Gains and Losses of Social Security: Evidence from Reforms in Hungary, the Czech Republic, and Slovakia[1]

Libor Dušek[2] and Juraj Kopecsni[3]

January 28, 2008

Abstract

We document gains and losses of social security in Hungary, Czech Republic and Slovakia by measuring the changes in the social security wealth induced by the pension reforms undertaken in these countries since the 1990s. Methodologically we follow upon McHale's (2001) study of selected reforms in G7 countries. We compute the changes in social security wealth separately for representative male and female workers in all age cohorts and different educational categories. Our results therefore provide more comprehensive picture of the differential impacts of pension reforms on different workers. In Hungary, the early (1993 and 1997) reforms had negative impact on workers near the retirement age. The 1998 reform which introduced a privately funded second pillar was advantageous for middle-aged and young men with university education but had a negative impact on most other workers, and exposed workers to additional uncertainty about future taxation of benefits. The Czech 1996 and 2002-03 reforms reduced the social security wealth of almost all workers by the magnitude of 1 to 3.5 annual average earnings. The negative impact was distributed fairly equally across cohorts and income levels. The Slovak 2004-05 reforms present a new transparent pay-as-you-go system as well as a mixed system with a fully funded pillar. Results show that switchers to multi pillar system are slightly worse off than stayers due to rather conservative investment strategy of pension funds at the beginning of their existences. The gainers of the reform are younger cohorts with university education, who receive positive SSW change by 4.6 annual average earnings. Overall, the paper documents that also a pay-as-you-go system is not a predictable source of income since legislative reforms, particularly in the Hungarian case, do frequently change the future taxes and benefits in different directions for different people.

JEL codes: H55, G32, P26

---

[1] This research was supported by the Grant Agency of the Czech Republic, grant no. 402/05/0711, and by Grant Agency of Charles University grant no. 318/2006 A-EK. We are grateful to the employees at ING Group and Mr Boris Burcin from the Charles University Department of Demography for providing the mortality tables for Hungary, Slovakia, and Czech Republic. We appreciate comments and suggestions from Ondřej Schneider, Andras Simonovits, Petr Hedbávný, Michal Bauer, František Turnovec, Vladimír Bezděk, Aleš Krejdl, Jan Škorpík, and participants at the Central European University seminar and CSE conference. Pavel Dvořák provided excellent research assistance. Kopecsni carried out parts of the empirical analysis while a visitor at the Institute of Economics at the Hungarian Academy of Sciences whose hospitality and access to the data is acknowledged.

[2] CERGE-EI, Prague (a joint workplace of the Center for Economic Research and Graduate Education, Charles University, and the Economics Institute of the Academy of Sciences of the Czech Republic). Contact: libor.dusek@cerge-ei.cz

[3] Institute of Economic Studies at the Faculty of Social Sciences, Charles University, Prague. Contact: kopecsni@centrum.cz

1. Introduction

The unsustainability of public pay-as-you-go pension systems and possible reform options have received substantial attention by economists. Several countries have adopted, or are considering adopting, a multi-pillar pension system in which a part of the traditional PAYG scheme would be replaced by a funded system of private savings.

A large number of papers (among others World Bank (1994), Koch-Weser (1997), McHale (1999), Mora (1999), Muller (1999), Lindeman, Rutkowski and Sluchynskyy (2000), Feldstein (2005a,b), Lindbeck and Persson (2003)) describes gains from pension reform, highlights basic principles of the reform and discusses the efficiency, distributional, stability, and risk sharing aspects. A shift from the PAYG system to a mixed system with a privately funded pillar can reduce the distortions in the labor market, lift national savings, increase internal rates of return on contributions, and increase the expected future consumption. The transition to such multi pillar system can be done gradually in a way that does not require large deficits, a tax increase or a decrease in retirement incomes.

It has been well recognized that one of the drawbacks of the funded pillar is the investment risk – as contributions are invested into stock and bonds and the returns are uncertain, workers cannot expect to receive a certain level of pension once they retire. Several authors (Feldstein and Ranguelova (2001), Feldstein, Ranguelova and Samwick (2001), Poterba et al (2005)) have quantified the risk contained in private funded schemes, estimated distributions of potential benefits upon retirement, and made expected utility comparisons between the private funded scheme and the PAYG.

These papers assumed, however, that some benchmark PAYG benefit will be provided with certainty. However, the PAYG systems are not free from risk either – workers are subject to the risk that pension legislation will be changed (because of, for example, necessary policy adjustments to increasing dependency rates), and that

they will receive lower social security benefits or will have to pay higher taxes than that they were promised by the original legislation.

The importance of political risk is often underestimated or neglected. Appropriate comparisons between the PAYG system and privately funded system require comparing a risky private system with a risky PAYG system, and therefore it is necessary to have some measures of the magnitude and consequences of the political risk. Major pension reforms are the largest manifestations of political risk. A large-scale change in the pension system usually involves numerous adjustments to formulas for computing taxes and benefits that are complicated, not very transparent, and contain a large number of parameters. Such adjustments may affect people of different ages and earnings histories differently, often times in ways that may not have been recognized and anticipated by the legislators.

An emerging literature has already produced some quantifications of the magnitude of the political risk. McHale (2001) computes the change in the social security wealth[4] (SSW) induced by pension reforms that were implemented in the G7 countries during the 1990's for workers with average earnings at age forty-five and at the standard retirement age. He finds that some of the reforms reduced the social security wealth by as much as 29% (the Italian 1992 reform) or 26% (the German 1992 reform). He also finds that those at the retirement age experienced only minor, and in most cases none, cuts in benefits. McHale's contribution was valuable as it demonstrated that cuts in social security benefits do happen and they can be substantial. Shoven and Slavov (2006) take a more systematic look at the political risk of social security in the United States since 1939 until today. They compute the internal rates of return for various age groups under the existing legislation in each year, and find "a considerable variation in the internal rates of return through time for a given birth cohort". They also find substantial differences in IRR's across cohorts. Blake (2004) shows that even the private pensions in the United Kingdom have not been completely immune from political risk, but have been less sensitive than the public pensions.

[4] The social security wealth is defined as the expected present value of pension benefits minus the expected present value of social security contributions, as promised by the current legislation.

In this paper, we provide evidence on the magnitude of the political risk of social security in Hungary, Czech Republic and Slovakia by measuring the impact of all major changes in pension legislation adopted in these countries since the early 1990's on the social security wealth of workers of different ages, genders, and income levels. All countries undertook major reforms of their outdated pension schemes a few years after the fall of communism (Hungary in 1993, Czech Republic in 1996, Slovakia in 2004), and all of them made surprisingly similar changes in the key parameters. Hungary is then a particularly interesting country to study since its 1998 reform reduced the size of the PAYG system and replaced it partially with a private funded pillar. In this sense these countries provide a somewhat representative picture of the other transition countries, either those who chose simple re-parameterization of the existing PAYG scheme (e.g., Slovenia) or a more radical reform (e.g., Poland).

Methodologically, our approach is similar to McHale (2001) but more comprehensive. For each of the reforms, we compute the expected present value of taxes and benefits under the pre-reform and post-reform legislation separately for representative men and women at different income levels (represented by educational categories) and, more importantly, all birth cohorts that were working or born but not yet working at the time of reform. Therefore we not only document that social security wealth has changed for some types of workers, but we observe richer distributional impacts of the reforms on workers of different ages, income levels, and genders.

For the two Czech reforms (adopted in 1996 and 2002-2003), we find that overall impact was negative for all workers. Except for the workers with less than 10 years until retirement, the reforms reduced the SSW of most workers by 200-350% of average annual wages (the 1996 reform) and 0.8-1.4 average annual wages (the 2003 reform). The reform had a fairly similar impact across genders, cohorts and educational categories, except that the university educated workers lost relatively less from the first reform and lost relatively more from the later reform. Also the workers with less than 10 years to retirement were hurt less than the younger workers.

The Slovak 2004-05 reforms present a new transparent pay-as-you-go system as well as a mixed system with a fully funded pillar. Results show that switchers to multi pillar system are slightly worse off than stayers due to rather conservative investment strategy of pension funds at the beginning of their existences. The gainers of the reform are younger cohorts with university education, who receive positive SSW change by 4.6 annual average earnings.

Most Hungarian reforms, on the other hand, had differential impacts on workers in different cohorts and education levels. The 1998 reform was most notable in this respect as it effectively created different sets of rules for workers who will retire before 2012 or after 2012. As a consequence, the impact of the 1998 reform varies widely by cohort – the SSW of university-educated men born in 1951 rose by approximately 170% of average annual earnings more than SSW of university-educated men born just before 1951. Particularly in the Hungarian case the social security appears to be a risky asset as the reforms were quite frequent and they were inducing both positive and negative changes in SSW in a pattern that hardly appears to be systematic or predictable.

The rest of the paper is organized as follows. Section 2 describes our methodology for computing the social security wealth and the assumptions involved. Section 3 provides a brief institutional background on the pension reforms in Hungary, Czech Republic and Slovakia and we present the results for individual pension reforms. Section 4 concludes.

2. Methodology and data

We compute changes in social security wealth implied by each pension reform. Social security wealth (SSW) is the difference between the present value of expected future contributions and benefits promised to workers under the current pension legislation. We compute the impact of each reform on the SSW of all cohorts were either working as of time of the reform or were born but not yet working, and within each cohort, we carry out the computation separately for men and women and for average workers in

four educational categories: elementary education, lower secondary (apprenticeship), upper secondary (high-school with a school-leaving exam), and college/university.

The SSW for each cohort *(a)* at the time of reform *(T)* is calculated according to the following formula:

$$SSW(a,T) = -\sum_{t=T}^{R-1}\left[\mathrm{w}_{a,t} \frac{EmployeeTax+EmployerTax}{(1+r)^{t-T}} \prod_{k=T}^{t}(1-d_{a,k}) \right] + \sum_{t=R}^{a+100}\left[\frac{B(a,R)}{(1+r)^{t-T}} \prod_{k=R+1}^{t}(1+i_k) \prod_{k=T}^{t}(1-d_{a,k}) \right]$$

where R is the year of retirement, t is a current year, B is the value of the initial pension, r is the discount rate, w is a gross nominal wage, d is the mortality rate and i is the rate at which the benefits are indexed. Calculating the SSW involves three basic steps. First, the discounted value of future contributions is calculated from a projected path of wages and contribution rates specified by current legislation. Note that they include contributions paid by both the employee and the employer. Second, the entry pension benefit is computed according to the formula prescribed in the legislation. Third, the discounted value of benefits is computed using the current indexation rules and a projected path of variables that affect the indexations. To put the results in perspective, we normalize the change in SSW by the average annual earnings in the economy. That is, a change in SSW of -1.0 units means that the worker lost SSW equivalent to annual earnings of an average worker. The level of SSW of the worker who is at the beginning of the working career also indicates the degree of redistribution built into the PAYG system. If it is positive, the system effectively provides a net transfer to the worker, while if it is negative, the system effectively taxes the worker.

Computing the social security wealth required a number of assumptions about the wage profiles of workers, evolution of certain variables in the future, and returns on savings in pension funds. These assumptions and the data used to construct them are described in detail in Appendix A. Our "average" workers start working at age 20[5],

[5] Workers with college education start working at age 22. The assumption on the time of retirement is probably the most problematic in the sense of missing an important distributional aspect of the reforms. Social security wealth clearly depends on whether a particular worker exercises the

work without interruption until the standard retirement age, and at each age they are earning the wage that is predicted by the earnings profile specific for their gender, educational category, and calendar year. The wage profiles were estimated for each country from large individual-level datasets. The length of life is probabilistic, and the future taxes and benefits are discounted by the survival probability.

We assume that as of the time of the reform people had perfect foresight about the future evolution of wage growth, inflation, and returns on assets in pension funds. That is, taxes and benefits in years up to 2005, as expected as of time of the reform, are computed from the wages, inflation rates, and returns as they were actually realized up to 2005. For the years 2006 onwards, we assume a 3% growth rate of real wages for all education categories and genders, and a 2% inflation rate.[6] To project the future returns on savings in the Hungarian pension funds, we compute their average returns realized since the time they were established (1998). For Slovakia, which introduced pension funds too recently to infer their historical returns, we set the expected future returns to the average historical return on the portfolios that the funds currently hold. The fees charged by the funds are deducted from gross returns.

3. Description of reforms and their impact on SSW

Below we describe the key features of each reform and present our results on its impact of SSW of different workers. The key features are summarized in Table KF. Tables in Appendix B present the main result, the change in SSW separately for men and women of different levels of education and ages. When the pension system has two pillars, separate tables are reported for workers in the PAYG pillar and the mixed pillar. Due to space limitations, we report results averaged over cohorts born during 5-year intervals.[7] Figures in Appendix B illustrate the impact of each reform for selected

---

early retirement option or continues working till the standard retirement age. However, modeling the individual decision to retire is beyond the scope of this paper

[6] These are roughly the rates of wage growth and inflation currently experienced by all countries.

[7] Detailed results for individual cohorts are available upon request.

genders and education levels for all cohorts, and also separate the overall impact into a change in contributions and a change in benefits.

3a. Hungary: Reform 1993

At the beginning of transition, Hungary had a pay-as-you-go pension system that was kept unchanged since the mid 1970's.[8] The first reform came in 1993, and since then there were five other reforms. The 1993 reform[9] postponed the eligibility age for women gradually from 55 to 60 and changed benefit formula. Before the reform the initial benefit was based on earnings during 4 years with the highest earnings in the period of 5 years before retirement while after it was based on earnings from 1988 until retirement. The benefit was set as a certain fraction (referred to as accrual) of average earnings during the period considered.

