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GENERATIONAL ACCOUNTING AND HUNGARIAN PENSION REFORM

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October 2001

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Abstract

The essence of generational accounting is to break down total net contributions in a given year to each cohort and to project this profile into the future. Using additional assumptions on the discount rate and the growth of productivity and population, the per capita net contribution of future generations can be determined, which satisfies the inter-temporal budget constraint. Generational accounts in the Hungarian pension system show that the 1997 reform package significantly reduced the financial tension generated by demographic and institutional factors. The main source of improvement was a rationalization of social security. These conclusions are robust. Nevertheless, future imbalances depend on the dynamics of model parameters, primarily the rate of productivity growth.

1. Introduction *

As in the case of many other East European countries, post-socialist Hungary inherited a mandatory pay-as-you-go public pension system at a high level of maturity in 1989 that provided most of the income for the elderly. Since the country introduced significant reforms in central planning in 1968, shortages were generally mitigated but inflation began to emerge. Pensions had to be adjusted from time to time. Although the system was cumbersome, pension benefits were somewhat less uniform than in other, more typical socialist countries. There was practically full employment at low wages, but prices for basic goods were also kept relatively low. Mandatory retirement age was liberal (55 years for women and 60 years for men), whilst replacement rates were generous (about 2/3 of average net wages at the beginning of the 1990s). The demographic situation was typical for a European country with some local distinctions: fertility, though fluctuating, was declining, though not at an exceptionally rapid rate, whilst life expectancy, after fast improvements up to 1960, remained quite low, despite steadily decreasing infant mortality.

During the first years of transition, the transformational depression (Kornai 1994) caused roughly a 30 percent drop in labor activity and a 25 percent increase in the pensioners population within 5-7 years. The Hungarian pension system fell into financial crisis, which

* The present study was supported by the Hungarian State Supervision of Pension Funds and the Prague-based Research Support Scheme (RSS No.: 1209/1999). We were supplied the population forecast and the 1 percent sample of the pensioner population by the Central Statistical Office Demography Research Institute (KSH NTI) and the National Pension Administration (ONYF), respectively. We gratefully acknowledge the contribution of

resulted in a severe cut in pensions in real terms. This will be amplified by a rapidly ageing population in the near future, peaking in the second decade of this century. The crisis has given rise to a number of prognoses and reform proposals (Augusztinovics 1995, World Bank 1995, Palacios and Rocha 1998, Benczúr 1999, Rocha and Vittas 2000, Simonovits 2000).

Apart from introducing a consistent wage-based indexation in 1992 and raising the retirement age in 1996, subsequent governments responded initially with various *ad hoc* steps (such as capriciously adjusting the benefit formula) and finally legislated for comprehensive pension reform in 1997. Indexation was adjusted from being wage-based to being half-wage, half-price based (the so-called Swiss indexation). Mandatory retirement age was increased to a uniform 62 years for both sexes, to be achieved within a transition period to be completed by 2009. The non-transparent and distorting pension formula is to be streamlined by 2013 due to phasing-out progressiveness of the formula and the introduction of a new scale of accrual rates. Most visibly, privately managed pension funds were set up in 1998 and people were to be allowed to redirect about one quarter of their total pension contributions to one of the funds (this proportion was to start at about 20% and rise to approximately 25% within two years; however, the starting proportion has been temporarily frozen). The majority of workers have opted for this type of multi-pillar, mixed system. New entrants to the labor market are obliged to contract into private pension funds.

In this paper we measure the impact of reforms on generational imbalance. The latter is a key indicator in generational accounting. It compares net contributions of the newborn cohort (the zero year-old) to net contributions of future generations, assuming the latter group has to cover all current as well as future deficits in the system.¹ In Section 2 we outline the methodology. In Section 3 general generational accounts are applied to the special problem of future institutional reforms scheduled in advance, such as the 1997 Hungarian pension law. In Section 4 we show the impact of individual reform measures and quantify their combined effect, and we also provide a sensitivity analysis and discuss different scenarios.

István Bedekovics, Rudolf Borlódi, Magda Dabóczy, Irén Éber, László Hablicsek, György Marosi, József Mészáros, János Réti and Miklós Toldi and two unknown referees.

¹We use the words cohort, year-group and generation as synonyms.

2. Generational accounting

Generational accounting,² proposed by Alan J. Auerbach, Jagadeesh Gokhale and Laurence Kotlikoff in place of the much-criticized, easily-manipulated calculation of budget deficit, is aimed at quantifying financial tensions invoked by the current situation of the redistribution system. The essence of the method is to break down net taxes by cohorts, and by projecting these values, the current age-tax profile, into the future. Given a few additional assumptions on the growth of productivity and the discount rate, as well as population forecasts, the level of contribution levied on future generations by the present net tax profile projected into the future can be determined so as to meet the inter-temporal budget constraint. The latter is simply a zero-sum constraint stating that someone (descendants in the absence of others) must defray possible over-spending of the present. To put it more precisely: the present value of future net contributions of current and subsequent generations has to be equal to the present value of current government debt and future government expenditures.

Net taxes and government expenditures differ from one another since personal income tax, social security contributions or pension benefits can be broken down to individuals and consequently for cohorts, whereas the amounts spent on defense or the police cannot.

Generational accounting reduces the role of expert forecasts for future trends to a minimum, its aim being to quantify tensions present in the current situation. Thus, besides predictions on population and institutional changes set in the pension acts in advance, no other estimated trends will be considered. Changes expected in employment, the practice of granting disability pensions, the proportion of entrants to higher education, age-earnings profiles, or personal income taxation, will be omitted. For all these variables a predictive model needs to reserve clear and explicit assumptions - generational accounting, however, is not predictive.³

The output of our calculations on the Hungarian generational pension accounts is a vector of dollar amounts. The entries of the vector indicate the difference between the present value of contributions expected to be paid by a generation throughout the remainder of their lives, and the present value of the benefits they are granted. Following on from the method

² See the first example of generational accounting in Auerbach, Gokhale and Kotlikoff (1991a). A theoretical background and international comparative results in connection with the method are found in the book of Auerbach, Kotlikoff and Leibfritz (1999). Regarding methodological questions refer to the web-site www.generationallaccounting.com for the study of Cardarelli, Kotlikoff and Sefton (1999) and Raffelhüschen (1999).

