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JAN HAGEMEJER
KRZYSZTOF MAKARSKI
JOANNA TYROWICZ

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JAN HAGEMEJER
National Bank of Poland
Faculty of Economic Sciences,
University of Warsaw
e-mail: jan.hagemejer@nbp.pl

KRZYSZTOF MAKARSKI
National Bank of Poland
Warsaw School of Economics
e-mail: kmakar@sgh.waw.pl

JOANNA TYROWICZ
Faculty of Economic Sciences, University of Warsaw
National Bank of Poland
e-mail: j.tyrowicz@uw.edu.pl

Abstract

In many countries the fiscal tension associated with the global financial crisis brings about the discussion about unprivatizing the social security system. This paper employs an OLG model to assess ex ante the effects of such changes to the pension reform in Poland from 1999 as implemented in 2011 and proposed in 2013. We simulate the behavior of the economy without the implemented/proposed changes and compare it to a status quo defined by the reform from 1999. We find that the changes implemented in 2011 and all of the proposed reform scenarios from 2013 are detrimental to welfare. The effects on capital and output are small and depend on the selected fiscal closure. Implied effective replacement rates are lower. These findings are robust to time inconsistency. The shortsightedness of the governments imposes welfare costs.

Keywords:
OLG, PAYG, pension system reform, time inconsistency

JEL:
C68, E17, E25, J11, J24, H55, D72

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1 Introduction and motivation

With progressing longevity and lowering fertility rates, maintaining defined benefit schemes may actually become fiscally (and socially) nonviable. Many countries expect increase the retirement age in order to avoid stark reductions in the replacement rates (e.g. Denmark, Germany, Austria). Indeed, policy makers and experts alike propose two types of solutions. One approach focuses on the fiscal side and proposes inevitably painful reforms to the pension system - raising contributions and/or lowering benefits to cut future expenditure. The alternative approach emphasizes the demographic component and favors fertility fostering policies and/or stimulating economic activity, thus effectively raising current expenditure. In fact, already now a variety of pension policy responses may be observed in Europe. Some countries (e.g. Italy and France) partially reduce the generosity of the social security system and attempt to raise contributions by increasing the participation and compliance. Macroeconomic simulations show, however, that such measures are far from satisfactory and at best delay the fiscal consequences. Other countries (e.g. Sweden and some of the Central and Eastern European countries) aim at relieving the future generations by imposing so-called partially funded schemes at the expense of a considerable reduction in the effective replacement rates.

Such reform - partial "privatization of the social security" - was implemented in Poland in 1999, with the introduction of the three pillar system. The first pillar is a PAYG notional defined contribution Social Insurance Fund (SIF), where current contributions are used to pay out current benefits, but the contributions are recorded in individual accounts and will serve as a basis for computing an annuity upon retirement. The contributions in that pillar are indexed annually according to payroll growth. The second pillar is a fully funded defined contribution one, where Open Pension Funds (OPFs) invest contributions in the name of participants, earning interest free of capital income tax. These contributions and interest, however, cannot be collected prior to the retirement. Both these pillars are mandatory. The system is completed by a third pillar, where savings are also exempt from the capital income tax, but the contributions are voluntary and subject to a cap. Due to insufficient incentives, the third pillar is not popular, with about 1.3% of the working population contributing to any voluntary pension savings schemes.

Due to the structure of the reform, immediately a gap is generated in the Social Insurance Fund, but at the moment of the reform Poland still had a relatively viable (although deteriorating) demographics, which in principle eases the burden associated with the shift of part of the contributions away from the PAYG scheme. In addition, over the first years of the transition between the systems the gap in SIF, who pays out the benefits was filled by the revenues from privatization. In fact, despite sudden slowdown in the privatization rate as of 2005, for as much as nine years after the reform, the cumulative privatization proceeds exceeded the actual transfer to the OPFs, cfr. Hagemejer, Makarski and Tyrowicz (2013). Due to a typical time inconsistency as well as political instability, this feature of the pension system reform was abandoned, with additional departures from the reform introduced by exempting some groups from the general pension system.

When introducing the reforms to the pension systems, one should expect consequences to emerge over a long horizon. Unfortunately, majority of the economic models has trouble encompassing changes in the demographics as well as consequences of eventual catching up. A viable solution to these shortcomings is offered by the Overlapping Generations (OLG) models as proposed originally by Auerbach and Kotlikoff (1987) and developed ever since. In these models subsequent generations get born and optimize life time consumption as well as savings patterns subject to a wealth constraint. Individual savings serve firms to invest and investment facilitates increase in output *per capita*.

In this paper we build on an OLG model developed by Hagemejer, Makarski and Tyrowicz (2013) and adapt it to provide an *ex ante* evaluation of the the changes in the pension system reform introduced in 2011 and proposed in 2013. We carefully replicate the institutional features of the implemented/proposed pension system and simulate the behavior of the economy subsequent to these changes. We compare the behavior of this economy to economy with an identical starting point, but which has stayed with the institutional features as designed in the original 1999 pension system reform. While this paper does not evaluate the original pension system reform from 1999, we find that the implemented and proposed changes to this reformed system are detrimental to welfare and replacement rates. We also find that the easing of the fiscal tension is only temporary, yielding an actual higher fiscal burden over the longer horizon.

The paper is structured as follows. In the next section we present general insights from the literature. In section 3 we discuss in detail how the pension system is designed and modeled, including the changes implemented in 2011 and the changes proposed in 2013. Section 5 describes the calibration of the model while in section 6 presents the results of this study.

2 Insights from the literature in the field

Pension reform is a complex policy change. While population aging turns the traditional defined benefit pay-as-you-go system (PAYG DB) systems fiscally unsustainable, the design of reformed, defined contribution system is debatable. Issues to be considered, among others, include: the short- and medium-run costs of the reform, ways to finance those costs, the effects of the reform on consumption patterns in short and medium run, labor market effects, extent of distortion resulting from the method of pension reform financing as well as the long-term level of capital. The studies of the reform need to be explicit on the two vital dimensions characterizing the system: the choice between the defined benefit and defined contribution, and the choice of the degree of funding and the intergenerational distribution. Typically, studies which only change the parameters of the system without actually introducing the changes along any of these dimension, are considered parametric reforms. The most frequent type of analyzed reforms concerns a shift from DB PAYG to a (partially or fully) funded DC system, see Fehr (2009).

In a pioneer study Auerbach et al. (1989) show using an overlapping generations (OLG) model that in four analyzed OECD countries (Japan, Germany, Sweden and United States), maintaining the PAYG DB social security system in an aging economy requires a considerable increase in taxation and at the same time leads to a deterioration of national savings and hence the capital stock. Subsequent studies encompassed both theoretical and actual reform scenarios employing the OLG framework. In addition, there are also numerous econometric and non-simulation general equilibrium approaches to analyze the reform. For example, subsequent to the policy papers by The World Bank in mid 1990s, potential for the reform, the benefits and the costs were analyzed for - among others - Central and Eastern European countries (CEECs). Chlon et al. (1999), for example, describe in detail the framework of Polish pension system reform. In a similar spirit, Chlon and Mora (2006) discuss introduction of a Notional Defined Contribution (NDC) system in the Czech Republic, Orbán and Palotai (2005) for Hungary, Rasner (2005) in Germany, just to name a few. A common note in the majority of papers is the expectation of greater financial stability and increase the savings rate with a positive impact on economic growth as an effect of change from PAYG DB system to a partially funded DC system. More recently, Góra (2013) shed light also on a political economy concepts such as the conflict of interest between the working and the retirees and the inter-generational distribution of the costs of the reform.

Studies based on OLG, which explicitly model theoretically all these issues, have grown in numbers irrespectively of the actual pension reforms. Majority of the papers in the literature point to superiority of the fully funded pension scheme over the PAYG pension scheme. Kotlikoff (1998) analyze effects of privatization of the US social security scheme. He shows that privatization brings a positive long-run effect on output of at least additional 10 percent and sizable welfare gains to future generations[1]. The overall welfare effects depend on the ability to compensate the current generations. In a similar paper, Kotlikoff et al. (1999) arrive at similar results and compare different fiscal closures. They show that the costs to the transition generations can be brought down by allowing their participation in the new system on a voluntary basis.