The reform did not affect the contributions paid by men, and its overall impact on the SSW of men was negligible. It had a negative impact on all cohorts of women, who lost between 0.38 to 2.15 annual average earnings (Table H1). Postponement of the retirement age is responsible for an increase in the PV of contributions which in percentage terms is particularly pronounced for cohorts close to retirement (by 50% - 100%). The change in the benefit formula was relatively more favorable to workers with lower wages, as evidenced by comparing an increase in the PV of benefits for women with elementary education (Figure H.1) with a decrease for women with university education (Figure H.2.) This is due to differences in wage profiles among educational categories. As the wage profiles for workers with university education are steeper, the new formula counts also the earlier years when the earnings of workers with university education are relatively lower than in their pre-retirement years. This effectively reduces the average earnings during the period considered. The differential impact on the SSW of women with low and high education (as well as on younger and older women) is well visible from Figures H.3-H.4.

[8] The Social Security Act of 1975 (Law No. 1975 II).
[9] Law No. 1993 VIII

3b. Hungary: Reform 1997

Next reform, adopted in 1997[10], postponed the eligibility age for men and women gradually to 62. However, it shifted the eligibility age back by 1 year for women born between 1942-1944. The contribution rate paid by employers was reduced from 24.5% to 24%, and the pension accrual increased by 1.5% - 8% depending on the number of years worked.

The reform was clearly beneficial for women in 1942-44 cohorts whose SSW rose by as much as 2 average annual earnings (Figure H.6). For the younger women, higher accrual and lower contributions did not compensate for the postponed retirement, and their SSW fell by approximately 0.4 average annual earnings (upper secondary education) and 0.8 average annual earnings (university education). Men close to retirement lost between 0.7 (elementary education) to 1.66 (university education) average annual earnings. Younger cohorts lost gradually less, those just entering the labor market lost about 4 times less than their counterparts close to retirement.

3c. Hungary: Reform 1998

The fundamental reform of 1998[11] split the mandatory PAYG system into a public PAYG and a privately funded pillar. The workers already employed had a choice either to switch from public to a mixed system or to stay further only in the public system, and more than 50% of eligible workers did switch[12]. For new entrants to the labor market participation in the mixed system was compulsory. Workers in the mixed system will have their benefit from the public pillar reduced by 25%.

The employer contribution was reduced from 24% to 23% by 1999 and to 22% by 2000. At the same time the employees contribution was increased from 6% to 7% by 1998, 8% by 1999 and 9% by 2000. From this percentage employees in the mixed

[10] Law No. 1996 LIX and 1996 LXXXVII

[11] Law No. 1997 LXXX deals with contributions, Law No. 1997 LXXXI regulates the Social Security Pension Scheme (public PAYG, 1st pillar), Law No. 1997 LXXXII establishes the legal framework for the Mandatory Private Pension Funds (2nd pillar)

[12] Augusztinovics et al (2002).

system had to pay 1% to the PAYG pillar and the rest of their contribution went to the private pillar.

The pension accrual will not change until 2013. After 2013 the benefit formula will switch from the net to the gross principle, meaning that the benefit will then be set as a fraction of average gross earnings instead of net earnings. It was also planned that benefits would become taxable at the same time; however, the corresponding change in the income tax legislation has not been made (yet). This rather ambiguous provision creates additional uncertainty over whether benefits will be taxable at all after 2013, and if so, what the income tax rates will be.[13]

In practice this means that a worker who retires after at standard retirement age in 2012 will have his initial benefit is calculated as 83% of the average net earnings. A worker one year younger than him retiring in 2013 will have his initial benefit set at 69.3% of the average gross earnings. The latter amount is approximately 20% higher than what the older retiree will receive. Should the benefits indeed become taxable at current income tax rates, the additional income tax should approximately erase the 20% difference, although the exact percentage will vary across retirees as they may face different marginal tax rates. Since our goal is to evaluate the impact of reforms as they were actually legislated, we do not subtract any income tax when we compute the benefits after 2012.

The indexation rule was changed gradually from the net wage indexation to the Swiss indexation (50% CPI and 50% net wage growth). The income brackets in the benefit formula were indexed by nominal wage growth till 1998 while between 1998 till 2013 they were to be indexed by nominal wage growth plus 8%. The annuities from the funded pillar must be unisex and also indexed by Swiss indexation.

Results are reported separately for workers who stayed in the PAYG system and those who switched to the mixed system (Tables H4 and H5). The present value of future contributions in the pure PAYG rose by 3.3% for all workers (Figures H7,H9,H11).

[13] (Augusztinovics et al (2002))

Changes in the present value of benefits vary substantially across cohorts, genders, and education levels. Those already retired see their benefits cut by about 20% due to a gradual switch to the Swiss indexation. Benefits rose for the younger, 1942-1950 cohorts, since they were also affected by faster indexation of income brackets in the benefit formula. It increased in the PV of benefits men with university education substantially (by approximately 49%, see Figure H.9) and for men with elementary education only slightly (by approximately 1%, Figure H7). Cohorts retiring since 2013 will have their benefits set according to a new formula. For them it implied a large increase in the PV of benefits - by 80% (!) for men with university education born in 1951 at the extreme. For post-1950 cohorts of women and men with lower earnings this increase is less dramatic since they face a smaller gap between gross and net earnings. (Compare Figures H.7 and H.9).

In SSW terms, the 1998 reform had highly differential impact across cohorts and education levels. Men and women with university education were the clear winners as they gained at least 2 average annual earnings. Among them, the cohorts born in the 1950's did particularly well (gained 3.2 to 3.5 average annual earnings). Both men and women with upper secondary education gained less than 1 average annual earnings, and again those born in the 1950's were treated better than cohorts born both earlier and later. Finally, workers with lower education levels unaffected or mildly negatively affected (the larges loss of 0.57 average annual earnings suffered by women with elementary education born in the late 1940's.)

Outcomes of workers who switched to the mixed system reveal a surprising result – most workers do not gain by switching to the mixed system, or gain only marginally. Consider the group that supposedly has most to gain from switching to the private pillar, i.e., men with university education at the beginning of their career (1975-79 cohorts). Their gain from the reform is 2.28 average annual earnings if they switch, but 2.37 if they stay in the PAYG. This is largely due to the generous increase in PAYG benefits stipulated by the reform. Since older cohorts contribute to the PAYG for a shorter time, they do not accumulate enough savings to compensate for the 25% cut in the PAYG benefit, and so they are relatively even worse off by switching. The

differential impact of the reform on the switchers and stayers is similar, although less pronounced in magnitude, for other types of workers. It should be pointed out that if the PAYG benefits do become taxable after 2013, the gains to switching to the mixed system relative to staying in the PAYG system will be more favorable that our computations suggest.

3d. Hungary: Reform 1999

Mere one year later, the new government which had been opposed to private pensions made adjustments that scaled down the importance of the private pillar.[14] It cancelled an increase in employees' contribution to the private pillar that was promised by the previous legislation; workers in the mixed system had to contribute additional 1% to the PAYG pillar, and employers' contribution was to be cut system from 23% to 22% by 1999 and to 21% by 2000.

In percentage terms, the reform had the same effect on all educational categories, but differential impact on different cohorts and on workers in the mixed system vis-à-vis workers in the pure PAYG. Figures H.15 and H.16 show that while men in both systems experienced a 3% cut in contributions, workers in the PAYG had their benefits unaffected while cohorts 1951 and younger saw the PV of their benefits decline by 2.6-6.5 % (gradually more for younger cohorts, who, due to longer accumulation of savings, have a greater gap between the benefit from the funded pillar and the benefit from the PAYG pillar). In SSW terms, the reform benefited everyone in the pure PAYG system by the order of 0.2 to 0.5 average annual earnings, and had negligible net effect on the SSW of workers in the mixed system.

3e. Hungary: Reform 2003

The 2003 reform[15] increased employees' contributions from 8% to 8.5%, reduced contributions to the PAYG pillar to 1.5% for workers in the mixed system, and increased their contribution to the private pillar form 6% to 7%. The major change brought by this reform was a gradual introduction of an additional monthly benefit

[14] Law No. 1998 LXVII
[15] Law No. 2003 IV

within the PAYG pillar. Pensioners received additional 25% of monthly benefit in 2003, this additional benefit being gradually increased such that they would effectively receive their benefits 13 times per year from 2006 onwards.

In SSW terms, the reform increased SSW of all workers by 0.1 to 0.8 average annual earnings It was more beneficial to workers in the pure PAYG system (who typically gained between 0.1 to 0.2. average annual earnings more than their counterparts in the mixed system; see Table H7). It was also more advantageous to cohorts close to retirement than to younger cohorts. (E.g. women with university education born in the late 1950's gained 0.66 average annual earnings while those born in the early 1990's gained 0.34 average annual earnings, and similar relative are observed for other types of workers.) Figure H17 illustrates the change in the PV of contributions and benefits for men with upper secondary education.

3f. Hungary: Reform 2007

The last reform covered in this paper[16] was motivated by cutting budget deficits. While the previous legislation was prescribing a reduction in employer contributions from 18% to 16% by 2009, the 2007 increased the employer contributions to 21%. The reform also affects the benefit formula for workers who will retire between 2008 and 2012 by changing the deduction of health care and unemployment insurance in a way that will effectively reduce the benefit. On the other hand the reform adjusts future indexation in a way that will slightly increase the future benefits. Specifically, earnings during the whole life will be indexed to the level of the individual's last working year, while before the reform earnings in last three working years were not indexed at all. The pension accrual will increase by 0.5% for each additional year but only for workers with more than 40 years of working history. The reform did not affect pensions that would be newly granted after 2012.

The combined effect of these changes was clearly negative, especially for workers with higher education and for all younger workers. The new formula cut the initial

[16] Law No. 2006 CVI

benefit by 5-6% for cohorts 1946-1950, graphically clearly demonstrated in Figure H21. In addition, the PV of contributions increased by 15-20%. The differential impact of the reform for different educational categories shows that the SSW of men with elementary education decreased by only 0.35 to 1.1 average annual earnings, while the SSW of men with university education decreased by 0.85 to 2.5 average annual earnings.

3g. Czech Republic: Reform 1996

The Czech pension system is a very traditional pay-as-you-go, defined benefit system. The 1996 reform[17], the first one undertaken after the end of communism, changed most of its parameters.

The system has been redistributive across as well as within cohorts – the benefit is increasing less than proportionately in past earnings. The benefit consists of a flat component (same for all retirees) and a variable component which is a regressive a function of average earnings earned over during a certain number of years before retirement. The 1996 made the benefit formula less regressive; among other changes, it abolished the ceiling on the maximum benefit[18]. It also increased the number of years over which the average earnings are computed – only 5 years with the highest earnings during the 10 years before prior to retirement counted, while the benefits after the reform are based on earnings from 30 years preceding retirement, or years since 1986, whichever is shorter.

The reform did not affect the contribution rates which were 6.50% (paid by the employee) and 19.5% (paid by the employer). The standard retirement age was increased by 2 years for men (from 60 to 62 for men) and by 5 years for women (from 55 to 60 for women with two children).[19] The increase was phased-in gradually such

[17] Law No. 155/1995.

[18] Effectively, workers with average earnings exceeding CZK 10,000, or 90% of the average earnings in 1996, received benefits equal to the ceiling.

[19] It is a peculiar feature of the Czech pension system that the standard retirement age of women declines in the number of children. Before the 1996 reform it was 57 for childless women, 56 for women with one child, 55 for women with two children, 54 (three or four children) or 53 (five and more children).

that the target retirement ages were supposed to apply since 2007. Higher eligibility age was somewhat neutralized by several options for early retirement – for example, workers who were unemployed for more than half a year could retire 2 years before reaching the standard eligibility age, and their pension was somewhat reduced.

The pre-reform system lacked any built-in adjustments to inflation. Once granted, the benefits were fixed and the legislation did not provide any rule for their indexation. High inflation during the early 1990's exposed this major drawback.[20] No only did benefits granted in the past declined in real terms, but also newly granted benefits lost value because they were based on historical wages that were not revalued to current levels, and because a higher fraction of retirees moved into the more regressive part of the benefit formula.

Prior to the reform the government attempted to compensate for inflation by passing ad-hoc increases in benefits. The new legislation laid out stable indexation rules. It prescribed a minimum level of indexations of benefits but gave the government discretion to increase benefits more generously. Specifically, benefits had to be increased each time when the increase in the consumer price index accumulated since the last increase exceeded 5%; the increase in benefits had to at least compensate for inflation, and at least once every two years the increase in benefits also had to include at least 33% of the growth in real wages. The past earnings used to compute the average earnings were to be indexed to current levels by the wage index.[21]

Table C1 shows the general pattern of the impact of the reform on SSW. Except for the cohorts that were just about to retire, all cohorts lost. The losses are larger for the younger cohorts and for workers with lower education.

---

[20] The inflation rate exceeded 9% every year between 1991 and 1995 and was as high as 50% in 1991.

[21] The last feature of the 1996 reform relevant to our computations was its safeguard against making some new retirees explicitly worse off. The entry benefit had to be compared with the benefit that the retiree would have been entitled to under the pre-1996 legislation, and if the latter was higher she would still receive the "old" entry benefit. As the income brackets and wages were indexed for inflation under the new formula but not the old one, this provision was applicable to fewer and fewer people over time until being explicitly abandoned in 2005.

Figure C.1 shows the results for men with lower secondary education (who have slightly less than average earnings). The PV of contributions increased for all cohorts as the retirement age was postponed. The percentage increase is naturally most dramatic for the cohort close to retirement in 1996. The PV of benefits declined for all cohorts except the 1936 cohort which was just about to retire, and declined more severely (by 18-25%) for the post-1944 cohorts as they were fully affected by the postponement of the eligibility age.

