MAGYAR TUDOMÁNYOS AKADÉMIA
KÖZGAZDASÁGTUDOMÁNYI INTÉZET

KTEI IE

INSTITUTE OF ECONOMICS
HUNGARIAN ACADEMY OF SCIENCES

MŰHELYTANULMÁNYOK **DISCUSSION PAPERS**

MT-DP – 2008/5

Underreported Earnings and Old-Age Pension: An Elementary Model

ANDRÁS SIMONOVITS

INSTITUTE OF ECONOMICS, HUNGARIAN ACADEMY OF SCIENCES
BUDAPEST, 2008

Discussion papers
MT-DP – 2008/5

Institute of Economics, Hungarian Academy of Sciences

Underreported Earnings and Old-Age Pension: An Elementary Model

András Simonovits
Institute of Economics, Hugarian Academy of Sciences
research advisor
E-mail: simonov@econ.core.hu

2008 May

ISBN 978-963-9796-17-1
ISSN 1785-377X

Underreported Earnings and Old-Age Pension: An Elementary Model

András Simonovits

Abstract

This paper analyzes the interconnections of underreported earnings, savings and old-age pension with the help of a most simple, elementary model. The workers can be divided into three groups: 1) well-paid who report their full earnings, 2) well-paid who report only the minimum earnings (evaders) and 3) the poorly paid. We assume that the evaders save a significant part of their hidden earnings for their old age. We compare three pension systems of equal size: (i) the proportional, (ii) the proportional plus basic pension and (iii) the proportional with means testing. Our major result is as follows: if the evaders can be recognized and excluded, then the means-tested system is superior to the basic system.

JEL: H55, D91

Keywords: reporting earnings, proportional pensions, basic pensions, means-assisted pensions.

INSTITUTE OF ECONOMICS, HUNGARIAN ACADEMY OF SCIENCES
BUDAPEST, 2008

Keresetbevallás és öregségi nyugdíj: egy elemi modell

Simonovits András

Összefoglaló

Ez a cikk a keresetbevallás, a megtakarítás és az öregségi nyugdíj kapcsolatát elemzi egy elemi modell segítségével. A dolgozók három osztályba sorolhatók: 1) a jól keresők, akik minden keresetüket bevallják, 2) a jól keresők, akik csak a minimális bért vallják be, 3) a minimálbért keresők. Feltesszük, hogy a járulékkerülők eltitkolt keresetük jelentős részét megtakarítják öregkorukra. Három azonos méretű nyugdíjrendszert hasonlítunk össze: (i) a bevallásarányost, (ii) az alapnyugdíjjal kiegészített bevallásarányost és (iii) a rászorultságival kiegészített bevallásarányost. Fő eredményünk: ha a járulékkerülők felismerhetők, és kizárhatók, akkor a rászorultsági nyugdíj előnyösebb, mint az alapnyugdíj.

JEL: H55, D91

Tárgyszavak: keresetbevallás, keresetarányos nyugdíjak, alapnyugdíjak, rászorultsági nyugdíjak

INSTITUTE OF ECONOMICS, HUNGARIAN ACADEMY OF SCIENCES
BUDAPEST, 2008

1. Introduction

There exist two pure forms of mandatory public old-age pension systems: the pension proportional to lifetime earnings (or contribution) and the basic benefit, paying a universal flat benefit. The *proportional pension* system transforms the workers' forced savings into pensions, proportionally to their lifetime earnings, while the *flat benefit*, paid independently of past earnings, dampens old-age poverty. The German and the Swedish systems are examples for the former, while the Czech and the Irish systems represent the latter. Of course, there exist a lot of combinations between these two extrema (see Disney, 2004). For example, the present Hungarian system—with simplifications—consists of a proportional system and of a basic system (Augusztinovics and Martos, 1996), which has been becoming more and more proportional since the reform of 1997/1998. The British system represents another type of combination, providing a flat benefit for everybody, and additional pensions are taken into account in means-testing.

An interesting debate has recently started in Hungary whether the phasing-out of the implicit flat component since 1998 was not an error which needs a quick correction. More precisely, the original system strongly favored workers with short lengths of employment and low earnings, and the future pension should be explicitly a sum of a flat and a proportional component. In this paper I try to debate this viewpoint and propose a much more modest and cheaper solution, namely means-testing, topping up only the low pensions due to genuine low earnings.

How do the proponents of the combined basic system argue? In her pioneering study, Mária Augusztinovics (2005) has shown that a large part of the cohorts retiring in the next decades will have quite low pensions. (For a newer treatment, see Augusztinovics and Köllő, 2008.) To avoid mass poverty, she proposed a significant scaling down of the present proportional benefits and contribution rate and introducing a universal flat benefit, to be financed from new taxes. An additional advantage of such a system is that however small contribution during however short period can be added to the flat base.

Barabás (2006) and Barabás et al. (2006) have a totally different starting point. According to Barabás, almost half the Hungarian contributors, 1.9 out of 4.3 million tax payers returned personal income tax files about or below the legal minimum wage in 2004. An additional problem arises that on average, the foregoing workers report only about 62 percent of the very minimum. According to Barabás et al., the Hungarian workers have already renounced the intergenerational pension contract, and the only solution is to withdraw to a universal flat system, phasing out entirely the proportional system, and reducing the pension burden. In the long run, everybody can do whatever he can and wants with his earnings above the modest minimum.

