

Pension Reform: How Macroeconomics May Help Microeconomics – The Czech Case

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Abstract

In this paper, we combine macro and microeconomic approaches to a pension reform. First, we modify an OLG model and estimate macroeconomic effects of a pension system switch from a pure PAYG to a mixed system. Second, we employ macroeconomic results in a microeconomic simulation in which we estimate individual welfare gains for various income groups in each cohort affected by the pension reform. We propose an unorthodox sequencing of the pension reform in which the pre-retirement generations would enter the reformed system first. This sequencing maintains the Pareto efficiency condition for all age cohorts, but it gives governments more flexibility in the reform process.

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1 Introduction

Demographic changes throughout the world have led to the phenomenon of population aging. The proportion of old people in the population is rising steeply - this process is already well under way in OECD countries and by 2050 only Africa will still be “young” (World Bank, 1994). While this result of improvements in medical care as well as the standard of living is impressive, it represents a substantial challenge for social security systems. In particular, increasing life expectancy and declining fertility lead to ever increasing dependency ratios¹ in developed countries, which render their public pension schemes financially unsustainable.

Most public pension plans were set up or expanded on a massive scale in the post-war era of “baby-boom” and significantly lower life expectancies. These plans have been largely financed out of payroll taxes on a pay-as-you-go (PAYG) basis, i.e. today’s workers pay the pensions of today’s retirees and these workers expect to be supported in the same manner in the future. However, owing to the aforementioned demographic developments, current workers face the prospect of being supported by a relatively less numerous work force for a much longer period than it was at the time these plans were introduced. These plans are, therefore, in need of reform because there is a looming possibility that they will encounter insurmountable difficulties in meeting their future liabilities.

An increasingly popular alternative to PAYG schemes are fully funded (FF) schemes in which individuals save for their own retirement through pension funds. Unlike PAYG plans which usually contain solidarity-based redistributive elements, these plans are actuarially fair and, ideally, every participant is entitled to no more and no less than his/her accumulated contributions plus interest.

While the average rate of return of a FF scheme equals the rate of interest, the average rate of return of a PAYG scheme equals the growth rate of the underlying taxable wage base in the economy, which is equal to the rate of growth of the labor force plus the rate of growth of wages (Samuelson, 1958). Data from various countries indicate that if the investment period is sufficiently long, the rate of interest on a combination of bonds and equity generally exceeds the rate of wage growth by approximately 2 to 3 percentage points (World Bank, 1994). Hence, given a stationary or even declining labor force, FF schemes’ performance is superior to that of mature PAYG schemes today.

By and large, both schemes have their pros and cons.² Most importantly, they are subject to different kinds of risk. Funded schemes are exposed to investment risk. In contrast, public pension schemes are susceptible to political risk and labor income risk. Since risks of these two systems are unlikely to be perfectly correlated, their combination leads to a reduction in the overall risk and this is an argument for introducing a pension scheme comprising both PAYG and FF plans. While the PAYG plan possesses a unique potential to redistribute income towards persons in need, the FF plan limits the government’s upper hand over the economy and rewards responsible behavior.³ Countries throughout the world have contemplated at least a partial shift towards funded schemes.⁴ While the most radical reforms

¹ Defined as the number of old-age pensioners in relation to the number of working persons.

² See e.g. the debate in Holzmann, Stiglitz (2001).

³ Unlike PAYG plans, FF plans do not hamper international labor mobility. See Schneider (2003).

⁴ Most countries reforming their pension systems have opted for a combination of PAYG and FF schemes, albeit the extent of switching varies considerably from main reliance on the PAYG scheme (Hungary and

have been implemented in Latin America, Central and Eastern Europe has been a keen reformer as well – see Table 1 below.

Table 1: Pension reforms in CEE countries

Country	PAYG contribution	Funded contribution	Reform started
Hungary	22	6	1998
Kazakhstan	0	10	1998
Poland	25	7,3	1999
Croatia	14,5	5	2002
Latvia	18	2	2001
Estonia	16	6	2002
Russia	22	6	2002
Slovakia	19	9	2005
Czech Republic	28	0	?

Source: ILO, OECD

Generally, high cost of a pension reform poses a barrier to any major reform. This is due to the fact that the government must continue to honor its obligations to pay pension benefits to current and some future pensioners long after part or all of the stream of PAYG contributions ceases, and the accumulated implicit debts of these pension plans are substantial.⁵ Also, such a complex reform requires adequate supervision and regulation of the capital market, pension funds and insurance companies in order to mitigate the risks associated with investment-based pension plans. If, however, the transition is financed at least partially through taxes and is connected with restrictive fiscal measures, national saving increases. Also, the reform may deliver a positive externality of great importance - capital market development. In sum, a well-defined reform may ultimately lead to higher economic growth as we demonstrate below.⁶

Thus, pension schemes need to be adjusted to the demographic developments sooner or later and the Czech Republic will be no exception. Indeed, it is beginning to feel the mounting demographic pressures which threaten the stability of its public finance and a profound reform of its social security system is becoming a necessity. Much has been written on this ubiquitous topic and various reform scenarios have been suggested. The seminal World Bank study (World Bank, 1994) was followed by a burst of literature on pension systems and their reforms. The most comprehensive review can be found in Holzmann, Stiglitz (2001).

Poland) to equal weight attached to both schemes (Switzerland) to almost full privatization of social security (Chile and Kazakhstan).

⁵ When most PAYG systems were established or expanded amidst the post-war euphoria, the generation which had previously contributed either very little or not at all reaped a windfall in the form of pension benefits. Analogously, if this scheme is ever to be abandoned, the “last” generation(s) must foot the bill. According to the accrued benefit obligation definition, if a PAYG system is discontinued (i.e. no future revenues), the implicit debt of the system is the present value of all benefit obligations accumulated until that moment minus accumulated pension reserves.

⁶ For more in the context of the Czech Republic, see e.g. Schneider (1998).

This worldwide discussion has been mirrored in the Czech context as well. While some economists oppose funded plans and believe that a parametric reform of the PAYG scheme suffices (Rusnok, 2001), some cautiously admit gradual introduction of a minor FF scheme while retaining reliance on the PAYG scheme (Laursen, 2000), some prefer a combination of both schemes (Bezděk, 2000 or Ježek, 2003) and some advocate a full switch towards a FF scheme (Kreidl, 1998 or Schneider, 1998).

In this paper we argue that the pros of funded schemes significantly outweigh their cons and a partial shift towards a funded scheme should be made soon. The objective of this paper is twofold. First we employ a complex, general equilibrium model that provides long-term projections of the pension system characteristics and its interactions with other economic variables.

Second, we estimate a specific Czech pension system reform proposal that is based on introduction of a funded pillar, financed on par with the traditional PAYG pillar. We estimate gains that various cohorts may gain from such a reform. While rather traditional in this respect, our proposal takes an alternative approach to the sequencing of the reform, as it opens the reformed, funded pillar first to older generations and only gradually broadens its scope toward younger generations.

Most countries which have switched at least partially towards a FF scheme instituted mandatory switching for new labor force entrants and some have done so for current workers under a certain age limit as well. This makes a pension reform very rigid and susceptible to political risks, as parameters are set decades before first “new” pensioners reach the retirement age and start drawing private pensions. In the decades meanwhile the government faces unpleasant deficits stemming from the fall in pension revenues channeled to a private pillar. Thus, it takes a very determined government to support the reform throughout the decades and not to change the rules.

Our proposal gives governments more flexibility, as it allows them to modify the speed at which younger generations are being included in a reformed system. At the same time, our proposal makes the reformed system more politically robust, as first private pensions are collected very soon and can help to underscore the reformed system superiority. As we show below, even pre-retirement cohorts may gain from a complex pension reform.

