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Pension reform, capital markets, and the rate of return

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Abstract: This paper discusses the consequences of population aging and a fundamental pension reform – that is, a shift towards more pre-funding – for capital markets in Germany. We use a stylized overlapping generations model to predict rates of return over a long horizon, taking demographic projections as given. Our simulations show that a transition to a partially funded system crowds out existing savings only partially. The capital stock increases initially, but decreases when the baby boom generations enter retirement. The corresponding decrease in the rate of return, which results from both population aging and pre-funded pensions, is only modest, less than one percentage point in the closed-economy, fixed-technology case. The return on capital can be improved by international diversification, that is, by investing pension funds in countries with a more favorable demographic transition path. Feedback effects from strengthened capital markets and improved corporate governance, which are unlikely to be achieved with capital market reforms alone, will raise capital performance further.

Keywords: aging; pension reform; rates of return; capital mobility; corporate governance
JEL classification: E27; G15; G34; H55; J11

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1. Introduction

Although the pace is slow, Germany is moving towards implementing a fundamental pension reform. Most economists and politicians seem to have accepted, if reluctantly, that the pressure on the current pay-as-you-go system caused by population aging can be alleviated only by introducing a substantial pre-funded component to the pension system. There is no need to repeat the arguments for (and against) such a fundamental pension reform; the interested reader is referred to Raffelhüschen (1993), Buslei and Kraus (1996), Börsch-Supan (1998a, 2000a), Wissenschaftlicher Beirat (1998), Sinn (1999) and Rürup (2000) for different perspectives on the pension crisis in Germany and alternative reform proposals.[1]

This paper concentrates on a rather narrow, but important aspect of pension reform that has gained attention relatively late in the pension reform debate in Germany – the consequences of population aging, and of a fundamental pension reform that involves a shift towards more pre-funding, for capital markets. The paper takes several different perspectives, but always concentrates on the central macro-economic link at question, the real rate of return on capital.

First, we flesh out the primary effects. We use a stylized overlapping generations model of pension reform to predict the rate of return on capital over a long horizon, taking as given demographic projections and pension reform schemes, both based on the extensive study by Birg and Börsch-Supan (1999). Our simulations show that a transition to a partially funded system does not crowd out existing savings totally. The capital stock increases initially, but then decreases significantly when the baby boom generations enter retirement. The corresponding decrease in the rate of return, which results from both population aging and pre-funded pensions, is only modest, less than one percentage point in the closed-economy, fixed-technology case.

We then show that the return on capital can be improved by international diversification, that is, by investing pension savings in countries with a more favorable demographic transition path than Germany. The rate of return can be further improved by feedback effects resulting

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[1] In addition to introducing a pre-funded component, a fundamental pension reform should comprise other elements such as steps to make the remaining pay-as-you-go component of the pension system more transparent, for example by introducing notional accounts, and to reduce incentives for early retirement. With respect to the former, De Nardi *et al.* (1998) show that making clear the linkage between past contributions and future pensions eliminates labor-supply distortions and improves welfare of all cohorts in a general equilibrium model. The problem of early retirement is discussed by Börsch-Supan and Schnabel (1998). There is also a strong case for introducing a minimum pension financed out of the federal budget. Börsch-Supan (2000b) discusses such measures more specifically in the context of a fundamental pension reform in Germany.

from strengthened capital markets which amount to changing the production technology. In Germany, a country characterized by relatively thin capital markets and poor corporate governance structures, a fundamental pension reform will improve shareholder control, insure better use of investment opportunities, and ultimately increase the return on households' retirement savings – effects that are unlikely to be achieved by capital markets reforms alone.

The remainder of this paper is structured as follows. Section 2 presents the demographic projections and the proposed pension reform schemes that form the background of our analysis. In section 3, we present a stylized overlapping generations model that can be used to evaluate the effects of population aging and a fundamental pension reform. Section 4 contains benchmark simulations which highlight the effects of aging and a shift towards pre-funded pensions on household savings, the capital stock, and the rate of return. Two important macroeconomic mechanisms that also influence the rate of return, international capital mobility and feedback from strengthened capital markets, are discussed in sections 5 and 6, respectively. Section 7 concludes.

2. Demographic projections and the implementation of pension reform

The current pay-as-you-go pension system in Germany is financed by contributions (19.3% of gross income) and general tax revenues (about 9% of gross income), resulting in a comprehensive contribution rate of about 28% of gross income. It provides a pension that is approximately proportional to life-time earnings. Hence, the system is much less redistributive than the U.S. social security system and most other European pension systems. The current average pension is about 70% of average earnings (U.S. social security provides only about 50%). The average retirement age is just 59.5 years, mainly due to an actuarily unfair pension formula that favors early retirement. In addition to old-age pensions, the system provides a generous disability pension and survivor benefits. Public pensions account for almost 12% of GDP, a share two-and-a-half times larger than in the United States. Börsch-Supan (2000c) provides more details on the German pension system and its current problems.

There are two main reasons for the increasing difficulties of the German public pension system: Population aging and early retirement which together result in a dramatically increasing old-age dependency ratio (i.e., the number of retirees relative to the size of the work force increases).[2] Any pension reform will have to deal with these trends. Before we describe the

[2] These trends are not new, and they are also not specific to Germany (see Auerbach *et al.*, 1989).

structure of the overlapping generations model used to simulate the effects of a fundamental pension reform, we discuss the projected dynamics of demographics in Germany over the first half of this century and ways in which a fundamental pension reform can be implemented.

Long-term projections of the demographic structure of the German population are taken from Birg and Börsch-Supan (1999); they last until 2075. Birg and Börsch-Supan distinguish several scenarios for demographic change, and they stratify their projections along several dimensions: life expectancy and fertility (which together determine population aging), migration, and labor force participation (which, in turn, comprises several components: female labor force participation, retirement age, and unemployment).[3] For the purpose of our simulation analysis, these demographic projections can be summarized by the dynamics of the population age distribution (i.e., the size of all living cohorts) and of the age-specific total labor force participation rates, both projected until the year 2075 on an annual basis.[4]

Figure 1 compresses these projections even further: It shows projections of the old-age dependency ratio (the ratio of the number of pensioners and the number of workers) for four demographic scenarios: strong aging and constant fertility, modest aging and constant fertility, modest aging and increasing fertility, weak aging and increasing fertility. In what follows, we restrict our analysis to the benchmark scenario which assumes modest aging and constant fertility.[5] In this benchmark scenario, the old-age dependency ratio flattens after the year 2035. We therefore take 2035 as the main year in which we evaluate the macroeconomic effects of pension reforms, although our projections extend until the year 2050.

Based on the demographic benchmark projection, the contribution rate to the existing German social security system, 20.3% of gross income in 2000, would reach about 30% at the peak of population aging in 2035 if the current replacement rate were maintained and age-specific labor force participation rates remained as they are; see figure 2. The comprehensive contribution rate, including subsidies to the pension system paid by the federal government, would rise from currently 28% to almost 40% (see Börsch-Supan, 1998a). Even if labor force participation increased more, and the replacement rate were reduced, the projected comprehen-

[3] In the overlapping generations model presented below, we do not model these labor supply decisions at the household level, but their projected long-term trends enter indirectly via these demographic projections.

[4] Since our simulation model, which covers the period until 2050, uses 75 forward-looking cohorts, we extend these projections using linear extrapolation. In all figures that follow, we show projections until 2050, the final year of the simulations of our overlapping generations model.

[5] All scenarios assume a modest increase of labor force participation. Birg and Börsch-Supan (1999) also consider the effects of more optimistic and pessimistic assumptions (i.e., strong and weak increase of labor force participation, respectively).

sive contribution rate would still reach 37%. Such levels appear to be politically unsustainable. Given the magnitude of the aging problem, no parametric reform can save a pay-as-you-go pension system as the primary source of retirement income in Germany. The need for a fundamental pension reform should be obvious.

Such a fundamental reform can be build on the gradual introduction of a substantial pre-funded component to the existing pay-as-you-go pension system (see, *inter alia*, Feldstein and Samwick, 1998, 2000). In our simulations of an overlapping generations model of pension reform, we take the reform proposals by Birg and Börsch-Supan (1999) as an example, but we should point out that the same mechanisms are at work in any scheme that involves the introduction of a funded component. Birg and Börsch-Supan analyze two different schemes, one based on a partial transition of a given size, and the other based on freezing the contribution rate at its current level of 21%.

The partial transition model assumes that after a sufficiently long announcement period, each cohort finances an increasing share of pension income by pre-funding until a target share of 33% is reached.[6] More specifically, our simulations assume that the pensions of all workers retiring before December 31, 2004 will be financed out of the PAYG system and remain at the level before the 1999 reform (i.e., a net replacement rate of 70.5%). Workers retiring after January 1, 2005 will receive pension benefits from the PAYG system based on the proportion of their working years accumulated before 2005. The remaining pension benefits, up to a net replacement rate of 70.5%, will be financed by a private pension to be specified below. We assume a 30-year transition period and a linear transition until 33% of the PAYG pension is replaced in the year 2035. From there on, all new retirees receive an equal share of their retirement income from the PAYG and the private funded system. As can be seen from figure 2, a pension reform using partial transition scheme with a target size of 33% would reduce the direct contribution rate relative to the pay-as-you-go system, with a peak contribution rate of about 25%.