First, let us note that Barabás obviously exaggerates, because he calculates with 4.3 rather than 3.9 million contributors. His data evidently contains persons working on occasional work, mothers on maternity leaves etc. It is difficult to accept that these so-called minimum wage earners only reported about 62 percent of the legal minimum. It is another issue that 90 percent of the mass of 1 million so-called entrepreneurs only report a minimum wage. In a new work, Köllő (2008) has estimated a much lower share of underreported earnings than Barabás did. For a comparative analysis of the hidden economy of transitional countries, see also Lackó (2000). Anyway, that phenomenon induced the recent government decision that unless one can prove that he earns little, every entrepreneur should pay the double of the contribution due to the minimum wage! It should be also noted that reporting a minimum wage leads to a very low old-age pension in the proportional system.

It can be presumed that a large part of the workers reporting minimum or below minimum wage have really low earning; however, the other part earn well but making use of the possibilities, they only report the minimal part. These evaders underestimate the use of old-age pension, and only save a part of the hidden earnings for their old-age, and presume that the government will bail them out. Therefore they are not worried by evading contributions.

Other experts, including the present author, are afraid that the introduction of a significant universal flat benefit would impose a huge and unnecessary burden on the government budget and seriously weaken the incentives to contribute. For example, if only half of the underreporting 1 million workers have decent earnings, and save in a hardly acceptable way for their old-age, then providing them with a flat benefit of 40 thousands HUFs per month (all nominal values refer to 2004) would cost superfluously 40 thousand HUFs $\times$ 12 $\times$ 0.5 million $=$ 240 billion HUFs to the budget, about 10 percent of the total pension expenditure. On the other hand, the average monthly pension of 80 thousand HUFs might be diminished by 10–20 thousands HUFs during such a reform. In an unpublished study, Menyhért (2006) has already analyzed the issue in detail, and also preferred a means-tested system to a universal flat one. (An additional difficulty would arise at the introduction of universal flat benefits: it would require the proportional reduction of contributions to the mandatory funded pillar.)

We encounter a problem which is prevalent not only in Hungary, not even only in post-communist countries but in other parts of the world as well. For example, only about half of the workers participate regularly in the much publicized Chilean mandatory funded pension system, because the bulk of the self-employed cannot "afford" it. In the other Latin-American countries, the participation is even lower (Gill et al., 2005).

In the present paper we try to model these issues. In our elementary model, we shall distinguish two or three types of workers: the low-paid (L) and the well-paid (not denoted). Within the well-paid, we further distinguish the type who reports all his earnings (H) and the type who only reports a minimal earning (M), the evader or free-rider. (P. Mihályi noted that a fourth group can also be studied: people earning the minimal wage but reporting nothing.) We make a key assumption: the system is able to separate the underreporter and the poorly paid. We are aware that many experts oppose means-testing, because it is humiliating and costly. But here the size of benefit expenditure is not as small as in the case of the much-publicized free text-books, given to families having at least three dependent children. No, here we are speaking about

benefits amounting to 1–2 percents of the GDP, and the government has a good reason to do something. It is noteworthy that it took a long period when at least the present government decided to check if health-care card holders paid their contributions last month. Until now cards obtained 15 years ago were accepted without any problem, and probably a significant part of the workers avoid paying any health (and consequently pension) contribution.

We mention here three results: 1) In our model, where the evaders can be excluded, *the means-tested system is superior to the basic system.* 2) If the government cannot exclude the evader, then the generous means-tested system is perhaps even socially inferior to the basic one, since it directly rewards the free-rider. 3) The difference between the consumption vectors of the two systems is small if the free-rider determines his saving from his hidden earnings so as to make his old-age consumption independent of the pension system chosen by the government.

The issue of universal versus means-tested pension was already discussed by Friedmann and Cohen (1972): they suggested the replacement of the former by the latter, thus reducing the size of the welfare program. Modeling this choice, Feldstein (1987) introduced individual utility functions and social welfare function and proved a major result for a small but no negligible set of parameters: a means-tested pension can be socially inferior to a universal one, because (i) the former "may induce some utility-maximizing workers to save nothing" or (ii) to avoid (i), the means-tested benefit is set lower than socially optimal. Note that Feldstein has not considered the central issue of our problem: underreporting and earnings heterogeneity.

It is difficult to resist to the temptation of summarizing the evidence of the British pension system. Indeed, our questions have already been discussed in the context of the ongoing British reforms: the universal flat benefit has been topped-up since 1997 (means-testing) and it was relaxed by the introduction of a pension credit in 2003 (Clark and Emmerson, 2003 and Sefton et al., 2008). In more detail: the British state pension system provides practically a universal flat benefit to everybody, the purchasing power of which is constant since 1980. Its value was cc. 75 pounds in 2003 for a single person per week. Due to budgetary pressure, the Labour Party retained rather than raised the value of this quite modest amount, but topped it up by a *means-tested benefit*, with a limit cc. 25 pounds in 1997. If somebody had no additional pension income, or it was less than 25 pounds, then his basic pension and his other old-age income was lifted to 100 pounds per week.

