model

[1] This chapter was written with Ferry Koster. An earlier version appeared as AIAS Working paper No. 98 and Netspar discussion paper 01/2001-003.

controlling for several economic and political covariates, including unemployment, GDP per capita, union density, the interest rate and type of government.

Together this suggests that the median voter approach to social security is incomplete. Two approaches are more in line with rising total expenditure yet decreasing generosity. Gonzales-Eiras and Niepelt (2007) propose a probability voting model. In such models, politicians choose the policy that maximizes the weighted utility of all voters where the weights are determined by the degree to which voters can be swayed by policies. The outcome is that aging leads to higher contributions and lower benefits. This is also the outcome of Chapter 2, which analyzed the interaction of probability voting and intergenerational risk sharing.

The same conclusion is reached by Breyer and Stolte (2001) who analyze a two-period OLG-model in which the retirees hold all political power and set contributions. The workers can react to contributions by adjusting their labor supply. This prevents the elderly from setting a contribution level of 100%. The effect of aging in this set-up is burden-sharing by simultaneously increasing contributions and decreasing benefits. This chapter cannot discriminate between the probability voting approach and the endogenous labor supply set-up.

Several earlier papers have investigated the relationship between aging and pension expenditure. Breyer and Craig (1997) use OECD-data for 20 countries in 1960-1990 with 10-year intervals and find that benefits as a fraction of GDP are positively and significantly related to the median voter age. Depending on the specification, an increase of one year of the latter increases spending relative to GDP by 0.4-0.6 percentage points. The median age is positively but not significantly related to benefits per pensioner. Tepe and Vanhuysse (2010) reach similar conclusions based on an analysis of 18 countries between 1980 and 2000 using eight-year intervals. They operationalize aging with the dependency ratio instead of the age of the median voter. Here both are considered. A controversial claim is made by Razin, Sadka and Swagel (2002) stating that a higher dependency ratio is associated with lower pension contributions. This has been challenged by Disney (2007) and Sanz and Velazquez (2007) who criticize both the (static) model specification and the operationalization of the dependency ratio (including children) and social security (which also includes unemployment benefits). Shelton (2008) re-estimates the model of Razin et al.. The most important change in this context is that he uses the number of people over 64 divided by the number of people between 15-64 as the dependency ratio. In one specification a higher dependency ratio has a positive and significant effect on per capita transfers while the dependency ratio is insignificant in a more elaborated model. The difference between Shelton and this study is first that the latter considers benefits per retiree as the dependent variable (instead of transfers per capita). The second difference is that Shelton does not include time effects, political control variables (union density and government features) or the interest rate while the model here does not include openness of the economy (a variable that Shelton includes). Mulligan, Gil and Sala-i-Martin (2002) have a somewhat different approach. They show that democracies do not spend more on Social Security than undemocratic countries. They conclude that for, social security, "much more important are economic and demographic variables, such as the aging of the population and economic growth."

The contribution to this literature is twofold. First, more recent data and relevant regressors not used earlier are considered. Also more observations are used than is common in the literature. This study has a minimum of 109 observations, whereas Breyer and Craig and Tepe and Vanhuysse have a maximum of 76 and 54 observations respectively. This elaborated, re-specified and updated approach generally confirms earlier findings, thereby strengthening previous conclusions. This is all the more relevant because aging is a relatively recent phenomenon that by its nature increases gradually over time. The data here thus allow to include observations with a median age higher than in earlier studies.

The second and novel contribution is that health care costs are evaluated as well. Health care costs are not incorporated in the mentioned literature but are often argued to be related to aging as well. Older voters are arguably as much interested in higher health care spending as in higher retirement benefits. A full analysis considers both factors, as Tepe and Vanhuysse state: "Recent studies indicate that elderly voters actually care less about the real value of their pensions than about health issues. Future research could therefore usefully analyze the effects of population aging on health care spending." This is exactly what is done here.

The rest of the chapter is organized as follows. The next section discusses the political-economic literature on Social Security and in particular the predicted effect of aging on contributions and benefits.

The third section discusses the data and the model. The fourth section shows the results, and the fifth section considers several extensions and robustness analyses.

3.2 Theoretical background and related literature

There is a well-developed and substantial literature on the political economy of social security, see Galasso (2002) and Breyer (1994) for still up-to-date and relevant overviews. The focus here is on the theorized influence of aging on contributions and benefits. An important and dominant approach in the literature uses the median voter concept as the central analytical framework, see Browning (1975), Persson and Tabellini (2000), Galasso (2006), Conesa and Krueger (1999) and Cooley and Soares (1999).

In median voter models, aging has two opposing effects on the preferences of the decisive median voter. A first economic effect is that the rate of return of a Pay-as-you-go system decreases, as the ratio between workers and retirees decreases. This will make a PAYG-system less attractive for all voters, including the median voter. A second political effect is that the median voter will be older. He or she will thus be more and more inclined to support more generous pension benefits. If elections take place once and the result remains in place forever after, this political effect outweighs the economic effect and an older median voter leads to higher benefits per retiree. This is the approach of Browning (1975) and Persson and Tabellini (2000). In this setting an older median voter successfully pushes for higher benefits, so that demographics is the main driving force for pension spending. The crucial implication of median voter models is that benefits will be more generous. As Persson and Tabellini state "A social planner, for example, would also spend more on pensions with a larger number of elderly people. The model really predicts that pensions per retiree will be higher, the higher the weight on old voters (..), as this shifts the median-voter equilibrium toward a more generous pension system."

This result hinges on the stringent assumption that elections take place once and the outcome is binding forever after. This assumption is clearly counter-factual as policies change over time.

Alternatively, Conesa and Krueger (1999) and Cooley and Soares (1999) understand PAYG arrangements as an intergenerational game where elections take place each period, see also Sjoblom (1985). In this case multiple equilibria arise. If voters expect that their own contribution will not influence future contributions made to them, an equilibrium with zero contributions results. If all other generations do not contribute, it is best to do likewise. Positive transfers can however be supported by the threat that future generations may withhold future contributions if current working generations do not contribute to current retirees. In this case, current contributions do influence future benefits. Generations then contribute to retirees because this results in future generations contributing to them. In this approach, each generation takes into account the behavior of previous generations in a reaction function. This reaction function gives the current contribution as a function of contributions of previous generations and it can be interpreted as a social contract between generations (Sjoblom (1985), Boldrin and Rustichini (2000)). Any transfer scheme that outperforms the default option of zero contributions and zero benefits can result as a subgame perfect equilibrium.

The effect of aging is not clear a priori as multiple equilibria are possible. However, if an effect is predicted, the aforementioned median voter reasoning is applied with an older median voter leading to increased pension contributions and benefits. Galasso (2006) for example predicts a dramatic increase in pension spending. Galasso predicts that Spain will increase its spending on Social Security from 21.3% of wages to 45.5% in 2050 and the UK from 14.5% to 33.2%.

An alternative to higher benefits per retiree is that aging simultaneously increases contributions and decreases benefits. The 'burden of aging' is shared between working and retired generations. This is the main outcome of an alternative model by Breyer and Stolte (2001). They postulate that (near) retired generations form a majority, holding all political power. This does not lead to contributions of 100% because young generations respond to taxation by adjusting labor supply. The older generations effectively maximize a Laffer curve that gives total tax revenues as a function of the tax rate. Breyer and Stolte predict that aging leads to both higher contributions and lower individual benefits. This prediction of higher contributions but lower benefits also results in probability voting models. In these models the incumbent party maximizes

political support by maximizing the sum of utility of different cohorts, weighing utility proportional to cohort-size, see Gonzales-Eiras and Niepelt (2007) and the previous chapter. Probability voting models thereby take the position that larger cohorts have more influence but that minorities are not politically powerless. It also allows for the possibility that pension policy is not the only factor that voters consider in their voting decision.

Yet another view is given by Boldrin and Rustichini (2000) who propose that aging leads to the break-down of social security altogether. Aging makes PAYG less and less attractive and at one point working generations will stop contributing to social security. Key in their two-period OLG-model is that this moment of break-down is uncertain because future demographic developments are uncertain. Each generation has the choice to continue social security, facing ex-ante a positive probability but not the certainty that the next generation will do the same. The last contributing generation will lose ex post, because older generations are not compensated. In this approach aging leads to a definite breakdown of social security at an indefinite moment. As no social security system has been dismantled in an OECD-country, this prediction cannot be confirmed though it cannot be ruled out that this scenario awaits.

3.3 Data and econometric model

All data are retrieved from publicly available sources at the OECD, the World Bank and the Comparative Political Data Set. Table 1 provides descriptive statistics.

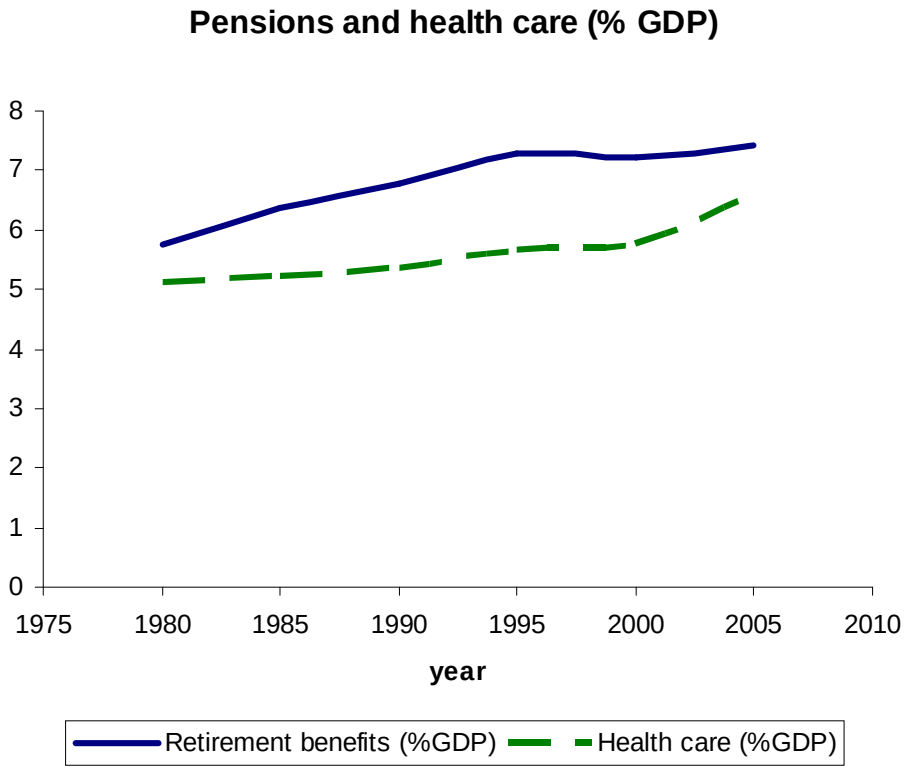
Table 1

	Mean	Standard dev.	Minimum	Maximum
Retirement spending / GDP	6.23	2.74	0.1	12.60
Benefit / retiree	10020.84	4808.92	312.20	26221.99
Health / GDP	5.57	1.07	3.13	8.24
Health / inhabitant	1350.38	536.06	308.57	4186.19
Median age	34.20	4.89	17.43	43.10
Dependency	21.81	5.38	7.58	32.55
Unemployment	6.72	3.78	0.18	18.76
GDP per capita	21310.02	8401.05	4865.44	59888.22
Union density	39.99	20.62	8.01	86.62
Interest rate	8.72	4.45	1.35	29.03
Government ideology	2.48	1.55	1	5
Minority government	0.16	0.37	0	1
Single party government	0.29	0.46	0	1

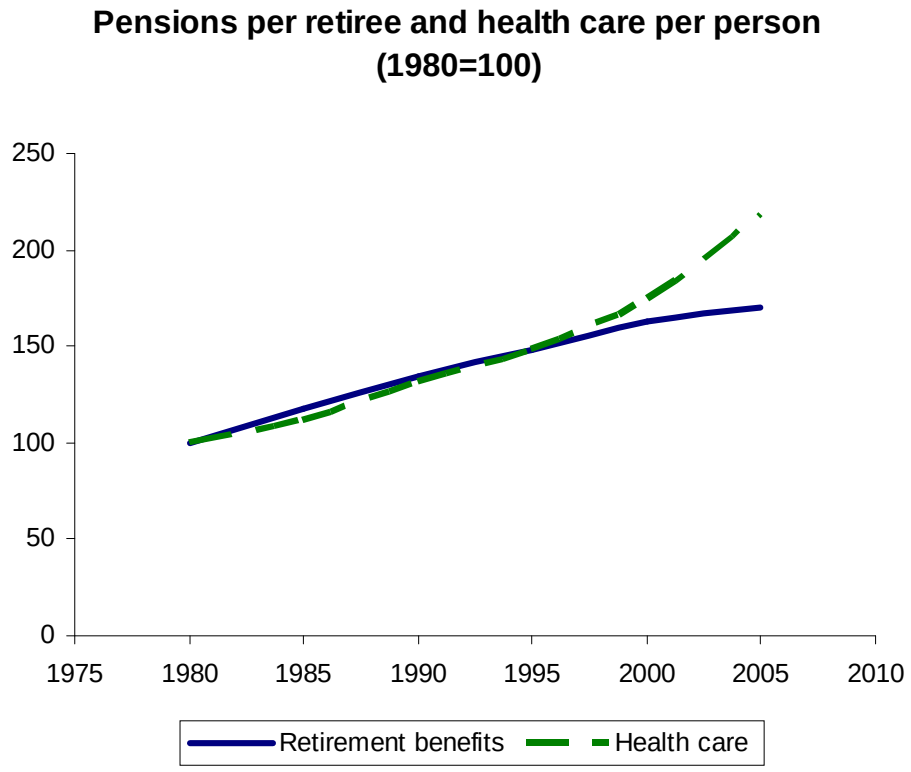
The median age of the electorate is proxied by the median age of the whole population, as reported by the World Bank. The latter does not coincide with the median age of the electorate which is the crucial factor in many theoretical models. This data limitation need not be restrictive as both median ages are driven by the same two factors, namely fertility rates and mortality rates. A second consideration is that the age of the median voter of the electorate anyway does not coincide with the median age of actual voters, since not everybody votes (and older voters tend to do so more).

In total four different dependent variables are considered. The first measure of retirement spending is total spending on retirements relative to GDP. This ranges between 0.1% and 12.1%. The following graph gives the average retirement spending relative to GDP for the 21 countries for which this figure is available each year.[2] The graph also gives health care spending as a share of GDP for the same countries.

[2]The enitre sample of 30 countries consists of Australia*, Austria*, Belgium*, Canada*, Czech Republic, Denmark*, Finland*, France*, Germany*, Greece*, Hungary, Ireland, Iceland*, Italy*, Japan*, Korea, Luxembourg*, Mexico, Netherlands*, New Zealand*, Norway*, Poland, Portugal, Slovak Republic, Spain*, Sweden*, Switzerland*, Turkey, United Kingdom*, United States*. For the 21 countries denoted * data are available for the entire period.



A second measure is benefits per retiree. This figure is derived by dividing total expenditure by the number of people older than 64. This is an approximation as it does not take account of differences in the retirement-age. The exact number of retirees in countries is however unavailable. The number of people over 64 is the best approximation available but it is a data limitation all the same. This indicator is also used in other analyses of the effects of aging. The next graph provides the development of individual benefits for the same 21 countries for which these numbers are available each year; 1980 is the baseline year, indexed 100. It also gives the development of health care costs per inhabitant.



The third variable is health care costs relative to GDP, while the fourth dependent variable is health care costs per inhabitant. Health care costs per retiree are not separately available and can thus not be considered. Meara et al. (2004) find for the USA that per person spending developed differently over time. In 1963-1987 spending per-person increased relatively faster for persons over 64 years; in 1987-2000 the costs for this age group declined compared with the age group of 35-44 years. For other countries cohort-specific health care spending is not available. The resulting limitation of using health care costs per inhabitant is acknowledged. However this need not be problematic as health care spending is difficult to target at a specific group. If retirees successfully plead for higher healthcare spending, this will thus lead to more health care available for all voters alike. Whether other age groups make use of increased health care possibilities is another issue.

The regressors can be grouped in economic and political control variables. Unemployment and the interest rate are economic control variables indicating the economic and financial circumstances of a country respectively. High unemployment arguably decreases the scope for social security while a high interest rate hinders debt-financing of retirement expenditure. The effect of GDP per capita is less straightforward. If pensions are indexed to GDP, GDP does not affect retirement spending relative to GDP. If this is not the case and benefits increase less than GDP, higher GDP is associated with lower retirement spending as a share of GDP. There may also be a political effect, when higher GDP makes it politically easier to redistribute; this would lead to higher pensions.

Political factors other than the age of the median voter are potentially important. The first factor considered is union density, ranging from 8% to 86%. A strong union may successfully press for higher benefits for their (former) members. A government of left-wing signature may likewise lead to higher benefits. The ideological signature of the government is indicated by the proportion of the government that is made up of left-wing parties. There were 59 governments that were exclusively made up of right-wing parties whereas 26 governments consisted solely of left-wing parties. Dummy variables are included for two relevant features of government composition. A first dummy indicates whether the government consists of a single party. Such a government may be either more effective in pushing through its own agenda or may shy away from policy changes, as blame cannot be shared with other parties. A second dummy indicates whether the government

is a minority government or not. A government without a majority in parliament is arguably less effective in pushing through its own preferred policy. Finally, time effects are considered by a dummy for each time period where the first time period (the year 1980) is the reference category.

The period 1980-2005 is chosen solely for practical considerations of data availability. Five-year intervals are considered, the reason being that pension reforms need time to be developed, discussed and implemented and reforms are thus not implemented yearly. A five-year period is chosen because that covers a political cycle in which one (or more) reform(s) can take place. There is also a practical reason to dismiss one-year intervals. The median age hardly changes one year to the next and estimation results would therefore not be robust.

The econometric model used is a panel data model with fixed effects, and the coefficients are estimated with the within-estimator. Pooled regression leads to an inconsistent estimator whenever time-invariant country-specific effects (like habit formation, geography, culture, path-dependent policies) correlate with covariates. Exactly the same holds for the random effects model. For non-experimental data fixed effects are thus more reasonable that the random effects. If the crucial assumption that fixed effects are uncorrelated with all regressors does hold, the fixed-effect estimator used here is still unbiased and consistent, but less efficient than the random effects estimator.

Sanz and Velazquez (2007) consider a dynamic model with a lagged endogenous variable as one of the covariates. A static approach is taken here instead. Lagged values of the median age are already considered below and there is no theoretical reason to assume that reforms take more than a period of five years to react to demographic changes. A more pragmatic motivation is that, with a dynamic specification, the observations of the first period could not be used, which means losing a substantial part of the observations. A dynamic specification is furthermore problematic because there are several missing values.

The base-line regression model is then given by the following equation:

$$y_{i,t} = \alpha + \beta_1 Medianage_{i,t} + \beta_2 Unempl_{i,t} + \beta_3 Interest_{i,t} + \beta_4 \ln(GDP\_cap)_{i,t} + \beta_5 Ideo\log ygov_{i,t} + \beta_6 Minoritygov_{i,t} + \beta_7 \mathrm{Si}\, nglepartygov_{i,t} + \sum_{j=1}^{5} \gamma_j I_{\{t=1980+5j\}} + \varepsilon_{i,t} \qquad i=1,2,..,30;\ t=1980,1985,..,2005$$

Here $y_{i,t}$ is one of the four dependent variables that were discussed. The period-dummies for 1985 until 2005 are given by indicator functions; the year 1980 is the reference category. For health care costs time effects can be interpreted as technological change that improves medical care but also increases medical spending.

In principle the data cover 30 countries over 6 periods, leading to potentially 180 observations. A considerable amount of observations are however missing, in particular from former Communist countries prior to 1990. The base-line model is estimated using 109 observations. This leads to an (unavoidable) loss in efficiency of the estimators. There is no reason to assume that the missing observations are correlated with the effect of interest here.

3.4 Results

The median age of the population does not significantly affect spending as a share of GDP, as Table 2 indicates. The estimated effect itself is positive and an increase of one year is associated with an increase of 0.13 percentage point of GDP. The R^2 equals 0.52; while this is reasonably high, not too much can be inferred from it. There is no statistical theory underlying R^2 and it increases when-ever more variables are included, irrespective of their relevance.

The median age negatively affects the size of benefits and this effect is significant; the associated t-statistic equals -3.36. The R^2 equals 0.81. This is again reasonably high but again not too much can be made of that. The regression shows no evidence for the claim of median voter models that an older median voter successfully presses for higher retirement spending. In fact, it shows quite the opposite.

Table 2

VARIABLES	Retirement spending/GDP	Benefits / retiree
Median age	0.134	-0.052***
	(0.113)	(0.015)
Unemployment	0.121**	0.008
	(0.049)	(0.007)
GDP per capita	-1.113	0.761***
	(1.329)	(0.182)
Union density	0.043**	0.007***
	(0.017)	(0.002)
Government ideology	-0.038	-0.007
	(0.069)	(0.009)
Minority government	-0.663**	-0.092**
	(0.294)	(0.040)
Single government	0.238	0.036
	(0.304)	(0.042)
Interest rate	0.010	0.004
	(0.057)	(0.008)
Year 1985	0.356	0.166***
	(0.385)	(0.053)
Year 1990	0.777	0.254***
	(0.531)	(0.073)
Year 1995	1.061	0.373***
	(0.754)	(0.103)
Year 2000	1.548	0.500***
	(0.941)	(0.129)
Year 2005	1.767	0.592***
	(1.127)	(0.154)
Constant	9.640	2.806
	(13.92)	(1.905)
Observations	109	109
R-squared	0.519	0.805
Number of countries	21	21

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The effect of other covariates varies. Union density is positively and significantly associated with both generosity of pensions and retirement spending relative to GDP. This indicates that strong unions can bargain for higher pensions for employees. The effect is quite substantial; the difference between no unions (so membership of 0%) and full unionization (100%) is five percentage points of GDP worth of pension spending.

Unemployment affects spending relative to GDP positively and significantly. It has to be noted that unemployment is potentially endogenous; this potential problem is addressed below by taking the lagged value of unemployment. A minority government spends less on retirement spending as a share of GDP whereas GDP per capita positively influences the size of retirement benefits. For the latter the coefficient of 0.76 is interesting; this indicates that if total production per inhabitant increases with 1%, benefits of retirees increases with 0.76%. Both regressions show a positive time trend in retirement spending -indicated by the coefficients of the time-dummies- though this is only significant for benefits per retiree.

Table 3 provides regressions with health care costs as the dependent variable. The effect of the median age on health care costs relative to GDP is positive yet insignificant. The same holds for health care costs per inhabitant. Considering the dependency ratio instead of the median age or considering both demographic variables together leads to the same conclusion.

Table 3.

VARIABLES	Health/GDP	Health/inhabitant	Health/GDP	Health/inhabitant
Median age	0.054	0.006		
	(0.076)	(0.014)		
Dependency ratio			0.003	-0.001
			(0.030)	(0.005)
Unemployment	-0.093***	-0.016***	-0.095***	-0.016***
	(0.033)	(0.006)	(0.033)	(0.006)
GDP per capita	-3.353***	0.381**	-3.346***	0.374**
	(0.892)	(0.160)	(0.933)	(0.167)
Union density	-0.024**	-0.005**	-0.024**	-0.005**
	(0.011)	(0.002)	(0.011)	(0.002)
Government ideology	-0.020	-0.004	-0.021	-0.004
	(0.047)	(0.008)	(0.047)	(0.008)
Minority government	-0.408**	-0.071**	-0.408**	-0.073**
	(0.197)	(0.035)	(0.203)	(0.036)
Single government	0.011	0.014	-0.006	0.011
	(0.204)	(0.037)	(0.204)	(0.037)
Interest rate	0.090**	0.018**	0.090**	0.018**
	(0.038)	(0.007)	(0.038)	(0.007)
Year 1985	0.513*	0.107**	0.591**	0.115***
	(0.258)	(0.046)	(0.235)	(0.042)
Year 1990	0.976***	0.197***	1.117***	0.214***
	(0.356)	(0.064)	(0.304)	(0.054)
Year 1995	1.817***	0.363***	2.022***	0.387***
	(0.506)	(0.091)	(0.423)	(0.076)
Year 2000	2.184***	0.447***	2.454***	0.480***
	(0.631)	(0.113)	(0.522)	(0.093)
Year 2005	3.269***	0.641***	3.605***	0.683***
	(0.756)	(0.136)	(0.613)	(0.110)
Constant	36.910***	3.000*	38.580***	3.273*
	(9.342)	(1.677)	(9.516)	(1.704)
Observations	109	109	109	109
R-squared	0.622	0.918	0.620	0.918
Number of countries	21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.5 Alternative specifications and robustness checks

The models estimated so far rest on several assumptions and operationalizations for which there are sensible and defensible alternatives. Therefore this section considers several alternatives for the baseline model to assess whether results are robust to changes in the model set-up. The results are given in the appendix.

The median age of the population increases over time and thus correlates with the time effects. The resulting multicollinearity increases standard errors and may obscure a significant effect. When the baseline regression is estimated without time dummies, the positive effect of median age on retirement spending

is indeed significant while the negative effect on benefits per retiree becomes insignificant. The positive relation between aging and retirement spending relative to GDP indicates that multicollinearity may have been present. As long as time effects are deemed relevant for explaining government spending they cannot be omitted in the baseline regression, however; omitting relevant variables leads to biased estimators.