The remainder of this paper is structured as follows. Section 2 presents a macroeconomic model inspired by the Auerbach-Kotlikoff overlapping generations model. The third chapter details the results of the simulations which sought to estimate the impact of the proposed reform on the incomes of future pensioners. The chapter 4 focuses on the micro foundations of the Czech pension system. A simulation model is then discussed and we compare various pension systems as to their impact on the individual pensions. The chapter 5 explains advantages of reverse sequencing of a pension reform that shifts older generations to the reformed system while keeping younger ones in the “old” PAYG. We also estimate financial costs of various reform scenarios. The final section gives some recommendations and concluding remarks.

2 The Model

The approach which has proved to be most productive in modeling a comprehensive reform of social security is the so called Auerbach-Kotlikoff model, an overlapping generations model based on a sequence of perfect-foresighted generations that maximize their respective utilities over time.⁷ Such a model uses a general equilibrium framework and an assumption of rational economic agents. Both assumptions (perfect foresight and rationality) might appear too extreme, but as analytical tools they provide useful benchmarks since deviations from them are not likely to be systematic.

In our model, we simplified the Auerbach-Kotlikoff model, as we did not need the overall budgetary sub-model. We assumed that the only function of the public sector (and taxes) is to deliver (and finance) pensions. We assume, following Auerbach and Koltikoff, that people live 75 years (20 de facto outside the model). These people are perfectly rational; maximize their life-time utility. Households are able to accommodate any expected changes in demography and adjust their behavior. People differ only in their productivity and thus in wages, they share the same preferences. There are three sectors: households, firms and the government.

Households

Households distribute their consumption (and savings) across their life time according to their utility function:

$$u_t = \left[c_t^{\left(1-\frac{1}{\rho}\right)} + \alpha \cdot l_t^{\left(1-\frac{1}{\rho}\right)} \right]^{\frac{1}{1-\frac{1}{\rho}}}$$

(1)

where c_t is the consumption and l_t is leisure in year t . The households' lifetime utility is given by:

$$U = - \sum_{t=1}^{55} (1 + \delta)^{-(t-1)} \cdot u_t^{\left(1-\frac{1}{\gamma}\right)}$$

(2)

Parameter ρ measures elasticity of substitution between c_t and l_t with respect to the wage rate w_t . The parameter α measures preference for leisure over consumption (and labour supply). The parameter δ measures pure intertemporal time preference. The higher the δ , the less is saved for the future consumption and more is consumed now. Finally, γ measures price elasticity of consumption.

Households are constrained by the budget constrain:

$$\sum_{t=1}^{55} \prod_{s=1}^t [1 + r_s]^{-1} \cdot [w_t e_t (1 - l_t) (1 - SST_t) - c_t] \geq 0, \quad (3)$$

where r_s is the interest rate in given year t , $l_t \leq 1$ measured time devoted to leisure, w_t is an annual wage rate and e_t is the wage curve adjustment,

The function e calibrates wages according to the age x :⁸

⁷ See Auerbach – Kotlikoff (1987) or the software Auerbach-Kotlikoff Tax Simulation Program, version 3/02 downloadable from the web page.

⁸ The equation corresponds to the Auerbach-Kotlikoff Tax Simulation Program expression $e_x = 4,47 + 0,033x - 0,00067x^2$ whereo $x \in \{1,2,\dots,55\}$, see Auerbach - Kotlikoff (1987).

$$e_x = e^{(-0,03233+0,033x-0,00067x^2)} \text{ pro } x \in \{1,2,\dots,55\} \quad (4)$$

So, the wage $w_t e_t$ for the first cohort is always equal 1.

Chart 1: Age profile $w_t e_t$

- CHART 1 TO BE PLACED HERE -

The wage peaks at age 45 and then falls to the level 78% of the starting level for cohort aged 75. Expression $w_t e_t$ then measures so called efficient wage and the annual wage revenue is given as:

$$w_t e_t (1 - l_t) \cdot (1 - SST_t) + k_{t-1} \cdot (1 + r_{t-1}), \quad (5)$$

where SST_t is the annual social security tax earmarked for pensions, k_{t-1} measures capital available to households. The total capital in t is then as follows:

$$k_t = w_t e_t (1 - l_t) \cdot (1 - SST_t) + k_{t-1} \cdot (1 + r_{t-1}) - c_t. \quad (6)$$

We assume that there is no inherited capital and households consume the whole capital. At the same time, we assume that capital markets are efficient and thus households do not face any liquidity constraint. It follows that a household maximizes its utility when its consumption is equal to

$$c_t = \left[\frac{1 + r_t}{1 + \delta} \right]^\gamma \left[\frac{v_t}{v_{t-1}} \right] c_{t-1}. \quad (7)$$

and leisure is equal to

$$l_t = \left[\frac{1 + r_t}{1 + \delta} \right]^\gamma \left[\frac{v_t}{v_{t-1}} \right]^{-\rho} \left(\frac{w_t^*}{w_{t-1}^*} \right)^{-\rho} l_{t-1}, \quad (8)$$

where w_t^* measures the efficient wage $w_t e_t$ and

$$v_t = \left[1 + \alpha \rho w_t^{*(1-\rho)} \right]^{\frac{\rho-\gamma}{1-\rho}}. \quad (9)$$

We can express leisure l_t as a function of consumption c_t

$$l_t = \left(\frac{w_t^*}{\alpha} \right)^{-\rho} c_t. \quad (10)$$

As α , raises, it increases $\frac{l_t}{c_t}$, *ceteris paribus*. If α remains constant, then a change in

the wage w_t^* the share $\frac{l_t}{c_t}$ changes by ρ .

Firms

The model includes a simple corporate sector, with a constant returns production function

$$Y_t = AP \cdot \left[\varepsilon \cdot K_t^{(1-\frac{1}{\sigma})} + (1-\varepsilon) \cdot L_t^{(1-\frac{1}{\sigma})} \right]^{\frac{1}{1-\frac{1}{\sigma}}}, \quad (11)$$

where product Y_t is produced using capital K_t and labor L_t . Capital is used with the rate ε and σ measures elasticity of substitution between capital K_t and labor L_t with respect to a change in relative prices of the two factors $\frac{w_t}{r_t}$. The parameter AP is constant over the time⁹.

The model assumes homogenous labor, where cohorts differ only in the quantity of labor supplied, not in its quality. Wage rate w_t is given by the marginal labor product:

$$w_t = (1-\varepsilon) \cdot AP \cdot \left[\varepsilon \cdot K_t^{(1-\frac{1}{\sigma})} + (1-\varepsilon) \cdot L_t^{(1-\frac{1}{\sigma})} \right]^{\frac{1}{\sigma-1}} L_t^{-\frac{1}{\sigma}}. \quad (12)$$

The capital is homogenous as well and its price equals the marginal product of capital¹⁰:

$$r_t = \varepsilon \cdot AP \cdot \left[\varepsilon \cdot K_t^{(1-\frac{1}{\sigma})} + (1-\varepsilon) \cdot L_t^{(1-\frac{1}{\sigma})} \right]^{\frac{1}{\sigma-1}} K_t^{-\frac{1}{\sigma}}. \quad (13)$$

Government

The model assumes that the government's only policy is the pension system financing. The government decides on the type of the pension system, establishes the replacement ratio μ_t and the retirement age. The pension system is financed by a linear tax on wage SST_t , and is always balanced. The tax rate is

$$SST_t = \frac{\eta_t \cdot \sum_{j=Pr odPOP_t}^{55} b_{t,j}}{\sum_{j=1}^{55} w_{t,j}^* \cdot (1-l_{t,j})}, \quad (14)$$

where $ProdPOP_t$ is the number of economically active non-pensioners, $b_{t,j}$ is the pension claim for pensioners aged j . The pension benefit is then equal to the product $b_{t,j}$ and the replacement rate μ_t .

Calibration

In order to solve the model, it is necessary to choose values for the preference parameters.¹¹ Some of these parameters have been estimated with a great deal of precision;

⁹ As [Auerbach - Kotlikoff, 1987, str. 35] show, a change in AP requires a change in the households preferences.

¹⁰ The model assumes a closed economy with an endogenous interest rate. This approach is justified, even in the case of the Czech Republic. As Feldstein and Horioka (1980) and Feldstein (1994) showed, the international capital markets are still sufficiently segmented that only a part of domestic saving is replaced by foreign capital flows. Gordon and Bovenberg (1996) showed that low capital mobility might be explained by a high degree of uncertainty faced by rational foreign investors due to asymmetric information across countries.

