ESSAYS ON RESPONSES TO TAXATION

by

Pálma Mosberger

Submitted in partial fulfillment of the requirements for
the degree of Doctor of Philosophy at
Central European University

Supervisor: Botond Kőszegi
Associate supervisors: Róbert Lieli, Péter Benczúr

Budapest, Hungary

10.14754/CEU.2016.02

CENTRAL EUROPEAN UNIVERSITY

DEPARTMENT OF ECONOMICS

The undersigned hereby certify that they have read and recommend to the Department of Economics for acceptance a thesis entitled "Responses to taxation" by Pálma Mosberger

Dated: June, 2016

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Chair: _____

László Csaba

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Supervisor: _____

Botond Kőszegi

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Associate Supervisor: _____

Róbert Lieli

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

External Examiner: _____

Attila Lindner

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Internal Examiner: _____

Gábor Kézdi

10.14754/CEU.2016.02

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Internal Committee Member: _____

Sergei Lychagin

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

External Committee Member: _____

Eyno Rots

10.14754/CEU.2016.02

CENTRAL EUROPEAN UNIVERSITY

DEPARTMENT OF ECONOMICS

Author: Pálma Mosberger
Title: Essays on responses to taxation
Degree: Ph.D.
Dated: June, 2016

Hereby, I testify that this thesis contains no material accepted for any other degree in any other institution, apart from that a preliminary version of the second chapter constituted the basis of my MA thesis submitted at the Central European University. The phd chapter is a fundamentally re-worked version of it. I also testify that this thesis contains no material previously written and/or published by another person except where appropriate acknowledgement is made.

Signature of the author: _____

10.14754/CEU.2016.02

DISCLOSURE OF CO-AUTHORS CONTRIBUTION

Title of the paper: The elasticity of taxable income of high earners: Evidence from Hungary
Co-author: Áron Kiss

The nature of cooperation and roles of the individual co-authors and approximate share of each co-author in the joint work are the following. Early versions of the taxable income elasticity were estimated separately by Áron and me; my results were the basis of my MA thesis at the Central European University. Then the two drafts were merged, improved and published as a working paper at the Central Bank of Hungary (Kiss and Mosberger, 2011). Results of the working paper version have been discussed in a survey article for a non-technical audience (Benczúr et al., 2013). Another version of the paper was published in the journal of Empirical Economics (Kiss, Mosberger, 2015). Subsection 2.4.3 and 2.5.4 are only included in the PhD dissertation chapter.

Title of the paper: Top Income Shares in Hungary: Capital and Labor, (1914-2008)
Co-author: Dimitris Mavridis

The nature of cooperation and roles of the individual co-authors and approximate share of each co-author in the joint work are the following. The paper was developed and the calculations were done in cooperation with Dimitris. As his knowledge of Hungarian is limited, I have contributed a larger share to data collection, and also it was my contribution to review the Hungarian tax code from the end of the 19th century till recent days.

Abstract

The thesis is about estimating different responses to tax reforms. All three studies are based on administrative tax data. In the first two chapters evidence is displayed on that both corporations and high income individuals responded to tax increase reforms. In the third chapter we provide evidence that top tax rates are not the prime determinants behind changes in top income shares, but other institutional determinants, such as liberalized wage settings and capital ownership.

Existing evidence indicates that companies' reported earnings react to tax incentives, but we do not know whether these are accounting responses, evasion responses or real responses. The first chapter tests for the responses using a quasi-experimental design of a corporate minimum tax scheme introduced in Hungary in 2007 that widened the tax base only for firms with low reported profit rate (profit as a share of revenue). With a new panel dataset containing administrative tax records on corporations I replicate previous findings on the earnings responses to tax incentives, but also document three additional pieces of evidence that suggest accounting rather than real responses. First, companies reacted too quickly to the change in incentives to reflect real responses: only a half year after the introduction of the reform the data exhibit sharp bunching in the distribution of profit rates in accordance with the new incentives. Second, direct measures of real production responses suggest no significant behavioral reactions. Additional analysis of the reported cost structure of corporations shows large changes only in reported material cost which is the most easily over-reportable item, supporting the reasoning that reported changes are mostly coming from reduced cost over-reporting.

The second chapter studies how high-income taxpayers responded to the introduction of the 'extraordinary tax on individuals' in Hungary in 2007. The study is based on a panel of tax returns containing information on 10 percent of tax-filers from 2005 and three subsequent years. We estimate the elasticity of taxable income with respect to the marginal net-of-tax rate and find that the taxable income of Hungarian high earners is moderately responsive to taxation: the estimated elasticity is about 0.24. We also find evidence for a sizeable income effect. The estimated effect is not caused by income shifting.

In the third chapter we present the first top income share series of a Central-Eastern European country - Hungary - and exploit the "exogenous shock" of the planned economy to analyse main mechanisms that generate income disparities. Within this quasi-natural experiment setup we study top income shares dynamics and the sources of income at the top of the income distribution. We use income tax statistics data from the establishment of income tax in the beginning of the 20th century up until recent years, in order to estimate homogeneous yearly top income shares. The evidence is complemented with earning census data during the state socialist period. To compute comparable series with other countries present in the World Top Incomes Database we follow their estimation strategy. Our estimates suggest that both capital income and labor income played a significant role in increasing income inequality during market economies. The former via the allocation of capital holdings from the state to private owners and securing property rights; the latter via wage-setting decentralization favoring the remuneration of skills.

Acknowledgements

First and foremost, I am indebted to my supervisors, Botond Kőszegi, Róbert Lieli and Péter Benczúr, for their continuous support, invaluable help and advise throughout my PhD years. They inspired and encouraged me to think about complex questions, simplify them and present them understandably.

I am also grateful for my co-authors, Áron Kiss and Dimitris Mavridis, who directed me towards analysing all aspects of the research questions, and paying attention to small details. I am very thankful for the comments of the PhD examiners, Gábor Kézdi and Attila Lindner. I would like to thank Tony Atkinson and Emmanuel Saez who supervised my work during my research visit at Oxford and at UC Berkeley.

I have benefitted from comments and suggestions on the first chapter by Stuart Adam, Pierre Bachas, Gergő Baksay, James Browne, Hedvig Horváth, Gábor P. Kiss, Attila Lindner, Benedek Nobilis, David Phillips, Barra Roantree, Danny Yagan, Owen Zidar, and participants at the IFS Lunch seminar, Berkeley Public Economics seminar, Public Economics UK Conference and MNB Fiscal Workshop. I would like to thank also Dóra Benedek, Péter Elek, Sándor Csanád Kiss and Ágota Scharle for comments on earlier drafts of the second chapter; and Facundo Alvaredo, Zsuzsa Ferge, László Katus, Salvatore Morelli and Gabriel Zucman, and seminar participants at the EHESS and WEast conferences for comments on the third chapter on the top income shares.

I gratefully acknowledge financial support from INET-EMod for my visit to Oxford, from the Rosztóczy Foundation for my visit to UC Berkeley and from the CEU Foundation for my visit to the Institute for Fiscal Studies in London.

I am very much thankful for the encouragement of my family, and especially to my parents who always emphasised how important my education was.

Contents

10.14754/CEU.2016.02

Chapter 1

1 Accounting versus real production responses among firms to tax incentives: Bunching evidence from Hungary [1]

1.1 Introduction

Existing evidence indicates that firms do respond to tax incentives and alter their reported income; however there is no convincing unequivocal research on breakdown into real production responses and accounting evasion responses. This paper is a major step to this direction on differentiating the types of responses. For example, there are two forces in effect in case of a tax base broadening aiming to reduce cost-overreporting: firms might respond by reducing real production or by reducing evasion. To know which force drives responses is essential for policy makers in order to be able to design an efficient and equitable tax system. If real production effect drives responses, then broadening the tax base would lower tax revenues and would have negative welfare implications; contrarily if evasion reduction effect drives responses, then it would increase tax revenue and impact positively welfare.

To empirically analyze and address the question of types of corporate responses to tax changes I take advantage of a policy quasi-experiment. In mid-2007 a minimum corporate tax scheme was introduced in Hungary aiming to discourage tax base elimination due to aggressive cost over-reporting. According to the new regulation a corporate income tax was levied on revenue for firms with very high reported cost ratios (hence low reported profit ratios or even loss), and remained on profit for others.

To detect the responses to the minimum tax scheme I use administrative data provided by the Hungarian Tax Authorities (NAV, APEH). The unbalanced panel data contains the universe of double-entry bookkeeping corporate tax returns between 2002 and 2012. The advantage of the dataset is that it is exceptionally large – containing 200-400 thousand observations each year – with very detailed information including figures in all cells reported on the tax form and its appendix balance sheet and profit and loss statement.

[1] I am thankful for comments and suggestions by Stuart Adam, Pierre Bachas, Gergő Baksay, James Browne, Hedvig Horváth, Gábor P. Kiss, Botond Kőszegi, Róbert Lieli, Attila Lindner, Benedek Nobilis, David Phillips, Barra Roantree, Emmanuel Saez, Danny Yagan, Owen Zidar, and participants at the IFS Lunch seminar, Berkeley Public Economics seminar, Public Economics UK Conference and MNB Fiscal Workshop. Péter Harasztosi kindly allowed to use his data cleaning codes for the Hungrian corporate tax micro database. All remaining errors are my responsibility. I gratefully acknowledge financial support from CEU Foundation during my visit at the Institute for Fiscal Studies in London and from the Rosztóczy Foundation during my visit at UC Berkeley. All opinions expressed in this paper are those of the author and do not necessarily represent the views of her past or present institutions.

My empirical findings are the following. First, I present graphical evidence on that corporations responded to the reform as soon as half year after the introduction of the reform. The speed of reaction supports the hypothesis that changes are driven by accounting rather than real responses. Then, to confirm the casual effect of the reform on the change in the distribution, I present further evidence that the magnitude of firms' responses is in line with the extent of incentives. In years when the corporate income tax (CIT) rate was higher, providing more incentives for firms to alter their behavior, the excess bunching mass was also larger compared to years with lower CIT rate. Second, I study responses among heterogeneous groups, and provide graphical evidence that groups that had more opportunity to over-report cost items before the reform (such as firms in the construction and manufacturing sectors, or the subgroup of small firms) also responded more to the reform; again suggesting accounting rather than real responses. Third, I directly identify and estimate the real responses of firms to the minimum tax reform; the findings suggest no significant production reactions. Finally, additional analysis of the reported cost structure of corporations shows large changes only in reported material cost which is the most easily over-reportable item, supporting the reasoning that reported changes are mostly coming from reduced cost over-reporting.

The paper contributes to three strand of the public economics literature. First, it contributes to the new strand of literature estimating corporate responses to tax legislation changes. Only a few papers estimate the corporate taxable income elasticities with respect to the statutory or effective corporate income tax rates based on tax legislation changes, such as Gruber and Rauh (2005) for USA, Devereux et al. (2012) for United Kingdom, and Dwenger and Steiner (2008) for Germany. In a recent paper Elek and Lőrincz (2015) made the first preliminary step toward the corporate income elasticity estimation of Hungarian firms, providing estimates on the relation between statutory and effective tax rates, but not linking it to changes in reported taxable income. The findings in these papers also confirm that firms respond to the tax code in accordance with the incentives.

Second, the paper contributes to the research on differentiating firms' real production responses versus evasion and accounting responses to the tax code. Almunia and Lopez-Rodrigez (2013) show that firms strategically adjust their reported revenue to remain below the threshold above which tax authority audit probability is higher. The authors provide evidence that rule out the hypothesis that bunching is due entirely to real response, but their evidence does not prove that it is all evasion response. Best et al. (2014) provide evidence on that when the tax base is broader the tax evasion is smaller. They also develop a simple model that put bounds on evasion responses using bunching in the profit rate distribution under different assumptions about the real output elasticity. My paper is innovative with respect to this literature on that dimension I estimate directly real production responses, and provide evidence for that responses are driven by accounting and not by real production responses.

Third, the methodology is related to the administrative micro data based bunching estimation literature. In a seminal paper, Saez (2002) proposes to estimate elasticity responses based on kink points – income thresholds where marginal tax rates jumps – in the tax schedule. Kleven and Wasseem (2012) improves the estimation strategy for notches in the tax schedule, i.e. income thresholds where the average tax rate jumps. In the bunching estimation studies the post-reform distribution with the excess bunching mass is compared to an estimated hypothetical counterfactual distribution, but it does not take into consideration extensive margin responses. To overcome this drawback I compare the empirical distribution directly to the actual pre-reform distribution, and not to a hypothetical counterfactual.

The structure of the paper is as follows. Section 2 describes the minimum tax scheme reform, and the incentives it provided for corporations and section 3 presents the bunching responses in the distribution of the profit rate and the heterogeneous responses among groups that might have been affected more intensively by the reform. The main pieces of evidence suggesting accounting rather real responses are presented in section 4, and section 5 concludes.

1.2 Minimum tax scheme

1.2.1 Reform and data

The Hungarian minimum tax scheme introduced in mid-2007 provides a natural policy experiment to differentiate between real and accounting responses to tax incentives.[2] The goal of the reform was to discourage tax base elimination due to aggressive cost over-reporting, and hence to increase tax revenue and ensure more equitable tax liability distribution. But at the same time it also increased the tax burden for specific companies, which could have generated reduction in their production.

Before the introduction of the minimum tax reform, corporate taxable income was calculated as revenue minus declared cost items (i.e the operating profit) providing an incentive to over-report cost, and hence decrease the reported profit. The operating profit could be further increased or decreased by the tax base modifying items to get the adjusted profit, i.e the final tax base.[3] The corporate income tax (CIT) rate was levied on this final adjusted tax base. Since the introduction of the reform in mid-2007, corporations have been subject to a minimum taxable income amount equaling 2 percent of their net revenue (revenue minus the purchase price of sold goods and services).[4] In practise according to the new regulation, the corporate income tax was levied on revenue for firms with very high reported cost

[2] See 1996. LXXXI. on corporate tax legislation and paragraph §6 on the details of minimum tax scheme.

[3] The most frequently reported tax base decreasing items include loss carry forward, the amount of donations, R+D, and allowances for employing young unskilled or disabled workforce, while tax base increasing items include tax penalty, received donations, etc. See 1996. LXXXI. §7. and §8.

[4] An earlier version of the reform scheme was announced during the summer of 2006, but the final version came into effect from July 2007.

ratios, and hence low (or negative) reported profit ratios, and still on profit for others.[5] Consequently, for these companies the reform decreased incentives to misreport costs as from this point tax liability is calculated based on revenue. Alternatively, firms can choose to submit a detailed form on their cost structure and income items, then get a tax audit with high probability, and still pay taxes based on their low profit. This way the reform shifted the cost of proving no tax evasion to firms that have genuinely high cost structure.

The analysis is based on Hungarian corporate tax returns covering the universe of double-entry bookkeeping companies for years between 2002 and 2012. The data structure is unbalanced panel including about 200-400 thousand observations each year. It contains very detailed information, including figures in all cells reported on the tax form and its appendix balance sheet and profit and loss statement submitted to the Hungarian Tax Authorities (NAV, APEH). (See Appendix A.1 for a detailed data description.)

1.2.2 Theoretical framework

My estimation strategy builds on Best et al.'s (2014) analysis of Pakistani companies, but adjusts the methodology to account for Hungarian circumstances, and extends it to leverage the more complete data on firms. According to the Hungarian corporate income tax regulations the tax is levied on revenue for firms with very high reported cost ratios, and hence low reported profit ratios or even loss, and still on profit for others. The same corporate tax rate is applied to the larger of the profit and the 2 percent revenue. In practise this means that there are two different effective tax rates in Hungary: the corporate tax rate applied to the profit, and the 2 percent of the corporate tax rate applied to the revenue.

Formally firms are either in the profit or in the revenue regime based on the below formula:

$$max\left[y - c + \Delta, 0.02y\right],$$

where y is the revenue net of purchase price of sold goods and services, c includes any cost items such as material, service cost items, investment, wages, rents, paid interest, and Δ is the sum of tax base modifying items. The tax is levied on the larger of the adjusted profit or the 2 percent of the net revenue: $\left[y - c + \Delta\right], \left[0.02y\right]$. The corporate income tax rate is identical on both tax bases, that is the tax liability amount is calculated as $\left[y - c + \Delta\right]\tau_\pi$ or $\left[0.02y\right]\tau_\pi = y\tau_y$, where τ_π is the CIT rate on the adjusted profit, and $\tau_y = 0.02\tau_\Pi$ is the effective tax rate on net revenue.

[5] Some corporations can be exempt from the minimum tax scheme and pay tax liabilities based on their profit independent from their minimum revenue. These corporations include non-profit legal entities, preliminary companies, and companies that suffered unexpected casualty loss. Also corporations can choose to submit a detailed form on their cost structure and income items, and still pay taxes based on their low profit, but in this case they face a tax audit with high probability. See 1996. LXXXI. §6 (6).

The tax liability amount is continuous as a function of the tax base, and at the border of the two regimes it equals to: $[y - c + \Delta] * \tau_{\Pi} = 0.02y * \tau_{\Pi}$. Firms switch between the two regimes when adjusted profit equals the minimum revenue:

$$[y - c + \Delta] = 0.02y$$

Hence the profit ratio – the ratio between the profit and the net revenue – equals 2 percent when firms switch between revenue and profit regimes. If the profit ratio is above this 2 percent cutoff then the tax base equals the adjusted profit, while if it is below then it equals the minimum required tax base. This special threshold profit ratio is:

$$p \equiv \frac{y-c+\Delta}{y} = 0.02$$

Alternatively, the minimum tax base reform can be also interpreted as imposing a 98 percent cap on cost deductions:

$$\frac{[c-\Delta]}{y} = 0.98$$

Figure 1.1 shows the minimum revenue tax schedule for a given fixed revenue level and varying cost (c) for firms with positive net tax base modifying items (Δ). The horizontal axis represents the profit ratio, and the vertical the tax amount liability. After the introduction of the minimum tax scheme, the tax base is independent of the reported cost for corporations in the revenue regime; this is left of the profit threshold. Meanwhile in the profit regime reported cost still reduces the tax base, and hence the tax liability. The tax liability equals tax base multiplied by CIT rate; therefore tax liability minimalization is the same as tax base minimalization.

After the introduction of a minimum tax scheme firms in the revenue regime face two main incentives to shift their profit rate to the right and bunch at the threshold profit ratio. First, there is an incentive to reduce real production as after the reform they gain less marginal benefit from an additional unit of production. Assuming decreasing returns to scale, it will shift their profit ratio to the right.[6] Second, firms in the revenue regime have an incentive to reduce cost over-reporting as it does not decrease their tax liability anymore, but still incurs cost to acquire these additional invoices, and also increases the probability of tax authority detection.[7] Reducing cost over-reporting also shifts the profit ratio to the right. The first incentive, the production distortion effect is small at the margin of the two regimes, as firms at the revenue regime face a low tax rate on their revenue (that is 2 percent of the actual CIT in case of the Hungarian context), while the profit tax does not distort real production.[8] The

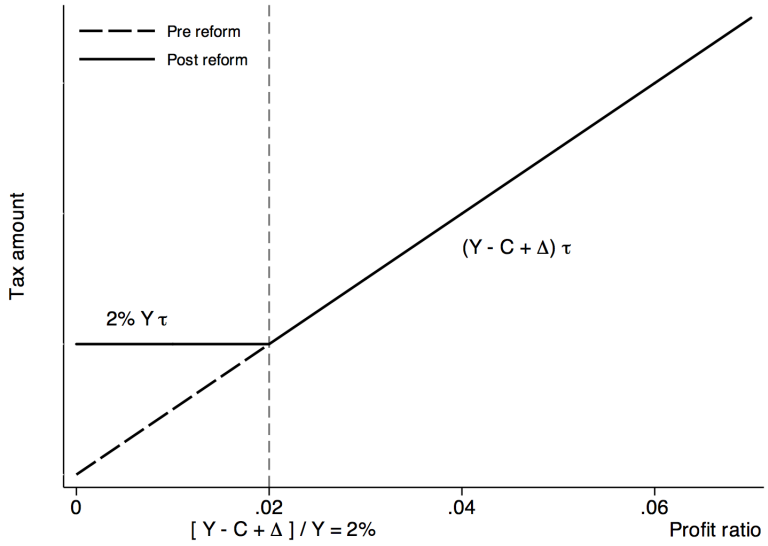
[6] In case of an increasing (constant) returns to scale, the profit rate would shift to the left creating a hole (no bunching) in the distribution.

[7] Anecdotal evidence supports that firms pay fee when acquiring additional invoices without real purchase transactions. Moreover, the probability of tax authority detection and penalty fee is higher in case of higher tax evasion.

[8] In case if the profit tax distort production then it even decreases the difference at the margin of the two regimes.

second incentive, evasion reduction, is large at the border of the two regimes. There is no incentive to over-report costs in the revenue regime, but incentive equals the CIT rate in the profit regime.

Figure 1.1: Minimum revenue tax schedule when $\Delta \geq 0$



As firms face optimization frictions such as adjustment cost, inattention, lack of information and unexpected shocks in profit, instead of creating an excess point mass exactly at the cutoff, they will create a diffuse excess mass around the 2 percent threshold. Meanwhile, firms at the right of the threshold are not affected by the reform, so they do not reoptimize their production and reporting behavior. On the basis of the above arguments Best et al. (2014) reason that as the real production incentive is small, and the evasion incentive is large, a large bunching response can only be reconciled with a large response in tax evasion reduction. They put bounds on evasion responses using different assumptions about real output elasticity, meanwhile in this study I estimate the production response directly.

The additional difference in the Hungarian minimum tax scheme setting compared to the Pakistani one analyzed by Best et al.(2014) is that the tax base modifying items can also influence the analyses; these are the items that can increase or decrease the operational profit to get the final adjusted profit. If the sum of the tax base modifying items is zero or positive, as explained above, then similarly to the Pakistan setting there is a kink in the tax schedule, meanwhile if it is negative then there is a notch in the tax schedule.

The framework is as follows when the sum of the tax base modifying items is negative, that is when

the operational profit is larger than the adjusted profit. The tax regime is determined based on the comparison of the operational profit and the minimum amount:

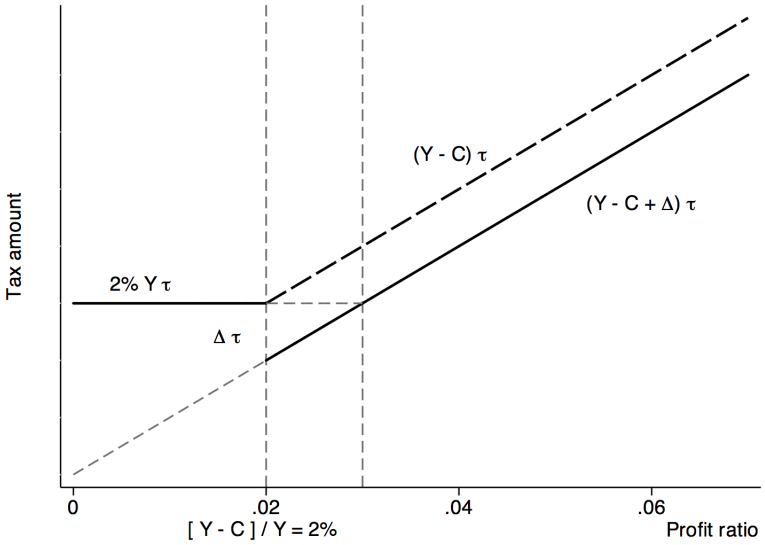
$$max\left[y-c, 0.02y\right].$$

But as before, the tax is levied on the adjusted profit in the profit regime, and on the minimum amount in the revenue regime: $\left[y-c+\Delta\right], \left[0.02y\right]$. So even though the regime is determined based on the operational profit, tax is levied on adjusted profit in the profit regime. This creates a jump in the tax liability at the border of the two regimes and firms face an individual specific notch in their tax schedule as depicted in Figure 1.2. The threshold profit ratio between the revenue and profit regimes is:

$$p \equiv \frac{y-c}{y} = 0.02.$$

So while theoretically in the Hungarian setting a subgroup of firms have a kink point in their tax schedule creating an incentive to bunch exactly at the threshold, in practise the bunching mass will be diffuse around the threshold due to adjustment costs and optimization frictions. While the other subgroup of firms have a notch – discontinuity – in their tax schedule facing an extra incentive to bunch above the threshold profit rate to be able to claim the tax base modifying items in order to reduce their tax liabilities.

