The Elasticity of Taxable Income

Income Responses after the Hungarian Tax Changes in 2005

By

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Abstract

The purpose of my paper is to estimate the *elasticity of taxable income* in Hungary. Several studies for different countries show the consequences of changes in income tax rates on taxable income. However there are no studies of the effects of the change in marginal tax rates in Hungary. The present paper fills that gap by analyzing taxpayer behavior after the 2005 change in the personal income tax schedule using a Tax and Financial Control Office two years panel data between 2004 and 2005 with roughly 480,000 observations. My empirical analysis suggests a tax price elasticity of about 6.5% that has a remarkable effect on the government's budget after a change in the marginal tax rate.

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Introduction

Governments must find the political balance between the needed revenue – to cover the costs of their general operations and the services they provide to citizens –, and their popularity, because people generally dislike paying taxes. Income taxation is usually an essential part of this revenue generating process, and thus its design fundamentally determines the whole tax system.

As emphasized by the pioneering work of Mirrlees (1971), practical income tax schemes are constrained to differentiate individuals according to their income – which is an outcome of individual decisions – and not their true underlying "ability". This creates an asymmetric information problem on the one hand, and on the other hand, it implies that the incidence of income taxation is mostly determined by its progressivity. Therefore the degree of progressivity is not only an economic, but also a moral, political and ethical question and it depends on the value choice of the society and of the politicians as well.

The trade-off between the potential social benefit of a more equal distribution of income and the distortions caused by the high marginal tax rates[1] required by a redistributing tax system plays a central role in evaluating tax policy. The deadweight loss – the measure of the distortion effect of the tax system – in a tax system is that amount that is lost in excess of what the government collects. It is equal – following Kay's (1980) measure[2] – to the difference between the tax revenue actually collected and the revenue that could be collected

[1] The marginal tax rate (MTR) shows the taxed away part of the change of the before tax income.
[2] Diamond and McFadden (1974) propose a different measure of welfare cost.

with a lump sum tax that leaves the taxpayer on the same indifference curve that he attains under the actual tax.[3]

In this framework the role of economists is central, since they provide inputs for policymakers to be able to make good decisions. The focus of this paper is on such an input, on *the elasticity of taxable income* with respect to changes in marginal tax rate which has important implications for the design of tax and budget policy and for estimating the budget's revenue and the deadweight lost (Feldstein, 1995a).

There are two main directions of the empirical studies on the effect of labor income tax rates. Firstly, the earlier research focused on the effect of taxation on *labor supply*. These empirical works – reviewed by Heckman (1993) – suggest that the labor supply of primary earners is rather insensitive to tax rates[4]. Secondly, later studies focused on the effect of taxation on *taxable income*. The estimated elasticities in these two fields are not the same, since taxable income can vary not only with the labor supply, but also with the decision about investments, tax-deductible activities, form of compensation or with the change in tax compliance as well.

The purpose of my paper is to estimate the *elasticity of taxable income* in Hungary. Several studies for different countries – primarily for the U.S., but there is study on Canada and Norway as well[5] – show the consequences of changes in income tax rates on taxable income. Two factors hinder the research on this field in Hungary: (1) frequent, but small changes in the tax system that make difficult on the one hand to observe significant behavioral response, and on the other hand to separate the effects of the different modifications; (2) data limitations: although the Tax and Financial Control Office collects data, there is no even

[3] Assuming that tax revenues are not wasted by the government.
[4] Eissa (1995) found however that the labor supply of married women sensitive to tax rate changes.
[5] For the detailed comparison see the literature review.

restrictive accessibility, moreover the dataset is not linked to other characteristics of the taxpayers, such as for example occupation. Therefore there are no studies of the effects of the change in marginal tax rates in Hungary. The present paper fills that gap by analyzing taxpayer behavior after the 2005 change in the personal income tax schedule using a Tax and Financial Control Office two years panel data between 2004 and 2005 with roughly 480,000 observations[6]. In this paper I report a preliminary analysis of the 2005 small "tax-reform" in Hungary that reduced the number of personal income tax rates from three to two, increased the extended employee tax credit and raised the maximum annual amount of social security contribution in pension scheme. These led to the decrease of middle income and increase of high income earner's marginal tax rates.

My paper proceeds as follows. The *first chapter* presents income taxation in general. The *second* presents the details of the changes in the Hungarian tax system between 2004 and 2005. The *third chapter* depicts the framework of my empirical analysis. The *fourth* presents my results, robustness check and implications. Finally, the *last chapter* concludes.

[6] During the 2006/2007 academic year I worked at the Economic Research Department of the Ministry of Finance as an intern. I would like to thank those at the Ministry and at the Financial Tax and Control Office who made this dataset available for my research.

I. Income Taxation

The purpose of this chapter is to give an introduction into income taxation from theoretical and practical aspect as well. Its first section focuses on theory of income taxation presenting the seminal paper of Mirrlees (1971), but at the same time it emphasizes the importance of empirical approach. Accordingly the second section presents the practical side of income taxation comparing Hungary to its region and to the European Union. The third section is the literature review that summarizes the results of empirical studies specifically in the topic of this paper.

I.1 Optimal income taxation

From the theoretical point of view income taxation has two main aspects. On the one hand an income tax is a tool of redistribution to meet objectives of equity; and on the other, it is a major disincentive of effort and enterprise, especially when the marginal tax rate increases with income. The trade-off between efficiency and redistribution – how to minimize distortions caused by income taxation and at the same time how to redistribute income from high earners to low earner individuals – is in the focus of the theory of optimal income taxation. The first formal analysis of this interchange between efficiency and equity was done by Mirrlees (1971). He argued that since the taxpayer's underlying ability is unobservable practical income taxation differentiates on the basis of income. However this is an imperfect proxy for ability and thus income taxation has not just redistribution, but also distortion effect. He assumed that individuals have identical preferences:

$$U = U(x, y)$$

where *x* is the consumption and *y* is the time worked. Both have to be non-negative and the upper limit for *y* is 1. *U* is strictly concave, continuously differentiable, (strictly) increasing in *x* and (strictly) decreasing in *y*. To each individual corresponds a number *n* which is a measure of productivity[7], thus if one works for time *y*, provides a quantity of labor *ny*. The total labor available in the economy is

$$Z = \int_0^\infty z_n f(n) dn$$

where $z_n \equiv n y_n$ and $f(n)$ is a density function for productivity. The aggregate demand for consumer goods is

$$X = \int_0^\infty x_n f(n) dn$$

Note that x_n , y_n is the consumption choice of an individual with productivity *n*. Using an income tax the government collects resources in such a way that the individual supplying *z* labor can consume at most *c(z)*. *c(.)* is a function that is chosen by the government. Thus the individual optimization problem is as follows

$$\max_{x_n, y_n} U(x, y)$$

such that $x \leq c(ny)$. The government problem is to choose function *c* to

$$\max \int_0^\infty U(x_n, y_n) f(n) dn$$

such that it must be possible to produce the consumption demand with labor input less than *Z*. After building the model Mirrlees stated the necessary conditions for the optimum and investigated the effect of a special type of utility function. Finally, he concluded that the shape of the optimal income tax schedule is sensitive to the distribution of skills within the population and to the individual's preferences.

[7] Mirrlees called it „ability-parameter"

A large literature of optimal income taxation grew out from this seminal paper. But the partial analysis of the tax system splitting it into direct and indirect optimal taxation was the characteristic mainly of the early research. Atkinson and Stiglitz (1976) for example investigate the optimal portion of direct and indirect taxes putting more emphasis on equity than Mirrlees did, and conclude that in an optimal system only income taxation is needed. However the same authors in a later work (Atkinson and Stiglitz 1980) show that the administrative costs justify the existence of indirect taxes. Slemrod (1990) points out that the amount of tax revenue is highly dependent on the tax moral of the society and on the efficiency of tax administration. Alm (1996) argues that the direct and indirect taxes jointly may decrease the distortion caused by the tax system and generally reduce the marginal tax rate, and thus this leads to the improvement of tax compliance.

It is important to note that all of the implications of these models are based on assumptions, so their application in practice needs further investigation, since as Gruber and Saez (2000) pp. 24 formulates:

> *"…despite the enormous theoretical importance of the optimal income tax literature …there was little use of the optimal income tax framework to provide guidance as to how taxes should be set. This likely reflects two limitations… First, the theoretical development is rather esoteric, and difficult to translate to empirically relevant quantities… Second, the set of predictions that were generated from these models …were of little relevance for real world tax design."*

Thus empirical research is crucial for the deeper understanding of the tax system, and for a more accurate tax planning. The next section places the Hungarian income taxation system into an international framework and helps us to understand its characteristics better.

I.2 Recent trends in income taxation[8]

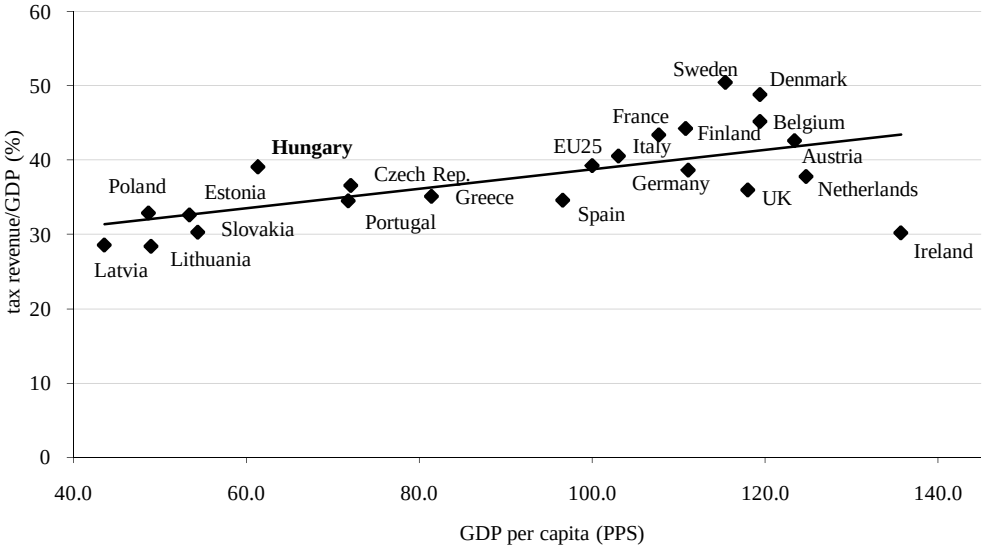
In the European Union every country has its own tax policy whose objective is on one hand to finance public expenses and the redistribution, and on the other to smooth the effect of shocks and thus to help maintain the common monetary policy. The most important aspect of the different tax policies is their compatibility with each other and with the goals of the European Union, especially with the four freedoms[9]. A common tax policy is not yet an ambition, but there are regulations mandatory for each member state which prohibit any kind of national policy and thus taxes as well that could lead to an unfair advantage against other member states. Beside these regulations the European Union issues recommendations for the desired direction of changes of the tax policy. The European Union emphasizes the importance of the incentive effects of the tax system on the labor market and the role of the tax system in competitiveness. Along with these values the European Commission (2006) expresses that the decrease of the tax burden on labor and enterprise income (direct taxes) and the increase or introduction of "green" (indirect) taxes is preferred[10]. The following comparison is largely based on Bakos, Benedek, Bíró and Scharle (2007) however it emphasizes different aspects of the Hungarian tax system. Now I focus on the income taxation and make concluding remarks at the end of the comparison.