One of the alternatives to total privatization of the pension system with a fully funded DC system, is a notional defined contribution (NDC) system, i.e. DC system but based on intergenerational redistribution mechanisms. Boersch-Supan (2004) provides the overview of features of such a system and argues that while NDC system changes "the microeconomics of labor supply and savings, it does not, however, change the macroeconomics of PAYG systems and thus does not substitute for the introduction of funded second and third pillars" if demography is deteriorating. Using a stochastic OLG model calibrated to Swedish data[2], Auerbach et al. (1989) show that NDC model can be a useful device to prevent excessive debt accumulation and, if designed correctly, can assure stability of the pension system. Using a microsimulation model, Borella and Moscarola (2010) show that in Italy the replacement of the unsustainable DB system by NDC should lead to the postponed retirement, thus keeping the effective replacement rates close the pre-reform levels.

Also using an OLG framework, Hagemejer, Makarski and Tyrowicz (2013) analyze the effects of introduction of a two tier pension system in Poland in 1999. They develop a model - closely calibrated to the Polish economy - with a variety of fiscal closures to the gap generated by the establishment of the funded pillar. They show that the 1999 reform brings sizable boost to the consumers welfare and capital stock in the long run through efficiency gains. However, there are non-negligible welfare costs of the reform that are borne by the generations living already in the moment of introducing the reform. The paper shows that from the welfare point of view, it is optimal to finance the pension reform with an immediate increase in taxation, when an efficient inter-generational redistribution is possible. If this is not the case and the first-best

[1] Typically in this literature long run implies 30-100 years.

[2] For details on Swedish pension system see Fredriksen and Stoelen (2011)

scenario is not feasible in practice, allowing the gap to accumulate into public debt provides a strict welfare improvement for all cohorts. A decomposition of the welfare effects of the pension reform shows regardless of the fiscal closure, a shift from DB to DC scheme is detrimental to the welfare of the transition generation and in general beneficial in the long run. In addition, the partial shift to a funded scheme from a purely PAYG system reduces welfare to a smallest extent, if it is financed by a temporary increase in public debt. Thus, they show that even accounting for the higher cost of servicing the public debt, introducing a capital pillar offers a welfare and efficiency gain.

There is virtually no literature on the reforms of the (partially) funded DC systems and this is the case for two reasons: (i) prior to the global financial crisis this was not considered a policy option; and (ii) such reforms would typically parametric, i.e. modify parameters of the system and not the system itself. The changes to the pension system undertaken by Baltic States, Ireland, Hungary and Poland raised a important research question concerning the long-run costs of changes in the pension system driven by short-time fiscal pressure. Nationalization of the fully funded tier of the pension system occurred in Hungary for example, while the funds were directly used for current budgetary needs. The 2011 reform in Poland as well as the proposals for the reform from 2013 effectively reduce the funded pillar of the pension system. In the spirit of the OLG models, one should expect the decrease in the speed of capital accumulation. However, the proposed reforms could in principle fulfill the officially stated objectives: easing the fiscal tension while preserving the value of the pensions. The objective of this paper is to see if that indeed is the case.

3 The pension system in Poland and its reform

The original pension reform from 1999 consists of two important changes[3]. First, defined benefit system was replaced by defined contribution system for virtually all cohorts. Only those who already collected pensions and individuals less than 10 years ahead of the official retirement age were exempt from this rule. The major difference between the defined benefit and defined contribution system consists of how the benefits are computed. In the former the benefit is an *ex ante* known proportion of wage received before retirement. In the latter, pension consists of individual stock of savings divided by one's remaining lifetime. The second component of the reform was introducing a partially funded capital pillar to the system. While the first defined contribution pillar works on a PAYG basis, the second defined contribution pillar was to be fully funded.

In order to implement the change from defined benefit to defined contribution scheme, the legislation specified the way the so called "initial capital" was to be computed for all individuals. Otherwise individuals short before retirement would have no chance to collect savings. The "initial capital" was to be computed based on individual employment tenure, with algorithms differentiated across genders and educational levels. Naturally, there were no savings in the Social Insurance Fund (SIF), but this calculation permits just calculation of pensions for the cohorts who were born too early to participate in the system after the reform.

The introduction of the capital pillar creates a gap in the pension system[4] because part of the contributions is transferred to be invested in the capital market rather than used for the paying out of the current benefits. This gap, accumulated over time contributes to raising public debt. The reason why such solution is chosen originates from the observation that the sustainability of the defined contribution systems is enhanced by diversification of the recession hazard, Blake (2000). Since capital markets are typically leading the business cycle, periods of high growth in the asset value precede periods of payroll growth and *vice versa*. In order for this mechanism to be effective, the proportion of social security contributions kept in the capital pillar and in the PAYG pillar should be fairly balanced.

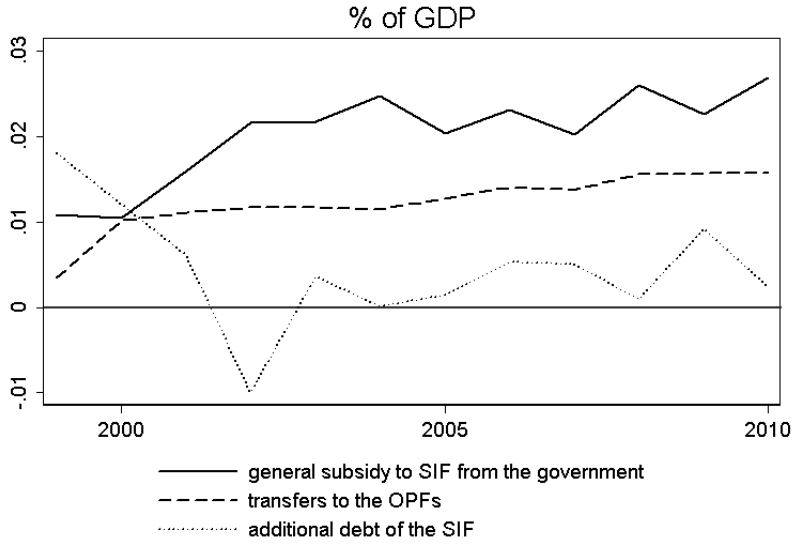
The introduction of the pension system reform in Poland involved certain transition periods. The two pillar reform became effective as of January 1st 1999 and was obligatory for all cohorts born on January 1st 1969 and younger. For the cohorts born between 1949 and 1969 the change from pay-as-you-go to NDC was mandatory, but there was no obligation to participate in the II pillar. In other words, the way the benefit was to be calculated changed for these generations, but they could decide that the entire contribution is directed to the NDC PAYG pillar in SIF. Finally, generations born prior to 1949 (thus at the age of 50 or older at the moment of pension system reform) stayed in DB PAYG pillar in SIF.

In Poland the 1999 reform maintained the contributions rate at 19.52% of the gross wage, splitting the part of the contributions that goes to two pillars unequally. The PAYG pillar in SIF received 12.22% to pay out the current benefits, while 7.3% of the contribution was forwarded to the Open Pension Funds (OPFs).

[3] In what follows we only discuss the mandatory components of the pension system.

[4] Please note, that the general balancing of the pension system is beyond the scope of this paper, but has received adequate tackling in the model, refer to section 4

Figure 1: The balance of SIF as a share in GDP.



S*ource*: SIF annual reports.

While the choice of the particular OPF was individual, participation in OPFs in general is mandatory. The legislation mandated OPFs to maintain a balanced portfolio with app. 60% of contributions invested in what the legislation considers "safe" asset, i.e. government bonds.

The system in this shape continued to operate without significant changes for 12 years, yielding an overall rate of return on savings invested by the OPFs at about 7.5% (net of payments, in real terms), which was fairly comparable to the indexation rate in SIF. The gap in SIF was financed from the general budget, which used revenues from privatization, general taxes and debt to fill this gap. On average the gap amounted to 1.2% of GDP each year, which is substantially less then the general subsidy for the SIF due to general imbalances (on average 2.0% of GDP over this period), Figure 1.

3.1 Changes in the pension system

The changes in the pension system implemented in 2011 focused on reducing the share of contributions to be transferred to OPFs. The original 7.3% of the contribution was to be reduced temporarily to 2.3% in 2011 and raised in subsequent years to reach 3.5% in 2017. The structure of the OPFs portfolio allowed by the legislation remained essentially unaffected. The legislation previewed that this temporary reduction in the contribution is accounted for separately from the general contribution to SIF and indexed with the GDP growth rate (5-year moving average) rather than the payroll growth rate. In 2011 the 4.9% of the gross wage was supposed to be directed to this dedicated account in SIF. In subsequent years, with the increase of the part of the contributions redirected to OPFs, this share was to be reduced to 3.7%.