The level and change in SSW of men with lower secondary education is illustrated in Figure C.2. The pre-reform system was generous to them in the sense that the SSW of the 1975 cohort was 3.89 average annual earnings above zero, and the reform reduced it to 1.05. Almost all cohorts lost. The losses are increasing in the cohort's year of birth and there are large differences among cohorts close to retirement – while the 1937 cohort was essentially unaffected, the 1944 cohort lost 1.68 average annual earnings. All remaining cohorts that were working at the time of the reform (1945-1975) lost approximately 2 annual average earnings, while the younger cohorts lost even more (on the order of 3 annual wages).

The negative impact on the SSW was less pronounced for workers with university education, as figure C.7 demonstrates. The main reason is the less regressive benefit formula. Except for the cohorts close to retirement, all cohorts lost about 2 average annual earnings. For women, the reform implied higher increases in contributions and comparable cuts in benefits (see Figure C5). The pattern of losses for women is similar to that of men, although women lost 0.1 to 0.2 average annual earnings more than men of the same age and education (Table C1).[22]

Interpreting our findings, one needs to bear in mind that the changes in SSW were computed for workers who retire at the standard eligibility age. However, the 1996

[22] We also checked whether our main result is not driven by a conservative assumption that benefits after 2005 would be indexed by the minimum prescribed by the reform legislation since the actual increases up to 2005 were more generous. To check robustness, we re-ran our computations with an assumption that benefits are indexed annually for inflation plus 33% of real wage growth, as later legislated in 2002. This had a negligible effect on the results for example, the reduction in SSW for women (for whom indexation rules are more important as they live longer) is smaller by 0.2 to 0.3 annual average earnings.

also made early retirement more generous, and a substantial fraction of the population did take up the early retirement option. By revealed preference argument, those retiring early must have preferred early retirement with lower pension to retiring at standard retirement age with higher pension, and therefore for those who did retire early the impact of the reform must have been less negative than what is shown in our results, and may have been even positive.

3h. Czech Republic: Reform 2002-2003

The next reform (adopted through two laws passed in 2002 and 2003 which we consider to be a single reform package[23]) was intended to improve the long-term financial sustainability of the PAYG system. It changed the indexation rule such that the benefits had to be adjusted annually and the minimum increase in benefits had to include inflation plus at least 33% of the real wage growth. This change had little impact as it merely codified the existing practice – ever since the 1996 reform the indexations were more frequent and more generous than what the legislation prescribed. Second, the 2002-03 reform further postponed the eligibility age, such that it would reach 63 for men and 61 for women by 2013. It increased employers' contributions from 19.5% to 21.5%.[24]

All workers lost from this reform, and women lost more than comparable men in absolute terms. Figures C.8 through C.11 compare the results for men and women with upper secondary education. The reform increased the PV of contributions for all cohorts due to the increase in contribution rates and postponement of the retirement age. It was most pronounced for the cohorts that were close to retirement and at the same time were fully affected by the phased-in postponement of the eligibility age (i.e., the 1953 cohort whose contributions rose by 14%). Younger cohorts were affected less (contributions rose by 9.2% for all cohorts that were not working yet as of 2003). The combination of more generous indexation of benefits and by postponed eligibility age implied a very slight increase in the PV of benefits for the 1942-1945

[23] Law No. 264/2002 and 425/2003.

[24] The reform also reduced the extent to which the time spent in school and other non-work activities can be counted as years of employment in the benefit formula and it made early retirement less generous and gradually increased the contribution rates of the self-employed. As our computations concern only employees who work till the eligibility age, these aspects of the reform are not captured in the results of this paper.

cohorts and a reduction for all younger cohorts. The reduction is proportional for all cohorts that were fully affected by the postponement of the eligibility age and varies between 4.9-6.5%. Translating into SSW (Figures C.9 and C11), the reform reduced SSW by approximately average annual earnings for all men born after 1955, and proportionately less for older cohorts (the 1942-1945 cohorts were essentially unaffected). For women, the patters are similar but the SSW reductions are about 10-20% greater in absolute magnitude than for men (e.g., while the SSW men with upper secondary education entering the labor market – the 1982 cohort – fell by 1.09 average annual earnings, the corresponding number for women is 1.45).

3i. Slovakia: Reform 2004 - 2005

As Czechoslovakia split in 1993, Slovakia inherited the same pension system as the Czech Republic did. In the Slovak case, however, the system remained unreformed until 2004. In the late 1990's the PAYG system generated a deficit caused by a combination of high unemployment and high evasion attributed to a weak connection between contributions and benefits (Melichercik (2006)). The government in response pushed through two successive reform packages in 2004 and 2005 that should be regarded as a single reform.[25] The first one modified most of the parameters of the PAYG system, while the second introduced a multi-pillar system with compulsory savings into the funded pillar.

The first reform legislation increased the eligibility age from 55 to 62 years for women[26] and from 60 to 62 years for men. The increase was phased-in gradually such that the target eligibility age of 62 is reached in 2020 for women and in 2006 for men. Employer's contribution was decreased from 20.6% to the 16%. Employee's contribution was also decreased from 5.9% to 4%. In addition, one of the parents could deduct additional 0.5% from contributions for every child aged below 26 as long as the child is studying.

[25] Laws No. 461/2003, 43/2004 and No. 121/2005.

[26] This is the case of women with two children. For women with no children the eligible age increased from 57, with 1 child from 56, with 3-4 children from 54 and for women with 5 or more children it gradually increased from 53 to 62.

The new benefit formula makes the benefit linear in the worker's average earnings over his entire working history since 1994, up to a cap beyond which workers with more than 3 times the average earnings do not receive higher benefits. The formula sets the benefit as the workers' average earnings times the number of working years times a number (the so called actual pension value) set such that a worker who has been working for 40 years and has always had the average wage in the economy achieves a 50% replacement rate

There is a transitory period, initially legislated to last till 2006 but prolonged till 2014 by the subsequent reform, during which the benefit is not linear in the worker's average earnings but in fact regressive, and the formula is gradually becoming less regressive over time.[27] Compared to the old formula, the new formula gives higher benefits to high-wage workers. The ad-hoc adjustments in benefits were replaced by the Swiss indexation, i.e. the benefits are increased by the average of the wage growth and inflation in the economy.

One year later, in 2005, the mandatory PAYG system was split into a public PAYG pillar and a mandatory fully funded pillar. The mixed system is mandatory for new entrants to the labor market. Workers aged below 52 had a choice to switch from pure PAYG to a mixed system, and 60% of workers did switch by 2006. After switching the workers cannot return back to the pure PAYG system.

The employees' contribution rates to the PAYG pillar remained unchanged. The employers' contribution rate was decreased from 16% to 14%. For switchers, the employers' contribution is split such that 5% goes to the PAYG pillar and 9% to the

27 Specifically, the benefit is set as B = APV * N * APWP where APV is the actual pension value, N is a number of years of paying contributions, and APWP is the average personal wage point, i.e., the average ratio of the individual's annual gross earnings to the average annual gross earnings in the economy during the individual's whole working career. If the workers' APWP is less than 1, certain percentage of the difference between 1 and APWP is added to the original APWP, while if APWP is between 1.25 and 3, a certain percentage of the difference between APWP and 1.25 is deducted. The percentage difference to be added/deducted was 60% in 2004, 40% in 2005 and 20% in 2006. Only *APWP* between 1 and 1.25 is counted without adjustments. After the transitory period, the benefits should increase linearly in one's average lifetime earnings.

funded pillar. The PAYG benefits for switchers are cut proportionately to the number of years they have participated in the mixed system.[28]

Savings into the funded pillar are managed by pension fund administrators who in turn have to offer three types of pension funds differentiated by their risk and expected return – a growth, balanced, and conservative fund. Deposits in the conservative fund can be invested only in bonds and money market instruments and must be secured against the currency risk. The balanced fund must keep at least 50% of its assets in bonds and money market instruments and at most 50% in stocks. The growth funds may invest at most 80% of their assets in stocks and at most 80% of their investments may be left unsecured against the currency risk. The worker's choice of the type of the pension fund is regulated in order to prevent a significant loss as the worker approaches the retirement age.[29]

The fees that the pension fund managers may charge are regulated by the law. They may charge 0.07% of the average monthly net value of the assets plus 1% of the amount of a monthly contribution.

The impact of the reform is clearly visible in Table S1. The reform greatly increased the SSW of men with university education (by more than 7 average annual earnings for some cohorts), and somewhat less to men with lower levels of education. It had a negative impact on women, and increasingly negative for the poorest women (women with elementary education born between 1955-59 lost 4.48 average annual earnings). It had a strong intergenerational distributional effect, as in each type of worker the older cohorts lost more or gained less than the younger cohorts.
The changes in the expected present value of taxes, benefits, and the social security wealth due to the Slovak 2004-05 reform are plotted in Figures S.1-S.6.

---

[28] The PAYG benefit formula for the switchers is B = = *APV* * *APWP*(N - M/2),* where *M* is a number of years of paying contribution in the mixed system.

[29] Young workers can choose the pension fund according to their risk preferences. Workers with less than 15 years until retirement age cannot invest in the growth fund while workers with less than 7 years until retirement age must invest only in the conservative fund.

Figure S.1 and S.2 compare the results for men with elementary and university education who stayed in the PAYG system. The reform affected the present value of taxes through two channels working in the opposite direction, the postponed retirement and lower contribution rates. The sign of the combined effects is negative for the cohorts very close to retirement age (1945-48) and positive for all other cohorts. Naturally, as the worker approaches retirement, the postponed retirement age implies a larger percentage increase in the length of working life while the reduction in contributions is enjoyed for a shorter period. The cohorts just at the beginning of their working careers experienced a 32% reduction in the present value of contributions.

The present value of benefits was affected by three factors: introduction of a systematic (and more generous) Swiss indexation of benefits, postponed retirement, and a less redistributive formula for the entry benefit. The retired cohorts were affected only by the first factor and their present value of benefits rose by 11-14%. The net impact on the working cohorts varies largely by the education level. The present value of benefits fell by 36% for almost all working male cohorts with elementary education while it increased by between 61 to 71% for almost all working male cohorts with university education. Elimination of the implicit redistribution from high-wage to low-wage workers that was built into the old formula therefore had a substantial impact on the relative pensions of high-wage and low-wage workers.

In social security wealth terms (Figure S.3 and S.4 – graph –SSW young cohorts) the reform clearly benefited the workers with university education, and the younger ones in particular. The SSW increased by at least 4 annual average earnings for all male cohorts with university education born in 1947 or later, and it increased by 7.6 annual average earnings for the 1982 cohort (i.e. those entering the labor market in the year of the reform). It should be noted, however, that the pre-reform system was taxing the high-wage workers particularly heavily – an average man with university education who just started to word had a negative SSW of minus 13.1 average annual earnings. Young men with elementary education gained comparably little from the 2004-05 reform (0.7 average annual earnings), although their post-reform SSW is still higher (-2 average annual earnings) than that of men with university education. The gains to men with elementary education diminish with age and are negative for the cohorts

1967 and older, they are most negative for the men shortly before retirement (-2.6 average earnings for men born in 1946). For the retired men in all educational categories, the change in indexation implied a gain in SSW in the magnitude of 0.4-0.8 average earnings.

The impact of the reform on workers who decided to switch into the mixed system is plotted for the group that is bound to gain most from the funded system, i.e. men with university education (Figures S.5-S.6). A major – and surprising – result is that even these high-wage workers are better off staying in the PAYG system than switching. This is apparent by comparing the figures S.4 (stayers) and S.6 (switchers). The switchers just entering the labor market (1982 cohort) have SSW of -5.8 average earnings, compared to -5.4 for stayers. The gap is naturally more pronounced for workers with lower earnings. This finding is due to a combination of rather high fees charged by the pension funds and regulated by the government and their very conservative investment strategy – even though the growth funds are allowed to invest 80% of their assets in stocks, they actually invest only 20%. While our calculations assume somewhat higher share (30%) the resulting projected nominal return of 6.9% is not sufficient to make switching into the mixed system attractive. It is our understanding that this very conservative strategy is induced by additional regulations of the funds performance which induce the funds [elaborate what exactly is going on]. The funded pillar has a potential to provide substantial gains to switchers if the share of assets invested in stock increases (e.g., investing 60% in stocks would increase the SSW of men with university education to -5.1). However, our goal is to evaluate the mixed system as actually implemented and not a potentially superior system that could have been implemented. As Slovakia implemented a regulatory regime which provides unnecessarily low returns on savings in pension funds, the PAYG system turns out to perform better (from the individual workers' point of view) than the mixed system.

3j. Slovakia: Reform 2006

The last changes in the pension scheme were legislated in 2006 and came into force in 2007[30]. First, the 0.5% deduction in contributions for every child was abolished. Second, the *APWP* is calculated based on the entire working period since 1984, which in turn should be at least 20 years, twice as much as the minimum working period before the 2007 reform. Finally, there was a change in the calculation of the adjusted *APWP*. The transitory period after which the unadjusted (linear) was prolonged till 2014. The percentage that is added/deducted from the *APWP* that falls bellow 1 or exceeds 1.25 will gradually decline by only 4% each year instead of 20% that were predefined by the 2004 reform.

The changes in the expected present value of taxes, benefits, and the social security wealth due to the Slovak 2006 reform are plotted in Figures S.7- S.10.

The results are ALMOST identical similar for men and women, as well as for workers in the pure PAYG system and in the mixed system. Results for switchers are very similar to stayers. In general the magnitudes of changes are smaller due to the composition of the entry pension calculation in the mixed system. Therefore we only report results for men in the pure PAYG. Figures S.7 - S.8 compare the results for men with lower secondary and university education.

The reform had a negative effect on the present value of taxes, because men lost the opportunity to gradually decrease their contribution rate by 0.5% for each child. The present value of taxes thus gradually increased up to 3.6% for cohort 1976 and then gradually decreased to 3.1% for cohort 1983. This is the result for all educational categories. There is no change in contribution rates for women.