³ Generational accounting, as indicated by the name, is accounting rather than economics. See Fehr and Kotlikoff (1999) for generational accounting in a general equilibrium context.

that neglects past contributions and benefits, such a calculation suggests that the elderly are net beneficiaries, while active cohorts are net contributors to the system.

Obviously, this outcome in itself is a sterile one. However, three approaches arise which may render the data fertile for analysis. The first is to perform not only forward-looking, but also retrospective calculations, that is to take account of former contributions and benefits as well. Given such data, intergenerational redistribution can be measured.⁴ The second procedure is that of international comparison. If the same method produces different distribution curves for different countries, this fact again informs us of intergenerational redistribution.

Finally, by comparing the new-born cohort with the as-yet unborn (who are treated as a unified age group), we obtain a measure of generational imbalance in the system. The method involves the assumption that changes in taxes and benefits apply only to future generations, whilst current generations are to pay taxes in accordance with the present distribution of the net tax burden. Consequently, an imbalance value indicates how much more (or, in a fortunate scenario, less) future generations have to pay for the same benefits, or how much less benefit they have to settle for (or how much more benefit they may receive) while paying the same taxes as those who were born into the original age-profile of taxes and benefits, and have their whole career ahead of them.

The measure of imbalance reflects the long-term sustainability of the system of redistribution. In this sense it is a relative of the amount of implicit debt (Holzmann, Palacios and Zviniene 2001). On the other hand, the imbalance gives an indication of intergenerational redistribution only to a limited extent, partly because it is forward-looking with no retrospective data and partly because it neglects the alternative of current generations footing the bill of imbalance. We will return this point below.

Generational accounting is supposed to extend over the entire government budget, including taxes on income, consumption and property, as well as pensions, family assistance, education, health care, and all other public programs. The work edited by Auerbach, Kotlikoff and Leibfritz (1999) contains such calculations for 17 countries. Recently such accounting has been undertaken in Hungary as well, covering the complete system of redistribution for the year 1996 (Gál, Simonovits, Szabó and Tarcali 2000). Many of these studies consider reforms in public finance or public services. It is less common to do generational accounting on spe-

⁴ Retrospective calculations have been made in the USA (see, Gokhale, Page and Sturrock, 1999).

cific institutional reforms⁵. Such calculations are more complicated because reforms are frequently not immediate, but rather they describe an agenda for future action. For this reason it makes sense to carry out generational accounting separately for pension systems in countries such as Hungary, where pension legislation sets the intended steps of institutional reform in advance. Moreover, the pension system alone was responsible for almost 40 percent of the generational imbalance in 1996.

In the first set of calculations we departed from the current profile of net contributions and ran the cohorts through, allowing only the size of generations to vary in accordance with demographic predictions. The 1997 reform of the Hungarian social security, as well as its partial privatization was excluded (with the exception that we employed the legal retirement age in force in 2000, i.e. 57 for women, and 61 for men. Since our pensioner sample reflects the conditions prevailing in January 2000, it would be mere speculation to estimate how much higher the number of pensioners would have been, and what pension they would have drawn, should the retirement age have remained 55 and 60, respectively.) In the second run however, we quantified these effects, in particular the introduction of the Swiss indexation, the completed retirement age adjustment, the new scale of accrual rates, the new benefit formula, and partial pre-funding combined with privatization.

Generational accounting, as mentioned above, makes future generations pay all deficits. Consequently, for each run below the pension system is considered closed, i.e. the inter-temporal constraint is met exclusively through manipulating contributions or benefits. In reality this is not the case. Deficits from the pension system are not financed exclusively from raising contributions or cutting benefits, but also from general taxes collected to the central budget. In other words, long-term inter-temporal constraint is supplemented with annual budget constraints. The system does not run into debt, but is topped-up annually from some external resource. This departure from reality does not affect the interpretation of the resultant imbalance index. However, it does limit the force of our conclusions on intergenerational redistribution since the age profile of general taxes does not correspond to that of pension contributions. A considerable volume of general taxes for instance, comes from consumption related taxes, the age distribution of which is much more uniform than that of pension contributions, which are collected as a kind of labor income tax. For this reason, the full effects of pension reform on redistribution will not be presented here, although we may still draw certain partial conclusions.

⁵For exceptions see Auerbach, Gokhale and Kotlikoff (1991b) on Medicare, Boll, Raffelhüschen and Walliser (1994) on German social security or Bonin, Gil, and Patxot (1999) on Spanish pension reform.

There are other effects on redistribution that could not be considered in any of the computation runs. Such as, for instance, the prospective redistribution that can be ascribed to the switches from the pure social security system to the mixed public-private system. As far as the already active cohorts were concerned, legislation left it for the individuals to decide whether to switch over to the mixed system or stay within the pure social security-based system, while giving most of the switchers government guarantee on returns. In view of the fact that there were more people who switched over than anticipated, the guarantee undertaken on benefits can plausibly entail palpable redistribution primarily among pension fund members, secondly between the taxpayers of the time and those retiring.

3. Generational pension accounts

Generational pension accounts are constructed in the following way. First, we delineate the net contribution profile of the cohorts as the difference of age-specific contributions and benefits for the base year. In the present study the base year was 2000, denoted here as $t = 0$.