¹¹ There are three stages of the simulation process. First, we solve the model for the long-run steady state of the economy under current policies. Second, we solve the model after policy changes take place. Finally, we find the transition path between these two steady states. We assume that households and firms have perfect foresight in both policy regimes, but they do not expect policy changes. The transition thus begins at the moment when the policy change goes into effect. We use the iteration technique known as the Gauss-Seidel method. The algorithm begins with a set of initial guesses and treats them as exogenous in the first round of simulation. Then the

others are more disputed. Nevertheless, as is shown below, choosing slightly different values did not alter the results in any significant manner.

A correct estimation of households' decision requires choosing a value for the *intertemporal elasticity of substitution* γ . A number of studies¹² have found this value to be between 0.15-0.40. For the baseline simulation, we used value of $\gamma = 0.25$. Further, we need an estimate of the *intra-temporal elasticity of substitution* ρ which measures the elasticity of substitution between labor and leisure in any given period. Ghez and Becker (1975) estimated the level of ρ to be equal 0.8. The coefficient α , *the leisure preference parameter*, is set at 2, which in our simulations secures the average working time to be about 171 hours per month. *The rate of pure time preference* δ was set at the level 1.5%, which is again in accordance both with Kotlikoff and Auerbach and with Neusser and Kugler (1998).

Production parameters have been a subject of considerable research and their values are broadly accepted. *The elasticity of substitution* σ was set at the level used by Neusser for the Austrian economy, $\sigma = 0.9$. *The capital intensity parameter* ε is equal to 0.25. *The production function constant* AP is used only to equal wage rate $w_t = 1$.¹³

3 Model results

In this chapter we will provide results of the macroeconomic model simulations in a long (100 years) horizon. In all simulations we compare three scenarios. The first scenario assumes no major changes in the current PAYG system, i.e. increasing deficits will have to be financed, eventually, from higher contribution rate.¹⁴ The second scenario (“Reform 1”) assumes a “notionally defined contribution” reform of the pension system, i.e. adjustment will come mostly in lower pensions being paid to more populous cohorts. Last scenario (“Reform 2”) assumes a switch to the fully funded pension system, phased in a 35 years period. These three scenarios are compared as to their impact on major economic indicators.¹⁵

algorithm seeks the uniform mapping with a predetermined precision. The Gauss-Seidel method finds a solution in most cases, provided that the model is correctly formulated.

¹² See for example Mankiw (1985), Summers (1982) or Ghez and Becker (1975).

¹³ We do acknowledge the arbitrariness of the calibration, especially when the parameter values are not always unquestioned. Nevertheless, we believe it is preferable to make such assumptions than to resort to oversimplified models that avoid such parametrization. Further, the uncertainty about the correctness of the parameter can be addressed by simulations of the same policy under a range of parameter estimates.

¹⁴ The total contribution rate is currently 28 % and we assume this rate to be increased to 30 % by 2005 in an attempt for a fiscally sustainable PAYG scheme. Since, however, almost 30 % of total PAYG expenditures cover non-old-age (disability and survivors) pensions, we assume that 10 percentage points of the total contribution rate go towards non-old-age pensions (with the ‘surplus’ being reallocated towards old-age pensions) and only 20 percentage points are earmarked for old-age pensions. Bezdek (2000) demonstrates that if there is to be full wage indexation of pension benefits, the current PAYG scheme may be fiscally sustainable with a contribution rate of 30 %, the statutory retirement age of 65 irrespective of gender, a reduction in early retirements by 50 %, a reduction in disability and survivors pensions by 10 % and the gross replacement ratio for the economy (i.e. the ratio of the average pension benefit and the average gross national wage) reduced from the current 44 % to 38 %. As the initial reduction in this replacement ratio is not assumed in the simulations, the expected performance of the PAYG system is still overestimated.

¹⁵ We calibrate the production function parameter $AP = 0.906967$. This sets the starting wage rate $w_t = 1$ in the first year of the reform (2002) to be equal to 1. This allows us to compare model simulations for various pension scenarios.

3.1 Capital and labor supply

The most profound changes occur in the two markets: capital and labor. Disregarding the pension system for the moment we can say that as the population ages, aggregate labor supply falls which leads to higher wages w_t . The capital supply, on the other hand, increases as most capital assets are held by pre- and early retirement cohorts (see Ingenué, 2001). Rise of the capital supply leads to lower interest rates r_t . Thus, aging may push up the capital/labor ratio $\frac{K_t}{L_t}$.

However, pension system does play a significant role in an aging society. The most likely consequence of aging in a mature PAYG pension system is creeping social security contribution rate SST_t . As SST_t rises net wage w_t^{net} falls. Lower net wages limit population's capital and may lead to an increase in the labor supply (depending on exact size of the income and substitution effects). Thus, the net "pension effect" may be a fall in the capital/labor ratio $\frac{K_t}{L_t}$ in the PAYG system. The chart 2 below shows development of the $\frac{K_t}{L_t}$ ratio in all the three scenarios. Note that the ratio remains unchanged in no-change scenario and rises by about 19% in the NDC reform and even by one third in the FF reform.

Chart 2: Capital/labor ratio in three pension scenarios

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These different developments in the $\frac{K_t}{L_t}$ ratio have a significant influence on the wage and interest rates level in the three scenarios. While wages generally rise in the reform scenarios (more profoundly in the FF reform), interest rate falls when a reform is carried out – see charts 3 and 4.

Chart 3 and 4: Wages and interest rates under three scenarios

- CHARTS 3 AND 4 TO BE PLACED HERE -

The high capital accumulation in the reformed pension system may have an adverse effect on the old-age pensions. As the chart 5 shows, the share of retired or pre-retirement cohorts' capital ownership is high and increasing over time. The FF reform places more than 35% of all capital in an economy in these "retirement" generations. Should they start selling these assets at the same time, the capital market may slump and the old-age pensions may be endangered.

Chart 5: The share of capital owned by the 61+

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3.2 Pension system (dis)equilibria

The changes in macroeconomic fundamentals influence significantly pension systems' balances. As indicated above, the most affected is the unreformed PAYG system that suffers from shrinkage of the contributing population and from the slow or even non-existent wage growth. Indeed, our simulations show that the unreformed system will need to hike the contributing SST_t rate to more than 30% of the wage bill.¹⁶ Correspondingly, the net wage w_t^{net} falls in the unreformed system by some 15%, remains more or less stable in the NDC reform scenario and rises by almost 30% in the funded reform scenario – see charts 6 and 7.

Charts 6 and 7: Social contribution and net wage under three scenarios

- CHARTS 6 AND 7 TO BE PLACED HERE -

Measured by the total spending, the pension system is under the biggest strain in the unreformed alternative, where the cost of financing pensions rises by 60% to 16% of GDP in 2050, when it peaks. The NDC reform manages to keep pension expenditures constant and the FF reform eliminates state expenditures on pensions in 40 years – see the chart 8.

Chart 8: Pension expenditures under the three scenarios

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3.3 Savings, consumption and GDP

Savings are an important factor in long-term growth as they allow higher investment rate.¹⁷ Aging societies tend to have lower savings, as they have less to save for. The same holds for the fast aging Czech society, as chart 9 illustrates. The savings ratio¹⁸ falls regardless of the pension system development. However, the saving ratio falls most in the unreformed PAYG system and least in the FF reform scenario. The FF reform brings higher savings as people save towards their retirement. A part of this savings is offset by higher consumption (provoked by expectations of higher net wages in the future), but still the FF reform savings ratio is higher than savings in alternative models – see charts 9 and 10.

Chart 9 and 10: Savings and consumption under the three scenarios

- CHARTS 9 AND 10 TO BE PLACED HERE -

The savings and consumption developments influence the total GDP per capita produced in the economy. As the capital assets rise in the economy, the economy gets more productive and the GDP increases. The GDP per capita first peaks in about 2035, just when large cohorts leave the labor market and draw pension benefits. The GDP per capita recovers

¹⁶ Our model assumes an initial contribution rate of only about 20% of the wage bill as the remaining 8% that is levied finances invalidity and other pensions.