Evidently, this system has not made the poorer workers interested in building up additional old-age entitlements. To weaken this conflict, in 2003 the British government introduced a *pension credit*, which took into account only 40 percent of the additional old-age income, up to 64 pounds. If somebody had a higher additional benefit than 64 pounds, then he did not receive anything. But if his additional income was lower than 64, say 30 pounds, then only 40 percent of 30 pounds, i.e. 12 pounds were deducted, i.e. he obtained $25 - 12 = 13$ pounds.

In a very sophisticated model, Sefton at al. demonstrated that the introduction of the pension credit raises the poor's savings but reduces the savings of the richer, hardly improving the overall situation.

Returning to our problem, note that for the time being, we have not assumed either individual or social optimization and neglected the choice between fully reporting or

underreporting. nevertheless, in a work-in-progress, I have found promising results with the use of so-called mechanism design (Mirrlees, 1971 and Diamond, 2003).

We shall outline the structure of the present paper. In Section 2 we shall discuss the model of the proportional system. Sections 2 and 3 analyze the models of the basic and the means-tested systems added to a proportional system, respectively. Section 5 displays numerical examples, while Section 6 concludes.

2. Proportional pensions

In our model, we make the following extreme, but still reasonable assumptions. The population is stationary, every young works, and every old retires. The workers work for R years, and the pensioners spend S years in retirement. Therefore the dependency ratio is $\mu = S/R$. Though the actual systems generally make an economically unsound distinction between employer and employee's contribution rate, we do not use this distinction. Economically the relevant wage category is the total wage cost, abbreviated here as *total wage*, notation: w. Everybody contributes τ part of his *reported* total wage into a pension account. (Beware: total refers to the category rather than the share of reported income to the true one.) There is no personal income tax, the health care contribution is outside of the model. We assume that the ratio of the reported to the true earning is independent of the pension system. For a while we fix the saving ratio of the evader, but later on we shall discuss its dependence on the chosen system. The pension system is in balance: its revenue (containing additional consumption tax) is equal to its expenditures.

In this model, we shall distinguish two or three types of workers: the poorly paid (L) and the well-paid (not denoted). Within the well-paid, we distinguish two subtypes: those reporting full earnings (H) and those who only report the minimal earnings (M). The frequency of the three types in the population is f_H, f_M and f_L, respectively generally positive numbers, exceptionally one of them can be zero. Their sum is 1: $f_H + f_M + f_L = 1$. Considering the employment as unity, the number of workers is equal to 1.

Approximating the present Hungarian system, at least what concerns the recent entry pensions, we assume that in the first model the pensioners receive benefits proportional to their reported earnings, notation: star. Let the contribution rate be τ^*. The actual earnings of the workers are $w_H = w_M$ and w_L; their benefits are b^*_H and $b^*_M = b^*_L$, respectively. Benefits are proportional to reported earnings: $b^*_H = \beta^* w_H$ and $b^*_M = b^*_L = \beta^* w_L$, where β^* denotes the *replacement rate* of the proportional system. If there were no actual and fictitious partial employment, then w_L would be the legal minimum wage, and its size would influence the level of formal employment. These important complexities will be neglected in the paper (see Kertesi and Köllő, 2003 and Tonin, 2005). We shall also need the aggregate reported and actual earnings, respectively:

$$W_L = f_H w_H + (f_M + f_L) w_L \quad \text{and} \quad W_H = (f_H + f_M) w_H + f_L w_L.$$

Since the system is balanced, we have $\tau^* W_L = \mu \beta^* W_L$. Therefore the following relation holds between the contribution rate τ^* and the replacement rate β^*: $\tau^* = \mu \beta^*$.

We can assume that those reporting their full earnings do not save for their old age, because their replacement rates are sufficiently high. In contrast, the evaders are assumed to save for their old age, proportionally from their hidden earnings, even if less than what the Social Security would force on them. Let $0 < \sigma < \tau^*$ be the saving ratio and let the annual saving be $\sigma(w_H - w_L)$. Simplifying the complex relationship between savings and dissaving, assume that the hidden saving during R working years allows for dissaving $\rho(w_H - w_L)$ during S retirement years. The efficiency ratio $\rho R/(\sigma S)$ can be less than or equal to or higher than 1. Young-age consumptions are equal to $c_H^* = (1-\tau^*)w_H$, $c_M^* = (1-\tau^*)w_L + (1-\sigma)(w_H - w_L)$, $c_L^* = (1-\tau^*)w_L$, respectively. Old-age consumptions are equal to $d_H^* = b_H^*$, $d_M^* = b_L^* + \rho(w_H - w_L)$ and $d_L^* = b_L^*$, respectively. The actual or reported low earning provides only low pension and moderate old-age consumption in the proportional system.