The second reform scheme assumes that the contribution rate remains at its current level (hence the corresponding line in figure 2 is flat). In a pay-as-you-go system, such a 'freezing' reform results in lower pension payments, given a rising old-age dependency ratio. This, in

[6] This value reflects the state of the political decision-making process in the Summer of 2000.

turn, results in lower replacement rates provided by the pay-as-you-go pillar of the pension system.

In the pension reform outlined by Birg and Börsch-Supan (1999), the funded system is provided privately via markets and designed in a fashion similar to a group life insurance.[7] This group insurance covers all three biometric risks (longevity, disability and survivorship) and is paid out on retirement as an annuity. The pension or insurance companies invest the accumulated capital in a broad portfolio of stocks, bonds, direct placement, and real estate. To the extent that existing saving is not crowded out (which our simulations show), this creates new investment in pension funds and changes the structure of capital markets.[8]

Both reform schemes result in lower public pensions for future retirees and higher net wages due to the reduced contribution rates. We assume that households chose their consumption path in order to maximize their discounted life-time utility, given their income path. When the government announces a pension reform scheme, households anticipate the resulting changes in the income path over the life cycle, re-optimize, and increase their savings.[9] The aim of this paper is to analyze how the rate of return on these retirement savings will evolve over time. To this end, we develop an overlapping generation model in which this rate of return can be derived endogenously in dynamic general equilibrium, taking the dynamics of the population age structure, the design of the pension system and possible reforms, as described in this section, as given.

3. Aging and pension reform in a stylized overlapping generations model

In this section, we present a dynamic macroeconomic model that allows to analyze the effects of a shift from a pay-as-you-go to a (partially) funded pension system. The model is based on a version of the overlapping generations model (Samuelson, 1958; Diamond, 1965) introduced by Auerbach and Kotlikoff (1987, chapter 3). Overlapping generations models have been used extensively to study the effects of population aging on social security systems, a purpose for which they are well suited since they are based on households' and firms' optimal

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[7] This involves assumptions about the ability of markets to provide such contracts which are not innocuous; these issues are discussed by Börsch-Supan (2000b).

[8] Note that this scheme does not resort to recognition bonds or similar devices that stretch the transition costs over several generations as, e.g., proposed by Feldstein and Samwick (1998). We discuss political feasibility and the need for debt financing in the concluding section.

[9] There is a recent literature that argues that boundedly rational individuals might not be able to make savings decisions that allow them to attain their desired levels of retirement wealth (O'Donoghue and Rabin, 1999). We take up this issue in the conclusions.

reactions to movements in the demographic structure and public policy measures. Recent examples include Kotlikoff, Smetters and Walliser (1999) and De Nardi *et al.* (1999) for the United States, Miles (1999) for Great Britain, and Fehr (1999) for Germany. Miles and Iben (1999) present a comparative analysis of pension reform schemes for the United Kingdom and Germany. Kotlikoff (1998) provides an overview of earlier applications of overlapping generations models.

Since the purpose of this paper is to study the effects of a fundamental pension reform on the rate of return on capital, we restrict the analysis to a very stylized version of the standard overlapping generations model that excludes many interesting aspects. However, we take great care to get the first-order effects of demographic change right by using 75 cohorts and annual demographic projections. In our model, we make three important simplifications relative to the existing literature. First, we do not explicitly consider taxes (other than the contributions to the pay-as-you-go pension system), second, we do not include labor supply in the households' decision problem, but rather assume that all households supply one unit of labor until retirement,[10] and third, we assume that labor productivity is fixed over the life cycle. While these issues surely are important, especially if one wishes to analyze the effect of population aging on labor supply in the presence of distorting taxes, we restrict our attention to households' life-cycle savings decisions as their primary means to prepare for demographic change and decreasing public pensions.

In our simulations, the projected demographic transition enters via time-specific sizes of the 75 living cohorts, denoted by N_t^a, where a is age, exogenously given at every point in time, t. The economic life of a cohort begins at the age of twenty years, for which we set a = 1. For ease of presentation, we take N_t^a to be number of workers for a = 1, ..., 39, and the number of retired persons for a = 40, ..., 75. This implies that there is a fixed retirement age of 60 at which everybody stops to work, stops to pay pension taxes, and begins to collect pension benefits from the pay-as-you-go-system. In our actual simulations, the retirement pattern is much more flexible: We include an age and time-specific weight that represents the fraction of the population that is retired, and this fraction increases from 0 to 1 over an extended retirement window from age 47 through 80. The time paths of these weights are cohort-specific,

[10] However, as described in section 2, we do account for unemployment and labor force participation decisions since the aggregate workforce is adjusted according to the labor market scenarios behind the demographic projections in Birg and Börsch-Supan (1999).

reflecting shifts in labor supply and retirement behavior. These weights are also taken from Birg and Börsch-Supan (1999).

The pension system and reform schemes enter the model through fixed and reform-specific time paths for either the contribution rate, τ_t, or the replacement rate, R_t^a (the latter is the ratio of the average net pension and the average net wage). In the partial transition model, the replacement rates are not only time specific, but also age specific, since different cohorts are affected differently. The per-capita pension at time *t* is given by the product of the replacement rate and the net wage,

(13) $$P_t^a = R_t^a \cdot w_t (1-\tau_t) .$$

As noted before, we do not explicitly consider any other taxes for the purpose of our analysis, although we adjust the net wage rate in the base year of our simulation such that the budget condition of the pay-as-you-go system holds given actual labor taxes and net wages.

The construction of general equilibrium in the overlapping generations model starts by looking at the production sector where, given factor inputs (capital and labor), output and factor prices are determined. The production sector consists of a representative firm that uses a CES production function given by

(14) $$Y_t = A\left(\alpha K_t^{1-1/\beta} + (1-\alpha) L_t^{1-1/\beta}\right)^{\frac{1}{1-1/\beta}} ,$$

where α and β are the factor share and the elasticity of substitution, respectively. From static profit maximization, we obtain the wage rate

(15) $$w_t = (1-\alpha) A\left(\alpha K_t^{1-1/\beta} + (1-\alpha) L_t^{1-1/\beta}\right)^{1/(\beta-1)} L_t^{-1/\beta}$$

and the interest rate

(16) $$r_t = \alpha A\left(\alpha K_t^{1-1/\beta} + (1-\alpha) L_t^{1-1/\beta}\right)^{1/(\beta-1)} K_t^{-1/\beta} .$$

Since investment is equal to consumption in the closed economy, an assumption we maintain for the first part of our analysis, and since we have no explicit role for the government, the capital stock evolves over time according to the recursion

(17) $$K_{t+1} = Y_t - C_t + (1-\delta) K_t ,$$

where C_t is aggregate consumption.

In order to determine aggregate consumption, we next consider optimal household behavior derived from intertemporal utility maximization. By choosing an optimal consumption path, each generation *a* maximizes, at any point in time *t*, the sum of discounted future utility. We assume that the within-period utility function can be characterized by constant relative risk aversion, and that preferences are additive and separable over time. The target function of generation *a*'s maximization problem at time *t* is then given by

$$U_t^{\,a} = \frac{1}{1-\sigma} \sum_{j=a}^{75} \frac{1}{(1+\rho)^{j-a}} \left(C_{t+j-a}^{j} \right)^{1-\sigma} , \tag{18}$$

where σ denotes the coefficient of relative risk aversion and ρ is the discount rate. Maximization is subject to a dynamic budget constraint which for generation *a* at time *t* is given by

$$B_t^a = \sum_{j=a}^{75} \left(\prod_{z=a+1}^{j} \frac{1}{1+r_{t+z-a}} \left(w_{t+j-a} \left(1-\tau_{t+j-a} \right) + P_{t+j-a}^{j} - C_{t+j-a}^{j} \right) \right) + A_t^a \left(1+r_t \right) = 0 . \tag{19}$$

Here, B_t^a is the life-time budget surplus, set to zero since we exclude bequests from our analysis, and A_t^a is total wealth, both specific to generation *a* at time *t*.[11] The solution to the intertemporal optimization problem can be characterized by an Euler equation,

$$C_{t+j-a}^{j} = C_{t+j-1-a}^{j-1} \left(\frac{1+r_{t+j-a}}{1+\rho} \right)^{1/\sigma} , \tag{20}$$

which reflects households' trade-off between current and future utility. As in any life-cycle model, this trade-off is determined by the ratio of the interest rate and the time preference rate, and by the degree of risk aversion.

Finally, we can determine the contribution rates to the pay-as-you-go pension system endogenously from the condition that the pension system's budget equation hold in all periods,

$$\tau_t \cdot w_t \cdot \sum_{a=1}^{39} N_t^a = R_t^a \cdot w_t \left(1-\tau_t \right) \sum_{a=40}^{75} N_t^a . \tag{21}$$

Alternatively, if the contribution rate, τ_t , is fixed as in the freezing model of pension reform, the replacement rate, R_t^a, is determined endogenously in all periods.