Figure 1.2: Minimum revenue tax schedule when $\Delta<0$



I estimate the corporate responses based on the bunching excess mass in the distribution of profit rates around the kink and the notch point in the tax schedule. The main underlying assumption is

that in equilibrium the distribution of firms' profitability is smooth. As the corporate income tax schedule is also smooth before the reform, these create a smooth distribution of profit rates. After the introduction of the minimum tax scheme a kink point is introduced in the tax liability schedule. With the new tax regime firms to left of the cutoff face an incentive to reoptimase their reporting and to increase their reported profit rate till the cutoff either via reducing over-reporting cost items or production, while firms above the cutoff are not affected. Firms in some interval $[\pi^* - \Delta\pi^*, \pi^*]$ – where π^* is the 2 percent cutoff – will find it more profitable to increase their reported profit till the cutoff and create an excess mass in the distribution. The marginal buncher firm is originally located at the $\pi^* - \Delta\pi^*$ profit rate, and all firms originally located between the marginal buncher and the 2 percent cutoff move to the kink point. Firms located below the marginal buncher will also increase their reported profit rate after the reform and fill up the hole in the interval $[\pi^* - \Delta\pi^*, \pi^*]$. Assuming two hypothetical populations of firms facing the same tax reform, the further the marginal buncher is from the cutoff, the larger the firms' response to the reform. How far from the left of the cutoff the marginal buncher is coming from can be linked to the amount of excess bunching based on the formula:

$$B = \int_{\pi^* - \Delta\pi^*}^{\pi^*} h_0(\pi) d\pi \simeq \bar{h_0}(\pi) \Delta\pi^*,$$

where B is total bunching mass that is estimated based on the empirical distribution, and $h_0(\pi)$ is the counterfactual density on the interval $[\pi^* - \Delta\pi^*, \pi^*]$. The marginal buncher can be backed out the marginal buncher (b) as $b = B/\bar{h_0}(\pi)$.

The counterfactual distribution (i.e. the distribution that would have been without the kink or the notch) is estimated by fitting a polynomial on the actual empirical distribution where the bunching interval is excluded, then predicted fitted values are calculated for the excluded range. Finally, the excess mass is the difference between the actual and counterfactual distribution. A drawback of this counterfactual estimation strategy is that it does not take into consideration extensive margin responses. To overcome this latter problem a novel characteristic of my estimation strategy is that I compare the empirical distribution directly to the actual pre-reform distribution, and not to a hypothetical counterfactual. I calculate bootstrapped standard errors for the point estimate of b by taking samples (with replacement) of the distribution a large number of times (N=1000), estimating the point estimates corresponding to these bootstrap samples, and then calculating the sample standard deviation of the sampling distribution of $\hat{b}$.

The methodology is similar in case of the tax schedule with a notch point. The marginal bunching firm is originally located at the $\pi^* - \Delta\pi^{'}$ profit rate, where π^* is the 2 percent cutoff, and all firms between the marginal buncher and the cutoff move to the notch point. In case of the notched tax

schedule firms face an additional incentive to bunch above the cutoff. The difference between the kink and the notch point is that the latter creates a dominated region. That is why though those firms located below the marginal buncher will also increase their reported profit rate, but will not fill up the hole entirely due to the dominated region. The excess mass is the difference between the empirical distribution and the actual pre-reform distribution in the range above the cutoff threshold. (See Saez 2002 and Kleven-Wassem 2013 for the theory on tax schedule kink and notch point created bunching responses).

1.3 Responses to tax incentives

In this section, first I provide evidence on that firms changed their behavior immediately after the reform consistently with the theoretical predictions described in the previous section. Only a half year after the introduction of the reform the data exhibit sharp bunching in the distribution of profit rates in accordance with the new incentives. The speed of reaction provide supporting evidence for that changes are driven by accounting rather than real responses. Second, to confirm the casual effect I present further evidence on that the magnitude of firms' responses is in line with the extent of incentives. In years when the CIT rate was higher, providing more incentives for firms to alter their behavior, the excess bunching mass was larger also compared to years with low CIT rate. Third, I point out a puzzling phenomenon suggesting other than financial incentives created by the reform are in force. In accordance with the theory on bunching the subgroup of firms with a notch point in their tax schedule create an excess mass above the 2 percent threshold to be able to take advantage of the decrease in the tax liability amount above the cutoff. Contrary to financial incentives, the subgroup with a kink point in their tax schedule overreact to the reform, and instead of creating an excess mass on the cutoff, they bunch on an interval above the threshold. A possible explanation could be that the 2 percent cutoff created by the policy change is a reference point also. Firms may perceive the minimum revenue legislation as the system identifying firms below the 2 percent threshold as tax evading firms, and therefore the target group of increased tax audits.[9]

Finally, I study responses among heterogeneous groups, and provide graphical evidence that groups that had more opportunity to over-report cost items before the reform also respond more, and hence exhibit larger bunching, suggesting accounting rather than real responses. An example for this group of firms are those in the construction and manufacturing sectors, generally with high and unverifiable material costs. In accordance with the reasoning, the analyses shows they reacted more to the reform. Also small companies tend to have more opportunities to over-report cost items either by reporting

[9]The National Tax and Custom Office (NAV) yearly audit directives also confirms this reasoning as they list as one of their audit target group firms reporting profit below the profit threshold.

personal consumption as company cost items, or by securing additional invoices. Consequently the graphs confirm that small companies responded saliently to the reform. On the contrary, multinational companies tend to have less possibilities to over-report cost due to reasons such as targeted audits for larger companies, and higher difficulty to evade when managers and owners are distinct. In accordance, I provide evidence that multinationals companies reacted less to the reform compared to domestic companies.

This study is based on an unbalanced panel of administrative tax return data, covering the universe of double-entry bookkeeping companies.[10] The solid grey line in figure 1.3 shows the distribution of companies for 2006, the last year before the introduction of the minimum tax reform. The horizontal axis is based on the profit ratio defined by the minimum tax scheme. As can be seen on the graph, the distribution is smooth without any bunching at the profit threshold rate of 2 percent. The bunching at zero profit may suggest the presence of some tax evasion, though other non-evasion reasons could also explain the extra mass such as the existence of some costs (economic, administrative or just mental) of going below zero reported profit; consequently then many firms with genuinely negative profit rates would report zeros. Another explanation could be that if the firm would not gain from going below zero as they would not have profits next year so could not carry forward the loss, or do not understand that a loss this year may save taxes next year.

The after-reform distribution is presented with a black solid line on the graph, displaying immediate responses as soon as half year after the introduction of the reform in the reported profit rates and sharp bunching at the threshold profit rate of 2 percent. Excess mass 4.32 is estimated as the difference between the observed empirical frequency for 2007 and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. This means that the excess mass is 4.32 times the height of the counterfactual distribution. It is indisputable from these graphs that corporations changed their behavior and reacted to the reform in accordance with the tax incentives. Moreover, the speed of the response is too quick to reflect real responses, therefore providing evidence for the hypothesis that firms respond via reporting rather than real production.

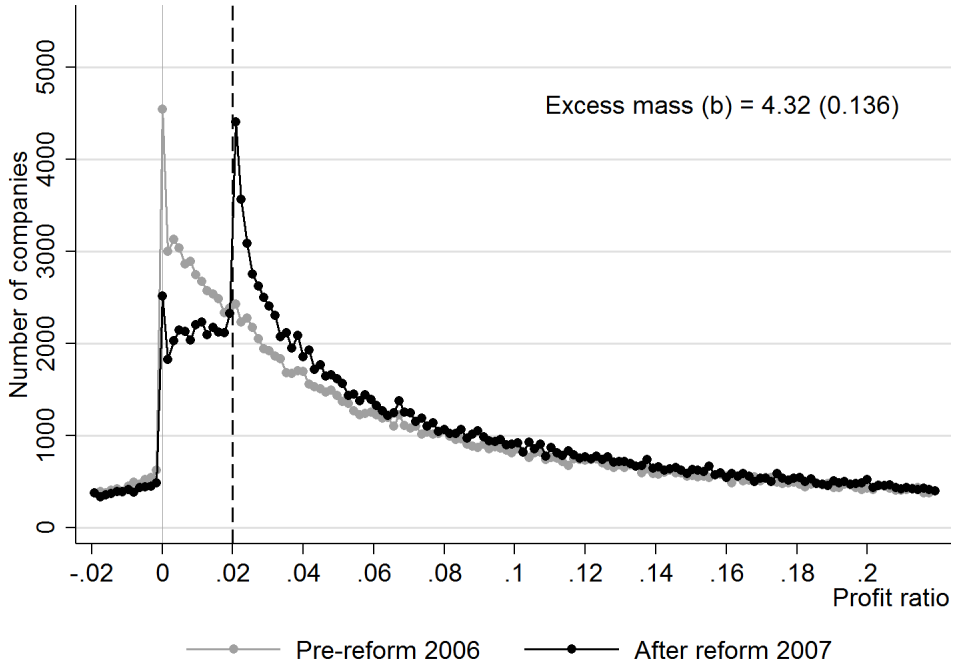
A significant CIT rate reduction reform episode allows me to look at the magnitude of bunching responses in case of diverse tax rate incentives. If firms' bunching responses are the consequence of the minimum tax scheme then during years when the CIT rate is higher, providing more incentive for firms to change their behavior, the excess bunching amount is also larger relative to years with lower CIT rate. During fiscal years 2008-09 the corporate tax rate on profit was 20 percent, while in interim year 2010 the tax rate was reduced, and remained 10 percent for 2011-12.[11] Firms affected by a higher

[10] See the detailed description of the data and data cleaning procedure in Appendix A.1.

[11] For 2008-09 the marginal corporate tax rate was 10 percent below 50 million HUF adjusted profit, and 16 percent

corporate tax rate had a stronger incentive to reduce adjusted profit till zero before the reform, and till the threshold profit rate of 2 percent after the reform. In line with this reasoning, Figure A.1 describes that excess bunching mass ($b = 4.01$) is larger in 2008-09 when the corporate tax rate on adjusted profit is larger, and it is smaller ($b = 2.85$) in 2011-12 when the effective tax rate was halved. These findings support the causality reasoning of the reform on firms' responses.

Figure 1.3: Pre-reform and after reform distribution of firms



Notes: The figure presents the empirical frequency of firms based on their profit rate for fiscal year 2007. The counterfactual is the last fiscal year before the introduction of the minimum tax scheme (2006). The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency for 2007 and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard error is shown in parentheses.

The special setting of the Hungarian minimum tax scheme provides both kink points and notches in the tax schedule for different companies. In case of a kink point in the tax schedule firms should bunch sharply at the kink point, but due to adjustment costs and optimization frictions firms usually bunch

above, meanwhile a general 4 percent surtax was in effect also. Firms had to comply with additional conditions to be allowed to apply the 10 percent rate, hence approximately only 4000 firms paid the 10 percent tax rate on profit in the lower bracket. Hence, a 20 percent corporate tax rate was in effect for the two years after the introduction of the minimum tax scheme. I leave out year 2010 from figure 6, as not only the top tax rate was increased to 19 percent beside the elimination of the general 4 percent surtax, but also the special conditions for the lower rate was stopped from the middle of the year. For 2011-12 a 10 marginal tax rate were in effect, with a 19 percent marginal tax above a very high threshold of 500 million HUF adjusted profit, but this upper tax rate affected only less than 200 companies.

diffusely around. On the other hand, in case of a notch in the tax schedule they face an additional incentive to bunch above the threshold profit rate. The empirical distribution of firms with a notch in their tax schedule is depicted in the left panel of Figure A.2, while the distribution of those with a kink point in their tax schedule is depicted on the right panel. The groups are identified based on the sign of their tax base modifying items (delta) in 2006, which is exogenous to the reform as it was chosen before it took into effect. In accordance with the theory those firms with a notch in their tax schedule bunch right of the threshold. Contrary to the theory, those firms with a kink point in their tax schedule also bunch right of the threshold and not diffusely around. As can be seen in Figure 1.1, after the introduction of the minimum tax scheme financial incentives – such as not being able to reduce the tax liability with cost over-reporting, however still bearing the risk of tax audit penalty – encourage firms to left of the cutoff to shift their profit rate till the 2 percent cutoff. In spite of this latter incentive, the empirical distribution shows that firms overshot their reported profit rate and create the excess mass at the right of the threshold, as it would be expected in the notch point scenario.

Kleven (2015) points out that the explanation could be that the creation of the statutory threshold not only provides financial incentives, but also creates a reference point for companies. Deveroux et. al (2014) also find asymmetric excess bunching of firms around a kink point in the corporate income marginal tax rate schedule, and suggest that it reflects some risk aversion as firms aim to avoid the higher tax rate even in case of unexpected future errors. Similarly, Seim (2015) finds excess bunching of reported taxable wealth asymmetrically below the kink point in the tax schedule. In his setup firms at the right of the kink point are affected by the higher marginal tax rate and incentivized to create bunching diffusely around the kink point, but instead the excess mass is located left of the kink point. He explains that it can be consistent with confusion of marginal and average tax rates, hence confusion of the kink and notch points in the tax schedule set-up. Seim further highlights that this phenomenon can be also consistent with a fixed cost only incurring above the threshold, implying taxpayers to locate just below the threshold to avoid the extra cost. In line with the previous arguments, the Hungarian asymmetric bunching result could be explained by the fact that firms consider the 2 percent threshold as a reference point introduced by the reform. A plausible explanation could be that firms do not consider credible the tax authority threat of more frequent audits of only those firms in the revenue regime submitting the extra form and still paying taxes based on their low reported profit, and suspect that tax authorities likewise would target also those firms in the revenue regime paying the minimum tax amounts.[12] The higher audit probabilities in the revenue regime would levy an extra cost only in the regime below the cutoff, in practice creating a notch in case of the kink, and also increasing the

[12]For example the RSM tax advisors' blog also raised the question of higher tax audit probabilities of firms paying taxes according the minimum income amount.

size of the jump in case of the notch. This would provide an incentive for firms with a kink in their tax schedule to move exactly above the threshold, and explain the empirical finding of excess bunching mass above the cutoff.

Finally, I look at those groups that had more opportunity to over-report cost items before the reform, and confirm that they display larger excess bunching, and accordingly respond more. These findings provide supporting evidence for the hypothesis that firms respond via reporting rather than real production. First, the left panel of Figure A.3 shows the response of firms in the construction and manufacturing sectors, generally with high and unverifiable material costs, accordingly with higher ease to over-report cost items to reduce their tax liability before the reform. Confirming accounting responses, the excess mass ($b = 3.45$) of firms in the construction and manufacturing sectors is larger, compared to firms in all other sectors ($b = 3.16$) displayed in the right panel of the figure.

Second, I look at whether small companies compared to larger ones responded diversely to the reform. The logic is that small companies tend to have more opportunities to over-report cost items either by reporting personal consumption as company cost items, or by securing additional invoices. In accordance with the reasoning, Figure A.4 displays larger responses among small firms with less than 10 employees ($b = 3.46$), compared to larger firms ($b = 2.46$). Third, I look at how those firms responded that had less possibility to over-report cost items before the reform. Multinational companies tend to have less possibilities to over-report cost due to reasons such as more targeted audits for larger companies including cost verifications, and higher difficulty to evade when managers and owners are distinct.[13] As can be seen in Figure A.5, multinational companies reacted less to the reform. The presented graphical evidence implies that firms with more ease to over-report their cost items before the reform, responded more, supporting the reasoning that bunching is driven by reporting rather than real production.

1.4 Evidence for accounting rather than real responses

1.4.1 No real production responses

Based on the findings presented in Section 3, it is clear that corporations did react to the reform. The question is whether the responses are real production or accounting responses. Evidence presented in the previous section, such as the speed of response and also that firms with more opportunity to over-report cost items responded more, supports the hypothesis that bunching is driven by accounting rather than real responses. In this section I directly identify and estimate the real responses of firms to the minimum tax reform. The direct measures of real production responses suggest no significant real

[13] According to Semjén-Tóth(2004) tax inspectors tend to target larger companies where the expected penalty fee amount is larger with the fixed cost of inspection to maximize the tax authorities' revenue.

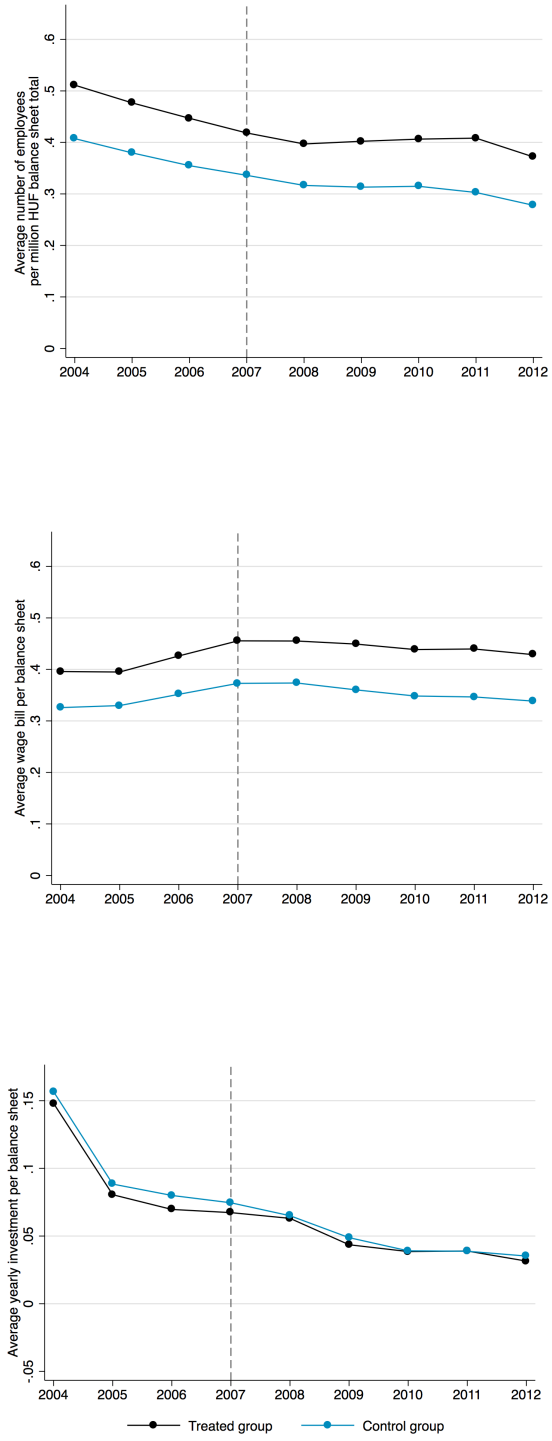
behavioral reactions. This part is a novelty compared to the Best et al. (2013) paper in that they put bounds on evasion responses using different assumptions about real output elasticity, while I estimate the production responses directly.

I estimate how an average corporation reacted to the tax code change by using a difference in difference (DID) estimation setup. As profit rate may have changed independent of the reform, I focus on the subsample of firms with stable profit rates in three years (2004-2006) preceding the reform. The control group includes firms that were above the profit rate in a narrow range (profit ratio between 2 and 8 percent) and the treatment group includes those below the threshold (between 0 and 2 percent) for three years before the reform. The treatment is the change in the tax code affecting those with low reported profit rates below the cutoff. The data shows that firms react to the tax code change, as 46 percent in the treatment group moved to the other side of the cutoff, while also more than half of those remaining below increased their profit rate to the right in 2007. The question is how much of this is an accounting versus a real response. As firms might not report their true income, to measure real responses I proxy production, and look at real variables that were not over-reported before the reform such as average employment, wage bill and investment. Firms have no incentive to reduce their profit with over-reported wages as the employer social security contribution is higher than the corporate tax rate. Similarly they do not face incentives to overreport the number of employees. In case of investments, firms have to keep track of them in a registry, that is checked by the tax authorities in detail in case of audits. Moreover, firms can't deduct their investment value as amortization immediately in the year of purchase, but only gradually spreaded over years.

First, I compare firms in the treatment group before and after the reform. Firms in the treatment group before the reform in year 2006 paid on average 21.7 million forint as wage bill, while after the reform in year 2008 on average 25.2 million forints. Looking at this comparison one might conclude that the introduction of the revenue taxation reform positively impacted the production. The problem is that the change beside containing the effect of the reform also incorporates the additional changes in the macroeconomic environment, and firms' evolutionary life cycle changes. The question is what part of the change is due to the reform and what part would have been realized nevertheless. To answer this question, I compare changes in the treatment group to changes in the control group before and after the reform. This latter changes in the control group presumably show changes due to these other factors only, that is how the treatment group would have been evolved without the reform. Firms in the control group before the reform in year 2006 paid on average 23 million forints as wage bill, while after the reform in year 2008 on average 26.2 million forints, that is showing a similar increase compared to those in the treatment group. If the treatment and control groups are sufficiently similar then the difference between the change in the treatment minus the change in the control group, i.e.

the difference in differences (DID), identifies the effect of the reform. Running the regression version of the DID estimation will also indicate whether the difference is significant.

Figure 1.4: Average employment, wage bill and investment trend



Notes: Treatment group includes firms with stable profit ratio between 0 and 2 per cent for three years before the reform (2004-2006), and the control group those between 2 and 8. The treatment group is marked by a black solid line, and the control grooups by a blue solid line. The wage bill contains the gross wage bill without employer social security contribution. Investment is measured as yearly change in book value investment plus accounting based amortization. Each variable is normalized by the firm's balance sheet total. Monetary variables are in million forints. The year when the reform was introduced is marked by a vertical dashed line.

The assumption underlying the DID estimation is that the treatment and control groups were "reasonably alike", therefore in the absence of the reform they would have progressed similarly. The estimation process of the DID does allow for level differences between the control and treatment groups, in that case if the differences were stable in the years before the reform. This is the so called parallel trend assumption. I argue that the group of firms stably above the threshold is a valid control group as the pre-reform historical trends of employment, wage bill and investment are parallel in the treatment and control groups as it can be seen in Figure 1.4. The variables are normalized by balance sheet total to avoid that results might be driven by extreme values. The graphs show clearly that firms in the treatment groups have on average higher employment and also pay higher wage bill. But the DID estimation allows for level differences, if differences were stable between the groups in years before the reform, that is confirmed by the figures.

To further compare the two groups I estime logit regressions, where the dependent variable is a dummy indicating whether a firm is in the control or the treatment group. These in addition to the trend graphs can also control for other possible characteristic differences between the two groups before the reform took into effect. As Table A.1 in the appendix shows there are level differences between the number of employees and average tangible assets between the groups. However, marginal effects in the third column shows that these differences have marginally negligible effect on the probability whether a firm is present in the treatment or in the control group, apart from the industry controls. To adjust for the differences in the industrial structure I include also industry dummy coviariates as controls in the DID regressions. To sum up, the control and treatment groups were chosen based on the profit rate of the firms, hence there could be systemic differences between the two groups. But the DID estimation can handle the differences as far as these are stable in time, i.e. the parallel trend assumption is fulfilled, and pre-treatment controls are included in the regressions.

I estimated the following regression specification that is identical to the DID estimation setup, where T_i controls for the common time trend between 2006 and 2008 in the treatment and control groups, while D_i for the different pre-reform levels between the two groups. The coefficient of $T_i * D_i$ is the main coefficient of interest, that measures the effect of the reform on production. If it is not significant then it provides evidence against the hypothesis that bunching response are driven by real production. Table 1.1 shows the values of the time and treatment dummies in the regression specification.

$$y_i = \alpha + \beta_0 T_i + \beta_1 D + \beta_2 T_i D_i + \beta_j' X_{j,i} + \varepsilon_i$$

The advantage of the regression compared to the simple DID comparison between the groups is that it can also control for other variables and estimate the significance of the effect of the reform. Adding

additional pre-treatment control variables can help account for level differences between the two groups (that is visible in the parallel trend graphs), and increase the credibility of the identification scheme.

Table 1.1: Control and treatment group variables

	2006	2008
Control	$D_i = 0, T_i = 0$	$D_i = 0, T_i = 1$
Treatment	$D_i = 1, T_i = 0$	$D_i = 1, T_i = 1$

As a common practise in the literature, dependent and control variables are top coded to avoid that the result might be driven by outliers. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, and variables without negative values are winsorized at the top 99%. The final sample in the regressions, and consistently in the trend graphs, contains firms with variables that were not dropped during the winsorization process in that given year.

Table 1.2 shows the results of DID regression estimations for years between 2006 and 2008, where the control group includes stable firms that were above the profit threshold for three years before the reform, and the treatment those stable below the threshold. The dependent variable is reported profit in the first two columns, to check whether firms in the restricted sample reacted similarly to the reform as those in the main sample in Section 3. In the remaining columns the dependent variables are the proxies for production, such as wage bill in the first two columns, employment in the next two columns, and investment in the last two. Each of them are normalized by the balance sheet total of the firm to avoid that results are driven by extreme values. Odd columns contain regressions without controls, and even columns with controls.

