Impact of the Slovak Social Security Reform on the Net Marginal Social Security Tax Rates

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ABSTRACT

Many alternative reforms have been proposed to restore the financial sustainability of the traditional PAYG systems, which is an urgent problem of many countries these days. However, the proposed reforms differ in their impact on labor market distortions. The Slovak social security reform of 2003, which introduces a 3 pillar social security system, was recommended by the World Bank and many countries are considering this type of reform. The proposed research will examine the effect of this reform on labor market distortions, specifically I compute the incremental tax rates and net marginal social security tax rates implied by the old and the new social security system for various population groups and compare them. The main preliminary findings are that the differences in tax rates between men and women as well as between agents of the same sex and different age have significantly narrowed due to the reform. Also, the new system is (almost) completely linear, thus there is no progressivity in the system.
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1 **INTRODUCTION**

The ambitious and radical economic policy reforms introduced in 2003 in Slovakia are frequently given as an example to be followed for other countries, in particular for those with similar characteristics such as the Czech Republic.\(^1\) In my research I concentrate on one of the most important reforms - the social security reform, which was in line with the World Bank proposals.\(^2\) Specifically I analyze the change in the net marginal social security tax rate and incremental tax rate\(^3\) structure as implied by the social security reform. Differences in these tax rates across income-demographic groups are one of the sources of labor market distortions as argued e.g. in Browning (1975) or Kotlikoff (1996). Thus if the tax rates differences were reduced due to the reform, the labor market distortions would be reduced too and vice versa. Moreover, the degree of progressivity implied by the tax rate schedule is important from the political point of view.

Therefore, the results of this research may be useful for many governments around the world that will sooner rather than later have to introduce reforms to current PAYG system because they are financially unsustainable.\(^4\) The primary goal of these reforms – long run financial sustainability, can be achieved by taking a number of different ways with different degree of implied labor supply distortions and different degree of progressivity in social security taxation. So a government that is deciding among various proposals that would restore long run financial sustainability of the system should choose the proposal that minimizes the net marginal social security tax rate differences because these are the source of labor market distortions.\(^5\) Alternatively, the government may want to maintain a certain degree of progressivity in social security taxation for political reasons even though it means larger labor market distortions.

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1 The World Bank has repeatedly named the Slovak Republic “the world’s leading reformer”, see e.g. publications at the World Bank website devoted to Slovakia. Or see e.g. Dušek, Jurajda (2004), p. 38, p. 58.  
2 The main feature of this reform was the substitution of a 1-pillar, mandatory PAYG system by a 3-pillar system. The three pillars are the 1\(^{st}\) mandatory non-funded PAYG, the 2\(^{nd}\) mandatory fully funded and the 3\(^{rd}\) voluntary fully funded pillar. The details of the reform will be discussed later.  
3 Loosely speaking, the net marginal social security tax rate is defined as the difference between the marginal social security tax rate and the present value of future benefits due to an additional unit of earnings. Incremental tax rate is defined as the difference between the social security taxes paid and the present value of future benefits due to an additional year of work.  
4 The main reason for the financial unsustainability of the traditional social security systems are current demographic trends – less children are born and people live longer, in sum the ratio of productive people who contribute to the social security system to retired people who receive benefits from the social security system is steadily decreasing. Chren, Švejna (2004) argue that whereas the ratio of retired to productive people in Slovakia is now 72, in 2040 it would be 136.  
5 This view is a bit simplified, of course. There are other variables that have a positive weight in the government’s objective function, such as the level of taxes and benefits, but let me neglect them for now.
The Slovak social security reform is one possible way how to achieve the long run financial sustainability and my analysis evaluates it precisely in terms of net marginal social security tax rate structure and progressivity of taxation changes. So it may help governments considering various reform proposals determine whether the Slovak reform is an example they want to follow or not.

Finally, net marginal social security tax rates and incremental tax rates are also important if one wants to analyze effects of taxation on labor supply in general, because they should be accounted for in the analysis if one wants to obtain precise estimates of these effects.

My paper has the following structure. First, I briefly discuss the existing relevant literature and the place of my research in thus literature. Then I describe the Slovak social security system and recover the tax rates formulas implied by the system, both before and after the reform. Next I show how the population groups will be defined and what variables and how will have to be calibrated. Finally, I discuss the data used. With all this information at hand the net marginal social security tax rates are computed. Section 8 concludes.

2 RELATED RESEARCH

The phenomenon of the wide range of net marginal social security tax rates over demographic groups was extensively documented for the USA. Feldstein and Samwick (1992b) compute the net marginal social security tax rates for as many as 72 income-demographic groups. Their main qualitative findings are that the net marginal social security tax rates decrease with age, which distorts labor supply towards working more at higher ages and that the net marginal social security tax rates are much higher for dependent spouses than for primary employees, which distorts labor incentives and division of labor inside households. They also find that the net marginal social security tax rates increase with income. Armour and Pitts (2002) extend this analysis by accounting for differences in life expectancies across income groups. This substantially reduces differences across income groups in terms of the net marginal social security tax rates.

The case of Slovakia is more interesting than the case of the USA from both the scientific and policy point of view, precisely because of the introduction of social security
The primary motivation for the social security reform was the financial unsustainability of the old PAYG system, caused by current demographic trends. However, the reform has other important effects besides the intended long run financial stabilization of the PAYG pillar. Melicharčík and Ungvarský (2004) compare the replacement ratios in the old system to those in the new system under several asset return scenarios. This is an important issue at both the micro and macro level because current contributors younger than 52 are allowed to decide whether they will enter the new 3 pillar system or remain in the reformed 1 pillar system. Since the tax rates are virtually equal in the old and the new system, this decision will be based precisely on the comparison of benefits in the two systems. The authors conclude that while the replacement ratios are constant over participants in the reformed 1 pillar system, in the new system they increase with asset return and the duration of participation in the system and they decrease with retirement duration. One can therefore expect older people to remain in the system and younger people to enter the new system. The macro effect of these decisions is their effect on the overall financial balance of the 1st non-funded PAYG pillar. It is worth stressing that people who enter labor force after the reform have to take part in the 3 pillar system. So Slovakia is currently experiencing a long transition period at the end of which there will be only the 3 pillar social security system.