The present value of benefits was affected by two factors, the change in the calculation of the adjusted APWP and the longer working period considered in the entry pension benefit formula. The first one affects cohorts 1945-1952 in different way for different educational levels. Men with income below the average received a

[30] Law No. 513/2006

large percentage increase in benefits (e.g., by 3.3% in the case of men with lower secondary education). On the other hand men with income between 1.25 and 3 times the average experienced a reduction in benefits (e.g., by 6.1% in the case of men with university education.) The second factor has, in general, a negative effect on benefits for all cohorts. It reduced benefits by approximately 0.1% for men cohorts 1953 – 1973 with lower secondary education and by approximately 2.8% for the same men cohorts with university education. The differential impact is attributed to a steeper wage profile of women with university education.31

Figure S.9 - S.10 compare the net impact of the reform for men with lower secondary and university education as a change in SSW. The changes are small overall. The only gainers of the reform are women cohorts 1950-1954 and men cohorts 1945-1952 with lower education. On average these men cohorts with lower secondary education received higher SSW by 0.16 annual average earnings after the reform. All other cohorts at this educational level received lower SSW by 0.10 annual average earnings. Men cohorts with university education lost more, on average about 3.4 times more than men with lower secondary education.

4. Conclusions

The purpose of this paper was to document and quantify the political risk of social security by computing changes in benefits, contributions, and the social security wealth induced by pension reforms in three transition countries, Hungary, Czech Republic and Slovakia. While all countries made similar adjustments to their pension systems in 1993, 1996 and 2004 respectively, their subsequent developments diverged as Hungary implemented some reform every three years on average.

Our findings confirm that the political risk is real and it can be substantial. We also show that the PAYG system exposes workers to both aggregate risk (when the reform changes the social security wealth for an average worker) and idiosyncratic risk (when the reform has a differential impact on different workers). For example, the 1993

[31] The increase in the length of working history counted in the calculation of the APWP did not, by construction, affect workers born after 1973.

Hungarian reform, both the 1996 and 2002-03 Czech reforms and 2006 Slovak reforms were typical manifestation of the aggregate risk, cutting the social security wealth to most workers by amounts equal to several years of labor earnings. The idiosyncratic risk is clearly shown by the 1998 and 1999 Hungarian reform and 2004-05 Slovak reforms. Some of the reforms affected different cohorts and education groups in quite peculiar ways. For example, the 1997 Hungarian reform provided sizeable gains to women born in the early 1940's while simultaneously hurting everyone else.

The introduction of the two-pillar system as actually implemented by Hungary in 1998 reform divided the workers into those born before 1951 and those born in 1951 or later. Such idiosyncratic treatment of different individuals is, in our view, impossible to justify on economic efficiency grounds, and we have doubts whether the idiosyncratic effects of the reforms were even anticipated by the policy makers. Additional uncertainty about the future level of benefits is being created by the fact that (at least in the Hungarian case) the reforms were frequent and therefore workers should expect that *some* reforms are very likely to happen again in the future and affect their social security wealth in either direction.

References

Augusztinovics M., R.I. Gal, A. Matits, L. Mate, A. Simonovits and J. Stahl (2002): *The Hungarian Pension System before and after the 1998 Reform*, was published as Chapter 1 of Pension Reform in Central and Eastern Europe, Vol. I (ed. by Fultz. E) 25-93

Bezděk, Vladimír et al (2005): *Závěrečná zpráva o přípravě podkladů pro rozhodnutí o důchodové reformě v České Republice*, Ministry of Labor and Social Affairs of the Czech Republic 2005. (http://www.mpsv.cz/files/clanky/2235/zaverecna_zprava.pdf)

Blake, David (2004): *What is a Promise from the Government Worth? Measuring and Assessing Political Risk in State and Personal Pension Schemes in the United Kingdom*. Discussion Paper PI-0409

Campbell, John Y and M. Feldstein, edited by (2001): *Risk Aspects of Investment Based Social Security Reform*, NBER conference report, Chicago: University of Chicago Press

Czajlik I. and Gy. Szalay (2006): A magánnyugdíjpénztárak működése és szabályozása, Magyar Nemzeti Bank tanulmányok, No. 48

Feldstein, Martin and Elena Ranguelova (2001): *Individual Risk in an Investment-based social security system*, American Economic Review, Vol. 91, No. 4., 1116-1125.

Feldstein, Martin, Elena Ranguelova and Andrew Samwick (2001): *The Transition to Investment-Based Social Security When Portfolio Returns and Capital Profitability Are Uncertain*, published in Campbell, John Y. and Martin Feldstein edited by (2001): *Risk Aspects of Investment-Based Social Security Reform*, University of Chicago Press.

Feldstein M. and H. Siebert, edited by (2002): *Social Security Pension Reform in Europe*, NBER conference report, Chicago: University of Chicago Press

Feldstein, Martin (2005a): *Reducing the Risk of Investment-Based Social Security System*. NBER Working Paper 11084

Feldstein, Martin(2005b): *Structural Reform of Social Security*. NBER Working Paper 11098

Koch-Weser, Caio K. (1997): *Pension Reform in Central and Eastern European Countries*, Social Welfare Reform and New Pension Schemes Panel, Central and European Economic Summit, Salzburg, Austria, Jul 9-11.

Lindbeck A. and M. Persson (2003): *The Gains from Pension Reform*, Journal of Economic Literature, Vol. XLI, 74-112.

Lindeman, D., M. Rutkowski and O. Sluchynskyy (2000): *The Evolution of Pension System in Eastern Europe and Central Asia: Opportunities, Constraints, Dilemmas and Emerging Practices*, The World Bank, Washington, D. C.

McHale, John (1999): *The Risk of Social Security Benefit-Rule Changes: Some International Evidence*. NBER Working Paper 7031

McHale, John (2001): *The Risk of Social Security Benefit-Rule Changes*. In Risk Aspects of Investment-Based Social Security Reform, edited by John Y. Campbell and Martin Feldstein. Chicago: University of Chicago Press, 247-282

Mora, M. (1999): *Pension Policy in the Czech Republic: Lessons from a Comparative Study with Hungary and Poland*, Europa-Kolleg Hamburg

Muller Katharina (1999): The political economy of pension reform in Central Eastern Europe, Studies in comparative economic systems, Cheltenham, GB : Edward Elgar

Poterba, James, Joshua Rauh, Steven Venti, and David Wise (2005): *Utility Evaluation of Risk in Retirement Saving Accounts*, published in D. Wise, edited by (2005): *Analyses in the Economics of Aging,* Chicago: University of Chicago Press, p. 13-52.

Shoven J. B. and S. N. Slavov (2006): *Political Risk versus Market Risk in Social Security*, NBER Working Paper 12135

World Bank (1994): *Averting the Old Age Crisis: Policies to Protect the Old and Promote Growth*, A World Bank Policy Research Report, New York, Oxford University Press

Appendix A. Detailed assumptions

Computing the social security wealth requires a number of "micro" and "macro" assumptions.

Wage profiles

Computing the social security wealth requires a number of "micro" and "macro" assumptions. Our "average" workers start working at age 20, work full-time until the standard retirement age[32], and at each age they are earning the wage that is predicted by the earnings profile specific for their gender, educational category, and calendar year. The wage profiles are estimated from individual level cross-sectional datasets described below and they have the standard form

$$\log w_{ijt} = \alpha_{jt} + \beta_{1jt} a_{ijt} + \beta_{2jt} a_{ijt}^2 + u_{ijt}$$

where w is the monthly wage, subscript i denotes an individual, j denotes the worker's gender and educational category[33], t denotes year, a is the worker's age, and α, β_1 and β_2 are parameters that we estimate. The profiles were estimated on the sample of workers aged between 20 and the standard retirement age who worked at least 6 months in a given year. The regression estimates and the corresponding wage profiles are available upon request.

We constructed the wage profiles from micro datasets that were best suited for the task in each country. All of them contain the basic information about each worker (gender, age, education level), and sufficient information about his/her employment status and labor income (either the monthly wage or the annual/quarterly wage and the number of weeks/months worked from which the monthly wage can be imputed.) For Hungary, we used the Harmonized Hungarian Wage Survey of the Public

[32] Workers with college education start working at age 22. The assumption on the time of retirement is probably the most problematic in the sense of missing an important distributional aspect of the reforms. Social security wealth clearly depends on whether a particular worker exercises the early retirement option or continues working till the standard retirement age. However, modeling the individual decision to retire is beyond the scope of this paper.

[33] To obtain the wage profile for the average workers, we run the regression on a sample of all men and women.

Employment Service. The survey collected at the firm level in 1986, 1989 and annually since 1992 to 2003 contains data on 100 000 to 200 000 employees depending on year. For the Czech Republic, we used the Czech Microcensus, a representative household survey conducted once every 4 or 6 years by the Czech Statistical Office. The surveys that we use were collected in 1992, 1996, and 2002[34] and they cover approximately 44,000, 64,000 and 19,000 individuals in the respective years. For Slovakia, we used the TREXIMA dataset, a representative survey of firms. Collected in 2001, it contains quarterly data on 350 000 employees.

Since the micro samples allow estimating the wage profiles only for some years[35], while we need to have profiles for all years since 1988 (Hungary), 1986 (Czech Republic) or 1984 (Slovakia), we impute the profiles for the remaining years. We assume that the coefficients on the age and age squared are the same as in the nearest adjacent year for which the profile was estimated[36]. Then we adjust the intercept α such that the average fitted wage in the sample is equal to the actual average wage in the year for which the wage profile is being imputed.[37]

---

[34] Unfortunately, the 1988 microcensus was not usable for our purpose, since all observations are recorded at a household level but not individual level. Even though it does report the earnings of the head of household and his spouse, it does not allow identifying the gender of workers who live in households other than the traditional families of married couples.

[35] The Hungarian Wage Survey is not available for 1987-1988, 1990-1991 and 2004+. Moreover, the surveys from 1993, 1998-1999 and 2002 appeared to contain data problems since the estimates of the wage profiles in these years produced estimates that were substantially different from the estimates for adjacent years and, more importantly, were economically implausible.

[36] For example, the coefficients on age and age squared estimated from the Czech 2002 Microcensus were used to generate wage profiles for 2000-2004.

[37] The average wages of employees by gender and education level were taken from the Czech Statistical Office publications "Průměrné hrubé měsíční mzdy v letech 1996 - 2004 v třídění podle vzdělání a pohlaví zaměstnanců", "Mzdová diferenciace v čs.národním hospodářství - zhodnocení vybraných aspektů odměňování na základě jednorázového šetření o mzdách pracovníků za červen 1984", and "Mzdy pracovníků za červen 1988 (z jednorázového výběrového šetření o mzdách za červen 1988) - I.díl", which altogether cover the year 1984, 1988, and 1996-2004. For the years 1985-87, and 1989-95, the average wages by education levels are not reported, only averages across all education levels. We imputed the average wages by education level by linearly extrapolating the ratios of the average wage in each education level to the overall average wage, and then multiplying this ratio with the overall average wage in each year for which the wages by education level were missing. For Hungary we computed the average wages from the Wage Survey and extrapolated them for the missing years. Slovak average wages were reported in "Statistický úrad SR: Priemerná mesačná mzda v hospodárstve SR a indexy miezd".

"Macro" assumptions

We need to make a number of assumptions about the future in order to project future benefits and contributions. The length of life is probabilistic, and the future money flows are discounted by the survival probability. We had survival probability tables for all countries, separately by men and women (but unfortunately without a finer breakdown by education categories) until 2004. For years 2005 and onwards, we assume that the survival probabilities are the same as in 2004.[38]

We assume that as of the time of the reform people had perfect foresight about the evolution of all economic variables that affect future taxes and benefits (aggregate and individual wage growth, inflation, survival probabilities). That is, future contributions and benefits that are expected as of time of the reform are equal to the wages and inflation rates that were actually realized up to 2005, and for the years 2006 onwards, we assume a 3% growth rate of real wages for all education categories and genders, and a 2% inflation rate.[39]

The rate of return on savings in pension funds is the key parameter affecting the benefits from the second pillar. It is to a large extent determined by the design of the second pillar, namely by regulations of the funds' investments and fees. Our choice of the rates of return is an estimate of the net rate of return that the pension funds, as actually established and regulated by the Hungarian and Slovak legislation, are expected to deliver to their clients. That is, we avoid using an average historical return on some "optimal" stock and bond portfolio as commonly done in similar simulations (e.g. Feldstein and Ranguelova 2001) since that approach would give the level of benefits that the pension reform could provide rather than the level that it did provide.

[38] We acknowledge that our assumption leads to an underestimate of true survival probabilities since the life expectancies have been increasing in all three countries since the 1990's and are expected to increase in the future. However, we were not able to obtain specific projections of future survival probabilities.

[39] These are roughly the rates of wage growth and inflation currently experienced by both countries.

For Hungary, the expected real return on savings is calculated as the weighted average of the real net return[40] of all Hungarian pension funds during 1998-2005, which was 2.7%[41]. Pension funds in Slovakia were established too recently to project future returns from historical returns. Instead we compute the expected future returns as the average historical returns on the portfolios that the growth funds currently hold. Specifically, we calculate the average historical return for each of the major government bonds and the stock indices in which the funds currently invest, and then compute the average of these returns weighted by their share in the average growth fund's' portfolio.[42] The resulting projected nominal rate of return is 6.9 percent.[43] As workers approach the retirement age they may prefer a gradual switch to a complete risk-free portfolio (and in Slovakia they are in fact required to switch for more conservative funds). We therefore assume that the above mentioned returns apply only from the beginning of employment until 15 years before retirement. Afterwards workers rebalance the portfolio each year such that the real return gradually decreases until it reaches zero at the age of retirement.