In the European Union there is a positive correlation between the tax burden – expressed as the ratio of the total amount of tax revenue and GDP – and GDP per capita (*Figure 1*)[11]. Hungary seems to be an outlier in the Central European region with its 39.1% high tax

[8] This subsection uses OECD statistics for comparison. Kiss (2005) emphasize the drawbacks of the assessment based on these data and suggests ways of modification to attain a more accurate comparison.
[9] Free movement of goods, services, capital and labor within the internal market of the European Union.
[10] More information on the European Union's preferences about tax policy: http://www.europa.eu.int/pol/tax/index_en.htm or http://ec.europa.eu/taxation_customs/taxation/index_en.htm.
[11] The country averages are always GDP weighted averages.

burden. The European Union has this average tax burden level, but with much higher national income.

Figure 1 The tax burden as a function of the national income, 2004

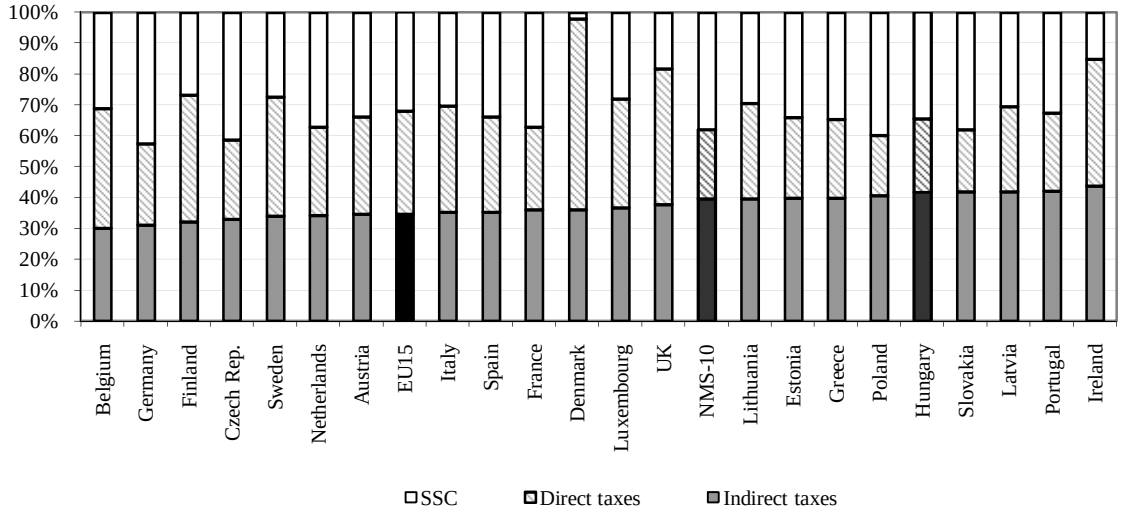


Source: European Commission (2006) and EUROSTAT (for the detailed table see the Appendix, Table A. 1)

One possible classification of taxes is to divide them into direct taxes, indirect taxes and the social security contributions. While direct taxes (e.g. income tax, corporate tax) are paid to the government by the individual on whom it is imposed, indirect taxes (e.g. VAT, excise duty, consumption tax) are collected by intermediaries who turn over the proceeds to the government. These classes have different incentive effects on labor and efficiency characteristics. The share of the revenue of the different taxes in the Hungarian tax structure is very similar to the New Member States (NMS-10) average, but the proportion of indirect taxes (41.7%) is higher, the proportion of direct taxes (23.8%) is lower than in the European Union (Figure 2). The share of the social security contributions (SSC) highly depends on a country's social security system, thus for example is Germany – where the social net is very

strong – its share is 42.6% within the total tax revenue, while this measure for Hungary is 34.5%.

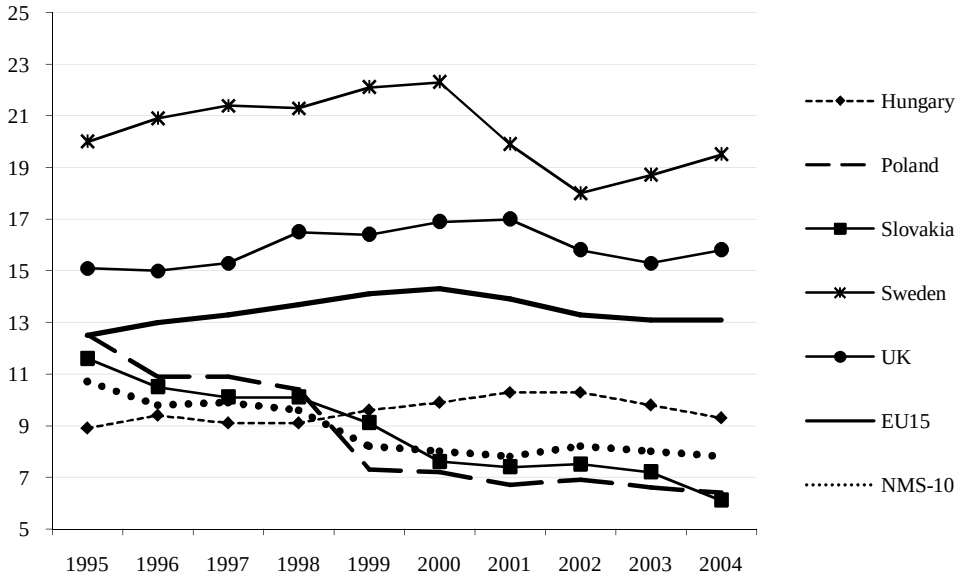
Figure 2 Tax revenues as percentage of total tax revenues, 2004



Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 2)

Figure 3 shows the time series of the proportion of direct taxes to the national income. From 1995 to 2004 we can separate two different trends in the changes. Interestingly Hungary is not in the same group as the countries in its region. The new member states have a decreasing trend from 10.7% to 7.8%, while in Hungary the ratio of direct taxes to the national income increased slightly from 8.9% to 9.3%. This is the characteristic of the change in the EU-15 as the ratio increased by 0.6 percentage point to 13.1%.

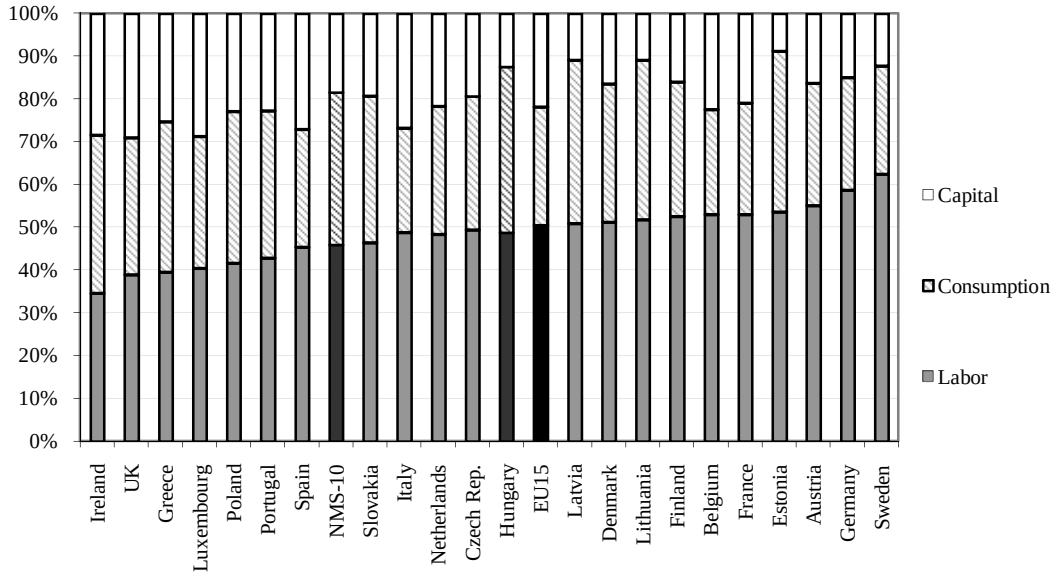
Figure 3 Direct tax revenues as percentage of GDP, 1995-2004



Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 3)

Since direct taxes are not perfect measure of the tax burden of labor or wages, in the followings I examine the tax burden by economic functions as well. Figure 4 shows the proportion of the taxes on labor, consumption and capital within the total tax revenue. We can see that taxes on labor are higher in Hungary by 3.6 percentage points than the average of the new member states, but approximately the same as in the EU-15.

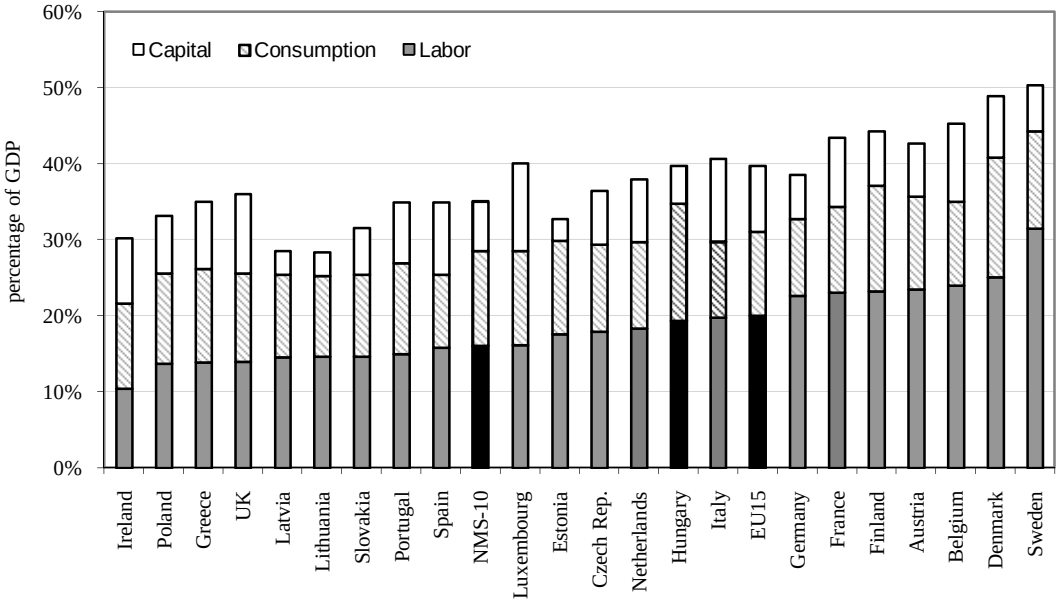
Figure 4 Taxes on labor, consumption and capital as the percentage of total tax revenue, 2004



Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 4)

Figure 5 shows that the order of labor tax burden – determined by Figure 4 among the new member states, Hungary and the EU15 – is the same if we look at the proportion of tax revenue within the national income. Hungary is again very close to the average of the EU15, and a bit above the average of the NMS-10. This implies robustness of the result for the tax burden of labor.