The balance of contributions and benefits is determined for each cohort. Since each cohort is described by one figure, the net contribution profile for the year 2000 is a vector with 96 entries, for the sequence starts with those born in 2000, i.e. aged zero, whilst those 95 or above are aggregated into one age group. The next step is to calculate the values of this vector for each forthcoming year through 2100, taking into account the assumptions based on population forecasts, productivity growth, and discount rates, as well as changing retirement regulations. Formally speaking, the vector is expanded to a 96x101 matrix. In the final step, the progress of each generation is explored diagonally in the 96x101 matrix: the present value of their net contributions are summed up for the rest of their lives.

Inter-temporal constraint

The sums obtained have to satisfy the inter-temporal constraint, described above. That is,

$$\sum_{s=0}^D M_s + \sum_{j=1}^{\infty} M_j = \sum_{t=0}^{\infty} G_t u^t - W \quad (1)$$

where

M_s = present value of remaining net contributions of currently living s year old cohort at $t = 0$;

M_j = present value of net contributions of future cohort to be born in year j ;

s = cohort variable; age of a cohort in $t = 0$;

t = time by years; $t = 0$ is starting year;

D = maximum age;

G_t = expenditures of the pension system

U = relative discount factor, ratio of the productivity growth factor $(1 + g)$ and the interest factor $(1 + r)$;

W = net wealth of social security system.

The left side of (1) contains net contributions, i.e. the difference between the present values of contributions and benefits, discounted to the base year, of future cohorts (M_j) and cohorts alive at $t = 0$ (M_s).

Although contributions are only paid through the active period and old-age pension benefits are only taken up during the retirement phase, children are also beneficiaries of social security due to orphan benefits. Thus s runs from 0 to $D = 95$. The birth date of people to be born is not limited in principle, thus all future cohorts are considered. However, in practice, the horizon of the calculation is 101 years, running to 2100, since discounting makes the effects of additional years negligible.

In the generational pension accounting the right side of (1) is simple. The net wealth of the pay-as-you-go social security, W is negligible. As for the value G_t , some clarification is required. In the general case, when we analyze the whole system of redistribution, G_t contains government expenditures, which is closer to pure public goods than to pure private goods and cannot be broken down for individuals. In the case of a pension system however, only the modest operational costs of the system can be considered indivisible. The system itself, which pools individual longevity risks and enforces the rules, is the public good. Otherwise, all contributions and benefits can be assigned to a person, even in a defined benefit plan, in principle at least. Operational costs of the public system planned for 2000 were \$67 million, about 1.8 percent of the total budget.

Remaining total net contributions of a cohort

Here we detail the terms of the left side of (1). Remaining total net contributions of a cohort are:

$$(2) \quad M_s = \sum_{k=s}^D T_{k,k-s} P_{k,k-s} \left(\frac{1}{1+r} \right)^{k-s} \quad (s = 0, 1, \dots, D)$$

if the cohort has been born and

$$(3) \quad M_j = \mathbf{n} \sum_{k=0}^D T_{k,k+j} P_{k,k+j} \left(\frac{1}{1+r} \right)^{k+j} \quad (j = 1, 2, \dots)$$

if not.

The following notations are used:

$T_{k,k-s}$ = per capita net contributions of cohort s at age k ;

$T_{k,k+j}$ = per capita net contribution of cohort born in j at age k ;

$P_{k,k-s}$ = size of cohort s at age k ;

$P_{k,k+j}$ = size of cohort born in j at age k ;

R = discount rate;

K = age of a cohort

J = time in years; for all years $t > 0$, $t = j$

\mathbf{n} = correction factor.

Both M_s and M_j refer to aggregate cohort contributions. Note, that calculating per capita values for a cohort at age k and multiplying this value by the number of surviving members of this cohort is not redundant. Per capita net contributions of a cohort at age k are derived from net contributions in the previous year of the cohort at age $k+1$. In this way we retain the vector of net contributions of the base year.

Equation (3) contains the correction factor \mathbf{n} . This needed be to introduced, since M_j/\mathbf{n} merely shows net contributions of the cohort to be born in year j , if its members go through the profile under the same conditions as the new-born, that is without footing any deficit. In order to meet the inter-temporal budget constraint, their balance has to be modified by ?.

Initial population and population forecast

We took population data from Habicsek (1995). Since his forecast stops at 2050, and we required a longer period, we lengthened his calculation, assuming that after 2050 no structural

change occurs in the Hungarian population, (a similar solution is used by Cardarelli, Kotlikoff and Sefton (1999) and Oreopoulos (1999)). Note that generational accounting considers all future cohorts as one.

Initial net contributions by cohorts

We have denoted the net contributions in (2) and (3) by a general term $T_{k,t}$ ($T_{k,k-s}$ for cohorts already present and $T_{k,k+j}$ for future cohorts). Net contributions consist of total contributions (C) and benefits (B). Formally:

$$(4a) \quad T_{k,t} = C_{k,t} - B_{k,t}$$

$$(4b) \quad C_{k,t} = C_{k,t-1}(1 + g)$$

$$(4c) \quad B_{k,t} = B_{k,t-1}(1 + g)$$

where

$T_{k,t}$ = per capita net contributions of the k year old cohort in year t ;

$C_{k,t}$ = per capita total contributions of the k year old cohort in year t ;

$B_{k,t}$ = per capita benefits for the k year old cohort in year t .

In the spirit of generational accountings, per capita contributions of a cohort in year t can be determined by two pieces of information: contributions in the previous year of the cohort which is a year senior to the cohort in question and the rate of productivity growth.

Data on social security contributions was obtained from two samples taken from personal income tax declarations for the year 1998, provided by the Tax and Fiscal Inspection Office (APEH, the Hungarian equivalent of the Internal Revenue Service). The first one comprised a 0.5 percent random sample of employers' declarations of employees' income comprising 10,874 cases, the other was a 1 percent random sample of self-declarations with 21,305 cases. Since our benefit data derives from the year 2000, the tax data for 2000 as estimated from the APEH file was used by multiplying taxable incomes by the rate of gross wage increase. This value was 16.1 percent for 1999,⁶ while the expert estimate for the year 2000 is 11.3 percent. It should be borne in mind that this procedure carries the implicit assumption that taxes change in line with earnings.