In 2013 the government has proposed another set of reform proposals. The share of contributions directed to the OPFs is planned to be further reduced for two reasons. First, the participation in the capital pillar, which was until now automatic and mandatory is envisaged to become voluntary with non-participation being the base option. Second, for those who actively choose to participate in the capital pillar, the contribution rates will be lowered to 2.92% of the gross wage. In one of the proposed scenarios, those who chose to stay in the capital pillar will be allowed to raise their contribution rate to 21.52% of the gross wage, of which 17.52% will be directed to SIF and 4% will be directed to an OPF of individual choice.

3.2 Analyzed scenarios

To encompass the complexity of the implemented and proposed reforms, we design a separate model for each of the system features. We thus develop four OLG models replicating the characteristics of Polish economy in 1999. The original reform is a "surprise" to the households, i.e. we do not allow the households to make provisions ex ante. This economy is simulated with the features from the original reform for 11 periods. As

Table 1: Overview of the analyzed reforms

	Baseline	Reform scenarios			
System features	1999 reform	2011RS1	2013RS2	2013RS3	2013RS4
Contribution rate to PAYG DC in SIF (indexed with payroll)	12.22%	12.22%	12.22%	12.22%	12.22%
Additional PAYG DC account in SIF (indexed with GDP growth)	0%	4.9%-3.7%	4.38%	4.38%	5.3%
Contribution to capital DC in OPFs	7.3%	2.3%-3.5%	2.92%	2.92%	4%
Portfolio structure of the OPFs (gov't bonds:stocks)	60:40	60:40	only stocks	only stocks	only stocks
Mandatory participation in capital pillar	yes	yes	yes	no (assume: 50%)	no (assume: 50%)

of period 12 two paths of simulations are used. First, we continue with the simulation of the original reform, which will constitute our *status quo*. In addition to this baseline scenario, we develop four simulations with features as described in Table 1.

From a theoretical perspective, there are two possible fiscal adjustments to accommodate for the pension reform: temporary increase in taxation (costs of the reform paid by the living generations) or allowing the public debt to accumulate (costs of the reform spread along future generations) [5]. Since taxes are distortionary, spreading the costs of reform over many generations may actually induce lower distortion, thus attenuating the adjustment in the economy due to the change in the pension system. To see if the results are in fact robust to the fiscal closure, we analyze two fiscal closure scenarios (debt and consumption tax).

Low level of voluntary pension savings seems to suggest that time inconsistency may play particularly important role. Financial literacy is relatively low in Poland while it has become customary to think about pensions in terms of replacement rate. The "privatization of the social security" might not have been fully accommodated by the citizens, making them unable to judge adequately the necessary level of private savings. This outcome would be empirically indiscernible from time inconsistency and thus it is useful to test the susceptibility of the conclusions to this phenomenon. To address this potential weakness, we run the simulations for two separate cases. In the first case, consumers are perfectly capable of determining the optimal saving path and follow it closely until unexpected changes in the incentives (such as the changes in the pension reform). In the second case, consumers exhibit certain extent of time inconsistency. More specifically, they expect to save more in the subsequent period in exchange for current consumption. Time inconsistency in the form of quasi-hyperbolic discounting was proposed in the economic literature Chung and Herrnstein (1967), while Imrohoroglu et al. (2003) embedded this feature in an OLG framework.

3.3 Fiscal closures

In order to perform simulations, assumptions are needed about the behavior of fiscal authorities. There are two possible adjustments: reduction of debt and reduction of taxes. However, both are of transitory nature, while they have significant fiscal effects. Reduction of debt implies welfare improvement to younger cohorts (less debt overhang to be paid in order to achieve the final steady state). On the other hand, reduction of taxes implies welfare improvement for the older cohorts (debt overhang will be carried to the future generations, while the older ones pay lower taxes). Overall, the total welfare effect remains an empirical question, but may be susceptible to the fiscal closure selected. In order to address this problem, we propose two cases for the simulations.

First, we assume that in the baseline scenario of no policy change debt is kept at the 55% of GDP until 2050 and later on it slowly declines to 45% of GDP in the new steady state (which is the same level as in the initial steady state). Next, in all four reforms scenarios we assume that until 2050 (which corresponds to period 61 in our model) all the tax rates remain the same as in the baseline scenario, and we allow the government debt to adjust. Afterwards, the debt slowly converges to the final steady state level which in all scenarios is equal to its initial value of 45% of GDP. We call this the debt closure.

In the second case we take the opposite assumptions. Namely, we try to keep the debt level at the 55% of GDP. We make only one exception to this rule. All reforms generate quite substantial initial improvement

[5] Please note, that under DC raising contributions to the pension system is not a solution, since actuarial fairness would simply imply higher benefits in the future

of the fiscal position. With this improvement keeping the debt at 55% would mean substantial reduction of taxes (to almost zero). We believe that it is quite unlikely, therefore we assume that taxes never fall below 11.5%. After 2050 year we allow the debt to converge slowly to 45% of GDP, adjusting taxes accordingly[6]. We call this the tax closure.

4 Theoretical model

We use an overlapping generations (OLG) general equilibrium model built along the lines of Auerbach and Kotlikoff (1987) and extended to match the features of the Polish economy by Hagemejer, Makarski and Tyrowicz (2013). Consumers can freely choose the level of labor supply up to retirement. Current income from labor and past savings can be either consumed or saved. In our setting government collects taxes and balances the pension system. Our model features perfect foresight and we introduce changes in the incentives schemes (e.g. pension system) as unexpected shocks (which is standard in the literature and we believe properly describes the nature of discussed changes). For the convenience of the reader we briefly describe the model structure, for more details see Hagemejer, Makarski and Tyrowicz (2013).

4.1 Consumer choice

Consumers live for $j = 1, ..., J$ years and discount future in a quasi-hyperbolic fashion, with the time inconsistency parameter[7] $\beta \leq 1$ and the regular discount factor δ. Their goal is to maximize lifetime utility

$$U_j(c_{j,t}, l_{j,t}) = u_j(c_{j,t}, 1 - l_{j,t}) + \beta \sum_{s=1}^{J-j} \delta^s \frac{\pi_{j+s,t+s}}{\pi_{j,t}} u_j(c_{j+s,t+s}, 1 - l_{j+s,t+s}). \tag{1}$$

where $c_{j,t}$ and $l_{j,t}$ denote, respectively, consumption and labor supply at age j in period t. In our model age $j = 1$ at which age agent is born corresponds to the age of 20 in the real world. Agents in our model live up to age of $J = 80$. Additionally, the probability of surviving to period age j at birth is equal to π_j. We denote the size of the generation born in period t as N_t. In our model there is heterogeneity across cohorts but not within. Longevity and lowering fertility is operationalized by decreasing across time the size of the 20-year old cohort as well as decreasing the mortality rates until J.

Consumers are free to chose their labor supply (labor supply is elastic) until the age of $\bar{J}$, when they are "forced" to retire. Real wage is denoted as w_t, (and is equal to marginal product of labor). Additionally, individuals are characterized by the same age-specific productivity pattern ω_j and their gross labor income at age j is equal to $l_j \cdot w \cdot \omega_j$. Agents have to pay labor income tax and social security contributions at rates, respectively, τ_l and τ_ι. Interest earnings on savings r_t are taxed with τ_k. In addition, there is a consumption tax τ_c as well as a lump sum tax/transfer Υ_t equal for all generations. Agents savings $s_{j,t}$ constitute of a bundle of capital assets and government bonds which pays interest rate r_t, which is taxed with τ_k. Thus, the budget constraint at time t is given by:

$$(1 + \tau_{c,t})c_{j,t} + s_{j,t} + \tau_{j,t} + \Upsilon_t = (1 - \tau_{\iota,t} - \tau_{l,t})w_{j,t}l_{j,t} + (1 - \tau_{l,t})(b_{\iota,j,t}) + (1 + r_t(1 - \tau_{k,t}))s_{j,t-1} \tag{2}$$

where $b_{\iota,j,t}$ denotes pension benefit for person at age j in time t. Pension systems are indexed by ι, which corresponds to different versions of the reforms presented in Table 1. Our model also features an additional lump sum tax from a special Lump Sum Redistribution Authority (LSRA) which we use to evaluate welfare effects of the reform. LSRA allocates taxes or transfers across cohorts in according to the change in their utilities so that they remain unchanged. Surplus or deficit in LSRA informs us about overall effect of the reform. We express it in terms of permanent consumption. While simulating each scenarios we keep it at zero and we compute the consumption equivalent afterwards. For details see Hagemejer, Makarski and Tyrowicz (2013) or Nishiyama and Smetters (2007).