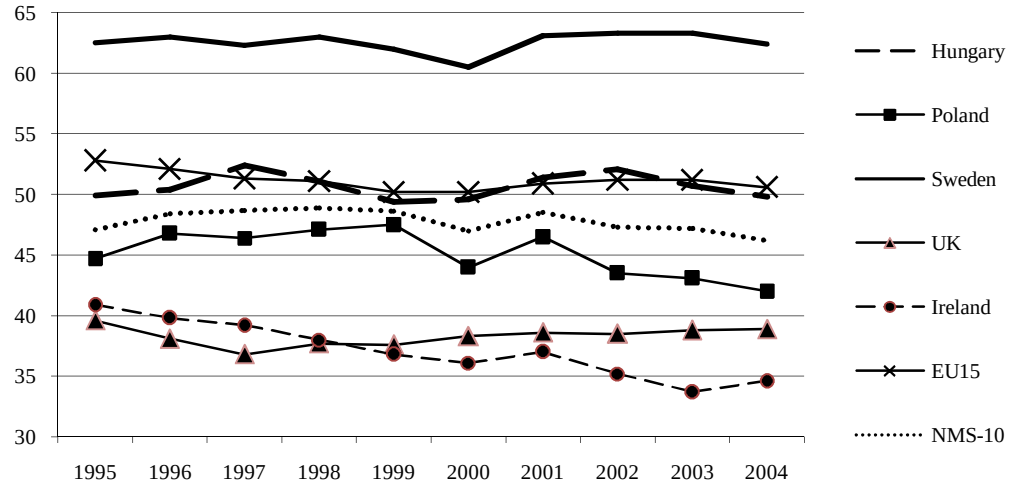
Figure 5 Taxes on labor, consumption and capital as the percentage of the GDP, 2004



Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 5)

If we look at the time series of the tax burden on labor we can see a small decrease in the average of the new member states (0.9 percentage points) and the EU15 (2.2 percentage points) as well (Figure 6). However this trend is not true for Hungary where this rate is the same in 2004 as it was in 1995. This implies that the tax burden on labor has not fallen during the period.

Figure 6 The change in tax burden on labor as a percentage of total tax revenue, 1995-2004

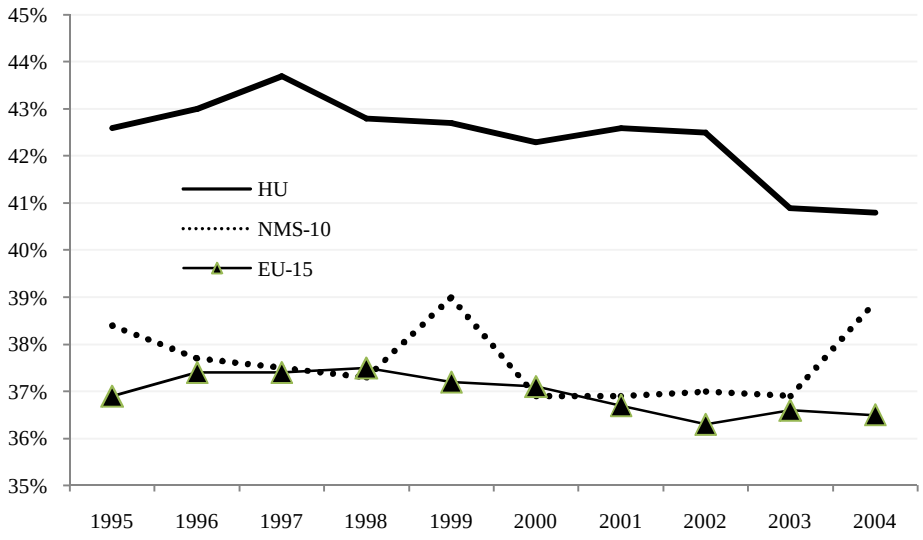


Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 6)
Note: I excluded Slovakia because of missing observations.

Concluding the figures above, we have seen in Figure 2 and Figure 3 that direct taxes are not exceptionally high in Hungary compared to the EU15 and to the NMS-10, and Figure 4 and Figure 5 showed also that the tax burden on labor in Hungary is very similar to the EU15 average and a little bit larger than the average of the new member states. This would imply that the Hungarian tax burden is not different than in the European Union; however Figure 7 depicts a different picture, showing the changes in the implicit tax rate[12] on labor. Although the implicit tax rate on labor decreased from 1995 to 2004 by 1.8 percentage points to 40.8% in Hungary, this level is still much higher than its counterpart for the EU15 (36.5%) or NMS-10 (38.9%). This means that in Hungary even if the tax revenue from labor tax – expressed as a percentage of the national income – is on the same level as in the EU15, the tax burden is much higher. The given amount of revenue is coming from a smaller tax base, consequently the Hungarian tax rates on labor are above the average of the EU15 and also of the NMS-10.

[12]The implicit tax rate is the ratio of the total revenue from the given type of tax and its tax base, thus this is a better measure of the tax burden than the aggregate numbers.

Figure 7 Implicit tax rates on labor, 1995-2004



Source: European Commission (2006) (for the detailed table see the Appendix, Table A. 7)

The main source of this high burden on labor is the small number of taxpayers; the high rate of inactivity in the Hungarian society. If Hungary wants to follow the recommendation of the European Union and decrease the tax burden on labor then it is a primary policy goal to widen the tax base which can make room for tax rate cut. But to have more accurate picture about the effect of a tax cut on the change in the government's budget balance and on the change in the taxable income, we need to know the elasticity of taxable income. This illustrates also the high importance of the research on my topic.

I.3 Literature review of empirical studies

Since the focus of this paper is to estimate the elasticity of taxable income with respect to the change in the marginal tax rates in Hungary, the literature review summarizes the main international results on this field. The elasticity estimates are diverse ranging from Feldstein's (1995) result at the high end to close to zero at the low end. This variety reflects the different

approaches applied in these papers such as the different definition of income, sample and source of identification.[13]

The applied empirical strategy however is similar in these papers. They estimate the effect of the change in the marginal tax rate on the taxpayers' income:

$$y_{it} = c_i + \gamma_t + \alpha x_i + \beta \log(1 - MTR_{it}) + u_{it},$$

where y_{it} is the measure of income. c_i is the fixed effect and γ_t is a time-specific effect. x_i are the individual characteristics that do not vary over time, but may have a time-varying effect on y_{it}. β is the elasticity of taxable income.

Lindsey (1987) analyses the U.S. personal tax rate reductions from 1982 to 1984, measures the response of taxpayers to changes in U.S. personal income tax rates and extends the results to predict the likely maximizing rate of personal income taxation. The paper finds large tax elasticities: the results of the constant elasticity specification are always above one[14]. Because of some data limitation he does not use panel data, but income distributions for different periods. Using these distributions he groups similarly situated taxpayers, and calculates elasticities based on the difference across these groups. The main limitation of this approach is that it assumes static income distributions over the investigated period.

To overcome this problem Feldstein (1995b) uses panel data and shows a substantial response of taxable income to changes in marginal tax rates.[15] He obtains the elasticity estimate by using a US Treasury Department panel of more than 4000 individual's tax returns before and after the 1986 tax reform. The analysis compares tax returns for 1985 and for

[13] For the comparative table of the results of the studies see Table A. 8.
[14] It varies with the range of dataset used for analysis.
[15] The focus of Feldstein's results is on the effect of the changes in tax schedule on the revenue collected by the Treasury and the deadweight loss caused by higher marginal tax rates.

1988, and shows an elasticity of taxable income with respect to the marginal net-of-tax rate at least one. Feldstein's elasticity estimates of adjusted gross income[16] plus gross partnership losses are 1.04, 1.48 and 1.25 among the medium, high and highest tax level groups classified by 1985 marginal tax rate respectively.

Similarly Auten and Carroll (1994) analyze the effect of 1986 tax reform using a larger panel of tax returns of 14,425 taxpayers. They report elasticity based on adjusted taxable income plus losses of 1.19 which is very close to the average of the three elasticities reported by Feldstein (1995b). However the same authors (Auten and Carroll 1999) redo the analysis about the effect of the Tax Reform Act of 1986 with a different approach, and find a significantly lower 0.6 tax-price[17] elasticity of reported income. They conclude that both tax-rate changes and nontax factors explain the changes in reported income during the 1980s. Their result suggests that controlling for nontax factors reduces the estimated elasticity by about 20%, and that behavioral responses vary considerably among occupation groups.

Sillamaa and Veall (2001) using the methods similar to those applied by Auten and Carroll (1999), estimate the responsiveness of income to changes in taxes to be substantially smaller in Canada after the tax reform in 1988 than in the study of the effects of the 1986 U.S. Tax Reform Act. Their estimate suggests tax-price elasticity for working-age individuals of about 0.25. They divide the income into its components, and find that self-employment income is more sensitive to the tax-price. They discover much higher response for seniors and individuals with high incomes as well.

[16] Adjusted gross income for 1988 equals actual 1988 taxable income minus capital gains. For 1985 it is obtained from actual 1985 taxable income by subtracting taxable capital gains, adding the percentage increase in per capita personal income between 1985 and 1988 (17.4% of 1985 AGI), and then using the 1988 rules for personal exemption and the standard deduction.

[17] Tax price=(1-MTR) is the proportion of the change in before tax income that remains at the taxpayer.

Similarly Aarbu and Thoresen (2001) find low elasticity measures for Norway analyzing the 1992 Norwegian tax reform. They employ a panel dataset of more than 2000 individuals, and find that estimates for the elasticity of taxable income range between -0.6 and 0.2. If they focus on the results from the regressions that include a reversion-to-the-mean variable, they find estimates between 0 and 0.2. From this they conclude that the income growth among individuals who experienced a substantial lowering of tax rate in 1992 is not very different from the income change for the individuals whose tax rate did not change at all.

Feldstein and Feenberg (1995) apply an analogous methodology to Feldstein's (1995b) but they did not have panel data, thus they handle the highest income taxpayers – with adjusted gross income greater than $200,000 – as a group and compared the changes of their taxable income. Several studies before have investigated the effect of lowering income tax rates, however theirs is the first that analyze the consequences of an increase of marginal tax rates. The estimated elasticities are lower than the sensitivity obtained by studies that analyze tax rate decreases of the 1980s, but this may reflect the fact that their estimates relate to the taxpayer response within the same year that the tax rate was enacted. Thus they also investigate the potential biases in the estimated taxpayer response caused by this short time horizon.