⁶Source: www.ksh.hu/hun/h1999/h103fo99/m1030612.htm.

The volume of social security contributions estimated from the sample amounted to \$3.886 billion, which was approximately 1.8 percent less than the estimated \$3.956 billion revenue of the National Pension Insurance Fund (ONYBA) for the year 2000. This latter sum includes employers' and employees' contributions, as well as government subsidies provided to supply the deficit resulting from switching over to private pension funds, but does not cover for instance, the budget contribution paid after maternity leave ("gyes"), maternity benefit ("gyed"), and maternity assistance ("gyet"), contributions to the preferential retirement system of the armed forces, receipts from supplements and penalties for overdue payments, and a few further minor subsidies. Normally the calculation should not include any input to the system other than contributions, but as a benchmark, for the no-reform scenario, we wanted to ignore the partial pre-funding and privatization of the system. Thus all contributions lost by the public pillar to private funds had to be taken into account.

The benefits were estimated from a 1 percent sample of pensioners stratified by so-called principal benefits (in the Hungarian system, a person may receive different benefits, e.g. old-age pension as well as survivor benefit simultaneously). The sample, consisting of a total of 31,487 individuals, was supplied by the National Pension Administration (ONYF).

Projecting the age-profile of initial net contributions for the future

Projecting the initial profile and calculating present values requires adequate growth and discount rates. In (1) a relative discount factor (μ) was applied, which contained a growth factor ($1+g$) and the absolute discount factor ($1+r$). Recouping contributions in the form of benefits is uncertain. We assumed that contributions to social security are more risky than long-term government securities. Social security contributions are mandatory, while purchasing government securities is not. Hence the government can collect the former with relative ease even if its real returns are minimal, or even negative; in the case of government securities, this is much more difficult to assure.⁷ Consequently, the discount rate has to be calibrated higher than the real interest rate of government securities. On the other hand, pension disbursements fluctuate less than the real returns of capital, and this fact justifies using a value between the interest rate of government bonds and the average yields of shares.⁸ By default, we calculated on the basis of a 1.5 percent annual average increase in productivity, and a 5 percent interest

⁷ On the political risks of pension systems, and the possible solutions for alleviating them, see Diamond (1997). On rates of return in social security pension systems see Geanakoplos, Mitchell and Zeldes (1998).

⁸ For a similar argument see Auerbach, Gokhale and Kotlikoff (1994).

rate, in accordance with the international practice of generational accounting. We also carried out the relevant tests for robustness.

In the absence of reliable empirical observations, we had to ignore the subjects' possible risk aversion. Accordingly, insofar as the assumption actually turns out to be justified, the fact that the funded system involves higher risks, detracts substantially from the return advantage of the funded system.⁹

Generational pension accounts

After projecting the initial net contribution profile and totaling this up for the cohorts, in the final step we determined the per capita net contribution for the cohort's remaining life. This balance takes the following shape for cohorts already alive at $t = 0$:

$$(5) \quad N_s = \frac{M_s}{P_{s,0}} \quad (s = 0, 1, \dots, D)$$

For future cohorts we have

$$(6) \quad N = \frac{\sum_{j=1}^{\infty} M_j}{\sum_{j=1}^{\infty} P_{0,j} u^j}$$

where

N_s = generational pension account for currently living cohort of age s ;

N = future cohorts' average generational pension account.

The first step in determining per capita values is to calculate the population size, which serves as the basis for projection. In the case of currently alive generations we project the net pension contribution onto the actual size of the cohort. In other words, the generational pension account shows the net position of a representative member of a cohort for the remaining part of his life within the pension system. The account is positive if the given cohort is a net contributor, negative if the present value of future benefits is greater than the present value of future contributions.

The generational account of future cohorts is determined in two steps. First, we project the cohort's account according to the size of the cohort at age zero. Secondly, we single out an average generational account from the corrected net contributions, which is the same for all future cohorts.

4. Generational pension accounts in Hungary

Firstly, we demonstrate here how strong, long-term tensions characterize the unreformed pension system. For this run we take into account only a single reform measure, raising retirement from 55 to 57 for women and 60 to 61 for men. As mentioned before, these are the reform steps that came into effect by 2000, the base year for our calculations.

Generational pension accounts without pension reform

Our calculations suggest that the Hungarian public pension system was unsustainable in the long-term without the comprehensive reform package of 1997. In view of a deficit in social security (exclusive of contributions lost to the new private funds and topped-up from central budget funds) amounting to \$430 million¹⁰, with the prospect of significant demographic deterioration, such a long-term imbalance came as no surprise.