Thus far the median age of the population has been used as the operationalization of aging. The median age is the crucial factor in the political-economic literature. There are however other notions of aging in the broader pension literature, in particular the dependency ratio. This ratio gives the number of retirees for each 100 persons of working age (15-64 year). This figure is prominent in many discussions as it gives the proportion between the elderly and the working people "supporting" them. The conclusions for this alternative operationalization of aging indeed differ substantially, as table 4 indicates. Now the demographic variable -here the dependency ratio- has a positive and significant effect on spending and an insignificant effect on generosity of benefits. This underlines that the median age and the dependency ratios are different entities. The latter is a better measure for the relative number of retirees, which explains why it is positively associated with pension spending. When more people are eligible for pension benefits, total retirement spending will automatically increase. In median voter models, the median age is the crucial political variable, as that captures the theorized political clout of elderly. To disentangle the two effects, both variables are jointly used as regressors. In this regression both variables have positive coefficients in both regressions, but only the effect of the dependency ratio on total spending (relative to GDP) is significant.

Policy changes may need some time to respond to the political influence exercised by the median voter. First a government is elected and installed and thereafter it usually takes a considerable time to design, implement and actually execute a reform. For that reason a lagged value of the median voter is considered. As can be seen, the sign of the estimated effects remains the same but now the effects in both regressions are insignificant. One reason is that using lagged values diminishes the number of observations; lagged values of the variables are not available for 1980. The number of observations decreases to 92, which may be too low to estimate fourteen parameters.

The baseline regression itself is estimated with 109 observations. When fewer regressors are used, more observations can be considered. When the omitted variables are relevant (as expected) this generally leads to biased estimates. The estimation results are thus flawed, but can be useful nonetheless as their standard errors are smaller due to the increased number of observations. Regressions with 155 observations but fewer covariates again lead to the same conclusions as the baseline regressions.

The base line regressions are also re-estimated using lagged values of unemployment instead of contemporaneous unemployment. This specification addresses the possible endogeneity of unemployment. Unemployment may not only affect pension spending but may itself also be influenced by it. Higher spending on pensions may lead to either higher employment (as spending boosts aggregate demand) or to lower employment (as higher taxes may discourage workers).

The overall conclusion is that aging does not lead to more generous pensions. If anything, it leads to lower pensions. In the baseline model aging also does not lead to higher spending relative to GDP. There is however a positive, significant effect when time effects are omitted or if the dependency ratio is considered as an alternative proxy for aging.

3.6 Discussion and conclusion

This chapter analyzed whether an older population and thus an older electorate leads to higher pension expenditure. Pension expenditure as a share of GDP is not significantly associated with an increase in the age of the median voter. Spending is positively and significantly associated with the dependency ratio. This is in line with expectations as more people are entitled to pension benefits (for which they contributed earlier in life). It is also in line with preferences of a majority of the population. Boeri et al. (2002) report that questionnaires in Italy and Germany indicate that a majority of citizens disapprove of pension-cutting reforms. Considering health care spending instead of retirement expenditure leads to similar conclusions.

The stronger claim that a greying electorate successfully pushes for more pension benefits per retiree, predicted by median voter models, is not supported. If anything, the opposite is the case; aging leads to

less generous pension benefits. These results challenge the prominent role attributed to the median voter in both explaining and predicting welfare state changes. The median voter model does not seem to fully capture what determines pension benefits.

Apparently other factors, offsetting the increased potential political clout of retirees, are important. Two approaches that can explain rising total expenditure and decreasing generosity are probability voting and endogenous labor supply. The results also indicate that the role of unions have a significant effect on political outcomes. Other potential factors include lobbying of insurance companies and the lack of commitment of government parties. As will be discussed in Chapter 6, many reforms are carried through between elections with little regard for party programs or the preferences of the majority of voters. This study cannot discriminate between the alternative explanations for the development of pension expenditure, but the empirical findings of this chapter suggests that ignoring these factors leads to an incomplete discussion about the sustainability of public finance.

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3.7 Appendix

Table 4: Retirement spending.

VARIABLES	%GDP	per retiree	%GDP	per retiree	%GDP	per retiree
Median age	0.258***	-0.013			0.217*	0.022
	(0.082)	(0.012)			(0.117)	(0.017)
Unemployment	0.151***	0.021***	0.108**	0.010	0.061	0.0022
	(0.036)	(0.005)	(0.043)	(0.007)	(0.073)	(0.011)
GDP per capita	0.152	1.174***	0.568	0.737***	-0.697	0.834***
	(1.037)	(0.153)	(1.206)	(0.203)	(1.385)	(0.200)
Union density	0.039**	0.005**	0.036**	0.007***	-0.014	-0.002
	(0.016)	(0.002)	(0.015)	(0.003)	(0.010)	(0.002)
Government ideology	-0.026	-0.003	-0.060	-0.006	0.284**	0.042**
	(0.067)	(0.010)	(0.061)	(0.010)	(0.130)	(0.019)
Minority government	-0.672**	-0.103**	-0.372	-0.095**	-0.365	-0.058
	(0.284)	(0.0418)	(0.263)	(0.044)	(0.467)	(0.067)
Single government	0.314	0.059	0.295	0.051	-0.887**	-0.116**
	(0.293)	(0.043)	(0.263)	(0.044)	(0.400)	(0.058)
Interest rate	-0.018	-0.005	0.013	0.004	0.072	0.015
	(0.047)	(0.007)	(0.050)	(0.008)	(0.104)	(0.015)
Median age (lag)						
Dependency ratio			0.200***	-0.005	0.306***	0.015
			(0.039)	(0.007)	(0.075)	(0.011)
Unemployment (lag)						
Year 1985			0.461	0.092*	0.040	0.022
			(0.304)	(0.051)	(0.702)	(0.101)
Year 1990			0.573	0.126*	-0.209	-0.032
			(0.393)	(0.066)	(0.756)	(0.109)
Year 1995			0.860	0.186**	-0.135	-0.005
			(0.548)	(0.092)	(0.932)	(0.135)
Year 2000			1.075	0.256**	-0.389	-0.041
			(0.674)	(0.113)	(1.057)	(0.153)
Year 2005			1.158	0.287**	-0.305	-0.024
			(0.793)	(0.133)	(1.193)	(0.172)
Constant	-6.429	-2.371*	-6.689	1.437	-1.858	-0.378
	(9.453)	(1.392)	(12.310)	(2.067)	(14.020)	(2.023)
Observations	109	109	109	109	109	109
R-squared	0.499	0.765	0.635	0.778	0.527	0.512
Number of countries	21	21	21	21	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.(continued)

	%GDP	per retiree	%GDP	per retiree	%GDP	per retiree
Median age			0.217**	-0.011	0.115	-0.051***
			(0.105)	(0.019)	(0.113)	(0.015)
Unemployment	0.096*	0.013	0.148***	0.0170**		
	(0.057)	(0.008)	(0.041)	(0.007)		
GDP per capita	-0.865	0.855***	-0.630	1.067***	-2.910**	0.608***
	(1.665)	(0.242)	(1.042)	(0.186)	(1.129)	(0.149)
Union density	0.042*	0.004			0.053***	0.007***
	(0.024)	(0.004)			(0.017)	(0.002)
Government ideology	-0.047	0.005			-0.027	-0.005
	(0.080)	(0.012)			(0.069)	(0.009)
Minority government	-0.498	-0.095*			-0.577*	-0.087**
	(0.329)	(0.048)			(0.297)	(0.039)
Single government	-0.034	0.037			0.088	0.030
	(0.375)	(0.055)			(0.307)	(0.041)
Interest rate	0.0138	0.005			0.0134	0.001
	(0.074)	(0.011)			(0.059)	(0.008)
Median age (lag)	0.017	-0.004				
	(0.026)	(0.004)				
Dependency ratio						
Unemployment (lag)					0.022	-0.005
					(0.039)	(0.005)
Year 1985			-0.006	0.045	0.729**	0.214***
			(0.348)	(0.062)	(0.352)	(0.046)
Year 1990	0.517*	0.014	0.459	0.078	1.222**	0.321***
	(0.304)	(0.044)	(0.454)	(0.081)	(0.512)	(0.068)
Year 1995	1.027**	0.0516	0.459	0.103	1.983***	0.459***
	(0.493)	(0.072)	(0.605)	(0.108)	(0.608)	(0.080)
Year 2000	1.500**	0.105	0.557	0.095	2.410***	0.596***
	(0.686)	(0.010)	(0.783)	(0.140)	(0.841)	(0.111)
Year 2005	1.845**	0.132	0.555	0.115	2.889***	0.682***
	(0.851)	(0.124)	(0.957)	(0.171)	(0.972)	(0.128)
Constant	11.830	0.473	3.579	-1.318	28.100**	4.335***
	(16.880)	(2.457)	(10.630)	(1.901)	(11.830)	(1.562)
Observations	92	92	155	155	112	112
R-squared	0.423	0.706	0.441	0.702	0.483	0.812
Number of countries	21	21	30	30	21	21

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Chapter 4

Demographic composition and risk of pension funds

4.1 Introduction

[1] The aim of this chapter is to assess whether Dutch pension funds' strategic investment policies depend on the age of their participants. A pension fund's strategic investment policy reflects its objectives, while the actual asset allocation may depart from the objective as a result of asset price shocks, since pension funds do not continuously rebalance their portfolios (Bikker, Broeders and De Dreu, 2010). This study focuses on the strategic allocation of equities and bonds as representing, respectively, risky and safe assets. The argument for age-dependent equity allocation stems from optimal life-cycle saving and investing models (e.g. Bodie et al., 1992; Campbell and Viceira, 2002; Cocco et al., 2005). An important outcome of these models is that the proportion of financial assets invested in equity should decrease over the life-cycle, thereby increasing the proportion of the relatively safer bonds. The key argument is that young workers have more human capital than older workers. Assuming no or low correlation between labour income and stock market returns, a young worker may better diversify equity risk with its large holding of human capital. Benzoni et al. [2007] however postulate that in the long-run wages and capital return are cointegrated. Therefore young workers need to take less, not more equity risk. This paper does not take a position in this theoretical debate, but instead assesses whether Dutch pension funds have an age-dependent asset allocation and if so, in what way.

For pension funds' strategic asset allocation in 2007, it is found that a rise in participants' average age reduces equity holdings significantly. A (cross-sectional) increase of active participants' average age by one year leads to a significant and robust drop in strategic equity exposure by around 0.5 percentage point. It is also found that the equity-age relationship is stronger for active participants than for retired and deferred participants.[2] This is in line with the basic version of the life-cycle model where retirees should hold a constant fraction of their wealth in equity, as they no longer possess any human capital. Other factors that influence equity exposure positively and significantly include pension fund size, funding ratio, and participants' average pension wealth. Pension plan type and pension fund type, however, do not have significant impact.

The negative equity-age relationship has been found in other studies as well. For pension funds in Finland, Alestalo and Puttonen (2006) report that a one-year average age increase reduced equity exposure in 2000 by as much as 1.7 percentage points. Likewise, for Switzerland in 2000 and 2002, Gerber and Weber (2007) report a negative relation between equity exposure and both short-term liabilities and age. The effect they find is smaller yet significant, as equity decreases by 0.18 percentage point if the average active

[1] This chapter is a slightly revised version of Bikker, J. A., D.W. Broeders, D.A. Hollanders and E.P. Ponds-Pension funds' asset allocation and participant age: a test of the life cycle model (*Journal of Risk and Insurance* (2011)). This chapter was partly written as a visiting researcher at the Dutch Central Bank (DNB).

[2] Deferred participants are former members who are entitled to future benefits, but who are no longer in the service of the employer.

participant's age increases by one year. For the US, Lucas and Zeldes (2009) did not observe a significant relationship between the equity share in pension assets and the relative share of active participants.

The set-up of this chapter is as follows. Section 2 discusses the theoretical relationship between the participant's age and equity investments, originating from the life-cycle saving and investing model. Section 3 describes pension funds in the Netherlands. Section 4 investigates the age-dependency of asset allocation empirically using a unique dataset of 472 Dutch pension funds at end-2007. The next section presents a number of variants of the model, which act as robustness tests. Section 6 concludes.

4.2 Life-cycle saving and investing

In the late 1960s Samuelson (1969) and Merton (1969) proposed that individuals should optimally maintain constant portfolio weights throughout their lives. A restrictive assumption of these models is that investors have no labour income (human capital). This assumption is clearly counterfactual. If labour income is included in the portfolio choice model, the optimal allocation of financial wealth of individuals changes over their life cycle (for an overview, see Bovenberg et al., 2007).

The basic version of the life-cycle model with risk-free human capital, see Campbell and Viceira (2002), can be summarized by the following equation for the optimal fraction of stock investment, denoted by w:

$$w = \frac{H+F}{F}\frac{\mu - R^f}{\gamma\sigma^2}$$

Here H denotes human capital, that is, the total of current and discounted future wages, of an individual, and F is the person's current financial capital. The risk-premium of the stock market is given by $\mu - R^f$, while γ and σ^2 denote, respectively, the individual's constant relative risk aversion and the variance of stock market returns. The optimal allocation to risky assets depends on total wealth, being the sum of financial wealth and human capital. As can be seen from the equation, more human capital leads to higher optimal investment in stocks. Furthermore, it follows that retirees should invest a constant fraction of their financial wealth in equities, as their human capital is depleted. Teulings and De Vries (2006) calculate that young workers should even go short in bonds equal to no less than 5.5 times their annual salary in order to invest in stock. The negative age-dependency of asset holdings corresponds to the rule of thumb that an individual should invest (100 – age) % in stocks (see Malkiel, 2007).

The negative relationship between age and equity exposure in the portfolio is usually derived under the assumption that human capital is close to risk-free, or at least is not correlated with capital return. Benzoni et al. (2007) put forward that the short run correlation is low indeed, while in the longer run, labour income and capital income are co-integrated, since the shares of wages and profits in national income are fairly constant. This finding implies that the risk profile of young workers' labour income is equity-like and that they should therefore hold their financial wealth in the form of safe bonds to offset the high risk exposure in their human capital. For that reason, Benzoni et al. (2007) suggest that the optimal equity share in financial assets is hump-shaped over the life cycle: co-integration between human capital and stock returns dominates in the first part of working life, whereas the decline in human capital accounts for the negative age-dependency of optimal equity holdings later in life.

This study focuses on the investment behaviour of pension funds. One may ask whether the pension fund should be responsible for optimal age-dependent equity allocation, as participants may adjust their privately held investments so that their total assets, including those managed by the pension fund, reflect their optimal allocation. There are four arguments in favour of optimal investment behaviour by the pension fund on behalf of its participants. First, not all participants have privately held assets permitting the required adjustment where the pension fund is suboptimal. Second, most participants of course have neither sufficient financial literacy nor the willingness to carry out such an adjustment (Lusardi and Mitchell, 2007; Van Rooij, 2008). For these reasons, most pension plans take care of investment decisions, often by default. Third, insurance companies are a very cost-inefficient alternative for private offsetting of pension funds' suboptimal

investment behaviour (Bikker and De Dreu, 2007). And fourth, pension funds are able to broaden the risk-bearing basis by distributing risk across generations. This option is not available to individuals.

4.3 Description of Dutch pension funds

As in most developed countries, the institutional structure of the pension system in the Netherlands is organized as a three-pillar system. The first pillar comprises the public pension scheme financed on a pay-as-you-go base. It offers a basic flat-rate pension to all retirees (if they were a resident in the Netherlands). The benefit level is linked to the statutory minimum wage. The second pillar is that of fully funded 'supplementary' pension schemes managed by pension funds. The third pillar comprises personal savings, which individuals undertake on their own initiative. Personal savings are generally tax-deductible, which has arguably led to oversaving. The Dutch pension system is fairly unique in that it combines a state run pay-as-you-go scheme in the first pillar with funded occupational plans in the second pillar. The first pillar implies that young individuals cede part of their human capital to older generations in exchange for a claim on part of the human capital of future generations. Given the life-cycle hypothesis, this type of intergenerational risk sharing reinforces the preference of younger people to invest in equity (Heeringa, 2008).

The supplementary or occupational pension system in the Netherlands is organized mainly in the form of funded defined-benefit (DB) plans. The benefit entitlement is determined by years of service and a reference wage, which may be final pay or the average wage over the years of service. Most Dutch pension plans are based on average wage. Because corporate sponsors have no legal obligation to cover any shortfall in the pension funds, the residual risk is borne by the participants themselves. This type of plan may also be labelled as hybrid, having characteristics of both defined benefit and defined contribution plans. It is partly DB by nature in that the yearly accrual of pension rights is specified in the same way as in a traditional DB plan, and partly DC because the yearly indexation is linked to the financial position of the fund and therefore related to the investment returns (Ponds and Van Riel, 2009).[3]

The defined-benefit formula takes the public scheme into account. The DB pension funds exhibit some intergenerational risk sharing (Ponds and Van Riel, 2009). Shock-induced peaks and troughs in the funding ratio are smoothed over time, thanks to the long-term nature of pension funds. Pension funds typically adjust contributions and indexation of accrued benefits as instruments to restore the funding ratio. Whereas higher contributions weigh on active participants, lower indexation hurts older participants most.[4] The less flexible these instruments are, the longer it takes to adjust the funding level, and the more strongly will shocks be shared with future (active) participants. Intergenerational risk sharing extends the risk bearing basis in terms of human capital. Gollier (2008] proposes that intergenerational risk sharing within pension funds should lead to more risk taking by pension funds compared to individual pension plans. Thus Dutch pension funds, with their partial reliance on intergenerational risk sharing, may be expected to invest relatively heavily in risky assets.

There are three types of pension funds in the Netherlands. The first is the industry-wide pension fund, organized for a specific sector of industry (e.g. construction, health care, transport). Participation in an industry-wide pension fund is mandatory for all firms operating in the sector. A corporate can opt out only if it establishes a corporate pension fund that offers a better pension plan to its employees than the industry-wide fund. Where a supplementary scheme exists, either as a corporate pension fund or as an industry-wide pension fund, participation by workers is mandatory and governed by collective labour agreements. The third type of pension fund is the professional group pension fund, organized for a specific group of professionals such as physicians or notaries.

[3] In recent years a few corporate pension plans where designed as Collective DC plans in which the pension promise is still based on average wage but where the contribution rate is fixed for an extended, typically a five year, period. Although employers can treat such schemes as DC for accounting purposes, from a legal and therefore regulatory point of view they are treated as DB schemes. Our data do not allow the distinction between DB and CDC plans.

[4] In an average wage defined benefit scheme, the accrued pension rights of the active members are often also subject to conditional indexation.

Table 1. Pension funds in the Netherlands (end-2007)

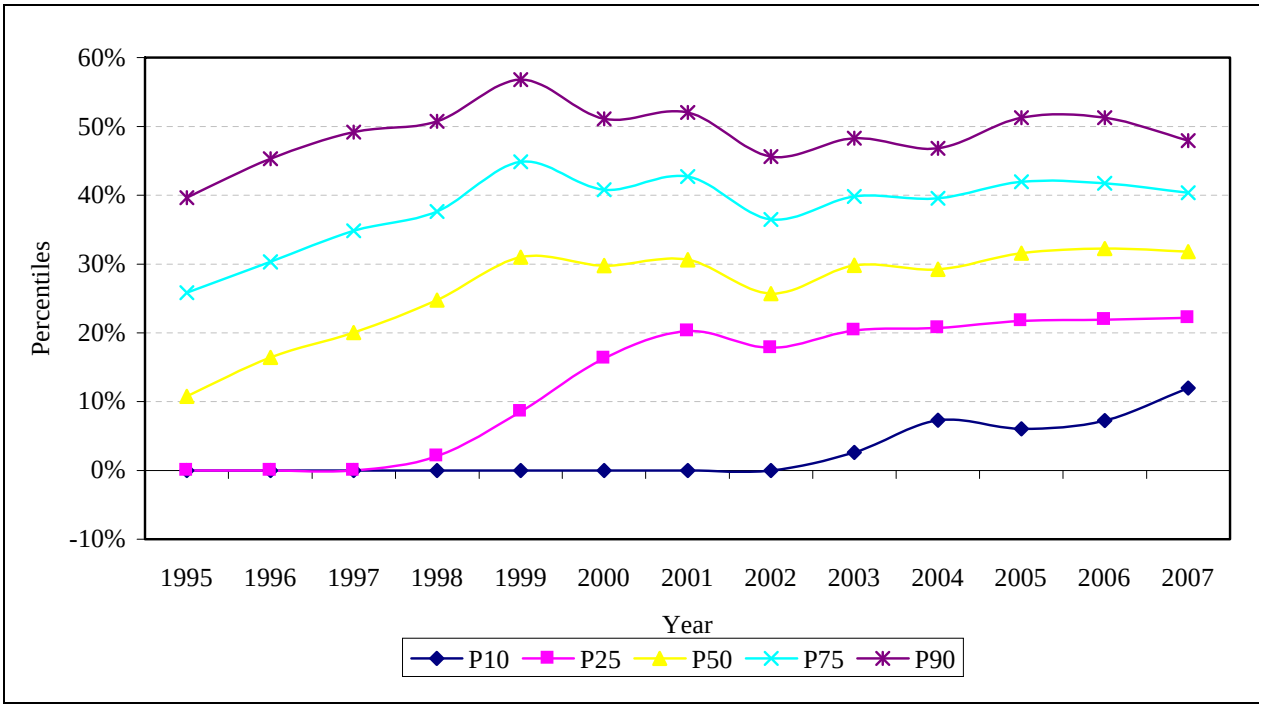
	# funds	Assets	Active members	DB^a	DC^a
	In %				
Corporate pension funds	85	27	12	90	10
Industry-wide pension funds	13	71	87	96	4
Professional group funds	2	3	1	83	17
	In absolute numbers				
Total	713	E 690 bln	5,559,677		

Source: De Nederlandsche Bank (DNB). [a]Figures as per begin-2006.

The Dutch pension fund system is massive, covering 94% of the active labour force. But whereas all employees are covered, the self-employed need to arrange their own retirement plans. As reported by Table 1, the value of assets under management at the end of 2007 amounted to € 690 billion, or 120% of Dutch gross domestic product (GDP). More than 85% of all pension funds are of the corporate pension fund type. Of the remaining 15%, most are industry-wide funds, besides a small number of professional group funds. The circa 95 industry-wide pension funds are the dominant players, both in terms of their relative share in total active participants (> 85%) and in terms of assets under management (> 70%). Almost 600 corporate pension funds encompass over a quarter of the remaining assets, serving 12% of plan participants. Professional group pension funds are small.

In the post-WW2 period, pension plans in the Netherlands were typically structured as final-pay defined benefit plans with (de facto) unconditional indexation. After the turn of the century, pension funds in the Netherlands, the US and the UK suffered a fall in funding ratios. In order to improve their solvency risk management, many pension funds switched from the final-pay plan structure to average-pay plans with conditional indexation. In many cases, indexation is ruled by a so-called policy ladder, with indexation and contribution tied one-to-one to the funding ratio (Ponds and Van Riel, 2009). Under an average-pay plan, a pension fund is able to control its solvency position by changing the indexation rate.

Graph 1 documents that Dutch pension funds increased their exposure to equities over time. Between 1995 and 2007 the median equity exposure tripled from 10.8% to 31.8%. This increase over time is a combined effect of more pension funds choosing a positive equity exposure (see P10 and P25 indicating, respectively, the 10th and 25th percentile), and pension funds increasing their exposure.



4.4 Empirical results

The dataset provides information on pension fund investments and other characteristics for the year 2007. The figures are taken from supervisory reports to De Nederlandsche Bank, the pension funds' prudential supervisor. Pension funds in the process of liquidation – that is, about to merge with another pension fund or to reinsure their liabilities with an insurer – are exempt from reporting to DNB. The original dataset covers 569 (reporting) pension funds, of which 472 (or 83%) invest on behalf of the pension fund beneficiaries, while the remainder are fully reinsured and do not control the investments themselves. Nineteen pension funds do not report the average age of their participants and 54 do not report their strategic asset allocation. Three pension funds with funding ratios above 250% were disregarded. These are typically special vehicles designed to shelter savings from taxes and therefore not representative of the pension fund population that is of interest here. Another three pension funds with assets worth over one million euros per participant were excluded for the same reason, as these are typically special funds serving a small number of company board members. These funds, as well as fifteen others for which one or more explanatory model variables were unavailable, were omitted from the regressions, so that the analysis is based on the remaining 378 pension funds, including all large pension funds.

Table 2 presents descriptive statistics of the dataset, with age and strategic equity allocation as key variables. One possible age measure is the average age of all participants in a pension fund (including active, deferred participants and retirees). This equals 50, ranging widely across pension funds between 35 and 79. An alternative operationalization of age is the average age of active participants, which equals 45, varying across pension funds from 35 to 63. The proportion between retired and deferred participants also varies strongly across pension funds. The share of equity in fund's strategic asset allocation averages 32.9%, but ranges from 0% to 91%. Actual equity allocation differs from the strategic asset allocation due to free-floating (meaning that asset allocation is not constantly rebalanced after stock-price changes), and averages 33.2%. Furthermore, Table 2 presents statistics on other pension fund characteristics, many of which act as control variables in the regression (see below). The 10% and 90% percentiles show that these characteristics tend to vary strongly. In the analysis a distinction is made between the age of active and the age of total participants.