To my knowledge, no research has been done for Slovakia as regards labor market distortions and the effect of the current social security reform on these distortions. Such research would complete the picture offered by Melicharčík, Ungvarský (2004) in the sense that it would analyze other important effect that the reform had. In order to fill in this gap, I compute the net marginal social security tax rates and incremental tax rates for various income-demographic groups in the old system and in the new 3 pillar system and the reformed 1 pillar system and compare them. Through the establishment of the 2nd pillar, the new 3 pillar system introduced a direct link between one’s contributions and benefits. Therefore, one would expect the distortions implied by the net marginal social security tax rates structure to decrease due to the reform, i.e., the tax rate differences across income-demographic groups should decrease in the 3 pillar system compared both to the old system and to the reformed 1 pillar system, which is what I have also found in the data. My analysis also confirms that progressivity of the social security taxation has decreased due to the reform.

As argued above, what makes the Slovak reform even more attractive for researchers is that it was line with the World Bank’s recommendations as regards the social security reforms that many other countries are considering. See for example the World Bank’s website on Slovakia. The complete link can be found in the references.
3 METHODOLOGY

In this section I will describe the net marginal social security tax rate and the incremental tax rate.

3.1 INCREMENTAL TAX RATE

The incremental tax rate for the year \( t \) is given by:

\[
ITR_t = \frac{T_t - \frac{\partial EPVB}{\partial t}}{PGW_t} = \frac{T_t - \sum_{j=t}^{\infty} \frac{P(j/t)}{\prod_{k=t}^{j} (1 + i_k)} \frac{\partial EB_j}{\partial t}}{PGW_t},
\]

(3.1)

where \( T_t \) is the amount of taxes paid from one’s gross wage in year \( t \),

\( PGW_t \) is the personal gross wage in \( t \).

In fact \( T_t / PGW_t \) corresponds to the flat tax rate for people under the cap.

\( \frac{\partial EPVB}{\partial t} \) is the change in expected present value of benefits due to working an additional year,

\( P(j/t) \) is the probability that the agent survives until age \( j \) given that she lives at time \( t \).

\( i_k \) is the nominal discount rate and therefore it is not constant. It is the sum of the real discount rate which is constant and the expected inflation rate which is not constant; \( i_t = 0 \).

\( \frac{\partial EB_j}{\partial t} \) is the expected change in benefits at time \( j \) due to working an additional year in time \( t \). The benefits will take the form of the benefits from the 1st PAYG pillar (old system and reformed 1 pillar system) or the sum of the benefits from the 1st pillar and the annuity from the 2nd pillar (the new 3 pillar system).

It is worth mentioning that \( \frac{\partial EB_j}{\partial t} \) can be positive, zero or negative. It is positive e.g. if a person is increasing her future benefits due to additional work. It will be zero if e.g. the individual is not allowed to get her benefits before the retirement age. Then all benefits before the retirement age don’t change – remain zero. Finally, it is negative if e.g. due to working an additional year after retirement age, the person loses the benefits in this one year.

3.2 NET MARGINAL SOCIAL SECURITY TAX RATE

The net marginal social security tax rate is based on a similar idea. The difference from the \( ITR \) is that the number of years worked is considered fixed now and we consider the change in benefits due to an additional unit of earnings. Earnings at time \( t \) will be denoted as \( pgw_t \), as a
The net marginal social security tax rate is given by the following formula:

\[ NT_i = m_t - \frac{\partial EPVB}{\partial pgw_i} = m_t - \sum_{j=1}^{J} \prod_{k=1}^{K} (1 + i_k) \frac{\partial EB_j}{\partial pgw_i}, \]  

(3.2)

where \( m_t \) is the marginal tax rate at time \( t \) which equals to the flat tax rate for people under the cap and zero for people over the cap. The rest of the variables are defined above.

4 SLOVAK SOCIAL SECURITY SYSTEM

In this chapter I will describe the Slovak social security system prior and after the reform. I will explain how the rules of the systems influence the computation of the tax rates defined above. Let me begin with a simple issue which was the retirement age change.

4.1 RETIREMENT AGE CHANGES

Table 1 summarizes the structure of retirement ages across people in the Slovak social security system before and after the reform. The increase in retirement age will be gradually phased in starting in 2003; every year the retirement age will increase by 9 months until it reaches 62 for every group. In the computations I will abstract from the phase in issue and assume the phase in is complete. I justify this simplification by the fact that I am interested in what the systemic change has done in general rather than what the effect of the temporary phase in was.

Table 1: Retirement age changes

<table>
<thead>
<tr>
<th></th>
<th>Before the reform*</th>
<th>After the reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>60</td>
<td>62</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 children and more</td>
<td>53</td>
<td>62</td>
</tr>
<tr>
<td>3 or 4 children</td>
<td>54</td>
<td>62</td>
</tr>
<tr>
<td>2 children</td>
<td>55</td>
<td>62</td>
</tr>
<tr>
<td>1 child</td>
<td>56</td>
<td>62</td>
</tr>
<tr>
<td>no children</td>
<td>57</td>
<td>62</td>
</tr>
</tbody>
</table>

in the old system, occupations were further divided into categories; employees who spent a given amount of years in heavy industry were allowed to retire sooner, which was true mainly for men

Source: Social Security Agency.
### 4.2 Taxes in the Slovak Social Security System

Table 2 describes taxes in the Slovak social security system.