In our model agents save by purchasing a bundle consisting of government bonds and capital assets. We use this assumptions in order to introduce different interest rates on capital and on government bonds. The interest rate on the bundle is equal to the weighted return on capital r_t^k and government bonds r_t^g, with $r_t = \xi r_t^k * + (1 - \xi) r_t^g$. The return on capital is equal to marginal product of capital minus depreciation and the return on government bonds is equal to the one third of return on capital. The interest rate paid by the

[6] In both cases we do not allow either taxes to fall below the initial steady state level of 11% nor the debt to fall below 45% of GDP. If such adjustment was to take place, debt is lowered or taxes are decreased, respectively.

[7] We follow Imrohoroglu et al. (2003), who discuss various alternatives to such formulation of time-inconsistency, as well as its micro-foundations.

government is a fraction of the prevailing market interest rate. Households have to buy all the outstanding government debt, whatever is left of the savings is allocated to investments in physical capital. The share of government debt in the portfolio is determined by the supply of bonds by the government.

4.2 Production

Producers combine capital and labor to produce consumption good. They have access to the Cobb-Douglas production function $Y_t = K_t^{\alpha}(z_t L_t)^{1-\alpha}$, where Y_t, L_t and K_t denote, respectively, aggregate output, aggregate labor and aggregate capital. We allow for exogenous labor augmenting technological progress $\gamma_{t+1} = z_{t+1}/z_t$. The problem of the firm is standard and yields the following first order conditions for wages and interest rates

$$w_t = (1-\alpha)K_t^{\alpha} z_t^{1-\alpha} {L_t}^{-\alpha} \text{ and } r_t^k + d = \alpha K_t^{\alpha-1}(z_t L_t)^{1-\alpha}.$$

Note that if the return on capital rate is r_t^k then the rental rate must be $r_t^k + d$, where d denotes capital depreciation.

4.3 Pension system and the government

The pension system collects contributions from the working and pays benefits to the retired:

$$\sum_{j=\bar{J}}^{J} \pi_{j,t} N_{t-j} b_{1,j,t} = \tau_{1,t} \sum_{j=1}^{\bar{J}-1} w_{j,t} \pi_{j,t} N_{t-j} l_{j,t} + subsidy_t \tag{3}$$

where $subsidy_t$ is a subsidy/transfer from the government to balance the pension system. The combined values of the subsidy from the government and commercial debt of SIF are an empirical equivalent to this concept. Between 1999 and 2004 this value averaged 1.9% of GDP, refer Figure 1.

The DC funded pension system collects contributions as individual stock of (mandatory) pension savings and at retirement converts them to annuity. For simplicity we denote by τ_1 the obligatory contribution rate in the 1st Pillar and by τ_2 the mandatory contribution rate in the 2nd pillar, whereas b_1 and b_2 denote benefits from these two components of the pension system. The analyzed reforms consists of two important components: (i) changing the values for these parameters and (ii) creating a sub-account in the SIF (Pillar 1a) with a different return than in the 1st Pillar. A sub-account is easy to model since it is quite similar to the 1st account with only different indexation rate. Naturally, in addition to balancing the social security, the government collects taxes on earnings, interest and consumption and spends a fixed share of GDP on unproductive (but necessary) consumption. Given that the government is indebted, it also services the outstanding debt. The government services the debt at app. 30% of the market interest, as marked to the literature and the data,Nishiyama and Smetters (2007); Hagemejer et al. (2013)

4.4 Market clearing conditions.

Market clearing in the goods market implies

$$\sum_{j=1}^{J} \pi_{j,t} N_{t-j} c_{j,t} + G_t + K_{t+1} = Y_t + (1-d)K_t \tag{4}$$

where G_t denotes government expenditure. This equation is equivalent to stating that at each point in time the demand for the goods from the consumers, the government and the producers would be met. Additionally, we have market clearing conditions for the capital market and labor market

$$L_t = \sum_{j=1}^{\bar{J}-1} \pi_{j,t} N_{t-j} \omega_{j,t} l_{j,t} \text{ and } K_{t+1} = (1-d)K_t + \sum_{j=1}^{J} \pi_{j,t} N_{t-j} \hat{s}_{j,t} \tag{5}$$

where $\hat{s}_{j,t}$ denotes private savings net of bond holdings as well as accrued obligatory contributions in fully funded pillar of the pension system.

5 Calibration

In our model behavior of population is taken from the demographic projection for Poland. As an input data we take the number of 20-year-olds for each period in time and we use mortality rates - as implied by the projection - in order to establish the number of agents in each cohort. Our model does not distinguish between sexes therefore we use the weighted average of the mortality rates for both sexes. The growth rate of productivity growth for the next 50 years were taken from the projection by the Aging Work Group of the European Commission, which contains such projections for all EU Member States. It was constructed under the assumption that poorer countries will continue to catch up until around 2030 when productivity in all countries will be slowly converging towards the value of 1.7% *per annum*.

First, using microeconomic and macroeconomic data from the Polish economy we found parameter values for preferences, taxes, growth rates, etc. Next, we set the discount factor δ so that the interest rate in the economy was close to 7.4% and the depreciation rate d so that the investment rate matches the one in the data, i.e. 21%[8]. Our computations suggest that the effective average annual return in the second pillar of the pension system was equal to 7.4% in real terms. Nishiyama and Smetters (2007) calibrate interest rate in their model to 6.25% for the US economy. We believe that a slightly higher number for a catching up country is reasonable. Our model features two interest rates, based on the past performance of the economy, interest paid by the government amounts to roughly 35% of the return on capital assets and has been decreasing. We thus calibrate that the government bonds give a return equal to $r_t^g = 0.33 \cdot r_t^k$. We match the average of the two interest rates (weighted by their shares in portfolio) to match 7.4% in real terms. The share of government debt in the portfolio is determined endogenously in the model and is approximately equal 75-80% of private savings (both mandatory and voluntary). We also set the leisure preference parameter ϕ so that the aggregate labor supply matches the participation rate of 56.8%, as observed in 1999. As it is common in the literature $\alpha = 0.3$. However, in the scenarios with time inconsistency, there is an additional discounting parameter β, whose values are set in line with the literature. Namely, we simulate the model for two values of $\beta = \{1, 0.9\}$, where $\beta = 1$ implies no time inconsistency and $\beta = 0.9$ mild time inconsistency. Table 2 presents the values of the parameters.

Table 2: Calibrated parameters

	Parameters	$\beta = 1$	$\beta = 0.9$
ϕ	preference for leisure	0.576	0.577
δ	discounting rate	0.998	1.003
d	depreciation rate	0.055	0.055
τ_l	labor tax	0.11	0.11
τ	social security contributions.	0.060	0.061
ρ	replacement rate	0.150	0.153
$\Delta k_{t+1}/y_t$	investment rate	21	21
r	interest rate	7.4	7.4

The productivity across lifecycle is a subject of a sizable body of literature. The major problem from an empirical viewpoint is separating the cohort effects (which usually exhibit downward sloping pattern) from the actual changes in individual productivity. A number of the microeconometric studies find an inverted U-shaped pattern[9]. There are also important papers showing that controlling for cohort effects and self-selection makes the age-productivity relation fairly flat or - if anything - slightly increasing until the age of 65, see Boersch-Supan and Weiss (2011). Therefore, we use Deaton (1997) decomposition to decompose the differences in individual productivities into age, cohort and time effects. To this end we use 16 years of consecutive quarterly Labor Force Survey data sets. While our computations do not allow for the Heckman-type selection effects, we do take into account education, occupation and industry. It allows us to account for the substantial structural changes endured by the economy during the transition from a centrally planned to a market economy. Additionally, we standardize the age effects to average 1. Figure 2 (left panel) presents the obtained age productivity profile. This set of parameters is stable throughout time.