Table 2. Descriptive statistics of our dataset including 378 pension funds[a]

Variable	Mean	Median	Other percentiles	
			10%	90%
Average age of active participants	45.2	44.6	39.9	50.1
Average age of all participants	50.2	49.7	41.7	59.6
Strategic equity exposure (% investments)	32.9	33.0	16.4	46.4
Actual equity allocation (in %)	33.2	33.6	17.6	46.9
Average assets of participants (Euro 1,000)	81.2	58.4	11.7	155.4
Share of retired (in %)	20.9	17.4	4.0	41.5
Share of deferred participants (in %)	42.3	40.8	23.3	65.7
Share of active participants (in %)	36.8	36.5	15.3	59.8
Funding ratio (in %)	139.4	135.4	120.2	163.9
Total assets (in million Euro)	1,791	150	20.3	2,153
Total number of participants (thousands)	42.3	2.5	0.4	43.3
Defined benefit schemes (in %)	0.97	1	1	1
Defined contribution schemes (in %)	0.03	0	0	0
Industry-wide pension funds (in %)	0.20	0	0	1
Corporate pension funds (in %)	0.78	1	0	1
Professional group pension funds (in %)	0.02	0	0	0

[a]The minimum number of pension funds included

Source: DNB calculations.

Average age of active participants

Most life-cycle theories suggest that the relationship between average age and equity allocation is negative (Equation (1); see also Malkiel, 2007), while others postulate a hump-shaped relationship (Benzoni et al.,

2007). Lucas and Zeldes (2009) investigate a relationship between the share of active participants and the equity allocation, also assuming a non-linear age pattern: a (constant) effect during the active years and zero during the retirement years. Gerber and Weber (2007) regarded two indicators of average age: age of all participants and age of active participants, where the latter implies a non-linear functional form of average age, due to the truncation at retirement age. Instead of choosing one of the various specifications found in the literature, the theoretical life-cycle model expressed in Equation (1) is followed: equity investment declining with the age of participants during their active years and remaining constant after retirement. In Dutch regulation deferred participants are treated equal to retirees. Therefore it is fair to assume a constant equity exposure. The baseline regression model reads:

$$Strategic\_Asset\_Allocation_i = \alpha + \beta_1 Age\_Active_i + \beta_2 Share\_retired_i + \beta_3 Share\_deferred_i + \beta_4 \log(size)_i + \beta_5 funding\_ratio_i + \beta_6 DB_i + \beta_7 PGPF_i + \beta_8 IPF + u_i$$

where i represents the pension fund and age active stands for the average age of each pension fund's active participants. Percentages of both retired and deferred participants (denoted by, respectively, share retired and share deferred) incorporate the (different) constant effect of each group on the equity allocation.

A control variable size is included as larger pension funds tend to invest more in equity (Bikker and De Dreu, 2009; De Dreu and Bikker, 2009). The pension fund's size is defined as its total number of participants, where logarithms of size are taken to reduce possible heteroskedasticity. The funding ratio is a determinant of equity allocation as a higher funding ratio provides a larger buffer against equity risk and thus may encourage risk taking. A higher risk margin for equity is required under the Dutch supervisory regime (Bikker and Vlaar, 2007). On the other hand, a high buffer ensures that all liabilities can be met, reducing or even eliminating the need to take further risks if meeting liabilities is the objective of the fund.

Note that – unlike the actual equity allocation – strategic equity allocation is not affected directly by price shocks, although gradually, over time, it may be influenced somewhat by trends in the stock market (Bikker, Broeders and De Dreu, 2010). A set of dummy variables reflects different types of pension plan (DB versus DC) or pension fund (professional group pension funds (PGPF) and industry-wide pension funds (IPF) versus corporate pension funds).[5]

The left-hand panel of Table 3 presents the estimation results of Equation (2), based on the average age of active participants. A one-year increase in the average age of active participants is associated with a drop in equity exposure of around 0.4 percentage point (first column in Table 3).[6] Unweighted estimation attaches equal informational value to each observation of a pension fund, irrespective of whether it has ten participants or 2.5 million. By contrast, a regression weighting each pension funds proportionally according to its size (measured by numbers of participants), assigns equal importance to each participant. The negative coefficient of age increases to 0.5 in the weighted regression case, while its statistical significance rises sharply. This result confirms the negative relationship between age and risky, while it rejects the '100-age' rule of thumb, as the estimate of -0.5 is significantly lower (in absolute terms) than -1. Results are similar in direction but not in size to the findings of Gerber and Weber (2007, for Switzerland) and Alestalo and Puttonen (2006, for Finland), who find 'active-age' coefficients of, respectively, -0.18% and -1.73%.

[5] Willingness of the sponsor company to compensate investment losses could be a relevant explanatory variable also. In practice however, we hardly observe this willingness, except for a few corporate pension funds. Industry wide pension funds service multiple corporations and it is unlikely that losses can be fairly distributed amongst those corporations.

[6] The Goldfeld-Quandt test indicates that the model's heteroskedasticity does not increase with pension fund size.

Table 3. Impact of the average age of active participants on the strategic equity allocation

	Equation (2)				Incl. 'personal wealth'			
	Unweighted		Weighted		Unweighted		Weighted	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Average age act. members	-0.39	-2.50	-0.51	-5.54	-0.44	-2.88	-0.56	-6.20
Share retired participants	0.09	1.91	-0.06	-1.33	0.04	0.89	-0.12	-2.60
Share deferred participants	0.03	0.71	-0.25	-9.68	0.09	2.09	-0.17	-4.73
# participants (logs)	1.07	2.74	0.94	3.57	1.07	2.79	0.78	2.98
Funding ratio	0.20	6.86	0.28	9.51	0.20	6.89	0.27	9.46
Personal wealth (in logs)					4.03	5.21	2.23	3.74
Dummy DB plan	1.62	0.45	6.51	1.35	0.37	0.10	6.00	1.27
Dummy Professional fund	1.68	0.41	-1.17	-0.22	0.56	0.14	-0.95	-0.18
Dummy Industry-wide fund	-4.14	-2.09	-0.74	-0.51	0.37	0.18	0.89	0.60
Constant	9.30	0.96	15.71	1.89	-5.02	-0.51	9.48	1.13
R^2, adjusted	0.16		0.50		0.21		0.52	
Number of observations	380		380		378		378	

In Equation (2), the coefficient of retirees is not significant. Only in the weighted regression case there is a small but statistically significant reduction of the equity share for pension funds having relatively many deferred participants. One percentage point more retirees implies a 0.25 percentage point reduction in equity allocation. The absence of this effect in the unweighted regression suggests that only the larger pension funds take the optimal equity allocation associated with deferred participants into account. This is confirmed when -as a robustness test- the two largest pension funds (30% of all participants) are dropped: the two dependency ratios drop to near or total insignificance (results not shown here). Remarkably, in that case, the absolute value of the age effect increases further to 0.66.

Turning to the other determinants of the equity allocation in Table 3, one can observe that the effect of (the logarithm of) size is positive and sizeable (with values around 1) which confirms with the stylized fact that large pension funds invest more in equity. The marginal effect of size – number of participants – on equity exposure is itself dependent on size, due to its logarithmic specification. An increase in the number of participants from 10 thousand to 100 thousand is associated with an increase of equity allocation by 2.5 percentage points. The reason may be that the largest pension funds are 'too big to fail' (major problems cannot be ignored by the government) which leads to moral hazard. The measure of size is the total number of participants. The variable total assets would be an alternative size measure but a drawback of total assets might be that this measure cannot safely be regarded as exogenous, because high equity returns would – for pension funds with a high equity allocation – enlarge both their size and their equity exposure. This is the more important given that pension funds do not continuously rebalance their asset portfolios, see Bikker, Broeders and De Dreu (2010). As a robustness check, the number of participants is replaced by total assets as the size measure. The size coefficient does not change much, and remains significant (see Table A.1 in Appendix I).

Pension funds with higher funding ratios invest more in equity. This is somewhat supported by regulation, which requires that the probability of underfunding is smaller than 2.5% on a one year horizon, see Broeders and Pröpper (2010). This permits better funded pension funds to take more risks. The coefficient of around 0.25 implies that an increase of the funding ratio by 1% translates into an increase of the equity allocation by one quarter percentage point. Note that the funding ratio does not suffer from endogeneity problems, as the dependent variable is strategic – not actual – equity allocation. Indeed, the actual equity exposure would be affected, as high stock returns simultaneously increase both the funding ratio and the equity allocation (at least under 'free-floating'). Because the strategic equity allocation may nevertheless have been adjusted to stock market developments, a lagged value of the funding ratio (that is, 2006 figures) is considered in the robustness analyses, see Section 5. As expected, the results hardly change. The dummy variables for pension plan type or pension fund category do not have significant coefficients, except the dummy indicating industry-wide pension funds, which points to less equity holdings. Over time, the distinction between DB and DC pension plans is increasingly blurring, as DB plans often show also some characteristics of DC plans (see Section 3). Furthermore, the number of DC plans is at 10% quite low while strong a priori assumptions about equity allocation across plan types are absent.

The goodness of fit of basic equation (2), measured by the adjusted R^2, rises from 0.16 for the unweighted model to 0.50 for the weighted specification. However not too much can be made of that, as weighting generally leads to a higher R^2 since the regression is estimated as if more observations have exactly the same relation.

In order to take the possible impact of changes in risk aversion into account, the average pension wealth of the participants in a pension fund is added to the equity allocation model as an extra explanatory variable. This variable is defined as total pension fund wealth per participant and reflects both the average (intended) level of the pension benefits[7] and the pension plan's maturity. It is assumed that a similar average duration of a participant's relationship with their pension fund across all pension funds, the duration being the sum of the endured employment contract and the endured retirement period, so that wealth reflects the (intended) level of a participant's pension benefits. Again logarithms of this variable are taken to reduce possible heteroskedasticity.

The results are presented in the right-hand panel of Table 3. The coefficient of (the logarithm of) personal pension wealth is statistically significant and varies from 4 (unweighted) to 2.2 (weighted). The marginal effect of an increase in personal wealth depends on its level, due to the logarithmic specification. Starting from the average value of 81 thousand, an increase by one standard deviation of 78 thousand is associated with an increase of equity allocation by 1.5 percentage points. These results indicate that pension funds with higher wealth per participant invest relatively more in equity, thereby accepting more risk. The active participants' age effect is slightly stronger in this specification than in the model without the wealth variable. Notably, the share of retirees now also has a significant impact on the equity allocation. For retirees, pension funds invest relatively less in equity and the same holds for deferred participants. The coefficients of size and funding ratio do not change after inclusion of the wealth variable. None of the dummy variables for pension plan type or pension fund category have statistically significant coefficients. Apparently, no systematic differences remain across types of pension plan or pension fund after the incorporated model variables have been taken into account. In fact, the alternative model including the wealth variable has a slightly better goodness of fit than equation (2).

Average age of all participants

So far, it was assumed that the average age of active participants is the key variable in explaining the equity allocation ratio and that, as retirees no longer possess any human capital anymore, they hold a constant fraction of their financial wealth in equities. An alternative specification of the model involves equal treatment of all participant categories, where the impact of age on equity allocation is concerned. This model has been used by Malkiel (2007) and Gerber and Weber (2007). Therefore, the three age-related variables in Equation (2) are replaced by one average age of all participants ('age total'), resulting in:

$$Strategic\_Asset\_Allocation_i = \alpha + \beta_1 Age\_Total_i + \beta_2 \log(size)_i + \beta_3 funding\_ratio_i + \beta_4 DB_i + \beta_5 PGPF_i + \beta_6 IPF + u_i$$

Table 4 reports the estimation results of Equation (3). The age coefficient of the average age of all participants is now insignificant for both the unweighted and the weighted regressions (left-hand panel). If personal wealth is added to Equation (3), the age coefficient becomes significant with a value of -0.17 and -0.38 respectively for the unweighted and the weighted regression (right-hand panel). The all participants' average age plays a role but with smaller (negative) magnitudes and lower levels of significance than the active participants' average age in Table 3. All these outcomes point to a limited role for the all participants' average age compared to the active participants' average age. The results suggests that the age of active participants is taken into account, while retirees contribute to the equity allocation with a constant, age-independent share of equities, each of which is in line with the life-cycle hypothesis.

Other model coefficients are roughly in line with what was observed before. The results of Table 3 are taken as the most convincing for three reasons. First, from an economic point of view, Equation (2) reflects a richer specification of the age-equity relationship, in line with the life-cycle hypothesis. Second, if the average ages of both all participants and active participants are included in the models of Tables 3 and 4, the coefficient of active age is larger than that of total age in all eight cases (in absolute terms),

[7] The average intended level of the pension benefits is proportionally to the product of the participant's average salary level and its replacement rate.

the coefficient of active age is significantly negative in all eight cases (as expected), and the coefficient of total age is never significantly negative. Third, formal testing of Tables 3 and 4 against a general model encompassing both Equations (2) and (3) provides evidence in favour of Table 3 (that is, Equation (2)), see Appendix II.[8] Therefore, Equation (3) is considered the most relevant estimates.

Table 4. Impact of average age of all participants on strategic equity allocation

	Equation (3)				Idem, including 'personal wealth'			
	Unweighted		Weighted		Unweighted		Weighted	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Average age all members	-0.04	-0.48	0.07	0.92	-0.17	-2.00	-0.38	-4.65
# participants (logs)	1.51	4.05	2.45	9.37	1.59	4.33	1.22	4.45
Funding ratio	0.21	7.10	0.33	9.89	0.20	6.83	0.29	9.55
Personal wealth (logs)					3.67	5.02	3.79	8.93
Dummy DB plan	0.76	0.21	3.69	0.66	-0.60	-0.17	3.97	0.78
Dummy Professional fund	0.59	0.14	1.62	0.26	-1.81	-0.46	-0.57	-0.10
Dummy Industry-fund	-5.22	-2.79	-7.11	-4.79	-0.12	-0.06	0.46	0.29
Constant	-6.63	-0.92	-41.67	-5.00	-13.21	-1.86	-18.50	-2.31
R^2, adjusted	0.15		0.33		0.20		0.45	
Number of observations	385		385		383		383	

4.5 Robustness Analysis

The specification in the previous section rests on several assumptions regarding relevant covariates, variable definition and functional form. This section considers various departures from the assumptions underlying Equation (2), using weighted regression.

Table 5. Alternative specifications of the weighted regression model as robustness tests

	Strategic equity allocation				Tobit		Actual equity	
	Incl.age^2		Funding rat. lag		regression[a]		allocation	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat	coeff.	t-value
Average age act. members	-0.51	-5.56	-0.39	-2.95	-0.50	-5.54	-0.44	-3.69
Ditto, squared[b]	0.01	0.59						
Share retired participants	-0.05	-1.29	-0.13	-2.71	-0.06	-1.34	-0.14	-3.13
Share deferred participants	-0.26	-9.39	-0.31	-10.19	-0.25	-9.71	-0.33	-12.02
# participants (in logs)	0.95	3.59	1.30	4.44	0.95	3.62	1.05	3.97
Funding ratio	0.28	9.37			0.28	9.54		
Funding ratio, lag (2006)			0.19	5.65			0.16	5.15
Dummy DB plans	6.47	1.34	4.05	0.71	6.46	1.35	7.31	1.55
Dummy Professional funds	-1.40	-0.26	-15.76	0.004	-1.12	-0.21	-14.01	-2.83
Dummy Industry-funds	-0.77	-0.53	-2.13	0.183	-0.72	-0.50	-1.95	-1.36
Constant	16.46	1.95	26.61	0.013	15.57	1.88	34.24	3.61
R^2, adjusted	0.50		0.41		0.07[c]		0.46	
Number of observations	380		363		380		368	

[a] There are four censored observations, that is, four observations with zero equity exposure;

[b] Expressed as the deviation from the average age of participants

[c] This is the so-called pseudo R^2.

[8] The logarithms of model likelihood in Table 3 are substantially higher than those in Table 4. Likelihood ratio tests reject the Equation (3) models (Table 4) in favour of the Equation (2) models (Table 3). he difference in degrees of freedom is taken into account as Equation (3) has two additional explanatory variables compared to Equation (2). The test is not a pure test on restrictions, as one explanatory variable is different: average age of all participants versus average age of active participants. For this test the additional five observations in Table 3 (concerning pension funds without active participants) are excluded, so that the same sample for both models is used.

As a first approximation, it was thusfar assumed that the effect of the average age of (active) participants on the equity allocation is linear. However, Benzoni et al. (2007) suggest that the relation between age and equity exposure may be hump-shaped rather than linear. They suggest that the age effect should be positive in the younger age cohorts, due to the positive long-term correlation between capital returns and return on human capital (that is, the wage rate). Benzoni's age-equity relation reaches a maximum around a certain point (seven years before retirement), after which it is downward-sloping, as the long-term correlation of wages and dividends loses relevance. A simple but effective way to allow for a non-linear relationship is the inclusion of a quadratic age term in the regression. The respective weighted regression model results show that the age coefficients are not in line with the assumption of Benzoni et al. (2007) about the investment behaviour of pension funds (Table 5, first column), as the squared term coefficient is not significant. Hence, Benzoni's recommendation does not apply to Dutch pension funds.

With regard to the dependent variable 'strategic equity allocation', several robustness checks may be considered. First, shocks in equity prices affect the funding ratio, but they may also have a certain impact on a fund's strategic equity allocation, which creates an endogeneity problem. For this reason we here lag the funding ratio, see Table 5, second column. The results hardly change, especially in terms of significance. The magnitude of the (lagged) funding ratio coefficient is slightly smaller here than in the unlagged specification.

Second, four pension funds have zero equity exposure. This is at odds with the OLS assumption that the dependent variable is continuous. In practice, equity exposure is censored at 0% and 100%. One may further argue that moving from zero equity allocation to a positive fraction requires an intrinsically different decision than raising an already positive equity exposure. One way to address this is to omit zero observations for equity, restricting attention to funds with positive equity allocations. This does not alter the essence of the results (not shown here). A more elegant alternative approach is the Tobit model which takes censoring into account. Table 5, third column, reports the Tobit outcomes. The effect of age and the other OLS results from Table 3 do not change substantially.

Third, where pension funds do not constantly rebalance their portfolio after stock price changes, the actual equity exposure of pension funds may differ from their strategic equity allocation. Bikker, Broeders and De Dreu (2010) document that pension funds' assets are indeed partially free-floating. As strategic asset allocation reflects a fund's actual decision, it is better suited for determining the decision-making and conscious behaviour of pension funds. On the downside, however, this affects comparability with other studies, such as Alestalo and Puttonen (2006) and Gerber and Weber (2007). Also, while the strategic asset allocation reflects a fund's intention, it does not give its actual behaviour. Table 5, right-hand columns, documents regression results with the actual stock allocation. To avoid endogeneity, the funding ratio is lagged by one year. Sign and size of the coefficients hardly change, though the magnitude of the (lagged) funding ratio coefficient is slightly smaller than in the other regressions. Table A.2 in Appendix I repeats Table 5 but with personal wealth as an extra explanatory variable. The results are quite similar, confirming the robustness of the model.

Finally, the model is applied to strategic bond allocation instead of strategic equity allocation, where a positive rather than a negative sign for age dependency is expected. The results (not shown here) deviate slightly, as bonds are not the exact complement of equity, due to other investment categories. These estimates confirm the age-bond relationship: the strategic bond exposure is significantly higher when the average age of active participants is higher.

4.6 Conclusion

This chapter addresses the effect of the average age of pension funds' participants on their strategic equity allocation. The first and main finding is that Dutch pension funds with older participants have significantly lower equity exposures than pension funds having younger participants. This negative age-dependent equity allocation may be interpreted as an (implicit) application of the optimal life-cycle saving and investing theory. The basic version of this theory assumes a low correlation between wage growth and stock returns. It predicts that the vast amount of human capital of the young has a strong impact on asset allocation because of risk diversification considerations, as human capital has a different risk profile than financial capital.

A second finding is that the average age of active participants has a much stronger impact on investments than the average age of all participants. This is in line with the standard version of lifecycle theory which suggests that retirees with depleted human capital should invest a constant fraction of their financial wealth in equities.

A third result is that the age effect is stronger in larger pension funds than in smaller ones. Apparently, larger funds' investment behaviour is more closely aligned with the age-dependency from the life-cycle hypothesis. A non-linear age effect allowing a hump-shaped pattern, as suggested by Benzoni et al. (2007), could not be confirmed. However, other factors significantly influencing the strategic equity allocation are pension fund's size, funding ratio, and average personal pension wealth of participants, which all have positive coefficients.

This study shows that age influences investment behavior. In itself that does not establish whether asset allocation should depend on age and if so, in what way. If age is indeed an important factor, as this study suggests pension funds do, cohort-specific investment policies could be considered. This would mean that assets of an age-group are invested separately from the oter assets. This has been suggested by Teulings and De Vries (2006) and Ponds (2008).

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4.7 Appendix Alternative estimations

This appendix tests an alternative specification of Equations (2) and (3). The left-hand panel of Table A.1 reports the impact of the average age of active participants on strategic equity allocation where the log of total assets has been added as an explanatory variable. This variable replaces the number of participants as a measure of size. Note that the coefficient of total assets is highly significant, implying that large pension funds have higher equity exposures. The use of strategic equity allocation as the dependent variable reduces possible endogeneity effects. Similarly, the right-hand panel of Table A.1 shows the results for the model with the age of all participants and total assets as size measure.

Table A.1. Impact of average age on the strategic equity allocation with total assets

	Equation (2)				Equation (3)			
	Unweighted		Weighted		Unweighted		Weighted	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Average age act. members	-0.35	-2.39	-0.52	-5.84				
Share retired participants	0.06	1.17	-0.08	-1.97				
Share deferred participants	0.05	1.22	-0.20	-6.60				
Average age all members					-0.02	-0.28	-0.18	-2.72
Total assets (in logs)	1.62	4.68	1.07	4.75	1.62	4.89	2.14	12.74
Funding ratio	0.20	6.84	0.27	9.56	0.20	6.57	0.31	9.90
Dummy DB plans	1.03	0.29	6.05	1.27	-0.11	-0.03	3.54	0.69
Dummy Professional funds	0.75	0.19	-0.73	-0.14	-0.71	-0.17	0.74	0.13
Dummy Industry-funds	-3.92	-2.27	-0.73	-0.58	-3.11	-1.95	-4.18	-3.60
Constant	-2.09	-0.21	9.84	1.17	-12.46	-1.70	-31.76	-4.25
R^2, adjusted	0.19		0.51		0.16		0.42	
Number of observations	381		381		389		389	

Table A.2 repeats the robustness tests of Table 5, but based on a model including personal wealth. The conclusion remains that the analyses are robust for these kinds of changes in the specification.

Table A.2. Alternative specifications of the weighted regression model as robustness tests

	Strategic equity allocation				Tobit regression[a]		Actual equity allocation	
	Incl.age^2		Funding rat. lag					
	coeff.	t-stat	coeff.	t-stat	coeff.	t-value	coeff.	t-value
Average age act. members	-0.58	-6.34	-0.38	-2.91	-0.56	-6.22	-0.42	-3.61
Ditto, squared[b]	0.01	1.28						
Share retired participants	-0.12	-2.61	-0.19	-3.53	-0.12	-2.62	-0.21	-4.38
Share deferred participants	-0.17	-4.85	-0.23	-5.17	-0.17	-4.75	-0.23	-5.79
# participants (logs)	0.78	3.00	1.18	4.03	0.79	3.03	0.88	3.37
Funding ratio	0.27	9.23			0.27	9.5		
Funding rat, lag			0.19	5.72			0.16	5.31
Personal wealth (in logs)	2.35	3.91	1.86	2.64	2.22	3.76	2.37	3.84
Dummy DB plans	5.88	1.24	3.41	0.60	5.95	1.26	5.10	1.09
Dummy Professional fund	-1.44	-0.27	-0.95	-0.18	-0.91	-0.17	-14.23	-2.93
Dummy Industry-fund	0.91	0.62	0.89	0.60	0.9	0.62	-0.11	-0.07
Constant	10.72	1.28	9.48	1.13	9.35	1.13	24.16	2.49
R^2, adjusted	0.52		0.43.		0.08[c]		0.48	
Number of observations	378		362		378		367	

[a] There are four censored observations, that is, four observations with zero equity exposure;

[b] Expressed as the deviation from the average age of participants

[c] This is the pseudo R^2.

Testing alternative model specifications for the impact of demographic variables

Table A.3 presents estimation results for a more general model of the impact of demographic variables on pension funds' strategic equity allocation, which encompasses both Equations (2) and (3). This specification allows testing of the models of these equations. Equation (2) results when the coefficients of the average ages of retired and deferred participants and the three interaction terms are jointly set to zero, while Equations (3) is obtained when the coefficients of the three average ages and the shares of retired and deferred participants are all set to zero while at the same time, the coefficients of the three interaction terms are assumed identical. Note that Equations (2) and (3) are not nested, so that the two alternatives cannot be tested against each other.