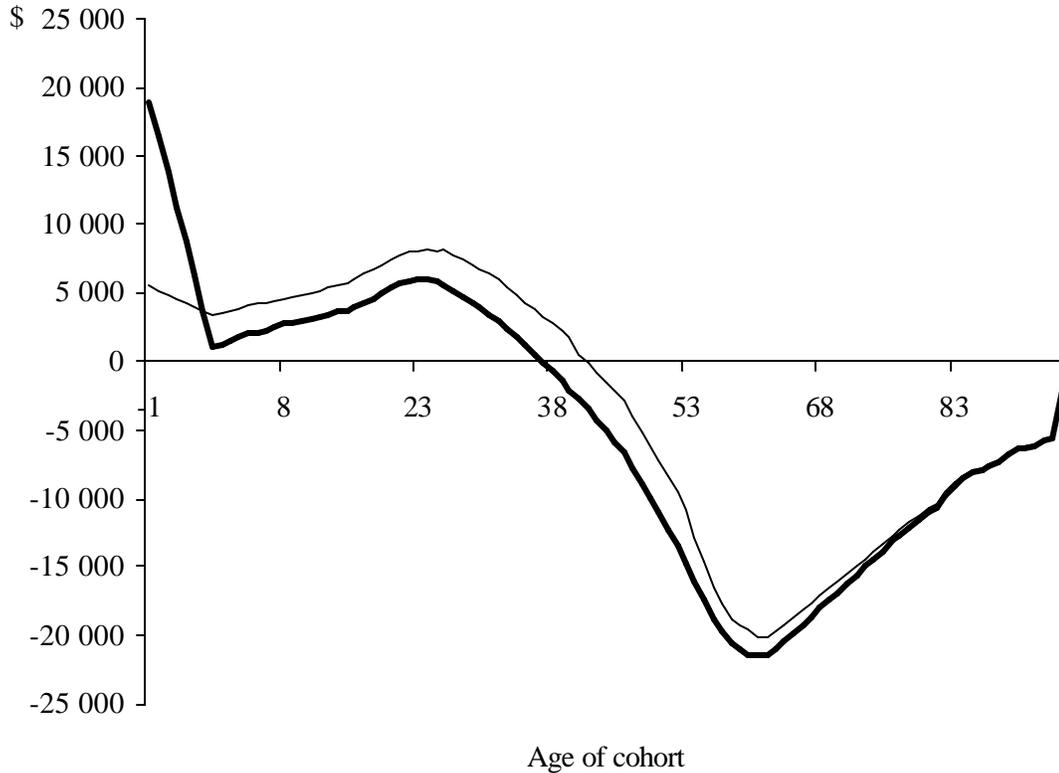
We present generational pension accounts in Figure 1. The bold curve in the figure begins with a sharp decline. The per capita account of future generations is \$18,950, while that of the zero year old is about \$1,130. This difference provides the most important index of generational accounting. If deficits in the system are devolved entirely on to the as-yet unborn, they will be burdened with making \$17,820 more lifetime contributions than those who are already in the system but have their whole careers ahead of them.¹¹ This line suggests an extremely severe internal tension.

⁹ See the paper by Orszagh and Stiglitz (1999).

¹⁰ This amount differs from the zero balance indicated in the budget estimate, since we used a different list of revenues as well as expenditures. Since we consider social security a closed system, only contributions are taken as revenues, general taxes are not (except for those that cover contributions lost to the private funds). On the expenditures side—as it has already been clarified in the body of the text—we took into account certain services not financed by ONYBA, although they are part of the pension system.

¹¹ For the sake of comparison the monthly net industrial wage was about \$220.

Figure 1
Generational pension accounts without and with pension reform
 (2000 present values)



Age -1 refers to future generations
bold curve: generational pension accounts without pension reform
regular curve: generational pension accounts after pension reform

Note that the unreformed system is inefficient even for the newborn. This rises further with age, as older children receive orphan benefits for an ever-shorter period. The greatest net contributors are the 24-year-olds. In practice they no longer receive orphan benefits, nor yet old-age nor disability pensions. For them it would require the immediate payment of a lump sum of more than \$6,020 to equalize lifetime contributions and benefits. This does not mean of course, that the current 24-year-old will necessarily end up worse off than the new-born generation. The careers of these two generations could only be compared if the account for the 24-year-old was calculated from the moment they were born as well.

For the 37-year-old, the account turns negative, i.e. they may start to expect more benefits from the system than contributions they have yet to make. Contributions and disbursements fall into balance at such an early age because without reform the time remaining before retirement is only twenty years for women and twenty-four for men, and disability pensions and other forms of early retirement reduce the active period even further.

Generational pension accounts favor the 61 age bracket the most. They have reached the point of paying almost nothing into the system, whilst they stand to withdraw \$21,530 over their remaining period in the pension system. Again we should note that this observation is not appropriate to describe redistribution among current generations. It is reviewed to serve as a base for the evaluation of changes produced by the introduction of respective reform measures.

In the above calculation, we took a look at how large the generational imbalance would be (apart from minor modifications to the retirement age) if no reform had taken place. Below, in the second run, not only are future demographic developments taken into account, but all aspects of institutional changes, Swiss indexation, the effects of further raising the female retirement age from 57, and male retirement age from 61 to 62; the phasing-out of progressiveness in the benefit formula¹²; the introduction of a new scale of accrual rates replacing the current one in 2013; the replacement of tax-free pension with taxable benefits and finally, partial pre-funding.

The impact of the pension reform on generational pension accounts

The second (thin) line of Figure 1 demonstrates that pension reform considerably reduced the severe imbalance originally prevailing in the system.¹³ Approximately three quarters of the net losses which were awaiting future generations were wiped out in consequence of the reform. The deficit fell from \$18,950 to \$5,510 (see the figures in Table 1). Most of the related costs are borne by the current active generations, however, to a lesser extent, primarily due to

¹² The pension formula is called progressive since it cuts from higher income brackets. So in the process of calculating the starting pensions the lowest bracket of the net income is taken in full, the second lowest in 90 per cent and so on.

¹³ Benczúr (1999) and Rocha and Vittas (2000) came to similar conclusions whilst applying different methods.

Swiss indexation, current pensioners also bear some of the costs. As mentioned before, this and all subsequent remarks about the effects of reform on intergenerational redistribution are

Table 1
Generational pension accounts for selected cohorts under different reform measures
(thousands of US dollars)

age of cohort	no reform	Swiss indexation	completed retirement age adjustment*	phasing out progressiveness from pension formula	new scale of accrual rates	partial pre-funding	complete reform
future	19.0	11.1	14.3	20.2	17.1	15.6	5.5
0	1.1	3.3	1.8	0.9	1.5	1.1	3.3
10	2.9	5.0	3.7	2.7	3.3	2.7	4.8
20	5.4	7.5	6.4	5.2	5.9	5.1	7.5
30	3.9	6.2	5.3	3.6	4.5	3.6	6.7
40	-2.0	0.3	0.0	-2.5	-1.1	-2.0	1.7
50	-11.0	-8.9	-8.6	-11.7	-11.0	-11.1	-7.2
60	-21.3	-19.7	-20.9	-21.6	-21.3	-21.3	-19.6
70	-16.9	-16.1	-16.9	-16.9	-16.9	-16.9	-16.1
80	-11.0	-10.7	-11.0	-11.0	-11.0	-11.0	-10.7
90	-6.4	-6.3	-6.4	-6.4	-6.4	-6.4	-6.3
absolute generational imbalance	17.9	7.8	12.5	19.3	15.6	14.5	2.2

Note: discount rate: 5%. productivity growth rate: 1.5%. real interest rate: 4%. population projection: Central Statistical Office Demography Research Institute.