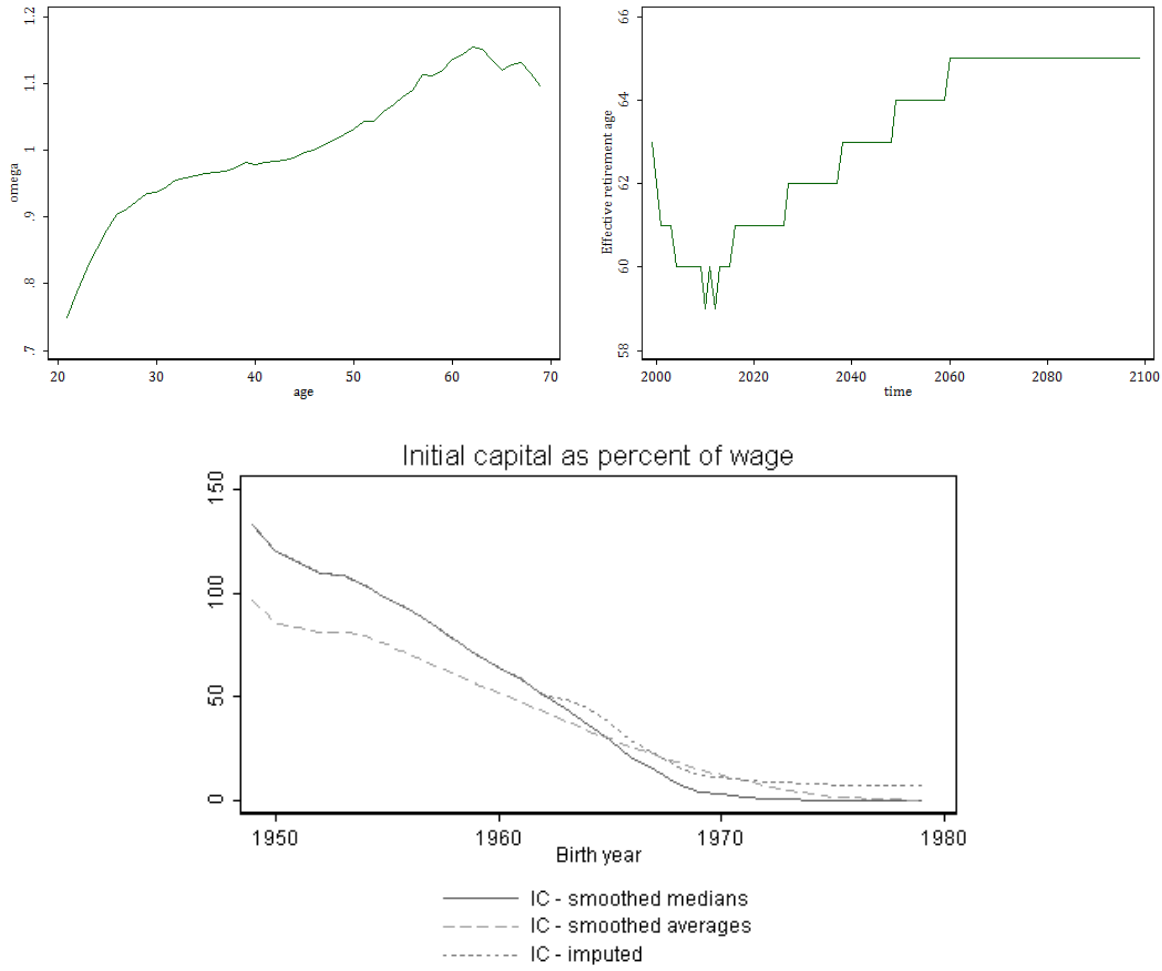
Prior to 2009 legal retirement age was 60 for women and 65 for men. However, due to numerous

[8]Depending on the period over which the average is taken, it ranges from 20.8% for five years ahead and five years post reform, 23.1% for 2 years before-after span and 24.1% for a 1 year before-after span. Average for a period between 1995 (first reliable post-transition data) and 2010 amounts to 20.7%.

[9]See e.g. Skirbekk (2004) and a forthcoming special issue of Labor Economics (volume 22, 2013).

exceptions, the actual retirement age was much lower. These exclusions from the general rule were mostly removed as of 2009, and at the same time the legal retirement age was gradually increased and is supposed to reach 67 for men in 2018 and for women in 2040. Therefore, as long as data are available we take the actual retirement age and for future years we take *de iure* retirement age. These legislative and cohort effects are reflected in a path of retirement age in our model, refer Figure 2 (right panel). Past values for the effective average age of retirement come from SIF annual reports.

Figure 2: Age specific productivity multiplier (left), actual retirement age in economy, past values and forecasts (right) and initial capital as percent of wage (bottom)



Source: ω computed according to Deaton (1997) decomposition using 16 years of LFS data for Poland. Effective retirement age based on SIF annual reports, own projection. For initial capital, own computation based on individual savings data from SIF.

Since the coverage for taxes and social security contributions is incomplete[10], we set the labor tax rate and the social security contributions rates such that the macroeconomic aggregates are matched. Thus, labor income tax is set at effective 11% (compare with legal tax rates equal 18% and 32%). We equalize the consumption tax rate at 11% to match the share of revenues from this tax in aggregate consumption in 1999. Since there are no tax exclusions for capital income tax, we set it at the legal level of 19%. Additionally, we set the effective contribution rate such that the pension system deficit in % of GDP in the original DB steady state matches the one observed in the data. The effective contribution rate in our model turns out to be app. 6% (compare with legal 19.52% of payroll). We use the data on the II pillar participation in order to split contributions between pillars for the 1949-1969 generations proportionally.

Moreover, the pension reform implied that the SIF needs to compute for all cohorts participating in DC

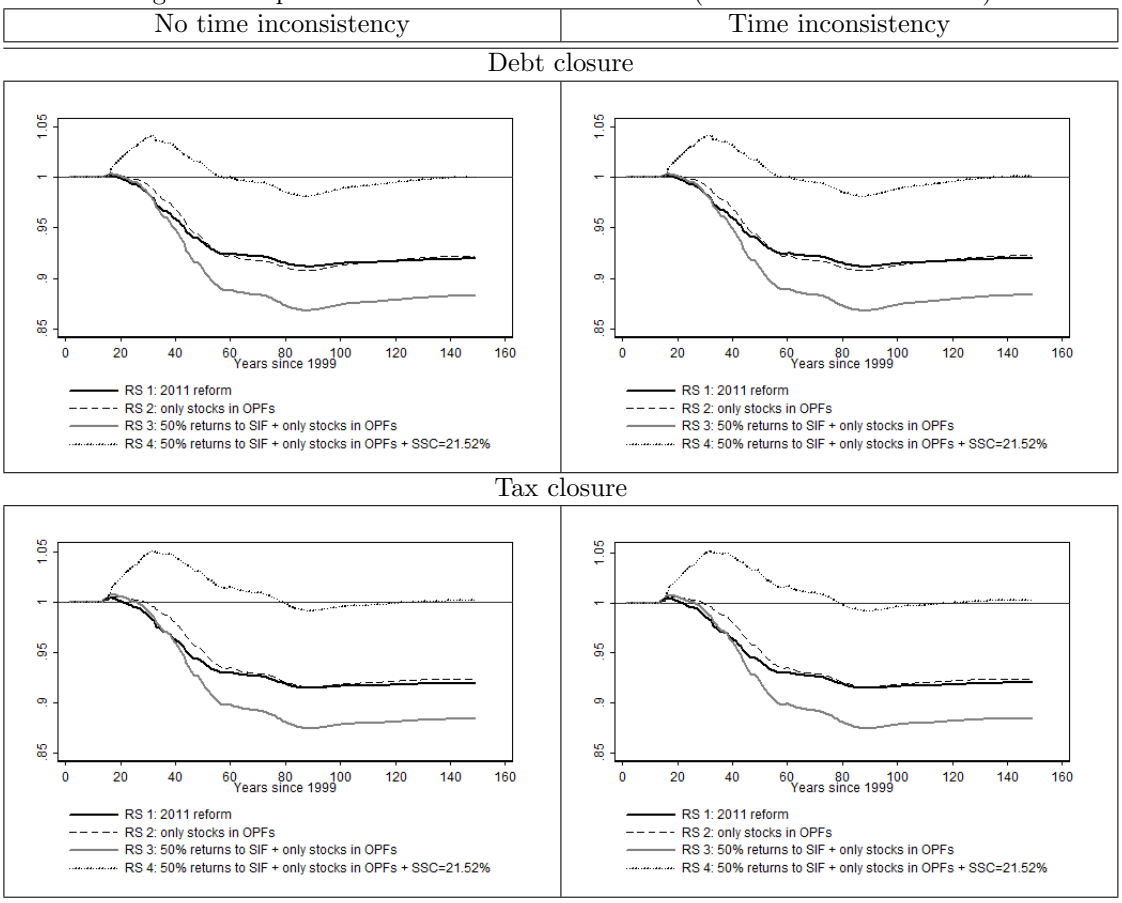
[10]The incomplete coverage is a consequence of differences of effective taxation of different forms of labor as well as a large number of exceptions, redemptions and caps, in a tax system. All of which lowers the actual share of taxes revenues in incomes.

system the so-called initial capital. Intuitively, the initial capital reflects the counterfactual scenario on what would be the value of the records in the NDC individual account had the NDC system been instated already in the past. Based on the SIF reported initial capital across cohorts medians were computed, see Figure 2. To assure comparability with the model, initial capital is expressed in terms of average wage.