Table A.3. A general model for the impact of demographic variables on strategic equity allocation

	General model				Idem, including 'personal wealth'			
	Unweighted		Weighted		Unweighted		Weighted	
	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat	coeff.	t-stat
Average age active members	-0.50	-1.92	-0.50	-2.70	-0.60	-2.38	-0.79	-4.02
Average age retired members	0.02	0.09	-0.20	-1.00	-0.10	-0.57	-0.61	-2.71
Average age deferred members	0.12	0.28	1.04	2.32	0.05	0.12	1.00	2.28
Share retired participants	1.96	3.21	0.72	0.87	0.78	1.21	-0.46	-0.53
Share deferred participants	0.00	0.01	-0.31	-0.76	0.05	0.11	0.13	0.30
Interaction age&share active	0.00	0.20	-0.01	-0.87	0.00	0.40	0.00	0.19
Interaction age&share retired	-0.02	-2.56	-0.02	-1.29	-0.01	-0.81	0.00	0.34
Interaction age&share deferred	0.00	0.27	-0.01	-0.73	0.00	0.58	-0.01	-0.74
# participants (in logs)	0.96	2.43	1.21	4.51	1.00	2.60	1.11	0.27
Funding ratio	0.21	7.00	0.29	9.92	0.19	6.55	0.27	9.41
Personal wealth (in logs)					4.01	4.68	2.66	3.83
Dummy DB plan	1.82	0.49	5.51	1.12	1.77	0.49	7.08	1.47
Dummy Professional fund	-1.23	-0.28	-4.53	-0.78	-2.07	-0.49	-4.20	-0.74
Dummy Industry-wide fund	-3.15	-1.56	-2.44	-1.66	0.68	0.32	-0.27	-0.17
Constant	-1.44	-0.05	7.61	0.26	-8.63	-0.31	4.63	0.16
R^2, adjusted	0.17		0.53		0.22		0.55	
Number of observations	377		377		377		377	

Using an F-test for restrictions, only one model, Equation (2) with personal wealth (unweighted), is not rejected at the 5% significance level, while a second model, Equation (2) without personal wealth (unweighted), is not rejected at the 1% significance level. All four Equation (3) models considered, with and without personal wealth and weighted as well as unweighted, are rejected, even at the 1% significance level. For all four models, the F-test statistic is higher for Equation (3) than for Equation (2), reflecting that Equation (3) is rejected more strongly (in three cases) or rejected instead of not rejected (one case). This confirms the empirical evidence and theoretical arguments in favour of Equation (2). Apart from the restrictions, the coefficients in Table A.3 are informative as well: the consistent and significant coefficient of the average age of active participants, and the non- significance of the other demographic coefficients is noteworthy and adds to the evidence favouring Equation (2) over Equation (3).

Chapter 5

Can pension funds improve welfare by lifting borrowing constraints?

5.1 Introduction

[1] An important outcome of life-cycle saving and investing models is that the optimal investment strategy of individuals depends on their age. The proportion of financial assets invested in risky stock should decrease over the life-cycle, thereby increasing the proportion of relatively safer bonds. The reason for the negative age-dependence of investment risk is that the young have more human capital than older workers. This means that a young worker can diversify stock risk with his or her human capital.

A pension fund may increase participants' welfare by investing the financial capital of different generations according to generation-specific investment rules. A pension fund can do this with generational accounts, see Teulings and de Vries (2006). With generational accounts the financial capital of each generation is completely separated from the financial capital of other generations. The financial capital of a generation can subsequently be invested in line with the risk preferences of that generation. This may improve welfare compared to a situation where the financial capital of each generation is invested according to the same, uniform investment rule. The possibility of an age-dependent investment strategy for each generation is a first feature of generational accounts.

A second feature of generational accounts is that it avoids intergenerational conflicts over which generation should bear financial losses if the financial position of a pension fund deteriorates (or conflicts over which generation is entitled to financial gains of a pension fund). Intergenerational conflicts can arise if property rights of the assets of a pension fund are fuzzy, that is, if the pension contract is incomplete and does not unambiguously assign property rights in all future contingencies. As it is difficult to write a complete contract, in particular over long time intervals, any deviation from generational accounts then comes with the risk of intergenerational conflicts. Such conflicts typically arise if the pension fund is in a difficult financial position and the pension fund has to take financial losses.

Conflicts over which generation should shoulder the losses can indeed be witnessed today in many pension funds, now that the credit crisis has negatively impacted the financial position of many pension funds; see van Ewijk (2009) for a discussion of the situation in the Netherlands. To restore the financial position of the pension fund, young generations typically want the pension fund to decrease benefits, whereas older generations want to raise contributions. Related to this distributional conflict over contributions and benefits is a discussion about the risk level. Older generations may feel that the pension fund is taking too much risk, whereas younger generations want to increase risks as they are less risk-averse. This difference

[1] This chapter is written with Mario Bersem. An earlier version was published as Netspar Discussion paper 10/2010-063 and AIAS working paper no. 99.

in risk-appetite is a direct consequence of the age-dependence of the optimal investment strategy. Again, generational accounts with ring-fenced financial capital avoid such conflicts over the risk level.

Generational accounts may thus come with several advantageous features. However, with generational accounts some generations may not be able to implement their optimal investment strategy if they are borrowing constrained, that is, if their optimal investment strategy is to borrow in order to invest in stocks. For example, Teulings and De Vries (2006) calculate that young workers should go short in bonds equal around 5.5 times their annual salary to invest in stock. In this case, the first feature of generational accounts, an age-dependent investment strategy, cannot be implemented optimally. The market is thus incomplete and the market solution that is implemented by strictly separated generational accounts is therefore inefficient. The message of this chapter is that in this case a pension fund with mandatory participation may overcome the market incompleteness and improve welfare. It can do this by facilitating that the young borrow from the old. In this way the borrowing constraint of the young is lifted. A pension fund is in a unique position to facilitate optimal borrowing against human capital because participation in a pension fund is mandatory. When the young borrow against human capital, they have a commitment problem. They want to borrow against their human capital, because this is optimal ex-ante, while promising to repay in case stock return is low. However, when the young indeed need to repay, they have an incentive to renege on their promise. Therefore insurance companies without mandatory participation cannot enable the young to borrow against human capital. A pension fund with mandatory participation may be able to enforce the promise of the young to repay the old out of human capital. Mandatory participation thereby acts as a commitment device for the young to repay their debt if they borrow against human capital.

The model consists of a pension fund that has two types of participants, young and old. The pension fund invests the financial capital of both groups on the capital market, which consists of a risk-free bond and risky stock. The young have more human capital than older workers and want to go short in bonds, that is, they want to borrow. The young are assumed to be borrowing constrained and strictly separated generational accounts are thus sub-optimal. It is shown that the pension fund can lift the borrowing constraint if the pension fund has two additional features vis-à-vis generational accounts. First, it needs to be able to determine the investment strategy at the pension fund level. Second, it needs to be able to give negative benefits to (young) participants. Negative benefits are interpreted as contributions that the pension fund levies on the young. With this extension of the possibilities of the pension fund, the optimal investment strategy for both the old and the young can be implemented.

With the two additional features, the pension fund can improve welfare. The borrowing constraint is essentially lifted by (implicitly) letting the young borrow from the old. The young can thereby invest more in stock than they otherwise could. As a consequence the risk level of the pension fund as a whole increases. The young need to repay the implicit debt to the old with their financial capital and, if this does not suffice when stock return is low, with their human capital. In the case that young participants borrowed against human capital, they pay contributions to the pension fund which redirects it to the old. This is why the pension fund needs to be able to give negative benefits, i.e. levy contributions.

The deviation from generational accounts may however introduce a generational conflict if contributions cannot be raised automatically, for example due to legal limits or resistance of young participants. The young then essentially have a commitment problem; they want to borrow against their human capital, promising to pay contributions in case stock return is low. However, if they need to repay via contributions, they have an incentive to renege on their promise and such a promise may not be enforceable by the pension fund. In that case, pension fund governance becomes important. If the board of the pension fund decides about contributions, the old will want to be represented on the board to ensure that they are repaid in full. However, the young wish to avoid seeing the old abuse their position to increase contributions beyond what is efficient ex-ante, so the young need to be represented adequately as well. The risk level of the pension fund ex-ante thus can not be separated from the contribution policy ex post; good pension fund governance takes this into account and considers both simultaneously through the adequate representation of both groups on the board.

When governance cannot solve the commitment problem, the first-best solution cannot be implemented. A second-best solution is that the risk level is scaled back to a level such that the young never borrow against human capital. This risk immunization policy is sub-optimal compared to the first-best solution, but is welfare-enhancing compared to strictly separated accounts. With a risk immunization policy, the young can still borrow but only with their financial capital as collateral.

This chapter relates to the literature on life-cycle saving and investing models; for an overview, see Bovenberg et al. (2007). This literature originated with Samuelson (1969) and Merton (1969) who proposed that individuals should optimally maintain a constant proportion invested in stocks throughout their lives. A restrictive assumption of these models is that investors have no human capital. This assumption is clearly problematic; if labor income is included in the life-cycle model, the optimal allocation of financial capital of individuals changes over their life-cycle, see Bodie et al. (1992). The central outcome of later models is that the optimal proportion of financial assets invested in stocks decreases with age, while the proportion invested in relatively safer bonds increases. The reason is that young individuals have risk-free human capital and can thereby increase their exposure to risky stocks, because they already implicitly hold a risk-free asset with their human capital.

The negative relationship between age and stock exposure is usually derived under the assumption that human capital is riskless. However, Benzoni et al. (2007) propose that the short run correlation is indeed small, but that labor income and capital income are co-integrated in the longer run, as the shares of wages and profits in national income are fairly constant. This finding implies that the risk profile of young workers' human capital is more stock-like and that they should therefore hold their financial capital in the form of safe bonds to offset the high risk exposure in their human capital. Benzoni et al. suggest that the optimal stock exposure of financial capital is hump-shaped over the life cycle: co-integration between human capital and stock returns dominates in the first part of working life, whereas the decline in human capital accounts for the negative age-dependency of optimal stock holdings later in life.

While the exact structure of the age-dependence of optimal stock exposure is clearly an important issue, it is not pertinent to the message of this chapter. The aim of this chapter is not to determine the exact optimal stock exposure over the life-cycle; rather it is to show that *if* a generation is borrowing constrained, be it the young or the old, *then* the pension fund is in a position to improve welfare, *but* that lifting the borrowing constraint has consequences for pension fund governance. This constitutes the contribution to the literature on life-cycle saving and investing models. The literature typically abstracts from problems arising from the collateralization of human capital and does not address how to lift the borrowing constraint. Instead it is implicitly assumed that these can be lifted via markets. This may however be problematic for at least three reasons. First and foremost, it is difficult to borrow against (future) human capital from insurance companies. Insurance companies cannot levy contributions ex post, whereas a pension fund with mandatory participation can do so. Second, insurance companies are generally cost-inefficient which may offset investment gains; see Bikker and de Dreu (2009). Third, relatively few individuals are active on the stock market and it would involve high fixed costs to become active. The lifting of borrowing constraints may indeed be an advantage of pension funds over insurance companies.

A strong assumption of the model is that a truly risk-free asset is available. This is a reasonable assumption for a small pension fund. However, a large pension fund internalizes that buying a risk-free asset implies that risk is shifted to the party underwriting the risk-free asset. That is, if retirees buy government bonds -which come closest to a safe asset- it are ultimately the tax-payers -thus the workers- that take on the risk of repaying the bonds in every contingency. Contrary to a small pension fund, a large pension fund will have a non-negligible effect on price and volume of bonds traded, and will thus internalize that the group of tax-payers largely coincides with the group of young participants. This chapter considers a variation of the model in which there is no riskless asset. Instead there is only risky stock available. In this case, it is optimal that the young and the old swap risks, that is, that the young insure the old against low stock return, in exchange for a larger claim on capital if the return is high. The reason that it is optimal for the young to take more risks is that they, as before, are less risk-averse due to their human capital. The pension fund can facilitate the exchange of risks between the young and the old by setting up an internal market on which the young and old swap risks. So again, the pension fund is in a position to improve welfare. The main difference with the base-line model is that the old now also profit from the pension fund. It remains possible that the young pledge human capital as collateral. In this case, they receive negative benefits from the pension fund, that is, they pay contributions. Therefore, pension fund governance remains important to address the exchange of risks ex-ante and contributions ex post simultaneously.

The remainder of this chapter is organized as follows. Section 2 discusses a small pension fund in the case of strictly separated generational accounts; it then shows how the pension fund can alleviate borrowing constraints by adjusting its investment strategy, and contribution policy and finally it discusses the consequences for pension fund governance. The third section considers the situation without the availability

of a riskless asset, while the last section concludes.

5.2 A small pension fund

The model considers a pension fund with mandatory participation. The pension fund consists of two groups that differ in one respect and one respect only, namely the size of human capital relative to financial capital. There is a group with relatively large human capital and this group is referred to as young (y). The other group does not have human capital and is referred to as old (o). The young are endowed with two types of capital: (i) human capital, denoted by $H > 0$, and (ii) financial capital, denoted by $F_y > 0$. One may think of H as the present discounted value of future wages. The old are retired and have only financial capital $F_o > 0$. The number of young is denoted by $N_y > 0$ and the number of old by $N_o > 0$. The relative size of the young is given by $n \equiv \frac{N_y}{N_o}$.

The pension fund invests the financial capital of participants on their behalf on the capital market. The capital market consists of a riskless asset (bond) and a risky asset (stock). The riskless asset yields a (gross) return of r. The stock return, denoted r^s, is Bernoulli distributed where $0 < p < 1$:

$$r^s = \begin{cases} \overline{r} & \text{with probability } p \\ \underline{r} & \text{with probability } 1-p \end{cases}$$

The following relation holds:

$$\overline{r} > r > \underline{r} > 0 \tag{5.1}$$

There is a nonnegative stock premium $\mu > 0$, where

$$\mu \equiv p\overline{r} + (1-p)\underline{r} - r \tag{5.2}$$

The pension arrangement can be interpreted as a Defined-Contribution plan. That is, the pension fund invests the assets on behalf of the participants without guaranteeing a certain benefit. The pension fund is small in the sense that from the perspective of the fund: (i) asset prices are exogenous, and (ii) there is a risk-free bond available. The availability of a riskless bond here means that the pension fund does not internalize that macro-risk exists and that this has to be borne by some party. That is, if one group owns a riskless bond -for example government bonds-, this means that some other party -the tax-payer- will bear the underlying risk that comes with underwriting the bond in every contingency. A small pension fund can buy bonds with negligible effects for tax-payers and thus for its own participants. However, a large pension fund should consider that the group of tax-payers largely coincides with the group of its own (young) participants or more generally, that there is no such thing as a riskless bond from a macro-perspective. The next section considers an extension in which there is no riskless bond available.

Members of both groups are risk averse and derive utility over total wealth. Utility of the old is then given by:

$$U_o \equiv u(\widehat{P}_o) \tag{5.3}$$

where u is a standard felicity function ($u' > 0$ and $u'' < 0$) and $\widehat{P}_o$ denotes the financial pay-outs from the pension fund to the old. How pay-outs to participants relate to their financial capital and the investment policy of the pension fund, is addressed below. Utility of young agents is analogously given by:

$$U_y \equiv u(\widehat{P}_y + H) \tag{5.4}$$

Here $\widehat{P}_y$ denotes the financial pay-outs from the pension fund to the young. Unless stated otherwise, a log felicity function $u(x) = \ln(x)$ is used.

5.2.1 Separated generational accounts

The first situation that is considered is a situation with generational accounts that are strictly separated. Financial capital of both groups is completely ring-fenced. The pension fund invests the financial capital of a generation (young or old) on behalf of that generation and according to a generation-specific investment rule. Here there are two generations -the young and the old- and the pension fund invests the financial capital of these two groups separately. Alternatively, this situation can be thought of as a situation in which each participant has an individual account, and his or her financial capital is invested by the pension fund on his or her behalf.

The pension fund then has two decisions to make: (i) how to invest the financial capital of the young, (ii) how to invest the financial capital of the old. The pay-outs ($\widehat{P}_y$ and $\widehat{P}_o$) follow directly from the stock exposure of the young and old; the pension fund is not allowed to withhold any of the post-return financial capital invested on behalf of participants and is also not able to increase pay-outs, as the pension fund does not have a capital buffer of its own.

This sub-section derives the optimal investment strategy for participants of both groups. Participants are assumed to be borrowing constrained, that is, they cannot borrow outside the pension fund. It is shown that the optimal investment strategy may for that reason be unfeasible. The next subsection considers how a pension fund can lift a binding borrowing constraint and the consequences for pension fund governance.

Now, consider first the optimal stock exposure of the young. Maximizing utility, the young solve the following maximization problem where α_y represents the fraction of financial capital invested in stocks:

$$\max_{\alpha_y} \qquad p\ln[F_y(\alpha_y\overline{r}+(1-\alpha_y)r)+H]+(1-p)\ln[F_y(\alpha_y\underline{r}+(1-\alpha_y)r)+H]$$

Taking the derivative with respect to α_y the first order condition (FOC) becomes:

$$\frac{p(\overline{r}-r)}{F_y(\alpha_y\overline{r}+(1-\alpha_y)r)+H}+\frac{(1-p)(\underline{r}-r)}{F_y(\alpha_y\underline{r}+(1-\alpha_y)r)+H}=0 \tag{5.5}$$

The optimal stock exposure, denoted α_y^*, is the solution of equation 5.5:

$$\alpha_y=\frac{(H+F_yr)[p(\overline{r}-r)+(1-p)(\underline{r}-r)]}{F_y(r-\underline{r})(\overline{r}-r)}=\frac{(H+F_yr)\mu}{F_y(r-\underline{r})(\overline{r}-r)}:=\alpha_y^* \tag{5.6}$$

Note that $\alpha_y^*>0$, as the equity premium, given by μ, is strictly positive. Note further that it is possible that $\alpha_y^*>1$. In that case the young want to go short in bonds, that is, they want to invest borrowed money on the stock market.

Comparative statics are such that the optimal stock exposure increases when human capital holdings increase and decreases if financial capital increases.[2] The intuition is that the young have implicit bond exposure through their human capital, as both human capital and bonds are risk-free. This in turn renders a higher stock exposure optimal if the young have relatively much human capital.

If the pension fund invests the financial capital of the young according to equation 5.6, then the young receive from the pension fund:

$$P_y^*=F_y(\alpha_y^*r^s+(1-\alpha_y^*)r) \tag{5.7}$$

Here, P_y^* denotes the optimal pay-out to the young. Expected utility in this optimal case, denoted U_y^*, is given by:

[2] The comparative statics are:
$\frac{d\alpha_y^*}{dH}=\frac{\overline{\mu}}{F_y(r-\underline{r})(\overline{r}-r)}>0$
$\frac{d\alpha_y^*}{dF_y}=\frac{\overline{\mu}}{(r-\underline{r})(\overline{r}-r)}\frac{-H}{F_y^2}<0$

$$U_y^* \equiv E[u\left(P_y^* + H\right)] = p\ln[F_y(\alpha_y^*\overline{r} + (1-\alpha_y^*)r) + H] + (1-p)\ln[F_y(\alpha_y^*\underline{r} + (1-\alpha_y^*)r) + H]$$

What is the optimal stock exposure for the old? The old essentially face the same type of maximization problem, though their human capital is equal to zero. Their optimal stock allocation, denoted α_o^*, is:

$$\alpha_o^* = \frac{r\overline{\mu}}{(r-\underline{r})(\overline{r}-r)} \tag{5.8}$$

The expression for α_o^* follows by substituting $H = 0$ in equation 5.6. Also here, it is possible that $\alpha_o^* > 1$; in that case the old want to invest borrowed money in stocks. The optimal pay-out to the old, denoted P_o^*, is given by:

$$P_o^* = F_o(\alpha_o^* r^s + (1-\alpha_o^*)r) \tag{5.9}$$

The resulting expected utility in this case is given by:

$$U_o^* \equiv E[u(P_o^*)]$$

The following relation between the optimal stock exposure of the two groups holds:

$$\alpha_y^* = \alpha_o^* + \tfrac{H\overline{\mu}}{F_y(r-\underline{r})(\overline{r}-r)}$$

It follows that α_o^* is always smaller than α_y^*, irrespective of the value of financial capital of the two groups. That is, $\alpha_y^* > \alpha_o^* \ \forall\ H,\ F_y,\ F_o > 0$. The intuition is that the young already (implicitly) hold a riskless asset with their human capital, thereby increasing the optimal stock exposure of their financial capital.

There are now three possible configurations for the optimal stock exposure of the old and the young.
(i) $\alpha_o^* < \alpha_y^* \leqq 1$; in this case the optimal stock exposure for both the young and the old can be implemented, because neither need to borrow. The resulting (expected) utility for the young and the old is given by U_y^* and U_o^* respectively.
(ii) $\alpha_y^* > \alpha_o^* > 1$; in this case both groups want to go short in bonds, that is, both groups want to borrow. It was however ruled out that participants can borrow *outside* the pension fund. Neither group can then -via the pension fund- implement its preferred stock exposure. The best the pension fund can do is to set $\alpha_y = \alpha_o = 1$ and pay out to both groups the post-return financial capital that results from that stock allocation.
(iii) $\alpha_y^* > 1 \geqq \alpha_o^*$; in this case the old can -again, via the pension fund- implement their preferred stock allocation. The young cannot, as they need to borrow and they are borrowing constrained. The borrowing constraint strictly decreases welfare for the young as the stock allocation that maximizes their utility cannot be implemented. Due to their borrowing constraint, the young alternatively invest all of their financial capital in stocks, that is, $\alpha_y = 1$ instead of $\alpha_y^* > 1$.

The overall stock exposure of the pension fund in case (iii) when the young are borrowing constrained while the old are not, denoted by α^{bc}, equals:

$$\alpha^{bc} = \frac{nF_y + \alpha_o^* F_o}{nF_y + F_o} \tag{5.10}$$

What is the utility of both groups in this case? Expected utility of the old is given by U_o^*. The young do not receive expected utility U_y^* as they are borrowing constrained but instead receive:

$$U_y^{bc} \equiv p \ln[F_y \overline{r} + H] + (1-p) \ln[F_y \underline{r} + H]$$

The remainder of this section exclusively focuses on case (iii): the situation that the old do not want to borrow (and might want to lend) while the young do want to borrow.

From now on it is assumed then, that parameters are such that

$$\alpha_y^* > 1 \geqq \alpha_o^* \tag{5.11}$$

so that the young wish to borrow at the risk-free rate and invest the proceeds in the risky stock.

5.2.2 Lifting the borrowing constraint

Optimal investment decisions for the young and the old were derived in the previous subsection. If 5.11 holds, the optimal investment strategy cannot be implemented with strictly separated generational accounts, as the young are borrowing constrained. Could welfare be improved by the pension fund relaxing the strict separation of the two accounts? The pension fund may indeed be able to lift the borrowing constraint -and thereby improve welfare- by setting up an internal market on which the young borrow from the old. The pension fund consists of a group -the young- that wants to borrow and a group -the old- that might want to lend. There is thus a potential gain from trade which the pension fund can exploit.

This subsection considers this possibility. Now, the pension fund still invests the financial capital of both groups on their behalf, but the pension fund has the following two features:

(a) It does not need to take separate investment decisions for both groups. Instead it can directly decide how to allocate the total financial capital of the pension fund -given by $F \equiv N_y F_y + N_o F_o$- over stocks and bonds. The pension fund as a whole remains borrowing constrained.

(b) Pay-outs to young participants are allowed to be negative. That is, after capital return has materialized, the young may have to pay the pension fund. The pension fund then levies a contribution on the young, which has to be paid out of human capital. The contributions are redistributed to the old. Formally, the pension fund can set a contribution $0 \leqq h \leqq 1$ which results in a transfer equal to hH from a young participant to the pension fund, which redistributes it to older workers.

The pension fund further needs to meet the following condition:

(c) The pay-outs to both groups need to be such that the participants are not worse off than in the situation with strictly separated generational accounts, as described in the previous subsection. That is, expected utility resulting from the pay-outs of the pension fund needs to be at least U_y^{bc} for the young and U_o^* for the old.

The pension fund now has to decide on (i) the overall investment strategy, (ii) pay-outs to the young and the old. Suppose the pension fund wants to implement the optimal stock exposure and the resulting pay-outs for both the young and the old, given by equations 5.7 and 5.9.

If the optimal stock exposure for both groups is implemented, the overall stock exposure of the fund, denoted by α^{fb}, equals:

$$\alpha^{fb} = \frac{\alpha_y^* N_y F_y + \alpha_o^* N_o F_o}{N_y F_y + N_o F_o} \tag{5.12}$$

The pension fund thus invests $\alpha^{fb}F$ in stocks and $(1-\alpha^{fb})F$ in bonds, resulting in total post return financial capital $Fr^s\alpha^{fb} + Fr(1-\alpha^{fb})$.

The optimal stock allocation of the fund is only feasible if $\alpha^{fb} \leqq 1$, that is, if:

$$n\alpha_y^* F_y + \alpha_o^* F_o \leqq nF_y + F_o \Leftrightarrow F_o(1-\alpha_o^*) \geqq n(\alpha_y^* - 1)F_y \tag{5.13}$$

This condition states that the total financial capital that the old want to lend exceeds the total amount the young want to borrow. If this condition is met, the pension fund can lift the entire borrowing constraint. Note that if n decreases, which indicates that there are relatively more old participants, this condition is more easily fulfilled. Unless stated otherwise, it is assumed that condition 5.13 holds, motivated by the observation that the old generally have (much) more financial capital than young workers. If this condition is not met, there is still scope for the young to borrow from the old, but the young cannot borrow the optimal amount.