The first two columns estimate changes in reported profit. The coefficient of interest is positive and significant after controlls are added to the regression confirming that similar increased reported profit responses are uncovered in the restricted sample as in the main sample. The estimated coefficient results without controls – in the odd columns – are identical to the simple before and after averages in the control and treatment groups. For example in the third column the constant 0.352 is the same as the average wage bill per balance sheet total in the control group before the reform, and the sum of the constant and the coefficient of the time dummy T_i, 0.374 is the same as the average wage bill per balace sheet total in the control group after the reform. The average wage bill per balance sheet total in the treatment group before the reform is 0.426 – that is the sum of the constant and the coefficient of the treatment dummy D_i – and 0.455 after the reform – that is the sum of all four coefficients.

The even columns in Table 1.2 show the results of the regression estimation with controls. The coefficient of the interaction term $T_i * D_i$ measures the effect of the reform. A negative (positive)

sign of the coefficient shows that the increase in the treatment group on average was lower (larger) compared to the control group assuming other macroeconomic and firm life cycle evolution were similar in the two groups. The coefficient of interest is positive for the wage bill and negative for the number of employees, but both are very small in magnitude and insignificant indicating that the impact of the reform was not significant on production. The coefficient of interest for investment is significant at 5 percent, but the magnitude is negligible. For robustness check I re-estimated the exercise for changes in longer time period (2006 - 2009, and 2006 - 2010), and get similar insignificant and small in magnitude treatment coefficient results (see Table A.5 in the appendix). Similar robustnes results with modified control groups, containing firms with stable profit rates between 2-6 and 2-10 percents, are reported in Table A.6 and A.7.

Table 1.2: Diff-in-diff estimation for changes in real production between 2006 and 2008

Dep. variables:	*profit*		*wage bill*		*# employees*		*investment*	
$T_i = 1$ *(after*	0.571*	-0.297	0.0219**	0.0724***	-0.039***	0.035***	-0.015***	-0.0128***
reform)	(0.298)	(0.248)	(0.01)	(0.009)	(0.010)	(0.009)	(0.003)	(0.002)
$D_i = 1$ *(treat.*	-4.876***	-2.968***	0.0741***	0.0760***	0.091***	0.084***	-0.0103***	-0.0103***
group)	(0.341)	(0.305)	(0.011)	(0.011)	(0.012)	(0.011)	(0.003)	(0.003)
$T_i * D_i$ *(effect*	0.457	1.118***	0.0071	0.0063	-0.011	-0.001	0.0084**	0.0085**
of reform)	(0.483)	(0.400)	(0.016)	(0.015)	(0.017)	(0.015)	(0.004)	(0.004)
Constant	5.988***	3.322***	0.352***	0.130***	0.356***	0.136***	0.0800***	0.0957***
	(0.210)	(0.482)	(0.007)	(0.018)	(0.007)	(0.018)	(0.002)	(0.005)
Controls		X		X		X		X
N	15 992	14 215	15 992	14 215	15 992	14 215	15 992	14 215

Note: The control group includes firms with stable profit rates, i.e. in the 2-8 per cent interval for three years before the reform, and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment and investment are normalized by the balance sheet total, while reported profit is not in order to look at the fiscal effect of the reform. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

I also re-estimated DID regressions for years before the reform took into effect as a placebo test. If there is no difference in the two groups' production changes for years before the reform, then it confirms the same production trend, and hence the validity of the comparison of the two groups for years before and after the reform. Table A.4 in the appendix reports estimates for changes in real production between 2004 and 2006 for firms with stable profit rates locating at the two sides of "hypothetical" 2 percent profit cutoff only introduced in 2007. The coefficients of the placebo treatment dummy are small in magnitude and insignificant in all specifications reconfirming the similar parallel trend differences between the two groups before the reform.

Coefficients of interaction terms measuring the effect of the reform are never significant and negative in either regression specifications. These results suggest that the introduction of the minimum tax scheme had not decreased production. The not significant production efficiency cost results should be interpreted carefully as even though the coefficient of the treatment variable is not significant, but it is negative in case of employment. Moreover, I only estimate the short run effect of the reform, and it may have a negative effect on production in the long run.

1.4.2 Presence of tax avoidance

Tax avoidance and evasion is a widespread practise in Hungary (see Balog (2014), and Benedek, Elek, Köllő (2013) for a summary on tax evasion studies). In this subchapter I present estimation results indicating the presence of tax avoidance among Hungarian firms. In the seminal model of tax evasion economic, agents base their decision on comparing the expected costs and benefits of tax evasion; hence the higher the audit probability and the amount of fine, the higher is the deterrence effect (see a survey by Slemrod and Yitzhaki (2002)). In an empirical study Kleven et. al (2011) find that prior audits have a strong positive impact on self-reported individual income in the following year, suggesting taxpayers update their beliefs about detection probability based on experiencing an audit. In line with their reasoning, I look at whether audited firms also increase their reported profit rate after tax inspections. If tax evasion is prevailing among firms, then after an audit they are likely to update their detection probability beliefs, and due to the deterrence, increase their reported profit rate (either via reducing cost over-reporting or revenue under-reporting).

There is no available micro data information on tax audit inspections conducted by the Hungarian tax authorities. However, there is a regulation requiring firms to increase their tax base with obligations and fines due to legal consequences set out by law penalties, that provides an indirect indication on previous tax audits finding any infringements. Beside tax penalties, the variable also includes fines established in binding decisions such as issued speeding fines when driving a company car.[14] The tax form does not contain the types of penalties; hence the variable is only a proxy for firms that were inspected and found to be not complying with the tax law.

According to the previous reasoning, if a tax evading firm experiences an audit, then it updates its detection probability belief, then based on this it is likely to increase the reported profit rate. Using the available firm level data on tax penalties, I look at whether firms that were audited and were issued with a fine increased their reported profit rate more than other firms. Table A.9 in the

[14] It does not include failure to perform the contract penalties.

appendix reports the regression results, where the dependent variable is the percentage point change in the reported profit rate, audit is a dummy variable for firms that were audited and fined before the tax year, and the coefficient of interest is the estimated coefficient for this latter variable. The coefficient of interest is positive and significant in each year, suggesting that firms that were audited and fined increased their reported profit rate on average more, hence it is a prima facie evidence on the deterrence effect of tax audit and the prevalence of tax evasion. After providing evidence on the widespread of tax evasion, I will look into how the introduction of the reform affected it.

1.4.3 Reduction in cost over-reporting

To be able to analyze the anatomy of behavioral responses, it is essential to detect how firms changed their reported cost structure when they switched from the revenue to the profit regime due to the reform. Hence, I estimate how an average firm behaved after the reform compared to how it would have behaved without the reform, this way estimating the additional changes due to the reform. I find large reduction changes only in material cost reporting, which is the most easily over-reportable item, providing further evidence for the hypothesis that responses are driven by accounting reporting rather than real production.

As firms switch regimes also independently of the reform, I compare the year to year changes in reported cost items after the reform to reported changes before the reform. As can be seen earlier in Figure 1.3, the excess amount of bunching is located between the profit threshold of 2 per cent and profit ratio of 6 per cent; this is why I focus on firms that reported a profit ratio between 0 and 2, and then switched to a profit ratio between 2 and 6 per cent in the next year.[15] In this difference in difference (DID) estimation setup, the control group contains firms that crossed the regime threshold from 2005 to 2006 immediately before the reform, while the treatment group contains those that crossed from 2006 to 2007, the year immediately after the reform.[16] The control group shows the normal year to year changes in cost structure before the reform as firms switch from a profit rate of 0-2 to 2-6 percent. The before-after comparison for the treatment group includes this operational change, and also additional changes due to the reform.

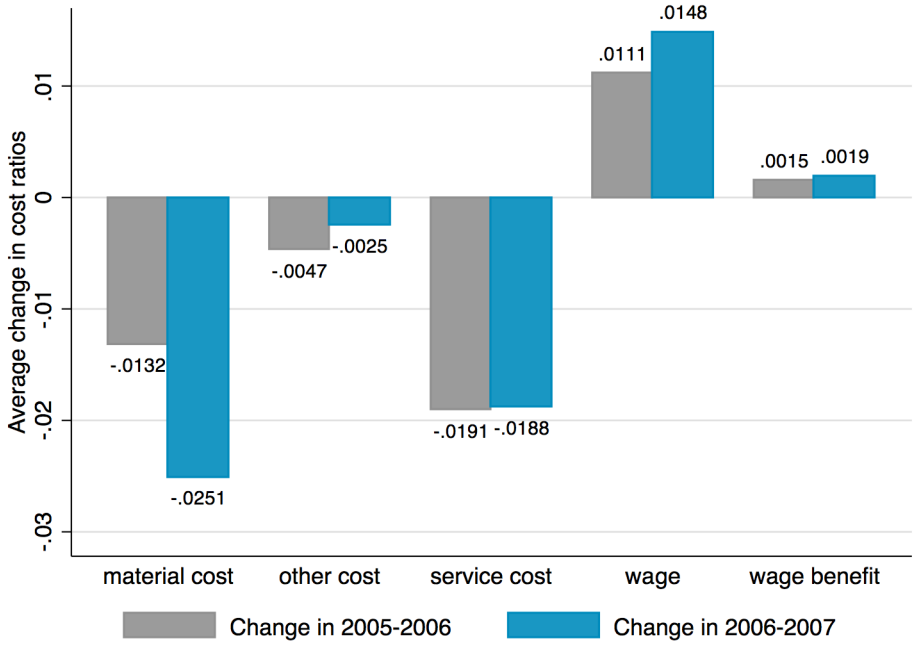
Figure 1.5 presents average changes in reported cost ratios, i.e. the cost item share in net revenue. The grey bars represent the average changes before the reform, the blue bars the changes after. For example the first two bars show that on average the reported material cost ratio was reduced by 1.32 percentage point among switching firms from 2005 to 2006, while the reduction was more than doubled from 2006 to 2007. A striking difference in the cost ratio patterns is that the reduction in reported

[15] As a robustness check I re-estimate the regressions with firms switching to a profit rate between 2 and 8 percent and get similar results.

[16] Two firms with more than one billion HUF loss were excluded from the sample.

material cost is twice as large after the reform. The easiest items to over-report, and then to suddenly stop over-reporting, are material cost items. Material cost can be manipulated easily as the stock level of the material items can be altered by stating items were outdated, disused, expired or stolen. Moreover, it is unlikely that suddenly the production function changed for these corporations and they managed to reduce their production costs so suddenly. Wage cost was unlikely to be over-reported before the reform as the employer social security contribution on wage cost was much higher than the corporate income tax. So that we do not see decreasing wage cost shares. The findings of sharp changes in material cost reporting, and no significant difference in other cost items reporting, suggest accounting reporting responses behind the profit ratio changes.

Figure 1.5: Pre-reform and after reform changes in reported cost ratios



Note: The grey bars represent the average changes in different cost ratios for firms switching from below the threshold profit rate to above before the reform (from year 2005 to 2006), while the blue bars represent those switching after (from year 2006 to 2007).

To formalize the results in Figure 1.5, I estimate the below regression, where I also include control variables.

$$\Delta CR_i = \beta_0 + \beta_1 T_i + \beta_j' X_{j,i} + \varepsilon_i$$

where the dependent variable, ΔCR_i is the change in the specific cost item amount level compared to the net turnover:

$$\Delta CR_i = \frac{c}{y}_{i,t} - \frac{c}{y}_{i,t-1}$$

The logit regression in Table A.10 in the appendix reports that though there are differences between firms in the two groups, but the differences are small in magnitude, also the estimated marginal effects in column three show that these differences have marginally negligible effect on the probability whether a firm is present in the treatment or in the control group. Adding additional pre-treatment control variables helps account for differences between the two groups, and increase the credibility of the identification.

Table 1.3: Changes in reported cost structure.

					Changes in				
Dep. variables:	*Profit ratio*	*Material cost/ turnover*	*Other cost/ turnover*	*Service cost/ turnover*	*Wage cost/ turnover*	*Wage benefit/ turnover*	*Depreciation / turnover*	*Sold goods/ turnover*	*Sold services/ turnover*
N=15 762				Regressions without controls					
$T_i = 1$ *(treatm. groups)*	-0.002***	-0.012***	0.002	0.003	0.004**	0.00	-0.002*	-0.03	-0.01
	(0.000)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.033)	(0.017)
Constant	0.026***	-0.013***	-0.005**	-0.019***	0.011***	0.002**	-0.002***	0.09***	0.043***
	(0.000)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.025)	(0.013)
N=15 548				Regressions with controls					
$T_i = 1$ *(treatm. groups)*	-0.002***	-0.0124***	0.002	0.001	0.004**	0.00	-0.001	-0.04	-0.005
	(0.000)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.032)	(0.0164)
Constant	0.016***	-0.0151***	-0.001	-0.037***	0.018***	-0.00	0.004***	0.146**	0.053*
	(0.000)	(0.004)	(0.004)	(0.006)	(0.003)	(0.002)	(0.002)	(0.061)	(0.031)
Controls	X	X	X	X	X	X	X	X	X
N=15 548				Regressions with controls including industry					
$T_i = 1$ *(treatm. groups)*	-0.002***	-0.0127***	0.002	0.001	0.004**	0.00	-0.001	-0.038	-0.005
	(0.000)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.033)	(0.016)
Constant	0.016***	-0.0162*	0.003	-0.03***	0.015***	-0.002	0.003	0.211**	0.032
	(0.001)	(0.008)	(0.007)	(0.01)	(0.006)	(0.003)	(0.001)	(0.105)	(0.053)
Controls	X	X	X	X	X	X	X	X	X

Note: The regressions in the first panel include only a treatment dummy and a constant, in the second panel pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag net immaterial assets, lag net property, lag net machines, lag share capital, lag distance to cutoff and age and age square are added, while in the third panel industry dummies are added also. The control group includes firms switching from below the threshold profit rate to above before the reform (from year 2005 to 2006), the treatment group include firms switching after the reform (from year 2006 to 2007). Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

In the regressions T_i is a treatment dummy for changes between 2006 and 2007, while the baseline category includes those firms that switched between 2005 and 2006. The control variables in the regression include lag distance to the threshold, lag profit, lag tax base, lag net turnover, lag employment, lag net immaterial assets, lag net property, lag net machines, lag share capital, age, age square and industry codes. Figure 1.5 in the appendix shows the coefficients of these regressions without control

variables. The grey bars represent changes in the control group that is the constant in the regression, and the blue bars represent changes in the treatment group that is the sum of the constant and the coefficient of the treatment dummy, T_i in the regression. As a common practise in the literature, variables are top coded to avoid that the result might be driven by outliers. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, and variables without negative values are winsorized at the top 99%. The final sample in the regressions contains firms with variables that were not dropped during the winsorization process.

The change in profit ratio defined by the legislation for corporations that switched from below the cutoff to above in the analyzed time period can be seen in the first column of Table 1.3. The positive coefficient of the constant confirms that those corporations are in the sample whose profit ratio shifted to the right. Firms in the control group increased their profit ratio on average by 2.6 percentage point, while those in the treatment group by 2.4 percentage point. The regression estimation in the second column indicates that the average change in material cost nearly doubled after the reform. Before the reform the material cost ratio decreased on average by 1.32 percentage point for switching companies in the sample, and by 2.51 percentage point after the reform. Surprisingly the change in service cost is not significantly different between the two groups as it is shown in column four. This could be because, although it is relatively easy to overreport service costs, it is not as easy to suddenly decrease them, probably due to long term agreements. The difference between other cost items and wage benefits are not significant either.

The finding of twice as large reduction changes in material cost reporting suggests accounting reporting responses are the reasons for the bunching at the cutoff. For robustness check I re-estimate the exercise with firms switching from the 0 - 2 range to a wider range of 1 - 8 percent, and get similar results (see Table A.14 in the appendix).

Table 1.4: Changes in reported cost structure for different years.

Dep. variables:	*Changes in material cost per turnover ratio*				
	02/03 -03/04	*03/04 -04/05*	*04/05 -05/06*	*05/06 -06/07*	*06/07 -07/08*
$T_i = 1$	0.002	-0.009**	0.004	-0.0124***	0.01***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Constant	-0.012	-0.005	-0.013**	-0.0151***	-0.033***
	(0.007)	(0.006)	(0.006)	(0.005)	(0.005)
Controls	X	X	X	X	X
N	5 978	8 175	11 352	15 548	14 795

Note: The control variables include lag distance to the threshold, lag profit, lag total turnover, lag net turnover, lag employment, lag assets, lag share capital, age and age square. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

I re-estimate the regressions on material cost changes for firms that switch from below to above the cutoff during other years before and after the introduction of the reform in 2007 as a placebo test. Table 1.4 displays the estimation results showing that firms significantly decreased their reported material cost exactly from the year when the reform was introduced. Before 2007 firms on average reduced their material cost share by 0.9 - 1.5 percentage point. In the year of the reform switching firms reduced their material cost share on average by 2.75 percentage point (sum of the constant and treatment coefficiens in column 4). Also during the first year after the reform the decrease among switching firms remained large, and significant -2.3 (-3.3+1) percentage point, reconfirming the causality between the reform and the reported material cost ratio reduction.

1.4.4 Changes in tax base modifying items

The operating profit can be further increased and decreased by the tax base modifying items (denoted by Δ in the equations) to get the adjusted profit. Before the introduction of the minimum tax scheme, firms paid the corporate income tax based on this adjusted profit, i.e. the final tax base. After the reform came into effect, firms with profit rate above the 2 percent cutoff still pay taxes based on this adjusted profit, while firms below the cutoff pay based on their net revenue. The largest share of these tax base modifying items is the obligatory modification between depreciation based on accounting rules and based on the tax legislation. Among those firms reporting any modifying items more than 90 percent reported depreciation adjustment figures in years before the reform, and it remained at the same level also in years after the reform. In practise, for taxation purposes firms are required to add back to the tax base the sum of amortization determined by themselves according to accounting practises, and to decrease the tax base with the sum defined by the tax code. All in all, for given value of buildings, machinery or immaterial goods, the amount of added accounting based depreciation modifying item simply cancels out the depreciation amount deducted during the profit calculation, while the amount of legislation based depreciation is strictly determined by the tax code, hence neither the revenue nor the adjusted profit tax base can be manipulated by the depreciation calculation.

The second most frequently reported item is the loss carryforward, i.e. the negative tax base realized in previous years that can be used to offset the actual positive tax base.[17] The overall share of firms reducing their profit with loss carryforward among those reporting any modifying items decreased from 22 percent to 18 and to 13 during the period of 2006 and 2008. The empirical frequency of firms reporting loss carryforward is marked with a line with diamonds in Figure 1.6, while the solid line

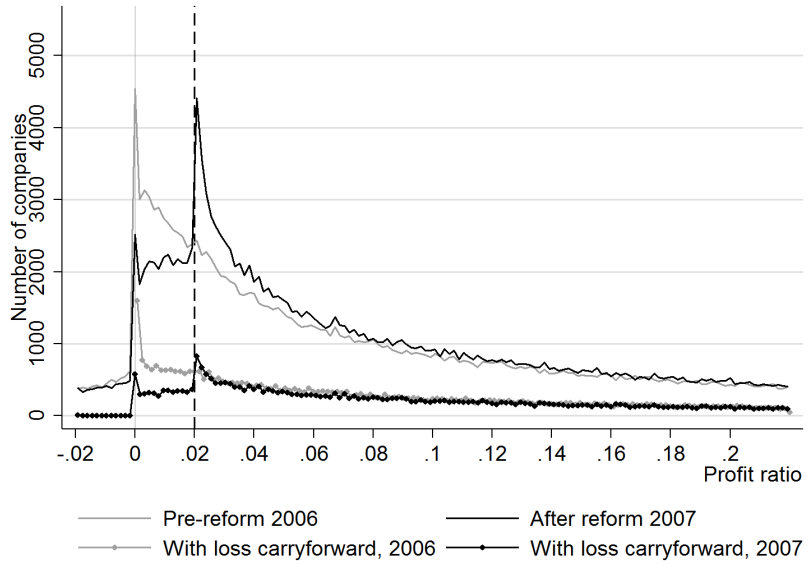
[17] Losses realized before 2015 can be used to offset profit without time limit, while losses realized from 2015 can be used only for 5 years.

represents all firms. Two findings emerge from the graph. First, the amount of bunching in the universe of firms denoted with solid line can not be solely due to changes in the loss carryforward reporting. Second, the number of firms reporting loss carryforward in the revenue regimes decreased, although it was not among the objectives of the reform.[18] The most frequently reported tax base increasing items include: 1) the amount of expenses due to given subsidies, debt assumption, released liabilities, in case if profit have been reduced by these amounts during profit calculation; and 2) loan impairment losses (see the empirical frequency in Figure A.6 in the appendix). The most frequently reported tax base decreasing items include: 1) amount of donation; 2) the amount of received subsidies, obtained debt assumption and released liabilities, in case if tax base have been increased by these amounts during the profit calculation; 3) investment subsidy for small and medium size enterprises; and 4) reserves for the purpose of future developments (see the empirical frequency in Figure A.7 and A.8 in the appendix). These empirical frequency figures in the appendix show that the number of firms reporting tax base modifying items in the revenue regime decreased, but it is not the driver behind the bunching in the distribution of all firms. All other tax base modifying items were reported by less than 5 percent of firms reporting any tax base modifying items, and hence figures on these distribution were not reported in the appendix.

Firms reporting tax base modifying items are reported in Figure 1.7 based on the sum of tax base modifying items as a share of profit for fiscal year 2006 and 2007. To see how firms intentionally modified their reported tax base, those with only obligatory depreciation modifying items were excluded from the graph. For firms located at 0, the sum of tax base modifying items is 0, while for firms located at -1, the sum of tax base modifying items equals the additive inverse of the operational profit, hence these firms decrease their adjusted profit till 0. The graph suggests that the number of those firms reducing their adjusted profit till zero with tax base modifying items decreased after the introduction of the minimum tax scheme, even though the regulator did not aim to reduce the tax base modifying items.

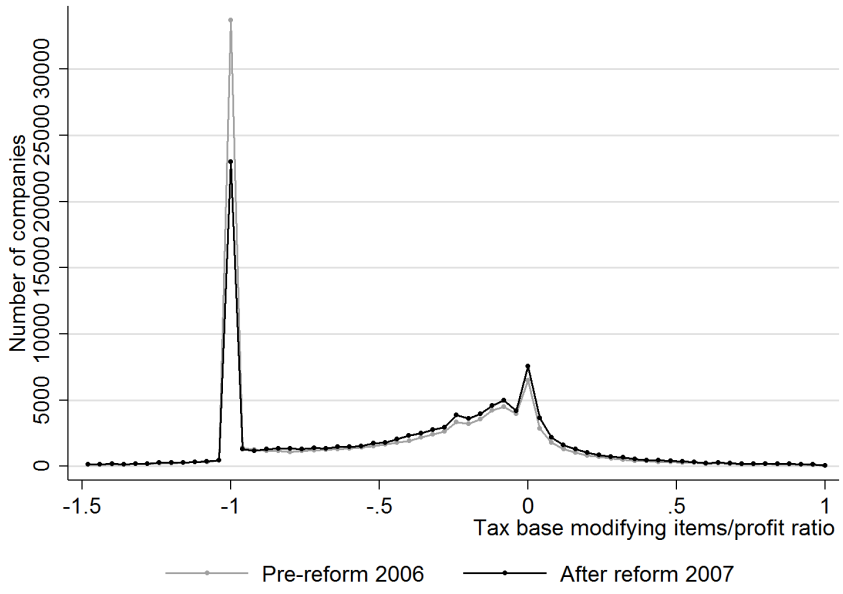
[18] Few firms still report loss carryforward in the revenue regime after the reform was introduced. Most of them probably have not understood the reform as eventhough they pay the tax amount based on their revenue, they still reduce their adjusted profit with the loss carryforward, or even if the 2 percent of their revenue is higher than their profit they simply continue paying taxes based on their adjusted profit lowered with loss carryforward. Few of them do understand the reform, as they lower their adjusted profit because they still can pay taxes based on this being exempt from the regulation (non-profit legal entities, preliminary companies, and companies that suffered unexpected casualty loss or firms that submit the extra form and get tax audit with high probability).

Figure 1.6: All firms and firms with loss carryforward



Notes: The figure presents the empirical frequency of firms based on their profit rate for fiscal year 2007. The counterfactual is the last fiscal year before the introduction of the minimum tax scheme (2006). The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. The solid line represents all firms in the profit rate range on the horizontal axis, while the line with diamonds represents firms with reported loss carryforward.

Figure 1.7: Tax base modifying items as a share of profit



Notes: The figure presents the empirical frequency of firms reporting tax base modifying items based on the ratio of the tax base modifying items and profit for fiscal year 2006 and 2007. Firms with only obligatory depreciation modifying items were excluded. The sum of tax base modifying items is 0 for firms located at 0, while the sum of tax base modifying items equals the additive inverse of the operational profit, hence these firms decrease their adjusted profit till 0.