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[11] Our actual simulations are more complicated. The budget constraint (19) is based on a fixed retirement age for the sake of simplified notation, but as noted before, we allow for a flexible retirement window so that in our simulations, the budget constraint most include the appropriate weights.

Since factor prices (i.e., wage and interest rates) and both contribution rates to, and replacement rates of, the pay-as-you-go pension system are known, we can now determine the lifetime consumption paths of all generations backwards, starting with zero wealth in the final period of life, and then iterating using the Euler equation and the budget constraint. The resulting time paths of consumption determine aggregate saving and wealth in the household sector.

Finally, we need three aggregation conditions which ensure market clearing and general equilibrium. In all periods *t*, we aggregate, in our stylized version with a fixed retirement age, over either the living generations ($a = 1, ..., 75$) or the working generations ($a = 1, ..., 39$).[12] The aggregation equations are given by (for capital, goods, and labor markets, respectively)

(22) $$K_t = \sum_{a=1}^{75} A_t^a \cdot N_t^a ,$$

(23) $$C_t = \sum_{a=1}^{75} C_t^a \cdot N_t^a , \text{ and}$$

(24) $$L_t = \sum_{a=1}^{39} N_t^a .$$

An equilibrium path of this overlapping generations model can be determined using a recursive numerical procedure. The solution algorithm starts with picking an arbitrary initial path for the capital stock. Since labor supply is exogenous in our model, we can readily solve the static optimization problem of the representative firm for a given trial value of the capital stock and the labor inputs implied by the demographic projections. We can then compute time paths of the factor prices (i.e., the wage and interest rates). Given factor prices, we can solve the age and time-specific intertemporal optimization problems of all cohorts at all points in time, which yields, after aggregating, time paths of aggregate consumption and savings. Since we operate under the assumption of a closed economy, aggregate household saving determines the economy's aggregate capital stock, and so we have solved the model for all endogenous variables. However, the size of the capital stock that is consistent with household optimization (conditional on factor prices) will not necessarily coincide with the trial time-path that we specified initially. So we need to change the initial capital stock and repeat the entire computation recursively until convergence with respect to the time path of the capital stock is achieved, and an intertemporal equilibrium of the dynamic economy is found.

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[12] Again, our actual simulations use appropriate weights to allow for flexible retirement.

The parameter values used in the calibration of our model are standard in the literature on simulated overlapping generations models; they are summarized in table 1.

4. Simulation results for the overlapping generations model

We begin by looking at the effects of a fundamental pension reform that freezes contribution rates to the public pay-as-you-go pension system at its current level. Figure 3 shows that projected aggregate savings rates under such a reform would be substantially higher than under the present system. For example, in the year 2035, when the peak of the aging problem occurs, savings rates are projected to be negative under the current pay-as-you-go system while they would be positive under both the freezing and the partial transition model of pension reform. Under the freezing model, it would be about 2.5%.

These projections also show that optimal life-cycle behavior generates additional saving under a fundamental pension reform – it is not the case that additional retirement saving crowds out other saving totally, as often claimed. Our projections indicate a substitution of about one third, leaving two thirds to new saving. Thus, applied to the 1965 cohort, the total household saving rate will increase from some 12.1% (1998) to 14.2%, well in the range of the historical variation in German household saving rates.

Next, we aggregate savings to obtain the economy's capital stock. Figure 4 shows projections of the total capital stock for alternative pension schemes. Obviously, the extra savings induced by one of the reform schemes result in a substantially higher capital stock. Before we analyze the effects of population and capital stock dynamics on the rate of return on capital, it is important to note that a significant decrease in the capital stock starting around 2030 would also occur if there were no pension reform at all – it would be even more pronounced, as can be seen from our projections in figure 4. The main reason for the shrinking capital stock in the middle of the 21st century is population aging itself, and not so much the fact that a fundamental pension reform would include a shift towards a pre-funded system. This is often overlooked in the public debate, maybe because the macroeconomic effects of population aging are not fully understood.

The projected time path of the capital stock shown in figure 4 has several implications. First, the magnitude of accumulated new savings is manageable relative to the current capital stock. The long run value (year 2050) represents about 10% of current gross fixed capital, and about 16% of gross fixed capital in the production sector. It is about equal to today's value of life insurance savings and occupational pensions. Second, there is no sudden decline in the capital stock around the year 2030 when the baby boomers retire because the baby boom retirement entry stretches about 10 years during which the pre-funded component has not yet matured. The continued increase in new pension accounts compensates a substantial portion of dissaving among the retired baby boomers.

As figure 5 shows, the capital-labor ratio increases dramatically even in the absence of a funded pension system. Of course, both reform proposals lead to a significant additional increase. In all cases, the increase in the capital-labor ratio translates into a reduced return on capital. These effects are, however, relatively small. The overall reduction in the rate of return is about one percentage point under the current pay-as-you-go system without any pre-funding (figure 6). Introducing a funded component, either by a freezing or a partial transition model, leads to an additional reduction of about 0.5 percentage points. This is much less than often claimed in the public debate. Moreover, we have so far operated under the assumptions of a closed economy and a fixed production technology, but the reduction of the rate of return will be even smaller when we allow for capital mobility and feedback effects from strengthened capital markets.

Finally, we illustrate that a fundamental pension reform affects generations differently and discuss its political feasibility. Figure 7 shows, by birth year, changes in total discounted life-time utility induced by a 33% partial transition reform scheme. These projections use the preference structure outlined in the previous section. Some generations (mainly those who are currently working and still some years away from retirement) suffer utility losses, while the younger and unborn generations benefit. Interestingly, there are also small utility gains for generations born before 1946 because net wages rise under a fundamental pension reform. In our simulations, the change in life-time utility induced by a fundamental pension reform is negative for all generations born between 1947 and 1985 (including all three authors of this paper).

The underlying problem is well known: Since at the time of the introduction of a pay-as-you-go system, at least one generation received pension benefits without contributing to the system, the system carries an implicit debt that is rolled over from one generation to the next. Reducing or abolishing the pay-as-you-go systems requires that this debt be paid back, so at least one generation is worse off. This raises political economy issues: It is obvious that when a Pareto criterion is applied, a pension reform which reduces or even abolishes the a pay-as-you-go pension system is politically not feasible.[13]

This is, however, not the full story, and a fundamental pension reform is possible for several reasons. First, a pension reform induces efficiency gains which, over long horizons, might be large enough to compensate the pay-as-you-go system's implicit debt. In our framework, such efficiency gains could translate into a rate of return that is higher than under a pure pay-as-you-go system. International capital mobility and corporate governance effects are possible mechanisms discussed in the next two sections of this paper. Efficiency gains might also arise on labor markets from changes in tax-induced incentive effects (e.g., Fenge, 1995). Second, if a Pareto improvement is not required and a majority vote is assumed instead, feasible transition policies might exist (see Hirte, 2000, for a simulation analysis using a median-voter framework for Germany).

In both cases, it is crucial that a fundamental pension reform distributes the transition burden across generations, shifting at least some of the cost to unborn generations. In practice, this could be achieved by temporary debt financing of benefits. Cooley and Soares (1999) show that, in the absence of efficiency effects, all politically feasible transition policies use debt to finance benefits during the transition period; Feldstein and Samwick (1998, 2000) provide calculations of how debt finance is used in their framework for Social Security reform in the United States.

Even without debt finance, the transition burden can be distributed across generations such that a reform is politically feasible – provided that some generations are willing to accept small losses relative to the status quo. The simulations depicted in figure 7 suggest that even those generations which are hit hardest only suffer drop of less than 5% in total life-time utility.[14] The increase in life-time utility for younger generations is striking, and this suggests that even a modest degree of altruism among currently working generations might make a funda-

[13] We do not attempt to review the theoretical literature on political feasibility of pension reforms here. See, e.g., Fenge (1995) and the review in Hirte (2000).

[14] The partial transition scheme proposed by Birg and Börsch-Supan (1999) implies smoothing of the transition burden across generations. Since the freezing scheme for pension reform does not smooth the transition burden without further adjustments, utility changes are less smooth across generations.

mental pension reform politically feasible. Recent polls by Boeri et al. (2000) suggest that this assumption is indeed warranted in Germany.[15]

5. Pension reform and capital mobility

The overlapping generations model presented in sections 3 and 4 was formulated for a closed economy. If we allow for international capital mobility, the additional saving induced by a transition to a partially funded pension system can be invested in other countries with a more favorable age structure. This cannot make households worse off, and we argue below that the welfare increases from investing pension savings internationally will be substantial. These effects of international diversification on savings behavior and the implementation of pension reforms receive rapidly increasing attention as the pension reform debate progresses. Deardorff (1985) contains an early analysis, and Reisen (2000) provides a comprehensive overview of these issues. Reisen argues strongly that there are pension-improving benefits of global asset diversification. In this section, we review the interactions of population aging, aggregate saving, international capital mobility, and pension reform.