3. Introduction of a basic pension

As we have already mentioned in the Introduction, several experts (Augusztinovics, 2005; Barabás, 2006) see the way out of the emerging pension tensions in the scaling-down of the proportional system and a simultaneous introduction of a basic pension (notation: hat). In this Section we shall model such a reform. Let the basic flat benefit b_0 be given, and financed from a consumption tax with rate $\hat{\iota}$. Of course, everybody pays this proportional tax after spending money for consumption and for mathematically simplicity, we shall assume that the basic benefit is given in net term. The gross pensions are as follows:

$$\hat{b}_H = \hat{\beta} w_H + \frac{b_0}{1-\hat{\iota}} \quad \text{and} \quad \hat{b}_M = \hat{b}_L = \hat{\beta} w_L + \frac{b_0}{1-\hat{\iota}}.$$

In contrast with the pension contribution, it is assumed that it is impossible to avoid paying consumption tax. There is no aggregate saving in this model, therefore the aggregate consumption is equal to the aggregate output, i.e. the aggregate earnings. Since μ pensioners correspond to 1 worker, the tax equation is as follows:

$$\mu b_0 = \hat{\iota} W_H,$$

whence the tax rate can be directly computed. The down-scaled contribution $\hat{\tau} w$ only finances the reduced labor pension $\hat{\beta} w$: $\hat{\tau} W_L = \mu \hat{\beta} W_L$, i.e. $\hat{\tau} = \mu \hat{\beta}$.

For the sake of comparability, we assume that the aggregate pension expenditure is invariant:

$$\hat{\tau} W_L + \hat{\iota} W_H = \tau^* W_L.$$

Substituting $\hat{\iota}$ from the old equation into the new one yields

$$\hat{\tau} W_L + \mu b_0 = \tau^* W_L.$$

Hence the reduced contribution rate can be determined:

$$\hat{\tau} = \tau^* - \frac{\mu b_0}{W_L}.$$

To obtain a nonnegative contribution, one must assume $\mu b_0 \leq \tau^* W_L$, i.e. $b_0 \leq \tau^* W_L/\mu$.

The young-age consumptions are respectively equal to

$$\hat{c}_H = (1-\hat{\iota})(1-\hat{\tau})w_H, \quad \hat{c}_M = (1-\hat{\iota})[(1-\hat{\tau})w_L + (1-\sigma)(w_H - w_l)], \quad \hat{c}_L = (1-\hat{\iota})(1-\hat{\tau})w_L.$$

The old-age consumptions are respectively equal to

$$\hat{d}_H = (1-\hat{\iota})\hat{b}_H, \qquad \hat{d}_M = (1-\hat{\iota})[\hat{b}_L + \rho(w_H - w_L)], \qquad \hat{d}_L = (1-\hat{\iota})\hat{b}_L.$$

The benefit and the consumption of workers with low reported income (regardless of under- or fully reported) are sharply raised with respect to the proportional system, those of the type H are reduced.

4. The introduction of means-tested pension

Recapitulating the relevant parts of the Introduction, we can list several objections to the introduction of basic benefits: a) the fully reporting well-paid workers (H) receive much lower benefit than they would obtain in the proportional system; b) the underreporting well-paid workers (M) gain more than they lose, though they do not deserve the bonus. As a rule, in the present paper we shall consider a particularly favorable case for the means-tested pension (denoted by bar): the government is able to distinguish the needy (L) from the evader (M), and is able to introduce a targeted benefit. (At the same time, our model considers the distribution of underreporters as given, thus it favors the basic system.) We speak of *means-tested* benefit if only the L-type receives additional benefit, i.e. M- and H-types do not. (In the simulation, however, we make a short detour and in the last rows of Tables 1 and 2, we analyze the generous means-testing, where in addition to L, also M receives additional pension. Notation: $^{\circ}$). There exist now three types of benefits: $\bar{b}_H = \bar{\beta} w_H$, $\bar{b}_M = \bar{\beta} w_L$ and $\bar{b}_L = \hat{b}_L$, where of course, $\hat{b}_L > \bar{\beta} w_L$. We must calculate again the contribution and the tax rates. For simplicity, we neglected the difference between the net and gross benefits, its quantitative impact is negligible.

Now only the additional benefit of the needy is financed from taxes:

$$\mu f_L(\hat{b}_L - \bar{\beta} w_L) = \bar{\iota} W_H.$$

The contribution $\bar{\tau} w$ finances the proportional component $\bar{\beta} w$: $\bar{\tau} = \mu\bar{\beta}$. Inserting into the equation for invariant pension expenditure

$$\bar{\tau} W_L + \bar{\iota} W_H = \tau^* W_L,$$

yields

$$\bar{\tau} W_L + \mu f_L \hat{b}_L - f_L \bar{\tau} w_L = \tau^* W_L.$$

After arrangement, the contribution rate of the means-tested system is

$$\bar{\tau} = \frac{\tau^* W_L - f_L \mu \hat{b}_L}{W_L - f_L w_L}.$$

To have a nonnegative contribution rate, we must assume $\tau^* W_L \geq f_L \mu \hat{b}_L$. The formulas for young- and old-aged consumption are easily obtained. By excluding the free riders, the means-tested system only differs from the proportional one at a single point: it raises the pensions of the needy, while reduces the benefits of the well paid, regardless whether they report full or partial earnings.