1.5 Conclusion

In this paper I have analysed firms' reactions to direct tax incentives, reconfirming that firms do respond to tax schemes. This paper addressed the question whether these are real production responses or accounting evasion responses. With a new richer dataset containing administrative tax records on corporations I replicated previous findings on responses to tax incentives, furthermore I presented additional evidence that confirmed these are accounting rather than real responses. First, companies reacted as soon as a half year after the introduction of the reform, implying the reaction was too quick to reflect real responses. In addition, the analysis of responses among heterogeneous groups provided graphical evidence on that groups that had more opportunity to over-report cost items before the reform also responded more when it took into effect, providing evidence for the hypothesis that responses are driven by reporting rather than real production. Second, direct measures of real production responses suggested no significant behavioral reactions. Finally, additional analysis of the reported cost structure of corporations showed large changes only in reported material cost which is the most easily over-reportable item, likewise supporting the reasoning that reported changes are mostly coming from reduced cost over-reporting, i.e. accounting responses.

The policy implications of the main results of accounting rather than real production responses should be considered with caution, as even though the coefficient of the treatment variable is not significant, but negative in case of employment in some estimation specification. Furthermore, I have only estimated short run local effects of the reform, that in the long run might have negative impact on production. Hence instead of the policy reform implication of increasing the profit threshold rate, i.e. the 2 percentage of the revenue as the tax base, considering increased tax enforcement audits among firms above the bunching mass would be more appropriate.

References

[1] M. Almunia and D. Lopez-Rodriguez. *The Impact of Tax Enforcement Policies: Evasion vs. Real Responses and Welfare Implications*. PhD thesis, University of California Berkeley, 2013.

[2] M. Almunia and D. Lopez-Rodriguez. The efficiency cost of tax enforcement: evidence from a panel of Spanish firms. *Munich Personal RePEc Archive MRPA*, (57408), 2014.

[3] A. J. Auerbach, M. P. Devereux, and H. Simpson. Taxing corporate income. *NBER Working Paper*, (14494), 2008.

[4] L. Bach. *Tax Collection and Corporate Governance: Evidence from French Businesses*. PhD thesis, Stockholm School of Economics, 2012.

[5] Á. Balog. Adóelkerülés és rejtett gazdaság magyarországon (tax evasion and shadow economy in hungary). *Köz-gazdaságtan*, 4, 2014.

[6] D. Benedek, P. Elek, and J. Köllő. Tax avoidance, tax evasion, black and grey employment. In K. Fazekas, P. Benczúr, and Á. Telegdy, editors, *The Hungarian Labor market 2013*. Hungarian Academy of Sciences, Budapest, 2013.

[7] M. Best, A. Brockmeyer, J. Spinnewijn, and M. Waseem. Production vs revenue efficiency with limited tax capacity: Theory and evidence from Pakistan. *Journal of Political Economy*, 2014.

[8] P. Carrillo, D. Pomeranz, and M. Singhal. Dodging the taxman: Firm misreporting and limits to tax enforcement. *Harvard Business School Working Paper*, (15-026), 2014.

[9] R. Chetty, J. Friedman, T. Olsen, and L. Pistaferri. Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records. *Quarterly Journal of Economics*, 126(2), 2011.

[10] M. P. Devereux, Li Liu, and Simon Loretz. The elasticity of corporate taxable income: New evidence from UK tax records. *American Economic Journal: Economic Policy*, 6(2), 2014.

[11] N. Dwenger and V. Steiner. Effective profit taxation and the elasticity of the corporate income tax base: Evidence from German corporate tax return data. *Discussion Papers of DIW Berlin*, (829).

[12] P. Elek and L. Lőrincz. The elasticity of effective corporate tax rate in Hungary based on the tax rate decrease between 2009-2011 (az effektív társasági adókulcs rugalmassága magyarországon a 2009-2011 közötti adókulcscsökkentés alapján). *Közgazdasági Szemle (Hungarian Economic Review)*, 1, 2015.

[13] J. Gruber and J. Rauh. How elastic is the corporate income tax base? Taxing Corporate Income in the 21st Century, 2005.

[14] H. J. Kleven. Bunching. *Annual Review of Economics*, 8, 2016.

[15] H. J. Kleven, M. B. Knudsen, C. T. Kreiner, S. Pedersen, and E. Saez. Unwilling or unable to cheat? evidence from a tax audit experiment in denmark. *Econometrica*, 79(3), 2011.

[16] H. J. Kleven and M. Waseem. Using notches to uncover optimization frictions and structural elasticities: Theory and evidence from Pakistan. *The Quarterly Journal of Economics*, 128(2), 2013.

[17] E. Saez. Do taxpayers bunch at kink points? *American Economic Journal: Economic Policy*, 2(3), 2002.

[18] D. Seim. Behavioral responses to wealth taxes: Evidence from Sweden. 2015.

[19] A. Semjén and I. J. Tóth. Hidden economy and tax behavior (rejtett gazdaság és adózási magatartás). *MTA Közgazdaságtudományi Kutatóközpont*, 2004.

[20] J. Slemrod and S. Yitzhaki. Tax avoidance, evasion, and administration. In *Handbook of Public Economics*, volume 3. Auerbach, A. J. and Feldstein, M., 2002.

[21] D. Yagan. Capital tax reform and the real economy: The effects of the 2003 dividend tax cut. *NBER Working Paper*, (21003), 2015.

10.14754/CEU.2016.02

Chapter 2

2 The elasticity of taxable income of high earners: Evidence from Hungary [1]

jointly written with Áron Kiss

2.1 Introduction

The elasticity of taxable income with respect to the marginal tax rate is a parameter of great policy relevance. Having a reliable estimate of the elasticity enables the policy-makers to make more accurate fiscal assessments of changes to the tax system. The elasticity also enables researchers to quantify the dead-weight loss of income taxation.[2]

The importance of the taxable-income elasticity is reflected in the growing literature of empirical work. The first estimates of taxable income elasticity based on a panel of tax returns were conducted by Feldstein (1995). The method used by Feldstein identifies two similar groups of taxpayers whose tax rates are affected differently by a change in tax rules. If the growth of reported taxable income differs between both groups, it is most likely caused by the change of tax rates. Later analyses developed regression methodologies that are able to control for many confounding factors in large panels (see, e.g., Auten and Carroll 1999; Gruber and Saez 2002). Recent surveys of the literature are provided by Giertz (2004) and Saez, Slemrod and Giertz (2009).

While the literature focused on the U.S. at the beginning, more recently empirical work was done on other countries as well, such as Canada (Sillamaa and Veall 2001; Saez and Veall 2005), Norway (Aarbu and Thoresen 2001), Sweden (Ljunge and Ragan 2004; Hansson 2007; Holmlund and Söderström 2007; Blomquist and Selin 2010), Hungary (Bakos et al. 2008),[3] Germany (Gottfried and Witczak 2009), Finland (Pirttilä and Selin 2011), and Denmark (Kleven and Schultz 2011).

[1]Kiss: European Commission, aron.kiss@gmail.com, Mosberger: Hungarian Central Bank, mosberger-palma@gmail.com. All opinions expressed in this paper are those of the authors and do not necessarily represent the views of their past or present institutions. An earlier version of the paper was published as a working paper at the Central Bank of Hungary (Kiss and Mosberger, 2011). Results of the working paper version have been discussed in a survey article for a non-technical audience (Benczúr et al., 2013). Another version of the paper was published in the journal of Empirical Economics (Kiss, Mosberger, 2015). Subsection 2.4.3 and 2.5.4 were not published before. The authors would like to thank Péter Benczúr for his support throughout the project, Dóra Benedek, Péter Elek, Sándor Csanád Kiss and Ágota Scharle for comments on earlier drafts of the paper, participants of the 2011 conference of the IIPF in Ann Arbor, Michigan, the 2011 EEA-ESEM meeting in Oslo, the 2010 meeting of the Hungarian Society of Economics (MKE) in Budapest, and seminar participants at the University of Münster, the Ludwig-Maximilians-University in Munich, the Institute for Economics of the Hungarian Academy of Science, and the Central Bank of Hungary, for useful comments and suggestions. Any remaining error is ours.

[2]The relationship between the elasticity of the taxable income and the dead-weight loss of taxation was analyzed by Feldstein (1999) and Chetty (2009).

[3]Updated results of Bakos et al. (2008) have been described by Benczur et al. (2013) for a non-technical audience.

While the empirical literature is growing, many important questions about the background of the estimated elasticities remain open. One important question is to what extent the estimated elasticities reflect labor supply response on the intensive margin (whether that is hours worked, work intensity or occupation choice) and to what extent they reflect income-shifting or changing tax-avoidance behavior.

The present paper studies how high-income taxpayers in Hungary responded to the introduction of the 'extraordinary tax on individuals' in January 2007. The extraordinary tax was a 4% surcharge on income above the pension-contribution ceiling. The analysis is based on a panel of tax returns, compiled by the National Tax Authority for this study, containing anonymous information on 10% of tax-filers in 2005 and three consecutive years.

In our main specification the elasticity of taxable income with respect to the marginal net-of-tax rate is estimated to be 0.24. This estimate is somewhat lower than most estimates for the U.S., but similar to many estimates for other countries. (Many estimates outside the U.S. are below 0.4, the preferred elasticity of Gruber and Saez (2002), which is itself in the lower range of U.S. estimates.) We also find evidence for a sizeable income effect.

Besides offering an analysis of a new policy episode outside the U.S., the paper intends to contribute to the literature in three ways. First, it focuses on a clean policy episode that affected high-earners. As in other countries, high-income earners have a great economic and fiscal significance in Hungary. In 2008, the lower income limit of the extraordinary tax was HUF 7.1 million (about EUR 28,000 at the contemporary exchange rate). The tax thus affected the top 2.5% of tax-filers who controlled 16% of the aggregate tax base and paid 28% of total personal income tax.[4]

Second, the focus on a well-defined group of high-income earners, and the relatively large number of observations, makes it possible for us to address a methodological problem many studies struggle with. It is known since the early literature that general income growth may differ across various segments of the income distribution for reasons not related to the change in the tax rates. One the one hand, incomes at the top might disproportionally grow because of skill-biased technological change. On the other hand, the phenomenon of 'regression to the mean' might affect individuals with very high or very low incomes at a given point in time. Since Auten and Carroll (1999) and Gruber and Saez (2002) it is common practice to address this problem by controlling for initial income. Still, results are often sensitive to the way initial income is controlled for, especially in studies where a broad income range is analyzed or the very top of the income distribution is involved. This study focuses on a relatively narrow range around the income limit at which the extraordinary tax was introduced. Our results are not sensitive to whether initial income is controlled for, which indicates that the sample that we concentrate on is homogeneous enough. The phenomena of mean-reversion or differential income

[4]Own calculation based on a 10% random sample of 2008 tax returns, excluding the full-time self-employed.

trends do not affect parts of our sample differently.

Third, we are able to conduct indirect tests suggesting that the estimated elasticity does not reflect income shifting.[5] First, we do not find differential growth of capital income for taxpayers who are likely, prior to the tax change, to be affected by the extraordinary tax. Second, similarly we do not find that taxpayers who are likely to be affected by the extraordinary tax would switch more from employer reported tax forms to individual reporting, this latter presumably providing more possibility for income-shifting. Third, we find that the estimated elasticity is higher for women, older and younger taxpayers. While it is likely, based on past labor-market research, that these groups have a more elastic labor supply than men or prime-age workers, it is unlikely that tax-avoidance or tax-evasion is more widespread among them. Finally, high-income taxpayers with wage income only, presumably the least able to engage in income-shifting, exhibit a similar elasticity of taxable income as individuals who have other incomes as well. These may indicate that most of the effect is caused by the adjustment of labor supply (whether it be hours or work intensity), but other explanations (such as the change in tax evasion, adjustment through non-wage benefits, etc.) cannot be excluded.

The rest of the paper is organized as follows. Section 2 describes the theoretical background, the Hungarian personal income tax system, the data, and the empirical specification. Section 3 presents the results of the main specification, provides some robustness checks and indirect evidence about the causes of the estimated elasticity. A discussion of the results concludes.

2.2 Methodology and data

2.2.1 Theoretical background and problems of identification

Estimations of the elasticity of taxable income with respect to the tax rates are motivated by a simple theoretical framework in which the labor supply decision of an optimizing individual is modeled (see Appendix B.2 for details).[6] Taxes affect the trade-off between leisure and consumption. The following relationship between income growth and tax rates can be derived from optimization:

$$\Delta log(y) = \beta \Delta log(1 - METR) + \phi \Delta log(1 - AETR) \tag{1}$$

where y is taxable income, METR is the marginal effective tax rate and AETR is the average effective tax rate. (We call them effective tax rates because social security contributions on the employee's

[5] In contrast, Goolsbee (2000) finds evidence in the US that a substantial part of the response of high-income individuals to tax changes is of a short-term nature, involving the timing of certain transactions, and thus does not represent real labor supply adjustment.

[6] The approach taken here follows Feldstein (1999), Gruber and Saez (2002), and Bakos et al. (2008).

side are also taken into account.) The variable (1 – METR) is the marginal net-of-tax rate. It measures what share of additional taxable income the taxpayer can keep. This is the central variable of the taxable-income literature. The coefficient of this variable β measures to what extent taxpayers respond to marginal incentives or, in other words, to what extent they generate less taxable income when facing a higher marginal tax rate.

The variable (1 – AETR) is the average net-of-tax rate. It measures what share of total taxable income the taxpayer can keep as net income. The coefficient of this variable φ measures the income effect: the extent to which taxpayers generate less taxable income if they receive a lump-sum transfer (or tax relief). If two taxpayers have the same taxable income and the same marginal tax rate, but face a different average tax rate, this means that the tax system treats them differently by a lump-sum component.[7]

The researcher faces two problems when estimating the relationship between taxable income and the tax rates. The first problem is that the income distribution might change for reasons independent of the tax changes: for instance, wage dispersion might increase because of skill-biased technological change. Another problem, having the opposite effect, is the phenomenon of 'regression to the mean': some individuals of extraordinarily high incomes might be experiencing a lucky year, most likely to be followed by a decrease in income. These phenomena might bias the estimation by making high incomes appear to grow faster or slower following a change in the tax code. The literature, following Auten and Carroll (1999), deals with this problem by including (log) initial income (i.e., taxable income in the period before the tax change) as a control variable. The coefficient of initial income will be negative if the phenomenon of regression to the mean is significant or if the income distribution becomes more compressed for reasons independent of the tax changes, while it will be positive if the income distribution becomes more dispersed for independent reasons. Including initial income as well as demographic variables to control for individual heterogeneity of taxable-income growth, we arrive to the following equation:

$$\Delta log(y_i) = x_i'\alpha + \gamma y_{0i} + \beta \Delta log(1 - METR_i) + \phi \Delta log(1 - AETR_i) + u_i \qquad (2)$$

where vector x' includes demographic control variables and y_i is initial income.

The second econometric problem to be taken care of is that there is inverse causality between the dependent variable and some explanatory variables. Taxable income might change for many other reasons independent of taxation. If taxable income of an individual grows above average, this will, in

[7] Previous studies chose different ways to operationalize the income effect in the empirical specification. This formulation follows Bakos et al. (2008) whose operationalization is a slight variant of that of Gruber and Saez (2002). For the derivation of this form and its comparison to Gruber and Saez (2002), see Appendix B.2.

a progressive tax system, increase their tax rate. A simple OLS regression might, spuriously, indicate that a tax hike makes taxable income grow faster.

This problem is solved here, as in much of the literature, by using the instrumental variable (IV) estimation procedure. The instruments for the actual (endogenous) tax rates are the so-called 'synthetic tax rates'. These are obtained by applying the after-change tax rules to the (indexed) before-change taxable income of each individual. Since they are based on before-change individual information only, they are exogenous to the after-change income. The details of the procedure as applied in this analysis are described after the description of the data.

2.2.2 The Hungarian Personal Income Tax (PIT) system during the period of study

The basic principles of the Hungarian PIT system have been fairly stable since the transition. It is an individual (as opposed to family-based) tax system. Total annual income of an individual is divided into two parts: taxable income[8] and capital income[9]. During the period, taxable income was subject to a (progressive) piecewise-linear tax function, while capital income was taxed at flat tax rates (which depended on the type of capital income but not on the tax base) that were lower than the upper income tax rate.

The progressive tax schedule that applied to taxable income consisted of two main tax brackets. The lower tax rate was 18% during the period. The upper tax rate was 38% in 2005 and 36% in 2008. The threshold between both tax brackets was raised from HUF 1.5 million (about EUR 6,000) to 1.7 million. The change that motivates our study is the introduction of the 'extraordinary tax of individuals' in 2007.[10] This was a 4 percentage point surtax applying to income above HUF 7,139,000 (about EUR 28,500) in 2008, effectively creating a third tax bracket for high income earners. (The main parameters of PIT are summarized in the top panel of Table 2.1.)

Since we are interested in taxpayers' reaction to the tax rates applying to 'taxable income,' it is natural that we focus on this definition of income in this study. (In subsection 3.3.2 we investigate how capital income of high earners changed between 2005 and 2008.)

Taxable income included three main types of income: (1) wage income (including cost reimbursements, severance pay, and some social benefits); (2) entrepreneurial income (including income from contract work and income of licensed small-scale agricultural producers); and (3) 'other taxable income' (income from scholarships in higher education, some social benefits and, under some circumstances,

[8]The official Hungarian term is, in literal translation, 'aggregated tax base' ('összevont adóalap').

[9]The official Hungarian term is, in literal translation, 'separately taxed incomes' ('külön adózó jövedelmek').

[10]The extraordinary tax of individuals was introduced by Act 59 of 2006 of the Republic of Hungary. According to paragraph 8, the extraordinary tax, as applied to those individuals who are not full-time self-employed, came into effect on January 1, 2007. The earliest newspaper articles announcing the reform were published during the summer of 2006. The official Hungarian name of the tax is 'magánszemélyek különadója.'

Table 2.1: Tax and contribution rates of Hungarian high-income earners in 2005 and 2008

	2005	2008
Personal Income Tax (PIT)		
PIT lower rate	18%	18%
Upper limit of lower tax bracket	HUF 1.5 M	HUF 1.7 M
PIT upper rate	38%	36%
Extraordinary tax on individuals (surtax on upper rate)	-	4%
Lower income threshold of extraordinary tax	-	HUF 7.139 M
Social Security Contributions (SSC)		
Employee pension contribution rate	8.5%	9.5%
Pension contribution ceiling	HUF 6.0 M	HUF 7.139 M
Other employee contributions	5%	7.5%
Marginal Effective Tax Rates (METR)		
Typical METR at income HUF 5 million	51.5%	53%
Typical METR at income HUF 8 million	43%	47.5%
Typical (1-METR) at income HUF 5 million	48.5%	47%
Percentage change relative to 2005	-	-3.09%
Typical (1-METR) at income HUF 8 million	57%	52.5%
Percentage change relative to 2005	-	-7.89%

Source: Hungarian Tax Authority and own calculations.

income earned abroad). This third group of income was special because although it was part of the tax base, it was not taxed itself.[11] Although no taxes were paid after these incomes, they could push other incomes into the higher tax bracket. Pensions, untaxed until 2006, became 'other taxable income' in 2007, which meant, in effect, that individuals whose only income was from pensions continued to pay no income tax, but the wage income of pension recipients came to be taxed at a higher rate than before.

The PIT system included a number of tax credits. All tax credits diminished the taxes payable after a given tax base, rather than diminishing the tax base itself.[12] By far the largest tax credit was the employee tax credit (ETC)[13], a non-refundable tax credit on earned-income for low and middle-income individuals with a gradual withdrawal phase at intermediate income levels. Individuals in our sample were not eligible for the ETC in 2005 since they earned high income. However, we took into account the ETC to the extent that it affected actual 2008 taxes of individuals whose income fell to relatively low levels.

The child tax credit (CTC)[14] diminished the tax payable by an amount that depended on the number of dependent children. Married or cohabiting couples could decide which one of them claimed

[11] This is why the official Hungarian term for this group of incomes is 'income not bearing tax burden' ('adóterhet nem viselő járandóság').

[12] For this reason, there is not as great a difference between 'taxable income' and 'gross income' in Hungary as in the US.

[13] The Hungarian term is 'adójóváírás.'

[14] The Hungarian term is 'családi adókedvezmény.'

the CTC. Couples could also divide the amount of credit between them. The CTC became less generous during the period of our study. Taxpayers with one or two children were not eligible any more for the credit in 2008, but the amount of credit for taxpayers with three or more children was reduced as well. In both years the CTC was withdrawn at a rate of 20% at relatively high income levels. The withdrawal phase started at income level HUF 8 million in 2005; in 2008 the withdrawal threshold varied between HUF 6 and 8 million depending on the number of children.[15]

Finally, a number of tax credits (including that for charitable giving) were subject to a common cap of HUF 100,000 (about EUR 400). This set of tax credits was also withdrawn at a rate of 20% starting at a total income of HUF 6 million in 2005 and HUF 3.4 million in 2008.

Income in Hungary is not only subject to PIT but also to Social Security Contributions (SSC), which finance the pension, healthcare, and unemployment benefit systems. SSC are paid by both employees and employers. Similarly to Bakos et al. (2008), we take into account the effect of employee contributions on average and marginal effective tax rates, since they drive a wedge between gross and net income the same way as the PIT does.[16] This is justified if the link between contributions and benefits are not closely linked (at least in the expectations of taxpayers). Benefits do not depend on contributions in healthcare (except for sick leave payments and some pecuniary child care benefits), but there is a link in the case of pensions. However, we believe that the perceived link between contributions and benefits is weak for three reasons. First, the marginal conversion rate from pension contributions to future benefits is not transparent in the Hungarian system. Second, changes to the pension system are frequent and significant. And finally, further changes can be expected since the long-term sustainability of the pension system is in question. Therefore, we believe we are justified to assume that employee SSC are perceived the same way as taxes.

The rates of employee SSC in 2005 and 2008 are summarized in the middle panel of Table 2.1. Employee contribution rates increased from a total of 13.5% to 17% in three years. Employee pension contributions are subject to a cap. The 'pension contribution ceiling' was at a high income level, and it is the income level at which the 'extraordinary tax' was introduced.

The bottom panel of Table 2.1 calculates the METR (and its inverse) for typical taxpayers at annual income levels of HUF 5 million and 8 million in 2005 and 2008. It shows that, as a result of all changes, the METR of typical taxpayers earning HUF 8 million increased by 4.5 percentage points, almost exactly by the rate of the extraordinary tax. The METR of high-income individuals below the pension contribution ceiling, not affected by the extraordinary tax, increased by 1.5 percentage points.

[15]Note that the withdrawal of all tax credits was conditional on 'total income,' that is, the sum of taxable income and capital income.

[16]Employer contributions were paid at a rate of 32% both in 2005 and in 2008.

2.2.3 Data and sample

The data base was compiled by the Hungarian Tax Authority for the purposes of this study. It contains information about a panel of anonymous individual tax returns from the years 2005 through 2008, based on a 10% random sample of the population of tax-filers in 2005, excluding the full-time self-employed. Not all taxpayers filed a tax return in all four years: while we observe 422,219 individuals in 2005, only 359,409 of these filed a tax return in 2008. Attrition is less severe among high-income earners who are the subject of this study: there are 14,467 taxpayers in the sample of 2005 with taxable income above HUF 5 million (about EUR 20,000).[17] Of these, 13,237 filed a tax return, and 13,159 had non-zero taxable income, in 2008.

The estimation is based on comparing the taxable income growth of different individuals between 2005 and 2008. The 'natural experiment' this paper uses for identification includes all tax changes that affected high-income individuals between both years. By far the most important of the changes was the introduction of the extraordinary tax on individuals effective from January 2007. This episode would theoretically allow 2006 to be chosen as base year. However, 2006 is not suitable as a base year because some changes in taxes and contributions, passed together with the extraordinary tax, took effect already in September 2006. Thus in some cases it is not clear what the relevant effective tax rate is for a given individual, and behavior in 2006 may already reflect a response to some of the policy changes. Therefore, 2005 was chosen as the base year. As comparison year, 2008 was chosen because changes in taxpayer behavior might take time. It is for this reason that most studies in the literature consider the effect of tax changes on a three-year horizon (see, e.g., Feldstein 1995 and Gruber and Saez 2002). As a robustness check, results for the period 2005–2007 are also reported.