There is some empirical evidence on how demographic change has affected savings behavior across countries in the past; Poterba (1998) and Brooks (2000) provide reviews. In a recent empirical study, Lührmann (2000) uses a broad panel of 141 countries that covers the period 1960-95 to investigate the effects of demographics on national saving and investment, and on international capital flows. She confirms that cross-country capital flows are indeed influenced by demographic variables. While this has been shown in other studies before, she can also show that across countries, *relative* differences in the age structure are the most important determinants of capital flows, a finding that is even more important for the analysis of pension reform than the fact that the absolute age structure affects a country's capital balance. These findings confirm that the mechanisms postulated by Börsch-Supan (1995) and Pemberton (1999) have always been at work in the real world. Such effects will be even more pronounced when a pension reform induces households to save more in order to maintain their living standards in old age.

In a theoretical paper, Pemberton (1999) highlights the importance of international externalities caused by the effects of national pension and savings policies on the world interest rate.

[15] While we do not allow for bequests in our stylized model, we should note that a pension reform is likely to result in variations in bequests, in particular in the absence of mandated intergenerational transfers. Based on an overlapping generations model, Miles and Iben (1999) provide estimates of such changes in bequests.

More recently, Pemberton (2000) goes a step further and shows that – while the switch from a pay-as-you-go system to a fully funded pension system implies that (at least) one generation necessarily loses – in a world where pension reform takes place in many small, open economies, an intergenerational Pareto improvement is possible (for some production technologies). Pemberton supports this finding by numerical simulations of a stylized model for the OECD countries.

Although there is a strong case that international capital mobility will improve rates of return, and more generally, the welfare effects of a fundamental pension reform, more work is needed in this area, using more realistic models of pension reforms in a multi-country setting. One obvious line of research extends the overlapping generations model presented in sections 3 and 4, with its careful analysis of demographic change in Germany, to a multi-country environment. This is, however, no easy task, and while existing work suggests that there are strong welfare effects, the extremely stylized overlapping generations model by Pemberton (2000) cannot yet account for realistic paths of demographic change within countries.

Extending work by Cutler *et al.* (1990), Börsch-Supan (1995) has taken an alternative approach. He uses a multi-country version of the Ramsey-Cass growth model (Ramsey, 1928; Cass, 1965) to evaluate the effects of capital mobility on rates of return. While such a growth model is not really suitable for the analysis of pension systems since it lacks a proper generational structure, it can still be used to evaluate the effects of allowing for capital exports and investment in countries with a more favorable capital-labor ratio. We have updated the analysis by Bösch-Supan (1995) with the most recent demographic projections used in this paper. Figure 8 shows projections of the rate of return on capital derived from this multi-country Ramsey-Cass model under the current pay-as-you-go pension system. The relative effects of capital mobility are of similar magnitudes for the alternative pension reforms considered in section 4.

Our simulations suggest that international diversification (i.e., allowing for investment in all EU and OECD countries) can reduce the decline of the rate of return on capital to just about 0.5 percentage points around the year 2035, when baby boomers' dissaving is most pronounced. If investment is allowed also in developing countries, this effect would initially be about the same, but over very long horizons, when countries such as China and India reach the peak level of demand for capital on world markets, the rate of return would increase further.

An important question is whether sufficient international diversification can actually be achieved when households are unrestricted in their portfolio choice. There is a large empirical literature on 'home bias' in international portfolio choice (e.g., French and Poterba, 1991), and it is not yet fully understood why households do not optimally diversify their portfolios across countries. A recent empirical study by Portes and Rey (1999) suggests that information asymmetries across countries are a major source of home bias effects, and that capital flows are affected by both geographic and informational proximity. Applied to pension reform policies, this literature suggests that households might be more willing to invest their retirement savings in 'similar' countries such as the OECD or EU countries than in, say, developing countries. Unfortunately, the latter are the countries where not only the highest returns are to be found over much of the next century, but which would also benefit themselves most from capital provided by the aging industrialized nations. Blommestein (1998) and Holzmann (2000) discuss theses issues, both concluding that investments in emerging markets can help to solve the OECD countries' pension crisis at the margin, but are unable to solve the demographic problem alone, and stressing that additional reforms are needed.

For the purpose of policy analysis, a scenario where international diversification of pension funds is allowed only in a small group of countries such as the OECD might be most realistic. As demonstrated by our simulations, even such a restricted diversification improves rates of return on capital during the demographic transition considerably.

6. Pension reform and corporate governance

Population aging affects the rate of return on capital through its influence on the capital-labor ratio; a pension reform that involves more pre-funding also affects the rate of return primarily through its (additional) influence on the capital stock and the capital-labor ratio. In the overlapping generations model of sections 3 and 4, we made the implicit assumption of a fixed production technology. In this section, we argue that the additional saving induced by a fundamental pension reform influences the rate of return on capital also via feedback effects from strengthened capital markets.

Few households in continental European countries such as France, Germany and Italy hold financial assets with at least some minimal ownership rights. Those assets are highly concentrated among few households, in stark contrast to countries in which a substantial share of retirement income is financed through pension funds. A lack of relatively actively managed pension funds results in diffuse corporate control structures and weak corporate governance, and thus lowers capital productivity relative to other countries. Pension reform towards a higher degree of pre-funding can therefore strengthen corporate governance, increase capital productivity at constant or even increasing levels of labor productivity, and increase total factor productivity. Even if such productivity effects of a fundamental pension reform are small, they change the growth path of an economy and therefore have large effects in the long run. In this section, we sketch the underlying mechanisms only briefly, for details see Corsetti (1994), Corsetti and Schmidt-Hebbel (1995), Holzmann (1997), and Börsch-Supan and Winter (1999).

Pension funds play only a minor role in the capital markets of continental European countries. As reported by the Bank for International Settlements (1998), in 1996 pension fund assets represented only 3 percent of total GDP in Germany and 4% in Italy, while in the U.S. and the U.K., the shares were 57% and 77%, respectively. A fundamental pension reform would lead to a significant increase in the funds controlled by investment funds in Germany. Based on the theoretical and empirical findings about the link between active pension funds and firm performance (see Börsch-Supan and Winter, 1999), we expect that an increase in the volume of equity controlled by pension funds would have major effects on corporate governance in continental European countries.

Most theoretical arguments made in the literature are based on the incentive structures faced by pension fund managers. Del Guercio and Tkac (1999) analyze the incentive structures faced by managers of mutual and pension funds. Based on U.S. data, they conclude that mutual and pension fund managers operate in fundamentally different environments, and that pension fund sponsors use much more sophisticated measures to evaluate their managers' performance. An important way for pension fund managers to improve the performance of their funds is to take an active role in improving corporate governance. The role of large shareholders in disciplining management and the effectiveness of shareholder activism are central to understanding the macroeconomic consequences of an increase in pre-funded pensions.

The basic theoretical argument has been made, for example, by Pound (1988): Institutional investors such as pension funds that have no business relations with a firm can do a better job in disciplining management. Even though the presence of active large shareholders results in a free-rider problem (since passive shareholders benefit from monitoring activities without incurring monitoring costs themselves), Admati *et al.* (1994) show that active large shareholders can exist in equilibrium under plausible conditions such as risk-averse investors. This result implies that when large investors (such as mutual or pension funds) specialize in specific monitoring activities in order to control firms better, individuals can hold shares in multiple funds such that their combined holdings sum to the market portfolio. In other words: Risk-averse individuals can invest optimally in pension funds which specialize in specific monitoring activities and provide better corporate governance.

There is a large number of studies which try to evaluate the effectiveness of pension fund activism. Black (1998) surveys the literature on large shareholder and pension fund activism and concludes that pension fund interventions are generally ineffective. However, in our assessment the empirical evidence is not that clear. First, due to methodological and measurement problems, it is difficult to quantify the direct stock price effects of pension fund interventions and to establish causality. Second, there are also quite a few more recent studies which indicate that pension fund activism has beneficial effects and that agency problems are not a major concern in practice. For example, Del Guercio and Hawkins (1999) study shareholder proposals of the largest, most active funds from 1987 through 1993. In contrast to earlier results by Karpoff *et al.* (1996) and Wahal (1996), they conclude that pension funds are successful at monitoring and promoting change in target firms. This finding is in line with earlier work by Gordon and Pound (1993) who also find that institutional investors have a significant influence on changes of the corporate charter. In addition, Del Guercio and Hawkins (1999) do not find evidence to support that funds have other motivations than value maximization. This result can be interpreted as indicating that agency problems might not be a major concern in practice, and that active pension funds can be successful in improving corporate governance.

Evaluating the effects of improved corporate governance on capital productivity is a difficult task given the absence of sufficient variation of institutional arrangements within a single country. International comparisons are another way to exploit variation in governance structures (see La Porta *et al.*, 1999, and Mueller and Yortoglu, 2000, for recent comparative country studies of corporate governance). Börsch-Supan (1998b) combines variation across countries and across companies, using data from company benchmarking studies by McKinsey Global Institute (1996) for West Germany, Japan and the United States. He estimates rates of return on investment and investigates the contribution of capital – more precisely, capital management and capital utilization – to total factor productivity. Notwithstanding substantial variation across companies and industries, the market sectors of West Germany and Japan had significantly lower rates of capital utilization in the early 1990s and created less productive capacity per unit of physical assets than the United States did. Börsch-Supan (1998b) shows that these low rates of capital utilization were only partially due to high labor costs relative to capital, leading to high capital intensity at short work hours. More important for the aggregate result of poor capital productivity were the many cases in which management did not focus on how productively they were using their assets. Conversely, a focus on financial performance, especially prevalent among U.S. firms, did create a clear performance objective that generally resulted in productivity improvements.