<table>
<thead>
<tr>
<th>Table 2: Taxes in the Slovak social security system</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pillar</strong></td>
</tr>
<tr>
<td>Old system</td>
</tr>
<tr>
<td><strong>New system choices</strong></td>
</tr>
<tr>
<td>Staying in 1 pillar system</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Entering the 3 pillar system</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

* including disability and survival insurance and reserve fund contributions
** participation is voluntary

Source: Social Security Agency.

Several comments apply to Table 2.

1. Taxes are paid from gross wage.
2. Income up to 8 times the minimum wage was subject to social security taxation before the reform, whereas after the reform the threshold is three times the average wage. This is a significant increase since the minimum wage in 2003 was SKK 4,000 implying a threshold of SKK 32,000 whereas the average wage in 2003 was roughly SKK 15,000 implying a threshold of SKK 45,000.
3. After the reform, in both systems one of the parents can deduct 0.5% of gross wage to be paid in taxes for the first pillar for every child, which was not possible before. For simplicity I will assume that a woman has 2 kids, thus paying 1% less in taxes.
4. I will assume full incidence of social security taxes on workers as suggested by other studies (e.g. Feldstein, Samwick, 1992a).
5. The contributions in the old system were not divided as regards their purpose. Therefore I will assume that the disability and survival insurance was 3% + 3% as in the old system and I will not consider it in my analysis. Similarly, I will assume that the reserve fund contributions were 4.75% + 0% in the old system and I will not consider them in my analysis. This implies a net social security tax rate for the purpose of old age insurance of 17.25% in the old system and 18% in the new system.
6. As the 3<sup>rd</sup> pillar of the new 3 pillar system is only voluntary, I will not consider it in my analysis.
To use the above information in the equations, I will simply plug in the flat tax 17.25% for the old system and 18% for the new system for the marginal tax rate for individuals with wage below the threshold – SKK 32,000 and SKK 45,000 respectively. People with earnings above the threshold face marginal tax rate 0. The amount of taxes paid $T_t$ needed in the $ITR$ formula will be computed in the same fashion. Now I will discuss benefits in the Slovak social security system before and after the reform. Let me mention at this point that social security benefits are neither taxed now, nor were they taxed before the reform.

### 4.3 Benefits before the reform

Before the reform, the structure of benefits was based on the Czechoslovak law number 100/1988 which was frequently amended, mostly by ad hoc increases in benefits. The basic structure with the appropriate necessary definitions looked as follows.\(^7\)

#### 4.3.1 Basic structure

AMI – average monthly income was calculated as an average of the 5 best years out of 10 years before retirement (the year when the individual starts collecting benefits doesn’t count); if there were less than 5 years with income during the last 10 years before retirement, previous years were included as well.

AAMI – average adjusted monthly income; the first SKK 2,500 were accounted fully, the amount between SKK 2,501 and SKK 6,000 was accounted as one third and the amount between SKK 6,001 and SKK 10,000 was accounted as one tenth. Income over 10,000 was not considered at all. These rules implied a maximum $AAMI = 2,500 + 1,167 + 400 = 4,067$. As a consequence of inflation, this rule was becoming more and more binding over time. The following formula summarizes the above discussion.

$$
AAMI = \min(2500, AMI) + \frac{1}{3} \cdot \max[0, \min(6000, AIME) - 2500] + \frac{1}{10} \cdot \max[0, (AIME - 6000)]
$$

$N$ - participation, insurance period that covers in principle all years in which the person was working. For a person to be eligible for regular benefits, $N$ was required to be at least 25. People with $N < 25$ were entitled to lower partial benefits that will be discussed below.

The regular benefits were calculated using the formula:

---

However, there was a complicated system of extra benefits based on two principles. First, individuals who worked more than 25 years and workers in heavy industry received extra benefits. Moreover there was a minimum (550 SKK) and maximum pension provision.\(^8\) These rules are summarized in the following table.

Table 3: Additional rules in the old system\(^1\)

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Retir. age</th>
<th>Years(^2)</th>
<th>AAMI rule</th>
<th>Extra benefits(^3)</th>
<th>(\Delta) for a year</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia Uranium mines</td>
<td>55</td>
<td>10</td>
<td>(P = AAMI \cdot 0.6)</td>
<td>20</td>
<td>2%</td>
<td>9219</td>
</tr>
<tr>
<td>Ib Mines</td>
<td>55</td>
<td>15</td>
<td>(P = AAMI \cdot 0.6)</td>
<td>20</td>
<td>2%</td>
<td>9219</td>
</tr>
<tr>
<td>Ic Heavy construction,</td>
<td>55</td>
<td>15</td>
<td>(P = AAMI \cdot 0.6)</td>
<td>20</td>
<td>2%</td>
<td>9219</td>
</tr>
<tr>
<td>chemistry, pilots etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Id Chemical industry etc.</td>
<td>58</td>
<td>20</td>
<td>(P = AAMI \cdot 0.6)</td>
<td>20</td>
<td>2%</td>
<td>8111</td>
</tr>
<tr>
<td>II</td>
<td>60</td>
<td>20</td>
<td>(P = AAMI \cdot 0.55)</td>
<td>20</td>
<td>1.5%</td>
<td>7309</td>
</tr>
<tr>
<td>III</td>
<td>60</td>
<td>25</td>
<td>(P = AAMI \cdot 0.5)</td>
<td>25</td>
<td>1%</td>
<td>7112</td>
</tr>
</tbody>
</table>

\(^1\) Armed forces and police were usually considered as category Id, from considered as Id or II depending on the rank, from 1999 as III.

\(^2\) Number of years necessary for a given occupation in order to be eligible for the AAMI formula in the next column.

\(^3\) If the number of years worked in the given category was greater than this number, every additional year increased the benefits by the percentage in the next column times AAMI.