The potential estimation bias, discussed in Subsection 2.1, caused by 'regression to the mean' or secular trends in inequality is remedied in two different ways in this paper. The first of these ways, based on the procedure of Auten and Carroll (1999) and the later literature, is to include (log) initial income as a control variable in the estimated regressions. The other way to deal with these issues is to focus on a sub-sample that is as homogeneous as possible so that the disturbing factors not to affect the lower and the upper end of the sample very differently. The main results presented in this paper are based on a sample that includes individuals having taxable income between HUF 5 and 8 million in 2005 (about EUR 20-32 thousand).[18] The robustness of the results to the sample's income limits is examined in Subsection 3.2.

To be able to compare the income of individuals between the years 2005 and 2008 we have to take

[17] During the period 2005-2008 the exchange rate varied around the convenient equivalence EUR 1 = HUF 250. We use this exchange rate to interpret figures in Hungarian Forints (HUF) in the text.

[18] While this income range, evaluated at the current exchange rate, would be considered a middle-income sample in the economy of a highly developed country, it is within the top 5 percent of income earners in Hungary.

into account the changes to the legal definition of taxable income during these years. As described in the previous subsection, pension income became part of the tax base in 2007. Since the effects of this measure should not contaminate the results, and since we do not observe pension income in 2005, all individuals with pension income in 2008 were left out of the sample. Of the 8,588 taxpayers in the sample with taxable income between HUF 5 to 8 million in 2005, 1,363 had to be excluded for this reason. After removing these individuals from the sample we have 7,225 observations.

We also exclude 314 taxpayers that either have 'other taxable income,' or income from abroad.[19] We can assume that the behavior of individuals with income from abroad does not reflect typical reactions to Hungarian tax rates. For a minority of these individuals 'other taxable income' comes from child care benefit of parents with children under age 3 ('gyes') or child care benefit of parents with three dependent children of whom the youngest is between 3 and 8 years old ('gyet'); since both benefits were conditional on the recipient not working full-time outside their homes, we exclude these taxpayers from the sample. Since their number is small, results are robust to their exclusion. Finally, we exclude 16 observations for which information about the residence cannot be observed.[20] We thus have 6,895 observations in our sample.

2.2.4 Variables and descriptive analysis

Individual characteristics like gender, age, and the type of locality of residence (Budapest, large cities, other cities, villages) are used to generate control variables in the regressions. Regional controls are not included since they were not significant in any specification. It should be noted that information about the taxpayer's gender is not part of a tax file as prepared by the taxpayer. The tax authority has run an algorithm based on first names to generate this information. As this procedure is imperfect, it may not be able to identify the gender in case of uncommon, misspelled or foreign names. Therefore, gender information is missing for 537 observations in our main sample. We tagged these observations with a dummy variable and included them in the analysis.[21]

In addition, we generate two control variables based on the information of 2005 tax returns. The first one is a dummy variable that takes the value of 1 if a taxpayer had high capital income in 2005 (defined as more than HUF 150 thousand, or about 600 Euro). The other is a dummy variable that takes the value of 1 if the taxpayer chose tax filing through his or her employer in 2005. This option meant that

[19] For the majority of high-income individuals earning 'other taxable income,' it is income from abroad. Income earned abroad can, however, also be reported in another line of the tax file, depending on the type of income and the source country where it was earned. In an earlier version of this paper (Kiss and Mosberger, 2011) we failed to exclude 5 individuals with income from abroad.

[20] For another 21 observations the locality could be identified despite an erroneous (outdated) postal code.

[21] The results are robust to their exclusion. In an earlier version of this paper (Kiss and Mosberger, 2011) we estimated the elasticity separately for men and women; results were similar to the overall results.

a taxpayer's employer prepared and sent one's tax file to the tax authority, saving considerable time and energy for the employer. A taxpayer had this option if he or she did not have outside incomes. The variable thus differentiates between taxpayers who had a single source of employment income in 2005 from those who had more sources of income (including contract work, second job, etc.). Both groups may differ in their ability to avoid taxes, but possibly also in other ways.

Marginal net-of-tax rates (1 – METR) and average net-of-tax rates (1 – AETR) are calculated based on tax rules described in Subsection 2.2. The bottom panel of Table 2.1 shows the 'typical' METR at the top and the bottom of our sample.

Regressions in this paper are estimated with the instrumental variable (IV) procedure to deal with the endogeneity of the marginal and average net-of-tax rate. The instruments are the 'synthetic' counterparts of these. They are obtained by applying the 2008 tax rules to inflated 2005 taxable income. The index used to inflate 2005 incomes is the average income growth of the sample. (Taxable income grew, on average, by 16.6%. Results are not sensitive to the precise index of nominal income growth.)

Table 2.2: Descriptive statistics of the sample

Variable	Mean	Std. Dev.	Min	Max
Female	0.311		0	1
Gender info missing	0.078		0	1
Birth year	1964		1940	1986
Residence: Budapest	0.360		0	1
Residence: large city	0.244		0	1
Residence: other city	0.249		0	1
Residence: village	0.147		0	1
High capital income in 2005	0.059		0	1
Tax filing through employer	0.440		0	1
Taxable income 2005, HUF thousand	6149.6	835.1	5000.0	7999.4
Taxable income 2008, HUF thousand	7167.4	3001.2	2.8	43362
Change of taxable income, 2005-2008	0.166	0.460	-1.000	6.412
Change of actual (1 — METR)	-0.019	0.147	-0.526	0.842
Change of synthetic (1 — METR)	-0.035	0.126	-0.443	0.649
Change of actual (1 — AETR)	-0.027	0.097	-0.206	0.551
Change of synthetic (1 — AETR)	-0.060	0.019	-0.400	-0.037

Note: The sample consists of 6,895 taxpayers with 2005 taxable income between HUF 5-8 million. In the last five rows a value of 0 means no change; -0.5 means a 50% reduction; 1 means a growth of 100%.

In the first stage of the IV estimation, the actual 2008 marginal and average net-of-tax rate is regressed on all control variables included in the main regression and both 'synthetic' tax rates. (Of course, only the synthetic marginal rate is included as a first-stage instrument in specifications where the average rate is not included as a right-hand-side variable in the main equation.) The predicted

2008 tax rates obtained from the first-stage regressions are not endogenous any more to 2008 income; therefore they can be used to explain 2008 income in the second stage.

Table 2.2 shows the descriptive statistics of the benchmark sample. Women constitute slightly less than one-third of the sample. Information on gender is missing for about 8% of the sample. More than one-third of the sample live in Budapest (the population of Budapest, the capital city, is less than one-fifth of Hungary's population), one-fourth live in large cities and another one-fourth in other cities, while 15% live in villages. About 6% of our high-income sample had high capital income in 2005, while 44% chose tax filing through their employer.

Taxable income of individuals in the sample grew by an average of 16.6% in three years; some individuals had near-zero taxable income in 2008, while some saw their taxable income multiply by a factor of six. The last four lines of Table 2.2 summarize the actual and synthetic tax rates. The statistics show that tax rates (average as well as marginal) rose during the three years. The variation is, naturally, higher in the change of individuals' actual tax rates than in the change of their synthetic tax rates.

Figure 2.1: Tax rates and change in taxable income, 2005-2008.

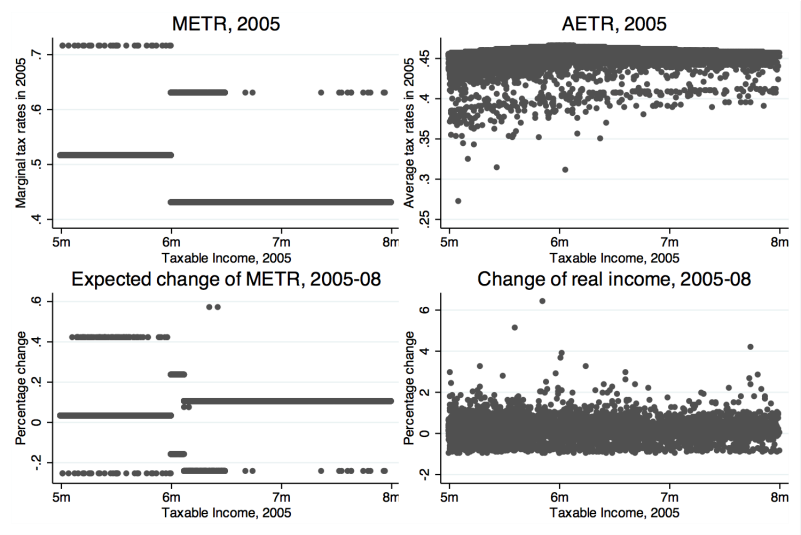


Figure 1 summarizes information regarding the tax rates and income change in the main sample. The four panels show, respectively, the 2005 marginal and average tax rates, the expected change of the marginal tax rate (where the expected 2008 marginal rate is the synthetic marginal tax rate) and the percentage change in income.

The upper left panel shows the actual 2005 marginal effective tax rate (METR) as a function of 2005 taxable income. Most high-income taxpayers form two continuous lines in the bottom part of the panel: their METR corresponds to the regular tax and contribution rates below and above the pension contribution ceiling. Their METR is 51.5% and 43%, respectively (see Table 2.1 for details).

Atypical values for the METR are only observed for those who fall into the withdrawal phase of a tax credit. Most of these taxpayers have taxable income between HUF 6 and 6.5 million (about EUR 24-26 thousand). They are eligible for one of the tax credits whose common withdrawal phase is in exactly that income range. However, since the withdrawal is based on total income (the sum of taxable income and capital income), some taxpayers fall into this withdrawal phase with a taxable income below HUF 6 million. They are the scattered dots to the left of the HUF 6m mark in the top left part of the panel. Atypical taxpayers to the right of the HUF 6.5 million mark are those who are in the withdrawal phase of the child tax credit (and reach the withdrawal threshold of HUF 8 million in total income because of their capital income).

The lower left panel in Figure 2.1 shows the percentage change (as opposed to the change in percentage points) from the actual 2005 METR to the synthetic 2008 METR. The figure shows that all typical taxpayers see their METR increase somewhat from 2005 to 2008: this is the result of the general increase in SSC. Taxpayers above the pension contribution ceiling face the extraordinary tax in addition: an increase in their METR of about 4 percentage points or about 10%. Just above the 2005 contribution ceiling there is a short interval of taxable income where individuals face a 20% increase in their METR. They are taxpayers who are above the contribution ceiling in 2005 but are expected to fall under the increased contribution ceiling by 2008 (the ceiling was raised in discretionary moves by the legislature at a higher rate than incomes grew in the sample). Other atypical taxpayers see their METR increase or decrease substantially because of the changes in the withdrawal phases of tax credits.

The upper right panel in Figure 2.1 shows the actual 2005 average effective tax rate (AETR) as a function of 2005 tax base. Most taxpayers are close to the average tax rates that track the statutory rates with only tax credits differentiating between them. Finally, the bottom right panel shows the change of taxable income in the main sample. Clearly, there is great variation in the income growth around its mean: some taxpayers see their taxable income reduced to almost zero, while others see their taxable income multiply. The regression analysis below investigates whether income growth has a systematic relationship with marginal and effective tax rates.

2.3 Estimation results

2.3.1 Results from the main specification

Every regression below is estimated with the IV procedure that can be thought of as a two-stage procedure. In the first step the actual 2008 marginal net-of-tax-rate is regressed on its synthetic

counterpart and the control variables of the main regression. (If the average net-of-tax rate is included as an explanatory variable it also has a first-stage regression. In that case both synthetic tax rates are included in both first-stage regressions.) The synthetic marginal net-of-tax rate is a good instrument: its coefficient in the first stage regression for its realized counterpart is about 0.7 (not reported in the results) and significant on all conventional levels of significance. Initial income, synthetic average net-of-tax rate and most of the demographic control variables are also statistically significant in the first stage regression, while the R^2 is around 0.45.

More systematic diagnostic tests are reported in the regression tables below. In an IV estimation, the researcher generally faces two problems: one is whether the instruments are exogenous, while the other is whether they are relevant. The exogeneity of the instruments is ensured by the way we constructed them based on information prior to the tax changes. As to the problem of relevance we report the p-value of the Kleibergen-Paap underidentification test (the generalization of the Anderson canonical correlations test for the case of non-i.i.d. errors). Under the null hypothesis, the equation is underidentified. Also, we report the partial F-statistics for the first-stage regressions. Since the problem of 'weak identification' is known to make estimators perform poorly even in cases when the underidentification test is rejected, we also report the Kleibergen-Paap Wald rk F-statistic. Finally, we also report a test for the exogeneity of actual (realized) tax rates (akin to the C-statistic).[22]

In the results below, all diagnostic statistics are favorable. The exogeneity and underidentification tests are in all cases rejected at all conventional levels of significance. The F-statistic of the K-P weak-identification tests are mostly around 1000 when only the marginal rate is included in the specification and around 200 when both tax rates are included. The F-statistics are safely high even in those cases, reported in the robustness analysis, where the regressions are run on smaller sub-samples.

The regression results of the main specifications are summarized in Table 2.2. In the first four columns we gradually introduce the control variables into the analysis. In the specification of column (1) the only explanatory variable is the marginal net-of-tax rate. The following specifications introduce log initial income, the average net-of-tax rate and demographic controls; column (4) reports the full specification.

The estimated coefficient of the marginal net-of-tax rate is between 0.15 and 0.17 in the three specifications without the demographic controls and 0.24 when all controls are included. In all specifications the estimated coefficient is statistically significant at the 5% level; in the full specification the 1% level. The coefficient of 0.24 implies that high-income taxpayers increase their taxable income by 0.24% if their marginal net-of-tax rate increases by 1%. The concluding section places the estimated elasticity in the context of earlier estimates found in the literature.

[22] All tests were performed using the ivreg2 package in Stata. More details on the tests can be found in Baum, Schaffer and Stillman (2003; 2007) and the references therein.

The variable controlling for the income effect (the average net-of-tax rate) has an estimated coefficient of about (-0.84) and is also statistically significant at the 1% level. The magnitude of the coefficient would imply that high-income taxpayers reduce their taxable income by about 0.84% if their average net-of-tax rate increases by 1%. The coefficient of initial income is negative in all specifications, which hints at a mild contraction of the income distribution, but the magnitude of the coefficient is small and statistically insignificant.

In the full specification of control variables, we included interaction terms of age and gender, as well as age-squared and gender. It appears that age significantly affects the increase in income only for women. As the interaction terms indicate, older women see their income increase more, but this effect becomes smaller with age. High-income women's income increases by less than that of men, but the coefficient of the gender dummy cannot be interpreted directly because of the presence of the age-gender interaction terms. Specifications without the interaction terms indicate that women's income increases by about 7% less than that of men.[23]

Interestingly, taxable income growth of individuals with missing gender information is about 5 percent higher than that for men (the effect is highly statistically significant). We noted that information on gender may be missing because of uncommon or foreign names. The finding that taxable income growth was higher in this group than the rest of the sample is consistent with the conjecture that some of these individuals are foreign employees of multinationals. We also find that individuals with missing gender information are younger, on average, than the rest of the sample (65% is younger than 35 as opposed to 37% of the whole high-income sample) and is more concentrated in Budapest than the rest (46% lives in the capital as opposed to about 36% of the whole high-income sample).

The type of locality is controlled for by dummy variables; the comparison group is Budapest. The results show that in the course of three years income growth in the sample was about 3 percentage points higher in large cities than in Budapest; while it was about 3 percentage points lower in villages than in Budapest. Only the first of these effects are statistically significant at the 10% level.

Of the tax-related control variables, only the dummy for employer filing is statistically significant. The estimated coefficient suggests that the taxable income of taxpayers choosing this option grew by an additional 5% as compared to others. This could be a reflection of the notion that individuals with a stable and high-paying employment contract see their income fall less often than individuals whose high income comes from multiple sources. The other tax-related control variable, the presence of high capital income, does not appear to affect the growth of taxable income significantly. The estimated coefficient is positive. If shifting earned income to capital income played an important role in the reaction to a tax increase on earned income, we should expect the opposite. (Subsection 3.3.2 provides

[23] Also, if the interaction terms are not included, the coefficients of age and age-squared are very close to zero and not statistically significant.

some direct evidence about the absence of income shifting.)

Table 2.3: Regression results in the main specifications

	(1)	(2)	(3)	(4)
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.157**	0.153**	0.166***	0.240***
	(0.066)	(0.069)	(0.061)	(0.064)
dlog(1-AETR)			-0.746***	-0.840***
			(0.235)	(0.277)
log(initial income)		-0.029	-0.024	-0.002
		(0.054)	(0.049)	(0.048)
Female				-1.412***
				(0.417)
Age				-0.014
				(0.010)
Female*Age				0.056***
				(0.021)
Age-squared				0.000
				(0.000)
Female*Age-squared				-0.001**
				(0.000)
Gender info missing				0.050***
				(0.019)
Large city				0.027*
				(0.015)
Other city				-0.004
				(0.017)
Village				-0.028
				(0.018)
High capital income 2005				0.019
				(0.026)
Employer tax filing 2005				0.049***
				(0.013)
Constant	-0.102***	0.351	0.254	0.233
	(0.007)	(0.847)	(0.766)	(0.762)
Number of observations	6,895	6,895	6,895	6,895
Diagnostic tests:				
Exogeneity of tax rate variables (p-value)	0.000870	0.000550	0	0
Kleibergen-Paap underid. test (p-value)	0	0	0	0
F-stat – first-stage reg. for (1-METR)	925.1	928.3	712.2	646.6
F-stat – first-stage reg. for (1-AETR)	-	-	260.5	214.4
Kleibergen-Paap weak ident. test (F-stat)	925.1	928.3	246.4	205.3

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level. The sample consists of taxpayers with tax base between HUF 5-8 million in 2005.

2.4 Robustness analysis

Three robustness checks are reported in this subsection. The first robustness check looks at whether results are sensitive to the income limits of the sample. In the second robustness check, the main analysis is repeated for the time period 2005 to 2007 (as opposed to 2005 to 2008). In the third robustness check, the analyses is repeated excluding atypical taxpayers whose METR increase or decrease substantially because of the changes in the withdrawal phases of tax credits to check whether identification come from these changes.

2.4.1 Robustness to sample limits

The first robustness check looks at whether results change if the sample is not restricted to taxpayers with a tax base of HUF 5–8 million in 2005. We broadened the sample both upward and downward. The results are reported in Table B.1 of the Appendix. The full specifications are reported in columns (2) and (4). The regressions reported in columns (1) and (3) exclude initial income and the average net-of-tax rate.

The first two columns of the table report results based on a sample of individuals earning HUF 4–8 million in 2005. The estimated coefficients are very similar to those obtained with the baseline sample. The coefficient of the marginal net-of-tax rate is slightly lower, about 0.18, still statistically significant at the 1% level. As a difference from the baseline results is that the coefficient of initial income is somewhat higher in absolute value (about -0.04) and statistically significant at the 10% level. Comparing columns (1) and (2) it appears that results are not sensitive to the inclusion of initial income and the average net-of-tax-rate.

The last two columns of Table B.1 report results based on a sample including taxpayers with income between HUF 5-20 million in 2005. The results are again qualitatively similar to the main results. In column (3), where only the demographic controls are included, the main elasticity is about 0.21 and statistically significant on the 1% level. Including initial income and the average net-of-tax rate as control variables in column (4) makes the elasticity fall to a level of about 0.15, maintaining its statistical significance.

In this specification, including higher incomes as well, the estimated coefficient of initial income is large in absolute value (-0.13), and is now statistically significant at the 1% level. The economic interpretation of this coefficient is that, all other things equal, 1% higher taxable income in 2005 implies that a taxpayer's income is expected to grow by about 0.13% less. The difference between the estimated coefficient of the marginal net-of-tax rate in column (3) and (4) suggests that, in this broader

sample, the inclusion of initial income interferes with the identification of the substitution effect. This is a potential problem noted by past literature (notably by Gruber and Saez, 2002). We conclude that our choice of a more restricted income range for our baseline sample is justified: the sample remains more homogeneous, and controlling for initial income does not interfere with the identification of the tax rate variables. Nevertheless, we note that our main results are qualitatively robust to modifications of the income limits of the sample.

2.4.2 Robustness to the time period

In the second robustness check the growth of taxable income is analyzed during the period 2005 to 2007 (rather than 2005 to 2008, as in the main analysis). The year 2007 was the first year after the introduction of the extraordinary tax. Thus, these results show the immediate effect of the tax changes while the main specification measures the effect in the second year after the tax changes. (The tax system remained virtually unchanged from 2007 to 2008). Results are shown in Table B.2 of the Appendix. The columns (1)-(4) report results of specifications where control variables are gradually added, similarly to Table 2.3.

The results are qualitatively similar to the main results. The estimated coefficient of the marginal net-of tax rate is between 0.10 and 0.13 before controls are added, and about 0.2 after controls are added. The estimated coefficient is statistically significant at the 1% level in the full specification and at least at the 10% level in all other specifications. The result suggests that taxpayers' response became stronger in the course of time.

Demographic control variables have a broadly similar effect than in the baseline sample. The interaction of age-squared and gender was not statistically significant and was therefore excluded. This affects the coefficient of the age-gender interaction, but the result remains that women's income growth is lower, the disadvantage becoming smaller with age.

2.4.3 Robustness to atypical taxpayers

In the third robustness check the analyses is repeated excluding atypical taxpayers to check whether identification came from their response. In the main estimation specification in Subsection 3.1 identification includes all tax changes that affected high-income individuals between 2005 and 2008. By far the most important of the changes was the introduction of the extraordinary tax on individuals effective from January 2007. As a robustness check the analyses is repeated excluding atypical tax-

payers, whose METR increases or decreases substantially because of the changes in the withdrawal phases of tax credits.[24] Results are shown in Table B.3 of the Appendix. The results are slightly higher compared to the main estimation specification, the estimated coefficient of the marginal net-of tax rate is between 0.27 and 0.32 before controls are added, and about 0.356 after controls are added. Demographic control variables have a broadly similar effect as in the baseline sample. The result suggests that the main source of identification is the introduction of the extraordinary tax on high income individuals.

2.5 What lies behind the elasticity?

Perhaps the most intriguing question related to the taxable-income elasticity is how much of it reflects adjustments in labor supply (reflected either in hours worked or work intensity), and how much of it reflects other types of adjustment? The question, by its nature, is very difficult to answer since researchers are very rarely able to connect data on hourly wages or hours worked to tax data. Also, it is hardly possible to measure the extent of tax evasion (e.g., income underreporting) or tax avoidance (e.g., tax exempt and non-reportable forms of remuneration).

We are able to conduct, however, four tests suggesting that our results are not a result of income shifting. In particular, in this section we show that (1) higher income elasticities are estimated for women, the young and the old, (2) taxpayers who only have wage income exhibit a very similar response to tax changes than taxpayers who have other sources of income, (3) we find no evidence for shifting of wage income into capital income; and (4) no evidence for switching from employer-filed tax forms to individual reporting.

The first of these findings is consistent with previous studies finding that labor supply of women is more sensitive to wage incentives than that of men (see, e.g. the survey of Meghir and Phillips, 2008), while no alternative explanation related to tax evasion or tax avoidance would predict this asymmetry between the sexes. On the contrary, Meghir and Phillips note that with respect to tax avoidance, one should rather expect the opposite asymmetry. Similarly, with respect to tax evasion Semjén et al. (2009) have found with a survey methodology that men are almost twice as likely to be paid partly or fully in cash, than women, in Hungary.[25] A similar argument can be made regarding the age groups: presumably, older and younger age groups can increase or decrease their work effort (or even working

[24] The typical taxpayer below the pension contribution ceiling has 2,9 (53/51.5) percentage expected change of METR, and 10,5 (47.5/43) percentage above the ceiling (see the left bottom panel of Figure 2.1, and the bottom panel of Table 2.2). 728 atypical taxpayers were excluded with larger than typical changes in absolute value, and an additional 3 taxpayers with smaller.

[25] In the survey, 19% of men and 11% of women said that they received such unreported payments in the course of the two years prior to the survey (Semjén et al., 2009, pp. 233−234).

hours) more easily than those between 30 and 55 years, who are more likely to work full-time in the first place. It is harder, however, to argue that older and younger groups are more prone to tax avoidance or tax evasion.

Result (2) can also be interpreted as indirect evidence against the tax evasion explanation of our results. Arguably high-income taxpayers who only have wage income have less opportunities for tax avoidance than individuals with multiple sources of income (e.g., including contract work). If the elasticity we estimate for this group is similar to that of other groups, it may be an indication that the behavioral response is not simply a result of tax avoidance. This evidence does not definitively settle the question whether the estimated elasticity reflects real labor supply adjustment at the intensive margin, but it provides some evidence against some alternative explanations.

Result (3) and (4) provide direct evidence for that tax evasion is not the main source of the taxable income elasticity. If tax shifting explained much of the estimated elasticity, we should observe a higher increase in capital income of those individuals who are likely to become subject to the extraordinary tax. Similarly, a larger share of taxpayers who are likely to be affected would switch from employer reported tax forms to individual reporting, this latter presumably providing more possibility for income-shifting. Contrary to what could be expected based on the income-shifting explanation, there is no indication for these in the data.