Gruber and Saez (2000) use a long panel of tax returns over the 1979-1990 period with roughly 46,000 observations. Their strategy was to relate changes in income between pairs of years to the change in marginal rates between the same pairs of years with a time length of three years. They use two different definitions of income such as broad and taxable income. Their empirical strategy is that they take a basic micro-economic framework and they derive a regression specification from this. They find that the overall elasticity of taxable income is

approximately 0.4 which is primarily due to a very elastic response of taxable income for taxpayers who have incomes above $100,000 per year and for itemizer taxpayers.

II. The Changes in the Hungarian Tax System

The *second chapter* presents the details of the changes in the Hungarian tax system between 2004 and 2005. The first section deals with the legal side of the modifications and its second translates them into the change of the marginal tax rate. Later, during my empirical analysis I investigate the effect of the change in the marginal tax rate.

II.1 Legislation

The main changes in the Hungarian income tax system, affecting wages, from 2004 to 2005 had four key elements (Income Tax Act 1995; OECD, 2004 and 2005; TARSZIM[18]).

1. The most important factor that allows me to estimate the elasticity of taxable income is the reduction of the number of tax rates from three to two. Taxpayers with taxable income between HUF 800,000 and 1,500,000 experienced an 8 percentage point decrease in their marginal tax rate. The tax schedule in Table 1 changed to the schedule in Table 2.

   Table 1 The tax schedule in 2004

		Number of tax filers
0 – 800 000 HUF	18 %	1 815 111
800 001 – 1 500 000 HUF	26 %	1 138 156
1 500 001 -	38 %	1 196 610

Source: http://www.apeh.hu/adotablak and Tax and Financial Control Office

   Table 2 The tax schedule in 2005

		Number of tax filers
0 – 1 500 000 HUF	18 %	2 806 935
1 500 000 -	38 %	1 342 948

Source: http://www.apeh.hu/adotablak and Tax and Financial Control Office

[18] The TARSZIM is the microsimulation model of the Hungarian Ministry of Finance that can simulate redistribution effects of changes in tax and social benefit system. Thus it contains all information about taxes, social security contributions and social benefits.

2. The extended employee tax credit was increased. In 2004 the tax credit was applicable to workers whose annual income was between HUF 600,000 and HUF 756,000, this range has changed in 2005 to HUF 600,000 to HUF 1,302,400. The monthly maximum of extended employee tax credit was increased from HUF 540 to HUF 1,240, however its rate has remained at the 18 percent of the annual wage income earned.

   The range within the applicable tax credit gradually reaches zero was changed from the HUF 720,000-756,000 interval to the HUF 1,000,000-1,302,400 interval. This also means that the rate of the linear decrease was altered from 18 per cent to 5 per cent.

3. Income limit was introduced in the system of tax credits for children. In 2005 an additional rule compared to 2004 is that if parent's total annual income is higher than HUF 8 million, the tax credit is reduced by 20 per cent of total annual income that is in excess of HUF 8 million limit.

4. The maximum annual amount of social security contribution in pension scheme was increased from HUF 451,095 to HUF 510,051. This implies that the income level after pension contribution has to be paid was changed from HUF 5,307,000 to HUF 6,000,600.

There were no changes in the rate of the social security contributions, namely in the pension, sickness and the unemployment scheme, their level remained 8.5, 4 and 1 percent respectively. Furthermore there were no changes in the employee tax credit, and in the tax credit for housing loans.

The following section presents the changes in marginal tax rate on different income levels implied by the modifications of the tax system.

II.2 Marginal tax rate

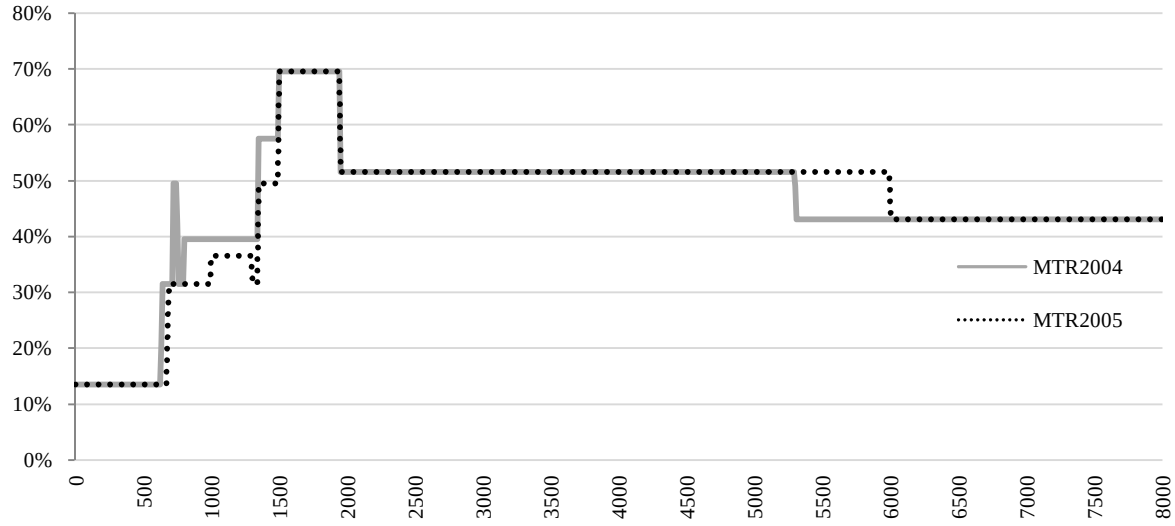
The marginal tax rate shows the taxed away part of the change of the before tax income.

$$MTR = 1 - \frac{\Delta\, after\ tax\ income}{\Delta\, before\ tax\ income}$$

This is a negative measure of the incentive effect on the supply side of the labor market. The higher this indicator the smaller the rate of increase of the after tax income assuming unit change in before tax income. If the level of MTR is high then supplying more labor – either to start working or to take on more working hours – results in a low increase of disposable income. Theory implies that if the marginal tax rate decreases then people will tend to supply more labor on average on the market, and thus taxable income will increase.

Because of the progressive tax system and the characteristic of the social benefit system, the level of MTR changes with income. Figure 8 shows the changes in the marginal tax rate from 2004 to 2005, taking into account the above mentioned modification of the personal income tax system. We can see that the marginal tax rate either remained or decreased in 2005. The MTR level has diminished almost in the full range of income between HUF 636,000 and HUF 1,500,000. The reason that the marginal rate increases to 31.5 per cent only at the HUF 684,000 income level, is the raise of the minimum wage, since the tax system and so the employee tax credit is designed to allow tax immunity for the minimum wage. Because the maximum amount of social security contribution within the pension scheme was raised, there was a change in MTR not only in the interval of Figure 8, but between HUF 5,307,000 and 6,000,600, where the marginal tax rate has increased from 43 to 51.5 percent.

Figure 8 The marginal tax rate under the 2004 and 2005 tax system[19]



Source: own calculations

Aside from the tax system the social benefit system also affects the marginal rates, its measure is called marginal effective tax rate. Scharle (2005) claims that on low income level the marginal effective tax rate can be exceptionally high, despite the fact that the tax system is progressively designed. This is because of the characteristics of the social benefit system. The empirical evidence for this is the existence of the poverty trap which is a situation where the individual does not want to increase his/her labor supply[20] because this would lead to a fall in his/her disposable income. The social benefits that are linked to the level of income can cause such a distortion. An example when one is entitled to flat maintenance benefit and does not want to work and earn more, because with the higher salary he/she would not receive the benefit, and at the end of the day the increase in the before tax income would cause a fall in the after tax income. Semjén (1996) points out that those benefits that are linked to income worsen the incentive problem on the labor market, especially if the decision about entitlement is made on the local administration level.

[19] For a more detailed graph of the MTR changes over the 0-3000 income interval see the Appendix, Table A. 9.
[20] Or simply does not want to start working.

It is important to note that in my analysis I take into account only the effects of the tax schedule, the tax credit and social security contribution modifications. I do not take into account the changes in the social benefit system, because I only want to measure the response to the change in the tax system and not in the social benefit system.[21] Moreover during my analysis as I exclude the very low income individuals I leave out most of the taxpayers who are eligible for any social benefit.

[21] Moreover my dataset does not allow me to calculate the METR changes for the individuals between 2004 and 2005.

III. The Empirical Framework

The *third chapter* depicts the framework of my empirical analysis. Its first section introduces the applied methodology step by step and the second presents the dataset, the variables and their descriptive statistics. It also deals with the filtering of the investigated sample and compares the income distribution in the population and in the dataset.

III.1 Methodology

I estimate the effect of the change in the marginal tax rate on the taxpayers' reported income following Auten and Carroll (1999) through a model that includes among its independent variables the marginal net-of-tax rate, henceforward called the log of the "tax price[22]":

$$y_{it} = c_i + \gamma_t + \alpha x_i + \beta \log(1 - MTR_{it}) + u_{it}, \quad (1)$$

where y_{it} is the measure of income in time t for individual i. c_i is the fixed effect for individual i (unobserved heterogeneity) and γ_t is a time-specific effect. x_i ($1 \times K$ vector of regressors) are the individual characteristics that do not vary over time, at least on our time horizon, but may have a time-varying effect on y_{it} (such as wealth or entrepreneurial skills that may not change between 2004 and 2005, but whose effect on income may have changed). $log(1 - MTR_{it})$ is the logarithm of tax price, and u_{it} is the idiosyncratic error term.

What is the proper method to estimate equation (1)? The key issue deciding between fixed and random effect is whether the unobserved heterogeneity (c_i) is uncorrelated with the observed variables (Mundlak, 1978). When there is no correlation between the observed explanatory variables and the unobserved heterogeneity, namely $Cov(x_{it}, c_i) = 0$ for all time

[22] The tax price is defined as one minus the marginal tax rate.

periods it is called random effect. On the contrary, when there is correlation between the two, $Cov(x_{it}, c_i) \neq 0$ for all t it is called fixed effect. In the model described by equation (1) it is reasonable to assume the latter case. For example one's ability for tax evasion is highly correlated with the level of marginal tax he or she is facing. Thus in our model $Cov(x_{it}, c_i) \neq 0$ is true and this has to be controlled for. Because we have only two periods first differencing will result the same estimates and inference as fixed effects method, thus following Auten and Carroll (1999) I estimate equation (1) with the first differencing technique.

Therefore in the next step I eliminate the individual effect by taking the 2005 less 2004 first difference of (1):

$$\Delta y_i = \Delta\gamma + \alpha x_i + \beta\Delta \log(1 - MTR_i) + \Delta u_i \ . \qquad (2)$$

This is the model to estimate, where Δ stands for the change in a variable between the 2005 and 2004. Since we have only two time periods by taking the first difference the time index disappears. As we can see, the time effect (γ_t) remains in the model and it will be embedded in the constant term.