¹⁷ We discussed the closed economy approach earlier in the paper.

¹⁸ The saving rate is equal to $1 - \left(\frac{C_t}{Income} \right)$, where C_t is the aggregate consumption and Income is the aggregate income in year t .

again in about 2050, when the demography stabilizes – see chart 11. The charts illustrate clearly that the FF reform delivers highest GDP growth of all the three scenarios considered.

Chart 11: GDP per capita under the three scenarios

- CHART 11 TO BE PLACED HERE -

3.4 Life-time utility

The aging and the pension systems reactions to this phenomenon have significant consequences for individual cohorts' life-time utility. Individuals react to changes in economic parameters by altering their labor supply and reshuffling consumption patterns. However, even these adjustments cannot compensate for the tectonic changes caused by aging process. Thus, as the chart 12 illustrates, life-time utility diverge in the three scenarios.

Under the unreformed PAYG scenario, lifetime utility falls until it reaches its nadir in 2044. Only after this year, stabilizing demography allows a small reduction in the SST_t and a corresponding increase in the net wage w_t^{net} that lifts the utility.

The NDC reform has relatively small impact on the life-time utility of future generations, while the FF reform lifts utility by as much as 10%. Interestingly, early generations benefit more from the NDC reform than from the FF reform. This is caused by the fact that while these generations pay the same contributions SST_t in both reforms, the NDC maintains some state financed pensions while the FF reform terminates state pensions after 35 years. In the long term, though, the FF reform dominates both alternatives as future generations benefit from higher net wages that allow them to increase consumption and decrease labor supply. The utility for generations entering the labor force around year 2000 is by about 20% higher in the fully funded system than in a PAYG system and by about 10% higher than in the NDC scenario.

Chart 12: Life time utility of various cohorts under the three scenarios

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4 Pension systems – microeconomic analysis

We now turn to the microeconomic aspects of the pension systems. Namely, we will be interested in the welfare effects of a pension reform that switches 50% of the contributions from the state pension system to a funded pillar of the pension system. By doing so, the pension system will be able to provide higher pensions upon retirement, though at a cost. As workers move their contributions from the “old” pure PAYG system to the “new” multipillar system, the gap opens between the (lowered) contributions and (unchanged) expenditures of the pension system.

While this financing gap reflects rather woes of the old PAYG system, it represents the most intricate hindrance to a reform. Moreover, the very logic of a standard reform, i.e. leaving older, pre-retirement workers in the PAYG system and excusing younger cohorts from paying the full PAYG contributions exacerbates the reform plight. Such sequencing postpones first multipillar pensions by decades but front-load costs of the reform, as the younger cohorts stop paying full contributions immediately, but start drawing pensions decades later.

In our proposal, we suggest a different sequencing. We allow (or in the simplest model, we make) the older pre-retirement cohorts to switch from the pure PAYG to multipillar system while all workers younger than 50 years remain in the PAYG system. This approach has several benefits.

- First, this sequencing brings forward first “combined” pensions that are paid both from the PAYG and the funded pillar. First such pensions will be paid after a year of the reform. The funded pillar will be small indeed, but the combined pension will be higher than without a reform, thus illustrating benefits of the reform.

- Second, the proposed reform alleviates fiscal problems of the reform. Only older workers leave the PAYG and the young keep paying their contributions in full – see Chapter 5 for details.

- Third, and perhaps most important, the proposed reform gives to the government control of the whole process. The government can manipulate the “entry age” in which participants can enter the multipillar system. If the government places more emphasis on the low fiscal costs of the reform, it may keep high “entry age” and thus keep young “captive contributors” in the PAYG system. If the main objective is fast reform (and the fiscal woes are taken care of by another means), the government may lower the “entry age”, and thus bringing more workers into the multipillar scheme.

Indeed, our proposal has its drawbacks. Older generations may be more risk averse and thus less willing to switch to a new system. Also, if they are more risk-averse and their investment horizon is short, the older generations may reap lower yields on their savings. We accommodate these fears by assuming a very conservative rate of return on savings (4%) that should be attainable even with a short investment horizon. But before we demonstrate effects of the reform, we must describe the two pension systems’ functioning in the Czech case.

4.1 Model Specifications and Assumptions

In this chapter we illustrate welfare effects of the two of pension scenarios described above. We do not analyze the notionally defined contribution system, as their rules make it very opaque and difficult to model. The first considered scenario is the existing Czech PAYG system in which we assume a gradual increase in the retirement age to 65 years and a gradual deterioration of benefits by some 14% (see Bezděk (2000) for discussion). Second, we explore a switch from the PAYG to a combined system with two equal pillars: pay-as-you-go and funded. In the funded pillar, we assume that workers channel there 50% of their contributions and receive 4% annual rate of return and we also assume that workers purchase an escalating annuity with escalation rate g , i.e. FF benefits rise at the same rate as PAYG benefits.¹⁹ The present value of annuity payouts is lower than the price of the annuity due to the cost of administration, marketing and also the phenomenon of adverse selection in the

¹⁹ Alternatively, the individual may buy a nominal annuity, which pays a constant nominal payout each period, or a real “inflation-indexed” annuity whose nominal payout is adjusted each period by the percentage change in the price level, etc. Since, however, none of the conclusions reached in this text would be affected by the choice of insurance product, an escalating annuity is used for convenience.

annuities market.²⁰ We assume that this cost represent 7% of the accumulated assets in a fund.
²¹

With respect to our model described in chapters 2 and 3, we assume that the reformed multi-pillar pension system lifts the wage growth. As the charts 3 and 7 show the average wage growth is boosted by 0.15% per year after the pension system is reformed. Thus, in our simulations, we assumed a 2.5% wage growth in the PAYG system and a 2.65% wage growth in a reformed, multipillar system. Also, with respect to our macroeconomic model, we assume that interest rate in the reformed system will be relatively low. After adjustment for a shorter investment horizons, we assumed a 4% yield rate throughout the period of simulation.

4.2 PAYG and funded alternative

One possible way of measuring the performance of pension schemes is comparing the amount of contributions an individual makes during his/her working life with the amount of benefits the very same individual can expect to receive after he/she has retired. Assume a five-year increase in current life expectancies, a real discount rate of 4 % p.a., and a 20% rate of contribution towards old-age pensions as used throughout our simulations.

By definition, the present value of contributions to the FF scheme equals the present value of benefits received after retirement. However, unlike public PAYG schemes, this scheme by itself may not provide insurance against longevity if, for instance, lump-sum withdrawals are an option. Therefore, if the performance of these schemes is to be compared, the cost of this insurance in the FF scheme has to be considered. As noted earlier, the present value of expected annuity payouts in the population at large may be up to ten percent lower than the price of the annuity. Therefore, the average FF scheme participant can expect to receive at least 90 % of his/her contributions with accrued interest back in the form of annuity payouts. This, however, is not the case of the PAYG scheme and if we compare the present values of individuals' benefits in the alternative pension plans, we find that they differ substantially. These differences can be seen in Table 3 and Table 4.²²

Table 3: Present values of contributions and benefits in 2005 (CZK) – men

	Monthly wage upon entry into labor force in 2005:			
	Subsistence wage (7,000 CZK)	25% percentil (10,000 CZK)	Median income (14,000 CZK)	75% percentil (20,000 CZK)
PVC	532,000	760,000	1,064,000	1,520,000
PVB _{FF}	495,000	707,000	990,000	1,414,000
PVB _{PAYG}	528,000	629,000	699,000	803,000

²⁰ The problem of adverse selection in the private annuities market means the empirical evidence that the annuitants' life expectancy is higher than in the population at large and insurance companies adjust the prices of annuities upwards accordingly. For more, see Finkelstein and Poterba (2002).