Now, when capital return has materialized, the pension fund pays out P_o^* to the old and P_y^* to the young. The pension fund thus needs to pay out in total: $N_o P_o^* + N_y P_y^*$. It is easy to show that this is exactly equal to the post-return financial capital of the fund, given by $Fr^s\alpha^{fb} + Fr(1-\alpha^{fb})$, that is: $Fr^s\alpha^{fb} + Fr(1-\alpha^{fb}) = N_o P_o^* + N_y P_y^*$.[3] This shows that if the pension fund invests its total financial capital F according to 5.12, it can exactly pay out the optimal amount P_o^* and P_y^* to all young and old participants.

Now, it is perfectly possible that $P_y^* < 0$ if $r = \underline{r}$. As can be seen from equation 5.7, this is the case when:

$$\alpha_y^* \underline{r} < (1-\alpha_y^*)r \tag{5.14}$$

In that case, the young have a negative pay-out when stock return is low, that is, they then need to pay to the pension fund. This is effected by the pension fund setting a contribution, denoted h^*, equal to:

$$h^* = \frac{rF_y(1-\alpha_y^*) - F_y\alpha_y^*\underline{r}}{H} \tag{5.15}$$

The young pay h^*H to the pension fund, which pays it out to the old. While such a negative pay-out is clearly welfare-decreasing for the young ex post, it is ex-ante welfare-increasing, as the pay-out maximizes expected utility.

The policy of the pension fund meets condition (c), as it results in expected utility $U_y^* > U_y^{bc}$ and U_o^* for the young and the old respectively. This is strictly welfare-improving for the young, whereas the welfare of the old does not decrease. The relaxation of the strictly separated generational accounts thus leads to a Pareto improvement.

How has the pension fund improved welfare? The pension fund has essentially lifted the borrowing constraint of the young by allowing them to (implicitly) borrow from the old. That is, the pension fund has implicitly set up an internal market on which the young can borrow from the old. The policy of the pension fund, characterized by equations 5.12, 5.7 and 5.9, is equivalent to the old extending credit to the young.

To see this, consider again case (iii) in the previous subsection, where the young were borrowing constrained. Suppose the pension fund enabled each young worker to borrow B^* from the old, where

$$B^* \equiv (\alpha_y^* - 1)F_y$$

The young can then invest $B^* + F_y = \alpha_y^* F_y$ in stocks, which is exactly their optimal investment strategy. After stock return has been realized, the young need to repay, via the pension fund, rB^*. The

[3] $Fr^s\alpha^{fb} + Fr(1-\alpha^{fb}) = (\alpha_y^* N_y F_y + \alpha_o^* N_o F_o)r^s + r(N_y F_y + N_o F_o) - r(\alpha_y^* N_y F_y + \alpha_o^* N_o F_o) =$
$N_y F_y(\alpha_y^* r^s + (1-\alpha_y^*)r) + N_o F_o(\alpha_o^* r^s + (1-\alpha_o^*)r) = N_o P_o^* + N_y P_y^*$

young can invest according to investment strategy 5.6, resulting in pay-outs according to 5.7. For the old it does not matter whether they lend to the young or on an anonymous capital market, therefore they can continue to invest according to investment strategy 5.8, resulting in pay-outs according to equation 5.9. The only restriction is that the maximum amount that all older participants are willing to lend to the young is enough to allow each young worker to borrow B^*. That is, the optimal stock exposure for both groups is feasible if:

$$F_o(1-\alpha_o^*) \geqq nB^* \tag{5.16}$$

Condition 5.16 is equivalent to condition 5.13. It states that the maximum amount that old participants are willing to lend exceeds the total amount the young want to borrow.

After the stock return has materialized, the young repay the old. Now, when the stock return is low, the young may need to repay (partly) out of their human capital that -in that case- served as collateral. Human capital serves as collateral when the following condition holds:

$$F_y\alpha_y^*\underline{r} < rB^* \tag{5.17}$$

This condition is equivalent to 5.14 and compares the amount that has to be paid back to the old, rB^*, with the total post-return financial capital of a young participant in case stock return is low. If the latter is smaller than the first, human capital is required to repay. That is, the young have borrowed against their human capital. In the context of pension funds, this implies the pension fund levies pension contributions on the young. Alleviating the borrowing constraint of the young thus results in a direct link between the risk level ex-ante of a pension fund and the contribution policy ex post.

If condition 5.17 holds, the percentage of human capital, denoted by h^*, that needs be transferred equals:

$$h^* = \frac{rB^* - F_y\alpha_y^*\underline{r}}{H} \tag{5.18}$$

And this expression is equivalent to 5.15. The pension policy of the pension fund given by investment strategy 5.12 and pay-outs to the young according to equation 5.7 and according to equation 5.9 to the old, is thus equivalent to the old extending credit to the young. In this way the borrowing constraint of the young is lifted, which strictly improves welfare of the young and does not decrease welfare of the old. The young can go short in bonds, in line with their preferences, whereas the old lend, in line with their preferences. This again shows the welfare-enhancing role of pension funds.

It is worth re-examining equation 5.12. When the optimal stock exposure is implemented, the overall stock exposure of the fund, denoted by α^{fb}, equals:

$$\alpha^{fb} = \frac{n\alpha_y^*F_y + \alpha_o^*F_o}{nF_y + F_o} = \alpha_o^* + \frac{nF_y(\alpha_y^* - \alpha_o^*)}{nF_y + F_o} \tag{5.19}$$

By lifting the borrowing constraint of the young, the overall stock exposure of the pension fund, given by α^{fb}, has increased. This can be seen by comparing 5.10 to 5.19 and noting that $\alpha_y^* > 1$. Lifting the borrowing constraint for the young -which improves welfare- thus comes with higher stock exposure of the pension fund as a whole. Indeed, lifting the borrowing constraint can be a justification to increase the risk level of the pension fund -given by stock exposure- compared to a situation where each generation (or each participant) has a separate account and the financial capital on that account is invested without allowing borrowing between generation.

Note that a decrease of n -which can be interpreted as aging- leads to a lower risk level. This is in line with empirical findings. The previous chapter documented that Dutch pension funds with older participants

decrease their risk level. An increase in the average participants' age by one year is associated with a decrease of half a percentage point of the stock exposure. Other studies find this as well, see Alestalo and Puttonen (2006) and Gerber and Weber (2007) for analyses of Finnish and Swiss pension funds respectively. Lucas and Zeldes (2009) on the other hand do not find a significant relation between the proportion invested in stocks by American pension funds and the share of active participants.[4]

5.2.3 A potential commitment problem: the role of pension fund governance

The preceding subsection has shown that a pension fund can improve welfare by alleviating the borrowing constraint of the young. The pension fund can also enable the young to borrow against human capital if this is optimal. This results in negative pay-outs to the young in case stock return is low. Negative pay-outs are interpreted here as pension contributions that the pension fund levies on the young. A pension fund can facilitate optimal borrowing against human capital because participation in a pension fund is mandatory. The young essentially face a commitment problem; they want to borrow against their human capital, because this is optimal ex-ante, while promising to repay via contributions to the pension fund ex post in case stock return is low. However, once the young indeed need to repay, they have an incentive to renege on their promise. Therefore insurance companies without mandatory participation cannot enable the young to borrow against human capital. A pension fund with mandatory participation can in principle enforce the promise of the young to repay the old, when necessary, out of human capital. Mandatory participation hence acts as a commitment device for the young to repay their debt if they borrow against human capital.

However, if contributions cannot be raised automatically, for example due to resistance of young participants ex post, intergenerational conflicts may arise. That is, feature (b) of the pension fund could prove impossible. Implementing the optimal investment strategy for both groups according to equations 5.6 and 5.8 is thus not feasible if condition 5.17 holds (optimally, the young borrow against human capital) *and* if the young are not able or not willing to repay the implicit debt to the old that results from implementing the optimal investment strategies. This shows that the investment strategy of the pension fund cannot be divorced from the contribution policy.

As said, the pension fund allows the young to borrow from the old and negative pay-outs to the young imply that the young have borrowed against their human capital. Now, in the most extreme case the pension fund cannot levy any contributions. In that case the young repay $\underline{r}\alpha_y^* F_y$ instead of rB^*. As condition 5.17 holds, this means that the old are not repaid in full[5] and therefore their utility decreases vis-à-vis the situation that their financial capital is invested separately by the pension fund according to equation 5.8. Conversely, if the young do not use human capital to pay off their debt, they essentially have a form of limited liability, similar to shareholders of a company, see Jensen and Meckling (1976) and Sharpe (1976). That is, once all their financial capital is lost when stock return is low, they do not face further losses, irrespective of the size of the borrowed amount. The young would then become quasi-shareholders who can reap the benefits of investing B^* in stocks but do not bear (all) losses. The old then become quasi-bondholders of the fund with a fixed claim on the young (rB^*) but with downside (default) risk.

[4] In this section the pension fund allows the young participants to (implicitly) borrow from the old participants. The interest rate against which the young borrow from the old is the internal interest rate of the pension fund. This internal rate is assumed to be equal to the return on risk-free bonds on the capital market; the return on risk-free bonds is the external interest rate. The assumption that the internal interest rate is equal to the external interest rate simplifies the analysis but is somewhat restrictive. The external interest rate does provide a lower bound for the interest rate that the old will accept; that is, the old will not voluntarily lend against an interest rate that is lower than the interest rate against which they can lend outside the pension fund. However, there is no fundamental reason that the internal interest rate cannot exceed the external interest rate. A direct consequence of this assumption is that the old do not profit from the implicit financial transaction between young and old participants. While the assumption that the internal and external interest rates are equal is in itself restrictive, the message of this chapter does not depend on this assumption and also applies if the internal interest rate does not equal the external interest rate. Once a subset of participants are borrowing constrained, a pension fund with mandatory participation is in a unique position to improve welfare.

[5] Post-return financial capital of the old equals $(\alpha_o^* F_o + n\alpha_y^* F_y)\underline{r} + r[(1-\alpha_o^*)F_o - n(\alpha_y^* - 1)F_y]$ instead of $\alpha_o^* F_o \underline{r} + r(1-\alpha_o^*)F_o$. The difference between the first and latter expression is: $n\alpha_y^* F_y \underline{r} - nr(\alpha_y^* - 1)F_y = \alpha_y^* F_y \underline{r} - rB^* < 0$, where the inequality follows from condition 5.17.

This indicates that negative pay-outs (resulting from borrowing against human capital) may come with a commitment problem. The young essentially want to invest borrowed money in stocks, simultaneously promising to pay contributions in case the return on stocks is low. However, once low stock return indeed materializes, the young have an incentive to break their promise, that is, such a promise may not be enforceable by the pension fund. This commitment problem could be solved if the young voluntarily relinquish their own power to resist higher contributions. Control over contribution could be handed over to the pension fund, giving the fund discretionary power to determine both the risk level of the pension fund and the contribution policy.

From the perspective of the old, a credible contribution policy would involve board representation of the old. However, the old may abuse their control over contributions to transfer more than necessary, redistributing from the young to the old through higher contributions. The commitment problem is then replaced by a dictatorship game where the old are the 'dictator' dictating their desired contribution level, which is as high as possible.

There is thus a natural trade-off when determining the composition of the board of the pension fund. Borrowing against human capital by the young from the old introduces a commitment problem, that can be solved by handing control over contribution policy to the pension fund board, in which the old are represented. When doing so, too much control for the old board members may in turn lead to excessive contributions. This suggests that control over contributions has to be shared in a balanced way between the young and the old.

What a balanced representation would mean is not formally modeled here. If condition 5.17 is not met, contributions do not need to be raised and the old do not need to be represented. If condition 5.17 is met, human capital needs to be transferred from the young to the old. An efficient board composition would result in contributions -as a percentage of H- equal to h^*, given in equation 5.18. Now, the young prefer $h = 0$ whereas the old prefer $h = 1$. If the pension fund board takes a weighted average of the contribution preferred by it's board members, then an efficient weight for the old in the board would be h^*, that is, the percentage of the board members representing the old should equal $100h^*$.

5.2.4 Risk immunization policy

If the commitment problem cannot be solved and negative pay-outs are not possible, a second-best solution is to limit the risk level ex-ante such that the young do not borrow against human capital and there are no negative pay-outs to the young. It should be noted that an insurance company can in principle provide this arrangement as well, as mandatory participation is no longer needed as a commitment device to enable the young to borrow against human capital. The pension fund is still able to choose the investment strategy at the level of the pension fund, according to feature (a). However, feature (b) that allows negative pay-outs no longer applies. What investment strategy and pay-outs could the pension fund choose if it has to meet condition (c) and wants to improve welfare for both groups as much as possible?

It is then useful to follow the interpretation that the young borrow from the old. Borrowing by the young is now restricted to the maximum that they can repay with financial capital as collateral. That is, they do not need their human capital to repay and the pension fund does not need to levy a contribution. This maximum restricted amount that the young can borrow, denoted by B_r, results from the following condition:

$$B_r r = (B_r + F_y)\underline{r} \Rightarrow B_r(r - \underline{r}) = F_y\underline{r} \Rightarrow B_r = \frac{F_y\underline{r}}{r-\underline{r}}$$

This is the maximum total amount that can be borrowed without human capital serving as collateral and therefore without negative pay-outs to the young. The expression for B_r shows that the young can borrow more when their financial capital is higher, while a higher risk-free rate or lower $\underline{r}$ decreases the maximum that can be borrowed.[6]

When the young borrow B_r via the pension fund, their restricted stock exposure, denoted by α_r, becomes:

[6] The comparative statics are:

$$\alpha_r = \frac{B_r + F_y}{F_y} = 1 + \frac{\underline{r}}{r - \underline{r}} = \frac{r}{r - \underline{r}} \tag{5.20}$$

Note that $\alpha_r > 1$; the reason is that the young can always invest at least their own entire financial capital in stocks, resulting in a proportion invested in stocks at least equal to 1, and a strictly positive amount can be borrowed as long as $\underline{r} > 0$, which is the case under assumption 5.1. When $\alpha_r < \alpha_y^*$, the young can only invest α_r instead of the optimal stock exposure α_y^*. When $\alpha_r \geqq \alpha_y^*$, the optimal stock exposure can still be implemented and the pension fund chooses -on behalf of the young- the optimal stock exposure α_y^*. When borrowing by the young is limited, the proportion of financial capital of the young invested in stocks thus equals $\min(\alpha_r, \alpha_y^*)$. Again a feasibility condition is that the old are able to lend:

$$F_o(1 - \alpha_o^*) \geqq nB_r \tag{5.21}$$

The pension fund then invests its assets according to:

$$\alpha = \frac{n\alpha_r F_y + \alpha_o^* F_o}{nF_y + F_o}$$

The pay-outs from the pension fund to the old are given by equation 5.9, whereas the pay-out to the young in this case is equal to $F_y(\alpha_r r^s + (1 - \alpha_y^*)r)$. While the optimal pay-out may now be out of reach, this pay-out still improves welfare for the young compared to the situation where the pension fund invests the financial capital of both groups separately. And as the old are not worse off, condition (c) is still met.

5.3 A variation: a large pension fund

This section considers a variation on the model of the previous section. Thus far the pension fund was small in the sense that (i) asset prices were exogenous to the pension fund, (ii) a truly risk-free asset was available. For large pension funds the assumption of a risk-free asset, which most resembles a government bond of solvent countries, is problematic. That is, there exists considerable macro-risk and it has to be borne by some party. If one group owns 'safe' assets like government bonds, this means that some other party bears the risk of underwriting the safe asset in all contingencies. For a small pension fund this is not an important consideration, as it can buy bonds without influencing prices or (traded) volume of bonds.

For a large pension fund this is not the case. Safeguarding one group, for example the old, means increasing risks for another group, here the young in their role as tax-payer. Assuming a risk-free asset then underestimates the risks that the young face, as they ultimately underwrite the risk-free assets in their role as tax-payer (in the case of government bonds). A large pension fund internalizes the risks that young participants have in their role as tax-payer.

This section considers the situation where a truly risk-free asset is absent; that is, the pension fund internalizes that such an asset shifts risks to the underwriting party. The pension fund as a whole faces macro-risk that it cannot avoid; the risk can only be shared between participants. The pension fund can still improve welfare, now by allocating the macro-risk optimally. Comparable with Cui and Ponds (2010), a pension fund can do this by setting up an internal market on which young and old participants swap risks. Optimal risk allocation can however lead to a similar commitment problem as before, if the young pledge human capital as collateral. The earlier results are thus robust in this respect; that is, good pension fund

$\frac{dB}{dr} = -\frac{F_y \underline{r}}{(r-\underline{r})^2} < 0$ and $\frac{dB}{d\underline{r}} = \frac{F_y r}{(r-\underline{r})^2} > 0$

governance considers the investment strategy and contribution policy jointly. An important difference is that the old now also profit from the pension fund, which was not the case thus far.

The model

Consider a nation-wide pension fund in a closed economy. The young, as before, have human capital, denoted by $H > 0$. There is a fixed capital stock denoted as K and it is owned jointly by the young and the old. The group of the young have a claim equal to $K_y = (1-\gamma)K$ and the old have a claim equal to $K_o = \gamma K$, with $0 \leqq \gamma \leqq 1$. There are N_y young participants and N_o old participants. The relative size of the younger cohort is again given by $n \equiv \frac{N_y}{N_o}$. Financial capital of a young participant equals $F_y \equiv \frac{(1-\gamma)K}{N_y}$ while financial capital of an old participant equals $F_o \equiv \frac{\gamma K}{N_o}$. The return on capital is Bernoulli distributed where $0 < p < 1$:

$$K = \begin{cases} \overline{K} & \text{w.p. } p \\ \underline{K} & \text{w.p. } 1-p \end{cases}$$

The following relation holds: $\overline{K} > \underline{K} > 0$. Now define $\overline{F}_y \equiv \frac{(1-\gamma)\overline{K}}{N_y}$ and $\underline{F}_y \equiv \frac{(1-\gamma)\underline{K}}{N_y}$. Further define $\overline{F}_o \equiv \frac{\gamma\overline{K}}{N_o}$ and $\underline{F}_o \equiv \frac{\gamma\underline{K}}{N_o}$.

The pension fund invests and administers the financial capital of both groups. Expected utility of the young is equal to $p\ln[H + \overline{F}_y] + (1-p)\ln[H + \underline{F}_y]$, whereas expected utility of the old equals $p\ln[\overline{F}_o] + (1-p)\ln[\underline{F}_o]$. It is assumed that the capital market does not offer instruments to hedge capital return risk. Markets are thus incomplete and potentially inefficient.

As the young hold a risk-free quasi-asset with their human capital, they prefer to take on more risk than the elderly, exactly as in the previous section. Both generations can thus gain from exchanging risk. Optimally, the young profit more when capital return is high while the old are hurt relatively less when capital return is low; the young and old participants exchange wage-risk (that is human capital risk, which is zero here as human capital is risk-free) for capital-risk such that the old are also exposed to wage-risk and the young have more capital-risk. The pension fund can again step in to complete markets and so improve welfare. It could do this by allowing risk exchange by letting the young and old trade a swap-instrument, denoted by Z. This asset pays out $\widehat{r}$ in case $K = \overline{K}$ and pays out -1 in case $K = \underline{K}$. Demand by the young and the old for this derivative depends on $\widehat{r}$, which follows from a market clearing condition.

First, consider the demand by the young for Z, given $\widehat{r}$. Maximizing utility, the young solve the following maximization problem, where Z_y denotes the amount of Z that the young hold:

$$\max_{Z_y} \qquad p\ln[H + \overline{F}_y + \widehat{r}Z_y] + (1-p)\ln[H + \underline{F}_y - Z_y]$$

Taking the derivative with respect to Z_y, the FOC is:

$$\frac{p\widehat{r}}{H + \overline{F}_y + \widehat{r}Z_y} = \frac{1-p}{H + \underline{F}_y - Z_y} \tag{5.22}$$

Solving equation 5.22 gives the optimal value of Z_y. The optimal value depends on $\widehat{r}$ and is denoted by $Z_y^*(\widehat{r})$:

$$Z_y = \frac{[H + \underline{F}_y]p\widehat{r} - (1-p)[H + \overline{F}_y]}{\widehat{r}} := Z_y^*(\widehat{r}) \tag{5.23}$$

Now, consider the demand by the old for Z, given $\widehat{r}$. Maximizing utility the old solve the following maximization problem, where Z_o denotes the amount of Z that the old hold:

$$\max_{Z_o} \quad p\ln[\overline{F}_o + \widehat{r}Z_o] + (1-p)\ln[\underline{F}_o - Z_o] \tag{5.24}$$

For the old the optimal amount, denoted as $Z_o^*(\widehat{r})$, is the solution to maximization problem 5.24:

$$Z_o = \tfrac{\underline{F}_o p\widehat{r} - (1-p)\overline{F}_o}{\widehat{r}} := Z_o^*(\widehat{r})$$

The expression for $Z_o^*(\widehat{r})$ follows by substituting $H = 0$ and interchanging subscripts y and o in expression 5.23.

Now, the internal market only clears when one group (the young) is in demand for the swap-instrument Z, while the other group (the old) is willing to supply it. The internal market for the swap-instrument Z clears if the price, implied by $\widehat{r}$, is such that demand by the young equals supply by the old. This market clearing return is denoted $\widehat{r}^*$, and it follows from the condition:

$$nZ_y^*(\widehat{r}) = -Z_o^*(\widehat{r})$$

The market-clearing return resulting from this condition is:

$$\widehat{r}^* = \tfrac{(1-p)[n(\overline{F}_y + H) + \overline{F}_o]}{p[n(\underline{F}_y + H) + \underline{F}_o]}$$

The young pay $Z_y^*(\widehat{r}^*)$ per person to the old in case $K = \underline{K}$, whereas the elderly pay $\widehat{r}^* Z_o^*(\widehat{r}^*)$ to the young in case $K = \overline{K}$. Ex-ante these transactions are strictly welfare improving vis-à-vis the situation without transactions.

The transactions can however lead to the same problems as before if the young cannot pay Z_y^* out of their financial capital; in this case human capital serves as collateral in the swap-transaction. This is the case when $Z_y^*(\widehat{r}^*) > \underline{F}_y$. As an example, if $\gamma = 1 \Rightarrow F_y = 0$ and the condition would follow for any positive amount of Z_y^*. In this case, there is again a commitment problem and mandatory participation can act as a commitment device for the young to credibly commit to paying the old in case capital return is low. If the pension fund cannot levy contributions on the young to repay the old, again an appropriate pension fund governance structure could be considered or the swap-transaction could be limited such that the young only use financial capital as collateral.

A special case arises when $H = 0$; then no transactions take place because both groups have exactly the same risk preferences. There is thus no $\widehat{r}^*$ for which there is simultaneously positive supply and positive demand; either both groups are in positive or both have negative demand for the swap-instrument.[7]

5.4 Conclusion

The literature on life-cycle saving and investing models suggests that young workers should invest more in stock than older workers because of their larger human capital. The optimal investment strategy of young workers may then be to go short in bonds to invest in stock; this strategy is however unfeasible if the young are borrowing constrained. In this case, a pension fund with strictly separated generational accounts is

[7] When $H = 0$, $\widehat{r}^* = \frac{(1-p)[n\overline{F}_y + \overline{F}_o]}{p[n\underline{F}_y + \underline{F}_o]} = \frac{(1-p)\overline{K}}{p\underline{K}}$
For this value of $\widehat{r}^*$ demand and supply equals zero, that is: $Z_y^* = Z_o^* = 0$.

suboptimal. This chapter has analyzed how a pension fund can improve welfare by lifting the borrowing constraint of young participants. It can do this by letting the young participants borrow from the old participants who want to lend. Lifting the borrowing constraint of participants has consequences for the pension fund's investment strategy and contribution policy. First, the investment risk at the pension fund level will increase. Second, if young participants borrow against their human capital, the young may need to repay out of their human capital; that is, the pension fund may give a negative pay-out to the young.

A pension fund with mandatory participation is in a unique position to facilitate optimal borrowing against human capital. The young essentially face a commitment problem when they borrow against their human capital. They want to commit credibly to repaying the old in case stock return is low. However, once young participants indeed need to repay, they have an incentive to resist repayment. Therefore insurance companies without mandatory participation cannot facilitate borrowing against human capital. A pension fund with mandatory participation can in principle enforce the promise of the young to repay the old, when necessary, out of human capital. Mandatory participation thereby acts as a commitment device for the young to repay their debt.

If contributions cannot be raised automatically however, then intergenerational conflicts may arise. Then the optimal investment policy can only be implemented by a proper governance structure, that considers the ex ante risk level and the contribution policy ex post jointly. If good governance cannot be organized, a risk immunization policy is a second-best solution. In that case only financial capital can be used as collateral, which limits the risk at the pension fund level.

The model used in this chapter is rich enough to show why participants are borrowing constrained and how this can be resolved by the pension fund. However, a richer model could, for example, include labor market distortions, a flexible retirement age, more generations, intra-generational heterogeneity, a more realistic capital market or a more general utility function. And while this chapter focuses on a potential conflict between participants, there may also be conflicting interests between participants and the sponsoring company, see Besley and Prat (2003) and Lavigne and Nze-Obame (2010). These limitations are acknowledged, but they do not affect the main message. If participants are borrowing constrained, then the pension fund may be able to improve welfare but this may result in conflicts between participants which good governance should address.