To illustrate possible feedback effects of improvements in corporate governance and capital productivity on the rate of return on capital, and on pension reform in general, we return to the stylized overlapping generations model of sections 3 and 4. Suppose that after the implementation of a fundamental pension reform, the growth rate of total factor productivity increases by 0.2 percentage points for 15 years, i.e., the productivity effects induced by the reform are rather modest and only transient. As can be seen from figure 9, such an increase in the growth rate of total factor productivity raises the rate of return on capital temporarily, by as much as a little over 0.2 percentage points around the year 2010. Such an increase is just enough to make the change in total life-time utility associated with a 33% partial transition scheme non-negative for all living cohorts.[16] This result shows that feedback effects from capital markets are very powerful. They can change the welfare effects and the political economy of a fundamental pension reform substantially.

7. Conclusions

In this paper, we have analyzed the consequences of population aging and a fundamental pension reform – that is, a shift towards more pre-funding – for capital markets in Germany, focusing on the central macro-economic link at question, the rate of return on capital. We used a stylized overlapping generations model of pension reform to predict the rate of return on capital over a long horizon, taking demographic projections of population aging as given. A transition to a partially funded system results, at least initially, in a higher capital stock, but when the baby boom generations begin to consume their retirement savings, the capital stock will decrease after 2030. Our simulations suggest that the decrease in the rate of return on capital, which results from secular shifts in the capital-labor ratio associated with an aging population and retirement saving, is less than one percentage point, and only if pension funds invest exclusively in Germany. However, capital markets these days are anything but closed national markets, and the return on capital can be improved by international diversification. Our analysis has also shown that capital performance should be further improved by feedback

[16] These calculations are similar to those reported in figure 7; see section 4 for details. Further results are available on request.

effects associated with strengthened capital markets and better corporate governance structures.

A few remarks on the economic model we used to simulate the macroeconomic effects of a fundamental pension reform are in order. We have already mentioned that our overlapping-generations model is very stylized and some important economic mechanisms are not taken into account, most importantly, endogenous labor supply decisions and taxation. While it would certainly be interesting to explore these issues in our model, we do not anticipate that they would change the basic message of our analysis.

More fundamentally, while the framework of rational, forward-looking life-cycle decisions is a convenient and broadly accepted tool for the analysis of the effects of pension reforms and other public policy measures, the underlying assumption of rational behavior has been criticized as being unrealistic. In many applications, one might ignore this problem by following an *as if* argument. For example, Rodepeter and Winter (1999) argue that simple rules of thumb might help individuals to achieve savings outcomes which are quite similar to the solution of the intertemporal optimization problem. However, in the context of pension reforms, another problem is relevant: Boundedly rational individuals who suffer from a lack of self-control might not be able to make time-consistent savings decisions that allow them to attain their desired levels of retirement wealth (O'Donoghue and Rabin, 1999; Diamond and Köszegi, 1999).[17]

It is difficult to quantify the importance of such effects, but this is an area of active research. If anything, we would argue that in Germany, in contrast to the United States, people tend to save too much for retirement rather than too little (see Börsch-Supan *et al.*, 1999), and under-saving due to time-inconsistent preferences has not been a problem in the past. Also, recent polls by Boeri *et al.* (2000) suggest that people are well aware of the need to save for their retirement. In any case, it should be clear that a fundamental pension reform needs to provide appropriate incentives that ensure that individuals save enough to close the future pensions gap, and that individuals invest their retirement savings wisely. Providing retirement savings products that facilitate such decisions and allow for self-commitment is an important task for insurance companies and banks, but there is no reason to believe that this cannot be achieved by the market sector.

[17] In our overlapping generations model, such time-inconsistent behavior would translate into intertemporal preferences which are based on hyperbolic, rather than exponential, discounting.

An important aspect which is not reflected by the overlapping generations model of sections 3 and 4 is financial markets risk. Our analysis concentrated on the long-term path of the rate of return on capital in a model with no stochastic aggregate fluctuations, so there was no role for risk. However, real-world investments are risky, and in their savings and portfolio decisions, households are concerned not only about the (expected) rate of return, but also about its variance, that is, about portfolio risk.

First of all, it is important to note that the average rates of return on capital projected in this paper are much lower than the rates of return on equity experienced on stock markets in the last few years. It is certainly not necessary that stock market valuations of productive capital grow at such rates to sustain a funded pension system. Even a considerable drop in the stock market relative to the record levels seen in the spring of 2000 would not jeopardize long-run average rates of return. Diamond (1999) provides an overview of these issues and discusses what average rates of return might be expected in the future; these are in line with the results we obtained from our simulations. We conclude this paper by discussing how these issues are related to our simulation analysis and to a fundamental pension reform in general.

Consider first the risk associated with short-run fluctuations. One of the most frequently raised objections raised against a transition towards a partially funded pension system is that the effects of risk will affect households' welfare negatively and might even wipe out any potential welfare gains associated with a fundamental pension reform. Burtless (2000), based on a retrospective simulation of returns on fictive U.S. pension accounts over the past century, takes the position that "returns under private plans would usually have been good, but that financial market risks in a private account system are empirically quite large." Following Feldstein and Samwick (1998), Birg and Börsch-Supan (1999) deal with this problem in an *ad hoc* fashion by using a constant 'risk adjustment' factor to correct the rate of return generated by the overlapping generations model when they evaluate they feasibility of a fundamental pension reform. This risk adjustment factor can be interpreted as the (implicit) premium households pay to insure against stochastic returns (i.e., aggregate shocks).[18]

The 'correct' reaction to the objection by Burtless (2000) and others would be to perform a simulation analysis of demographic change and pension reform in an overlapping generations model which allows for stochastic returns and which models households' preferences over

[18] It is an open question, however, whether and how markets could provide such insurance; see Börsch-Supan (2000b) and Miles (2000). We should also note that there is a related literature that focuses on the role of idiosyncratic, rather than aggregate, risk in stochastic overlapping generations models; see Geanakoplos et al. (1999) and Rust (1999) for overviews. We do not discuss insurance against idiosyncratic shocks in this paper.

risky assets. Such a model would generally imply that older households shift assets from risky equity into risk-free bonds since older households tend to exhibit more risk aversion in their portfolio decisions (Bakshi and Chen, 1994; Jaganathan and Kocherlakota, 1996), but quantitative predictions about the size of these effects are hard to obtain.

Miles (2000) presents a step in this direction, although his interest is more on the possibility of insurance against financial markets fluctuations, and he does not derive asset prices from household behavior in an explicit intertemporal CAPM model. More advanced stochastic general equilibrium models that allow for portfolio choice are technically quite difficult and have rarely been used in the analysis of pension reform. Such models raise the issue that the equity premium (the spread between the interest rates for risk-free and risky assets) needs to be explained endogenously, a task that has proven quite difficult under standard assumptions on households' preferences (Mehra and Prescott, 1985; Kocherlakota, 1996). Brooks (2000), which appears to be the most advanced paper in this strand of the pension reform literature, solves this problem by introducing participation constraints (following Constantinides *et al.*, 1998) in an overlapping generations model with portfolio choice. While his results, based on stylized demographic assumptions of an aging economy, are difficult to compare with our results which are based on realistic demographic projections and detailed reform proposals, we should note that the interest rate effects he obtains are in the same order of magnitude as the ones we report in this paper.[19]

In any case, it is important not to forget the relative importance of the issues that are at stake. Burtless (2000) concludes his study of social security privatization and financial markets risks by taking an extreme position: "Because public social security is backed by taxing and borrowing authority of the state, it can spread risks over a much larger population ..., including contributors and beneficiaries in several generations." While this argument may sound reasonable, exact welfare comparisons in stochastic overlapping generations models that allow for (idiosyncratic or aggregate) risk are conceptually quite difficult (see Sargent, 1999), and

[19] Brooks (2000) reports that during the initial phase of demographic transition, when the baby boomers save more and drive the capital stock up, the expected rate of return on capital rises above its steady-state level by ten base points, while the risk-free rate is 23 base points higher. When the baby boomers get old and dissave, the rate of return on capital falls by ten base points, and the risk-free rate by 24 base points, below their steady-state levels. In our simulations, we have an ongoing demographic transition, and a steady state to which we could relate our results does not exist.

Burtless' empirical *ex post* approach deals inadequately with the nature of the risks involved.[20]

More importantly, given the severity of the population aging problem that lies ahead, the 'tax and borrow' approach to reforming social security is just not feasible – the political strain caused by the degree of intergenerational redestribution required for sustaining the existing pay-as-you-go system is likely to outweigh the benefits of mandated intergenerational risk sharing by far. While more research is needed on the capital market effects of a fundamental pension reform, our analysis suggests that the rate of return on capital can sustain such reforms, and that macroeconomic feedback effects make a shift to more pre-funding appear to be even more attractive.