²¹ Mitchell and McCarthy (2002) compare the present values of expected annuity payouts with the prices of annuities in a range of developed countries, using the population mortality tables. They conclude that "a typical member of the population could anticipate receiving at least 90 percent of his premium from the single life annuity. The results also imply that adverse selection as well as loadings and administrative charges must be below ten percent of the purchase price" (p. 14). In our paper, we assume this costs to reach 7%.

²² PVC denotes the present value of contributions, $PVB_{FF} = 0.93 \cdot PVC$ denotes the present value of FF benefits, and PVB_{PAYG} denotes the present value of PAYG benefits. While PVB_{FF} may well be higher than $0.93 \cdot PVC$, PVB_{PAYG} is likely to be slightly lower than presented due to our overly optimistic assumptions about the financial sustainability of the PAYG scheme.

Table 4: Present values of contributions and benefits in 2005 (CZK) – women

	Monthly wage upon entry into labor force in 2005:			
	Subsistence wage (7,000 CZK)	25% percentil (10,000 CZK)	Median income (14,000 CZK)	75% percentil (20,000 CZK)
PVC	494,000	706,000	988,000	1,412,000
PVB _{FF}	460,000	657,000	919,000	1,313,000
PVB _{PAYG}	635,000	756,000	840,000	965,000

Thus, it is clear after comparing these present values that while participants in the FF scheme can expect to receive approximately 7 % less than they will have contributed, the expectations of most PAYG-scheme participants cannot be so high. A man entering the work force with the median wage (CZK 14,000 in 2005) can expect to receive pension benefits by 35% lower than his discounted contributions during his working life and a woman with that wage can expect by 15% less. If a worker's wage is in the 75th percentil (CZK 20,000 in 2005), he can expect to receive only 50% of his past contributions and a woman earning that wage can expect to receive by 32% less than she has contributed.

Note that while the latter workers contribute over three times more than subsistence-wage earners, they receive only by 50% higher benefits. This is due to the redistribution towards individuals who are not able to contribute sufficiently for their own retirement. Surprising as it may seem, however, a man earning the subsistence wage (CZK 7,000 in 2005) upon entry into the labor force can expect to receive no more than his past contributions in pension benefits. A female worker with that wage can expect to receive (only) about 30 % more. Thus, calculations reveal that only women earning 60 % of the national average wage (i.e. about CZK 12,000 in 2005) or less when entering the work force are net recipients in the PAYG scheme and in the population of men, this scheme is actuarially fair only to subsistence-wage earners. Given the mounting demographic pressures, it is unthinkable that this situation should improve.²³

This indicates that the PAYG scheme is challenged by the FF scheme even at the microeconomic level and it seems that a partial transition to the FF system would make most labor force entrants and young workers better off.

4.3 Welfare gains from Reform

In this subsection we will compare pensions that workers can expect from the existing PAYG system and pension they would qualify for in a multi-pillar reformed system. For this purpose, we simulated life-time income flows and pension benefits of all cohorts active at the moment of the reform (2005) under the two systems. We repeated this exercise for three income groups in both scenarios, so we have six different pension histories. As shown on charts 13-18 below, the multipillar system delivers higher pensions to all workers, regardless of their income and age. This is caused by the fact that the pension claims from the PAYG are fully recognized (PAYG pension is cut proportionally with the age spent in the system). Thus anybody leaving the PAYG qualifies for his/her share of the pension and, on the top, enjoys a higher yields offered by the funded pillar.

The gain rises with income: while the 50 years old worker earning CZK 16,300 monthly (25 percentil income for that cohort) gains only 5% higher pension by switching from the pure PAYG to the multipillar system, the same age median income worker receives a

²³ Unless redistribution towards certain groups of workers is strengthened even further.

8% higher pension upon retirement and a 50 years old worker earning CZK 26,000 monthly (75 percentil income for that cohort) gains handsome 14% higher pension by switching.

The gains of switching are highest for young workers: the median income worker aged 25 years enjoys a 27% higher pension in the multipillar system than he/she would in the PAYG. The median worker aged 40 gains 19% from the reform, but the 50 years old gains 8% only and the gain fizzles to 1-2% for workers above 60 years of age.

The reformed multipillar system is able to provide not only higher pension in absolute terms, but it does provide also better replacement rates (share of the pension over the last wage) even though wages are generally higher in the reformed system – see discussion above. While the traditional PAYG musters only 42%, 38% and 30% replacement ratio for 50 years old earning 25% percentile wage, median wage and the 75% percentile wage respectively, the reformed system increases the replacement rations to 44%, 40% and 34% respectively.

Chart 13 and 14: Pension benefits and the replacement ratios for the 25 percentil income

Chart 15 and 16: Pension benefits and the replacement ratios for the median income

Chart 17 and 18: Pension benefits and the replacement ratios for the 75 percentil income

- CHARTS 13 TO 18 TO BE PLACED HERE -

5 Costs of a pension reform

As has been observed many times, a pension reform that eliminates a PAYG system and replaces it with a funded, either full or partial, system has its budgetary costs – see Holzmann (1997). While these costs reflect rather inefficiencies of the old PAYG system, they also represent a major hurdle for a pension reform, as policy makers often prefer generating even higher debts in the unreformed system, as they do not need to pay for them.

Schneider (1999) provided an estimate of the implicit debt, i.e. the difference between the future discounted balances of the Czech pension system. The implicit debt consists of two parts. First, the currently retired pensioners have to be paid their pensions in the future as they have not created the savings to provide for themselves. The capital missing for the payment of future pensions is a potential public debt, but it is not officially acknowledged. Second, all current workers have already acquired some pension rights. The capital represented by those rights is another form of the implicit public debt of the present pension system.

Using methodology of Gomulka (2000) Schneider estimated that the Czech old-age pension system has accumulated debt in excess of 200% GDP, level similar to other European countries (see Herd, den Noord, 1993). The debt level is, indeed sensitive to the government policies. Should the future governments apply very restrictive policies and keep pension benefits fixed in real terms, the overall implicit debt would reach 171% of GDP only. On the other hand, more generous pension benefits indexation in line with wage growth would lift the implicit debt to 275% of GDP. Therefore, the medium estimate, 210% of GDP, seems a reasonable compromise.

We have already argued that the proposed “reversed sequencing” of the pension reform gives the government a tool to adjust fiscal costs of the reform to its resources. If the government wants to complete the reform quickly and has fiscal means to subsidize the

pension reform, it can start lowering “entry age” to the combined system rather quickly. By doing so, the government will lower its revenues from pension system contributions but it will, at the same time, reduce its future pension liabilities. As we show below, pension reform can be extended to the whole working population in about 25 years without generating excessive fiscal debts provided the pension system is capitalized prior the reform.

If, on the other hand, the government opts for a more cautious approach, it may fix the “entry age” at 50 years. This will limit foregone revenues, as all workers younger than 50 will keep contributing to the PAYG pension system. At the same time, workers will not be able to accumulate as sizeable savings to finance their pensions, as they will have saved for only 15 years. As we show below, this scenario is fiscally less demanding than the previous one, but it does not increase pensions as substantially either.

5.1 “Cautious” reform

First, we explore a rather cautious reform scenario in which only 15 oldest working cohorts switch to the reformed combined pension system. Every worker, after turning 50, channels 50% of his/her pension contribution to a private pension fund. As above, we assume that the pension funds yield a 4% interest rate on the contribution. The remaining 50% of contributions remains in the official PAYG system and the eventual pension claims from the PAYG are proportionally reduced, i.e. if a worker contributed to the combined system for one year only, his/her PAYG pension is reduced by 2,4% (1/42th).

Even this cautious reform increases pensions. It does so only marginally for cohorts already very close to the retirement age when the reform starts – pensions of 60 years old worker rises by lowly 1,3% if he/she is at 25 percentil income of his/her age cohort, by 2% if he/she is at the median income and by 4% if he/she is at the 75 percentil of income distribution. As workers spend more time in the combined system, their gain increases: to 3%, 6% and 11% in the respective income groups for workers spending 15 years in the combined system – see charts 13-18.