There can be a major problem estimating equation (2), namely the endogeneity of the actual tax price. The MTR can change both because of the change in legislation and because of the shift of taxable income. In a progressive tax system like the Hungarian one, the latter can cause – holding other factors fixed – a decrease in MTR as the taxable income decreases. This means that $Cov(\Delta\log(1 - MTR_i), \Delta u_i) \neq 0$ and so we face endogeneity problem. In the case of endogeneity ordinary least square estimation leads to inconsistent estimators. To overcome this problem and to avoid the inconsistency of the estimates I employ an instrumental variable technique and obtain two-stage least squares estimates.

The instrumented variable is the difference in the logarithm of taxpayers' 2005 and 2004 tax prices $\Delta\log(1 - MTR_i)$ (*dlmtr*):

$$dlmtr_i = \log(1 - MTR_{2005,i}) - \log(1 - MTR_{2004,i}) , \quad (3)$$

and the instrument is the difference in the logarithm of taxpayers' synthetic tax price in 2005 and the actual tax price in 2004 (*dlsmtr*):

$$dlsmtr_i = \log(1 - SMTR_i) - \log(1 - MTR_{2004,i}) . \quad (4)$$

The synthetic tax price is one minus the marginal tax rate that would have been applicable in 2005 had the taxpayers' real income not changed.

In the first step of two-stage least squares estimation I regress the difference in the logarithm of taxpayers' 2005 and 2004 tax prices ($dlmtr_i$) on the synthetic tax price ($dlsmtr_i$) and all the other control variables:

$$dlmtr_i = x_i\delta + \theta_1 dlsmtr_i + \varepsilon_i . \quad (5)$$

In the second step I use the fitted values from this equation ($dl\widehat{m}tr_i$) instead of the difference in the logarithm of taxpayers' 2005 and 2004 tax prices ($dlmtr_i$). I regress the difference in the logarithm of incomes on the fitted values and all the other control variables:

$$dlincome_i = x_i\vartheta + \lambda_1 dl\widehat{m}tr_i + \epsilon_i . \quad (6)$$

To use *dlsmtr* as an IV it needs to satisfy two conditions:

- it must be exogenous in equation (2) that is uncorrelated with Δu_i $Cov(dlsmtr, \Delta u_i) = 0$. It satisfies this condition by construction. The instrument eliminates the effect of income changes, because it is calculated using the 2004 income inflated to 2005, therefore *dlsmtr* reflects only the exogenous statutory changes in tax rates; and

- in the linear projection of *dlmtr* on *dlsmtr* and all the other explanatory variables (5) the coefficient on *dlsmtr* must be nonzero, $\theta_1 \neq 0$. The latter condition means that *dlsmtr* is partially correlated with *dlmtr* once the other explanatory variables have netted out.

Before doing the estimation above I test the possibility of endogeneity of *dlmtr* following Hausman (1978) to legitimate the use of 2SLS. He suggested comparing the OLS and 2SLS estimators as a formal test of endogeneity. If *dlmtr* is uncorrelated with Δu_i then the OLS and 2SLS estimators will differ only by sampling error. Except for the case when there are no exogenous variables in equation (2) the matrix appearing in the quadratic form is singular, and the original form of the statistic is arduous. Hausman (1983) suggests a regression based, but asymptotically equivalent test instead of the original form of the Hausman test. The regression based method is as follows.

We regress the suspicious variable ($dlmtr_i$) on the instrument ($dlsmtr_i$) and all the other explanatory variables:

$$dlmtr_i = x_i\delta + \theta_1 dlsmtr_i + \varepsilon_i \,, \tag{5}$$

where all the right hand side variables are exogenous. After estimating (5) and obtaining the residuals we simply include $\hat{\varepsilon}_i$ along with the other explanatory variables in equation (2):

$$dlincome_i = x_i\xi + \rho_1 dlmtr_i + \rho_2\hat{\varepsilon}_i + \nu_i \,, \tag{7}$$

and attain the t-statistic of $\hat{\varepsilon}_i$ by OLS. If its coefficient is significantly different from zero, it means that we found evidence of endogeneity of the suspicious variable (*dlmtr)*, and the use of instrumental variable is a validated.

III.2 Data

My data source is the Hungarian Tax and Financial Control Office (TFCO) panel of tax returns for the years 2004 and 2005. This dataset was prepared for the Hungarian Ministry of Finance and it contains all the line items from the personal income tax form 0453. The random sampling was done by the tax authority choosing 250,000 individuals for the year 2004, and collecting their tax returns for the year 2005. It is a natural phenomena that individuals fallout from the sample from one year to another, since it is not necessary that an individual with taxable income in 2004 has to have taxable income in 2005 as well.[23] Thus the panel for the second year contains 8,9% less individuals, however it is still an exceptionally large panel including roughly 229,000 individuals. The individuals are characterized by serial numbers and their anonymity is guaranteed.

I limit my sample to taxpayers who filed in both years, and have income between HUF 100,000 and HUF 6,000,600 in both years. The reasons for this interval are first, to exclude individuals with extreme income level (control for the reversion-to-the-mean effect); second, above HUF 6,000,600 there is no change in the marginal tax rate thus no behavioral response is expected. I examine separately the HUF 684,000 – 6,000,600 income interval that allows me to exclude the effect of the raise in the minimum wage from HUF 636,000 to HUF 684,000. I also limit my sample to individuals with age between 23 and 55 to investigate only the economically active cohort, and to exclude most of the students and the pensioners.

In equation (2), to estimate the effect of the change in the marginal tax rate on the change of the income, I need to control for more effect to avoid the obvious endogeneity of the model.

[23] The most plausible case when one becomes inactive during the period.

All of the following characteristics' – taxpayer's wealth, entrepreneurial skills, life cycle of the individual, is he or she living in large city, gender and income in 2004 – relationship to income may have changed during the investigated period. Look at these effects separately.

The *taxpayer's wealth* is likely to be correlated with the ability to alter portfolios and labor arrangements as tax changes. Thus I include a *wealth* dummy as a control variable which takes the value 1 if the taxpayer had some dividend income or shareholder income (profit or share lending) or real estate renting income or any kind of savings in the form of life or pension insurance[24] in 2004. I expect to obtain positive sign for this dummy.

Entrepreneurial skills may affect the individual's tax price, because it may reflect the ability of income shifting from high taxed income to low taxed income and the propensity of risk taking. The *entrep* dummy shows whether a taxpayer reports income from any kind of self employment in 2004.[25] I anticipate positive sign for this dummy.

The *life cycle of the individual* can have effect on the tax price, because it can show one's ability to response in the tax change. For example a middle-aged taxpayer with children is on average less sensitive to tax changes than a young single. Thus I include the effect of age and having children as control variables. The *family* dummy takes the value 1 if the taxpayer applied tax allowance after the children in 2004[26]. *Age* and *agesq* are the age in 2004. I expect negative sign for *family* dummy, since it puts constraints on taxpayers' time available for work.

[24] An individual is entitled for tax allowance after his or her life or pension insurance. During my analysis I assumed that those who have this kind of savings they applied tax allowance.
[25] These are the lines in the tax form 0453 of sjj062, sjj065 and sjj072.
[26] I implicitly assume that taxpayers who have family applied the tax allowance.

I apply *urban dummies* to control for the difference in income growth and so in changes in tax price in urban and rural area (Aarbu and Thoresen 2001), since the effect of macroeconomic changes do not always coincide in time in the two different type of region. I use a dummy for the capital (*bp*) and another for the 19 region capitals (*regcap*). I anticipate positive sign for these two dummies.

My dataset does not allow me to control for occupation, however it may have significant effect as Auten and Carroll (1999) showed. I include a gender dummy that may capture the different opportunities for income growth that existed in different professions during the period. Therefore I include a *female* dummy as well.

Some taxpayers who have *unusually high or low incomes* in 2004 may experience large offsetting changes in income and so in their tax price from 2004 to 2005. This is the so called reversion-to-the-mean effect which results biased estimate for tax price elasticity. The exclusion of low and high income taxpayers from the sample helps me to limit this bias, but to control for the reversion-to-the-mean effect entirely I include initial income in the model as Moffitt and Wilhelm (1998) suggest. I use the logarithm of the income in 2004, *linitincome*.[27]

The variable of my interest is *dlmtr* that is the difference of the logarithm of the tax price facing by a taxpayer in 2005 and 2004:

$$dlmtr_i = \log(1 - MTR_{2005,i}) - \log(1 - MTR_{2004,i}) \; . \qquad (3)$$

[27] As Gruber and Saez (2000) argue that aside from tax rate changes there are two reasons why individuals at different points in the income distribution might experience different income growth rates. The first is mean reversion and the second is a change in the distribution of income. The problem with the inclusion of lagged income is that these two effects do not necessarily operate linearly. Thus richer controls for period one income might be needed; however with only two years of data, a much richer set of controls can destroy identification. In a framework as Gruber and Saez's (2000) with 12 years of data one can apply a very rich set of controls and still identify tax effects. Thus they employ in addition to period one income, a 10 piece spline in log period one income.

Table 3 shows the changes in marginal tax rate from 2004 to 2005 (for the graph see Figure 8), we can see that the change in the MTR happened in the income range of HUF 636,000 – HUF 6,000,600.

Table 3 The level of marginal tax rate in 2004 and 2005 in different income levels (in thousand HUF)

2004			2005		
MTR	Income		MTR	Income	
13.5%	0	636	13.5%	0	684
31.5%	636	720	31.5%	684	1,000
49.5%	720	756	36.5%	1,000	1,302.4
31.5%	756	800	31.5%	1,302.4	1,350
39.5%	800	1,350	49.5%	1,350	1,500
57.5%	1,350	1,500	69.5%	1,500	1,950
69.5%	1,500	1,950	51.5%	1,950	6,000.6
51.5%	1,950	5,307	43%	6,000.6	
43%	5,307				

Source: own calculation

The *dlsmtr* variable that is used for an instrument for *dlmtr* is also a difference in logarithm of tax price. However this is not the difference of the two actual tax prices, but the synthetic and the tax price in 2004:

$$dlsmtr_i = \log(1 - SMTR_i) - \log(1 - MTR_{2004,i}) \,. \quad (4)$$

The synthetic tax price is calculated as follows. The initial income is inflated to 2005 using 8.81%[28] wage inflation between 2004 and 2005. *SMTR* is equal to the marginal tax rate of the inflated income using the tax rules for 2005.

The dependent variable in the model is the difference in logarithm of income (*dlincome*) in the years 2005 and 2004. Income is defined as the incomes that are taxed under the tax

[28] Using the data of the Hungarian Statistical Office: http://portal.ksh.hu/pls/ksh/docs/hun/xstadat/tabl2_01_01_13c.html, the average before tax wage has increased from HUF 145,520 to HUF 158,343.

schedule[29]. The fact that the tax allowances did not change during the period means that the taxable income is the same in both years and this allows me to use the same income definition during my analysis.

Table 4 presents the descriptive statistics of the variables in two different subsamples that show very similar means and standard deviations for the tax price variables as Sillamaa and Veall (2001) for Canada, but somewhat lower means and higher standard deviations than Auten and Carroll (1999) for the U.S. We can see that the fraction of females is the same in both subsamples, there are less entrepreneurs and more urbanites in the higher income group. The number of observations decreased to 176,845 and 117,332 from 217,013 because of the sample limitation defined above.