The 2004-05 Slovak reform allowed one of the parents to deduct 0.5% for every child from their PAYG contributions. We assume that the deduction is claimed by men since they earn more on average, and we do all our calculations for a family with two children that has both children at the average age of first and second childbirth.[44]

Computing future indexations of benefits in the Czech Republic and Slovakia required additional assumptions. The legislation before the first reform did not

---

[40] That is, after deducting the fees.

[41] Source: Czajlik and Szalay (2006)

[42] Specifically, the expected returns are computed from the returns on the following indices over the periods indicated: UX 1991-2007, PX 1995-2007, SLOVN SK 1999–2007, VIX 1990-2003, MXEU 1995-2007, FTSE 1990-2003, DAX 1990-2007, SPX 1990-2007. The funds' stock portfolio is composed of stock indices in the Visegrad countries (20%), the EU-15 countries (50%), and the United States (30%). Data on the portfolio compositions were taken from the funds' annual reports.

[43] The growth funds currently invest 80% of their assets in bonds, which appears to be an overtly conservative strategy, particularly if the legislation restricts them to invest at most 80% in stocks. Even though other regulations give funds incentive to invest in stocks less than the maximum prescribed by the legislation, several fund managers admit in official reports that they do plan to increase the share of stocks in the near future. In our computation of the expected return we therefore assume that they will invest 30% in stocks.

[44] The average age of farther at the first and second childbirth is 28 and 30, respectively. Source: Statistical Office of Slovak Republic, publication: "Pohyb obyvateľstva v Slovenskej republike v roku 2006".

prescribe any indexations, yet it is implausible to assume that the benefits or parameters of the system would never be indexed. In fact, benefits were being indexed in an ad-hoc manner with a clear goal to prevent a significant reduction in the real value of benefits. Therefore we assume that once granted, benefits would have been indexed for inflation, and the income brackets in the benefit formula would be indexed for wage growth. Under these assumption, the replacement ratio[45] remains at a similar level (48-50% in the Czech Republic, 30-35% in Slovakia) as it was during the years just preceding the reform.[46] After the 1996 reform, the Czech law prescribed minimum indexations, but the government frequently provided more generous increases. Therefore until 2006 we assume perfect foresight and compute the benefits as they were actually indexed, and only after 2006 we index them conservatively by the minimum prescribed by the legislation.

Appendix B. Tables and graphs

Key features - KF

Tables Hungary – H1-H10

Tables Czech Republic – C1-C2

Tables Slovakia – S1-S4

Graphs - Hungary – H1-H24

Graphs - Czech Republic – C1-C13

Graphs - Slovakia – S1-S10

[45] The ratio of the benefit to the (gross) wage in the last year before retirement

[46] In addition, prior to 1995, the new benefits were computed according to the old formula but were increased immediately (by 32% in 1995) to make up for the inflation that accumulated since 1990. We assume that such increases in newly granted benefits would continue into the future with the same purpose for compensating for a reduction in the real value of past wages that enter the benefit due to inflation. We increase the new benefits by 32%, and further increase it by the ratio of the price index at the time of retirement to the average price index during the 5 years preceding retirement.

Key Features - KF

	Retirement Age	Contribution Rate	Assessed Earnings	Benefit Formula	Mixed System	Retirement Indexation
Hungary (1993)	Men: 60 Women: 55 to 60 gradually	Employer: 24.5% Employee: 6%	average net monthly earnings during 4 years with highest earnings in the period of 5 years before retirement ➜ average net monthly earnings from 1988 until the year of retirement	degression [average(net earnings after taxation * valorization)] * accrual, taxation changes every year, after the reform the degression is less restrictive		Net wage indexation
Hungary (1997)	Men: 60 to 62 gradually Women: 55 to 62 gradually	Employer: 24.5% to 24.0% Employee: 6%		higher accrual was applied		
Hungary (1998)		PAYG Employer: 24% to 23% (1999), to 22% (2000) Employee: 6% to 7% (1998), to 8% (1999), to 9% (2000)		degressions are less restricitve, higher accruals are applied, benefit as a fraction of average net earnings ➜ a fraction of average gross earnings since 2013		net wage indexation ➜ Swiss indexation gradually 2001
		Mixed system Employer: 24% to 23% (1999), to 22% (2000) Employee (PAYG): 1% Employee (2nd pillar): 6% (1998), 7% (1999), 8% (2000)		degressions are less restricitve, higher accruals are applied, switchers' accruals are 75% of stayers' accruals, benefit as a fraction of average gross earnings ➜ a fraction of average net earnings since 2013	switchers receive unisex annuities from the amount invested at the pension fund	net wage indexation ➜ Swiss indexation gradually 2001
Hungary (1999)		PAYG Employer: 23% to 22% (1999), 22% to 21% (2000) Employee: 8% (1999), 9% to 8% (2000)				
		Mixed system Employer: 23% to 22% (1999), 22% to 21% (2000) Employee (PAYG): 1% to 2% Employee (2nd pillar): 7% to 6% (1999), 8% to 6% (2000)				
Hungary (2003)		PAYG Employer: 18% Employee: 8% to 8.5%		Additional (13th monthly) monthly pension benefit gradually 2006		
		Mixed system Employer: 18% Employee (PAYG): 2% to 1.5% Employee (2nd pillar): 6% to 7%		Additional (13th monthly) monthly pension benefit gradually 2006		
Hungary (2007)		PAYG Employer: 17% to 21% (2007), 16% to 21% (2009) Employee: 8.5%		for entry pension benefits that will be granted between 2008 and 2012 employees' pension and health care contributions and the employees' contribution to the employment fund will be deducted from the net earnings entering the calculation of the entry pens		
		Mixed system Employer: 17% to 21% (2007), 16% to 21% (2009) Employee (PAYG): 0.5% Employee (2nd pillar): 8%		for entry pension benefits that will be granted between 2008 and 2012 employees' pension and health care contributions and the employees' contribution to the employment fund will be deducted from the net earnings entering the calculation of the entry pens		
Czech Republic (1996)	Men: 60 to 62 gradually Women: 55 to 59 gradually	Employer: 19.5% Employee: 6.5%	earnings from 5 years with the highest earnings during the 10 years priors to retirement ➜ average monthly earnings from the 30 years of employment preceding retirement since 1986	$B=B_0+0.5*I+0.01*(max(y-25,0)+0.04*max(y-R,0))+I$, where B is the benefit, B_0 is the fixed component of the benefit, I is the income base, y is the number of years of insurance, and R is the eligibility age, there is degression applied on past average earni		indexation ad hoc ➜ indexation as a combination of consumer price index and real wage growth
Czech Republic (2002 - 03)	Men: 60 to 63 gradually Women: 55 to 61 gradually by 2013	Employer: 19.5% to 21.5% Employee: 6.5%				change ➜ annual indexation with inflation plus min 33% of real wage growth
Slovakia (2004-05)	Men: 60 to 62 gradually Women: 55 to 62 gradually	PAYG Employer: 20.6% to 16% (2004), to 14% (2005) Employee: 5.9% to 4%, one of the parents can deduct additional 0.5% in contributions for every child		B=B0+0.5+I+0.01+(max(y-25,0)+0.04+max(y-R,0))+I, where B is the benefit, B0 is the fixed component of the benefit, I is the income base, y is the number of years of insurance, and R is the eligibility age, there is degression applied on past average earni		indexation ad hoc ➜ Swiss indexation
		Mixed system Employer (PAYG): 5% (2005) Employer (2nd pillar): 9% (2005) Employee: 4%, one of the parents can deduct additional 0.5% in contributions for every child	earnings from 5 years with the highest earnings during the 10 years priors to retirement ➜ entire working period since 1994, which in turn should be at least 10 years	B = APV * APWP*(N - M/2), where M is a number of years of paying contribution in the mixed system.	switchers receive unisex annuities from the amount invested at the pension fund, they pay remuneration for managing the pension fund (0.07% of the average monthly net value of assets), remuneration for keeping personal pension account (1% of the amount of	indexation ad hoc ➜ Swiss indexation
Slovakia (2006)		Employee: the 0.5% deduction in contributions for every child was abolished	entire working period since 1994, which in turn should be at least 10 years ➜ entire working period since 1984, which in turn should be at least 20 years	change in calculation of APWP		

Tables – Hungary

Reform 1993, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average wage, H1

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	-0.01	-0.03	-0.19	-0.23					
1940-44	0.11	0.07	-0.03	-0.16	1940-44	-0.48	-0.63	-1.04	-1.45
1945-49	0.27	0.25	0.15	0.09	1945-49	-0.45	-0.46	-0.79	-2.06
1950-54	0.23	0.24	0.11	0.10	1950-54	-0.45	-0.50	-0.83	-2.15
1955-59	0.19	0.19	0.06	0.06	1955-59	-0.43	-0.52	-0.87	-2.07
1960-64	0.16	0.16	0.00	0.02	1960-64	-0.41	-0.53	-0.88	-2.02
1965-69	0.13	0.12	-0.06	-0.01	1965-69	-0.40	-0.54	-0.89	-1.95
1970-74	0.09	0.08	-0.08	0.03	1970-74	-0.39	-0.53	-0.85	-1.80
1975-79	0.06	0.05	-0.09	0.04	1975-79	-0.38	-0.52	-0.82	-1.67
1980-84	0.04	0.02	-0.11	0.02	1980-84	-0.39	-0.52	-0.81	-1.57
1985-89	0.02	0.00	-0.12	0.01	1985-89	-0.39	-0.51	-0.79	-1.50
1990-94	0.01	-0.01	-0.12	0.00	1990-94	-0.38	-0.50	-0.76	-1.44

Reform 1997, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.04	0.02	-0.07	-0.34					
1940-44	-0.69	-0.84	-1.18	-1.66	1940-44	0.63	0.74	0.99	1.00
1945-49	-0.49	-0.53	-0.70	-1.09	1945-49	-0.09	-0.11	-0.17	-0.60
1950-54	-0.42	-0.45	-0.59	-0.92	1950-54	-0.31	-0.34	-0.45	-0.97
1955-59	-0.35	-0.38	-0.50	-0.77	1955-59	-0.27	-0.29	-0.39	-0.86
1960-64	-0.31	-0.34	-0.44	-0.67	1960-64	-0.24	-0.26	-0.35	-0.78
1965-69	-0.27	-0.29	-0.38	-0.58	1965-69	-0.21	-0.23	-0.30	-0.69
1970-74	-0.23	-0.25	-0.34	-0.51	1970-74	-0.18	-0.20	-0.26	-0.63
1975-79	-0.20	-0.22	-0.30	-0.46	1975-79	-0.15	-0.17	-0.23	-0.57
1980-84	-0.18	-0.20	-0.28	-0.43	1980-84	-0.14	-0.16	-0.21	-0.54
1985-89	-0.17	-0.19	-0.26	-0.41	1985-89	-0.13	-0.15	-0.20	-0.51
1990-94	-0.16	-0.18	-0.25	-0.38	1990-94	-0.12	-0.14	-0.19	-0.48

Reform 1998, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	-1.13	-1.21	-1.36	-1.46					
1940-44	-0.38	-0.16	0.69	2.08	1940-44	-1.74	-1.92	-2.49	-1.91
1945-49	-0.05	0.21	1.06	2.72	1945-49	-0.57	-0.37	0.57	2.55
1950-54	0.07	0.37	1.36	3.49	1950-54	-0.47	-0.25	0.78	3.46
1955-59	0.04	0.31	1.17	3.24	1955-59	-0.44	-0.26	0.65	3.27
1960-64	-0.03	0.20	0.88	2.77	1960-64	-0.42	-0.29	0.44	2.78
1965-69	-0.08	0.10	0.65	2.44	1965-69	-0.40	-0.31	0.29	2.45
1970-74	-0.12	0.03	0.54	2.37	1970-74	-0.36	-0.29	0.26	2.45
1975-79	-0.12	0.02	0.48	2.27	1975-79	-0.30	-0.24	0.26	2.47
1980-84	-0.08	0.03	0.45	2.14	1980-84	-0.22	-0.15	0.29	2.45
1985-89	-0.04	0.06	0.45	2.04	1985-89	-0.14	-0.09	0.32	2.36
1990-94	0.00	0.09	0.44	1.95	1990-94	-0.08	-0.03	0.34	2.26

Reform 1998, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1951-54	-0.57	-0.32	0.51	2.41	1951-54	-1.10	-1.00	-0.31	1.72
1955-59	-0.47	-0.26	0.46	2.29	1955-59	-0.84	-0.78	-0.24	1.57
1960-64	-0.38	-0.19	0.42	2.21	1960-64	-0.58	-0.53	-0.14	1.45
1965-69	-0.31	-0.14	0.39	2.17	1965-69	-0.34	-0.31	-0.02	1.42
1970-74	-0.23	-0.08	0.42	2.27	1970-74	-0.10	-0.09	0.15	1.58
1975-79	-0.14	0.00	0.46	2.28	1975-79	0.12	0.12	0.32	1.71
1980-84	-0.07	0.05	0.47	2.17	1980-84	0.27	0.28	0.42	1.70
1985-89	-0.03	0.08	0.47	2.06	1985-89	0.35	0.35	0.45	1.63
1990-94	0.00	0.10	0.46	1.97	1990-94	0.39	0.38	0.47	1.56