6 Results

For the model to be solved we first establish the initial and final steady states on a path. The length of the path assures that the new steady state is reached slowly, i.e. last generation analyzed lives the whole life in the new demographic steady state. While eventually the length of the path was set to 250 periods it is actually irrelevant for the results as long as it exceeds 140 periods (60 years of demographic projection plus 80 years of optimization of the first generation born in the new steady state). Following the literature, we focus on comparing the reform scenarios along the paths, rather than initial and final steady states. The results are presented in tables and figures below. All four reform scenarios (as described above) are discussed in relation to the baseline of no changes to the original 1999 reform.

Figure 3: Replacement rates under four reforms (the ratio to the baseline)

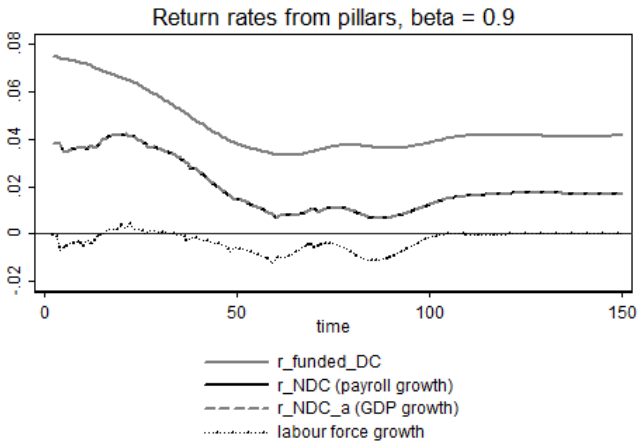


First, note that 3 out of the 4 considered reforms bring substantial changes to replacement rates, see Figure 5, while similar level under RS4 is associated with much higher contribution rates. This conclusion is independent of fiscal closure. The decrease in the replacement rates of 7-14% is additional to the overall drop in pension beneftis relative to wages[11]. The shift of the contributions from the funded pillar to the PAYG pillar leads to a decline in replacement rates due to effectively lower returns in the PAYG pillar. As explained earlier, the contributions shifted away from the funded pillar will be indexed according to the GDP *per capita* growth rate, which is less than the return to capital, as recorded in the OPFs. In our model, OPFs earn a weighted average of capital market interest rate and the returns on debt they hold,

[11] Importantly, in general the reform from PAYG DB to partly funded DC substantially lowers the replacement rates. Thus, this further decrease is of importance.

$r_{fundedDC} = (MPK - \delta) * risky + r_{gov} * (1 - risky)$. In the equilibrium, with demographic change, along the transition Poland is expecting a population decline. This will reduce the dynamics of the GDP *per capita*, effectivelly keeping it below the market interest rate, see Figure 4.

Figure 4: Return rates



The RS1 and RS3 reforms reduce the funded pillar and increase the contribution to the PAYG pillar (keeping the overall contribution rate unchanged). They both have a detrimental effect on the replacement rate (roughly 6% loss with respect to the baseline). In the RS2 scenario the rates of return fall as well, as the OPFs may now only hold stocks, not government bonds, but the part of the contributions formerly allocated to bonds is now attributed to the PAYG pillar with a lower effective rate of return. Under RS4 the effects of the higher contribution rates are of the same magnitude as the negative effects of the overall return rate on the retirements accounts relative to the baseline in the long run. This results in a replacement rate that is close to the one in the baseline and the temporary changes in the replacement rates are mainly due to wage developments following temporary adjustments in the capital stock.

Next, we discuss the effect of the reforms on financial standing of the pension system. Figure 5 presents the cumulative deficit in the Social Insurance Fund measured in percent of GDP (in percentage point difference from the baseline; the lower the position of the line, the slower is the accumulation of debt)[12]. Clearly, the implemented reform and all of the proposed ones yield improvement in the fiscal stance relative to the baseline of 1999 over the whole simulation horizon. The improvement of the deficit of the SIF if the implemented scenario of 2011 RS1 is substantial, but all versions of the reform considered in 2013 add to fiscal savings considerably. The government choice, 2013 RS3 is considerably better than 2011 RS1 and 2013 RS2, however it brings less savings than RS4 where overall revenues of the SIF increase.

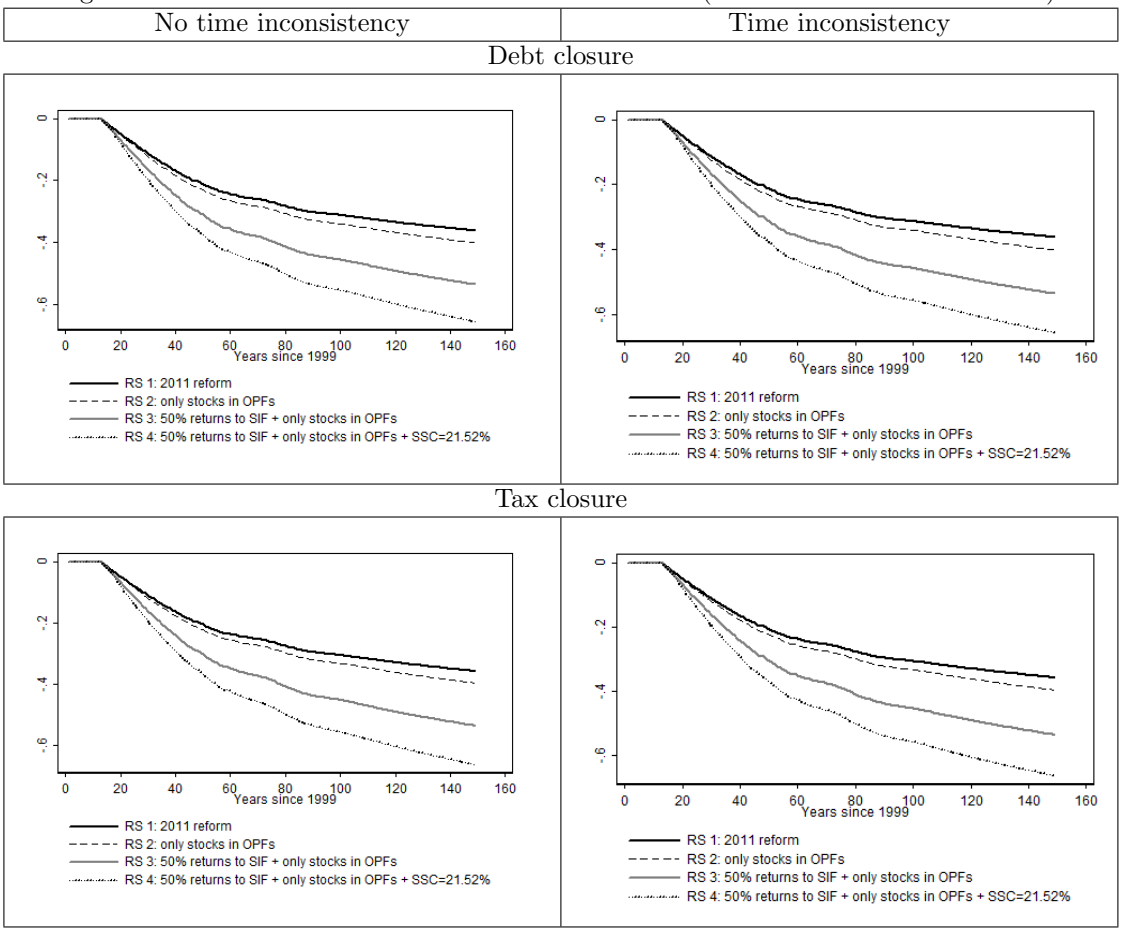
Clearly, all the reforms lead to decline of the government debt over the medium run, see Figure 6[13]. RS1 scenario which only changes the composition of the contributions to the PAYG and FF pillars, there is a gradual improvement in the government debt under the debt closure. All other scenarios feature a step-wise reduction in debt due to the conversion of currently issued government bonds into the future pension system liabilities. The ranking of the overall effects of the considered scenarios on government debt is the same as the one stemming out from the comparison of the changes in the SIF deficit. The RS2 scenario brings less saving than RS3 and RS4 as it only moves the bond part of the OPFs portfolio to the PAYG pillar, while the RS3 and RS4 additionally boost the contribution base of the PAYG pillar. RS3 and RS4 differ in the contribution rate level which drives the difference between them. In the tax closure, the changes in debt are by construction much smaller and they mainly stem from the lagged and dampened response of taxes to the changing situation of the government budget (i.e. taxes are allowed to decrease in response to lower fiscal tension, but in order to avoid sudden drops, these changes are smoothened).