Table 4 Means and standard deviations of variables

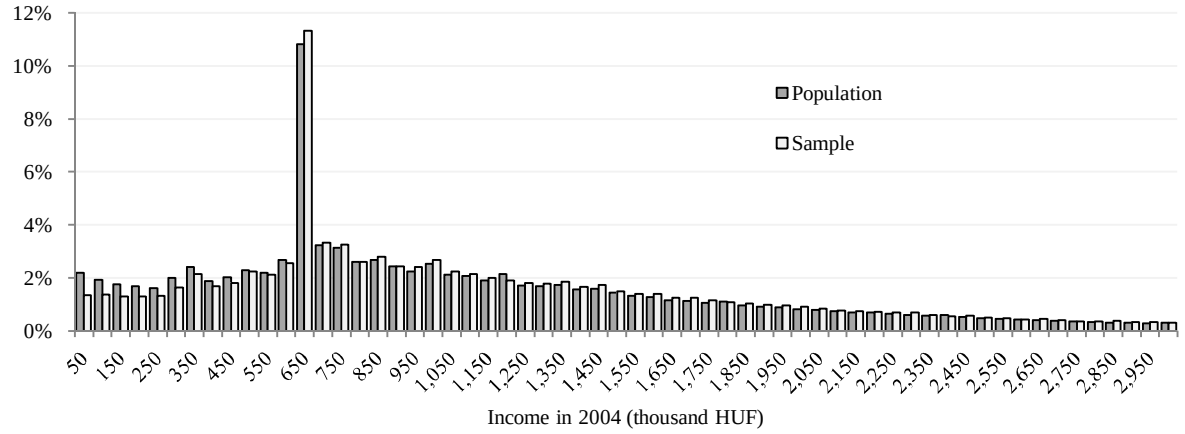
Variable	Income 100k-6000.6k		Income 684k-6000.6k	
	Mean	Std. Dev.	Mean	Std. Dev.
Δlog taxable income	0.0910	0.3998	0.0865	0.2314
Δlog (1 - marginal tax rate)	0.0201	0.2341	0.0336	0.2374
Δlog (1 - exogenous marginal tax rate)	-0.0020	0.1507	0.0260	0.1580
log 2004 gross income	6.9569	0.6951	7.3169	0.4860
wealth dummy	0.2195	0.4139	0.2904	0.4539
age in 2004	38.2476	9.5284	38.9636	9.5014
age in 2004 squared	1,553.6660	741.1953	1,608.4360	743.6204
entrepreneurship dummy	0.1224	0.3277	0.1180	0.3226
family dummy	0.2853	0.4516	0.3507	0.4772
female dummy	0.5365	0.4987	0.5388	0.4985
Budapest dummy	0.1699	0.3755	0.1728	0.3781
regional capital dummy	0.3922	0.4882	0.4022	0.4903
observations	176,845		117,332	

Source: own calculations

[29] Thus I exclude for example capital incomes from the definition of dlincome, because under Hungarian law it has to be taxed with a separate tax rate that is not changing with income.

Figure 9 compares the wage distribution in the population and in the sample. We can see that they show a very similar pattern that is – very importantly – the analyzed sample describes the population well. The peak around HUF 650,000 is because of the minimum wage level.

Figure 9 The wage distribution in the whole population and in the sample, 2004*



Source: own calculations and Tax and Financial Control Office
**For the better visualization only until HUF 3,000,000 (for the whole income range see the Appendix, Table A. 10).*

IV. Results

First I formally test the endogeneity of the actual tax price following (Hausman, 1983). I use the residuals from equation (5) as an explanatory variable in equation (6) and get the following result[30]:

$$\widehat{dlincome} = x\xi + \underset{(0.011)}{0.221}dlmtr - \underset{(0.013)}{1.217}\hat{\varepsilon}\ .$$

N=217,012 R^2=0.25

The coefficient on the residuals is highly significant and that is the sign of the endogeneity of *dlmtr* in equation (2). Thus the use of instrumental variable to estimate the tax price elasticity of income is justified.

In the first stage of the 2SLS I estimate equation (5) again, but now I obtain the fitted values of *dlmtr*[31]*:*

$$dlmtr = x\delta + \underset{(0.004)}{0.5}dlsmtr + \varepsilon\ .$$

N=176,845 R^2=0.12

The following two conditions ensures me that *dlsmtr* can be used as an IV for *dlmtr*. First, *dlsmtr*'s coefficient is significant thus I conclude that it is partially correlated with *dlmtr* once the other explanatory variables are have netted out. The high partial F-statistics for the coefficient of the tax price instrument confirms this finding. Second, by construction *dlsmtr* is not correlated with the error term in equation (2).

In the second stage of the 2SLS I use the fitted values from the first stage and estimate equation (6). Table 5 presents the estimates for the HUF 100,000 – 6,000,600 income

[30] Robust standard errors in parenthesis

[31] Here I present the results for the 100k-6000.6k income interval, however the same is true for the 684k-6000.6k interval as well. Naturally during the 2SLS estimation I always use the proper income range.

interval. Model 1 includes only one regressor, the tax price. In Model 2 I include all the financial factors, while Model 3 contains demographic variables as well. Finally, Model 4 has the most regressor it comprises regional factors too.

It is showed by Auten and Carroll (1999) that behavioral responses are different among occupation types, however including these controls their elasticity estimate remains virtually unchanged. This might be the case in my analysis as well, but it is important to note that I could not control for occupation groups.

The estimates for the key regressor – that is the difference in the logarithm of the tax price – are not much influenced by the choice of model if I control for more factors. Note the importance of the control for the mean reversion (Model 1 versus 2, 3 and 4). The preferred model is the fourth thus the tax price elasticity is 0.18 that is lower than Auten and Carroll's (1999) 0.6 or Gruber and Saez's (2000) 0.4, but it is close to Sillamaa and Veall's (2001) 0.25 and to Aarbu and Thoresen's (2001) estimates. The difference between these elasticities can be a natural consequence of the characteristics of the different – U.S., Canadian, Norwegian and Hungarian – tax systems, even if individuals in different countries exhibit identical behavioral responses (Slemrod 1998).

Table 5 2SLS regression results: change in log of gross income

Δ*log taxable income*	Income between 100,000 – 6,000,600			
	Model 1	Model 2	Model 3	Model 4
Δ*log (1 - marginal tax rate)*	**0.0156***	**0.1684*****	**0.1729*****	**0.179*****
	(0.0091)	**(0.0104)**	**(0.0104)**	**(0.0105)**
Log 2004 gross income		-0.1688***	-0.1668***	-0.1691***
	-	(0.0022)	(0.0022)	(0.0022)
Wealth		0.0524***	0.0584***	0.0584***
	-	(0.0024)	(0.0023)	(0.0023)
Age			-0.0041***	-0.004***
	-	-	(0.0011)	(0.0011)
Age squared			0.00003*	0.00003*
	-	-	(0.00001)	(0.00001)
Entrepreneurship			0.0208***	0.0205***
	-	-	(0.0029)	(0.0029)
Family			-0.0049**	-0.0031
	-	-	(0.0021)	(0.0021)
Female			-0.0017	-0.0032
	-	-	(0.0019)	(0.0019)
Budapest				0.0225***
	-	-	-	(0.0032)
Regional capital				0.012***
	-	-	-	(0.0024)
Constant	0.0907***	1.25***	1.35***	1.36***
	(0.0010)	(0.0154)	(0.0271)	(0.0271)
Observations	176,845	176,845	176,845	176,845

Robust standard errors in parenthesis
**significant at 10% level; **significant at 5% level; ***significant at 1% level*

However the result changes if I restrict the sample to the HUF 684,000 – 6,000,600 income range (Table 6). Again, except for Model 1 the tax price elasticity does not really changes with the choice of the model. Here I found much lower – 0.065 – elasticity than in the wider sample.

Table 6 2SLS regression results: change in log of gross income

Δ*log taxable income*	Income between 684,000 – 6,000,600			
	Model 1	Model 2	Model 3	Model 4
Δ*log (1 - marginal tax rate)*	**0.1043*** (0.0075)**	**0.0657*** (0.0073)**	**0.0644*** (0.0073)**	**0.0643*** (0.0073)**
Log 2004 gross income	-	-0.0752*** (0.0016)	-0.0764*** (0.0017)	-0.0776*** (0.0017)
Wealth	-	0.015*** (0.0119)	0.0176*** (0.0016)	0.0176*** (0.0016)
Age	-	-	-0.0024*** (0.0008)	-0.0023*** (0.0008)
Age squared	-	-	0.00002** (0.000009)	0.00002* (0.000009)
Entrepreneurship	-	-	0.0298*** (0.0022)	0.0296*** (0.0022)
Family	-	-	-0.0134*** (0.0015)	-0.013*** (0.0015)
Female	-	-	0.0053*** (0.0014)	0.0047*** (0.0014)
Budapest	-	-	-	0.002 (0.0024)
Regional capital	-	-	-	0.0066*** (0.0017)
Constant	0.083*** (0.0007)	0.6299*** (0.0119)	0.6968*** (0.0194)	0.7014*** (0.0195)
Observations	117,332	117,332	117,332	117,332

Robust standard errors in parenthesis
**significant at 10% level; **significant at 5% level; ***significant at 1% level*

IV.1 Robustness check

Table 5 and Table 6 show the sensitivity of the results on the sample restrictions thus in the following I present a number of robustness checks. All of these robustness checks are based on Model 4. Table 7 shows that if I look at the economically active age group the tax price elasticity does not change too much, generally in the larger sample there are a little bit larger elasticities. However I cannot find statistically significant elasticities among the 60 years and older age group which can be because pensioners on average do not response to change in the marginal tax rate.

If I look at the income dimension I find much larger changes in tax price elasticity. The result of the robustness check shows that among the above found elasticities the 6.5% describes better the behavioral response of the taxpayers for the change in tax system in the beginning of 2005. This means that if the tax price, (1 – MTR) increases by 1% the average taxpayer decreases his or her taxable income by 0.065%.