5. Numerical examples

Since even our very simple model does not yield clear-cut results, it is worth of presenting numerical simulations. Since we have a very rude model, it is sufficient to use simple numbers. Length of employment: $R = 40$ years, time spent in retirement: $S = 20$ years, i.e. the dependency ratio: $\mu = 0.5$. Earning distribution: $w_H = 4$, $w_L = 1$. Note that the average reported wage is $W_L = 2.8$, which is largely consistent with the Hungarian data (again at 2004 prices): $2.8 \times 70,000$ HUF $= 196,000$ HUF. Contribution rate with respect to total wage: $\tau^* = 0.2$. (The traditional rate with respect to gross wage, assuming a rational, equalized employee and employer's rate, results in $0.2/0.9 = 22.2$ percent.) Then the net replacement ratio in the proportional system is equal to

$$\beta_n^* = \frac{\tau^*}{\mu(1-\tau^*)} = \frac{0.2}{0.5 \cdot 0.8} = 0.5.$$

We shall assume that the basic benefit is equal to the half of the average proportional pension: $b_0 = \tau W_L/(2\mu)$. A further assumption is: the contribution evader saves half the money what the Social Security would save for him from his hidden earnings: $\sigma = \tau/2$. By assumption, this rate is independent of the chosen pension system. We shall, however, relax this assumption at the end of the simulation.

First of all, we display the crucial parameters of the various runs in a table.

Table 0. *Runs and parameters*

Parameter	Type H share f_H	Type M share f_M	Type L share f_L	Saving rate σ
Base run	0.6	0.2	0.2	0.1
Full reporting	0.8	0	0.2	0.1
Every low earner evader	0.6	0.4	0	0.1
Endogenous saving rate	0.6	0.2	0.2	x

Base run

Let us start from the following distribution of types: $f_H = 0.6$; $f_M = 0.2$ and $f_L = 0.2$. First we shall present the parameters (Table 1) and the benefits of the evader in the three pension systems, then we turn to the consumption vectors (Table 2). The meaning of the last row will be explained later on.

Table 1. *Parameters of three pension systems (base run)*

Type	Contribution rate τ	Tax rate ι	The evader's benefit b_M
Proportional	0.200	0.000	0.400
Plus basic benefit	0.100	0.082	0.810
Plus means-tested benefit	0.184	0.013	0.368
Plus means-tested benefit $^{\circ}$	0.166	0.028	0.810

Rather arbitrarily we choose the parameters of the basic model so that in the system with basic benefit, on average, the proportional and the constant components be equal to each other. (By and large, this is true for the Swiss system.) Then the contribution rate is halved with respect to the proportional system, but a consumption tax with a rate 8.2 percent emerges. This system doubles the benefits of those reporting low earnings but does not make any distinction between full reports (L) and underreports (M).

This issue is solved by the introduction of a means-tested component: here the contribution rate significantly rises with respect to the basic system and the tax rate almost disappears: drops to 1.3 percent.

We now turn to the description of the consumption vectors, leaving aside the last row.

Table 2. *Characteristics of the three pension systems (base run, $w_L = 1$)*

Type	Young-age consumption			Old-age consumption		
	H c_H	M c_M	L c_L	H d_H	M d_M	L d_L
Proportional	3.200	3.500	0.800	1.600	1.000	0.400
Plus basic benefit	3.304	3.304	0.826	1.294	1.294	0.744
Plus means-tested benefit	3.221	3.470	0.805	1.455	0.956	0.800
Plus means-tested benefit $^{\circ}$	3.243	3.435	0.811	1.289	1.371	0.787

Of course, the benefits of H- and L-types—-apart from taxes—are equal to their old-age consumptions. In turn, the M-type saves half his earnings for his old-age, with the same efficiency as that of the Social Security. Although the insufficient saving rate of M reduces the replacement rate from 0.5 to 0.29, there is no reason to be afraid of M's starvation: his consumption is still 2.5 times of L's. It is striking that in the basic system, the consumptions of H and M coincide in both age-groups: $\hat{c}_H = \hat{c}_M$, $\hat{d}_H = \hat{d}_M$. The reason is simple: by chance, the saving rate is equal to the reduced contribution rate: $\sigma = \hat{\tau}$. If the saving rate changes or the efficiency of saving differs from the Social Security's, then this coincidence disappears. *The means-tested system is superior to that of the basic one, because the former supports the needy's old-age consumption but not the evader's.*

Since the calculation in terms of minimum wage may be difficult, we shall display the results of the base run in terms of the actual average earnings (Table 2).

Table 2.a. *The characteristics of the base run in terms of W_H*

Type	Young-age consumption			Old-age consumption		
	H	M	L	H	M	L
	c_H	c_M	c_L	d_H	d_M	d_L
Proportional	0.941	1.029	0.235	0.471	0.294	0.118
Plus basic benefit	0.972	0.972	0.243	0.381	0.381	0.219
Plus means-tested benefit	0.947	1.021	0.237	0.428	0.281	0.235

The following question naturally arises: what happens if the government cannot or does not want to exclude the evaders from the means-tested system? According to the marked rows (°) of Tables 1 and 2, the contribution rate is somehow reduced, the tax rate is more than doubled. The vector of young-age consumption hardly changes, but the old-age consumption of H drops from 1.45 to 1.29 units, while that of the free rider rises from 0.86 to 1.37 units, overtaking that of H. What a pity! Still, the needy's benefit hardy diminishes, i.e. it stays much above that in the basic system. In summary: *In this case, the generous means-tested system is neither superior nor inferior to the basic system.*

After this detour, we return to the sensitivity investigations: how strongly do our results depend on some parameters of our model? For example, what happens if everybody fully reports his earning, or just the opposite, there is no low-paid? Or what saving rule, i.e. saving ratio ensures the same old-age consumption for the evaders in all the three systems? Finally, what happens if the evaders do not save at all? For the sake of transparency, we keep presenting our results in two twin tables, but we skip the analysis of the generous means-tested system.