[20] Bohn (1999), Shiller (1999), Storesletten *et al*. (1999), and Rangel and Zeckhauser (1999) provide formal analyses of institutional arrangements for intragenerational, intergenerational, and international risk sharing.

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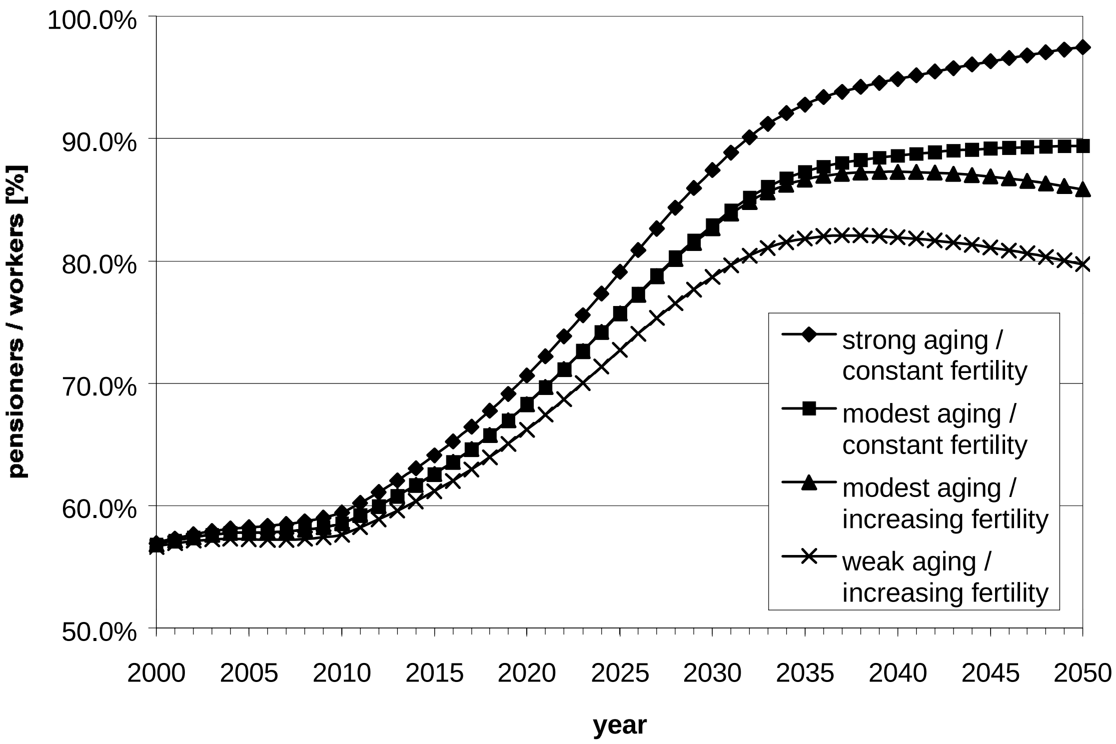
Table 1: Calibration of parameters in the overlapping generations model

α: output share of capital in the CES production function	0,4099
β: elasticity of substitution in the CES production function	0,9990
δ: depreciation rate of capital	0,0528
ρ: rate of time preference	0,0150
σ: elasticity of intertemporal substitution in consumption	3

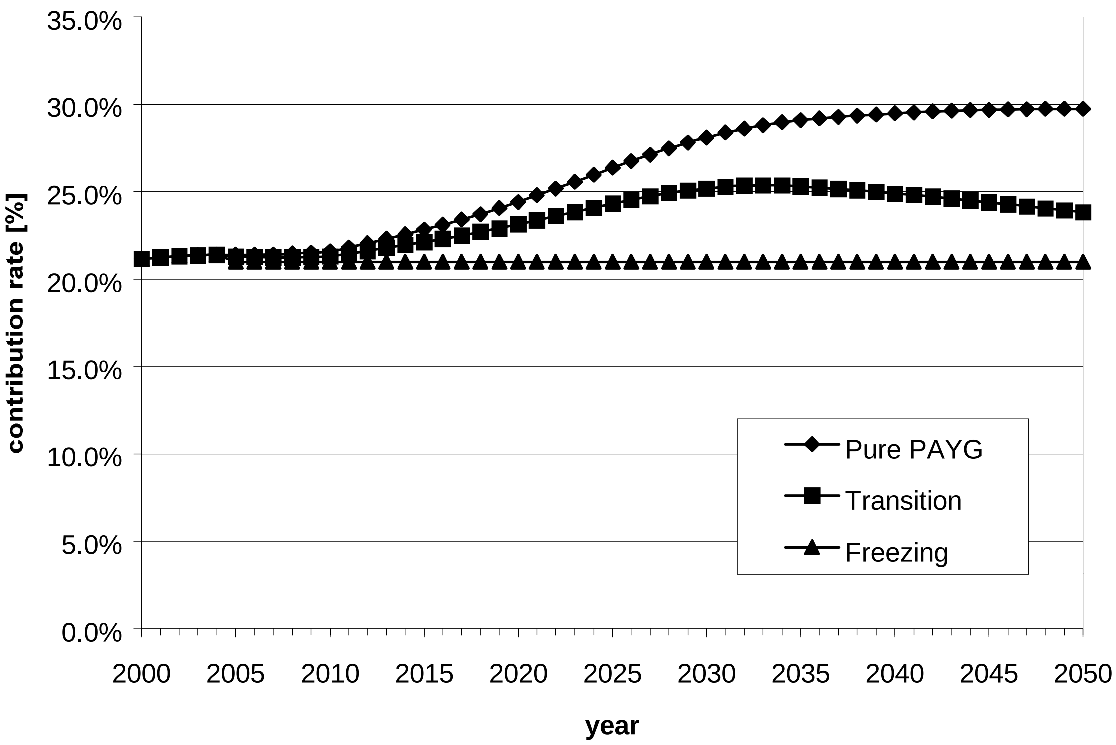
Figure 1: Projections of the old-age dependency ratio



Notes: This figure shows projections of the number of pensioners as a percentage of the number of workers for four demographic scenarios.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

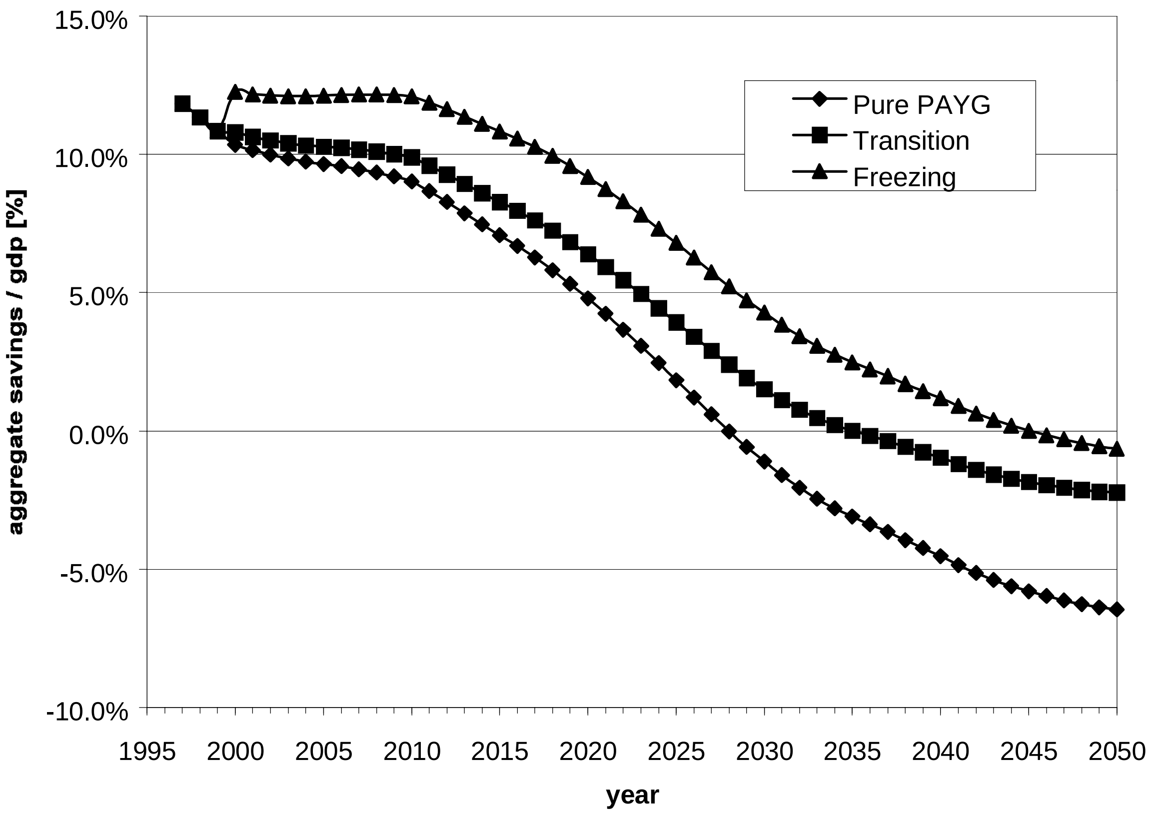
Figure 2: Projections of the contribution rate to the public pension system under alternative pension systems