The maximum increase in benefits due to working more than 25 years was 25% of AAMI, 30% of AAMI for some workers from the I. category, was not limited for other workers from the I. category.

4.3.2 Abolishment of the categories in 2000

A great simplification for the current analysis is that occupations were considered as category III starting from 2000 which means that the same rules applied to an additional SKK of earnings or an additional year worked for all occupations in 2003 which is going to be the base year of the analysis. Therefore I will consider everyone being in the III category.

4.3.3 Valorizations

Moreover, there were frequent amendments to the law. By law, benefit adjustments had to be made if cost of living increased by more than 10% or wages by more than 5%. Benefits were then increased either by a fixed amount if the reason was the cost of living increase or by a

---

\(^8\) I will not explicitly consider the minimum pension provision in my analysis. However, the maximum pension provision is quite important because for people with higher earnings it was often binding.
proportion of the already assigned benefit if the reason was the wage increase. However, the exact size of these benefit adjustments was not given by law and was frequently used as a political tool. Examples of these ad hoc increases are given in the table below.

**Table 4: Benefit adjustments in the old system**

<table>
<thead>
<tr>
<th>From</th>
<th>Pension approved</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>All</td>
<td>Complicated structure, see $146 and $159</td>
</tr>
<tr>
<td>06/1992</td>
<td>1991</td>
<td>30</td>
</tr>
<tr>
<td>06/1992</td>
<td>1992</td>
<td>270</td>
</tr>
<tr>
<td>03/1993</td>
<td>till 02/1993</td>
<td>270 + 3%</td>
</tr>
<tr>
<td>03/1993</td>
<td>03 – 12/1993</td>
<td>20%</td>
</tr>
<tr>
<td>01/1994</td>
<td>1994</td>
<td>300 + 16% (the 300 included)</td>
</tr>
<tr>
<td>01/1997</td>
<td>1997</td>
<td>46.8% + 683</td>
</tr>
<tr>
<td>01/2003</td>
<td>2003</td>
<td>112.1% + 1270</td>
</tr>
</tbody>
</table>


Eventually, one’s benefits were determined by a sum of a fixed amount as given by the amendments above plus the initial benefit computed as a proportion of the AAMI as implied by the formula above plus a given percentage of the initial benefit as defined by the amendments. To use the above information to compute the change in expected present value of benefits in equations (3.1) and (3.2) I will proceed by taking into account the last adjustment of pension benefits valid for benefits acknowledged in 2003 by laws 306/2002 and 639/2002. The final initial benefit assigned by this law in 2003 was (using the definition of \( P \) from equation 5.1): \[ B_{2003} = P + 1.121 \cdot P + 1,270 = 2.121 \cdot P + 1,270. \] (4.2)

These adjustments were designed to keep in line benefits with inflation and wage increases, however, they were also designed to account “fairly” for past earnings of someone who is just being calculated her initial benefits. These earnings have been namely depreciated by the high inflation in the 1990’s. More importantly, these adjustments also dealt with the issue, that the thresholds for computing the AAMI, in particular the top one were becoming more and more “unrealistic”.

Still, I need to model the expected future adjustments of the benefits. I will assume that\(^9\) benefits will be growing by Swiss indexation. In other words, an individual will expect

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\(^9\) I admit that this is a great simplification. Most importantly, it is obvious that the SKK 10,000 cannot be kept in long run.
benefits at time $t$ to be equal to benefits at time $t-1$ increased by the average of inflation and wages at time $t-1$:

$$B_t = \left[0.5 \cdot (1 + dCPI_{t-1}) + 0.5 \cdot (1 + dAGW_{t-1})\right] \cdot B_{t-1}. \quad (4.3)$$

This assumption is also supported by the data. If we set the Swiss index to 100 in 1993 then it is 228.6 in 2002. Setting the average worker’s pension to 100 in 1994 gives 224.5 in 2003. So the average increase in the Swiss index corresponds almost perfectly to the average increase in the average pension. If we compare growth rates in these years, it shows up that the growth rate of average pension is on average only 0.2 percentage points lower than the growth rate of the Swiss index. Therefore, I conclude that the Swiss indexation is a reasonable assumption. Moreover, one could argue in favor of this specification by pointing out that the Swiss indexation is used in the reformed PAYG system, so probably, if the old system was kept, the government would be adjusting pensions in a similar fashion. Finally, this scenario is indirectly justified by the above mentioned law. Consequently the formula for computing the expected present value of benefits will then be (I will be using the year 2003 as a base year):

$$EPVB_{2003} = \sum_{j=2003}^{P(j/2003)} B_j \cdot \prod_{k=2003}^{j-1} \left(1 + \frac{\left[0.5 \cdot (1 + dCPI_j) + 0.5 \cdot (1 + dAWG_j)\right]}{1 + i_k}\right), \quad (4.4)$$

where $B_j$ is the benefit in year $j$ and evolves in the following way:

$$B_j < 2003 \rightarrow before \quad \text{the individual decides to retire.} \quad B_{2003} \rightarrow after \quad \text{is given by formula (4.2).}$$

Note that the formula tacitly assumes that the individual will retire no earlier than 2004.

As a result of the complicated structure, the benefits were hardly connected to one’s earnings. An additional unit of earnings did not entitle an individual with average monthly earnings over the best five years greater than SKK 10,000 to any additional benefits at all. So, the net marginal social security tax rate was the entire gross tax rate. For example in 2003 the average wage in Slovakia was SKK 14,345. Of course, the distribution of wages is not symmetric, but still it is obvious that the NMSSTR for an important proportion of people was the full social security tax rate. Moreover, this proportion was growing with inflation. In fact, the same applies to the majority of people, since only the best 5 years mattered and they were taken from the last 10 years before retirement. Therefore it seems more relevant to look at the ITR’s. Note that working an additional year changes future benefits (almost) always, since $N$, the number of years, increases.
4.3.4 Partial benefits

A male individual who was employed for at least 10 years (20 years for women\(^{10}\)) and is at least 65 years (60 for women) is entitled to partial benefit given by:

\[ B = AAMI \cdot 0.02 \cdot N \]  \hspace{1cm} (4.5)

Clearly by reaching \( N = 25 \) the equations becomes standard.