** completed: the calculation started from 2000, so it does not take into account the effects of previous retirement age increases.*

subject to restrictions due to the assumption of generational accounting that all imbalances are covered by future generations. This does not contradict to the previous sentence. We compare two distinct computations and separately both are built on the assumption mentioned. A comparison of the resulting accounts gives some hints on intergenerational redistribution. Should the inter-temporal budget constraint of the model be supplemented with annual budget constraints, not only future generations, but all current generations would be made to defray the annual deficit on the basis of the current profile of net general taxes. By aggregating the annual supply of deficit (or redistribution of surplus) for all years, the redistributive effect of pension reform on any generation can be precisely determined.¹⁴

Besides the main result that long-term financial tensions decreased, another important conclusion is that in spite of the significant changes (on the baseline assumptions) the system still falls short of a clear balance. Newborn and future generations are expected to remain net contributors to the system, i.e. their contributions will produce negative real returns.

The introduction of the new rules on indexation into an expanding economy substantially alleviated the imbalance in the system. The sole beneficiaries of the change are future generations. As far as they are concerned, their overpayment under the no-reform scenario of \$18,950 falls to \$11,120, which is itself still high. For all other generations Swiss indexation reduces the amount of prospective pensions. The balance of contributions and benefits for the new-born rises from \$1,130 to \$3,270. Since the difference between the accounts of the zero-year-old and future generations is cut from both sides, the generational imbalance reduces from \$17,820 to \$7,840. This still does not represent a balance, it simply serves to diminish the disadvantage that the yet unborn have compared to the new-born.

The new indexation rule also raises the age at which individual contributions fall into balance with benefits. The age of the first generation that will take more out of the system in the future than it will contribute rises from the previous figure of 37 to 41. The 61-year-olds remain the greatest net beneficiaries, although they would receive a lump sum of just \$20,080 in compensation for the loss of their annuities. Among pensioners, the effect of indexation diminishes with age, as it applies to shortening periods.

Completing the adjustment to the retirement age realigns generational imbalance from \$17,820 to \$12,440, a smaller alteration that arose from Swiss indexation (though this may not be true for the impact of the full adjustment of the retirement age)¹⁵. Future generations as

¹⁴ A detailed analysis of intergenerational redistribution in public finances could be completed with the addition of private inter-vivos transfers and bequests. This would also allow a test of the Ricardian equivalence. See preliminary results by Medgyesi (2000).

¹⁵ Note that these results are not additive, as each effect is compared separately to the pre-reform situation.

well as the zero-year-olds are net contributors to the system. The as-yet unborn cohorts benefit from the higher retirement age, although practically no one else does. Net contributions of the zero-year-olds for instance, increase from \$1,130 to \$1,820 owing to the longer contributing period and shorter retirement, while for that of the greatest net contributors, i.e. those aged 24, rise from \$6,020 to \$7,190. As for the rest of their lives, the 40-year-olds are already net beneficiaries in the system. In contrast to Swiss indexation, the burden of raising the retirement age, being imposed as it is exclusively on the active generations, becomes more concentrated.

Legislators wanted the progressive nature of the benefit formula to be phased out gradually by raising annually the so-called progressive brackets by 8 percentage points above net income growth. By means of this discrepancy, the uppermost brackets will gradually "empty", and all income will eventually fall into the 100 percent bracket. In practice, we took the net contribution profile for the base year and raised the old-age pension of generations currently retiring each year at the above-mentioned rate.¹⁶

Phasing out progressiveness in the benefit formula, in contrast to the rest of the measures of the pension reform, does not diminish, but rather improves the position of all living, still active generations. Current pensioners are left unaffected. For future generations, however, phasing out progressiveness further increases the imbalance even though this change is not a major one. A further \$1,280 is added to the original deficit of \$18,950. Similarly, the gains of the current generations have no decisive impact on the balances emerging in default of the reform, either. The differences per generation vary from \$180 to \$690.

Of all measures of the pension reform, it is the effect of the new pension scale which is to replace the current one in 2013 that is the most difficult to quantify. In this case we cannot use the year 2000 pension profile, we need to modify it in accordance with the new scale. The new scale entails two significant changes. First, *accrual rates* (depending on the number of years of service) are new. They are specified by the law. Secondly, from 2013 the *pension base* (which is to be multiplied by the accrual rate to obtain the starting pension) will be determined on the basis of *gross* estimated lifetime income, and the resulting benefit will be taxed as personal income. This is contrary to the rules in force at present and until 2012, by

¹⁶ At this point we need to refer to a methodological problem, in particular the difference between the projection of current conditions and the projection of current changes. Considering changes occurring in the given year as a result of new retirements would effectively raise the average old-age pension of the given generations only according to the relative weight of starting pensions. However, in 1999 approximately only one third of the cohort reaching retirement age actually retired – the rest had retired early, that is, under the official retirement age. In order to avoid having the calculations distorted by one extreme year, data on the mean of many years' of new

which firstly the net base of the pension is determined and then multiplied by the accrual rate to yield the net pension. The post-2013 accrual rates are lower than the current ones, i.e. where the net pension base is equal, a smaller pension will result. The fact though that the taxable part is initially reduced on the basis of these rates, and only subsequently is the rest taxed, results in a lower average personal income tax rate, which in turn pulls the post-2013 starting pensions closer the present ones.