Since the implemented reform as well as the proposed ones consist mostly of adjusting the amount of savings in the capital pillar, the changes in the stock of capital are closely related to that of the debt.

[12] It is important to stress here, that SIF deficit should not be associated with the government budget deficit. It can be understood as the *additional* burden on the government budget that is caused by the imbalance in the pension system.

[13] As of 2050 we assume convergence to the same debt ratio to GDP in all scenarios. Otherwise final steady states would not be comparable, undermining the comparability of the scenarios from the welfare perspective.

Figure 5: Cumulative deficit in SIF under four reforms (the difference to the baseline)



However, for capital, three effects interact. First, less public debt implies lower crowding out and higher overall rate of return. For these two reasons, private savings grow. Second, in our model agents have perfect foresight. Thus, expecting lower replacement rates they *ex ante* increase private savings to smooth life-time consumption[14]. The above effects exhibit in raising the capital stock relative to the benchmark of no policy change. Third, reduction of the savings in the OPFs causes the capital stock to drop (relative to benchmark).

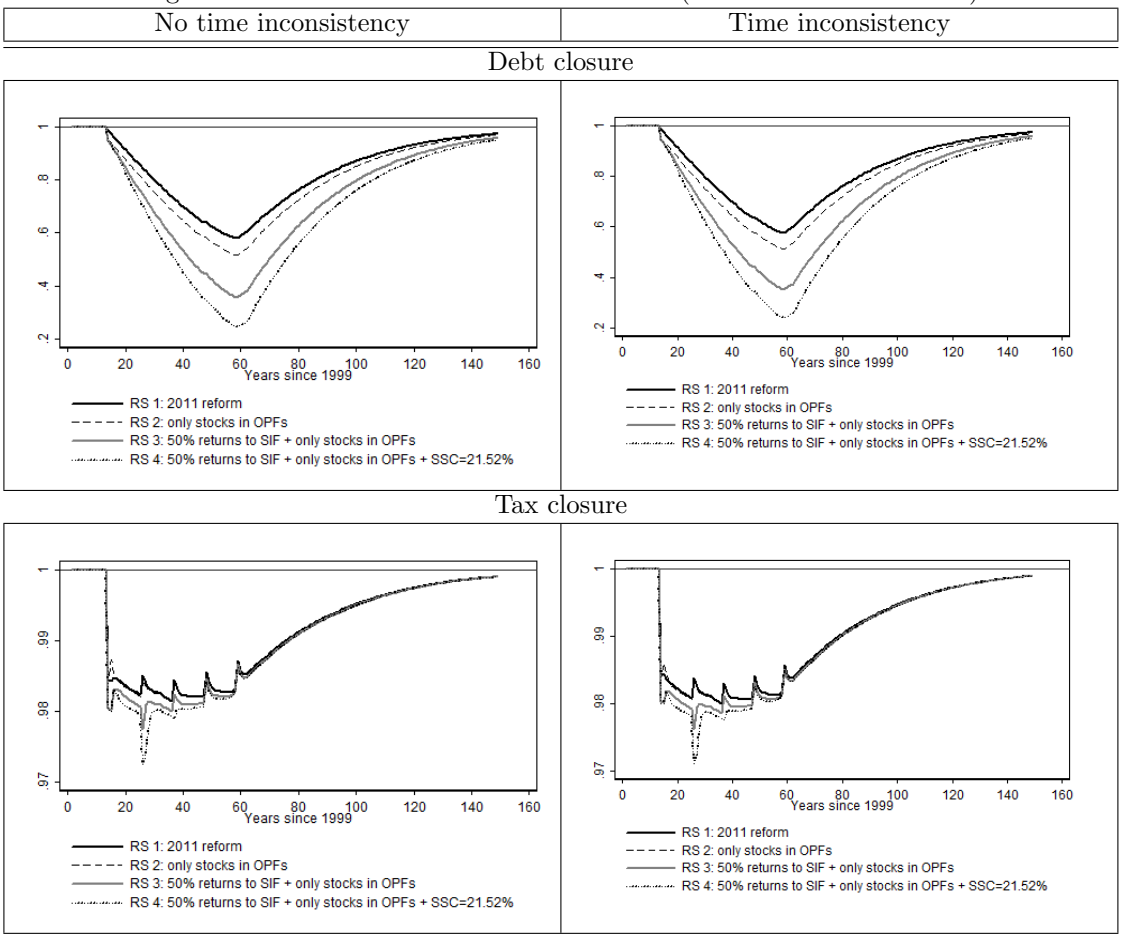
In the long run the (steady-state) effects on the capital stock are negative in the case of all analyzed scenarios[15], therefore the negative effect of the reduction in savings in the OPFs prevails. However, over large part of the simulation horizon, all scenarios bring a transitory boost in the capital stock due to the reduction of public debt (in the debt closure). 2013 RS3 and RS4 bring a highest capital stock premium over the baseline (reaching 4.5% percent by 2050) followed by 2011 RS1 and 2013 RS2. Under tax closure where the effects on public debt are considerably smaller, the negative effects of the reduction of savings in the OPFs on the capital stock materialize immediately amounting to -1.5% relative to the baseline in 2013 RS3 (roughly 0.5% in the long run).

Table 3: Welfare effects of the proposed reforms (consumption equivalent as % of permanent consumption).

Reform scenarios	Debt closure		Tax closure	
	No time inconsistency	Time inconsistency	No time inconsistency	Time inconsistency
2011 RS 1	-0,05%	-0,04%	-0,03%	-0,03%
2013 RS 2	-0,16%	-0,12%	-0,13%	-0,10%
2013 RS 3	-0,13%	-0,09%	-0,08%	-0,07%
2013 RS 4	-0,40%	-0,28%	-0,36%	-0,26%

[14]The latter is not likely to materialize strongly in reality.
[15]Under 2011RS1 these effects are negligible.