4.3.5 Late and early retirement

Benefits of individuals, who worked even though they were entitled to full benefits and didn’t collect them, were increased by 1.5% of AAMI for every additional 90 working days, i.e. by 6% of AAMI for an additional year. However, there is not the 1% increase in working one more year. Moreover, the AAMI was computed either from the period before the retirement age or from the period before the person actually stopped working – the higher AAMI was used in this case. So, in working extra years after retirement age, one can increase his/her AAMI as well.\(^{11}\) Early retirement will not be explicitly accounted for in my analysis, thus I will not describe the rules here.

4.3.6 Widow’s and widower’s benefits

The last issue that complicates the analysis is widow’s and widower’s benefits. Widower’s benefits were a lump sum transfer provided that certain conditions were met. Hence they were not at all related to earnings and I can neglect them in my analysis. On the other hand widow’s benefits were computed as 60% of the husband’s benefits. In this way a widow was in general eligible for two benefits, her own and 60% of her deceased husband’s benefits. The rule was that the higher benefit was paid out fully, the lower one 50%. I don’t include the widow’s benefits in this paper.

4.4 Benefits after the reform from the 1\(^{st}\) pillar

After the reform, people can decide whether they want to enter the new 3 pillar system or remain in the modified 1 pillar system. As for the pensions from the 1\(^{st}\) pillar, they are defined in the same way in both systems using the definitions bellow.

\(^{10}\) The number is greater than for men probably because periods like maternity leave were included as well. Since periods of unemployment and schooling were included as well, I will assume that everybody is entitled for at least these partial benefits.
4.4.1 Basic definitions and rules

AGW – average gross wage in a given year
PGW – personal gross wage in a given year
PWP – personal wage point defined as \( PWP = \frac{PGW}{AGW} \)

\( N \) – participation, insurance period is counted in days and then divided by 365 to get the insurance period in years. The number is rounded to 4 digits afterwards.\(^\text{12}\) Periods of unemployment and secondary and tertiary schooling are not counted anymore. For a person to be eligible for benefits, \( N \) must be at least ten.

APWP – average personal wage point over the period starting in 1994. If a person was participating in the system for less then ten years since 1994 previous years included in \( N \) count as well, i.e., 1993, 1992, 1991 etc. until the number of years equals 10. (However, the law was changed in 2005 and the decisive period now is from the year 1984 and the minimum number of years must be at least 22. If it is less then the period can be prolonged beyond 1984.) Consequently, the number of years included in the computation of the APWP will be steadily rising. Since social security taxes are only paid from income up to 3 times the average wage, the maximum value of APWP is also 3; plus there is an adjustment of APWP that will be gradually phased out until 2007. The phase out will be abstracted from for reasons mentioned above.

APV – actual pension value; set to 183.58 for the year 2004 (195.31 in 2005) to provide a 50% replacement rate to a worker who has been working for 40 years and has the APWP = 1. The 50% replacement rate will not hold until 2007 for people with the same number of working years and different APWP due to the APWP adjustment mentioned earlier. However, it will hold after that, because the APV is indexed to nominal wage change.

More precisely:

\[
APV_t = APV_{t-1} \cdot \left( \frac{AGW \text{ in } 3^{rd} \text{ quarter of } t-1}{AGW \text{ in } 3^{rd} \text{ quarter of } t-2} \right).
\]

Finally, the initial pension benefit for those who remained in the 1 pillar system equals:

\[
B = APV \cdot N \cdot APWP = APV \cdot \sum_{j \in N} PWP_j. \quad (4.6)
\]

Note that the second equality holds again only after the full phase in, i.e. when all years count into the computation of APWP. Those who chose to enter the new 3 pillar system pay 50% of

\(^{11}\) The maximum possible benefit after these adjustments was SKK 9219. The increase for one extra year was initially 7% and later it was 4%. Starting from 2000 the increase was 6%.


\(^{13}\) In fact I use the average wage in the given year, not just in the 3\(^{rd}\) quarter.
contributions to the 1st pillar (9% compared to 18% of the gross wage), so their benefits are adjusted accordingly:

\[ B = 0.5 \cdot APV \cdot N \cdot APWP = 0.5 \cdot APV \cdot \sum_{j \in N} PWP_j. \] (4.7)

The monthly pension is then adjusted to the average of price and wage changes of the previous year.\(^{14}\) The expected present value of benefits for those who stay in the 1 pillar system (and will retire after 2007) as of year \(t\) yields similarly to equation (4.4):

\[ EPVB_j = \sum_{j=t}^{\infty} \frac{P(j/t)}{\prod_{k=t}^{j-1} (1 + i_k)} \cdot B_j \cdot \prod_{l=t}^{j-1} \left[ 0.5 \cdot (1 + dCPI_l) + 0.5 \cdot (1 + dAGW_l) \right]. \] (4.8)

\( B_j < 0 \rightarrow \text{before retirement.} \) \( B \rightarrow \text{after retirement.} \) \( B \) is the initial benefits given by (4.6). The Swiss indexation term is not used in the first year of retirement. For simplicity this is not accounted for in this equation. I will explicitly account for this fact later.