No evaders

We start our sensitivity analysis with the ideal case when there are no evaders: $f_H = 0.8$ and $f_M = 0$. We also keep the contribution rate $\tau = 0.2$ as in the proportional system, although there is another alternative: to fix the value of the total pensions. Table 3 contains the new parameters and Table 4 displyas the results.

Table 3. *Parameters of three pension systems (no evader)*

Type	Contribution rate	Tax rate
	τ	ι
Proportional	0.200	0.000
Plus basic	0.100	0.100
Or means-tested	0.165	0.035

Since the evaders disappeared, in the basic system the tax rate rose from 8.2 to 10 percent, but in the means-tested system from 1.3 to 3.5 percent, while the contribution rate diminished from 18.4 to 16.5 percent.

Table 4. *Characteristics of three pension systems (no evader)*

Type	Young-age consumption H c_H	M c_M	L c_L	Old age consumption H d_H	M d_M	L d_L
Proportional	3.200	–	0.800	1.600	–	0.400
Plus basic pension	3.240	–	0.810	1.280	–	0.740
Or means-tested	3.223	–	0.806	1.272	–	0.793

The modification of the consumption landscape is more complex. The proportional system is unchanged but in the flat system the well-paid's young-age consumption rises, its old-age counterpart remains unchanged, the low-paid's consumption pair remain more balanced. The advantage of the means-tested system over the flat one is significantly reduced, practically disappears, only the low-paid's old-age consumption rises somewhat.

Every "low-paid" is evader

We examine now the other extremum, namely when all the "low-paid" workers are evaders: $f_M = 0.4$, $f_L = 0$. (If the reader is worried that in this case, there is no asymmetric information, he can modify the set-up by allowing a tiny mass of L-types.) Then the means-tested system is by definition reduced to the proportional one (since there is no needy), therefore we drop this system. Table 5 presents the new parameters, while Table 6 displays the results.

Table 5. *Parameters of three pension systems (all evaders)*

Type	Contribution rate τ	Tax rate ι	Evader's benefit b_M
Proportional	0.2	0.000	0.400
Plus basic pension	0.1	0.070	0.802

There is only one interesting change with respect to the base run: the tax rate decreases from 8.2 to 7 percent.

Table 6. *Characteristics of the three pension systems (no evaders)*

Type	Young-age consumption H c_H	M c_M	L c_L	Old-age consumption H d_H	M d_M	L d_L
Proportional	3.200	3.500	–	1.600	1.000	–
Plus basic pension	3.348	3.348	–	1.304	1.304	–

We only discuss the change in the basic pension system: the H-type's consumption increases with respect to the base run. At the same time, the pitfalls of the basic pension becomes evident: the evaders exploit the full contributors.

Endogenous saving rate

Until now we have considered the saving rate as given. Now we drop this assumption and discuss the situation when the evaders choose their saving rates so as to make the old-age consumption independent of the pension system. With trial and error, we find that in a basic pension system the free rider's saving rate drops to 4.7 percent (from 10 percent of the proportional system), while in the means-tested system, it rises to 10.7 percent. Since this modification has no impact on the other parameters and variables, we unify the usual two tables into a shortened Table 7.

Table 7. *Evader's characteristics (endogenous saving)*

Type	Saving rate σ	Evader's consumption young-age c_M	old-age d_M
Proportional	0.100	3.500	1.000
Plus basic pension	0.047	3.449	1.002
Or means-tested pension	0.107	3.449	0.997

It is noteworthy that under endogenous savings, the difference between the young-age consumption vectors of the basic and the means-tested systems is minimal and M's young-age consumption is only 0.05 units lower than the proportional system's. With respect to the base run, however, the change is significant: in the basic system, M's young-age consumption modestly grows (from 3.3 to 3.45 units), but his old-age consumption significantly drops (from 1.29 to 1.0 unit). In the means-tested system, the change is even sharper: though the young-age consumption is essentially unchanged, the old-age consumption drops even more (from 1.37 to 1.0).

No voluntary saving

The following question can be asked: what happens if the evaders do not save anything at all: $\sigma = 0$? Similarly to the previous runs, it can be shown that the young-age consumption increases by 0.3 units, while its counterpart drops by 0.6 units – with respect to the base run. Then the government must help even the free rider, therefore the basic system is not that bad.