Figure 6: Debt in % GDP under four reforms (the ratio to the baseline)

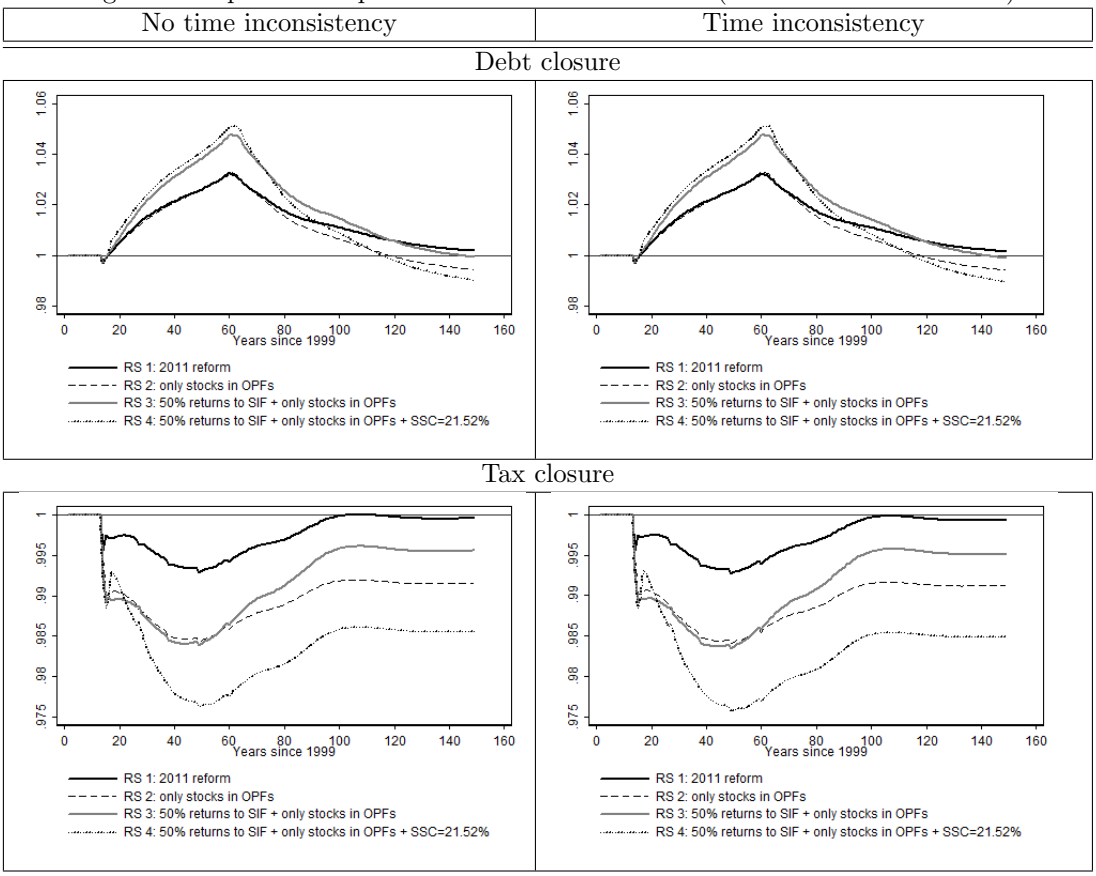


Finally, we discuss the welfare consequences of the reforms. They are expressed in terms of permanent consumption change and are presented in Table 3. All four amendments to the reform are detrimental to welfare. Irrespectively of the fiscal closure and time inconsistency, the welfare based ordering is preserved, which suggests our results are fairly robust. Welfare deterioration is associated with a substantial reduction in pensions. While in RS4 it is due mainly to increased taxation, in all other scenarios the welfare deterioration is due to a unfavorable indexation of pensions.

In our economy demography is unfavorable, which leads to low rates of return in the NDC pillar (i.e. approximately productivity growth rate plus the growth rate of working age population). This is less than the returns offered in the OPFs in our model (i.e. market interest rate). The differences in welfare changes across reforms stem mostly from the composition and relative strength of policy changes. 2011RS1 changes the involvement in OPFs reducing the overall return rates. 2012RS2 and 2013RS3 impose a conversion of bonds to future liabilities of the government which not only brings lower initial pensions but also lowers the rate of pension indexation[16].

[16]While the intuition suggests that 2013RS3 should be deteriorating welfare further than 2013RS2, it is not the case due to a modelling feature of our model. Namely, on our model government expenditure is kept a constant share in GDP. With even small changes in GDP (due to different paths of capital), govenment expenditure is different under the two considered scenarios. While these effects are minor quantitatively, they explain why 2013RS3 proves slighly less deteriorating welfare than 2013RS2. In fact, transitorily it brings a lower boost to economic activity which leads to a proportional decrease of government expenditure, relative to baseline. Since agents do not derive utility from government expenditure, this dampens the negative welfare effects of lower replacement rates. Additional simulations run with baseline levels of government spending (available upon request) confirm that this explains the counter-intuitive ordering between 2013RS2 and 2013RS3.

Figure 7: Capital stock per worker under four reforms (the ratio to the baseline)



7 Conclusions

Subsequent to the global financial crisis, many countries have experienced fiscal difficulties and developed policies aimed at relieving that fiscal tension. In countries where pension systems are at least partially funded, increasing the PAYG pillar at the expense of the funded pillar is a considered policy option. If the indexation rules in the PAYG pillar are consistent with the actuarially fair growth, such change should be neutral to the replacement rates, while it can help to ease the fiscal tension. The effects on the speed of capital accumulation and thus economic growth over the long run are likely to be negative, but also small. The objective of this paper was to provide an *ex ante* quantification of these qualitative predictions. We use the example of the changes to the pension system implemented in 2011 and proposed in 2013 in Poland. This case is interesting because Poland implemented a two-tier pension system only 12 years earlier, which implies that the majority of the fiscal costs associated with establishing *de novo* a pre-funded pillar are materializing exactly contemporaneously.

The evaluation of the pension system reform from 1999 has been done by Hagemejer et al. (2013), who demonstrate that the original reform has enhanced economic growth as well as welfare, while financing the establishment of the capital pillar with public debt is a preferable solution from the welfare point of view. Given this positive overall effect, changes introduced to the system should be focused on raising further wealth of current and future generations. The objective of this paper is to inquire if the implemented and proposed changes to the pension system fulfill these expectations. We developed an OLG model and matched the system features in the model design. The model closely replicates the Polish economy in 1999 and traces the subsequent history. We simulate the reaction of the model economy to the alternative versions of the reformed pension system. It allows us to compare the capital accumulation, output, replacement rates and deficit as well as welfare in the pension system depending on its reformed or proposed features.

The proposed changes reduce the funded DC component of the pension system. The reform from 2011 reduced the contribution rate to the pre-funded pillar, whereas the proposals from 2013 reduce the stock of savings accumulated in that pillar in addition to changing the contribution rates. We find that these changes take away some of the economic gains of the original reform. Long run capital accumulation will be lower

than it would have been without any subsequent changes. Consequently, output will increase by less, but the total long run effects are small. More importantly, the proposed changes lead to a considerable reduction in the effective replacement rates and welfare. As far as fiscal tension is concerned, clearly over the short run an improvement in the pension system balance is observed.

We have tested the sensitivity of these findings to the type of fiscal adjustment subsequent to the reform and time inconsistency of the consumers. While clearly adjustment paths differ if the reform is complemented by tax adjustment from when it is complemented with public debt adjustment, the overall conclusions for the replacement rate and welfare remain essentially unaffected by the fiscal closure. On the other hand, undersaving relative to the life time optimum is an important theoretical justification for having a pension system at all. The results demonstrate, that potential time inconsistency *on the part of consumers* changes the conclusions quantitatively but not qualitatively.

Given the negative *ex ante* evaluation of the reforms, our results suggest, that models with explicit (and potentially myopic) government should be built into the OLG models of pension reforms. Effective capital pension systems posit a strong temptation to the governments. The more effective the pre-funded pension systems are in raising capital, the higher is the stock of wealth to be captured by a government under fiscal tension. A number of countries, facing the crisis, partially or totally suspended the contributions to the capital pillar, but only few decided to dismantle it. This paper suggests that there are little or no long-run benefits to the fiscal stance from such policy. On the other hand, the shortsightedness of the governments imposes an immediate welfare costs.

Back in 1978 future Noble Prize winner in Economics, James Buchannan, together with John Burton and Richard E. Wagner published a booklet with The Institute for Economic Analysis entitled "The Consequences of Mr. Keynes". The second part of the title - "An Analysis of the Misuse of Economic Theory for Political Profiteering With Proposal for Constitutional Disciplines" - suggested to the reader what bottom line should be expected from the booklet. As much as economists may disagree on the extent of the effectiveness of the fiscal stimuli, all economists more or less agree on the judgment that politicians abuse the stimulus argument in order to cushion politically the adverse effects of economic slowdown. Authors suggest that without a regime (e.g. fiscal rules), the appealing notion that economy may be stimulated by fiscal policy has already generated excessive indebtedness due to the attempts to "fine tune" the business cycles to - among others - political cycles. While compulsory, *quasi*-public pre-funded pension pillars are a novelty introduced relatively recently, they bring the long-known debate on how to constrain the governments from implementing myopic policies to a new level.

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Faculty of Economic Sciences
University of Warsaw
44/50 Długa St.
00-241 Warsaw
www.wne.uw.edu.pl