The derivatives as implied by the definitions of ITR and NMSSTR (3.1) and (3.2) will be applied to this equation. Those, who choose to enter the new 3 pillar system, will receive 50% of the pension of those who stayed in the 1 pillar system as shown above, so in equation (5.8) the RHS would just be multiplied by 0.5.\(^{15}\)

### 4.4.2 The NMSSTR formula

In particular, additional 1,- SKK earned at year \(t\) (note I will be using 2003 as the base year) increases the sum of personal wage points \(\sum_{j \in N} PWP_j\) by \(\frac{1}{AGW_t}\), where \(AGW_t\) is the yearly average gross wage. The increase in the initial expected benefit at retirement age \(R\) will be:

\[ \frac{\partial EB_k}{\partial pgw_t} = \frac{1}{AGW_t} \cdot APV_R = \frac{1}{AGW_t} \cdot APV_t \cdot \prod_{t=r}^{k-1} (1 + dAGW_t). \] (4.9)

The total increase in expected benefits will then be:

---

\(^{14}\) This is the so called Swiss indexation, see §82 law 461/2003.

\(^{15}\) At the time of writing there have been valorizations (i.e. increases of the pensions above what they would have been according to the law of 2003) again. I abstract from these because I am primarily interested in the effect of the reform in its pure form; at the time it was done.
\[
\frac{\partial EPVB}{\partial pgw} = \sum_{j=0}^{l} \frac{P(j,t)}{\prod_{k=1}^{l}(1+i_k)} \frac{\partial EB_k}{\partial pgw} \cdot \prod_{i=0}^{l-1} \left[0.5 \cdot (1 + dCPI_i) + 0.5 \cdot (1 + dAGW_i)\right].
\] (4.10)

Again note that the first benefit would not be multiplied by the Swiss indexation term. Then I will use the above in equation (3.2) to get the NMSSTR assuming that people will retire at the age of 62. For people over this age I will assume that they are working for the last year.\(^{16}\)

### 4.4.3 Note regarding the ITR

Note that if we assume that people make constant relative wage, their personal wage point is constant and cancels out in equation (3.1) if \(PWP \leq 3\). Therefore this system abolishes any progressivity inherent in the old system. In fact, as regards the ITR’s it is regressive. For \(PWP > 3\) the ITR decreases because the amount of taxes paid and benefits obtains is the same as if \(PWP = 3\), but the wage in the denominator is increasing. Therefore, if we express the ITR for \(PWP \leq 3\) as \(ITR(3)\) the ITR for \(PWP = x > 3\) will be \(ITR(x) = ITR(3) \cdot 3/x\).\(^{17}\)

In fact if one decides to model lifetime wage profiles as a function of age, the reasoning remains valid. The wage profile is actually irrelevant here, because the system is perfectly linear. This is certainly not true if 1. earnings exceed more than 3 times the average wage, 2. earlier and late retirement (see bellow).

### 4.4.4 Late retirement and the ITR formula\(^{18}\)

Let me discuss the rules on late retirement now. A person that reached retirement age before December 31\(^{st}\) 2003 is getting benefits according to the old law. A person that that reached retirement age before December 31\(^{st}\) 2003 but continued working till December 31\(^{st}\) 2003 will get the benefit that is higher.\(^{19}\) There are different adjustments of benefits for people that collect benefits and continue working and those who don’t collect benefits and continue working. Let’s consider a person that continues working after retirement age without collecting benefits.\(^{20}\) Moreover, I will assume that the person has been working all the way

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\(^{16}\) Feldstein, Samwick (1992a,b) compute the NMSSTR assuming standard retirement age and people retiring at 70, which would be another possibility.

\(^{17}\) Note that the linearity of the system implies that NMSSTR = ITR, which has served as a check of consistency of the computations.

\(^{18}\) $66$ law 461/2003.

\(^{19}\) See example 1 and 2 in sample computations at www.socpoist.sk.

\(^{20}\) For clarity of exposition let’s say that she reaches given age on December 31\(^{st}\) midnight.
until now. So a person that has been working until time \( t \) is eligible to the following benefits at time \( t+1 \):

\[
B_{t+1} = \left[ 1 + 0.06 \cdot (\text{age}_{t+1} - R) \right] \cdot APV_t \cdot \left( \sum_{i \in I} PWP_i + \frac{PGW_i}{AGW_{t-2}} \right)
\]  
(4.11)

Note that the benefits of such a person is increased by her personal wage points “acquired” in the period after the retirement age multiplied by the APV valid when she decides to start collecting benefits. Moreover, the \( PWP \) from the last year before retirement \( PWP_t \) is obtained using \( AGW \) two years back into past - \( AGW_{t-2} \) in the last term of the equation.\(^{21}\) Note that even the “original benefit” – sum of their personal wage points acquired before the retirement age is multiplied by the actual \( APV_t \). This implies a change in benefits of such a person because \( APV \) is increasing with gross wage whereas benefits that are already being paid are growing by Swiss indexation (another motivation to work longer if real wage grows). Finally and most importantly, the benefit is increased by 0.5% for every 30 days of working after the retirement age – by 6% for every year.

The present value of such a stream of benefits (with the initial one defined by 4.11) is given by the following formula. This expression is also sometimes called the personal social security wealth. In order to express the ITR it is more convenient to compute these first than try to express directly for the difference in benefits due to working an additional year.

\[
PV_{t+1} = B_{t+1} \cdot \left[ 1 + \sum_{j \geq t+1} \frac{P(j \mid t + 1)}{(1 + i_k)^{j-t}} \cdot \prod_{k=t+1}^{j-1} (0.5 \cdot dCPI_j + 0.5 \cdot dAGW_j) \right]
\]  
(4.12)

Similarly to (4.11), if the individual decides to work one more year, at \( t + 2 \) she will be entitled to the following initial pension.

\[
B_{t+2} = \left[ 1 + 0.06 \cdot (\text{age}_{t+2} - R) \right] \cdot APV_{t+1} \cdot \left( \sum_{i \in I} PWP_i + \frac{PGW_{t+1}}{AGW_{t-1}} \right).
\]  
(4.13)