6. Conclusions

We have completed the analysis of our elementary model. We have proved that in our custom-made basic model, where the free riders can be excluded from the means-tested system but they save for themselves, regardless of the chosen pension system, the government should introduce a means-tested rather than a basic system. If the evaders cannot be excluded, then the ranking is not unequivocal. Finally, if the free rider's saving depends on the system, then the consumption differences between the two systems may even disappear.

We have neglected the issue of self-selection of the contribution evaders. Nevertheless, we have good reasons to assume that the lower the share of the proportional component in the total pension, the higher is the share of the evaders among the well-paid workers. The clarification of this issue is under way in another paper, where I apply the method of mechanism design (Mirrlees, 1971 and Diamond, 2003).

References

Augusztinovics, M. (2005): "The Missing Pillar", *Fultz, E. eds.* 379–395.

Augusztinovics, M. and Martos, B. (1996): "Pension Reform: Calculations and Conclusions", *Acta Oeconomica, 48 (1–2).*

Augusztinovics, M. and Köllő, J. (2008): Pension System and Fragmented Labor Market Careers, *Gál et al., eds.* 154–170.

Barabás, Gy. (2006): "Pension Reform in the Trap of Tax system and Low Employment", (in Hungarian) Portfolio Conference The Hungarian Pension Reform in International Mirror.

Barabás, Gy.; Bodor, A.; Erdős, M.; Fehér, Cs.; Hamecz, I. and Holczer, P. (2006): "The Benefit of Retirement", (in Hungarian) typescript. A shortened version: *Élet és Irodalom, 41.* October 13.

Clark, T. and Emmerson, C. (2003): "Privatising Provision and Attacking Poverty? The Direction of UK Pension Policy under New Labour", *Journal of Pension Economics and Finance, 2:1* 67–89.

Diamond, P. A. (2003): *Taxation, Incomplete Markets and Social Security, Munich Lectures*, Cambridge, MA, MIT Press.

Disney, R. (2004): "Are Contributions to Public Pension Programmes a Tax on Employment?" *Economic Policy 39*, 267–311.

Feldstein, M. S. (1987): "Should Social Security Means Tested?", *Journal of Political Economy 95*, 468–484.

Friedmann, M. and Cohen, R. (1972): *Social Security: Universal or Selective*, Washington: American Enterprise Institute.

Fultz, E., ed. (2005): *Pension Reforms in the Baltic States*, Budapest, ILO.

Gál, R. I; Iwasaki, I. and Széman, eds (2008): *Assessing Intergenerational Equity*, Budapest, Akadémiai Kiadó.

Gil, I. S.; Packard, T. and Yermo, J. (2005): *Keeping the Promise of Old Age Security in Latin America*, Washington, D.C. World Bank.

Kertesi, G. and Köllő, J. (2003): "Fighting Low Equilibria by Doubling the Minimum wage? Hungary's Experiment", Bonn, IZA's Discussion Paper.

Köllő, J. [2008]: Two Notes on Unreported Employment and Wages, "Incentives to work informally", World Bank and the Hungarian Prime Minister's Office.

Lackó, M. (2000): "Hidden Econmomy – An Unknown Quantity? Comparative Analysis of Hidden Economy in Transitional Countries", *Economics of Transition.*

Menyhért, B. (2006): "Basic Pension and Means-tested Pensions", (in Hungarian) typescript, Budapest, Budapest Corvinus University.

Mirrlees, J. A. (1971): "An Exploration in the Theory of Optimum Income Taxation", *Review of Economic Studies, 38*, 175–208.

Sefton, J.; van de Ven, J. and Weale, M. (2008): "Means Testing Retirement Benefits: Fostering Equity or Discourageing Saving?", 118, 556–590..

Tonin, M. (2005): "The Effects of the Minimum Wage in the Economy with Tax Evasion", Stockholm, IIES, Stockholm University.

Discussion Papers published since 2005

2005

Gusztav NEMES: The Politics of Rural Development in Europe. MT–**DP**. 2005/5

Gusztav NEMES: Integrated Rural Development – the Concept and Its Operation. MT–**DP**. 2005/6

JUHÁSZ Anikó –SERES Antal –STAUDER Márta: A kereskedelmi koncentráció tendenciái **MT**–DP. 2005/7

Hajnalka TARJÁNI: Estimating some Labour Market Implications of Skill Biased Technology Change and imports in Hungary. MT–**DP**. 2005/8

L. HALPERN – M.KOREN.- Á. SZEIDL: Import and Productivity. MT–**DP.** 2005/9

Szabolcs LŐRINCZ: Persistence Effects in a Dynamic Discrete Choice Model – Application to Low-End Computer Servers. MT-**DP.** 2005/10

Péter VIDA: A Detail-free Mediator and the 3 Player Case. MT-**DP.** 2005/11

László Á. KÓCZY: The Core Can Be Accessed with a Bounded Number of Blocks. MT-**DP.** 2005/12

Viktória KOCSIS: Network Asymmetries and Access Pricing in Cellular Telecommunications. MT-**DP.** 2005/13

István KÓNYA: Economic Development, Exchange Rates, and the Structure of Trade. MT-**DP**. 2005/14

Gábor G. SZABÓ – Krisztina BÁRDOS: Vertical Coordination by Contracts in Agribusiness: An Empirical Research in the Hungarian Dairy Sector MT-**DP.** 2005/15