Table 7 The tax price elasticities in the different samples

Income	Age		
(thousand HUF)	23-55	18-60	60+
100-6000.6	0.179***	0.189***	-0.1822*
	(-0.0105)	(0.0107)	(0.1071)
300-6000.6	0.1252***	0.1301***	-0.1655**
	(0.0089)	(0.009)	(0.0778)
500-6000.6	0.0956***	0.1016***	-0.1
	(0.0077)	(0.0076)	(0.068)
684-6000.6	**0.0643*** **	0.063***	-0.0193
	(0.0073)	(0.0072)	(0.0756)
800-6000.6	0.0687***	0.0673***	-0.056
	(0.0072)	(0.0071)	(0.0825)
684-8000	0.0663***	0.0651***	-0.0181
	(0.0074)	(0.0073)	(0.0759)
100-	0.157***	0.1658***	-0.1976*
	(0.0104)	(0.0105)	(0.1066)
684-	0.0683***	0.0676***	0.0227
	(0.0075)	(0.0074)	(0.0822)

Note: These coefficients belong to different sample sizes. For the number of observations see the Appendix, Table A. 11

Table 7 shows that the extension of the sample to low income individuals results in a raise in the elasticity. The change in the elasticity estimate to this extent is unexpected, because as we have seen in Figure 8 the marginal tax rate did not change in this income interval. My paper does not deal with the explanation of this phenomenon; it would need further investigation of the dataset. However possible reasons for the higher elasticities in the lower income group are:

- Although the reversion-to-the-mean effect has been – at least partly – controlled for by the inclusion of the initial income in the estimation, this can be one reason for the higher elasticity on lower income levels, because it has larger impact among low earners.
- Another reason can be the inclusion of the minimum wage earners, whose income has increased by 7.5% (HUF 48,000) from 2004 to 2005.
- The tax evasion and avoidance influences the tax price elasticity, but these factors are very hard to control for and most of the empirical studies exclude them. Since the tax compliance in Hungary is worse than in the U.S. the exclusion of these factors has not the same effect on the Hungarian elasticity than on the U.S. elasticity. The most used form of tax evasion in Hungary to report less than the real income, generally the minimum wage level. Therefore this can be also a reason for the higher tax price elasticity in this income range.[32]

Possible reasons for the lower robust elasticity estimate compared to the international studies:

- The short time horizon of the analysis. It is reasonable to assume that taxpayers are not able to adjust their taxable income perfectly within one year, and probably a study comparing 2006 or 2007 to 2004 would find a larger behavioral response.
- Gruber and Saez (2000) claims that the high tax price elasticities for the U.S. are driven by the itemizers. This is a cost reduction status that can be chosen by taxpayers, however in Hungary this is not a choice for an employer only for a self-employer. This can lead to lower tax price elasticity in Hungary as well.
- My measure of tax price elasticity rather describes the middle-income taxpayers, because the main marginal tax rate changes happened in this income range. It is reasonable to assume that high-income taxpayers are more sensitive to marginal tax

[32] For a detailed analysis about the tax compliance in Hungary see Kiss and Krekó (2007)

rate changes, because they have more opportunities for altering their behavior and their marginal tax rates are on average higher.

IV.2 Implications

Using the same technique as Benczúr (2007) I model the changes of the Hungarian tax system and their effects on the individual's taxable income and on the budget of the government. I have chosen two – a low and a high – income ranges where the marginal tax rate altered and I present them in two different tables.

Table 8 shows the effect in the HUF 720,000 – 756,000 income range where the marginal rate changed from 49.5% to 31.5%. The number of taxpayers in 2004 who have taxable income within this range is 89,432 and their average income is HUF 733,143. The second part of the table presents the after reform situation with three different tax price elasticities. If there is no behavioral response (first column) the after reform income is the same as the before reform[33], and the tax cut increases the burden of the budget by almost HUF 1 billion. However if I apply the estimated tax price elasticity (second column) the average taxable income increases as the marginal tax decreases (from HUF 733,143 to 750,129), and thus the total amount of tax in 2005 is higher than without any response. This means that with a 6.5% tax price elasticity the burden of the budget increases not by HUF 1 billion but only 0.5 billion. The third column shows that if I calculate with the higher, 18% elasticity than the tax cut results in an increase of the budget's revenue by around HUF 330 million.

[33] I am interested only in the effect of reform thus I do not inflate the income.

Table 8 The effect of marginal tax cut in the HUF 720,000-756,000 income range

2004 - Before reform			
Average income in 2004	733.143		
Personal income tax	19.826		
Social security contributions	98.974		
Total tax in 2004	118.800		
Tax price elasticity	*0%*	*6.5%*	*18%*
2005 - After reform			
Δ in taxable income*	0%	2.32%	6.42%
Average income in 2005	733.143	750.129	780.180
Personal income tax	8.766	11.823	17.232
Social security contributions	98.974	101.267	105.324
Total tax in 2005	107.740	113.090	122.557
Δ paid tax	-11.060	-5.710	3.757
Number of taxpayers in this income range	89,432	89,432	89,432
Δ in the budget	-989,117.920	-510,612.826	335,973.110

Source: own calculations and Tax and Financial Control Office
**The tax price increased by 35.64% from 51% to 68.5%. This increase has to be multiplied by the calculated elasticity to get the change of taxable income (e.g. 0.3564*0.065=0.0232)*

Table 9 shows the effect of the marginal tax raise from 43% to 51.5% in the HUF 5,307,000 – 6,000,600 income interval. Because of the progressive tax schedule this table is split into two parts, one shows the tax burden on the income range below 5,307,000 and the other one shows the rest. I present only the effect of the change in the tax burden on the income above 5,307,000 and not the effect of the change in the total tax burden. The first column of the table shows that without any behavioral response the raise in marginal tax rate increases the budget's revenue by approximately HUF 700 million. However if I apply the calculated tax price elasticity then the HUF 700 million revenue increase disappears and the budget ends up with HUF 40 million deficit. The deficit rises extremely if I calculate with the 18% elasticity to HUF 1.3 billion. The phenomenon that despite the tax rate increases the tax revenue decreases can be explained by the Laffer-curve concept. The idea is that the government is able to maximize the tax revenue with an optimum level of tax rate. The increase in the tax rate above this optimum level leads to a decrease in the total tax revenue.

Table 9 The effect of marginal tax increase in the HUF 5,307,000-6,000,600 income range

2004 - Before reform			
Average income in 2004	5,617.892		
Income range 0 - 5,307	5,307.000		
Personal income tax	1,772.660		
Social security contributions	716.445		
Sum	2,489.105		
Income range 5,307-	310.892		
Personal income tax	118.139		
Social security contributions	15.545		
Sum	133.684		
Total tax in 2004	2,622.789		
Tax price elasticity	*0%*	*6.5%*	*18%*
2005 - After reform			
Δ in taxable income*	0%	-0.97%	-2.68%
Average income in 2005	5,617.892	5,563.545	5,467.201
Income range 0 - 5,307			
Personal income tax	1,716.660	1,716.660	1,716.660
Social security contributions	716.445	716.445	716.445
Sum	2,433.105	2,433.105	2,433.105
Income range 5,307-	310.892	256.545	160.201
Personal income tax	118.139	97.487	60.876
Social security contributions	41.970	34.634	21.627
Sum	160.109	132.121	82.504
Total tax in 2005	2,593.214	2,565.226	2,515.609
Δ paid tax in this income range	26.426	-1.609	-51.226
Number of taxpayers in this income range	25830	25830	25830
Δ in the budget	682,578.658	-41,571.199	-1,323,179.407

Source: own calculations and Tax and Financial Control Office
**The tax price decreased by 14.91% from 57% to 48.5%. This decrease has to be multiplied by the calculated elasticity to get the change of taxable income (e.g. -0.1491*0.065=-0.0097)*

Both tables above show the huge importance of the effect of the behavioral response on the change in the marginal tax rate. Even the internationally small elasticity estimate (6.5%) has a remarkable effect on the government's budget.

Conclusion

The elasticity of taxable income is a very important parameter in evaluating tax policy and estimating tax revenue. My empirical analysis suggests a tax price elasticity of about 6.5% that is significantly lower than elasticities found by other studies. However it still has a remarkable effect on the government's budget as the implications presented. The robustness check showed that this elasticity is sensitive to the income range of the analyzed sample. The preferred 6.5% result is, however, robust in the sense that it is stable on the income range where the marginal tax rate changes happened. My paper is a preliminary analysis of the 2005 income tax changes in Hungary, further results are expected from the ongoing research on this field.

One possible extension of this analysis could be to control for other characteristics of the taxpayer, such as the education level, his or her profession or the region where the individual lives. The use of a longer panel may also improve the results because (1) the tax changes in the beginning of 2005 might have long effects on the taxable income and (2) it allows us to investigate other changes in the tax system (e.g. top rate change from 2006 to 2007) and to apply a richer set of controls for period one income. Further step can be too to investigate the effect of the tax evasion on the elasticity of taxable income.

Appendix

Table A. 1 The tax burden and the national income, 2004

	GDP per capita (PPS)	tax revenue/GDP (%)
Austria	123.4	42.6
Belgium	119.4	45.2
Czech Rep.	72.1	36.6
Denmark	119.4	48.8
UK	118	36
Estonia	53.4	32.6
EU25	100	39.3
Finland	110.8	44.3
France	107.7	43.4
Greece	81.4	35.1
Netherlands	124.7	37.8
Ireland	135.7	30.2
Poland	48.7	32.9
Latvia	43.6	28.6
Lithuania	49	28.4
Hungary	**61.3**	**39.1**
Germany	111.1	38.7
Italy	103	40.6
Portugal	71.8	34.5
Spain	96.6	34.6
Sweden	115.4	50.5
Slovakia	54.4	30.3

Table A. 2 Tax revenues as percentage of total tax revenues, 2004

	Indirect taxes	Direct taxes	SSC
Belgium	30.1	38.8	31.1
Germany	31.1	26.3	42.6
Finland	32.2	40.9	26.9
Czech Rep.	32.9	25.8	41.3
Sweden	34	38.6	27.4
Netherlands	34.3	28.5	37.2
Austria	34.7	31.5	33.8
EU15	34.8	33.2	32
Italy	35.2	34.5	30.3
Spain	35.3	30.8	33.9
France	36.1	26.7	37.2
Denmark	36.1	61.8	2.1
Luxembourg	36.8	35.1	28.1
UK	37.7	43.9	18.4
NMS-10	39.6	22.4	38
Lithuania	39.7	30.8	29.5
Estonia	39.9	26.1	34

Greece	39.9	25.5	34.6
Poland	40.6	19.5	39.9
Hungary	41.7	23.8	34.5
Slovakia	41.8	20.2	38
Latvia	41.8	27.6	30.6
Portugal	42.1	25.2	32.7
Ireland	43.7	41.1	15.2

Table A. 3 Direct tax revenues as percentage of GDP

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Czech Rep.	9.6	8.5	9.0	8.5	8.7	8.5	9.0	9.3	9.7	9.4
Germany	10.9	11.3	11.1	11.4	11.9	12.5	11.0	10.7	10.6	10.2
Hungary	8.9	9.4	9.1	9.1	9.6	9.9	10.3	10.3	9.8	9.3
Poland	12.5	10.9	10.9	10.4	7.3	7.2	6.7	6.9	6.6	6.4
Slovakia	11.6	10.5	10.1	10.1	9.1	7.6	7.4	7.5	7.2	6.1
Sweden	20.0	20.9	21.4	21.3	22.1	22.3	19.9	18.0	18.7	19.5
UK	15.1	15.0	15.3	16.5	16.4	16.9	17.0	15.8	15.3	15.8
EU15	12.5	13.0	13.3	13.7	14.1	14.3	13.9	13.3	13.1	13.1
NMS-10	10.7	9.8	9.9	9.6	8.2	8.0	7.8	8.2	8.0	7.8