As the maximum time span in the reformed combined system is fixed at 15 years, the gains are limited as well. The cautious reform, however, has some fiscal appeal. The government budget in this reform scenario loses contributions from the fifteen cohorts only, so the revenue loss is manageable: 1,2% of GDP only – see chart 19. The gains from this reform scenario stem from lower PAYG pensions paid later. As the chart illustrates, in early years of the reform, the gain is too small to compensate for foregone revenues and the pension system sinks into the deficit of about 1% of GDP. Only when workers with higher private pension begin to retire, the system’s balance improves. In 2030, the system switches to surplus for the first time and the surplus stabilizes at about 2,2% of GDP after 45 years of the reform.

The chart 20 presents the accumulated balance of the combined pension system.²⁴ We see that the debt peaks at 37% of GDP after 27 years of the reform. After further 30 years the debt is eliminated and the government starts to make money from the reform. As the chart illustrates the accumulated gain for the government in 2100 would be substantial – over 125% of GDP. However, this surplus could be instead used to finance cuts in pension contributions or, as we have argued before, the government may gain confidence in the reform and may accelerate it by widening the group of “eligible” cohorts, i.e. by lowering the “entry age” at which workers may start to contribute to the combined system. Indeed, the following section looks in detail on such a more aggressive reform scenario.

²⁴ We used the 3% interest rate paid on the government debt or yielded on the pension surplus throughout the simulation as we assume very conservative government investment.

Chart 19 and 20: Annual deficits and the accumulated debt of the “cautious reform” scenario

- CHARTS 19 AND 20 TO BE PLACED HERE -

5.2 “Expansionary” reform

We have shown that a “cautious” reform can be tailored as to make fiscal position manageable. Its benefits, however, are rather limited: pensions rise by 3-11% depending on the income. The reforming government may opt for a more ambitious reform instead. Such a reform scenario would see the “entry age” into the combined system to be lowered so workers may stay longer in the combined system and gain more from a higher yield of the private pillar.

We estimated potential gains for the three income groups if the “entry age” is cut by a year annually. In this scenario, the whole working population is enrolled in the combined system after 28 years when the “entry age” reaches 22, our “starting age” when workers enter the labor market. As the charts 13-18 illustrate, pensions of workers then rise by 15% (for the 25 percentil income), 25% (for the median income) and even by 40% (for the 75 percentil income).

This more ambitious reform scenario dents more into the government revenues as more workers cut their contributions to the PAYG system. As the chart 21 illustrates, the revenue loss quickly rises to 4% of GDP after 20 years and then stabilizes at about 5% of GDP. This loss is only partially compensated by lower pensions paid by the system: the system first gets balanced after 24 years and the surplus stabilizes at 1,4% of GDP after further 10 years.

This scenario leads naturally to higher debt accumulated during the reform. Indeed, the debt may rise so fast that the whole system becomes unstable and the debt may explode. That is why we calibrated the initial subsidy to the system as to achieve zero debt in 2100. In the case of the “expansionary” reform scenario, the initial subsidy to the pension system is relatively small: 9% of GDP in the first year of the reform guarantees zero debt in 2100. If this subsidy is deposited with the system in the initial reform year, the debt peaks at 41% of GDP after 30 years of reform.

Chart 21 and 22: Annual deficits and the accumulated debt of the “cautious reform” scenario

- CHARTS 21 AND 22 TO BE PLACED HERE -

While debt this large does represent a substantial burden, there seems to be no way how the government may escape from the “pension trap” without accumulating huge debts. Indeed, any reform that moves a part of pensions from the PAYG to a funded pillar is bound to reveal implicit pension debt inherited from the PAYG system as discussed above. Thus, we believe that the “expansionary” reform is preferred to the “cautious” reform, not to speak of the “no” reform seemingly favored by the Czech authorities.

6 Policy Implications and Conclusion

In this paper we have analyzed various pension reforms proposals. While we used parameters of the Czech pension system, our analysis is applicable to most pension systems

operating on the pay-as-you-go principle. The major contribution of this paper is in this dual approach to the pension reform and the reverse sequencing of the pension reform that increases government's flexibility in introducing the reform.

First, we formulated and estimated an over-lapping generations macroeconomic model that illustrated long-term benefits of a pension system financed through private savings. We showed that a switch from the PAYG to a funded system would contribute to faster capital accumulation, higher wage growth, lower taxation, higher economic growth and higher lifetime utility for all cohorts.

Results of the macroeconomic model were then plugged into the detailed microeconomic model that analyzed individual workers' incomes over their lifetime. We demonstrated that under rather conservative assumptions, a gradual switch from the PAYG system to a funded one might increase pension benefits for all income and age groups. The gain is positively correlated with income and negatively with age at the time of reform. However, even the low paid and close to the retirement cohorts do gain from the reform, as their PAYG claims are fully accepted in the new system.

A critical question is the extent of switching. The World Bank (1994, p. 23) states: "The right mix of [schemes] is not the same at all times and places. It depends on a country's objectives, history, and current circumstances, particularly its emphasis on redistribution versus saving, its financial markets, and its taxing and regulatory capability. The kind of reform needed and the pace ... will also vary..." Both schemes are subject to different kinds of risk - the FF scheme is associated with investment risks whereas participants in the PAYG scheme are exposed to political risks. Disney *et al.* (1999, p. 22) point out that "it should not be assumed that [political] risk is *a priori* lower than the investment risk associated with funded plans." Browning (1975) shows that it is rational for a politician in a democracy to overpromise pensions since the cost is to be borne by future generations when the respected politician is already out of office. The two schemes should be viewed as two portfolios with very imperfectly correlated returns. In order to diversify the risks, a combination of both schemes seems optimal for individuals although people with different degrees of risk aversion may favor different combinations.

Because the transition to a mixed scheme is, however, associated with substantial costs, the extent to which individuals are allowed to opt out of the PAYG scheme is likely to depend on the political climate.²⁵ It is, thus, crucial to give governments certain leverage as to calibrate the pension reform costs. Our proposal, i.e. reverse sequencing, allows government to adjust the speed of the pension reform expansion to their specific needs. Thus, we showed how the government might control the reform dynamics by manipulating the "entry age" to the reformed, combined pension system. A more fiscally conservative (or budgetary strained) government might prefer a slow reform in which it keeps majority of workers in the PAYG system and limits the transitory budget deficits. Such a "cautious reform" would generate higher pensions than unreformed PAYG system, but the gain would be relatively modest.

A more ambitious reform, on the other hand, expands the pool of eligible workers very quickly. This gives workers a chance to participate in a more effective pension system and raise their pensions more substantially. At the same time, "expansionary reform" is more fiscally demanding, as the transitory deficits are higher. We have illustrated that the "expansionary reform" would require a front-loaded capitalization amounting to some 9% of GDP in order to eliminate eventually the transitory debt.

²⁵ The greater the switch, the higher the short-term transition costs. For instance, Hungary and Poland have so far allowed workers to divert over 1/5 of mandatory contributions to pension funds as shown in table 1

Due to unfavorable demographic conditions, the Czech PAYG scheme would be outperformed by a FF scheme and it can be expected to be so for as far down the road as the eye can see. Indeed, we have demonstrated under certain conservative assumptions about rates of return, life expectancies and wage developments all workers and future pensioners gain from a switch to the combined multi-pillar pension system. Workers should not be denied the right to increase their standard of living in old age via a combination of a public PAYG scheme and a private FF scheme, and we have shown that this increase could be non-negligible even for future pensioners with a history of relatively low earnings. The sooner the reform, the better.