Reform 1999, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.00	0.00	0.00	0.01					
1940-44	0.03	0.04	0.06	0.09	1940-44	0.01	0.01	0.01	0.02
1945-49	0.07	0.08	0.11	0.17	1945-49	0.06	0.07	0.09	0.15
1950-54	0.10	0.11	0.16	0.26	1950-54	0.09	0.10	0.14	0.24
1955-59	0.13	0.15	0.20	0.34	1955-59	0.12	0.13	0.18	0.31
1960-64	0.16	0.18	0.24	0.42	1960-64	0.14	0.16	0.21	0.37
1965-69	0.19	0.21	0.28	0.50	1965-69	0.17	0.18	0.25	0.42
1970-74	0.21	0.24	0.31	0.56	1970-74	0.19	0.20	0.28	0.47
1975-79	0.23	0.27	0.34	0.59	1975-79	0.21	0.23	0.30	0.51
1980-84	0.24	0.27	0.34	0.57	1980-84	0.21	0.23	0.30	0.50
1985-89	0.22	0.25	0.32	0.54	1985-89	0.20	0.22	0.29	0.47
1990-94	0.21	0.24	0.31	0.51	1990-94	0.19	0.21	0.27	0.45

Reform 1999, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1951-54	0.00	0.00	0.00	0.01	1951-54	-0.07	-0.06	-0.04	0.03
1955-59	0.01	0.02	0.02	0.04	1955-59	-0.08	-0.07	-0.04	0.06
1960-64	0.03	0.03	0.04	0.07	1960-64	-0.10	-0.09	-0.04	0.09
1965-69	0.04	0.05	0.06	0.11	1965-69	-0.11	-0.10	-0.04	0.11
1970-74	0.05	0.06	0.08	0.14	1970-74	-0.12	-0.11	-0.04	0.13
1975-79	0.07	0.07	0.09	0.16	1975-79	-0.12	-0.11	-0.04	0.15
1980-84	0.07	0.08	0.09	0.16	1980-84	-0.13	-0.12	-0.05	0.16
1985-89	0.07	0.07	0.09	0.15	1985-89	-0.13	-0.12	-0.05	0.15
1990-94	0.06	0.07	0.09	0.14	1990-94	-0.12	-0.11	-0.04	0.15

Reform 2003, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.24	0.26	0.33	0.40					
1940-44	0.37	0.41	0.53	0.69	1940-44	0.31	0.36	0.47	0.57
1945-49	0.36	0.40	0.50	0.68	1945-49	0.42	0.47	0.61	0.81
1950-54	0.29	0.33	0.43	0.62	1950-54	0.35	0.39	0.52	0.76
1955-59	0.24	0.27	0.35	0.52	1955-59	0.30	0.33	0.44	0.66
1960-64	0.20	0.22	0.28	0.41	1960-64	0.27	0.29	0.38	0.56
1965-69	0.16	0.18	0.23	0.33	1965-69	0.23	0.25	0.32	0.48
1970-74	0.13	0.15	0.19	0.29	1970-74	0.20	0.22	0.29	0.44
1975-79	0.10	0.12	0.15	0.24	1975-79	0.18	0.19	0.25	0.41
1980-84	0.08	0.10	0.12	0.20	1980-84	0.16	0.17	0.22	0.37
1985-89	0.08	0.09	0.11	0.19	1985-89	0.15	0.16	0.21	0.35
1990-94	0.07	0.08	0.11	0.18	1990-94	0.14	0.15	0.20	0.34

Reform 2003, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1951-54	0.24	0.27	0.36	0.53	1951-54	0.30	0.33	0.43	0.61
1955-59	0.21	0.23	0.31	0.46	1955-59	0.28	0.31	0.39	0.54
1960-64	0.18	0.20	0.26	0.39	1960-64	0.27	0.29	0.35	0.47
1965-69	0.15	0.17	0.22	0.34	1965-69	0.26	0.27	0.32	0.42
1970-74	0.13	0.15	0.19	0.31	1970-74	0.25	0.26	0.30	0.40
1975-79	0.12	0.13	0.17	0.28	1975-79	0.24	0.25	0.29	0.38
1980-84	0.10	0.12	0.15	0.25	1980-84	0.23	0.23	0.27	0.35
1985-89	0.09	0.11	0.14	0.24	1985-89	0.22	0.22	0.25	0.33
1990-94	0.09	0.10	0.13	0.23	1990-94	0.21	0.21	0.24	0.32

Reform 2007, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.00	0.00	0.00	0.00					
1940-44	0.00	0.00	0.00	0.00	1940-44	0.00	0.00	0.00	0.00
1945-49	-0.26	-0.29	-0.37	-0.66	1945-49	-0.21	-0.24	-0.30	-0.47
1950-54	-0.25	-0.28	-0.38	-0.61	1950-54	-0.24	-0.26	-0.35	-0.63
1955-59	-0.33	-0.38	-0.53	-0.85	1955-59	-0.31	-0.34	-0.47	-0.86
1960-64	-0.46	-0.53	-0.72	-1.22	1960-64	-0.43	-0.47	-0.64	-1.16
1965-69	-0.58	-0.67	-0.90	-1.58	1965-69	-0.54	-0.58	-0.80	-1.44
1970-74	-0.70	-0.81	-1.07	-1.91	1970-74	-0.64	-0.69	-0.95	-1.69
1975-79	-0.81	-0.94	-1.22	-2.19	1975-79	-0.74	-0.80	-1.08	-1.90
1980-84	-0.92	-1.04	-1.35	-2.40	1980-84	-0.83	-0.89	-1.20	-2.09
1985-89	-0.99	-1.12	-1.45	-2.45	1985-89	-0.90	-0.96	-1.28	-2.15
1990-94	-0.97	-1.09	-1.40	-2.33	1990-94	-0.88	-0.94	-1.24	-2.04

Reform 2007, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1951-54	-0.21	-0.24	-0.34	-0.52	1951-54	-0.20	-0.22	-0.30	-0.55
1955-59	-0.33	-0.38	-0.53	-0.85	1955-59	-0.31	-0.34	-0.47	-0.86
1960-64	-0.46	-0.53	-0.72	-1.22	1960-64	-0.43	-0.47	-0.64	-1.16
1965-69	-0.58	-0.67	-0.90	-1.58	1965-69	-0.54	-0.58	-0.80	-1.44
1970-74	-0.70	-0.81	-1.07	-1.91	1970-74	-0.64	-0.69	-0.95	-1.69
1975-79	-0.81	-0.94	-1.22	-2.19	1975-79	-0.74	-0.80	-1.08	-1.90
1980-84	-0.92	-1.04	-1.35	-2.40	1980-84	-0.83	-0.89	-1.20	-2.09
1985-89	-0.99	-1.12	-1.45	-2.45	1985-89	-0.90	-0.96	-1.28	-2.15
1990-94	-0.97	-1.09	-1.40	-2.33	1990-94	-0.88	-0.94	-1.24	-2.04

Tables – Czech Republic

1996 reform, change in Social Security Wealth as a fraction of the average annual earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1936-39	0.00	-0.08	-0.34	-0.31					
1940-44	-1.30	-1.26	-1.48	-1.22	1940-44	2.38	2.03	1.36	0.96
1945-49	-1.79	-1.62	-1.83	-1.54	1945-49	-1.24	-1.37	-1.13	-1.12
1950-54	-1.97	-1.80	-1.99	-1.68	1950-54	-1.74	-2.04	-1.82	-1.70
1955-59	-2.17	-2.02	-2.15	-1.78	1955-59	-2.02	-2.35	-2.06	-1.87
1960-64	-2.42	-2.29	-2.30	-1.80	1960-64	-2.31	-2.63	-2.17	-1.94
1965-69	-2.66	-2.56	-2.50	-1.88	1965-69	-2.63	-2.94	-2.32	-2.08
1970-74	-2.86	-2.73	-2.65	-1.96	1970-74	-2.88	-3.18	-2.44	-2.17
1975-79	-3.04	-2.89	-2.80	-2.05	1975-79	-3.10	-3.40	-2.56	-2.25
1980-84	-3.26	-3.10	-3.01	-2.20	1980-84	-3.37	-3.68	-2.77	-2.43
1985-89	-3.44	-3.26	-3.18	-2.30	1985-89	-3.59	-3.91	-2.91	-2.52
1990-94	-3.63	-3.43	-3.35	-2.39	1990-94	-3.81	-4.14	-3.05	-2.62
1995-96	-3.86	-3.65	-3.58	-2.55	1995-96	-4.05	-4.40	-3.26	-2.81

2003 reform, change in Social Security Wealth as a fraction of the average annual earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1941-44	0.02	0.02	0.02	0.02					
1945-49	-0.09	-0.10	-0.18	-0.23	1945-49	-0.02	-0.02	-0.02	-0.04
1950-54	-0.44	-0.49	-0.60	-0.78	1950-54	-0.54	-0.55	-0.65	-0.86
1955-59	-0.56	-0.61	-0.74	-0.99	1955-59	-0.85	-0.90	-1.10	-1.38
1960-64	-0.61	-0.67	-0.82	-1.12	1960-64	-0.90	-0.94	-1.18	-1.49
1965-69	-0.64	-0.70	-0.87	-1.21	1965-69	-0.91	-0.95	-1.21	-1.53
1970-74	-0.70	-0.77	-0.95	-1.34	1970-74	-0.96	-1.01	-1.29	-1.63
1975-79	-0.76	-0.83	-1.03	-1.46	1975-79	-0.99	-1.04	-1.32	-1.67
1980-84	-0.79	-0.85	-1.06	-1.51	1980-84	-0.99	-1.04	-1.33	-1.67
1985-89	-0.81	-0.88	-1.08	-1.50	1985-89	-1.02	-1.08	-1.38	-1.69
1990-94	-0.82	-0.88	-1.09	-1.49	1990-94	-1.05	-1.10	-1.40	-1.71
1995-99	-0.79	-0.85	-1.05	-1.43	1995-99	-1.02	-1.08	-1.37	-1.66
2000-03	-0.82	-0.88	-1.07	-1.45	2000-03	-1.08	-1.13	-1.43	-1.72

Tables – Slovakia

Reform 2004-2005, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.37	0.39	0.41	0.42					
1940-44	0.21	0.24	0.52	0.89					
1945-49	-2.38	-1.83	-0.41	3.97	1945-49	0.46	0.49	0.59	0.98
1950-54	-1.83	-1.22	0.11	4.69	1950-54	-4.25	-3.99	-2.74	-0.15
1955-59	-1.29	-0.66	0.62	5.27	1955-59	-4.48	-4.24	-3.17	-0.83
1960-64	-0.80	-0.14	1.10	5.89	1960-64	-4.08	-3.82	-2.83	-0.43
1965-69	-0.37	0.33	1.54	6.42	1965-69	-3.64	-3.34	-2.37	0.10
1970-74	0.01	0.76	1.92	6.86	1970-74	-3.25	-2.89	-1.95	0.54
1975-79	0.35	1.13	2.28	7.31	1975-79	-2.87	-2.47	-1.53	1.01
1980-84	0.65	1.45	2.58	7.55	1980-84	-2.51	-2.07	-1.12	1.39
1985-89	0.75	1.54	2.62	7.24	1985-89	-2.29	-1.84	-0.92	1.38
1990-94	0.71	1.46	2.49	6.87	1990-94	-2.17	-1.75	-0.87	1.31

Reform 2004-2005, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1953-54	-1.72	-1.16	0.14	4.59					
1955-59	-1.38	-0.80	0.45	4.94	1955-59	-4.61	-4.40	-3.31	-1.17
1960-64	-0.91	-0.32	0.90	5.51	1960-64	-4.25	-4.05	-3.02	-0.88
1965-69	-0.49	0.14	1.33	6.05	1965-69	-3.82	-3.59	-2.59	-0.40
1970-74	-0.10	0.57	1.72	6.53	1970-74	-3.43	-3.17	-2.18	0.04
1975-79	0.26	0.95	2.08	6.96	1975-79	-3.05	-2.75	-1.76	0.49
1980-84	0.56	1.28	2.37	7.15	1980-84	-2.70	-2.36	-1.35	0.82
1985-89	0.67	1.38	2.41	6.85	1985-89	-2.48	-2.12	-1.15	0.83
1990-94	0.63	1.30	2.29	6.50	1990-94	-2.35	-2.02	-1.09	0.79

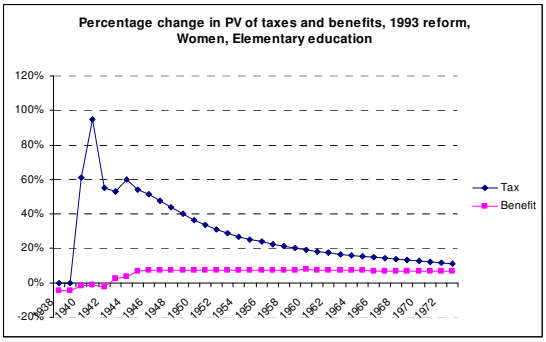
Reform 2006, pay-as-you-go, Change in Social Security Wealth as a fraction of annual average earnings

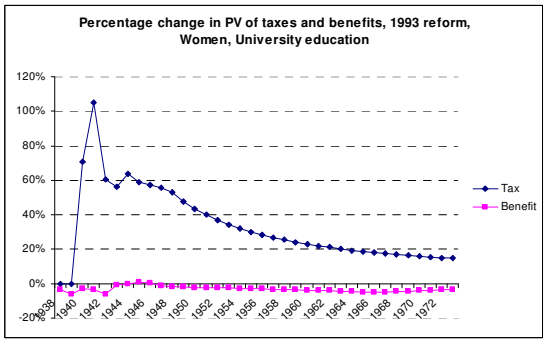
Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1935-39	0.00	0.00	0.00	0.00					
1940-44	0.00	0.00	0.00	0.00					
1945-49	0.30	0.19	0.02	-0.85	1945-49	0.00	0.00	0.00	0.00
1950-54	0.08	0.09	-0.05	-0.26	1950-54	0.44	0.40	-0.03	-0.16
1955-59	0.00	0.03	-0.10	-0.25	1955-59	-0.06	-0.01	-0.14	-0.11
1960-64	-0.07	-0.05	-0.19	-0.45	1960-64	-0.10	-0.02	-0.13	-0.20
1965-69	-0.11	-0.11	-0.21	-0.41	1965-69	-0.08	-0.02	-0.09	-0.13
1970-74	-0.12	-0.14	-0.19	-0.32	1970-74	-0.03	-0.01	-0.02	-0.02
1975-79	-0.14	-0.16	-0.19	-0.36	1975-79	0.00	0.00	0.00	0.00
1980-84	-0.13	-0.16	-0.19	-0.35	1980-84	0.00	0.00	0.00	0.00
1985-89	-0.13	-0.15	-0.18	-0.34	1985-89	0.00	0.00	0.00	0.00
1990-94	-0.12	-0.14	-0.17	-0.32	1990-94	0.00	0.00	0.00	0.00