Notes: This figure shows projections of the contribution rate to the public pensions system derived from an overlapping generations model under benchmark assumptions for demographic change and alternative pension systems.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

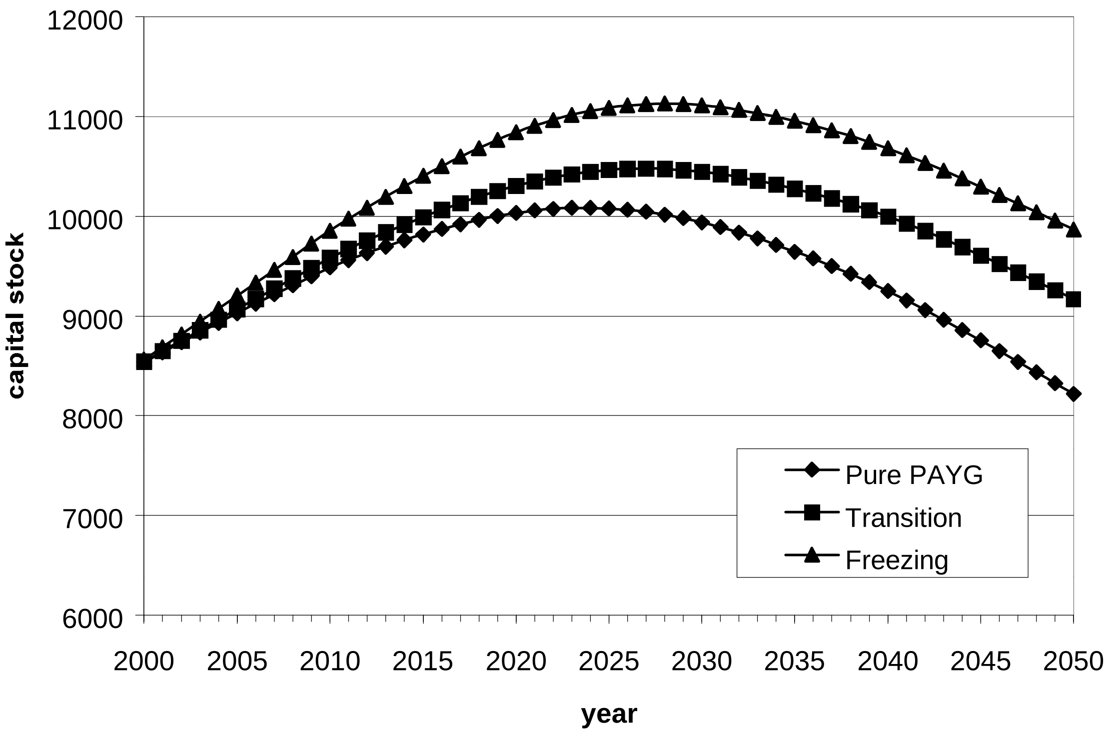
Figure 3: Projections of the aggregate saving rate under alternative pension systems



Notes: This figure shows projections of the aggregate saving rate derived from an overlapping generations model under benchmark assumptions for demographic change and alternative pension systems.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

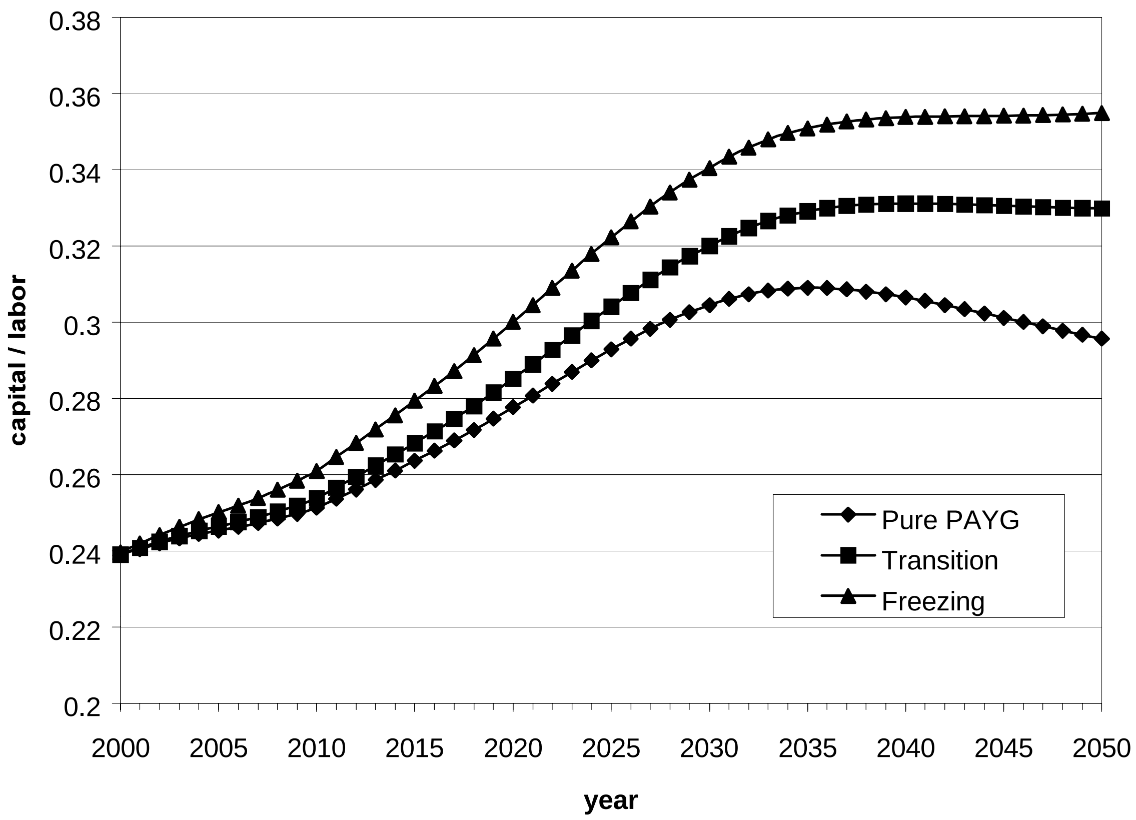
Figure 4: Projections of the aggregate capital stock under alternative pension systems



Notes: This figure shows projections of the aggregate capital stock derived from an overlapping generations model under benchmark assumptions for demographic change and alternative pension systems. All figures in DM and in 1997 prices.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

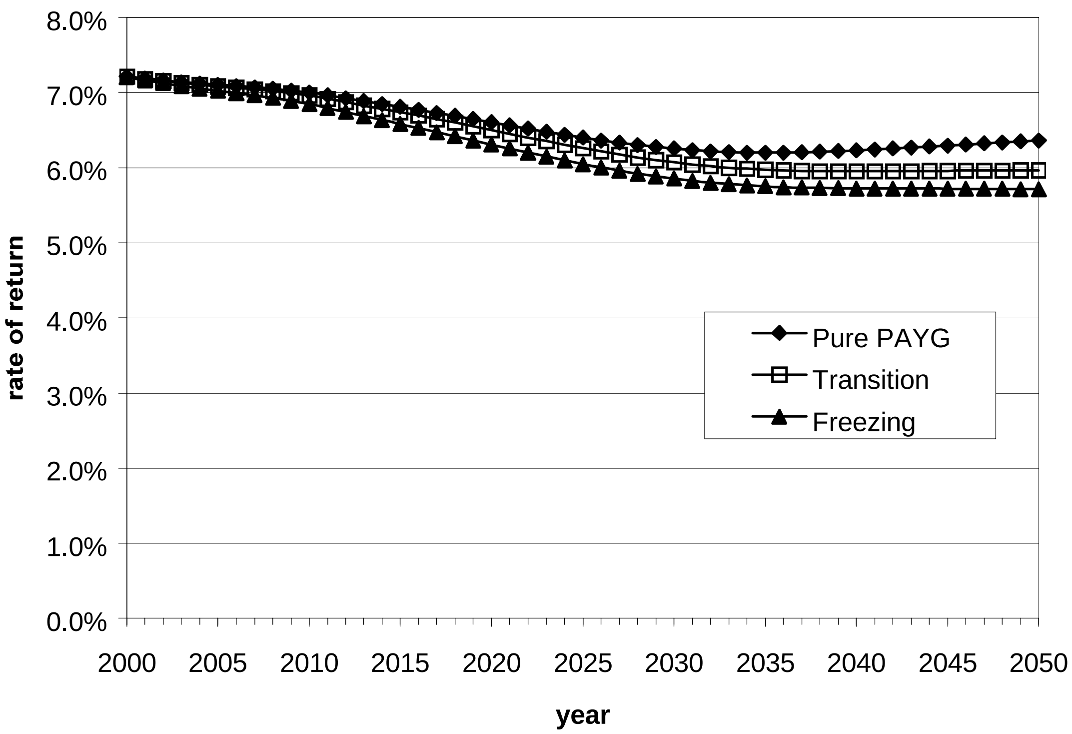
Figure 5: Projections of the capital-labor ratio under alternative pension systems



Notes: This figure shows projections of the capital-labor ratio derived from an overlapping generations model under benchmark assumptions for demographic change and alternative pension systems.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