The present value of such a stream of benefits is:

\[
PV_{t+2} = B_{t+2} \cdot \left[ \frac{P(t+2 \mid t + 1)}{1 + i_{t+1}} + \sum_{j > t+2} \frac{P(j \mid t + 1)}{(1 + i_k)^{j-t}} \cdot \prod_{k=t+2}^{j-1} (0.5 \cdot dCPI_j + 0.5 \cdot dAGW_j) \right].
\]  
(4.14)

---

\(^{21}\) I am abstracting from this in the benchmark computations. Note that this only makes working more even more attractive in times when wages are growing.
The net gain from working one more year then is \( PV_{t+2} - PV_{t+1} \) and the incremental (implicit) tax rate is then given as:

\[
ITR_{t+1} = T \cdot \frac{\min(3 \cdot AGW_{r+1}, PGW_{r+1})}{PGW_{r+1}} \cdot \frac{PV_{r+2} - PV_{r+1}}{PGW_{r+1}} \quad (4.15)
\]

### 4.4.5 Late retirement and the NMSSTR formula

Fortunately, the adjustment of the NMSSTR is simpler. Assuming that the person will retire at standard retirement age + \( i \) the NMSSTR at time \( t \) will be the same as in section 4.4.3, just multiplied by \( (1 + i \cdot 0.06) \).

### 4.4.6 Early retirement and the ITR formula

An individual that has been insured in the system for at least 10 years can decide to collect partial benefits before reaching the retirement age provided that the benefit is larger than 1.2 times the minimum living expenses which is a number announced by the government. The benefit itself is determined exactly as in the case of regular benefit only that it is decreased by 0.5% for every 30 days left to retirement age. For the whole year the reduction is 6.5%. This means that only people with high record of PWP or close to retirement age will be eligible to partial benefits. Hence, a person below retirement age if she is eligible will get the following benefit at \( t+1 \) if she has worked till \( t \) (I assume everyone has worked for at least 10 years):

\[
B_{r+1} = \left[ 1 - 0.065 \cdot (R - age_{r+1}) \right] \cdot APV_i \cdot \sum_{i=t} PWP_i \quad (4.16)
\]

However, in this paper I will assume that people will wait with collecting benefits until retirement. Assuming that a person will not collect benefits until retirement age leads to a conceptually simple expression for the \( ITR_{t+1} \). Assuming that the year when the person reaches retirement age is \( t + 1 + (R - age_{r+1}) \) the increase in initial benefit due to working one more year at \( t+1 \) is:

\[
\Delta B_{r+1}^{t+1+(R - age_{r+1})} = PWP_{r+1} \cdot APV_{r+1+(R - age_{r+1})} = PWP_{r+1} \cdot APV_i \cdot \prod_{j=1}^{t+1+(R - age_{r+1})} dAGW_j \quad (4.17)
\]

This assumes that the person knows her wage in coming year \( t+1 \) and also has some expectations about the development of \( APV \). The increase in benefits is then discounted to get the change in present value (for simplicity I drop the indexes from the previous formula):

---

The first summand of the above equation is the discount factor of the difference in the initial benefit. The second summand is the sum of discount factors for the rest of one’s life that has to be corrected for the Swiss indexation term. Finally, the ITR is given as:

\[ ITR_{t+1} = T \cdot \frac{\min(3 \cdot AGW_{t+1}, PGW_{t+1})}{PGW_{t+1}} \cdot \frac{APV}{PGW_{t+1}} \]  

(4.19)

### 4.5 2nd Pillar Benefits

Moreover, these individuals will receive income from their pension fund. They have two options, either they can buy an annuity for the total amount of savings they have accumulated at the fund or they can buy an annuity only for part of their saving and use the rest of their savings as they wish. However, the annuity must be at least 0.6 times the minimum living expenses, which is a number determined and adjusted regularly by the government. For the purpose of this exposition, I will assume that the rate of return on savings in the pension fund is constant at rate \( r_r \) and that the individual will actually choose to collect annuity benefits from his/her entire savings. Then an additional SKK of gross earnings at time \( n \) will mean the following accumulated amount of savings at the time of retirement \( R \):

\[ S = 0.09 \cdot (1 + r_r)^{R-n} \]

The amount of savings necessary to buy a regular monthly benefit of SKK 1,- at retirement age \( R \) is given (by law n. 43/2004) by:

\[ NS = 12 \left[ \sum_{t} \frac{1}{1+i} \cdot \frac{l_{R+t}}{l_t} - \frac{11}{24} \right] \]  

(4.20)

where \( i \) stands for the “technical interest rate” and \( l_t \) stands for the number of people alive at age \( x \) (of both sexes together, i.e. the fraction is the unisex survival probability). Then, the additional SKK of earnings at time \( n \) will result in an increase of benefits in the amount of \( \Delta B = S/NS \). Plugging into formula (2) for people who chose to enter the new system yields:

\[ EPVN_n = \sum_{r<R} P(t/n) \cdot \frac{0.5 \cdot dCPI + 0.5dAGW}{AGW_n} \cdot \frac{0.5 \cdot APV}{AGW_n} + \sum_{r>R} P(t/n) \cdot \frac{S}{NS} \]  

(4.21)

where the first summand stands for the first pillar and the second summand for the second pillar.
Based on this section the tax rates as defined by equations (3.1) and (3.2) will be computed. The remaining information needed and simplifications made are described in section 5.1.