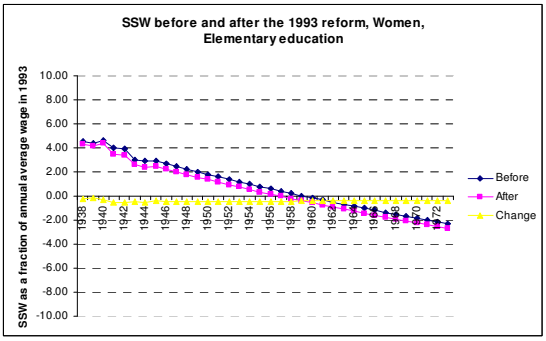
Reform 2006, mixed system, Change in Social Security Wealth as a fraction of annual average earnings

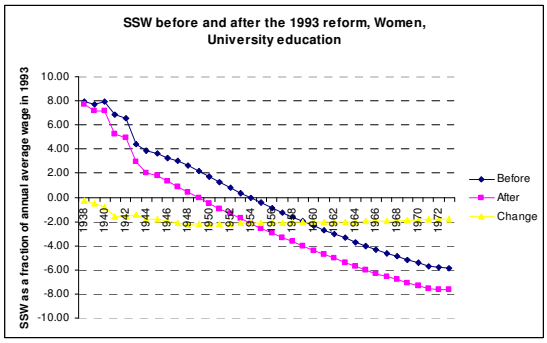
Men					Women				
Cohort	Elementary	Lower	Upper	University	Cohort	Elementary	Lower	Upper	University
1953-54	0.02	0.06	-0.06	-0.10					
1955-59	0.00	0.02	-0.08	-0.21	1955-59	-0.05	-0.01	-0.13	-0.09
1960-64	-0.06	-0.05	-0.15	-0.37	1960-64	-0.08	-0.02	-0.10	-0.15
1965-69	-0.10	-0.10	-0.18	-0.35	1965-69	-0.06	-0.02	-0.06	-0.09
1970-74	-0.12	-0.13	-0.18	-0.31	1970-74	-0.02	0.00	-0.02	-0.01
1975-79	-0.14	-0.16	-0.19	-0.36	1975-79	0.00	0.00	0.00	0.00
1980-84	-0.13	-0.16	-0.19	-0.35	1980-84	0.00	0.00	0.00	0.00
1985-89	-0.13	-0.15	-0.18	-0.34	1985-89	0.00	0.00	0.00	0.00
1990-94	-0.12	-0.14	-0.17	-0.32	1990-94	0.00	0.00	0.00	0.00

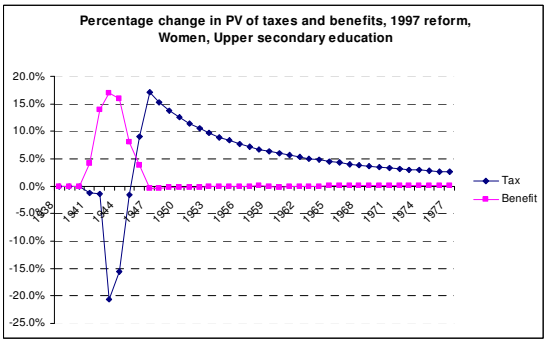
Graphs - Hungary

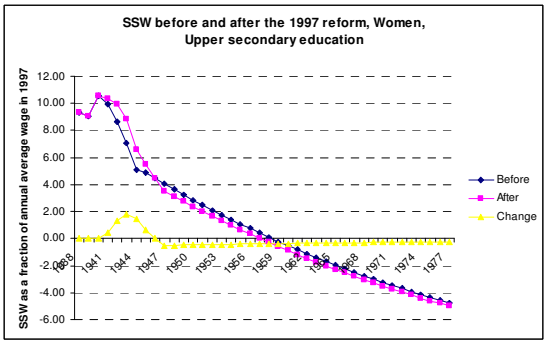


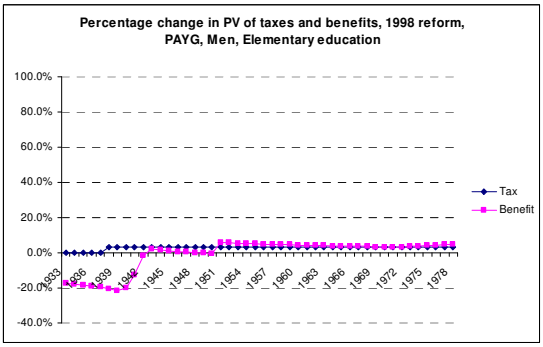


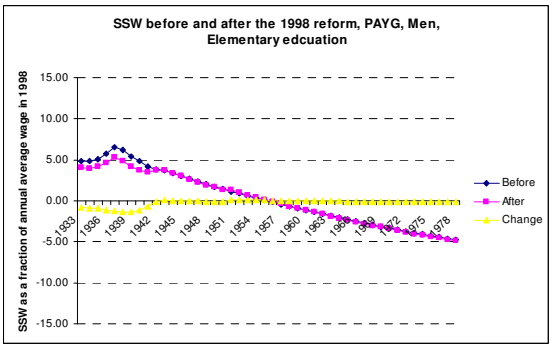


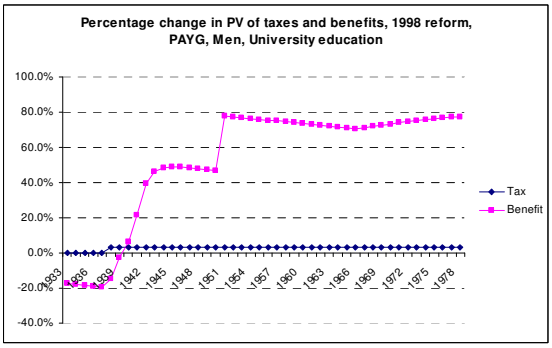


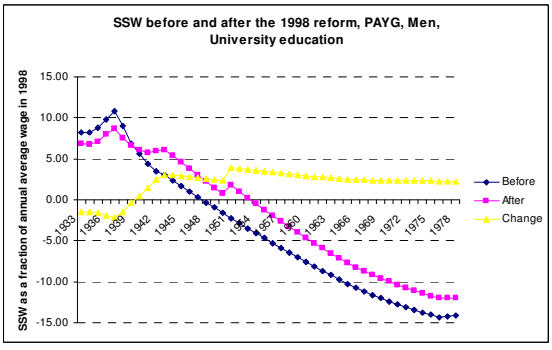


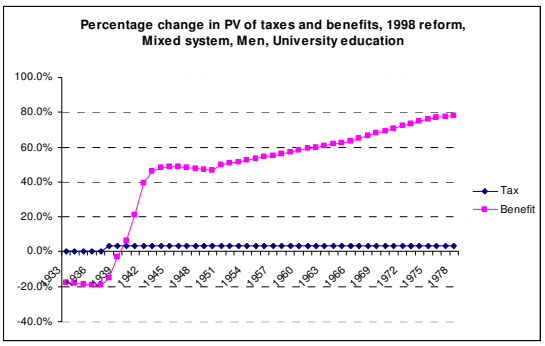


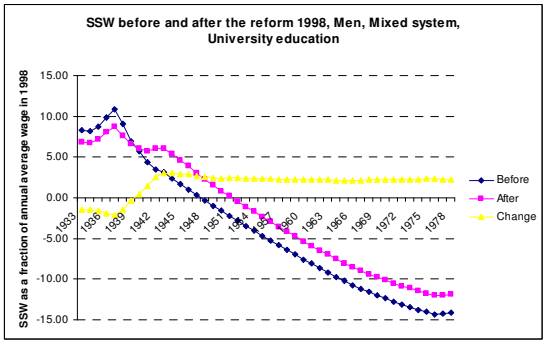


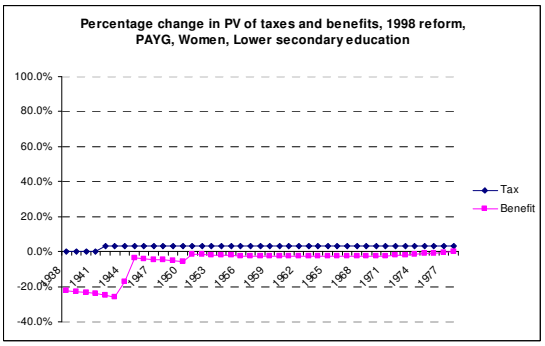


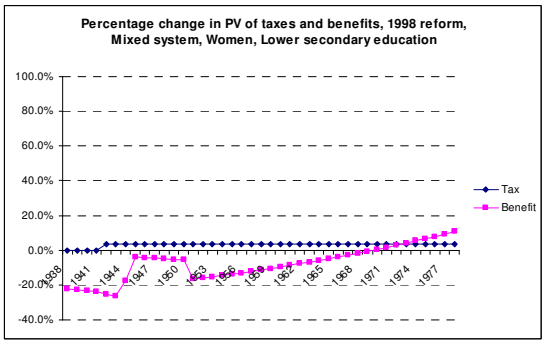


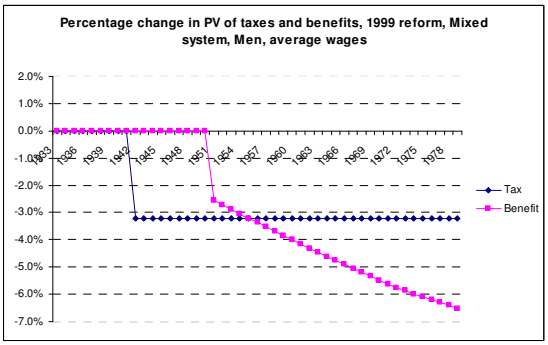


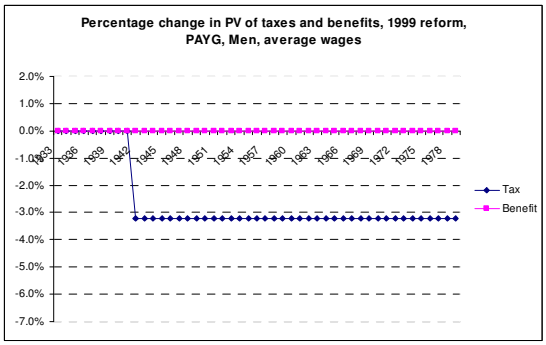

Percentage change in PV of taxes and benefits, 1998 reform, Mixed system, Men, University education
Tax
Benefit

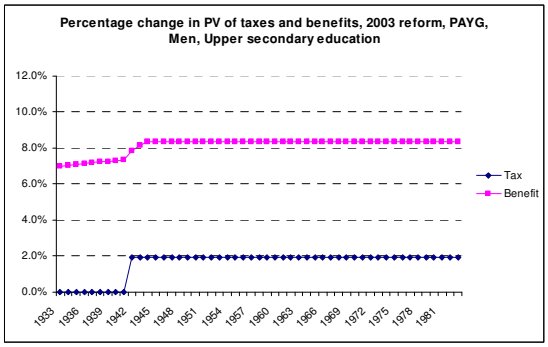

SSW before and after the reform 1998, Men, Mixed system, University education
SSW as a fraction of annual average wage in 1998
Before
After
Change

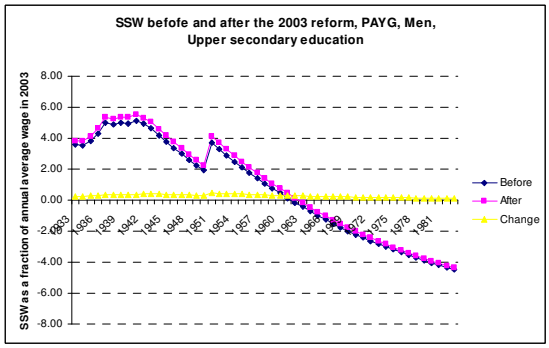

Percentage change in PV of taxes and benefits, 1998 reform, PAYG, Women, Lower secondary education
Tax
Benefit

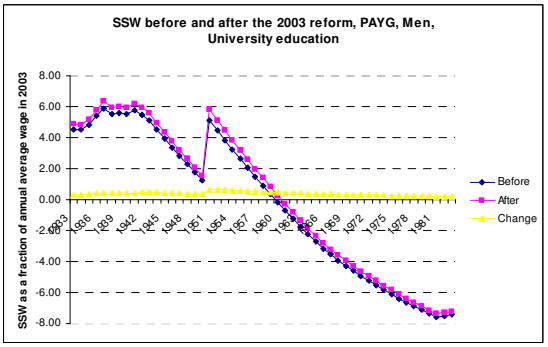

Percentage change in PV of taxes and benefits, 1998 reform, Mixed system, Women, Lower secondary education
Tax
Benefit