2.5.1 Higher income elasticities are estimated for women, the young and the old

To see whether different demographic groups exhibit different behavior, regressions of the main specifications are run for the sexes and age groups separately. Results show that the marginal tax rate influences the taxable income of all subgroups, albeit to a different degree. Table B.4 of the Appendix shows the regression results for women and men separately. The first two columns show the results for women and the last two columns for men. In the regressions reported in column (1) and (3) the average net-of-tax rate was omitted as an explanatory variable. The table shows that estimated coefficients are higher for women (0.29-0.32) than for men (0.21-0.24). For both sexes separately, the coefficient is statistically significant.

The estimated coefficients of the control variables show that the sexes are affected differently by factors controlled for in the estimations. Notably, age affects the taxable-income growth of the sexes in the opposite way: it affects income growth positively for women in the sample, but negatively for men; both effects are highly statistically significant. It is likely that this finding is caused by the fact that many younger women reduce their labor supply when they have young children. The estimated effect of the type-of-locality variables is rarely statistically significant in the sub-samples but is broadly

in line with overall findings. The coefficient of initial income (tax base in 2005) is negative for men, positive for women, but it is not statistically significant in either case. The income effect seems to be much stronger for women.

In the next step, regressions were run separately for different age groups. Taxpayers were divided into three groups: below 30 years, between 30 to 55 years, and above 55 years (as of 2005). Table B.5 of the appendix shows the results. As above, results from two specifications are reported for all three groups: the full specification is reported in the even columns, while in the odd columns the average net-of-tax rate is omitted as a control variable. The results of the odd-numbered columns are interpreted here, as the inclusion of the average net-of-tax rate makes the estimation of smaller groups unstable (especially column (2) and column (6)). In these two cases the first-stage equation for the average net-of-tax rate is not well specified (or the synthetic average net-of-tax rate is not strong enough as an instrument) as testified by the low values of the Kleibergen-Paap weak identification F-statistics reported in column (2) and column (6). These are the only instances in the analysis where we have a weak instrument problem, caused probably by the small number of observations in these subgroups.

Interpreting the results of the specifications without the income effect, we find that the taxable-income elasticity is estimated to be lowest for taxpayers between 30-55 years of age (a coefficient of 0.17), while it is larger for those under 30 years (0.67) and those above 55 years of age (0.33). The estimated coefficient of the marginal net-of-tax rate is significant at the 5% level (at the 10% level for taxpayers below 30 years). The coefficients for the subgroups indicate that younger and older taxpayers have a higher elasticity than those in-between.

Turning to the control variables we find that the difference in income growth between women and men is affected by age. High-earning women's disadvantage in income growth is strongest for those under 30 (here the difference is almost 33 percentage points and statistically strongly significant); the disadvantage is above 10 percentage points for those older than 55 years, but here the high variance makes the effect statistically insignificant. The disadvantage of high-earning women between 30 and 55 is about 4 percent and statistically significant.

2.5.2 Similar elasticity is estimated for individuals with wage income only

For this exercise we divided our baseline sample into two groups and repeated the analysis separately for those taxpayers who had only wage income in 2005 (4,239 observations), and the rest (2,656 observations). Additionally, we repeated the analysis for the subsample of taxpayers who had at least some capital income in 2005 (714 observations). The results are reported in Table B.4 of the Appendix.

The estimated elasticities are very similar in both samples: the estimated coefficient of the marginal net-of-tax-rate is 0.252 in the wage-only, 0.235 in the not-only-wage, and 0.215 in the some-capital-income subsample. The income effect is also very similar in the subsamples (-0.841, -0.845, and -0.807, respectively, even though it is not statistically significant in the least numerous capital-income subsample).

Control variables show some differences across subsamples, although not dramatic ones. (Controls that were statistically insignificant in both larger subsamples have been dropped.) The sign of the coefficient of initial income is different in the wage-only and not-only-wage subsamples, but the magnitude is small in both cases and is statistically insignificant. The interaction of gender and age seems to be significant only in the not-only-wage subsample; here we get the pattern seen in the baseline results, while the interaction terms are insignificant in the wage-only subsample. Missing gender information, on the other hand, is smaller and insignificant in the not-only-wage sample.

In sum, based on the results of the full specification, individuals with wage income only seem to exhibit a similarly sensitive reaction to tax changes as others, contrary to the prediction of the tax-avoidance explanation.

2.5.3 No evidence for income shifting I

If tax shifting explained much of the elasticity estimated in this paper, we should observe a differential increase in capital income of those individuals who are likely, ex-ante, to become subject to the extraordinary tax. In this spirit, we divided our baseline sample to two sub-groups: individuals who, based on the average growth rate of income, are expected to be subject to the extraordinary tax in 2008 (the 'higher-income group'), and those who are not ('lower-income group').

Since three new types of capital income were defined between 2005 and 2008, we applied the 2005 definition also in 2008 to keep the two years comparable. The new types of income are not very significant: combined, they represented about 3% of capital income in our high-income sample. It is thus not surprising that, repeating the same exercise with contemporaneous definitions of capital income, we get the same results.

The lower-income group consists of 3738 taxpayers, while there are 3151 taxpayers in the higher-income group. Six outliers were excluded from the sample: these were cases where an individual received capital income of HUF 100 million (about EUR 400,000) or higher. The income earned by these six individuals was great enough to move the results; the results are robust to any further restriction on the sample. The summary statistics of this comparison are shown in Table 2.4.

Contrary to what could be expected based on the income-shifting explanation, there is no indication

in the data that the higher-income group increased its capital income to a greater extent than the lower-income group. Indeed, the share of taxpayers that has reported positive capital income grew more in the lower-income group (a growth of 1.3 percentage points compared to 0.1). Average capital income stayed largely flat in both groups, increasing by a mere HUF 17,000 (EUR 68) for the lower-income group as opposed to HUF 10,000 (EUR 36) for the higher-income group. The results stay the same if we compare capital income of both groups as a share of 2005 tax base or as a share of contemporaneous tax base.

Table 2.4: The behavior of capital income in the high-income sample, 2005-2008

	Lower group	Higher group
Income in 2005	HUF 5–6.12 m.	HUF 6.12–8 m.
No. of observations[a]	3738	3151
% having capital income[b] in 2005	10.0	10.8
% having capital income[b] in 2008	11.3	10.9
Average capital income in 2005, HUF thousand	248	164
Average capital income in 2008, HUF thousand	266	174
Average increase of capital income, 2005-2008, HUF thousand	+17.4	+10.2
Capital income as a share of taxable income in 2005 (average)	4.49%	2.39%
Cap. inc. in 2008 as a share of 2005 taxable income (average)	4.81%	2.55%
Increase of capital income between 2005 and 2008, as a share of 2005 taxable income (average)	0.31%	0.16%

a Six outliers were removed; these were instances of capital income above HUF 100m. Subsample averages were sensitive to these outliers but not to further restrictions on the data.

b We applied the 2005 legal definition to generate a comparable capital income for 2008. Additional items became taxable as capital income in the years between 2005 and 2008. The inclusion of these items into the definition of 2008 capital income, however, does not change the results.

2.5.4 No evidence for income shifting II

Similarly to the previous exercise, if tax evasion explained much of the estimated elasticity, we should observe that a larger share of taxpayers who are likely to be affected by the extraordinary tax would switch from employer reported tax forms to individual reporting, this latter presumably providing more possibility for income-shifting. In Hungary employees can decide whether they want to submit their income report independently or get it submitted by their employer.[26] During the period of 2005 and 2008 the overall share of self-reported tax forms among the universe of taxpayers increased from 55% to 77%.

[26]The taxpayers have to obligatory self report their income several cases, for instance if the taxpayer has mainly separately taxed income, if the employer declines the request of the taxpayer to forward the tax application form, or if the taxpayer's main occupation is self-employment, or the taxpayer has no employer at the last day of the tax year, and if he determines his cost deductions based on expenses.

Table 2.5: The behavior of capital income in the high-income sample, 2005-2008

	Lower group	Higher group
Income in 2005	HUF 5–6.12 m.	HUF 6.12–8 m.
No. of observations[a]	3738	3151
% individual reporting in 2005	55%	57%
% individual reporting in 2008	69%	70%
Percentage point increase in individual reporting share	15%	13%

a Six outliers were removed as in the previous subsection; these were instances of capital income above HUF 100m.

The sample is divided up to lower-income and higher-income groups similarly as in the previous subsection where we analysed capital income reporting. The share of self-reporting taxpayers grew more in the lower-income group, compared to those in the higher-income group (a growth of 15 percentage points compared to 13). Contrary to what could be expected based on the tax evasion explanation, there is no indication in the data that the higher-income group increased self-reporting to a greater extent than the lower-income group.

In sum, there is no indication that income-shifting increased more for the group affected by the extraordinary tax.

2.6 Discussion

The paper examines how high-income taxpayers in Hungary responded to the introduction, in 2007, of the extraordinary tax on individuals and other tax changes. The elasticity of high earners' taxable income with respect to the marginal net-of-tax rate (1 – METR) is estimated to be about 0.24 in the full specification. Direct evidence is presented suggesting that the estimated effect is not a result of income-shifting, while there is indirect evidence against tax evasion as the main source of the effect. This latter evidence is, however, not definitive. Multiple explanations remain possible, including that of real labor supply reaction.

The estimated elasticity of 0.24 in this study is lower than most estimates for the U.S. but close to some recent estimations for other countries. Differences across countries with respect to the taxable-income elasticity do not necessarily pose a puzzle. As Slemrod (1998) and Slemrod and Kopczuk (2002) pointed out, the elasticity depends on aspects of the tax system (definition of the tax base, possibility of income-shifting, etc.) that are not accounted for in the estimations.

The fiscal significance of the elasticities estimated in this paper can fully be assessed only with the help of behavioral microsimulation models. Simple calculations, like the one presented in an earlier version of this paper (Kiss and Mosberger, 2011), can be performed only if a significant income effect is not present. Benczúr et al. (2012), using a taxable-income elasticity of 0.2, have shown that an income

effect of (-0.5) reduces the stimulative effect of a large and complex tax reform by about 80%. Thus it appears that the income effect estimated in this paper implies that tax cuts at high incomes are not likely to boost taxable income in Hungary dramatically. Note, however, that the fiscal significance of the income effect will depend on the exact design of the tax reform. In a typical reform in which one tax rate is modified in a piecewise-linear tax system, the substitution effect will dominate for taxpayers just above the income threshold from which the tax rate changes, while the income effect may dominate at higher income levels.

Another caveat is in order regarding the application of estimated elasticities to assess tax policy. The reaction of taxpayers is, in this study, based on a policy episode where statutory marginal tax rates increased by 1.5–4.5 percentage points (see Table 1). With more radical changes to the tax system it is conceivable that mechanisms become operative that were not operative in the case of a smaller tax change, limiting the usefulness of past estimations. For example, radical changes might affect the relative tax burden of different types of income (e.g., wage vs. entrepreneurial income) and thus influence the decision of taxpayers (or employers) about the type of their income. Radical changes in the tax system might also influence the choice of legal form for businesses. While some of these mechanisms shift the tax base between types of taxes, others may influence the total tax base as well.

While this is a warning to any policy advice related to radical tax reform, it must also be noted that limited changes in the tax code (like in the episode analyzed in this paper) provide a better opportunity to estimate the behavioral effects that economists are interested in, exactly because there are less confounding factors than in the case of radical tax reform.

Meanwhile, in Hungary top tax rates were radically cut in 2011, with a fiscal effect that is an order of magnitude larger than the changes analyzed in this paper. It is the task of future research to assess the behavioral effects of that tax reform.

References

[22] K. O. Aarbu and T.O. Thoresen. Income responses to tax changes: Evidence from the Norwegian tax reform. *National Tax Journal*, 54(2):319–334, 2001.

[23] G. Auten and R. Carroll. The effect of income taxes on household behavior. *Review of Economics and Statistics*, 81(4):681–693., 1999.

[24] P. Bakos, P. Benczúr, and D. Benedek. The elasticity of taxable income: Estimates and flat tax predictions using the Hungarian tax changes in 2005. *MNB Working Papers (Central Bank of Hungary)*, 7, 2008.

[25] C.F. Baum, M.E. Schaffer, and S. Stillman. Instrumental variables and GMM: Estimation and testing. *The Stata Journal*, 3(1):1–31., 2003.

[26] C.F. Baum, M.E. Schaffer, and S. Stillman. Enhanced routines for instrumental variables/generalized method of moments estimation and testing. *The Stata Journal*, 7(4):465–506., 2007.

[27] P. Benczúr, G. Kátay, and Á. Kiss. Assessing changes of the Hungarian tax and transfer system: A general-equilibrium microsimulation approach. *MNB Working Papers (Central Bank of Hungary)*, 7, 2012.

[28] P. Benczúr, Á. Kiss, and P. Mosberger. The elasticity of taxable income. In K. Fazekas, P. Benczúr, and Á. Telegdy, editors, *The Hungarian Labour Market*, pages 77–99. Hungarian Academy of Science, Budapest, 2013.

[29] S. Blomquist and H. Selin. Hourly wage rate and taxable labor income responsiveness to changes in marginal tax rates. *Journal of Public Economics*, 94:878–889., 2010.

[30] R. Chetty. Is the taxable income elasticity sufficient to calculate deadweight loss? The implications of evasion and avoidance. *American Economic Journal: Economic Policy*, 1(2):31–52., 2009.

[31] M. Feldstein. The effect of marginal tax rates on taxable income: A panel study of the 1986 tax reform act. *Journal of Political Economy*, 103(3):674–680, 1995.

[32] S.H. Giertz. Recent literature on taxable-income elasticities. *Congressional Budget Office Technical Paper Series*, 2004.

[33] A. Goolsbee. What happens when you tax the rich? Evidence from executive compensation. *Journal of Political Economy*, 108(2):352–378., 2000.

[34] P. Gottfried and D. Witczak. The responses of taxable income induced by tax cuts: Empirical evidence from the German taxpayer panel. *IAW Discussion Papers*, 57, 2009.

[35] J. Gruber and E. Saez. The elasticity of taxable income: Evidence and implications. *Journal of Public Economics*, 84:1–32., 2002.

[36] A. Hansson. Taxpayers' responsiveness to tax rate changes and implications for the cost of taxation in Sweden. *International Tax and Public Finance*, 14(5):563–582., 2007.

[37] B. Holmlund and M. Söderström. Estimating income responses to tax changes: A dynamic panel data approach. *CESifo Working Paper*, 2121, 2007.

[38] Á. Kiss and P. Mosberger. The elasticity of taxable income of high earners: Evidence from Hungary. *MNB Working Papers (Central Bank of Hungary)*, 11, 2011.

[39] H. J. Kleven. Bunching. *Annual Review of Economics*, 8, 2016.

[40] H.J. Kleven and E.A. Schultz. Estimating taxable income responses using Danish tax reforms. *American Economic Journal: Economic Policy*, 6(4), 2014.

[41] M. Ljunge and K. Ragan. Who responded to the tax reform of the century? Paper presented at the EEA Congress in Madrid., 2004.

[42] C. Meghir and D. Phillips. Labour supply and taxes. *IZA DP Working Paper*, 3405, 2008.

[43] J. Pirttilä and H. Selin. Income shifting within a dual income tax system: Evidence from the Finnish tax reform of 1993. *Scandinavian Journal of Economics*, 113(1):120–144., 2011.

[44] E. Saez, J.B. Slemrod, and S.H. Giertz. The elasticity of taxable income with respect to marginal tax rates: A critical review. *NBER Working Paper No. 15012*, 2009.

[45] E. Saez and M.R Veall. The evolution of high incomes in Northern America: Lessons from Canadian evidence. *American Economic Review*, 95(3):831–849., 2005.

[46] A. Semjén, I. J. Tóth, M. Medgyesi, and Á. Czibik. Adócsalás és korrupció - lakossági érintettség és elfogadottság, (Tax evasion and corruption: Population involvement and accepetance). In *Rejtett Gazdaság, (Hidden Economy)*. MTA Közgazdaságtudományi Intézet, 2009.

[47] M.-A. Sillamaa and M.R. Veall. The effect of marginal tax rates in taxable income: A panel study of the 1988 tax flattening in Canada. *Journal of Public Economics*, 80:341–365., 2001.

[48] J. Slemrod. Methodological issues in measuring and interpreting taxable income elasticities. *National Tax Journal*, 51(4):773–788., 1998.

[49] J. Slemrod and W. Kopczuk. The optimal elasticity of taxable income. *Journal of Public Economics*, 84:91–112., 2002.

10.14754/CEU.2016.02

Chapter 3

3 Top Income Shares in Hungary: Capital and Labor (1914-2008) [1]

jointly written with Dimitris Mavridis

3.1 Introduction

What drives income inequality? Income disparities have long been a focal topic in economics. Beyond documenting the evolution of inequality by constructing homogeneous long run time series, one of the most interesting and substantial questions concerns the main mechanisms that generate income disparities. Perhaps surprisingly, to date little attention has been paid to a large scale institutional experiment that could provide stronger causal inference on the effect of institutional and market forces on top income shares. The planned economy period in Central-Eastern European countries could offer such an "exogenous shock" setting.

According to one strand of the literature the recent surge in top income shares are governed by skill biased technological changes and globalization favoring top earners (see Acemoglu (2002), Goldin and Katz (2008), Kaplan and Rauh (2013)). Another strand of the literature highlights several other explanations including tax policy changes, modified labor and financial market regulations, more lenient social norms towards earning differences, and increased bargaining power of high earners (see Piketty et. al (2014), Piketty and Saez (2006)). Other studies have looked at the effects of growth, financial development and banking shocks on top income shares (see Morelli (2012), Roine et al (2009)). Recently there has been much attention to the role of capital behind the increment in top shares (Piketty (2014)). The evolution of several top income series suggest that institutional and market forces may have played an important role behind their changes.

In this paper we construct the first top income share series of a Central-Eastern European country in order to exploit the "exogenous shock" of the planned economy and its equality by design to analyse

[1]Mavridis: University of Luxembourg, dimitrios.mavridis@uni.lu. Mosberger: Central European University and Hungarian Central Bank, mosbergerpalma@gmail.com. We are thankful for comments and suggestions from Facundo Alvaredo, Tony Atkinson, Zsuzsa Ferge, László Katus, Christos Koulovatianos, Botond Kőszegi, Róbert Lieli, Rajnish Mehra, Salvatore Morelli, Emmanuel Saez and Gabriel Zucman, and seminar participants in Southampton, Luxembourg, and the London School of Economics. We are also indebted for help with data collection to Balázs Farkas, Ákos Lencsés, Katalin Molnárné Brinzik, Péter Őri, Dávid Rózsa and Zsuzsanna Szőkéné Boros (Central Statistical Office), Róbert Gál and Lili Vargha (Tárki), Katalin Demény (National Tax Authorities), Csilla Klettner (Hungarian Central Archives), Ilona Kovács (Hungarian Academy of Sciences), Lajos Papp (TEIR). Mosberger gratefully acknowledges financial support from INET-EMod during her visit at Oxford and from the Rosztóczy Foundation during her visit at UC Berkeley. All opinions expressed in this paper are those of the authors and do not necessarily represent the views of their past or present institutions. Any remaining error is ours.

mechanisms that generate income disparities. Within this setup we study the effect of capital income and liberalized wage settings on the top income shares. Beside this question we also look into how both the incidence of state socialism, and the post-socialist transition have shaped the income distribution at the very top, as well as how quickly and through what mechanisms the shares returned back to Western-European levels after the transition into the market economy. The control periods are the decades before and after the communist period, when market forces determined both capital and labor incomes. The treatment period of the planned economy provides a source of variation that is exogenous to the level of top income shares, or any special characteristics of the country.

Comparing different time periods of one single country is more likely to reduce the effect of variables other than the ones of interest on the outcome variable, that is the top income shares. But obviously these are not the only sources of difference between the control and treatment periods, as the political regimes and reigning ideology were also different. In this study we do not look at other possible effects of communism on top shares such as shortage of goods, price settings and selected access to education.

During the studied period the Hungarian top income share series follow a U-shape. During the first decades of our time frame the top shares were as high as in Western countries (USA, UK, France) and came from large capital structures, as well as land and real-estate. A downward trend in the top income shares started after World War II in most Western countries, while the Hungarian shares decreased twice as much, and remained constantly low during the four decades of state socialism. After the transition to a market economy we can observe a rapid top income share adjustment; in less than a decade they increased to levels prevalent in western countries. This increase is due to a surge both in capital and labor income factors.

With the exogenous shock we can study the effects of market forces on the top income shares, i.e. the effect of decentralized capital ownership and liberalized wage settings. After the transition to the market economy, the shift from a single capital owner (the State) to multiple ones was completed, markets for capital started to operate and investment opportunities emerged. The remuneration proportion of capital in the total gross income substantially increased, from which the top of the income distribution benefitted the most. We find that in just two decades the significance of capital income component at the very top of the distribution became supreme, reaching comparable levels even to the USA, a country with high capital income concentration.

Furthermore, we find that wage-setting decentralization favoring the remuneration of skills also played a role in the increase of the top income shares. The comovement between the skill premium and top shares series is apparent; during most of the planned economy both series had a negative overall downward trend with a jump in 1970, exactly when for a short reform period the strict wage settings were relaxed and delegated to enterprises. The upward trend in the skill premium from the

mid-80's happened parallel with the delegation of executive wage and bonus setting to enterprise level. This policy shift, that marked a first step to complete liberalization of the labor market, was followed by an increase in the top shares also. After the transition to the market economy both series continued to increase.

These estimates suggest that both capital income (via the allocation of capital holdings from the state to private owners and securing property rights), and labor income (via wage-setting decentralization favoring the remuneration of skills) played a significant role in increasing income inequality during market economies.

The structure of the paper is as follows. In section 1 we briefly summarize the data and methodology we used for the top income share estimates, in section 2 we present the top income series, and conclude with describing the mechanism leading to increased income disparities in section 3.

3.2 Data and Methodology

This section describes the three essential data ingredients for the construction of the income share estimates: the income statistics, the population control total and the income control total, as well as the measurement methodology.

3.2.1 Income and earning statistics

We assemble primary data from historical statistics and administrative sources. We use the tax system and its generated income tax statistics as a measurement instrument for the upper tail of the income distribution for the periods prior to the Second World War, and after the transition to a market economy. We use the available earning censuses in the socialized sector for the period of the People's Republic of Hungary up till the transition to the Republic of Hungary, a period that we will refer to as the planned economy period.

The first comprehensive, progressive general personal income tax in the Hungarian Kingdom came into effect from 1914 with a very high income reporting threshold of 20,000 korona.[2] The tax statistics depict the number of taxpayers and their total income by income ranges. Detailed income categories by income ranges are also reported, such as income from land, built property and real estate, business activity (crafts, industrial and trade income). The share of profits accruing to management (tantième income), wages and salaries, income from liberal professions such as doctors, lawyers and other liberal professionals are also reported separately. Capital income includes interest from annuities, royalties, savings, securities, dividends. The reported income concept is defined as total income net of expenses, depreciation, and maintenance cost. We use this income definition for computing the top shares.

Apart from the reduced reporting threshold and higher tax rates, the basic concept of this general

[2] A prime minister that time earned 24.000 korona, while a worker on average earned 800.

income tax did not change till the suspension of the market economy. We use the available income statistics tables for the period of 1914-15 and 1927-40 to estimate the top income shares. For 1914-15 the figures document total declared income and tax levied on tax units across the sixty-four provinces of Hungary, and the eight provinces of the autonomous Kingdom of Croatia-Slavonia along with the port of Fiume and its suburbs, which together constitute a region that fell under the jurisdiction of the Hungarian Kingdom at the time. For the interwar years the tax statistics cover the area of Hungary after the Treaty of Trianon after World War I. We use the population and income controls accordingly. Detailed description of the tax system and the adjustment of the tax tables are described in Appendix C.2.2 and C.2.3. The sources of tabulated income statistics are listed in Table C.4, and the tax rates in Figure C.1 in the Appendix.

For the planned economy we use the tables reporting the distribution of earnings series found in the Statistical Yearbooks for the period 1951-68, and published subsequently up to 1988 by the Central Statistical Office (KSH). The frequency of the earnings statistics is irregular, with the earliest available table referring to 1951. For the period 1955-62 the censuses were collected yearly, while from 1962 onwards they were published every two years. The statistics depict the distribution of gross monthly earnings, including bonuses, allowances, in-kind benefits, and benefits from profit sharing. The income concept is gross earnings before deduction of the employee social security contributions for the entire period of 1951-86, and for 1988 also before the deduction of taxes levied under the newly introduced personal income tax.[3] (See data description in Appendix C.3.1, C.3.2, and data sources in Table C.5.)