The most important drawback of the model is that it considers only one period. This hinders the analysis of dynamic effects, for example the possibility that old participants benefitted from lifting the borrowing constraint when they were young. A related issue is that the model does not include inflation risk; including inflation risk would also make that older generations also profit from the pension fund if the fund arranges intergenerational risk sharing.

These drawbacks are partly addressed by a variation on the base line model, where no riskless bond is available. This is in particular relevant for large pension funds, which internalize that a government bond, which best approximates a risk-free asset, is ultimately underwritten by tax-payers and that this group coincides with young participants. The pension fund can still improve welfare by setting up an internal market on which generations can swap risks. As human capital of the young may serve as collateral for the swap-transaction, the possibility of intergenerational conflicts and the need for good governance therefore remain.

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Chapter 6

Voters' commitment problem and the Timing of Welfare-Program Reforms

6.1 Introduction

[1] Public opinion research shows that the cards are very much stacked in favor of the welfare state status quo. A majority of the voters, including the crucial median voter who holds the median policy preference, cherishes core welfare programs such as public pensions and unemployment benefits and prefers to uphold the status quo rather than cutting back these programs (Boeri et al., 2001; Blekesaune and Quadagno, 2003; Becker, 2005; Brooks and Manza, 2006; Van Groezen et al., 2009; Schumacher et al., 2010). Consequently, vote-seeking political parties have the best chance of attaining their vote-seeking goal when they refrain from reforming these programs in the direction that the median voter dislikes, that is to say, by retrenching them. This (political) obstacle to reform is one of the central explanations in the comparative literature on welfare states for why welfare states remain remarkably stable despite mounting pressures for change, such as ageing populations and globalization (e.g. Pierson, 2001; Brooks and Manza, 2007).

Notwithstanding the serious political obstacles to reform, many governments in advanced democracies have pursued reforms that are unpopular according to public opinion data, for example increasing retirement age or cutting back benefits. When do governments do so? When are they willing to accept the electoral risk involved and pursue unpopular reforms of welfare programs? These are questions that have arrived at the forefront in the comparative welfare state literature (see e.g. Starke, 2006; Vis, 2010), but which are not answered satisfactorily yet. Most studies simply assume that when governments get the chance to reform, for instance because the institutions allow it, they will do so. When this involves reforms that are unpopular among most voters, hence including the median voter, the government will turn to so-called blame avoidance strategies to try to divert the blame attached to the reform (Weaver, 1986; Pierson, 1994; Vis and Van Kersbergen, 2007). A possible blame avoidance strategy is to find a scapegoat, like blaming the European Union (EU) for the measures taken. Another is to include the opposition into the reform plans, so as to offer the voter no other party to turn to. While providing useful insights into how reforms unpopular by the median voter can be implemented, this literature leaves unexplained why some governments do enact such reform and turn to blame avoidance strategies while other governments do not.

This study adds to the comparative welfare state literature by proposing a mechanism that simultaneously explains the occurrence and the timing of reforms in welfare programs that are unpopular among the median voter. Whereas there exists much political-economic literature about the commitment problem of politicians, the mechanism here, dubbed voters' commitment problem, instead derives from the commitment problem faced by voters. This chapter presents a simple game-theoretical model that formalizes how economic voting makes voters unable to commit to re-elect a government that will not reform during economic hardship. If voters vote economically, they – correctly or not – at least partly blame their government for

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weak economic performance (Tufte, 1978; Hibbs, 1979; Lewis-Beck and Paldam, 2000). The commitment problem of voters makes that vote-seeking governments are only willing to consider reform when they know they will likely be voted out of office anyway amidst economic hardship. Consequently, an electorate that opposes reform and a government implementing unpopular reform are reconcilable. The central empirical implication of our model is that reforms take place during economic downturns only. This implication tallies with the work of for instance Høj et al. (2006). Focusing on 21 OECD-countries between 1975-2003, Høj and colleagues find that economic crises, operationalized as output gaps larger than 4 per cent, are associated with more reform in the labor market and in the product market (see also Pitlik and With, 2003; Vis, 2010).

There is a prominent alternative explanation for the coexistence of economic lows and reforms. It may also result from a sense of urgency on the side of both voters and politicians. Reforms are easier accepted when the (perceived) need for it increases. Awareness and perceptions are indeed important factors which reinforce the mechanism put forward here. This study however takes the position that political outcomes are ultimately determined by preferences and incentives. This study shows that reforms, vote-seeking politicians and reform-hostile voters are reconcilable within a rational agent approach. This in itself does not show that this approach is the most suitable; it does show that the puzzle how and why vote-seeking politicians pursue reforms that voters don't want, need not be a puzzle.

The structure of the chapter is as follows. First, the comparative welfare state and political-economic literature on welfare reforms is discussed. It is argued that this literature does not adequately account for the occurrence and, especially, the timing of reforms unpopular with the median voter. Next, we introduce the game-theoretical model, whereby we begin by discussing three central assumptions of the model. Then, we turn to elaborating a special case of the model that provides some intuition on how the model works and subsequently elaborate the general, more realistic model. We end with some concluding remarks.

6.2 Related literature

When does reform of welfare programs that is unpopular among the median voter occur?[2] The answers put forward in the comparative welfare state literature and the political-economic literature on reform do not fully explain reform's timing, as we show below.

Comparative welfare state research

A first body of comparative literature on reforms of welfare programs that the median voter dislikes, argues that the main cause for pressure on the welfare state – and thereby for reform – is socio-economic change and the ensuing problem load (Rodrik, 1997; Garrett and Mitchell, 2001; Huber and Stephens, 2001; Pierson, 2001; Iversen, 2005). Theoretically, this argument makes sense. For example, if population ageing is projected to lead to budgetary problems, it is likely that the government will take measures to try to deal with the issue. However, the socio-economic account provides little theoretical footing as regards when exactly such measures are taken. When do governments pursue cutbacks that may be necessary, but which are also electorally risky? Why do some "objective" problems lead to reform yet others do not?

A second perspective on retrenchment of welfare programs focuses on political struggles, sometimes integrating socio-economic variables too. The argument is that the variation in the degree and type of reform is influenced by the partisan complexion of the government (e.g. Ross, 2000; Korpi and Palme, 2003; Allan and Scruggs, 2004) or by the dynamics of party competition (e.g. Kitschelt, 2001; Green-Pedersen, 2002). While offering useful insights into some of the factors that hinder or facilitate reform, this account cannot explain when governments engage in electorally risky activities. Why, for example, have unpopular measures been taken by some right-wing and by some left-wing governments in Germany, Denmark, and the Netherlands, but not by others (see Vis, 2009)?

A third body of comparative literature on unpopular reforms of welfare programs focuses on the influence of institutions. The usual argument is that countries with the least institutional hurdles, and therefore the highest degree of power concentration, should display the highest degree of reform. Consequently, reform should be higher in Westminster countries (such as the United Kingdom) than in political systems with a high level of power fragmentation (like Switzerland and the United States). Several empirical studies support this hypothesis (e.g. Bonoli, 2001; Swank, 2001). However, some authors note that

[2] This section draws heavily on Vis (2009).

the reverse relationship is also plausible (see Ross, 1997). Political systems concentrating political power also concentrate political accountability. As a result, '(...) voters know very well who they may blame for unpopular cutbacks' (Starke, 2006: 109). In political systems where power is fragmented, conversely, avoiding blame for unpopular measures is easier (Weaver, 1986; Pierson, 1994), which may result in more cutbacks. The institutionalist approach has been helpful for explaining the cross-national variation in welfare reform. However, it cannot explain the when of reform as governments in the same country face the same institutional constraints and opportunities (Armingeon et al., 2005), yet display various degrees of reform.

A final strand of literature proposes that ideas matter for retrenchment of welfare programs. The argument here is that by invoking a specific discourse or imperative, governments may overcome the hindrances to unpopular reform and successfully implement it (Cox, 2001; Schmidt, 2002; Stiller, 2010; see Campbell, 2002; Lieberman, 2002). Studies focusing on the importance of ideas have added to the knowledge of the process of unpopular welfare reform. However, this literature offers little theoretical foothold as regards when ideas matter (see Lieberman, 2002). Klitgaard (2007) offers a partial solution to the question of when retrenchment of welfare programs occurs by arguing that Social Democratic parties in universal (Social Democratic) welfare states pursue market-oriented reforms when the party elite considers the policy problems to be a threat to the welfare state's legitimacy. However, this explanation cannot be generalized to other type of parties or types of welfare regimes, as it premises on the assumption that the universal welfare state is a power resource for Social Democratic parties.

Political economy of reform of welfare programs

Next we discuss political-economic literature on reforms of welfare programs that are unpopular among the median voter. The studies we focus on deal with pension reforms but the arguments they present are not necessarily limited to the retrenchment of pension programs. Many pension reforms, in particular the increase of the retirement age, are taken during recessions. As these reforms hit virtually the whole population, they qualify as unpopular reforms that affect the median voter negatively. This is certainly not to deny that small incremental changes in pension entitlements may matter as well, but the model does not focus on these latter reforms.

Selén and Ståhlberg (2007) posit that the pension reform in Sweden, which gradually transformed the public defined-benefit pension system into a so called notional defined contribution one, could be implemented successfully because the reform would benefit a majority of the voters. Adopting a political-economic perspective, they argue that the winners who would vote in favor of the reform outnumber the losers who would vote against it, accounting for the reform. The underlying assumption that voters know ex ante, and with a fair amount of certainty, if they are a winner or loser of the reform is problematic. For most voters, pension systems are complex – to say the least. Calculating the present value of expected pension benefits and expected contributions in the old and the proposed new system is something that surely goes well beyond the capacities of the 'average' voter (see Boeri et al. 2002).

In a recent political-economic contribution, Kemmerling and Neugart (2009) propose that countries in which financial markets are politically powerful – measured by among other things the degree of assets held by institutional investors as a share of GDP –, are more likely to pursue pension reform that increases the private savings component. The reason is that financial markets have an interest in such reforms, as they typically manage defined-contribution schemes. Although this argument is plausible, it fails to account for the large-scale pension reform that included a shift toward defined-contribution in, for example, Sweden (Selén and Ståhlberg, 2007), as the financial market of that country is comparatively weak (BIS, 2007).

6.3 The model

This chapter proposes a new mechanism, labelled voters' commitment problem, to account for the timing of reforms of welfare programs in democratic systems that are unpopular among the median voter. The thrust of the argument is that due to economic voting voters cannot commit to re-elect a government that will refrain from reform when the economy is in a poor state. Due to this commitment problem, reforms of welfare programs take place during economic lows only.[3] Elections come with a pre-election commitment

[3] This mechanism differs from political-economic explanations that focus on the absence of reform. This body of literature has often assigned the absence of reform to the 'nonneutrality' in the distribution of gains and losses in society. Reform is

problem on the part of politicians, as they cannot commit themselves to implement the plans they propagate during elections. When in office, they may use their power to break the election promise with the voters. The crucial aspects of elections, the ability to 'throw the rascals' out at the next election, partly solves this commitment problem. There is however a similar commitment problem between elections on the side of the voters. This problem results from economic voting. Voters generally oust a government during an economic recession because they blame politicians, at least partly, for poor economic performance. Due to the omnipresence of economic voting (see below), the promise to do otherwise in the absence of reform is not credible. The pledge of the median voter before the election to re-elect the government if it refrains from an unpopular reform is not believable and certainly not enforceable. Consequently a vote-seeking government might reform during a recession, as reform of one or more welfare programs will hardly influence the prospect of re-election.

To formalize the argument, a tractable game is proposed that captures economic voting and the commitment problem that comes with it in a simple way. First, the players and their preferences (section 3.1) are discussed and then the assumptions of the model (section 3.2). Then, the set-up of the model (sections 3.3) is discussed, followed by a special case of the model that provides insight and intuition about how elections can discipline politicians (section 3.4). Finally, the most general version is presented (sections 3.5 and 3.6).

A game-theoretical model allows formalizing the argument and thereby ensuring its internal consistency. The logic of the model may also lead to results not easily thought of otherwise. For example, in the model political parties may face a coordination problem between two equilibria (one reforming, the other not). This shows that postulating the voter's commitment problem does not just mechanically lead to presence of reforms during recessions but reveals a more subtle potential problem in democratic processes. The logic of economic voting leads to the possibility of parties colluding or coordinating on reforms. It would subsequently be interesting to operationalize this collusion empirically or think about ways the democratic process could address this.

Players and preferences

First the preferences of the players in the game are discussed. There are three players: two politicians and one voter (the median one). Focusing on one voter only may seem too strict an assumption and one that does away too easily with voters' possible heterogeneous preferences regarding reform. Although it is not dismiss that the voters' preferences may very well vary, from the perspective of the governing party (or parties in a coalition government), the median voter's preferences are key. There is an extensive body of literature that shows that mainstream parties, which typically make up the government, cater to precisely this median voter (e.g. Adams et al., 2004, Adams et al., 2006, Adams et al., 2009; Ezrow et al., 2010). If the median voter opposes reform of one or more welfare programs – either because it hurts his or her own consumption directly or because he or she sociotropically cares about the income of welfare programs' recipients –, the reform entails an electoral risk for the governing party (or parties).

There is ample survey research showing that the median voter prefers the status quo to reform, see Boeri et al. (2001). Reform of one or more welfare programs is thus politically risky and something one would theoretically expect vote-seeking parties to steer clear from. The model identifies those conditions under which vote-seeking parties reform nonetheless. The focus on two politicians, who can be seen as two political parties, means that the model applies directly to two-party systems such as the US, Malta or – to a lesser extent – the UK

The two politicians both have a time-additive utility function, V_t, with a felicity function $U(x_i)$ that is concave and positive and where x_i represents consumption at time i. The discount rate is β. The utility-function at time t is given by:

$V_t = \sum_{i=t}^{\infty} \beta^{(i-t)} U(x_i)$

non-neutral because the winners from the status quo are assumed to be politically strong, whilst the losers are politically weak. Fernandez and Rodrik (1991) expand the argument, stating that it is the uncertainty about the distribution of gains and losses that impedes reform. If some of the winners and losers of the reform cannot be identified ex ante, the status quo is likely to prevail. In principle, reform and its absence are two sides from the same coin. However, a number of important theories accounting for the absence of reform fail to adequately explain its occurrence. Pierson's (2001) argument that political obstacles impede reform is one of them. Also Fernandez and Rodrik's (1991) work helps one to explain better the absence of reform than its presence, although the latter authors do specify a condition under which reform occurs (certainty over the distribution of gains and losses).

At each point of time one and only one politician holds office. If a politician is out of office, he or she does not have any decision to make and utility is normalized to 0. If the politician is in office he or she receives a positive endowment $w > 0$.

The median voter also has a time-additive utility function with a well-behaved felicity function, denoted $W(c)$. In each period the voter consumes c_g in good economic times and c_b in bad economic times with $c_g > c_b > 0$. We assume, realistically as we argue above, that the median voter dislikes reform. The negative effect of a reform equals θ of consumption. This cost of reform is strictly positive. We think of this as the real costs of reform to the median voter -not necessarily all voters-, an example being less generous unemployment insurance or pension benefits. However it can be perfectly be (re)interpreted (partly) as the psychological costs of any deviation from the status quo. Research on habit formation shows that many people prefer the status quo (the 'status quo bias') to change. The costs are positive but consumption in both economic circumstances remains positive, so $c_g - \theta > c_b - \theta > 0$. As the felicity function is increasing in consumption it follows that $W(c_g - \theta) > W(c_b - \theta)$.

The preferences of the median voter are therefore such that under all circumstances he or she prefers no reform (the status quo) to reform. It is further necessary to assume that reforms are the only (salient) issue in elections.

Assumptions

The model hinges on three underlying assumptions. The first is that reforms are unpopular among (most) voters and, crucially important, the median voter. It was already argued that public opinion research into voters' preferences regarding welfare programs and reforms therein offers ample support for the plausibility of this assumption. Boeri et al. (2002), for example, find in a survey of the opinions on pension reform in Germany and Italy that most voters, including the median voter, oppose reform in welfare programs and instead favor the state quo. Related, Van Groezen et al. (2009) find that a preference for the status quo induces voters, again including the median one, to be weary of pension reforms, even if these might improve their financial position in the longer term. Other scholars have found similar preferences as well for welfare programs other than pensions (e.g. Boeri et al., 2001; Blekesaune and Quadagno, 2003; Becker, 2005; Brooks and Manza, 2006; Schumacher et al., 2010).

A second assumption is the imminence of economic voting. There is a widespread consensus in the literature that economic voting is 'a generalized phenomenon in industrial democracies' (Pacek and Radcliff, 1995: 44; see Van der Brug et al., 2007), indicating that this is a plausible assumption. This does not mean that economic voting is equally strong in all electoral systems. In majoritarian systems, which typically have a one-party government, it is clear who is to blame for the economic failure. This higher clarity of responsibility makes that voters are more likely to vote retrospectively (that is economically) than in systems with lower degrees of clarity. Examples of the latter are systems with minority governments or parliamentary ones (Powell and Whitten, 1993; see also Whitten and Palmer, 1999). Since the game-theoretical model is closest to a majoritarian system with a one-party government, the lower relevance of economic voting in other electoral systems is not a problem.

A final assumption is that governments are first and foremost vote-seeking (Downs, 1957), but that they can also be office-seeking or policy-seeking. This assumption follows the behavioral literature on political parties (Strøm, 1990; Müller and Strøm, 1999). In the model, a government faces a trade-off between 1) remaining in office by catering to the wishes of the median voter, which means the government behaves vote-seeking, and 2) exclusion from office by adopting a policy that goes against the wishes of the median voter, which means that the government acts policy-seeking. In particular, when facing sure electoral defeat the policy-seeking motive dominates, as winning office is no longer possible.

Note that since both the median voter and the politicians are rational and forward-looking in the model, the argument offers a rationalization of the occurrence and timing of reforms and thereby does not depend on bounded rationality or irrationality of any actor, which is not to deny that both may be relevant.

The stage-game

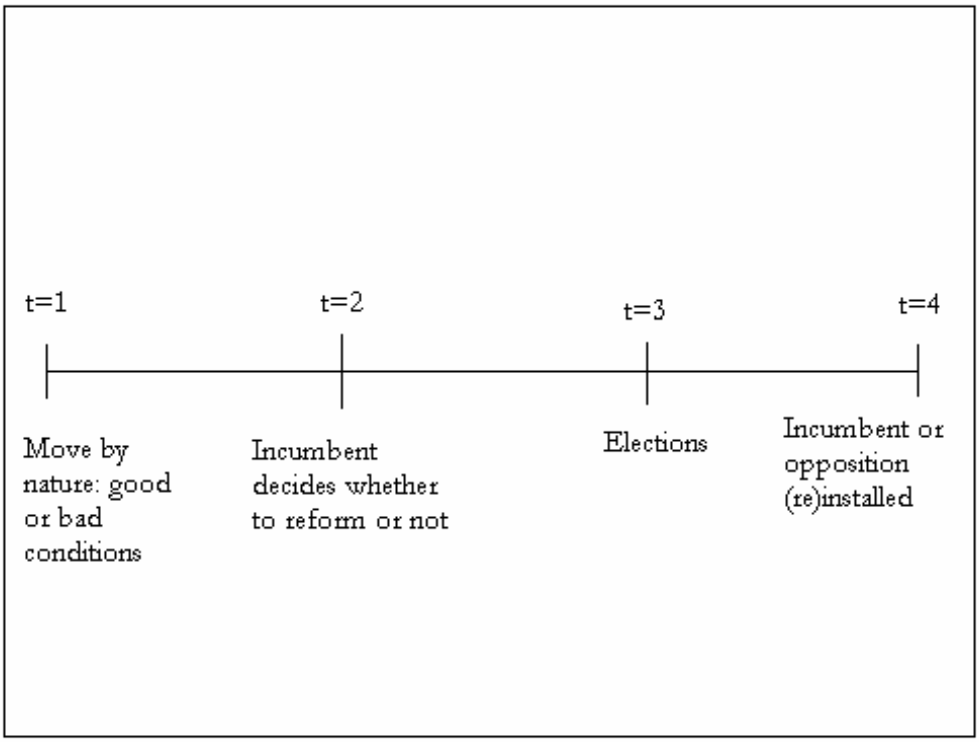
For both the politician in office and the median voter, the following stage game unrolls:

1. There is a move by nature that determines the economic circumstances. With probability λ the economic circumstances are good, with probability $1 - \lambda$ they are bad.

2. Next, the politician in office can choose between two actions. The first is to reform, the second is to stick to the status quo with no reform. In the case of reform, the politician receives, next to w, a positive

amount $r > 0$. This may be interpreted as his or her personal benefit of reforming, for instance in the form of ideological satisfaction.

3. After observing the state of the economy and the action of the politician, the median voter has the option to either re-elect the politician or not. If the politician is not re-elected, the other politician is automatically elected. The graph depicts the sequence of the stage game where the (re)instalment of the new government at t = 4 closes the stage game.



The action space of the politicians consists of two actions, reform and no reform. The action space of the median voter also consists of two actions, re-election or no re-election. Strategies and equilibria are restricted in several ways. First, only pure strategies are considered. Second, attention is restricted to Markov equilibria. In Markov equilibria, actions of players are a function of the current, pay-off relevant state. Here this state is defined as the state of the economy (either good or bad). This rules out that the players condition their actions on the entire economic history or the history of others players' actions. Third, as the two politicians are identical, only symmetric equilibria are considered.

For the politician a strategy maps the state of the economy into the action reform or no reform. A strategy thus consists of a pair that prescribes the action when the economy is in a bad and good state, respectively. The voter has a strategy that maps the economic condition and the action of the politician into the action re-election or no re-election. Therefore the strategy of the voter has to prescribe an action in four circumstances, conditional on the state of the economy (either good or bad) and on the action of the politician.

Equilibria with perfect conditioning

First, the situation where the voter can condition re-election perfectly on the occurrence of reform is considered. This is a special case of the more general version of the model that is presented later. Economic circumstances are not relevant in this first model, which means that the voter has the optimal strategy to re-elect a politician that does not reform and does not re-elect a politician that reforms. Subsequently, there

are two potential pure strategy equilibria; one with both politicians always reforming and one with both politicians never reforming.

The equilibrium with both politicians always reforming occurs if the following condition holds[4]:

$$U(w+r) - U(w) > \frac{\beta}{1-\beta} U(w) - \frac{\beta^2}{1-\beta^2} U(w+r) \qquad (i)$$

The left-hand side gives the immediate gain of reforming compared to not reforming. The right-hand side gives the difference of the remaining lifetime utility of never reforming and the lifetime utility of always reforming (given that the other politician always reforms). In the latter case both politicians are in office every second period and reform when they are. Under condition (i), given that the other politician always reforms, it is best to do likewise. As the two politicians are similar, this constitutes a Nash-equilibrium. Note that if $\beta = 0$, the condition is always met, as $r > 0$. In that case, future income is not considered at all and reforming is more attractive.

Another possible equilibrium is one with both politicians not reforming. A necessary condition for such an equilibrium is:

$$U(w+r) - U(w) < \frac{\beta}{1-\beta} U(w) \qquad (ii)$$

Note that if $\beta = 0$, the condition is never met. This condition states that – given that the other politician never reforms – never reforming and hence holding office forever after, leads to higher life-time utility than reforming once and never being (re)elected again.

Summarizing, there are three possibilities.

1. $U(w+r) - U(w)$ is small and condition (ii) is met and condition (i) is not met. This means that lifetime utility of always holding office is large. Reforming is not attractive, even if the other politician does likewise. The equilibrium with both politicians never reforming occurs.

2. $U(w+r) - U(w)$ is large and condition (i) is met and condition (ii) is not. Utility of even a onetime reform is large and there will always be reform. In that case there is no way for the voter to discipline the government by not re-electing him.

3. $U(w+r) - U(w)$ has an intermediate value and both condition (i) and (ii) are met. In this case both equilibria are possible. Which one occurs, depends on the ability of the two politicians to coordinate on the equilibrium of both of them reforming. This latter equilibrium provides both politicians with a higher lifetime utility than the equilibrium where both never reform.

This third case is arguably the most interesting case as it results in a coordination problem where both politicians can coordinate on an equilibrium that benefits them but is not in the interest of voters. As indicated such a situation is perfectly reconcilable with a democratic process and vote-seeking parties because of the commitment problem of voters. The outcome is then that both parties constantly pursue reforms voters dislike.

If the politicians indeed succeed in coordination, a further strategy of the voter could be to never re-elect one of the two politicians once he reformed and to always re-elect the other one, irrespective of him reforming or not. With such a strategy of the voter, the politician who is targeted by the voter, will not reform. Note that it is not possible that both conditions are not met, as the right-hand side of condition (ii) is larger than the right-hand side of condition (i).

Equilibria with economic voting

This section considers the more general and more realistic version of the model wherein the voter can only condition re-election imperfectly on the action of the politician in office. As an extreme case of economic voting, the politician is never re-elected when the economy is slowing down, irrespective of whether he reformed. This constitutes the commitment problem of the voter who cannot credibly commit to re-electing a government that does not reform. Consequently, the politician will always reform during a recession. For the politician reforming does not alter the prospects of being re-elected while there is a positive pay-off $r > 0$. During booms, a politician is still never re-elected after a reform, as before.

[4]Here and in the remainder of the chapter, the familiar convergence result of a geometric series is used.