5  EMPIRICAL RESULTS

5.1 ASSUMPTIONS
Let me summarize the assumptions that I have in order to make the computations manageable.

General assumptions:
1. Constant relative wage
2. Full tax incidence on worker
3. Person that continues working after retirement age does so without collecting benefits
4. Person has been working all the way until now
5. Exogeneity of the retirement age decision
6. Women have 2 children (retire at 55 in old system are able to deduct 0.5% for each in the new system)
7. Survival probabilities projections from http://www.infostat.sk/vdc/ - Demographic Research Centre
8. I assume people live at most till 100 years
10. Real discount rate 4%, nominal discount rate = 4% plus inflation

Old system:
1. Tax rates as of 2003
2. Start working since 18
3. Working in III. category
4. Benefits and the maximum benefits grow with Swiss index
5. Current earnings don’t change AAMI (note that AAMI can be only changed in the best 5 years not further that 10 years from retirement)

New system:
1. Tax rates as of 2004
2. Start work since 23 (doesn’t matter if standard retirement age)
3. Phase-ins complete
4. Valorizations abstracted from
5. Asset return (not yet included)

5.2 BENCHMARK COMPUTATIONS OF ITR

5.2.1 Before the reform

The empirical results are given in the tables below. Note that the wage is measured in terms of average wage.

Table 5: ITR in the old system: men

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<th>age</th>
<th>wage</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
</tr>
</thead>
<tbody>
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<td>-17.8%</td>
<td>-20.0%</td>
<td>-22.4%</td>
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<td>-5.0%</td>
<td>-5.4%</td>
<td>-4.5%</td>
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<td>4.0%</td>
<td>3.1%</td>
<td>9.7%</td>
<td>9.0%</td>
<td>8.1%</td>
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<td>11.1%</td>
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</tr>
</tbody>
</table>

Source: own computation from the Demographic Research Centre data and Melichercik, Ungvarsky (2004)

Table 6: ITR in the old system: women

<table>
<thead>
<tr>
<th>age</th>
<th>wage</th>
<th>20</th>
<th>25</th>
<th>30</th>
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<td>-16.6%</td>
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<td>-116.6%</td>
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</tr>
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<td>-11.9%</td>
<td>45.1%</td>
<td>46.4%</td>
<td>46.4%</td>
<td>46.4%</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5.4%</td>
<td>5.1%</td>
<td>4.8%</td>
<td>4.5%</td>
<td>4.2%</td>
<td>6.3%</td>
<td>6.0%</td>
<td>-5.8%</td>
<td>22.7%</td>
<td>23.3%</td>
<td>23.3%</td>
<td>23.3%</td>
<td></td>
</tr>
</tbody>
</table>

Source: own computation from the Demographic Research Centre data and Melichercik, Ungvarsky (2004)

Notes:
1. Women get much better deal out of social security. In their 50’s their survival probabilities are higher by 0.5% to 1.5%, in their 60’s by 1.5% to 2.5% in their 70’s and early 80’s by more 2.5%. Men’s survival probabilities get higher in the 90’s, but that is quite irrelevant. Plus, here women retire earlier.
2. Progressivity.
3. Huge differences over one’s lifetime. Late retirement is a good deal at retirement age.
4. Taxes are so high after retirement because people sacrifice relatively high benefit in exchange for low income.

5. Nobody hits the benefit cap at 60. The cap is hit when man and women face the same tax rates.

6. High income people pay a lot in taxes and don't gain so much in benefits, moreover they hit the cap soon, but benefits are relatively low for them.

7. There is a spike at the age of 45 because that is where the agents come from partial to full benefits.
Figure 1: ITR in the old system: men

Figure 2: ITR in the old system: women
5.2.2 After the reform – the 1 pillar system

Table 7: ITR in the reformed 1 pillar system

<table>
<thead>
<tr>
<th>wage/age</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
<th>55</th>
<th>60</th>
<th>65</th>
<th>70</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3</td>
<td>6.8%</td>
<td>6.4%</td>
<td>6.1%</td>
<td>5.7%</td>
<td>5.4%</td>
<td>5.2%</td>
<td>4.9%</td>
<td>4.3%</td>
<td>3.3%</td>
<td>3.9%</td>
<td>22.0%</td>
<td>49.7%</td>
</tr>
<tr>
<td>4</td>
<td>5.1%</td>
<td>4.8%</td>
<td>4.5%</td>
<td>4.3%</td>
<td>4.1%</td>
<td>3.9%</td>
<td>3.7%</td>
<td>3.2%</td>
<td>2.5%</td>
<td>2.9%</td>
<td>16.5%</td>
<td>37.3%</td>
</tr>
</tbody>
</table>

Notes:
1. Gaps between men and women and over one’s lifetime have significantly narrowed.
2. Progressivity is gone.

5.2.3 After the reform – the 3 pillar system

5.3 Net marginal social security tax rates

5.3.1 Before the reform

Full tax 17.5% all people further than 10 years from retirement and not in their best 5 years in nominal earnings. Due to high inflation rates (and wage increases) best 5 years would tend to be last 5 years – full tax on the majority of people. Their future benefits are increasing only due to additional working time.

5.3.2 After the reform

For those under the age of 60 the same as the incremental tax rates.

6 Conclusions
REFERENCES


Other sources

http://www.dochodock.gov.sk/ - Slovak government server dedicated to the social security reform


www.hayek.sk - a Slovak liberal “think tank” web, source of information about the Slovak social security system

http://jaspi.justice.gov.sk/jaspiw1/jaspiw_maxi_fr0.htm - Slovak government server with juridical information

http://www.socpoist.sk/index/ - Social Insurance Agency of the Slovak Republic

http://www.statistics.sk/ - Statistical Office of the Slovak Republic, source of data


http://www.zbierka.sk/ - Collection of all Slovak laws

http://www.ssds.sk/statist/ssds/ - Slovak Statistical and Demographical Society

http://www.infostat.sk/vdc/ - Demographic Research Centre – source of data

http://www.infostat.sk/slovakpopin/ - Slovak Republic Population Information – source of data