In order to grasp the effect in generational accounting, we calculated how the ratio of the net starting pension compared to the final gross income changes. The first step was to calculate the ratio for the currently retiring generations, drawing on data from 1998 (the figures used in the calculation were *generational* averages, and not the averages of *those currently retiring*). The value of the replacement rate was 0.409; as a generational average, it cannot be compared directly with other replacement ratios.

The corresponding replacement ratio for the year 2013 can only be calculated in a number of steps. The *final* monthly gross wage is provided on the basis of monthly wages in the base year and the growth rate of productivity. For the *lifetime* monthly gross wage however, only a rough estimate can be given. We assumed that the ratio of the final monthly gross wage to the lifetime monthly gross wage remains the same as in the 1988-1998 period. This latter calculation was computed on the basis of Toldi (2000), using his Tables 3, 1.15, 1.16 and 1.17. The value in question came to 0,907, covering the period through 1998, where the monthly average of the gross indexed lifetime wage equaled approximately 90 percent of the final monthly gross wage. This was the value we used to obtain lifetime monthly gross wages from final monthly gross wages after 2013. This latter serves as the basis for determining pensions after 2013 with the new accrual rates.

The starting pensions generated in this way were reduced by the average personal income tax. In order to derive the latter, we calculated the retiring generations' average gross as well as net wages for the year 1998, from the available APEH files.¹⁷ From these, the average tax rate came out at 30.1 percent.

This was how we came to have figures for net starting pensions as well as final gross wages for each generation, on the basis of the new pension scale. The rate of the two, the post-2013 counterpart of the replacement ratio used above, took a value of 0.366. So to sum

retirements is required. Unfortunately, no such data was available, so instead of the changes, the initial conditions were projected into the future at this point.

¹⁷ These wages are again *generational* averages, and do not necessarily equal the average final wage of *those imminently retiring*.

up, the new scale reduced starting pensions by an average of 10.5 percent for calculations based on 1998 figures.

This ratio was incorporated into the model in such a way that old-age pensions were cut by 10.5 percent on the profile of the base year for those generations whose members will already receive their pensions according to the new scale (i.e. those aged 49 and below in 2000). For this calculation also, we followed the method employed for the quantification of progressiveness, i.e. we applied the same rate for the entire generation, for the reasons specified in detail above.

The above methodological description also implies that the procedure, by which we used fully indexed wages to produce the lifetime gross wage, in practice solved the problem that, given decreasing inflation, partial indexation also exerts a depressing influence on the dynamics of starting pensions.

The beneficiaries of these changes are future generations, in other words, the introduction of the new scale improves the long-term sustainability of the system. The volume of changes roughly equals the impacts of phasing-out progressiveness, only one is positive and the other is negative. These two reform measures more or less cancel one another out, as far as the long-term effect is concerned. The same does not apply however to the intergenerational redistribution. While all active generations benefit from phasing-out progressiveness, the costs of the new scale will be borne exclusively by younger generations, those presently at the age of 49 or under. Those retiring in the decade preceding 2013 are the main winners from this discrepancy.

Partial pre-funding of the pension system – i.e. establishing private pension funds – raises a theoretical rather than methodological problem in generational accounting. A deficit evolves in social security, while capital is accumulated in the private pension funds. Both bear interest, therefore realistic assumptions are required regarding these interest rates.

According to our approach, the pension system (being an endowment life insurance combined with annuities) comprises two stages, accumulation and benefit payment, independent of whether the system is pay-as-you-go or funded. In the funded scheme, the period of accumulation is simply the accumulation of contributions in the course of one's active life. In a pay-as-you-go scheme the "fund" is the taxpaying capacity of the new up-coming generations that can be best approached by the covered wage bill as a proxy. Thus, accumulation is the process of bringing up and training new generations, enhancing the efficiency of their labor and collecting their payroll taxes. The optimal allocation of contributions should depend

on the comparative efficiency of these two kinds of accumulation provided annuities from the two schemes do not differ.

The empirical background for making assumptions on comparative efficiency is limited. We have data on the covered wage bill in Hungary only from the 1990s. Rocha and Vitas (2000) show that the covered wage bill declined from 31 percent of GDP in 1991 to 22 percent in 1998, a fall that was not compensated for by the 12 percent growth in GDP over the same period. In contrast, the BUX-index of the Budapest Stock Exchange closed in the year 2000 at 7850 points (its CPI corrected value was 2050). It began at 1000 points in 1991. These trends reflect significantly higher rates of return on private savings as compared to public investments in terms of taxpaying capacity, although the 1990s may give a distorted picture. Between 1947, the first year of the pay-as-you-go scheme and 1990, the covered wage bill may have grown much faster whereas the stock exchange did not exist in the centrally planned economy. So without venturing into actual figures we came to a conservative conclusion, that a combination of pre-funding and private management of savings brings additional efficiency to the system assumed to be closed. As for real figures we based our assumptions on international experiences. We set the average annual returns of private pension funds at 4 percent (also assuming additional administrative costs. Testing the robustness of our conclusion was particularly crucial at this point.

In order to incorporate the increase in efficiency into the conceptual system of generational accounting, we needed to come up with novel solutions for the inter-temporal budget constraint, that is the very fact that the system is closed, is a fundamental component of generational accounting.

The extra efficiency brought into the system can be combined with the framework of generational accounting in two ways. One possible variation is that contributors paying the same volume of contributions receive larger pensions. This refers to a (theoretically pure) situation in which private pension funds make investments exclusively abroad, that is fund accumulations come to take effect only when the first, higher pensions are paid out from them. The other way to incorporate the surplus resulting from the increase in efficiency is to assume the same pensions defrayed from lower contributions, i.e. there is an increase in efficiency right from the beginning. In other words, we assume that the part of the contributions which flow into private pension funds will work more effectively, which is how it may be interpreted as increased contributions. In this case, the generational accounts of those already in retirement do not change, the net contributions of the presently active cohorts rise, and consequently, due to the inter-temporal constraint, future generations face lower liabilities. It

should be noted that both methods are extraordinary to generational accounting, and depart from the methodologies applied up to now, yet by these procedures one may grasp the net effect of pre-funding on the positions of future generations. The calculation below was carried out on the basis of the second variation mentioned above.