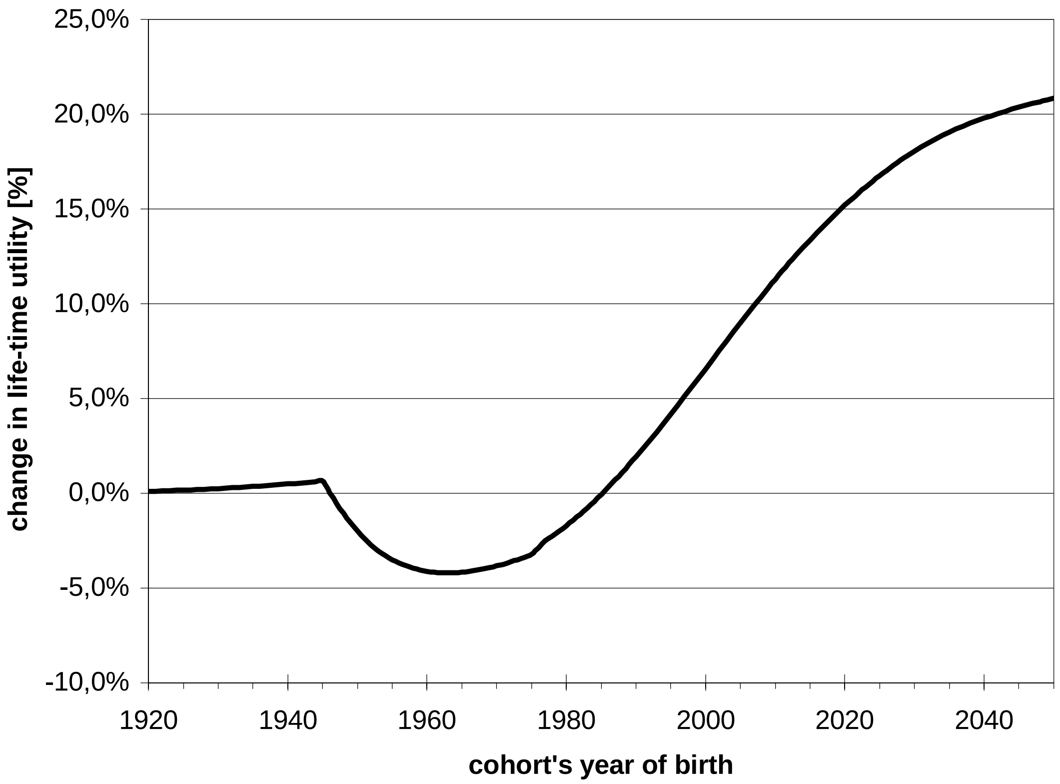
Figure 6: Projections of the rate of return on capital under alternative pension systems



Notes: This figure shows projections of the rate of return on capital derived from an overlapping generations model under benchmark assumptions for demographic change and alternative pension systems.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

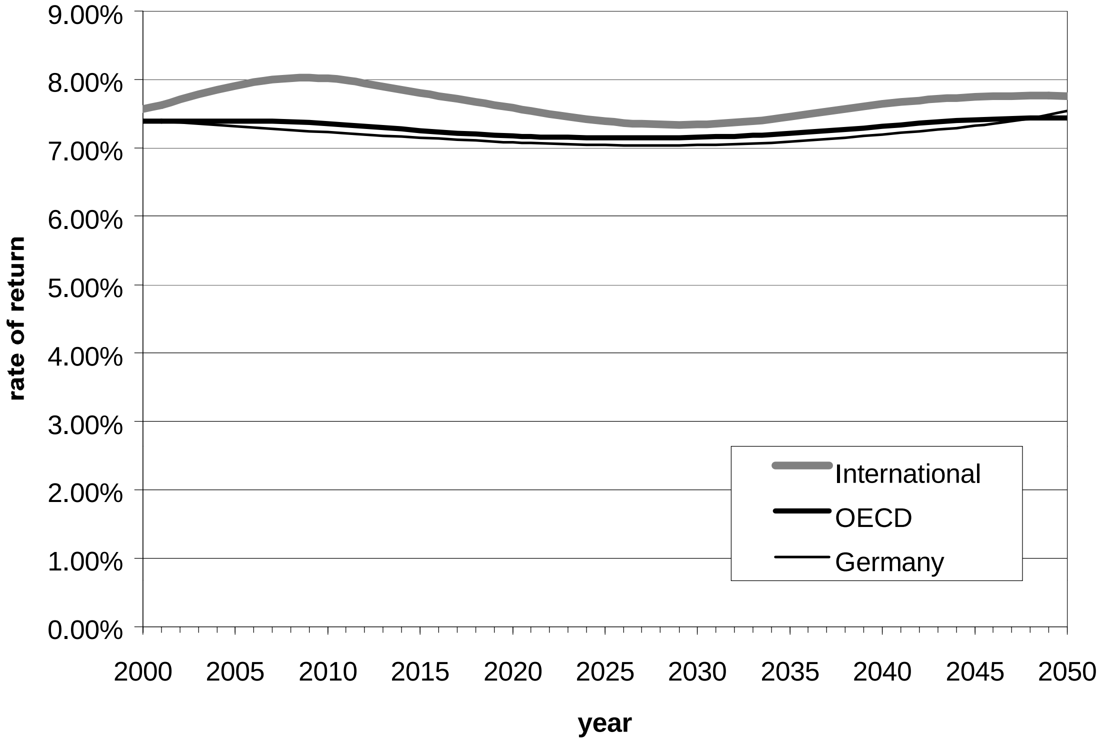
Figure 7: Change in discounted life-time utility induced by a fundamental pension reform



Notes: This figure shows, by birth cohort, projected changes in discounted life-time utility induced by a fundamental pension reform, assuming a 33% partial transition scheme. Assumptions on households' preferences are discussed in the main text.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

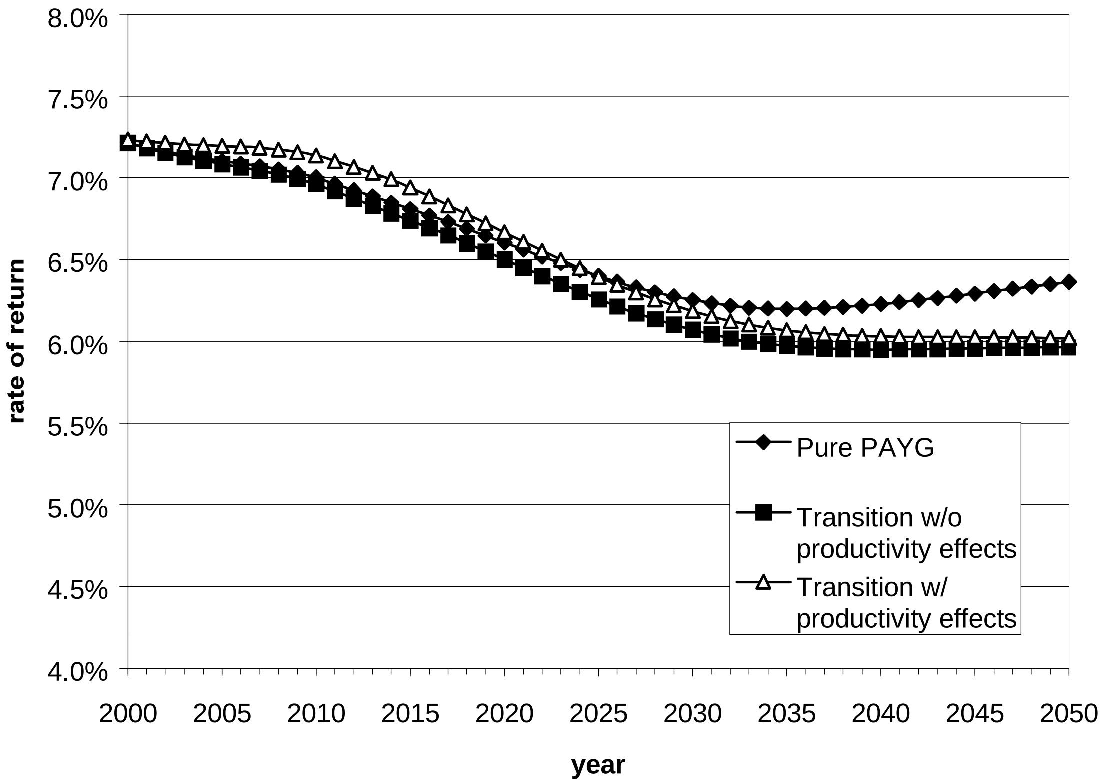
Figure 8: The effect of international capital mobility on rates of return



Notes: This figure shows the projected effect of international capital mobility on the rate of return on capital derived from an Ramsey-Cass model under benchmark assumptions for demographic change and a pension reform following the freezing model.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).

Figure 9: Projections of the rate of return on capital with transient productivity effects



Notes: This figure shows projections of the rate of return on capital derived from an overlapping generations model under benchmark assumptions for demographic change and assuming a 33% partial transition scheme.

Source: Own calculations, based on demographic projections by Birg and Börsch-Supan (1999).