Again, two equilibria are possible. The appendix shows the following necessary condition (iii) for an equilibrium where both politicians will not reform in good times; this is the analogy of condition (ii):

$$U(w+r) - U(w) < \frac{\beta(1-\lambda\beta)(\lambda U(w)+(1-\lambda)U(w+r))}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2} \qquad (iii)$$

Note that condition (iii) reduces to condition (ii) if $\lambda = 1$. In this particular case economic circumstances are always positive and the voter can perfectly condition re-election on the actions of the politicians. Note also that if $\beta = 0$, the condition never holds; in that case the future is not taken into account by both politicians and they will therefore always reform.

For the equilibrium with both politicians reforming the necessary condition reads:

$$U(w+r) - U(w) > \frac{\beta(\lambda U(w)+(1-\lambda)U(w+r))}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2 U(w+r)}{1-\beta^2} \qquad (iv)$$

Note that, as before, condition (iv) reduces to condition (i) if $\lambda = 1$. Note also that if $\beta = 0$, the condition always holds.

The appendix shows that the right-hand side of condition (iii) is larger than the right-hand side of condition (iv). Therefore it is not possible that both conditions are not met and there is always at least one equilibrium. Generally, there are again three possibilities. A unique equilibrium with both politicians always reforming; a unique equilibrium with both never reforming during booms; and the possibility that there are two equilibria. Which one occurs in the latter case depends on which equilibrium the two politicians coordinates. The equilibrium where both reform has higher life-time utility than the one where neither reforms. This follows from the observation that condition (iii) is met and it is then better not to reform than to reform, given that the other politician does not reform. Condition (iv) is also met, implying that it is better to reform than not to reform, given that the other politician reforms. It holds that not reforming when the other reforms gives a higher lifetime utility than not reforming when the other does not reform. In both cases, the politician has the same income when in office and is only out of office after bad economic circumstances. In the latter case however the probability of coming back into office is smaller, as the other politician does not reform during booms. Combining these observations, it holds that in the case of multiple equilibria, the two politicians have higher lifetime utility in the equilibrium of both reforming than of both not reforming. For the voter the opposite holds; the equilibrium with both not reforming provides higher lifetime utility.

Comparative statics

This section investigates the comparative statics to assess how the willingness to reform and the ability of voters to discipline politicians is influenced by the four different parameters in the model (see table 1).

Table 1.

Comparative statics	Condition (iii)	Condition (iv)
w	+	−
r	−	+
λ	+/−	+/−
β	+/−	+/−

It can be shown that, ceteris paribus and for all w, condition (iii) will more likely be met when the endowment w increases, that is the right-hand side increases more than the left-hand side. If the endowment increases, reform is less likely to occur. This follows as reform leads to the loss of the endowment w in the next period and possibly subsequent periods. The higher this loss is, the less likely a government is to reform. This implies that higher income for government members – the endowment w – decreases the probability of reforms during prosperous economic times. The opposite holds for condition (iv); the higher w is, the less likely the condition is met and the less likely is an equilibrium with both reforming.

Furthermore, ceteris paribus and for all r, condition (iii) will less likely be met when rents r increase; then the right-hand side decreases more than the left-hand side. The higher r is, the more likely reform is. This formalizes that higher rents of reform make its undertaking more attractive. The opposite holds for

condition (iv); the higher is r, the more likely the condition is met and the more likely is an equilibrium with both reforming.

For both conditions, the comparative statics of λ and β are not straightforward. The partial derivative of the bound can be both positive and negative. This means that a higher value of the probability of economic hardship and a higher value of the discount rate do not have an unambiguous effect. Consider for example the equilibrium that both reform during good economic times (and are voted out of office because of that). A higher subjective discount rate probability increases the value of keeping office as the expected future gains that come with it increase. However, it also increases the discounted values of future reforms during good times. These counteracting effects depend on the discount factor β in a non-linear way. Neither of the effects dominates and thus the net effect can go both ways. The sign depends on the particular values of the parameters and the functional form of the utility function, making general predictions of the effect impossible.

A positive effect of reform on economic conditions

The basic model postulates that reforms do not affect the economy besides a positive endowment for the reforming politician -interpreted as rents- and a one-time negative impact on the median voter. While this is enough to capture the mechanism we focus on -the voter's commitment problem- this does away with the possibility that reforms will eventually increase (or decrease) welfare. One could for example argue that pension reforms -while lowering utility of the median voter- have a positive impact on welfare of future generations, see for example Browning (1975).

To incorporate such effects fully the probability of the economy being in a good state should be dependent on all previous reforms. This can be done in numerous and complicated (non-linear) ways. This section considers the simplest version that one and only one reform leads to a one-time increase in the probability the economy is in a good state from λ to λ^*. First we consider preferences and actions of voters, then strategies of politicians.

Thusfar the interpretation of the median voter was immaterial to the outcomes of the model. When current actions affect future periods, the interpretation becomes important. Two interpretations of the median player are possible. If the median voter differs each period with current young and unborn voters being the median voter of the future, it is clear that at one point future voters want a reform that results in λ^* while the current median voter might not want a reform. In these cases reform is beneficial to future (median) voters and current politicians but not to the current median voter.

If however the median voter is interpreted as a long-lived player, (s)he may also prefer a one-time reform (and none thereafter) during economic prosperity to no reforms at all if the following condition is met:

$$W(c_g - \theta) + \tfrac{\beta}{1-\beta}[\lambda^* W(c_g) + (1-\lambda^*)W(c_b)] > W(c_g) + \tfrac{\beta}{1-\beta}[\lambda W(c_g) + (1-\lambda)W(c_b)] \qquad (v)$$

For the median voter there is now a trade-off between the immediate negative impact, captured by θ and the future benefit of the reform, indicated by $\lambda^* > \lambda$.

However beyond the first reform the median voter does not want any further reforms due to the assumption that only a one-time increase in λ. is possible.

A politician facing a reform decision now not only faces the current gain of a reform, given by r, but also the long-term impact given by λ^*. In principle the increase of λ is not in the advantage of the politician, as (for now) it does not raise the probability of being re-elected while it does lower the probability of being in office any time soon. In the extreme case when $\lambda^* = 1.$, the politician may never be in office again. The paradoxical situation may then result that both politicians never reform (that is neither in bad and good economic times) if the following condition holds:

$$U(w)[1 + \beta\tfrac{(1-\lambda)\beta}{1-2\beta\lambda-\beta^2+2\lambda\beta^2}] > U(w+r) + \beta\tfrac{(1-\lambda^*)\beta[\lambda^* U(w)+(1-\lambda^*)U(w+r)]}{1-2\beta\lambda^*-\beta^2+2\lambda^*\beta^2} \qquad (vi)$$

(This expression is derived under the assumption that the equilibrium with both not reforming results after one reform, see appendix for the details.) The extension thus leads to a new equilibrium with both politicians never reforming, expanding the types of equilibria that can be rationalized. It is thus possible that future median voters do want a one-time reform but this never happens because the reforming party

thereby not only increases the probability the economy ultimately prospers but also that the other party remains in office.

As indicated above the median voter, when interpreted as a long lived player, may desire a reform if condition v is met, but does not necessarily do so.

In that case the median voter may consider reelecting a government that reforms during an economic upswing (during busts the commitment problem hinders this still) if this is the first reform. After any subsequent reform voters do not reelect the reforming government. This strategy will induce a party to reform as it now receives both the rents from reforming and remains in office. However, this will also trigger multiple reforms later on when times are bad and that the median voter dislikes. The median voter will reward the first reform nonetheless if the increase in λ is large enough. Formally the following condition is necessary for the median voter to reelect during a boom the first party that reforms:

$$W(c_g - \theta) + \tfrac{\beta}{1-\beta}[\lambda^* W(c_g) + (1-\lambda^*)W(c_b - \theta)] > W(c_g) + \tfrac{\beta}{1-\beta}[\lambda W(c_g) + (1-\lambda)W(c_b)]$$

(This expression is again derived under the assumption that the equilibrium with both not reforming results after one reform. If however the equilibrium with both parties always reforming results the condition becomes harder to fulfill as then the utility during good economic times equals $W(c_g - \theta)$ after a reform.) The condition describes the situation that voters prefer for example a one time reform to the pension system but reject incremental cut-backs.

As said, a more complicated relation between the number of reforms and the probability λ is both possible and reasonable. The model can likewise be extended in several other ways. More parties than two could be considered or more issues or changing preferences of voters (due to heterogeneous preferences). This adds to plausibility of assumptions and thereby to validness of results. However, it also makes the model more complex and analytical solutions can quickly become intractable if not non-existent. More important, the basic arguments of this paper can be formalized and analyzed in the basic set-up put forward here.

6.4 Discussion and conclusion

Under which conditions do vote-seeking governments pursue reforms in welfare programs that are unpopular among the median voter and that, consequently, likely lead to electoral punishment? Existing work in comparative welfare state research and the political economy of reforms offers some helpful starting points, but do not provide a convincing answer to this question. This chapter presented a simple game-theoretical model to identify under which conditions politicians pursue unpopular reforms and when they do not. It was shown that parties that primarily seek votes can still opt to reform welfare programs when the very same voters the parties adhere to do not want that. The model stacks the cards against this outcome by assuming that parties are first and foremost vote-seeking and that voters are reform-averse. The model shows that even in this reform-hostile setting, a reform of welfare programs in a democracy is reconcilable with the median voter opposing such reforms.

The most interesting outcome is that for a relevant range of parameters the political parties face a coordination problem. It is in their advantage to coordinate on an equilibrium with both constantly reforming. This hurts the median voter, but (s)he cannot prevent this due to an inherent and unavoidable commitment problem caused by economic voting. An extension of the model considers the situation where the probability of future prosperity is positively influenced by a first reform. The paradoxical outcome may result that an equilibrium with both parties never reforming is possible, although future voters want this first reform. When the median voter is interpreted as a long-lived player, it is even possible that the current median voter wants the reform. In this case the median voter may agree with an initial reform that increases future welfare while simultaneously disliking the future reforms that are triggered by it.

The result of the model helps solving a theoretical puzzle in the literature on reforms in welfare programs that are unpopular among the median voter. In line with for example Høj et al. (2006), the empirical implication of the model is that reforms of welfare programs, if at all, are initiated during recessions. The contribution lies in presenting the underlying theoretical mechanism that the occurrence and timing of reforms spring from an intrinsic commitment problem of voters in times of economic recession. Due

to economic voting, there is a high chance that the incumbent party or parties will not be re-elected, irrespective of their particular policy. Subsequently, the vote-seeking motive of parties gives way to a policy-seeking motive of governments. Subsequently, the policy-seeking motive of governments prevails over the vote-seeking motive which in principle has priority for political parties.

The empirical implication of the model, reform occurring during economic lows, contributes to the socio-economic account in the comparative literature on the welfare state by identifying the condition under which an "objective" socio-economic problem matters: socio-economic dire straits. Economic setbacks allow a government to act against the wishes of the median voter, as the government knows that the poor socio-economic situation is likely to lead to electoral defeat anyhow. Moreover, and putting theoretical body to the literature on ideas, a poor socio-economic state enables a government to act on its ideas or interests. As regards studies focusing on partisanship, the model shows that the color of the government does not matter, as both leftist and rightist politician face a median voter that opposes reform of welfare programs. The empirical work of for instance Vis (2010) corroborates this prediction.

The model with two politicians and one voter (the median one) captures advanced democracies with a two-party system and majority, or plurality, one-party government. The number of such countries is low since most countries have more than two parties (although when the number of parties is low, single-party governments still emerge typically). In future work, it would be interesting to see if expanding the number of parties, and thus politicians, in the model changes the outcome of the game.

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6.5 Appendix

This appendix derives some results given in the main text.

Derivation of equation (iii)

Equation (iii) gives the condition for the equilibrium where both politicians do not reform during booms:

$$U(w+r) - U(w) < \frac{\beta(1-\lambda\beta)(\lambda U(w)+(1-\lambda)U(w+r))}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2} \qquad (iii)$$

To derive this condition, assume the first of the two politicians does not reform. It is best for the second politician to do likewise if, given the first politicians' strategy, the life-time utility of no reform is at least as high as that of always reforming.

If the second politician reforms during good times, he has utility $U(w+r)$ when in office and is then voted out. When out of office he will at one point be back in office, so he also has a positive life-time utility at the beginning of the next period when still out of office, denoted here U^{out}. U^{out} can be determined in a recursive manner:

$$U^{out} = (1-\lambda)[\beta U(w+r) + \beta^2 U^{out}] + \beta\lambda U^{out}$$

With probability $1-\lambda$ economic circumstances will be bad, and the other party will be voted out. Then the politician will be back in office within one period. Otherwise, he remains out of office which provides lifetime utility of U^{out} the next period. Solving this equation:

$U^{out} = \frac{(1-\lambda)\beta}{1-\beta\lambda-(1-\lambda)\beta^2}U(w+r)$

This gives life-time utility of reforming of:

$U(w+r) + \beta U^{out} = U(w+r) + \beta\frac{(1-\lambda)\beta}{1-\beta\lambda-(1-\lambda)\beta^2}U(w+r)$

If the second politician does not reform during good times, he has utility $U(w)$ and he stays in office. This gives lifetime utility:

$U(w) + \beta U^{in}$

It remains to determine U^{in}. This can be determined with the following two equations:

$U^{in} = \lambda[U(w) + \beta U^{in}] + (1-\lambda)[U(w+r) + \beta U^{out}]$

$U^{out} = \lambda\beta U^{out} + (1-\lambda)\beta U^{in}$

Here U^{in} and U^{out} are the lifetime utility of entering the stage game while being in and out of office respectively. When a politician is currently in office, he faces a probability λ that economic times will be good. If so, he receives both his endowment w and he remains in office, which offers again the prospect of U^{in} the next period, discounted by β. With a probability $1-\lambda$ economic times will be gloomy, in which case he will reform and thus receive $w+r$. In the next period he will be out of office, and has the prospect of U^{out}, discounted.

Now consider the latter equation:

$U^{out} = \lambda\beta U^{out} + (1-\lambda)\beta U^{in} \Longrightarrow U^{out} = \frac{(1-\lambda)\beta}{1-\lambda\beta}U^{in}$

This gives an expression for U^{in} in terms of U^{out}. Using this:

$U^{in} = \lambda[U(w) + \beta U^{in}] + (1-\lambda)[U(w+r) + \beta U^{out}] \Longrightarrow U^{in} = \lambda[U(w) + \beta U^{in}] + (1-\lambda)[U(w+r) + \frac{(1-\lambda)\beta^2}{1-\lambda\beta}U^{in}] \Longrightarrow$

$U^{in} - \beta\lambda U^{in} - \frac{(1-\lambda)^2\beta^2}{1-\lambda\beta}U^{in} = \lambda U(w) + (1-\lambda)U(w+r) \Longrightarrow U^{in}[1-\beta\lambda - \frac{(1-\lambda)^2\beta^2}{1-\lambda\beta}] = \lambda U(w) + (1-\lambda)U(w+r) \Longrightarrow$

$U^{in}[\frac{(1-\beta\lambda)^2-(1-\lambda)^2\beta^2}{1-\lambda\beta}] = \lambda U(w) + (1-\lambda)U(w+r)$

Now it remains to working out the brackets:

$U^{in}[\frac{(1-\beta\lambda)^2-(1-\lambda)^2\beta^2}{1-\lambda\beta}] = \lambda U(w)+(1-\lambda)U(w+r) \Longrightarrow U^{in}[\frac{1-2\beta\lambda-\beta^2+2\beta^2\lambda}{1-\lambda\beta}] = \lambda U(w)+(1-\lambda)U(w+r) \Longrightarrow$

$U^{in} = \frac{1-\lambda\beta}{1-2\beta\lambda-\beta^2+2\beta^2\lambda}[\lambda U(w) + (1-\lambda)U(w+r)]$

Lifetime utility of no reform is:

$U(w) + \beta U^{in} = U(w) + \beta\frac{1-\lambda\beta}{1-2\beta\lambda-\beta^2+2\beta^2\lambda}[\lambda U(w) + (1-\lambda)U(w+r)]$

The politician will not reform if:

$U(w) + \beta\frac{1-\lambda\beta}{1-2\beta\lambda-\beta^2+2\beta^2\lambda}[\lambda U(w) + (1-\lambda)U(w+r)] > U(w+r) + \frac{(1-\lambda)\beta^2}{1-\beta\lambda-(1-\lambda)\beta^2}U(w+r)$

Derivation of condition (iv)

An equilibrium with both reforming may arise if:

$$U(w+r) - U(w) > \frac{\beta(\lambda U(w)+(1-\lambda)U(w+r))}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2 U(w+r)}{1-\beta^2} \qquad (iv)$$

Given that the other politician reforms, it is best to do likewise during a boom if the life-time utility of reform is at least as high as that of not reforming during booms. If the politician also reforms, he has $U(w+r)$ immediately and every second period. This leads to life-time utility of:

$\frac{1}{1-\beta^2 U(w+r)} = U(w+r) + \frac{\beta^2}{1-\beta^2}U(w+r)$

When the politician does not reform he receives utility $U(w)$ and stays in office. Denote the lifetime utility of being in office U^{in} and of being out of office U^{out}. These can be determined by solving the following two equations that recursively define both:

$U^{in} = \lambda[U(w) + \beta U^{in}] + (1-\lambda)[U(w+r) + \beta U^{out}]$

$U^{out} = \beta U^{in}$

Solving these two equations gives:

$U^{in} = \frac{\lambda U(w)+(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2}$
This gives the condition for both reforming:
$U(w+r) + \frac{\beta^2 U(w+r)}{1-\beta^2} < U(w) + \beta\frac{\lambda U(w)+(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2}$

Right-hand side of condition (iii) larger than that of condition (iv)
Condition (iii) and (iv) are respectively:
$U(w+r) - U(w) < \frac{\beta(1-\lambda\beta)(\lambda U(w)+(1-\lambda)U(w+r))}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2} \qquad (iii)$
$U(w+r) - U(w) > \frac{\beta(\lambda U(w)+(1-\lambda)U(w+r))}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2 U(w+r)}{1-\beta^2} \qquad (iv)$
To show:
$\frac{\beta(1-\lambda\beta)(\lambda U(w)+(1-\lambda)U(w+r))}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)U(w+r)}{1-\beta\lambda-(1-\lambda)\beta^2} > \frac{\beta(\lambda U(w)+(1-\lambda)U(w+r))}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2 U(w+r)}{1-\beta^2}$

First note that: $\frac{\beta^2}{1-\beta^2} > \frac{\beta^2(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2}$
This follows from:
$\frac{\beta^2}{1-\beta^2} > \frac{\beta^2(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2} \iff \frac{1}{1-\beta^2} > \frac{(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2} \iff$
$1-\beta\lambda-\beta^2+\lambda\beta^2 > (1-\lambda)(1-\beta^2) \iff 1-\beta\lambda-\beta^2+\lambda\beta^2 > 1-\lambda-\beta^2+\lambda\beta^2 \iff$
$-\beta\lambda > -\lambda$
Second note that:
$\frac{\beta(1-\lambda\beta)}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2} > \frac{\beta}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2}{1-\beta^2}$
This follows from:
$\frac{\beta(1-\lambda\beta)}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} - \frac{\beta^2(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2} > \frac{\beta}{1-\beta\lambda-(1-\lambda)\beta^2} - \frac{\beta^2}{1-\beta^2} \iff \frac{\beta}{1-\beta^2} + \frac{(1-\lambda\beta)}{1-2\beta\lambda-\beta^2+2\beta^2\lambda} > \frac{\beta(1-\lambda)+1}{1-\beta\lambda-(1-\lambda)\beta^2}$
For $\lambda = 0$, there is equality with both terms equaling $\frac{1+\beta}{1-\beta^2}$. The derivative of right-hand side with respect to λ equals zero, whereas the derivative of the left-hand side is proportional to $\beta(1-\beta)^2 > 0$. Therefore the left-hand side is larger than the right-hand side for all $0 < \lambda < 1$. As this holds for all $0 < \beta < 1$, the inequality follows.

From this inequality the original condition follows if $r = 0$. When $r > 0$, it holds that $U(w+r) > \lambda U(w) + (1-\lambda)U(w+r)$. From $\frac{\beta^2}{1-\beta^2} > \frac{\beta^2(1-\lambda)}{1-\beta\lambda-(1-\lambda)\beta^2}$ it follows that the right-hand side decreases faster in r than the left-hand side. Therefore the condition also holds for any $r > 0$.

Derivation of condition (vi)

Both politicians may never reform if the following condition holds:
$U(w)[1+\beta\frac{(1-\lambda)\beta}{1-2\beta\lambda-\beta^2+2\lambda\beta^2}] > U(w+r) + \beta\frac{(1-\lambda^*)\beta[\lambda^* U(w)+(1-\lambda^*)U(w+r)]}{1-2\beta\lambda^*-\beta^2+2\lambda^*\beta^2}$
Given that the other politician never reforms, it is best to do likewise if the life-time utility of never reforming is at least as high as that of reforming (and being ousted). If the politician never reforms, he has $U(w)$ immediately. If he stays in office he has U^{in} the next period, U^{out} otherwise. It remains to determine U^{in} and U^{out}. These follow from the following two conditions:

$U^{in} = U(w) + \beta[\lambda U^{in} + (1-\lambda)U^{out}]$
$U^{out} = \beta[\lambda U^{out} + (1-\lambda)U^{in}] \Longrightarrow U^{out} = \frac{(1-\lambda)\beta}{1-\beta\lambda}U^{in}$
Combining gives:
$U^{in} = U(w) + \beta\lambda U^{in} + \frac{(1-\lambda)^2\beta^2}{1-\beta\lambda}U^{in} \Longrightarrow U^{in}[1-\beta\lambda-\frac{(1-\lambda)^2\beta^2}{1-\beta\lambda}] = U(w) \Longrightarrow$
$U^{in} = \frac{1-\beta\lambda}{1-2\beta\lambda-\beta^2+2\lambda\beta^2}U(w)$
Now it follows that:
$U^{out} = \frac{(1-\lambda)\beta}{1-2\beta\lambda-\beta^2+2\lambda\beta^2}U(w)$
Since $U^{in} > U^{out}$, the worst outcome for a politician not reforming is that he is ousted immediately (due to economic voting) and this results in life-time utility:
$U(w) + \beta U^{out} = U(w) + \frac{(1-\lambda)\beta^2}{1-2\beta\lambda-\beta^2+2\lambda\beta^2}U(w)$
This gives life-time utility of never reforming given that the other politician does not reform.

If a politician reforms he receives $U(w+r)$ immediately and subsequently βU^{out}. The latter expression depends on which equilibrium results, either the equilibrium with both always reforming or both never

reforming during economic good times. In the latter case and incorporating the higher value λ^*, condition *vi* results. Otherwise the expression can easily be adapted accordingly.

Chapter 7

News and consumer confidence

7.1 Introduction and related literature

[1] The media are now frequently blamed for both deepening the credit-crisis as well as failing to see it coming.[2] The argument underlying this somewhat diffuse allegation is that gloomy news weakens consumer confidence beyond the point justified by real economic conditions. During a recession lower consumer confidence further depresses consumption, thereby adding to a negative spiral of declining aggregate demand, contracting production, and soaring unemployment with a depression cum deflation scenario with low confidence and postponed consumption as an ultimate outcome.

This chapter investigates for the Netherlands in 1990-2009 whether there is an empirical link between media-coverage on the one hand and consumer confidence and economic circumstances on the other hand. This chapter extends existing research in two ways. First it considers more recent data, up to and including 2009; this allows an analysis of the credit-crisis period. Second, it analyses a considerable longer time series than is commonly done. Twenty years observations allows for testing whether the media-effect differs for different business cycles instead of assuming it does not.

The importance of consumer confidence for consumer spending and, thereby, for economic growth has been established by for example Acemoglu and Scott (1994) and is reviewed by Ludvigson (2004). Consumer confidence itself is influenced by several factors. A first and important factor of consumer confidence is the real economy itself, which includes unemployment, economic growth, and the stock market. The influence of economic developments has been established by many authors, including Vuchelen (2004), Berry and Davin (2004), Otoo (1999), De Boef and Kellstedt (2004) and Jansen and Nahuis (2001).

A second important factor that is identified by several authors is media coverage (for a theoretical discussion see Van Raaij (1989)). There are several papers that consider the link between media and consumer confidence empirically. Blood and Philips (1995) find that recession headlines influence consumer sentiment in the USA in 1989-1993. Doms and Morin (2004) show that several media-variables influence consumer confidence for the US in 1978-2003. Wu et al. (2002) demonstrate that recession news in the New York Times influences public perceptions about the state of the economy during the period 1987-1996, especially during times of economic recession. Wu et al. (2004) however do not find a similar effect in Japan in 1988-1999 (the 'Lost Decade'). They suggest that occurrence of the media-effect on consumer confidence depends on the type of economic contraction. The effect may be present in relatively short recessions, not in long periods of stagnation. The paper that speaks most clearly to this study is Alsem et al. (2008). They find for the Netherlands in the period 1998-2002 that media-coverage has a short-run effect on consumer

[1] This chapter was written with Rens Vliegenthart. It is published in *The Journal of Economic Psychology,* 32(3), pp. 367-373.