The emergence of private pension funds affects the position of social security from two angles. First of all, contributions are lost to private funds in proportion to the number of individuals who switch to private contributions and the magnitude of membership fees. Secondly, according to the rules of switching, disbursements will also drop with time for those who have switched over to the mixed system.¹⁸

In calculating accumulations to private pension funds we used a uniform retirement age (62 years). We assumed contributions to private pension funds to yield interest until the individual reaches the age of 62, then everyone collects the accumulated wealth uniformly in a lump sum.

The figures in Table 1 suggest that partial pre-funding, on the assumptions made, brings about a significant net improvement in the accounts of future generations. Where contribution rates of 6 percent of gross wages are paid to private pension funds, members of the as-yet unborn generations have to pay \$3,320 less as compared to the case of no reform. The position of those born in 2000 remains practically the same as in the baseline case.¹⁹ Note that we have not provided estimates for prospective pensions, but for changes taking place in the balance of the pension system in consequence of any of the reform measures. Given contributions of 6 percent of gross wages, the difference between the generational accounts of those born in 2000 and the future generations is \$14,490, i.e. imbalance is reduced by \$3,330 as compared to our baseline.

Robustness of conclusions

Changing any of the assumptions does not affect the main conclusion, that the long-term balance significantly improves in consequence of reform although in most scenarios the newborn and the future cohorts will remain net contributors to the system, such that the internal

¹⁸ Our model cannot take account of the possible effects on redistribution of mistaken switches and the government guarantee on benefits. In addition, as private pension funds only pay the private pensions of old-age pensioners, and as prescribed by the transitional regulations presently in force, the accumulations on individual accounts of disabled fund members are transferred to ONYBA, we followed the same procedure.

¹⁹ The 5-year cycles of the values that do not fit into the trend arise from the fact that we only have switch rates in a 5-year breakdown.

rate of return will remain negative. Yet, the magnitude of improvement strongly depends on the parameters. Some important results of our sensitivity analysis are presented in Table 2.

It is the growth rate of productivity which the absolute generational imbalance is most sensitive to. If impacts of the reform are calculated at a growth rate of 2 percent rather than the base run's 1.5 percent, then the generational imbalance practically disappears (decreases from \$17,820 to \$-180, a relative surplus, that is the new-born cohort has to pay a shade more), even though the long-term indebtedness of the system does not fully evaporate. Future generations still have to pay more than they get back. Assuming a growth rate of 3 percent, the system almost achieves a long-term balance, i.e. the net contribution of future cohorts approaches zero (it falls to a mere \$1,125). There is a price to pay for this - cohorts already living have to pay higher net contributions. Higher productivity influences the generational accounts from two sides: a higher retirement age increases contributions whereas the combined price-wage indexation diminishes the benefits (in the unreformed system faster growth of productivity would simply increase generational imbalance, since benefits would increase even faster than contributions).

The choice of the discount rate has a much weaker influence on the results. For example, at a 4 percent discount rate the imbalance would be \$2,520 instead of \$2,170 and even at 3 percent, it would only grow to \$3,540.

Raising the contribution rate to the mandatory private pillar from 6 to 8 percent of gross wages would not influence the generational imbalance (it would remain \$2,170) but it would reduce the long-term indebtedness of the system. The generational account of future cohorts would decrease from \$5,510 to \$5,210.

Reducing the real rate of return of the second pillar from 4 percent to 1.5 percent, the speed of growth of productivity (maintaining the contribution rate at 6 percent of gross wages) has a similarly weak impact. The resulting generational imbalance would be \$2,150, practically the same as in the baseline reform scenario, while the generational account of future cohorts would increase by about 6 percent. Both results support the view that the partial pre-funding of the system contributed to an improvement in the balance, but the main effect was a downsizing in the social security system.

Table 2
Generational pension accounts: robustness of results
(thousands of US dollars)

<i>age of cohort</i>	<i>no reform</i> <i>r=5, g=1.5</i>	<i>reform</i> <i>r=5, g=1.5</i>	<i>reform</i> <i>r=5, g=1.5;</i> <i>contribution to</i> <i>private funds=8%</i>	<i>reform</i> <i>r=5, g=2</i>	<i>reform</i> <i>r=5, g=3</i>	<i>reform</i> <i>r=4, g=1.5</i>	<i>reform</i> <i>r=5, g=1.5;</i> <i>interest rate =1.5%</i>
future generations	19.0	5.5	5.2	4.0	1.1	6.2	5.8
0	1.1	3.3	3.0	4.2	6.6	3.7	3.7
10	2.9	4.8	4.4	5.7	7.8	5.0	3.8
20	5.4	7.5	7.0	8.1	9.7	7.3	4.0
30	3.9	6.7	6.4	7.0	7.6	5.7	4.2
40	-2.0	1.7	1.5	1.6	1.2	-0.2	4.4
50	-11.0	-7.2	-7.2	-7.7	-8.8	-9.6	4.5
60	-21.3	-19.6	-19.6	-20.1	-21.1	-21.6	4.6
70	-16.9	-16.1	-16.1	-16.3	-16.9	-17.1	4.8
80	-11.0	-10.7	-10.7	-10.8	-11.0	-11.1	5.1
90	-6.4	-6.3	-6.3	-6.3	-6.4	-6.4	5.2
absolute generational imbalance	17.9	2.2	2.2	-0.2	-5.5	2.5	2.2

r: discount rate; *g*: growth of productivity; rate of contribution to private funds is 6% of gross wage unless indicated otherwise; real interest rate is 4% unless indicated otherwise

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