Attila AMBRUS: Theories of Coalitional Rationality. MT-**DP.** 2005/16

Jin-Chuan DUAN – András FÜLÖP: Estimating the Structural Credit Risk Model When Equity Prices Are Contaminated by Trading Noises. MT-**DP.** 2005/17

Lawrence UREN – Gábor VIRÁG: Wage Inequality in a Burdett-Mortensen World. MT-**DP.** 2005/18

Berthold HERRENDORF – Ákos VALENTINYI: Which Sectors Make the Poor Countries so Unproductive? MT-**DP.** 2005/19

János GÁCS: The Macroeconomic Conditions of EU-inspired Employment Policies. MT-**DP**. 2005/20

CSATÓ Katalin: Egy fiziokrata: Paul-Pierre Le Mercier de la Rivière. **MT**-DP. 2005/21

2006

Krisztina MOLNÁR – Sergio SANTORO: Optimal Monetary Policy When Agents Are Learning. MT-**DP**. 2006/1

András SIMONOVITS: Social Security Reform in the US: Lessons from Hungary. MT-**DP**. 2006/2

Iván MAJOR - Why do (or do not) banks share customer information?. A comparison of mature private credit markets and markets in transition. MT-**DP**. 2006/3

Mária LACKÓ: Tax Rates with Corruption: Labour-market Effects. Empirical Cross-country Comparisons on OECD Countries. MT-**DP.** 2006/4

György MOLNÁR – Zsuzsa KAPITÁNY: Mobility, Uncertainty and Subjective Well-being in Hungary. MT-**DP**. 2006/5

Rozália PÁL - Roman KOZHAN: Firms' investment under financing constraints. A euro area investigation. MT-**DP**. 2006/6

Anna IARA: Skill diffusion by temporary migration? Returns to Western European working experience in the EU accession countries. MT-**DP**. 2006/7

György MOLNÁR - Zsuzsa KAPITÁNY: Uncertainty and the Demand for Redistribution. MT-**DP**. 2006/8

Péter BENCZÚR - István KÓNYA: Nominal growth of a small open economy. MT-**DP**. 2006/9

Gábor VIRÁG: Outside offers and bidding costs. MT-**DP.** 2006/10

Péter CSÓKA - P. Jean-Jacques HERINGS - László Á. KÓCZY: Coherent Measures of Risk from a General Equilibrium Perspective. MT-**DP**. 2006/11

Norbert MAIER: Common Agency with Moral Hazard and Asymmetrically Informed Principals. MT-**DP.**2006/12

CSERES-GERGELY Zsombor – CSORBA Gergely: Műkincs vagy működő tőke? Gondolatok a kutatási célú adatok hozzáférhetőségéről. **MT**-DP.2006/13

Dr. SERES Antal: Koncentráció a hazai kereskedelemben. **MT**-DP.2006/14

Balázs ÉGERT: Central Bank Interventions, Communication and Interest Rate Policy in Emerging European Economies. MT-**DP.**2006/15

Gábor BÉKÉS - Jörn KLEINERT - Farid TOUBAL: Spillovers from Multinationals to Heterogeneous Domestic Firms: Evidence from Hungary. MT-**DP.**2006/16

2007

Mirco TONIN: Minimum Wage and Tax Evasion: Theory and Evidence. MT-**DP**.2007/1

Mihály LAKI: Evolution on the market of foreign language teaching services in Hungary. MT-**DP**.2007/2

VINCZE Péter: Vállalatok tulajdonosi irányításának változatai. **MT**-DP.2007/3

Péter CSÓKA - P. Jean-Jacques HERINGS - László Á. KÓCZY: Stable Allocations of Risk. MT-**DP**. 2007/4

Judit TEMESVÁRY: Signal Extraction and Hyperinflations with a Responsive Monetary Policy. MT-**DP**. 2007/5

Péter KARÁDY - Ádám REIFF: Menu Costs and Inflation Assymmetries. Some Micro Data Evidence. MT-**DP**. 2007/6

Mária LACKÓ: Interrelationships of the Hidden Economy and Some Visible Segments of the Labour Market. MT-**DP**. 2007/7

HERMANN Zoltán: Iskolai kiadási egyenlőtlenségek, 1992-2005. **MT**-DP.2007/8

2008

CSERES-GERGELY Zsombor - MOLNÁR György: Háztartási fogyasztói magatartás és jólét Magyarországon. Kísérlet egy modell adaptációjára. **MT**-DP.2008/1

JUHÁSZ Anikó – KÜRTI Andrea – SERES Antal – STAUDER Márta: A kereskedelem koncentrációjának hatása a kisárutermelésre és a zöldség-gyümölcs kisárutermelők alkalmazkodása. Helyzetelemzés. **MT**-DP.2008/2

Ákos VALENTINYI – Berthold HERRENDORF: Measuring Factor Income Shares at the Sectoral Level. MT-**DP.**2008/3

Pál VALENTINY: Energy services at local and national level in the transition period in Hungary. MT-**DP**.2008/4

Discussion Papers are available at the website of Institute of Economics Hungarian Academy of Sciences: http://econ.core.hu