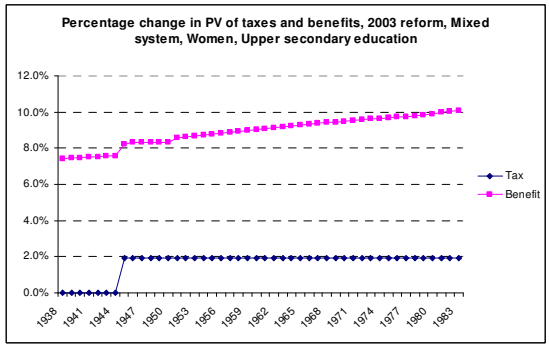

Percentage change in PV of taxes and benefits, 1999 reform, Mixed system, Men, average wages
Tax
Benefit

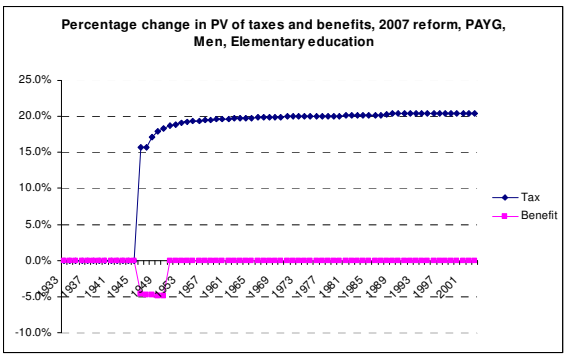

Percentage change in PV of taxes and benefits, 1999 reform, PAYG, Men, average wages
Tax
Benefit

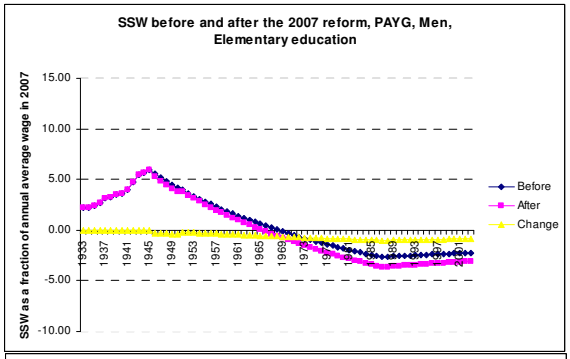

Percentage change in PV of taxes and benefits, 2003 reform, PAYG, Men, Upper secondary education
Tax
Benefit

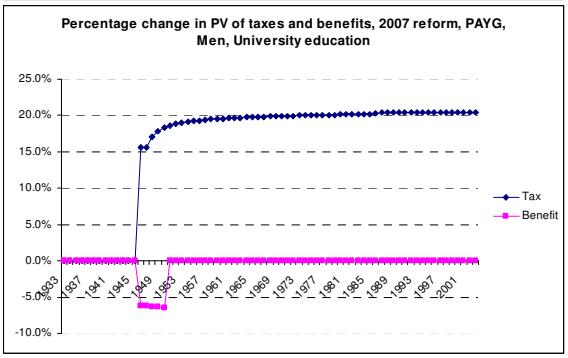

SSW befofe and after the 2003 reform, PAYG, Men, Upper secondary education
SSW as a fraction of annual average wage in 2003
Before
After
Change

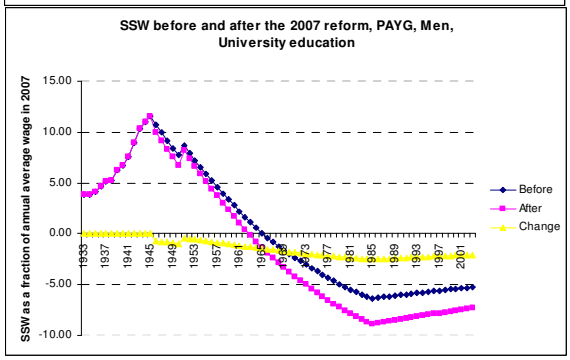

SSW before and after the 2003 reform, PAYG, Men, University education
SSW as a fraction of annual average wage in 2003
Before
After
Change


Percentage change in PV of taxes and benefits, 2003 reform, Mixed system, Women, Upper secondary education
Tax
Benefit

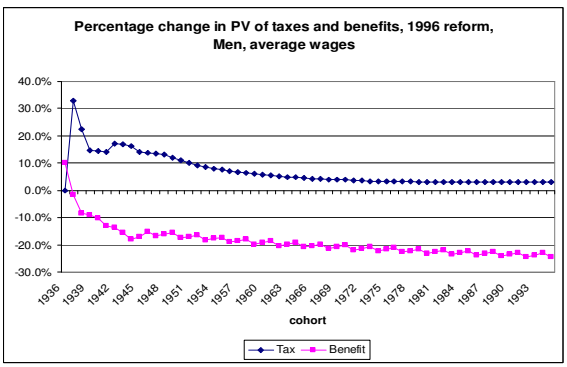


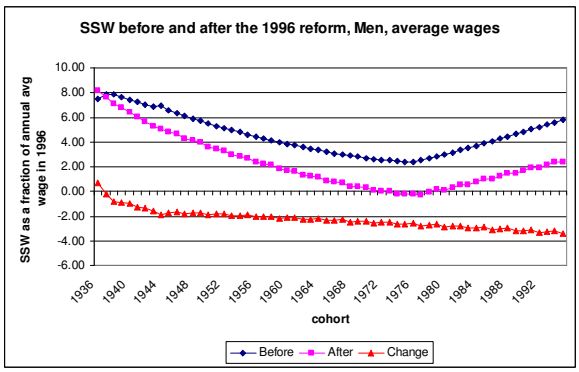


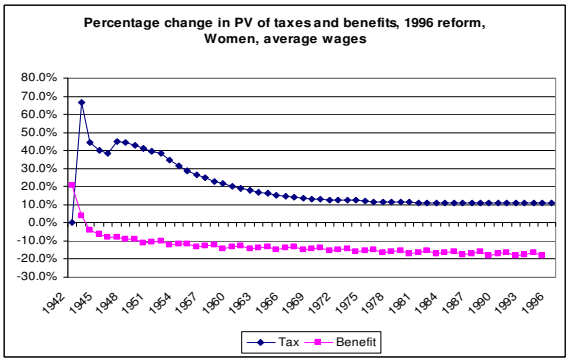


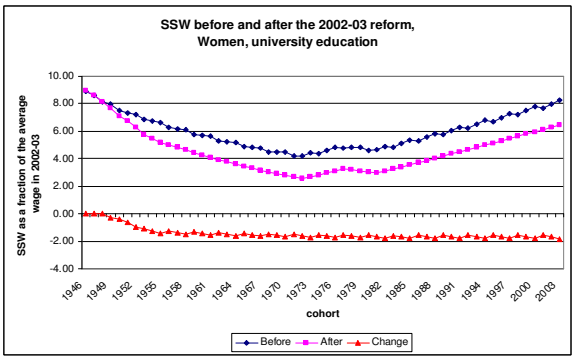


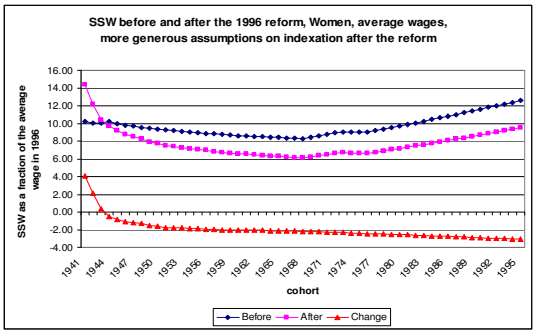
Graphs – Czech Republic

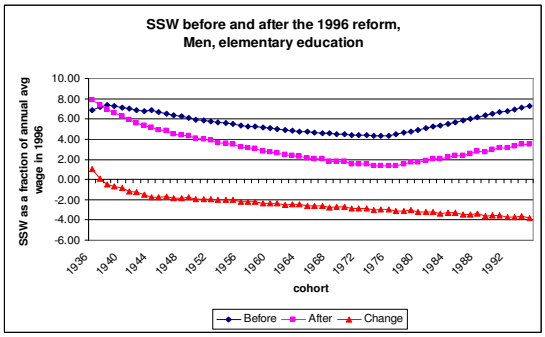


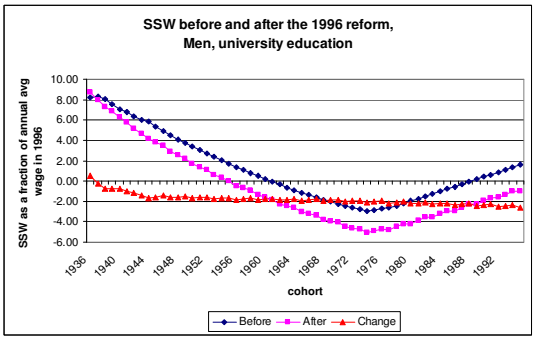


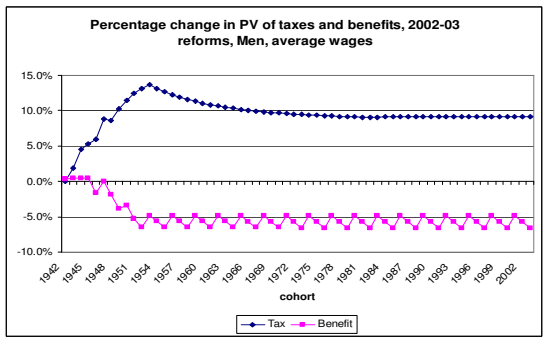


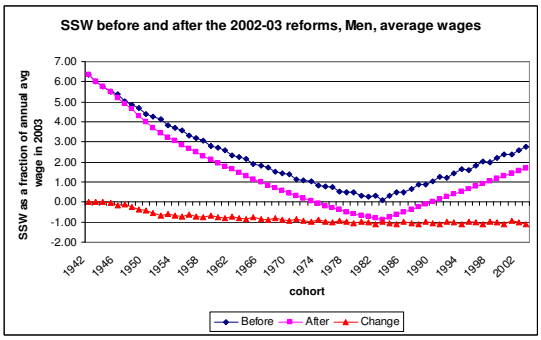


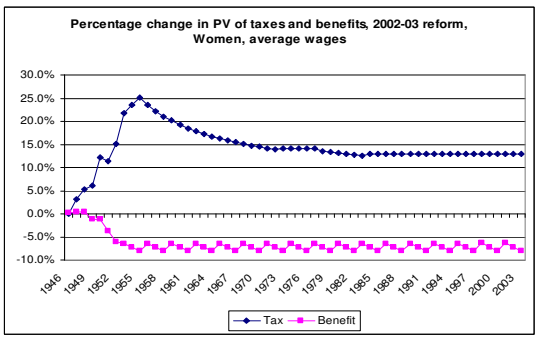

SSW before and after the 1996 reform, Women, average wages, more generous assumptions on indexation after the reform
SSW as a fraction of the average wage in 1996
cohort
Before
After
Change

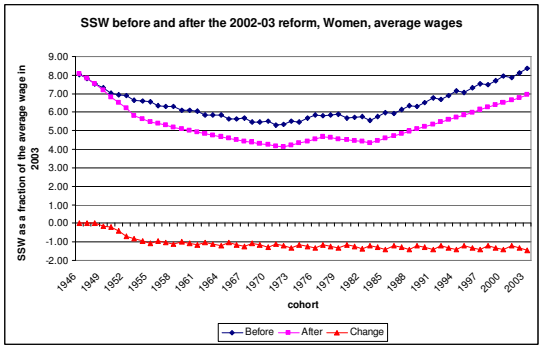

SSW before and after the 1996 reform, Men, elementary education
SSW as a fraction of annual avg wage in 1996
cohort
Before
After
Change

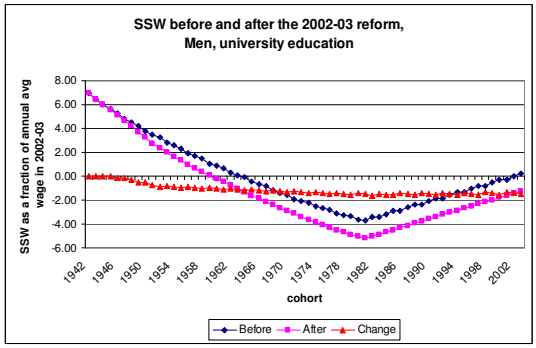

SSW before and after the 1996 reform, Men, university education
SSW as a fraction of annual avg wage in 1996
cohort
Before
After
Change

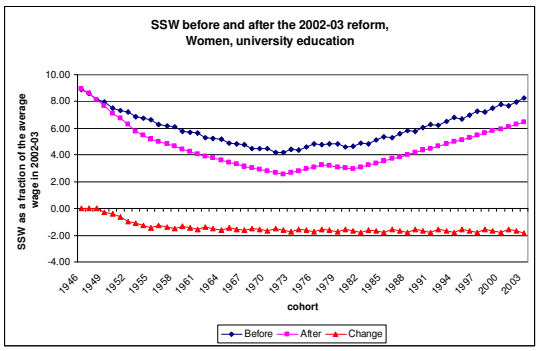

Percentage change in PV of taxes and benefits, 2002-03 reforms, Men, average wages
cohort
Tax
Benefit


SSW before and after the 2002-03 reforms, Men, average wages
SSW as a fraction of annual avg wage in 2003
cohort
Before
After
Change


Percentage change in PV of taxes and benefits, 2002-03 reform, Women, average wages
cohort
Tax
Benefit


SSW before and after the 2002-03 reform, Women, average wages
SSW as a fraction of the average wage in 2003
cohort
Before
After
Change


SSW before and after the 2002-03 reform, Men, university education
SSW as a fraction of annual avg wage in 2002-03
cohort
Before
After
Change


SSW before and after the 2002-03 reform, Women, university education
SSW as a fraction of the average wage in 2002-03
cohort
Before
After
Change

Graphs – Slovakia