The statistics depict the share of employees in the official sector belonging to specific gross earning brackets based on the employment censuses of state-owned enterprises conducted by the State. For the period 1951-68 earnings statistics refer to workers employed at state-owned enterprises and state-owned farm establishments of the State Sector, and at state-owned enterprises, state-owned farms, and at cooperatives in the broader Socialist sector for the rest of the time frame. In order to establish comparability for the entire time frame of the planned economy, we explicitly assume that the distribution of earnings in the Socialist Sector at the top coincides with the distribution of earnings at the State Sector. Supporting evidence for this choice is provided by statistics tables published by the KSH on average earnings of employees with specific university degrees employed either at the state or the cooperative sectors at the year of 1963 and 1967 showing similar earning amounts (Appendix Table C.13 and Table C.14).

The present income tax code was introduced in 1987 and was modified after the transition by Act XC of 1991. The declared total income comprises two categories: "comprehensive income" and "separately taxed income". The comprehensive category contains three main income subcategories: 1)

[3]To estimate comparable shares we add to the constructed income denominator the total personal income tax amount collected by the government in 1988. See 1989. XXIV.1§.

income from dependent activity, mainly wages and salaries; 2) income from independent activity such as self-employment, liberal profession, or small-scale agricultural activities; and 3) other income such as income earned abroad and tax-exempt income (pensions, scholarships, and maternity benefits). The comprehensive income was taxed progressively during the studied time frame till 2008.[4] The separately taxed income is formed as a schedular tax on capital income items, with different flat tax rates applied to separate categories of capital income, such as dividends, capital gains, and profit from private businesses.

We use administrative micro data and tabulated administrative income tax statistics for this period to estimate the top income shares. For both sources, the income concept is gross income before deductions, employee's payroll and personal income taxes, but after employers' payroll taxes. Based on the detailed micro data we estimate the top shares both excluding and including realized capital gains for the period of 1992-2008. The total income denominator of the latter series includes all realized capital gains. Detailed description of the tax system and data sources are in Appendix C.2.4. The sources of tabulated income statistics are listed in Table C.4, and the tax rates in Figure C.2, C.3 and C.4 in the Appendix.

3.2.2 Population control total

To estimate the top shares we need to construct population and income denominators to be able to compare to these the tabulated income tax statistics described in the previous subsection. Tax statistics during the period prior to the Second World War report aggregated income of the extended family dwelling under the same living quarters. The tax unit consists of either a single individual or a couple with dependent persons, with the head of the family being the major income earner. Dependent persons are considered those related to the head of the family by blood or marriage (grandparents, children, grandchildren, in-laws), provided that they are economically dependent on the head of the family. We approximate the number of households as the total number of population above the age of 15 minus the number of married women at province level reported in decennial censuses. [5] We adjust the data for territory change as a consequence of the treaties after World War I. For the interwar period, we obtain an estimate by linearly interpolating the appropriate figures from the censuses of

[4] A flat tax was introduced in 2011, and the overall statutory tax rate was gradually decreased from 20,32% (16% on the so called supergross tax base that is the tax base inflated by 27%) to 15% since the introduction.

[5] As pointed out by Atkinson (2007) the estimated share changes when moving from joint taxation to individual taxation depending on the assumption of the joint distribution of income between couples. Considering the two extreme assumptions we can calculate the correction factors for the top shares. If all high income individuals are unmarried or have partners with zero income, then moving from joint to individual taxation would raise the shares as the top X% will include more observations, hence also a larger total income. If all high income couples have equal incomes, then moving to individual taxation would reduce the shares as the same amount of income is received by a larger share of the population. In the first case the shares would be raised by a factor of $(1+m)^{1-\frac{1}{\alpha}}$. while in the second case they would be reduced by a factor of $(2/(1+m))^{1-\frac{1}{\alpha}}$, where m is the number of individuals exceeding the tax units and α is the Pareto parameter. For example, the share of top 0.1 in 1940 is 5.6, then with $m = 0.42$, $\alpha = 2.2$, the upper and lower bounds are 4.7 and 6.8.

1920, 1930, 1940, and 1949 covering the Trianon borders of the country.

For the period of the planned economy and the period after the transition we estimate a population total that consists of the total population above the age of 15. See Table C.6 for sources, and Appendix C.4 for detailed description of data and its adjustments.

3.2.3 Personal income control total

To construct an income denominator, first we assemble a GDP series during the period of study denominated in current prices. We also compute personal income totals for the years when these statistics are available. For the years when these statistics are not available, we proxy the total personal income by assuming it is the same fraction of the GDP as in the neighboring years.

For the beginning of our time frame we use the income total series reported in Schulze (2005) that consist of estimates of the gross domestic product in the 64 provinces of the Hungarian part of Austria-Hungary, Fiume, and the provinces of Croatia-Slavonia, consistently with the income statistics tables. For the interwar period we use the output figures in Eckstein (1955) corresponding to the post-World War I Trianon treaty territory of the country.[6]

For the first decade of the planned economy only Net Material Product series are published by KSH, an accounting concept that does not include the contribution of "unproductive" services to national income. We correct this series by using the average fraction of the official GDP and NMP series between 1961-88, and apply it to the period 1950-60 (1.23%). For the period of 1961-1990 we use the official GDP data published by KSH under the modern SNA definition. From 1991 up to today, we use the official Eurostat GDP index.

To proxy the individual income control total for the first decades of our time frame we use the 73% of our GDP series as a proxy for the personal income. We get this average ratio based on Matolcsy and Varga's (1936) total individual household income series available only for the period of 1925-35 and our GDP figures. For the planned economy period we compute a personal income total defined as the sum of labor income, social security contributions (including pension, unemployment benefits, family allowances, maternity benefit, scholarship grants, other social benefits) and an amount of capital income (such as lottery, interest, insurance) in the national income accounts data calculated by the Central Statistical Office. For the 1991-2010 period we use national income accounts data calculated by the Central Statistical Office. Our constructed personal income total contains wages and salaries, mixed income, property income including net interest, dividend, property income attributed to insurance

[6]Eckstein computes net national product at factor cost. To get an output measure in market prices we inflate the figures by 5% based on the estimate of indirect tax amount in the year of 1935 in Matolcsy (1938). We further inflate this estimate with an estimate of capital depreciation of 5% to obtain the gross national product figures. An implicit assumption in producing the estimate is that the installed capital base, albeit expanding, was relatively modest compared to the European West. Moreover, the difference between GNP and GDP is not large in countries with small capital flows with foreign countries, and this is the case for Hungary in this period as documented by Tomka (2001).

policy holders, rental income, state social contribution (pension, sickness pay, unemployment benefits, family allowances, maternity benefit), scholarships and grants. We also include the total realized capital gain amount reported at the Tax Authorities summary tables containing items corresponding to the actual tax code. See Table C.2 and Table C.3 for sources, Appendix C.6 for detailed description of data and its adjustments.

We assemble data from several published series in order to construct a CPI that honors a currency unit's worth from 1913 to today, given that historical statistics on CPI indices for Hungary are rare and often incomplete. See Table C.1 for sources, and Appendix C.5 for a detailed description of data.

3.2.4 Pareto estimation

To estimate the exact top shares from raw data tables we approximate the top tail of the income distribution by a Pareto distribution. We follow the methodology described in Atkinson(2007), and Piketty-Saez(2003). According to the Pareto distribution the cumulative share of people with income above a given threshold yi is:

$$1 - F_i(y) = \left(\frac{c}{y_i}\right)^a$$

where a is the Pareto parameter, and c is the scale parameter. Assuming constant Pareto parameter in two neighboring brackets and loglinearizing the equation we can back out the a parameter:

$$a = log(p_i/p_{i+1})/log\,(s_{i+1}/s_i)$$

where si is the income threshold of the bracket and pi is the cumulative share of people with income above this threshold. Then

$$c = s_i * p_i^{1/a}$$

Finally, given the values of a and c parameters we can calculate the exact income threshold and income share for any top population share in the neighborhood of the two brackets.

3.3 Top Income Shares

This section analyzes the evolution of the Hungarian top income shares for the period between 1914 and 2008, and also provides historical background to put into context the evolvement of the shares. The Hungarian top income share series follows a U-shape with shares as high as in Western countries (USA, UK, France) during the first decades of our time frame (see Figure 3.3). A downward trend in the top income shares started after World War II in most Western countries, meanwhile the Hungarian shares decreased twice as much compared to them, and remained constantly low during the four decades of state socialism. The estimated shares immediately after the transition into the market

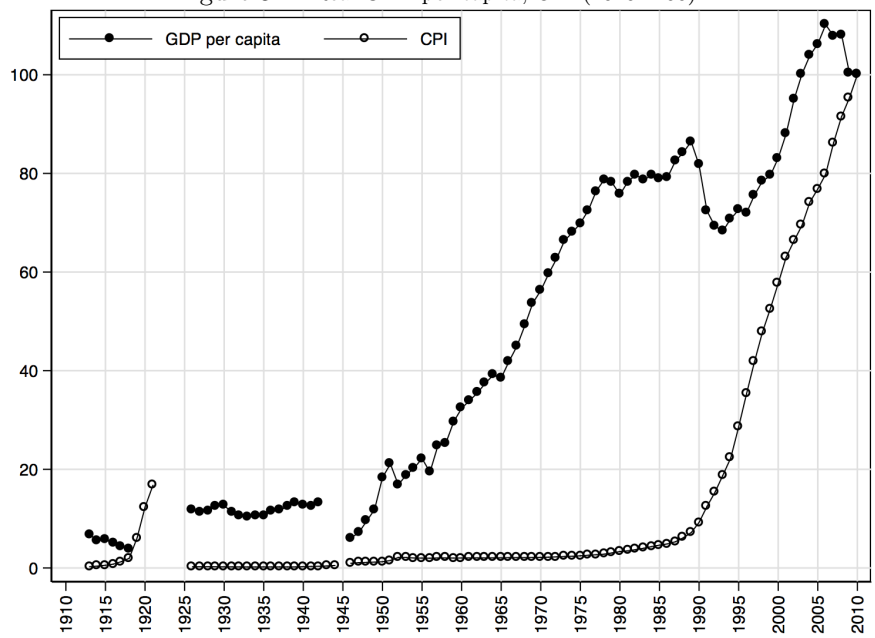
economy jumped and showed an increasing trend reaching the level of several western countries in only two decades. Income from both capital and labor were larger among top income people during the market economy periods producing larger top shares. We can also observe a rapid top shares adjustment; in less than a decade they increased to levels prevalent at western countries after the transition. This "natural experiment" episode suggests that both capital income via the allocation of capital holdings from the state to private owners and securing property rights, and labor income via wage-setting decentralization favoring the remuneration of skills played, a significant role at increasing income inequality. One has to keep in mind when comparing the top shares between the different periods that even though we construct denominators in a same way for the overall time frame to get homogeneous top estimate series, and provide evidence on that capital income was negligible during the planned economy, still the planned economy top shares are based on earning tables.

3.3.1 Economic overview

At the beginning of the 20th century the Hungarian Monarchy was still mainly an agricultural economy with nearly half of its production originating from farming; but the industrialization process slowly started to take place and its GDP per capita started to catch up, reaching nearly 60% of Western countries. During the 1914-49 period the two world wars and the financial crises halted economic growth; these fallbacks were reversed by strong recovery periods resulting in similar growth patterns than in the developed European countries. After the Second World War the market economy was quickly converted into a command economy between 1947 and 1953 by drastic collectivization of agriculture, forced improvement of heavy industry, and nationalization of the industrial companies and banks. The Soviet economic model included the promotion of heavy industry, but it could not generate long-term growth, as the possibility of increasing the labor force without limits was not possible, nor was the technological development sufficient. Through the four decades of planned economy the lag between Hungary and Western Europe got ever larger. During the turbulent years of the transition into the market economy the per capita output decreased drastically, while for recent years including the financial crises years it was around 1,8% (1992-2010).[7] Figure 3.1 presents the evolution of per capita GDP and CPI index since the beginning of the 20th century.

[7]See: I. T. Berend, G. Ránki (1974), p. 15, A. Eckstein (1955), p. 165, T. Erdős (1982), p. 277, B. Tomka (2010), pp 31-38. GDP comparison figures are based on Tomka's calculation, who compares the Hungarian per capita GDP to an average per capita GDP of 13 Western European countries (UK, France, Netherlands, Belgium, Ireland, Germany, Austria, Switzerland, Sweden, Denmark, Norway, Finland, Italy) for the period of 1890-2005.

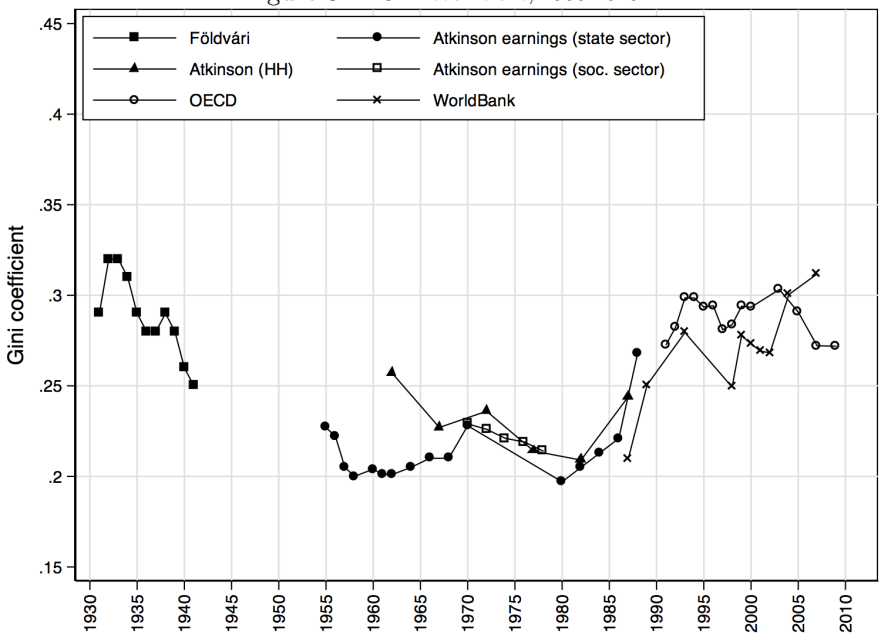
Figure 3.1: Real GDP per capita, CPI (2010=100)



Note: Hyperinflations are excluded from the graph. See Table C.15 for 1922-1925 CPI values.

Source: Table C.1, Table C.2, Table C.15 and Table C.16.

Figure 3.2: Gini coefficient, 1930-2010



Source: 1928-1941: Földvári(2010) computes Gini estimates based on official income tax statistics, and by assuming Pareto distribution. 1951-1988: Atkinson-Micklewright(1992) calculates Gini coefficients based on per capita household income (HH), and employee earnings both at the state and socialist sectors. 1987-2009: OECD publishes per capita Gini series based on the Tárki Household Monitor survey. 1987-2007: WorldBank publishes Gini series based on the household surveys of the Hungarian Statistical Office. The unit of analyses is all workers at the state or socialist sectors for the series based on the employee earning censuses, and per capita household income for all other series.

The evolvement of the overall inequality during the time frame of the paper is displayed in Figure

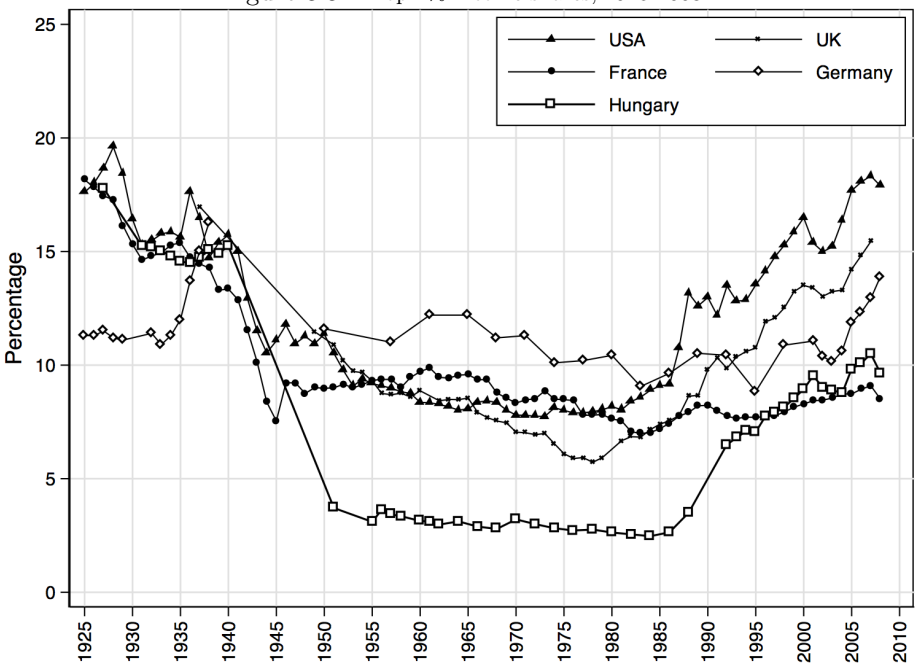
3.2. Since the Gini series for the interwar period were not computed the same way, the levels are not comparable; but it is still meaningful to see how the series evolved during this period. We can see increasing inequality during the great depression and the financial crises at the beginning of the 1930's. The overall inequality was much lower during the planned economy with a hump in 1970 after the New Economic Mechanism was introduced, and the transition into the market economy was followed by a significant expansion in inequality. The Gini series documents high inequality for the market economies, and lower for the period of planned economy, which are in line with our the top income share estimates described in the next subsections.

3.3.2 Comparison with other countries

How high were the top income shares at the beginning of the last century compared to Western European countries? How far did state socialism manage to compress the income distribution compared to these countries? And how quickly did the shares adjust after the transition into the market economy? We address these questions by comparing the Hungarian top shares to the evolution of the US and other Western European countries top shares in Figure 3.3 below. As can be seen, the interwar Hungarian top income shares were as high as the shares in western countries. This indicates that, in the absence of communist rule, it is probable that inequality at the top would have evolved similarly to these other western countries. After the Second World War most countries experienced a drop in their top shares; however the Hungarian shares decreased twice as much and continued to be at low level during the four decades of state socialism. It is also apparent that immediately after the transition to the market economy, the Hungarian top income shares rapidly adjusted, and only in 5 years the top 1 percent income concentration reached the French level, and then even continued to increase.

This is an unexpectedly rapid catch-up in income concentration at the top of the income distribution. What could have been the driving factors behind the fast adjustment? On the one hand, the income concentration in capital was growing rapidly after 1990; for example among the top 1 percent the capital income fraction was on average 15 percent already in 1992, and 20 percent in 1995. The high level of capital income fraction suggests that savings and investment were not the main source of capital accumulation. Instead, the transition of state wealth into private wealth likely drove the increase in income concentration in that period. On the other hand, we also see large increases in the income concentration in labor income suggesting that wage-setting decentralization favoring the remuneration of skills also play a role in the increase of the top income shares.

Figure 3.3: Top 1% income shares, 1925-2008



Note: The shares are reported without realized capital gains, with total income denominators excluding realized capital gains.
Source: World Top Income Database, and Table C.17.

Alvaredo et al (2013) highlight two trends in the long run top income shares: the English speaking countries following a U-shape, and the continental European countries and Japan displaying an L-shape. The recent Hungarian top income shares show an increasing trend similar to the U-shaped countries, but the level of the shares is similar to the L-shaped countries. In the next subsections we investigate in detail the shares in the three periods of the study, namely the first decades of the 20th century, the planned economy and the market economy after the transition.

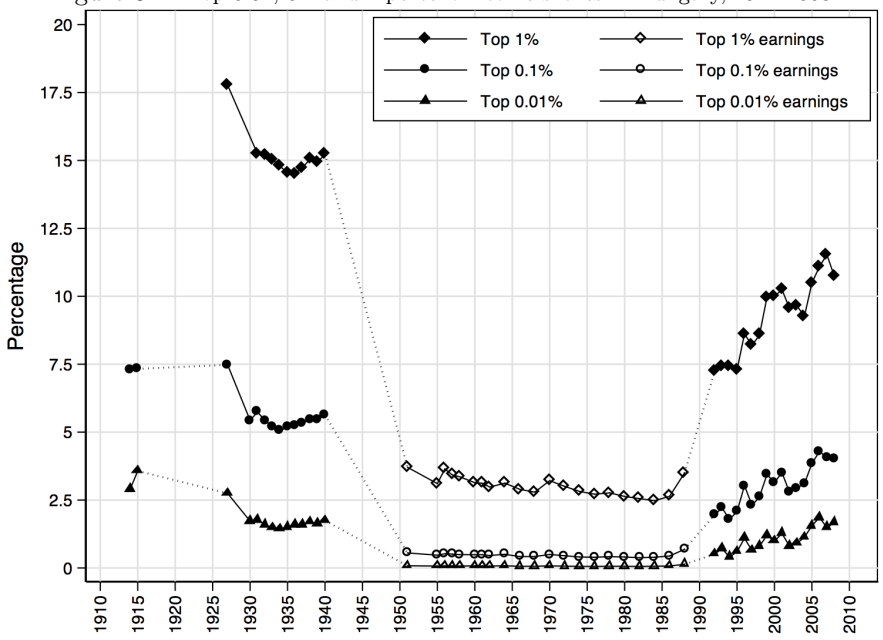
3.3.3 First decades of the 20th century (1914-1915, and 1927-1940)

The Western-level high interwar top income share estimates are in line with other studies finding very high income inequality in Hungary. Agrarian Hungary had a very disproportionate income distribution, mainly with three distinct society groups: the bottom 80 percent included servants, agricultural and factory workers with below average income; the less than 20 percent middle class included mainly privately employed administrative employees, civil servants, technical intelligentsia (engineers), doctors, teachers with much higher than average income; and the high income people, and wealth holders belonged to the very top of the distribution with sometimes 20-40 times higher than average income.[8] An early inequality study by Matolcsy(1938) finds a Lorenz curve similar to the high inequality Germany and USA in 1930.[9]

[8]Land ownership was especially screwed with 0.2 percent of landowners possessing more than 30 percent of all agricultural land area.
[9]See: Matolcsy (1938), p. 5, Ö. Éltető – Gy. Láng(1971), pp. 303-324, Berend-Ránki (1974), p. 127, Table 21

The evolution of the top income shares is depicted in Figure 3.4. At the beginning of the first part of the 20th century the top 1% is estimated to be in excess of 15 percent, while the top 0.1% in some years even reached 7.5 percent, which are in line with top share estimates at the Western countries that time. The top shares display an overall decreasing trend during this period, while Hungary underwent the First World War, hyperinflation, the Great Depression and a banking crises. We do not have direct evidence of the effect of the First World War as the first available income statistics after the war are from 1927. The 1927 estimate show similar level with the pre-war shares. During the interwar period the Hungarian economy was not only distressed by the 1929 Great Depression, but the situation worsened when it was also hit by the banking and credit crises starting in the summer of 1931 with the insolvency of the Viennese Credit-Anstalt that had a vast interest in Hungary also.[10]

Figure 3.4: Top 0.01, 0.1 and 1 percent income shares in Hungary, 1914-2008



Note: Percentage of total income received by each of the top groups. Income is defined before taxes and excludes capital gains for 1914-1940, and includes capital gains for 1992-2008. For 1951-1988 income is based on earning tables. For 1914-1988 the fractiles are defined by total income excluding realized capital gains, and for 1992-2008 including realized capital gains also. (For details see Appendix section C.2, C.3 and C.6.)