[2] See for example 'Is the media to blame for the credit-crisis?', Independent, November 17th 2008, D. Crossley-Holland, and 'MPs assail journalists on credit crisis', Financial Times, February 5th 2009, B. Fenton. 'Why didn't the City journalists see the financial crisis coming?', J. Robinson, the Observer, October 12th 2008. For a Dutch discussion see 'Media versterken crisis', J. van Duin, de Journalist, January 28th 2009 and 'Crisis ook geen lolletje voor RTL Z', W. Dekker, de Volkskrant, March 12 2009. See also 'Credit crisis: how did we miss it?', D. Schechter , British Journalism Review, 20(1), 209, pp. 19-26.

confidence. An important difference between their paper and this chapter is that by using a computer assisted content analysis, a time series that is both longer and more recent can be considered. This offers the additional advantage that effects of media coverage in times of economic growth and economic decline can be compared, testing precisely the proposition put forward by Wu et al..

To understand why media coverage matters for consumer confidence, even after controlling for real economic circumstances, insights from the field of communication science, where causes, content and effects of media coverage are central topics can be helpful. Communication scientists have proposed different mechanisms that account for the effects news coverage has on individuals' attitudes and behaviour. The prevailing ones are agenda setting and framing (Scheufele and Tewksbury, 2007). Agenda setting refers to the notion that the importance that people attribute to an issue is influenced to a considerable extent by the attention that media devote to this issue (McCombs and Shaw, 1972). Agenda setting theory asserts that media might not determine what people think, but where they think about. For example, a lot of media coverage about the economy makes this an important issue in the eye of the public as well. Framing assumes that the way mass media report about issues makes a difference. By emphasizing certain aspects of an issue (e.g. problem definitions, solutions) and not others, mass media can directly influence people's attitudes and evaluations about that issue. In several recent empirical studies especially framing effects have been established (e.g. Druckman, 2005; De Vreese, 2005). In the case under study, agenda setting and framing combined predict that the amount of attention devoted to negative aspects of the economy (e.g. unemployment, recession) results in increased awareness of economic problems among the public and will consequently lower their confidence.

The chapter is organized as follows. The second section discusses the data and the operationalization of the media-variable whereas the third section presents the model and estimation results, as well as several robustness checks. The fourth section concludes.

7.2 The data

The data are from publicly available data sources.[3] The table in the appendix provides descriptive statistics. The three variables are discussed in more detail here. For the stock market development the Amsterdam Exchange Index (AEX) is used. This index gives the weighted average of the 25 most traded shares on the Dutch stock exchange. The AEX is used as a control variable, considering news-coverage and consumer confidence are both influenced by economic conditions (following Alsem et al. (2008) and Jansen and Nahuis (2001)). In theory, the stock market reflects current economic circumstances as well as future economic expectations. In so, it serves as a leading economic indicator with the advantage that it is available on a monthly basis, in contrast to many quarterly reported economic growth-figures. A drawback of using the stock market is that it may move irrespective of economic conditions; this is in particular the case when a bubble forms on the stock market.

Consumer confidence figures are derived from a monthly questionnaire. In many European countries consumer confidence is measured in a similar way, see Jansen and Nahuis (2003). In the first ten days of each month 1000 randomly selected new people are interviewed by telephone, and asked how they perceive the state the economy. Individual answers are unfortunately not available, and – if so – would also not be exploitable in the present context as media-usage at the individual level is unknown. Thus, several aggregate level measures are used. When it comes to media effects, aggregate level studies offer great opportunities. To put it in the words of communication scientist Michael Slater (2004: pp. 178) – "When such [time series] studies are an option [...] they permit exceptionally robust inference concerning real world effects of media exposure on national populations."

Consumer confidence is based upon five questions. The five questions include two questions on the general state of the economy, one asking how the respondent thinks that the economy evolved the last twelve months, one asking how (s)he expects it to develop the next twelve months. Next, it includes two questions on how respondents perceive their own personal financial position. Again one backward-looking question

[3] Consumer Confidence was taken from Statline of the Dutch Bureau of Statistics (CBS, "Centraal Bureau voor de Statistiek"). The AEX index was downloaded from yahoo.finance, and media-variables were constructed using the digital newspaper archive LexisNexis.

asks how that position improved the last twelve months, while one forward looking question asks whether the interviewed expects this to improve in the next twelve months. A fifth question asks whether it is currently a good time to purchase durable goods.

For each category, the Central Bureau of Statistics (CBS) calculates the difference between the percentage of people with a positive or very positive answer and a negative or very negative answer, leaving aside the intermediate answering-category and the answer "I don't know". Consumer confidence is the average of the resulting five calculations, and thus ranges between -100 (if all people answer negatively on all questions) and 100.

To assess media content, a computer-assisted content analysis of one of the largest Dutch national newspapers, NRC Handelsblad, was conducted. This centre-right newspaper is one of the most read Dutch newspapers and gives much attention to economic issues (Bakker and Scholten 2005). An additional practical advantage is that the database of this newspaper covers the longest available time-period. Since correlation between news-coverage for the NRC Handelsblad and the four other national newspapers (Telegraaf, Trouw, Financieele Dagblad en Volkskrant) was very high results for other newspapers are similar to those of NRC Handelsblad.[4] The monthly number of references to negative aspects of the economy in the latter newspaper is used. These negative aspects included recession (recessie), economic crisis (economische crisis), shrinking economy (economische krimp) and economic downturn (economische neergang) or fall (economische teruggang). References on the front page and in the headline of an article were counted twice to account for their more prominent position in the newspaper. A total number of 17,455 occurrences in 11,585 articles were registered. The use of computer assisted content analysis is well-established in social scientific research and has multiple advantages in terms of efficiency and consistency, especially when it comes to analysing general characteristics of documents such as newspapers – as is done in this case (for an overview see Cardie and Wilkerson 2008).

7.3 Estimations and results

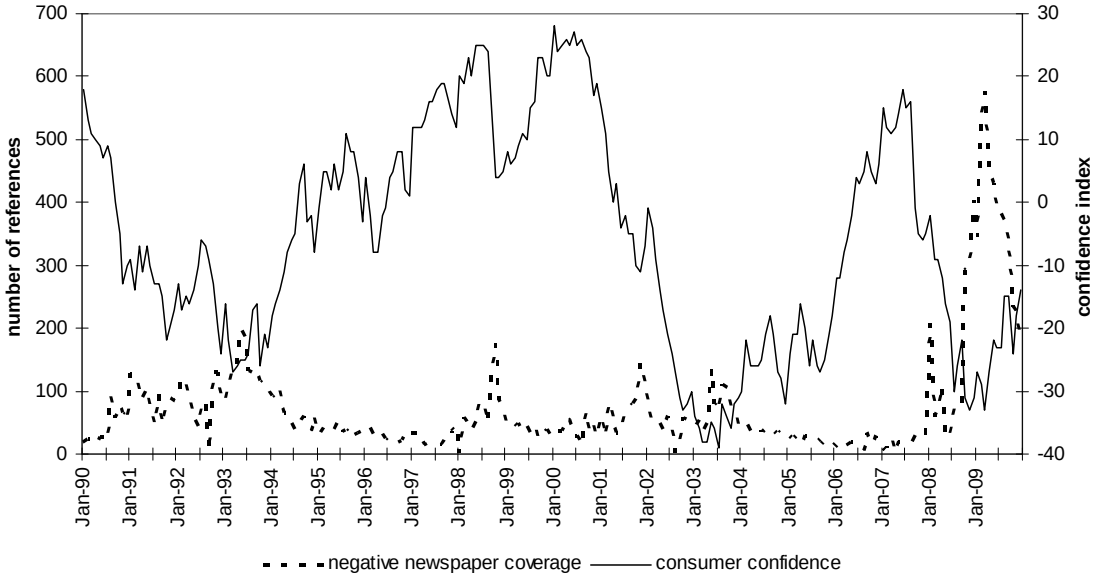
Figure 1 shows the development of negative news coverage and consumer confidence. As can be seen there is considerable variation in both variables. The figure shows that peaks in negative news coverage coincide with dips in consumer confidence. The overall correlation between the two variables is -0.38, indicating that the lower consumer confidence in a certain month, the more negative newspaper coverage there will be in that month. Negative economic news peaked at in the last part of the research period. After the collapse of Lehman Brothers in September 2008 it became clear and immediate that the banking-crisis would affect the real economy. Other peaks are 1993, 1998 (the rouble-crisis and the collapse of hedge-fund LTCM), 2001 (9/11), 2003 (accounting fraud at several large companies as Enron, Parmalat and in the Netherlands Ahold and Shell) and 2007 (start of the credit-crisis).

While economic news coverage and consumer confidence tend to move in tandem, this does not prove that the first causes the second. Both may be driven by economic conditions or the correlation may result from a common time trend. To disentangle these different reasons for the correlation a Vector Autoregression-model (VAR) is estimated, see Enders (2004). First, the model controls for economic conditions by taking into account its proxy stock market developments. Second, all variables are tested for the presence of a time trend (a so called unit root, see below). If it cannot be rejected that the variables are non-stationary, variables are considered in differences instead of levels. This removes a (common) time trend in the variables and the spurious relation that may result from it. Third, a system of three regression equations are estimated simultaneously with the three (possibly differenced) variables subsequently entering once and once only as the dependent variable and with lags of all three variables as regressors (see also the system of equations in the appendix). A variable is thus allowed to be jointly determined by both its own past values and lagged values of the other variables. Causality can subsequently (only) be established in a statistical sense. A variable x is said to Granger cause another variable y if lagged values of x have statistically significant predictive power for y, also after taking lagged values of y into account, see again Enders (2004).

[4] The correlation for monthly number of references to negative aspects of the economy ranges from .96 to .97 for the individual outlets and equaling .98 for the four other newspapers taken together.

A VAR-model allows variables to be determined jointly. This allowance for endogeneity of all variables is important here as media-coverage and stock markets returns not only influence consumer confidence but may be influenced by it as well. A second advantage is that the model does not impose parameter-restrictions a priori, as the lag length is part of the estimation procedure and no parameter is in advance restricted to equal zero as some would be under an exogeneity assumption. The estimation of potentially irrelevant parameters however might decrease efficiency; this is especially relevant as the number of estimated parameters increases with every additional lag length and every variable.[5]

The maximum number of lags included is here restricted to four. This means that the direct impact of the media is assumed to be in effect within four months or less. As the psychological and communication scientific effects described are short-run, this seems a reasonable long, even conservative cut-off point. The maximum number of four is also in line with the literature and was not binding in any of the regressions. Moreover, longer lags would result in non-robust statistical findings due to the relative large number of estimated coefficients.



An important assumption underlying the VAR-model is that all variables are stationary. The basic Dicky-Fuller test could not reject the null hypothesis that consumer confidence, media-coverage and the stock market are non-stationary, see table 1. As the hypothesis of a unit root is rejected for differenced series, all variables are difference stationary or I(1) integrated. Note that logarithms of the AEX are taken. In this way, the model relates relative changes to each other instead of absolute changes. The difference of the logarithms is an approximation of the relative change of the stock market.

Table 2. Dickey-Fuller unit-root tests (critical value for 5% significance is -2.882)

Variable	DF-test
Consumer confidence	-1.849
ΔConsumer confidence	-15.116
Negative newspaper coverage	-2.256
ΔNegative newspaper coverage	-18.709
Ln(AEX)	.791
Δln(AEX)	-13.624

[5]In a VAR-model with n variables and p lags, n+pn2 parameters are estimated.

The estimated VAR-model includes consumer confidence (abbreviated CC), negative newspaper coverage (MEDIA) and the stock market (AEX). The logarithms of these variables enter the model; the model equations themselves are:

$$\triangle CC_t = \alpha^{CC} + \sum_{i=1}^{k} \beta_i^{CC} \triangle CC_{t-i} + \sum_{i=1}^{k} \gamma_i^{CC} \triangle \ln(AEX)_{t-i} + \sum_{i=1}^{k} \delta_i^{CC} \triangle Media_{t-i} + \varepsilon_t^{CC}$$

$$\triangle \ln(AEX)_t = \alpha^{AEX} + \sum_{i=1}^{k} \beta_i^{AEX} \triangle CC_{t-i} + \sum_{i=1}^{k} \gamma_i^{AEX} \triangle \ln(AEX)_{t-i} + \sum_{i=1}^{k} \delta_i^{AEX} \triangle Media_{t-i} + \varepsilon_t^{AEX}$$

$$\triangle Media_t = \alpha^{Media} + \sum_{i=1}^{k} \beta_i^{Media} \triangle CC_{t-i} + \sum_{i=1}^{k} \gamma_i^{Media} \triangle \ln(AEX)_{t-i} + \sum_{i=1}^{k} \delta_i^{Media} \triangle Media_{t-i} + \varepsilon_t^{Media}$$

The number of lags is indicated by k. The lag length is selected by the Akaike Information Criterion (AIC), following a common approach in the literature. The AIC suggests a model with one lag the most appropriate. The results are presented in table 2. Using a five per cent threshold, the effect of the media-variable in the equation with consumer confidence as the dependent variable is negative and significant, indicating that (changes in) negative news is negatively related to (changes in) confidence, in line with expectations. A referral to negative economic developments knocks of almost 0.02 point of consumer confidence. The media time-series thus Granger causes consumer confidence, as it has predictive power for consumer confidence over and beyond the explanatory power of lagged values of consumer confidence.

Table 4. VAR-analysis of consumer confidence, newspaper coverage and ln(AEX)

	ΔCC	ΔMEDIA	Δln(AEX)
Independent variable			
ΔCC			
1st lag	-.012 (.068)	.89 (.58)	.0004 (.001)
Granger test, p-value	0.027	.125	.635
ΔMEDIA			
1st lag	-.017 (.008)	-.22 (.064)	-.0003 (.0001)
Granger test, p-value	.027	0.001	.001
Δln(AEX)			
1st lag	2.96 (4.97)	-100.61 (41.98)	.067 (.068)
Granger test, p-value	.551	.017	.327
Constant	-.11 (.27)	1.36 (2.32)	.004 (.004)
R-squared	.024	.063	.059
Granger test overall, p-value	.053	.042	.004
Number of observations	238	238	238
AIC	12.78		

Standard errors in parentheses

As a robustness analysis, several deviations from the baseline model are considered. When the VAR-model is estimated with AEX itself instead of its logarithm results are similar (not shown here), that is, the impact of media-coverage on consumer confidence is negative, significant and substantial. The same holds for a VAR-model that excludes the AEX (not shown here). Including the three variables in levels rather than differences does not change conclusions either (also not shown here).

While the main focus is on the influence of media on consumer confidence, it is also interesting to consider the relationship between the AEX index and negative newspaper coverage. As one would expect, there exists a negative influence from AEX on coverage: the better the stock market is doing, the less negative economic coverage. This is in itself not very surprising, as it shows that economic news coverage (partly) reflects the underlying 'real world' economic conditions, indicated by the stock market. Interestingly enough, negative newspaper coverage is also associated with the AEX index: negative coverage results in decreasing stock prices. This suggests that investors may partly react to negative news coverage of the economy and/or particular companies. In that case, newspapers is one of relevant channels through which

economic information is made publicly available before this information is reflected in stock prices. This hypothesis is testable on new data. This could also show whether an exploitable trading strategy can be derived from the correlation between news coverage and stock market developments.

Thus far it was tacitly assumed that the effect of media-coverage is constant over time. The substantial number of observations, 240 in total, allows for testing that assumption. Looking at GDP-growth figures, the sample period consists of two full business-cycles. The first full business-cycle is the period 1990-1999. This period starts with a relatively mild recession after the first Gulf-war, which was turned around by what is now known as the new economy or the dotcom-bubble. The second cycle runs from 2000 to 2007. It starts with the bursting of the dotcom-bubble, worsened by the 9/11 attacks; from 2003 onwards the economy recovered, partly due to low interest rates.

The exact same modelling procedure as before is used for the periods 1990-1999 (120 observations) and 2000-2007 (96 observations). This resulted in a selection of two lags for the first period. The Granger causality test for the first period shows a significant effect with a p-value of 0.034. The effect is also substantial, as the coefficients of the two-lags add up to -0.047. In 2000-2007 there is not any evidence that media-coverage influences consumer confidence: relevant model statistics suggest a model with zero lags.

A third business-cycle started in 2008, when the credit-crisis took hold, culminating in the collapse of Lehman Brothers in autumn 2008. The period 2008-2009 is analyzed to see whether the effect of media-coverage is important or not. The effect of media-coverage equals -0.028, whereas the p-value is 0.055. This means that the effect is significant at a significance level of 0.10. It is not significant at a significance level of 0.05, but it has to be borne in mind that samples with few observations (only 24 in this case) typically do not result in significant results. With relatively few observations it is difficult to discriminate the null and the alternative hypothesis. It is therefore remarkable that the effect is already significant at the 0.10 level.

Also the effect has more impact here, as the volatility of media-coverage is much higher in the period 2008-2009 than before. In 2008-2009 the average value of media-coverage was 258 with a standard error of 168, whereas those numbers were 52 and 37 in the period 1990-2007. This means that a one standard error deviation in news-coverage decreased consumer confidence with 4.7 points, a much larger impact than a one standard deviation had prior to the credit-crisis.

Last the effect in 2008-2009 is compared with the first two years in the previous business-cycles that GDP-growth declined. For 1991-1992 the effect is smaller (-0.015) and insignificant (0.42), whereas the period 2000-2001 does not show any effect whatsoever with a coefficient of 0.01 and a p-value of 0.72.

Taken together, the analysis of sub-samples provides two interesting insights. First, the effect of media-coverage does not seem to be constant over time. This cannot be detected when analysing one single business-cycle as is common in the literature. One possible explanation is that the dotcom-era and the credit-crisis are more driven by debt-financed demand and positive expectations with media-coverage stimulating both. This contrasts with the intermediate period that was more influenced by real world events as the accounting fraud and the attack of 9/11 and the subsequent lowering of interest rates worldwide. Together this leads to the hypothesis that media-attention influences consumer confidence more during a boom-bust cycle that is internal to the economic system (in particular debt-financed consumption and inflated prices of assets and houses) than during a period where a shock (partly) comes from outside the economy. This is in line with the hypothesis of Wu et al. (2004).

A second result is that in the current credit-crisis newspapers seem to have much more impact than before, both in terms of size and significance. Although the sample period is too short to draw generalizable conclusions, the result is nonetheless suggestive, interesting and potentially highly relevant. Media not only cover the crisis, but may also influence it considerably.

7.4 Discussion and conclusion

This chapter has investigated the causal relation between media, the economy and consumer confidence in the Netherlands in 1990-2009. The first finding is that overall the amount of negative news, as operationalized by the monthly referrals to negative economic developments in one of the Dutch leading newspapers, Granger-causes consumer confidence, controlling for economic circumstances, as proxied by the stock market.

The main difference with the existing literature is that this chapter takes both a larger and a more recent period into account. This allows analysis of structural breaks and thereby follows the suggested extension of Blood and Diamond (1995: pp. 18) who state that "it seems worthwhile to extend the statistical analysis to longer data sets that allow for (..) periods of economic expansion as well as recession." The effect indeed differs for different business-cycles, a result that would have gone unnoticed when analysing smaller samples. The period 1990-1999, representing a full business-cycle, witnessed a substantial, significant and sizable effect and the same holds even more so for the two years 2008-2009. In the intermediate period 2000-2007 consumer confidence hardly budged when media-reports varied.

This suggests that the claim that news coverage has real economic consequences, via consumer confidence, is valid in the current economic episode. This in turn further suggests that journalists should consider the independent impact their reporting has on consumers. By amplifying negative economic developments, as the extremely high values of negative newspaper coverage towards the end of the research period indicate, media contribute to a development of declining consumer confidence. In those cases, a more toned down coverage seems appropriate. The other way round, a more critical stance in the face of up going economic trends that cannot be but unsustainable might be warranted.

Additionally, the analyses reveal a mutual causal relationship between stock market rates and negative economic coverage. Especially the result that the AEX index is influenced by changes in negative economic newspaper coverage is compelling. Ultimately, this implies that stock market analysts could profit from considering media coverage as an important variable when understanding and forecasting changes in stock prices. While further research should point out whether this predictability is really exploitable in trading strategies, it suggests that media-attention might also have a direct economic effect. Overall, the chapter demonstrates the value of media coverage as an independent and relevant factor in economic analyses that consequently deserves more attention, both theoretically and empirically.

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Summary

The main topic of this dissertation is the effect of aging on pension systems. As the population of many Western-European countries ages, this topic has gained wide attention in both the public debate and the academic literature. Aging in the Netherlands can be illustrated with the development of the dependency ratio, defined as 100 times the number of people who are 65 years or older divided by the number of people between 19 and 65 years of age. In 1960 (three years after the state-pension 'Algemene Ouderdoms Wet' was introduced) the dependency ratio equaled 16.8. In 2010 the dependency ratio was 20.1, and it is projected to increase to 49.3 in 2040 (while decreasing to 46 in 2060).

The first chapter forms an introduction to the main topic. Chapters 2, 3 and 4 of this thesis analyze the effect of aging on intergenerational risk sharing, public pension expenditure, and the asset allocation of pension funds respectively. Chapter 5 shows how a pension fund can improve participants' welfare by facilitating financial transactions between generations. Chapter 6 is more general and focuses on the politics of reforms of welfare programs, including pension reforms. Finally, the seventh chapter is not related to pensions; it analyzes the association between media coverage and consumer confidence.

Chapter 2 analyzes the political limits to intergenerational risk sharing. Intergenerational risk sharing can be efficient from an ex-ante perspective. Intergenerational risk sharing cannot generally be implemented by markets. The reason is that risk sharing may lead to transfers that are disadvantageous for some generations ex post, in particular young generations might not voluntarily participate in risk sharing if they have to 'bail out' older generations. A feasible risk-sharing mechanism requires mandatory participation, which can only be enforced by the government. The question then is whether efficient intergenerational risk sharing will arise endogenously in a democratic political process. Chapter 2 uses a probability voting model with overlapping generations to address this question. The main result is that the political process generally does not lead to ex-ante efficiency. Source of the inefficiency is that politicians have an electoral incentive to redistribute ex post to larger cohorts. The political process may however still lead to some risk sharing which from an ex-ante perspective is preferable to no risk sharing at all.

Chapter 3 estimates how an aging electorate influences public pension expenditure, using data for 30 OECD-countries between 1980-2005. The first result is that the dependency ratio has a positive and significant effect on expenditure relative to GDP, controlling for several economic and political variables. A one-unit increase in the dependency ratio is associated with an increase in pension expenditure relative to GDP of 0.2 percentage points. Such an increase in expenditure is not unexpected as there are more people on the receiving end of Social Security and an increase in total expenditure could only be avoided by a relatively large decrease in individual benefits. Median voter models predict that aging not only leads to an increase in total expenditure but also to an increase in benefits per retiree. The reason is that the age of the median voter increases, and politicians therefore have an electoral motive to increase individual benefits. The second result of this chapter is that there is no empirical support for this stronger hypothesis, derived from median voter models. In fact the opposite is the case: an increase in the age of the median voter has a negative impact on benefits per retiree.

Chapter 4 documents the effect of the demographic structure of Dutch pension funds on their strategic asset allocation, using a unique data set of pension fund investment plans for 2007. The main result is that an increase in the average age of active participants by one year is associated with a decrease in the equity exposure of pension funds equal to 0.5 percentage points. As equity is generally a risky asset class, older pension funds thus tend to decrease the risk level of their investment portfolio. The negative relation between age and equity allocation is in line with the theoretical literature on optimal saving and investment over the

life cycle. Other factors that have a positive effect on the equity exposure of pension funds are pension fund size, funding ratio, and average pension wealth of participants. Pension plan type and pension fund type have no significant impact.

Chapter 5 develops conditions under which a pension fund with mandatory participation can improve the welfare of young, borrowing-constrained participants who want to go short in bonds, that is, invest borrowed money in stocks. The pension funds may enable young participants to borrow against their human capital from older participants who want to lend. A pension fund with mandatory participation may subsequently enforce the promise of the young to repay the old. The pension fund in particular levies contributions ex post on younger participants to repay older participants in case stock return is low. Mandatory participation thus acts as a commitment device for the young to repay their debt when they borrow against human capital. Mandatory participation is a necessary but not a sufficient condition for optimal intergenerational financial transactions. The optimal investment policy can only be implemented by a proper governance structure. In particular, if the board of the pension fund has discretionary power to decide over contributions, the old will want to be represented on the board to ensure that they are repaid in full. However, the young want to avoid that the old abuse their position to increase contributions arbitrarily, so the young will need to be represented adequately as well. This chapter shows that the risk level ex ante and the contribution policy ex post cannot be separated and that good pension fund governance considers both simultaneously.

Chapter 6 gives a theoretical explanation for why and when vote-seeking governments pursue unpopular welfare reforms that are likely to cost them votes. Examples of such reforms are increases in the pension age or cutbacks of social benefits. Using a novel game-theoretical model, it is shown that a government enacts reforms that are unpopular with the median voter during bad economic times like recessions, but generally not during good ones. The key reason is that voters cannot commit to re-elect a government that does not reform during recessions. This voters' commitment problem stems from economic voting, that is voters' tendency to punish the government for poor economic performance. The voters' commitment problem means that a vote-seeking government will consider reforms only if it will likely be voted out of office anyway because of economic hardship. A recession thus enables a government to act according to its own economic ideas or interests. The central empirical implication of the model is that unpopular reforms are generally initiated during recessions, which is consistent with empirical findings.

The seventh chapter, which is unrelated to pensions, addresses the question whether economic news coverage affects consumer confidence. Using data for the Netherlands during the period 1990-2009, the main finding is that in this period, more negative news coverage significantly decreased consumer confidence.