Table A. 4 Taxes on labor, consumption and capital as the percentage of total tax revenue, 2004

	Labor	**Consumption**	**Capital**
Ireland	34.6	37.0	28.4
UK	38.9	32.1	29.0
Greece	39.5	35.2	25.3
Luxembourg	40.4	30.9	28.7
Poland	42.0	35.9	23.1
Portugal	42.8	34.3	22.8
Spain	46.0	27.9	27.5
NMS-10	46.2	36.0	18.6
Slovakia	46.9	34.6	19.5
Italy	48.7	24.5	26.7
Netherlands	48.7	30.2	21.8
Czech Rep.	49.2	31.2	19.3
Hungary	49.8	39.5	12.8
EU15	50.6	27.7	21.9
Latvia	50.9	38.1	11.0
Denmark	51.4	32.4	16.6
Lithuania	52.0	37.4	10.9
Finland	52.6	31.4	16.0
Belgium	53.0	24.6	22.4
France	53.1	26.1	21.0
Estonia	54.0	37.8	8.9
Austria	55.1	28.6	16.3
Germany	58.7	26.2	15.0

Sweden	62.4	25.4	12.2

Table A. 5 Taxes on labor, consumption and capital as the percentage of GDP, 2004

	Labor	**Consumption**	**Capital**
Ireland	10.5%	11.2%	8.6%
Poland	13.8%	11.8%	7.6%
Greece	13.9%	12.3%	8.9%
UK	14.0%	11.6%	10.5%
Latvia	14.6%	10.9%	3.1%
Lithuania	14.7%	10.6%	3.1%
Slovakia	14.7%	10.8%	6.1%
Portugal	15.0%	12.0%	8.0%
Spain	15.9%	9.6%	9.5%
NMS-10	16.1%	12.5%	6.5%
Luxembourg	16.2%	12.4%	11.5%
Estonia	17.6%	12.3%	2.9%
Czech Rep.	18.0%	11.4%	7.1%
Netherlands	18.4%	11.4%	8.2%
Hungary	19.4%	15.4%	5.0%
Italy	19.8%	10.0%	10.9%
EU15	20.1%	11.0%	8.7%
Germany	22.7%	10.1%	5.8%
France	23.1%	11.3%	9.1%
Finland	23.3%	13.9%	7.1%
Austria	23.5%	12.2%	7.0%
Belgium	24.0%	11.1%	10.2%
Denmark	25.1%	15.8%	8.1%
Sweden	31.5%	12.8%	6.1%

Table A. 6 The change in tax burden on labor as a percentage of total tax revenue, 1995-2004

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Hungary	49.9	50.4	52.4	51.1	49.4	49.6	51.4	52.1	50.7	49.8
Poland	44.7	46.8	46.4	47.1	47.5	44	46.5	43.5	43.1	42
Sweden	62.5	63	62.3	63	62	60.5	63.1	63.3	63.3	62.4
UK	39.6	38.1	36.8	37.7	37.6	38.3	38.6	38.5	38.8	38.9
Ireland	40.9	39.8	39.2	38	36.8	36.1	37	35.2	33.7	34.6
EU15	52.8	52.1	51.3	51.1	50.2	50.2	50.9	51.2	51.2	50.6
NMS-10	47.1	48.4	48.7	48.9	48.6	47	48.5	47.3	47.2	46.2

Table A. 7 Implicit tax rates on labor, 1995-2004

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HU	42.6	43.0	43.7	42.8	42.7	42.3	42.6	42.5	40.9	40.8
NMS-10	38.4	37.7	37.5	37.3	39.0	36.9	36.9	37.0	36.9	38.9
EU-15	36.9	37.4	37.4	37.5	37.2	37.1	36.7	36.3	36.6	36.5

Table A. 8 Elasticity Results of Previous Studies

Author (Date)	Data (Years)	Tax Change	Sample	Controls for Mean Reversion and Income Distribution	Income Definitions	Elasticity Results
Lindsey (1987)	Repeated Tax Cross-Sections (1980 to 1984)	ERTA 81	AGI>$5K	None	Taxable Income	Elast.: 1.05 to 2.75 Central Estimate: 1.6
Feldstein (1995)	NBER Tax Panel (1985 and 1988)	TRA 86	Married, Non-Aged, non-S corp creating, Income>$30K	None	AGI, Taxable Income	Elast. of AGI: 0.75-1.3, Elast. of Taxable Income: 1.1 - 3.05
Navratil (1995)	NBER Tax Panel (1980 and 1983)	ERTA 81	Married, Income>$25K	Use Average Income	Taxable Income	Elast. of Taxable Income: 0.8
Auten-Carroll (1999)	Treasury Tax Panel (1985 and 1989)	TRA 86	Single and Married, age 25-55, Inc.>$15K, Non-S corp creating	Include Log Income in base year	Gross Income, Taxable Income	Elast. of Gross Inc.: 0.66, Elast. of Taxable Income: 0.75
Sammartino and Weiner (1997)	Treasury Tax Panel (1985 to 1994)	OBRA 1993	Less than 62 years old	None	AGI	Close to zero permanent response of AGI
Goolsbee (2000)	Panel of Corp. Exec. (1991 to 1994)	OBRA 1993	Corporate Executives 95% with income>$150K	Use Average Income	Wages, Bonus, and Stock Options	Long Run Elast.: 0.1 Short Run Elast.: 1
Caroll (1998)	Treasury Tax Panel (1987 and 1996)	OBRA 1993	Married aged 25-55 Income>$50K	Use Average Income	Taxable Income	Elast.: 0.5
Saez (1999)	NBER Tax Panel (1979 to 1981)	Bracket Creep	Married and Singles only	Include Log Income and Polynomials in Income	AGI, Taxable Income	Elast. of AGI: 0.25, Elast. of Taxable Income: 0.4
Moffitt and Wilhelm (1998)	SCF Panel (1983 and 1989)	TRA 86	High Incomes Oversampled	Use Various Sets of Instruments	AGI	Elast. of AGI: 0 to 2, depends on Instruments
Goolsbee (1999)	Tax Statistics Tables (1922-1989)	Various Tax Ref.	Incomes >$30K	None	Taxable Income	Elast. from -1.3 to 2 depending on Tax Reform
Sillamaa and Veall (2001)	LAD Tax Panel (1986 and 1989)	Federal Tax Reform 1988	Aged 25-61, 64+, exclude Quebec, Income>$9K	Include Log Income in base year	Gross, Taxable, Regular- and Self-employment, Work	Elast. from 0.08 to 1.32 depending on Income Definition
Aarbu and Thoresen (2001)	Income Distribution Survey Panel 1991-94	Tax Reform 1992	Aged 22-64, Income earners and self-employed	Use pre-reform income	Taxable Income	Elast. from -0.6 to 0.2

Source: Gruber and Saez (2000) with two additional empirical studies

Table A. 9 The changes in MTR over the 0-3000k interval

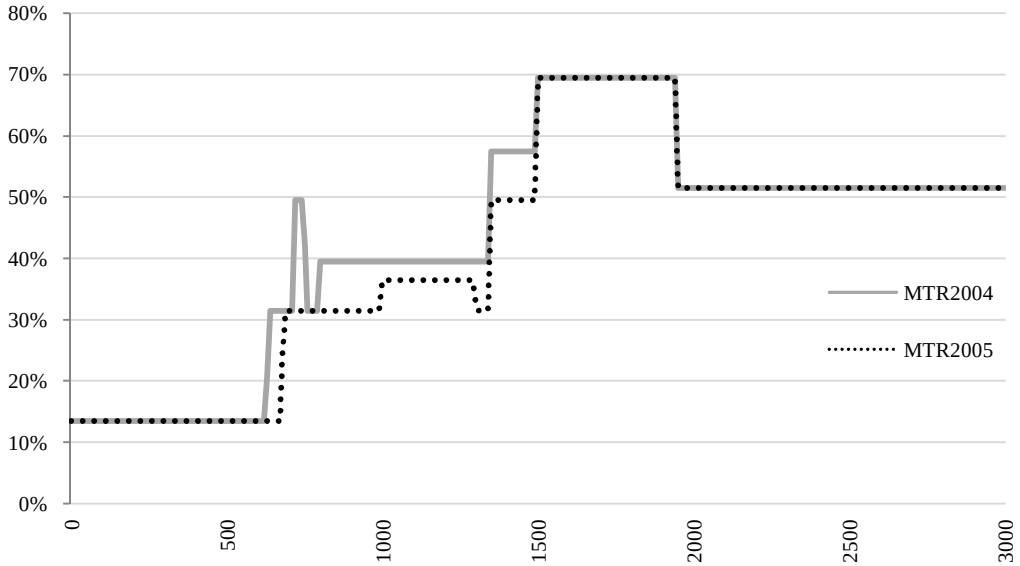


Table A. 10 The wage distribution in the whole population and in the sample in thousand forints, 2004

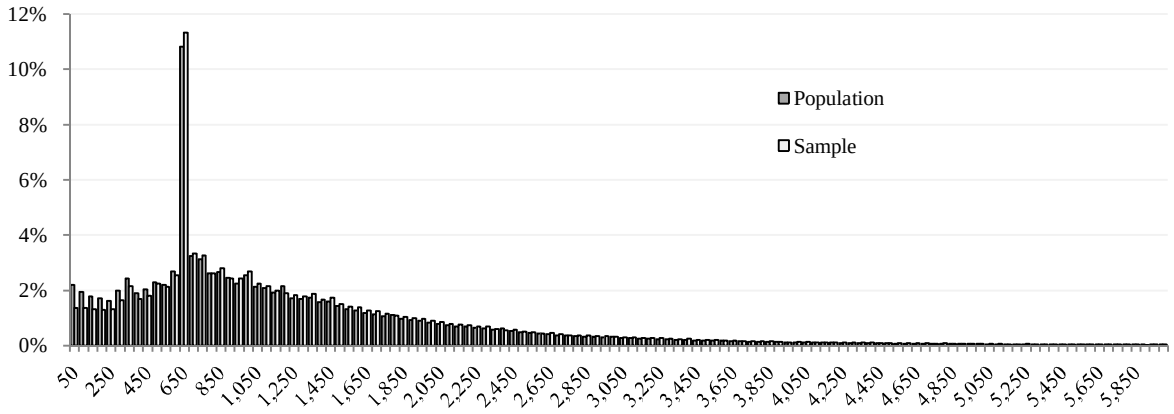


Table A. 11 Robustness checks – Number of observations

Income	Age		
(thousand HUF)	23-55	18-60	60+
100-6000.6	176,845	197,748	5,631
300-6000.6	166,134	183,442	4,342
500-6000.6	150,508	164,682	3,369
684-6000.6	117,332	128,118	2,688
800-6000.6	104,340	113,563	2,358
684-8000	119,800	130,859	2,812
100-	182,052	203,605	5,963
684-	122,481	133,902	3,013

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