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Chart 1: Age profile $w_{t}e_{t}$

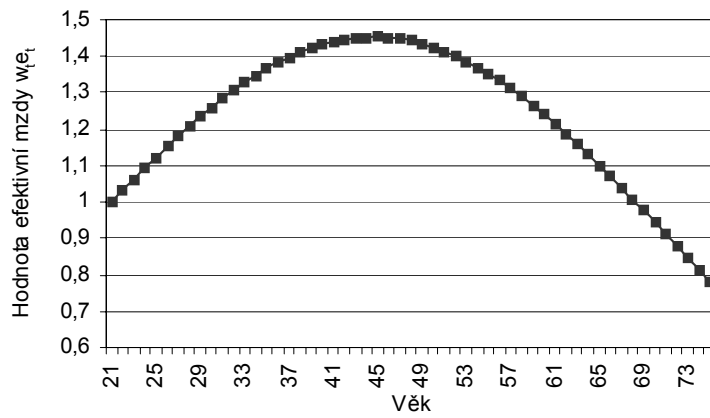


Chart 2: Capital/labor ratio in three pension scenarios

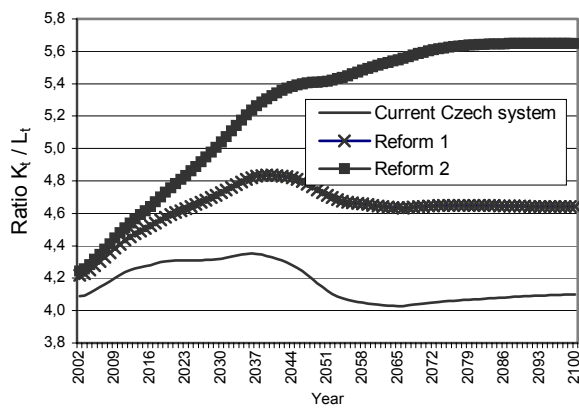


Chart 3 and 4: Wages and interest rates under three scenarios

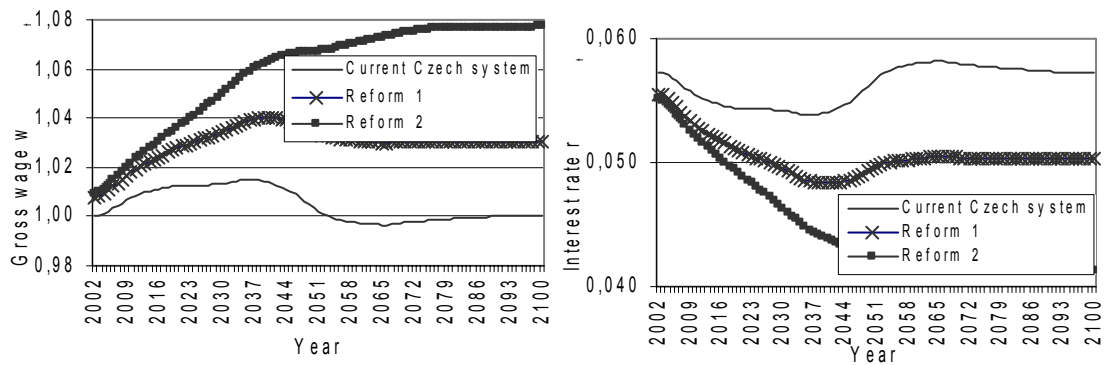
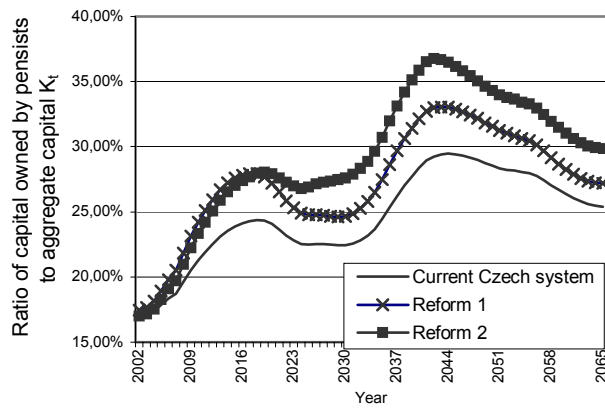


Chart 5: The share of capital owned by the 61+



Charts 6 and 7: Social contribution and net wage under three scenarios

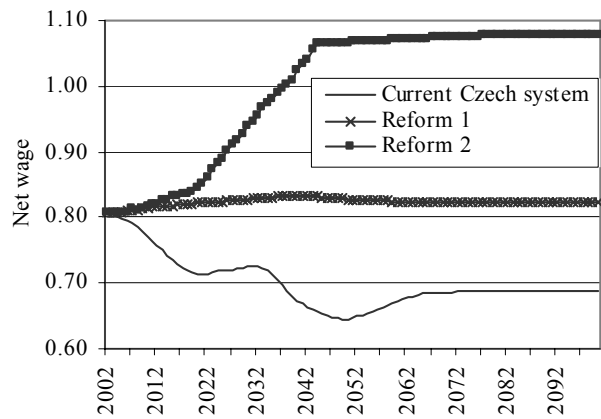
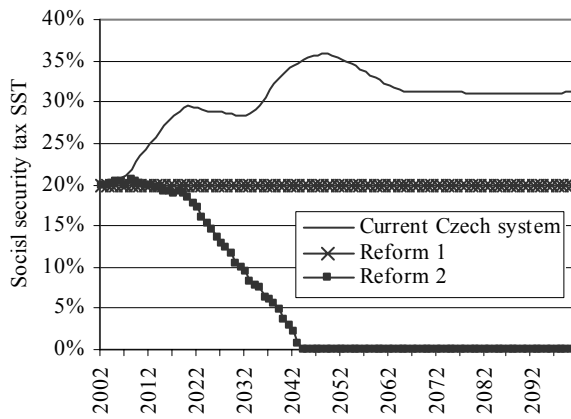


Chart 8: Pension expenditures under the three scenarios

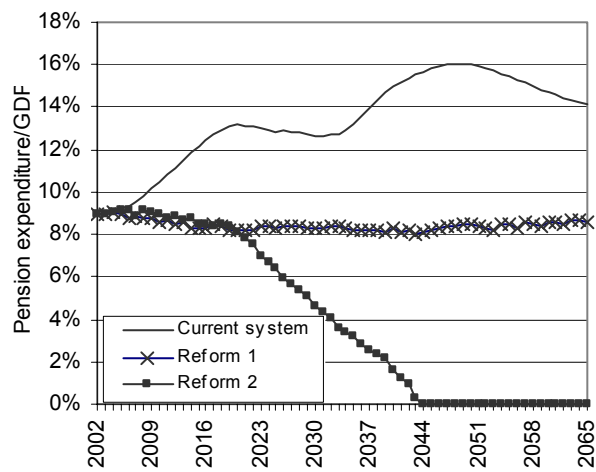


Chart 9 and 10: Savings and consumption under the three scenarios

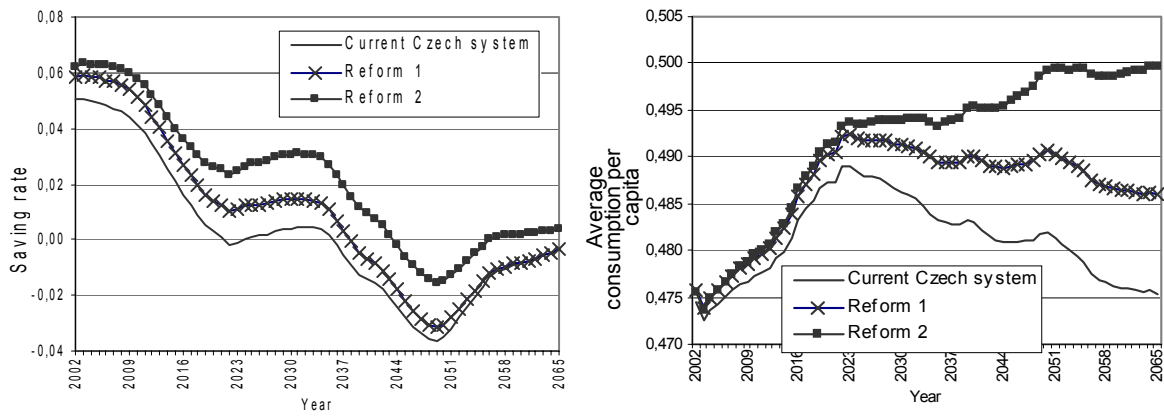


Chart 11: GDP per capita under the three scenarios

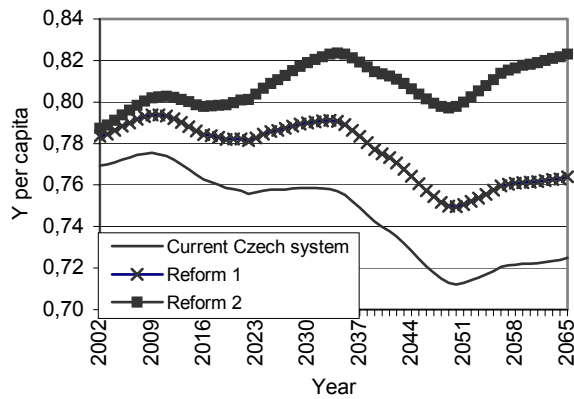


Chart 12: Life time utility of various cohorts under the three scenarios

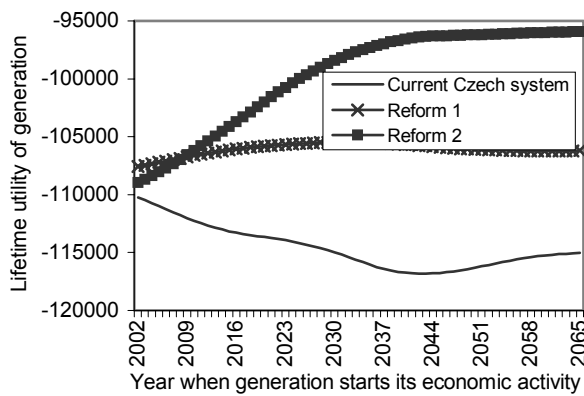


Chart 13 and 14: Pension benefits and the replacement ratios for the 25 percentil income

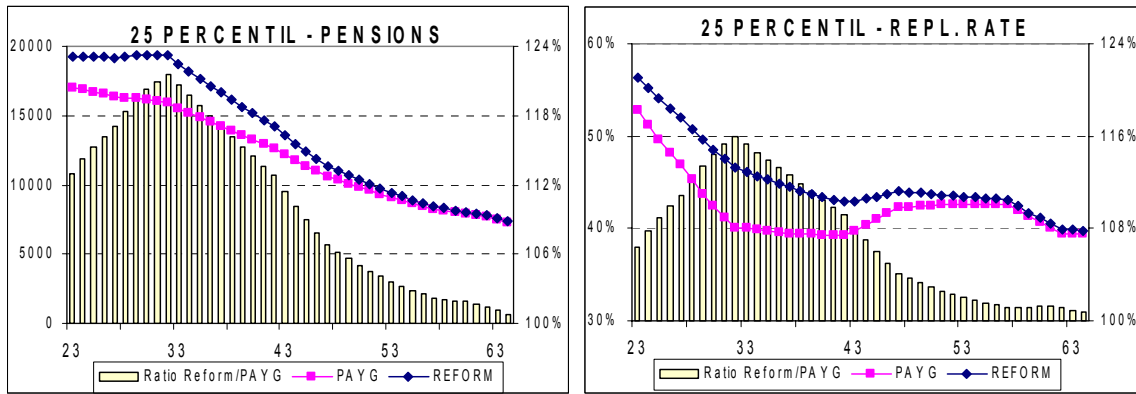


Chart 15 and 16: Pension benefits and the replacement ratios for the median income

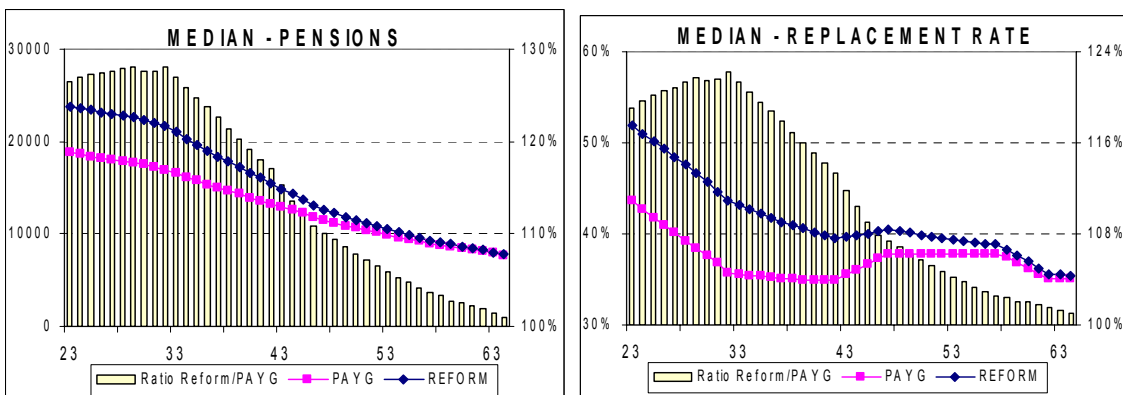


Chart 17 and 18: Pension benefits and the replacement ratios for the 75 percentil income

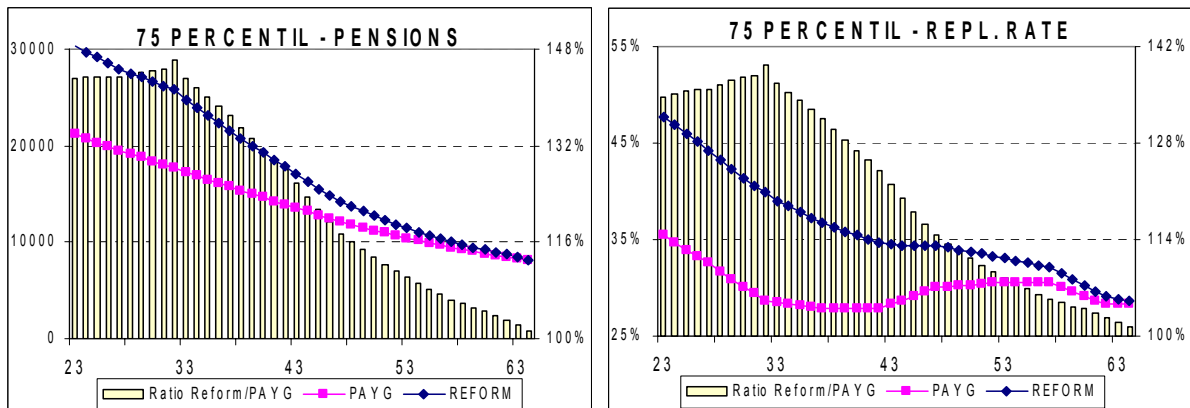


Chart 19 and 20: Balance and accumulated debt of the “cautious” reform scenario

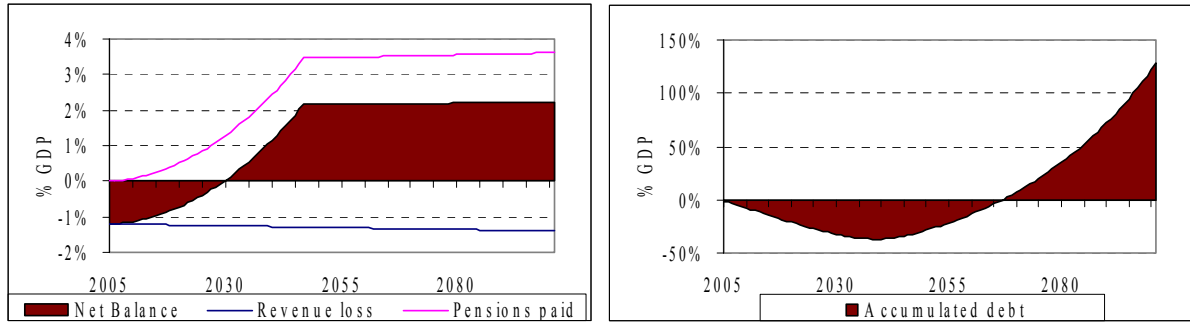


Chart 21 and 22: Balance and accumulated debt of the “expansionary” reform scenario