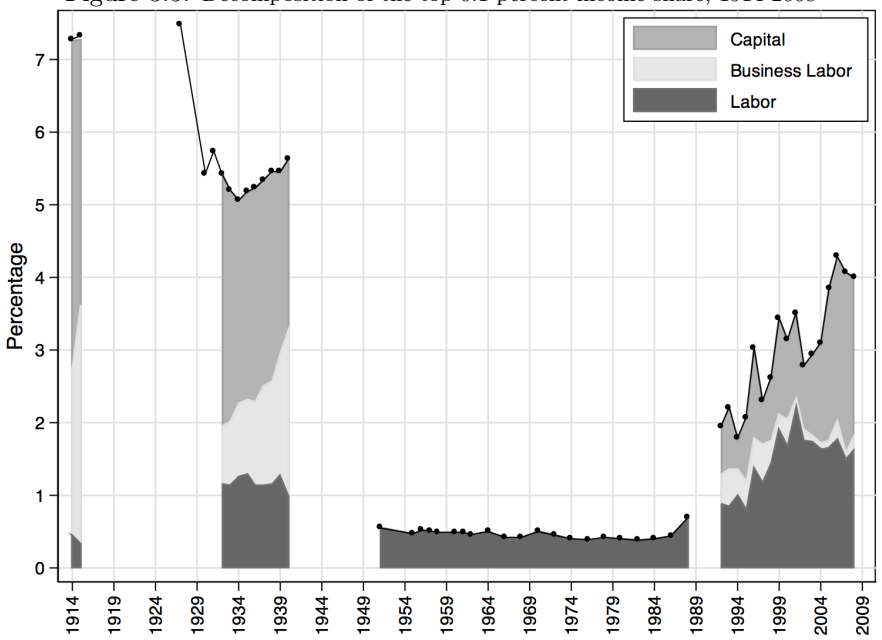
Source: Table C.17

Banking crises are mostly followed by shocks at the stock and property markets, liquidity shortage, economic recessions and high unemployment rate. Usually the former hurt the top shares more severely, especially in times when mostly people at the very top owned capital and had access to the stock market; and the latter hurting the bottom of the distribution more.[11] The change in the top shares depends on the relative decline in the different parts of the distribution. Bordo and Meissner(2011) finds that during the interwar years in most countries the top of the distribution was hit more severely leading

[10] Berend-Ránki (1974), pp. 111-113, M. Fior (2008), pp. 109,138
[11] S. Morelli (2012), p. 5

to contracting top shares. Our estimates show the same trend with a 17 and 33 percent decrease in the 1% and 0.1% shares between 1927 and 1934, respectively.

Figure 3.5: Decomposition of the top 0.1 percent income share, 1914-2008



Note: Capital: income from capital assets, land and buildings, for 1992-2008 also realized capital gains are included. Labor: wages and salaries and other employment income. Business: mixed income. In 1914 the decomposition of top 0.1 income share is assumed to be the same as the decomposition of top 0.14, and in 1915 as the top 0.2 (see Appendix C.2.2). See Table C.12 for detailed income categories.

Source: Table C.21

The income decomposition of the top shares is shown in Figure 3.5 for the years when income source figures are also reported at the official statistics. The series shows that during the first decades of the last century more than half of the income accrued from capital holdings for income earners at the top 0.1 percent. The figure displays that both capital and business income were hit severely in the crises period as they contracted by the beginning of 1930's compared to 1915.[12] It can also be seen on the graph that employment income became a significant part of the top shares, increasing 3-4 times higher in less than two decades, suggesting structural changes in the elite of the society. Similarly to the western parts of Europe the Hungarian top shares started to recover only after the mid 1930's.[13] The source of recovery in the top shares were mainly generated by an increase in the business income as depicted in Figure 3.5. This coincided with the recovery of the economy driven by some specific industrial sectors such as electrical production, chemical, pharmaceutical, textile, paper and canned food industry. Though mass production was not prevalent, and the industrial development of Hungary was lagging behind most European countries, slowly the dominance of the agricultural and

[12]Berend-Ránki (1974, pp. 147-148) reports 4500 million pengő saving bank deposits before World War I, and only 752 million pengő after the financial crises.

[13]Source: World Top Income Database

food industries finally started to fade away.[14]

3.3.4 Planned economy (1951-1988)

After World War II the market economy was quickly converted into a command economy by forced collectivization of agriculture, nationalization of the industrial companies and banks. Private property and especially capital were eliminated.[15] Income tax statistics were not prepared during this period, however comprehensive earning census tables are available covering all enterprise employees.[16] Mostly enterprise managers were at the very top of the earning distribution. The earning differentials between enterprise managers and blue-collar workers were primarily created by bonuses, allowances, and benefits from profit sharing funds that are also included in the census data. We estimate the income shares based on the earning tables as income was essentially composed of labor income since production profit accrued to the ultimate capital owner. The state reserved the right to manage all productive assets and extract profit from them. Moreover households had limited capacity to own real or financial assets, property rights were not secured and investment possibilities were lacking.

Households' financial asset portfolios were very simple containing cash, and deposits, savings, loans and mortgages at the National Savings Bank (*OTP*) or at the Saving Cooperatives (*Takarékszövetkezet*). The standardized products, conditions and interest rates were all centrally regulated. A practically unchanged nominal interest rate with high inflation resulted in negative real interest rates for several years. Moreover the prospect of a deposit confiscation by the state was always a possibility. Owner occupied housing stock was the most important real asset. But neither rental income, nor capital gain were part of the household income as both the rental and secondary property markets were practically non-existent.[17] Based on this supporting evidence, it seems convincing that the earning census table estimation is a good proxy for the top income shares. Notwithstanding, we provide an upper bound estimation on possible capital income as a robustness check, that confirms capital income was negligible among the top 1% compared to the era before and after the planned economy (see Appendix C.3.2 and Figure C.9 in the Appendix).

Even though we construct the personal income denominator and the population control total in a same way in order to get homogenous top estimate series for the planned and the market economy periods, one still has to keep in mind the following caveats when comparing the top shares during

[14] Berend-Ránki (1974), pp. 116, 122, 134-144, 167

[15] Berend (1990), pp. 2-14

[16] For 1951-1968 earnings statistics refer to state-owned enterprises and state-owned farm establishments of the State Sector, and state-owned enterprises and state-owned agricultural and non-agricultural cooperatives in the broader Socialist sector for the rest of the time frame. We explicitly assume that the distribution of earnings in the Socialist Sector at the top coincides with the distribution of earnings at the State Sector. Supporting evidence is provided by statistics tables published by the KSH on average earnings of employees with specific university degrees employed either at the state or the cooperative sectors at the year of 1963 and 1967 showing similar earnings amounts (Table C.13, Table C.14). See detailed data description in Appendix C.3.1

[17] Ábel, Székely (1992), pp. 2-3, 8-10, 23

different eras. First, in contrast to the free price settings during the market economy, prices were regulated during the four decades of planned economy era. The overall direct price determination by authorities was abandoned with the introduction of the New Economic Mechanism, and replaced by a mixed-price setting mechanism. This included the so called "free" prices set by enterprises – though controlled by the state via a set of regulations – and the still existing centrally regulated official prices. These price regulation instruments included profit-margin restrictions, temporary "price stops", laws of "unfair prices", informal instructions and direct price regulations at least one stage of the production process.[18] Second, the shortage of goods was a prevalent phenomenon during the planned economy; moreover it affected the diverse segments of the society unevenly: "Everything is available, just not always, not everywhere and not to everyone."[19] The situation was further distorted by the special foreign currency shops open only to the political elite.

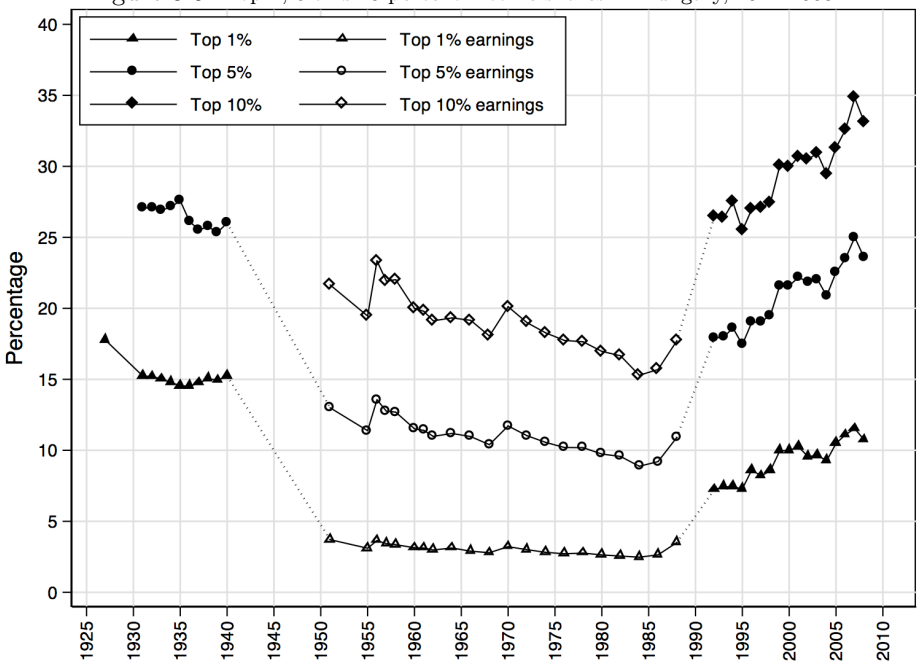
During the planned economy political and ideological concepts favored a more compressed income distribution than what prevailed in other market economies. From Figure 3.6 we can see how far the system managed to compress the distribution of income by comparing the top shares during this era to the shares during the market economy decades before and after the planned economy. Beside the significant difference in the level of top shares immediately after the beginning of the new economic regime, there is an overall decreasing trend afterward. The reason behind the downward trend in the top shares is that the total income denominator is growing faster than the income accruing to the top shares.[20] The two distinct jumps in 1957 and 1970 are tightly connected to different reforms aimed to increase wage differentials of enterprise managers particularly via sharp differences in bonus payments to provide incentives resulting in higher productivity. The increasing trend from the mid-1980's also occurred after managerial wage and bonus setting were delegated to enterprise councils.[21] It is an interesting phenomenon that the top P90-95 and P95-99 series perfectly coincide during the era. Most likely it is a coincidence as it is not prevalent in the upper shares (see Figures C.10 and C.11 in Appendix).

How wage setting mechanism worked at the planned economy? Wage setting was a central component of the planned economy; different wage tables existed for blue and white-collar employees that based on ideological reasons decreased earning differentials between workers, intellectuals, administrative workers and managerial staff. However for short reform periods the strict wage settings were relaxed and delegated to enterprises in order to increase production efficiency.[22]

At the beginning of the era companies had no autonomy, production was planned centrally in every

[18]Swan (1990), pp. 248-251.
[19]Farkas, Pataki (1984), pp. 288-289.
[20]The population denominator is slightly growing during this period, that would ceteris paribus increase the top shares.
[21]Cukor (1990), p. 9, Héthy (1991) p. 1
[22]Boote, Somogyi(1991), p. 18, Éltető, Láng (1971), pp. 303-314

Figure 3.6: Top 1, 5 and 10 percent income shares in Hungary, 1914-2008



Note: Percentage of total income received by each of the top groups. Income is defined before taxes and excludes capital gains for 1914-1940, and includes capital gains for 1992-2008. For 1951-1988 income is based on earning tables. For 1914-1988 the fractiles are defined by total income excluding realized capital gains, and for 1992-2008 including realized capital gains also. (For details see Appendix section C.2, C.3 and C.6.)

Source: Table C.17

details, and market prices were set centrally without reflecting the demand and supply of the goods. With fixed prices, artificially low raw material and energy prices the managers were not incentivized to realize higher profits through lower production cost or more efficient production, as they received their bonuses if the centrally planned production target quantities were fulfilled at any cost. These mechanisms led to low investment in research and development, lower quality, overproduction of some specific stocks, and shortage of other goods; moreover actual production was far from the five-year plan targets. Due to the visible defaults and the manifested discontent with the system during the 1956 revolution, partial reform corrections were introduced. The reforms aimed to provide higher welfare, which was only possible via increasing economic efficiency. The planners tried to achieve these goals via allowing more autonomy to enterprises by reducing the number of centrally given commands; however the most crucial production indicators were still set centrally. Further changes concerned wage settings; instead of determining wages via the compulsory payroll figures it was regulated through wage allocation and average wage instructions, moreover enterprises received more freedom to set the allocation of bonuses.[23] Exactly after this partial reform the top income shares depicts a 12 percent increase in 1957 compared to 1955 displayed in Figure 3.6.[24]

[23] Berend(1990), pp 2-14, 75-78

[24] The increase already in the 1956 shares is more likely to be due to the drastic jump in the income denominator in the year of the 1956 revolution. While the increase from 1957 can not be due to a change in the denominator as real per capita GDP went back to its trend level immediately in the year following the revolution. See Figure 3.1.

As the system required further reforms the New Economic Mechanism (NEM) program was introduced in 1968 giving more autonomy to enterprises. Instead of detailed commands on the resources to be used and production targets, the State tried to provide further profit incentives to the plans to meet with the central plan. Although more freedom was allowed for wage settings, average wages were still centrally determined with upper and lower wage limits for specific occupations. Additionally, if the enterprise wage bill increase was above a certain level, then heavy taxation was imposed. As part of the reform the profit was not taxed away completely by the state, but part of it was channeled into the profit sharing funds to be distributed among the managers and employees. Income benefits from the profit share were maximazed as the 15, 50 and 80 percent of wages respectively for the workers, middle-level management and top management. Figures 3.4 and 3.6 respectively depict a 11-26 percentage increase in the very top shares, and a 5-7 percentage increase at the lower shares between 1966 and 1970 exactly after the introduction of the New Economic Mechanism (NEM).[25]

The NEM favored those with skills and expertise, while those untalented party rank and file at the state or managerial apparatus who felt that their power was in jeopardy were against and heavily criticized the new mechanism and the profit sharing incentives of the managers in order to defend the "values of socialism" and the workers' interest. Moreover blue-collar workers were also against the reform as they claimed it shifted the income distribution unfavorably for them. The elite wanted to get the support of the workers more than of the intelligentsia, so they started to decrease the earnings difference of skilled and unskilled workers especially after 1972, which seems to be a plausible reason behind the decrease in the top share after the jump in 1970.[26] The increase in the top shares from the mid-80's happened parallel with the delegation of executive wage and bonus setting to enterprise level. All in all, these findings suggest that when strict wage settings were relaxed and delegated to enterprises the top shares started to increase.

3.3.5 Transition to the market economy (1992-2008)

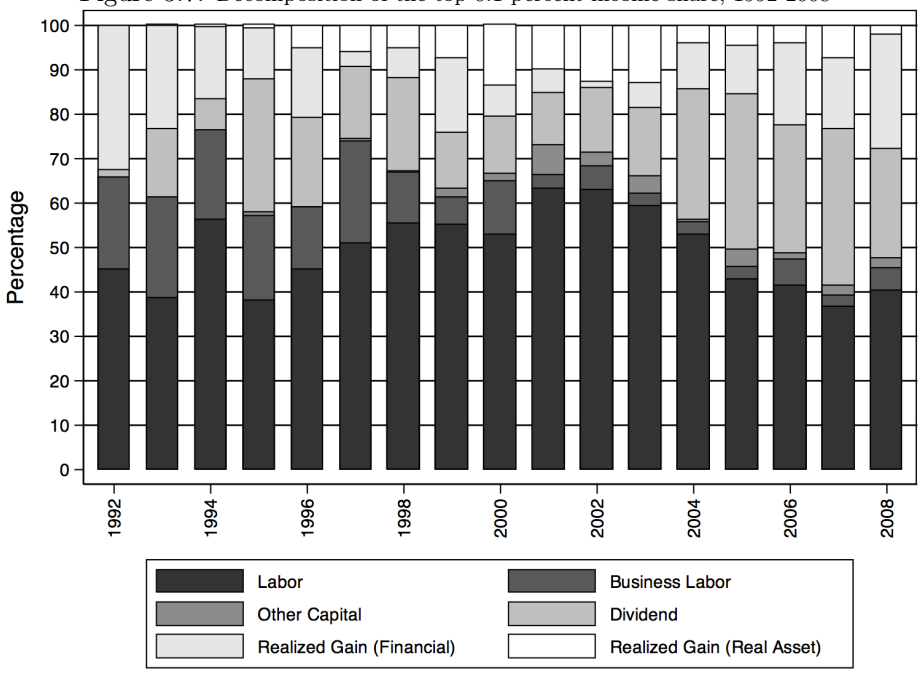
After the transition into market economy wage settings were liberalized, property ownership rights were decentralized through privatization, and the transition from a single capital owner (the State) to multiple ones (the domestic and international markets) was achieved. Privatization started earlier in Hungary and was completed more quickly compared to most East European countries; already in 1992 one-third of the firms were privately owned. At the earliest period management buyouts were the norm, while from 1991 the process become more regulated and sellings were completed mostly via competitive tenders.[27] A restitution program was also implemented, giving back real property (land, buildings and equipment) that was expropriated since 1939 during the fascist, pre-communist

[25] Berend(1990), pp. 170-179
[26] Berend(1990), p. 202, Mieczkowski(1975), pp. 222-223, Flakierski (1986), pp. 54-55 Table 4
[27] Brown et al (2006), p. 71

and communist regimes to the original owners or their descendants. The process was completed by giving partial compensation paid in freely tradable coupons that could be used to bid in auctions for state property.[28] It is apparent from both Figure 3.5 and 3.8 that income concentration in capital at the top of the income distribution was growing rapidly already after 1990, suggesting that savings and investment was not the main source of capital accumulation. Instead, the transition of state wealth into private wealth what is likely to drove the increase in income concentration in that period.

Beside the decentralization of property rights, markets for capital started to operate and investment opportunities emerged. Income shares of both capital and labor increased in tandem, as capital began to be remunerated. Immediately after the transition the top 0.1 percent share tripled and the top 1 percent doubled, while the next percentiles increased less saliently (P95-99 by 65%, P90-95 by 50%, see Figures C.10 and C.11 in Appendix). It is interesting that after the transition the top 1% share increased much faster than the next fractiles; in 2008 the top 1% shares were still below the 1940 level, while the income share of the next four percentile surpassed the 1940 level.

Figure 3.7: Decomposition of the top 0.1 percent income share, 1992-2008



Note: Income decomposition of total income received by the top 0.1 percent. Labor: wages and salaries, bonus, in kind benefit, stock option, and employee stock, taxable cost compensations, pension, unemployment and maternity benefit, scholarship. Business labor: self-employed and partnership income, liberal profession, agricultural income. Dividend: general dividends, and dividends received through partnership. Real asset capital gain: realized gain from selling property, movable goods, rights. Financial capital gain: realized gain from selling financial assets. Other capital: any other taxable capital income such as rent, annuities and interest not taxed at the source. See Table C.12 for detailed income categories.

Source: Table C.19

There is an apparent increasing trend in the recent top income shares as displayed in Figure 3.4 and Figure 3.6, with a peak in 1999 followed by some stagnation years and an increase again from 2005.

[28] Bornstein (1997), pp. 325-326

To be able to detect the driving forces behind the movement of the top income shares, we estimate the decomposition of the top shares displayed in Figure 3.7. As can be seen from the figure, capital income shares followed clearly the market movements with significant drops in realized financial gains during 1997-1998 and 2002, when Hungary was severely hit by the financial crises originating from the Asian stock market, and by the burst of the dotcom bubble. There is an increased share of realized real asset gains since the mid-90's with a drop in 2007, following the real estate boom and burst of the housing bubble, associated with decreased foreign investment in the property market. It is also apparent from our estimates that there was a significant drop in business income shares after 2002 as a result of drop in business activities among the top income recipients.[29]

These findings suggest that Hungarian top income shares started the adjustment immediately after the transition into the market economy both via the labor and capital components, and during the market economy the shares sensitively react to market movements.

3.4 Discussion: Capital and Labor

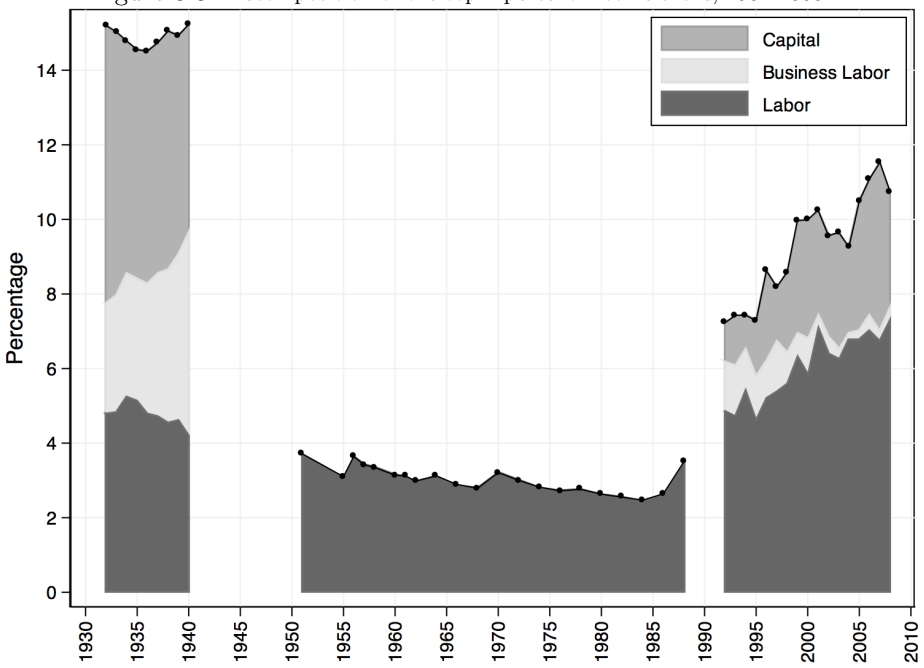
Several top income papers provide empirical evidence on an inverse relation between the top income series and the top marginal tax rates.[30] We have constructed the top marginal tax rates in effect for the top 0.1 income individuals during the market economy periods before and after the communist era, displayed on Figure C.5 in Appendix. If we consider the communist system as an extremely high taxation of income above an income threshold, then the overall negative relationship between top tax rates and top income shares is apparent in Hungary during the overall analysed time period. However, when focusing at subperiods between 1927-1944 and 1992-2008 we do not see direct negative relation between movements in the top tax rates and shares, suggesting that the top tax rates are not the only determinants behind the changes in top income shares. We further investigate the question of the channels generating income disparities by exploiting the exogenous shock of the planned economy and its equality by design. The analyses suggests that both secured capital ownership right, and liberalized wage settings played significant role in the evolvement of the top shares. By constructing the Hungarian top income series from 1914 up till recent years, we can also study how quickly the top income shares are reverted back after the end of the planned economy to prevalent level at Western European market economies, and also that which income factor is behind the surge in the shares.

The factor decomposition of earners at the top 1 percent is displayed in Figure 3.8. As can be seen from the figure, the interwar period top income shares are high and they come from large capital

[29]The decreasing trend in business income from 2001 is unlikely to be due to simple reorganization of tax labels as only one main item was excluded from business income, but from several years earlier from 1996. From 2003 entrepreneurs with income below 25 million HUF could choose to declare their income in a simplified system (*Egyszerűsített vállalkozói adó* - EVA), in this case they are not present in the personal income tax statistics, hence we can not include their income in the top income share calculation.

[30]See: Saez (2004) on USA, and the Chapters on India, Japan, Argentina, Italy, Sweden in Top Incomes Global Perspective (2010).

Figure 3.8: Decomposition of the top 1 percent income share, 1932-2008



Note: Capital: income from capital assets, land and buildings, for 1992-2008 also realized capital gains are included. Labor: wages and salaries and other employment income. Business: mixed income. See Table C.12 for detailed income categories.

Source: Table C.21

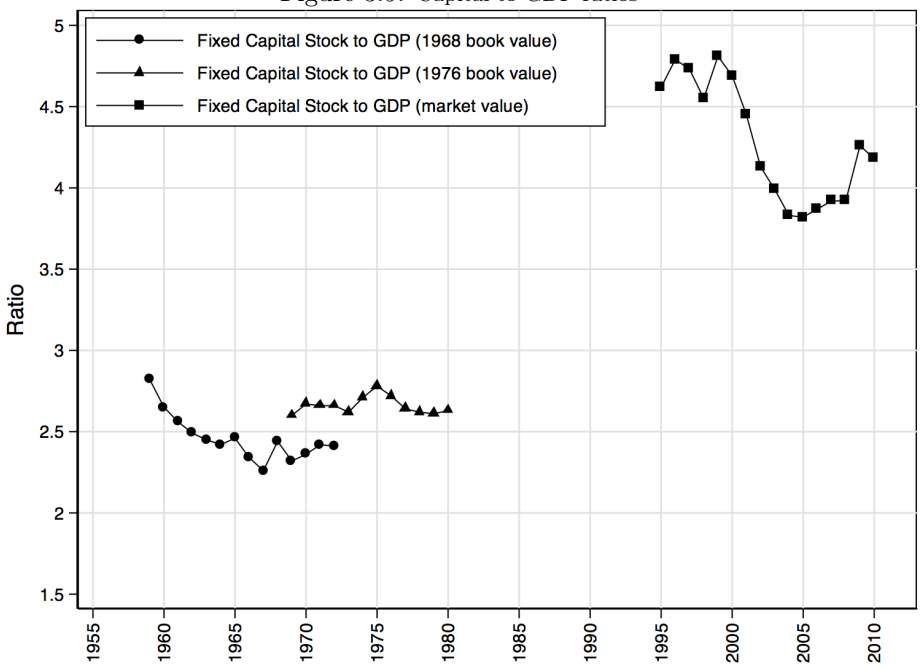
structures as well as land and real-estate. Approximately 40 percent of the top 1 share income is from capital, that is similar to the US trend as can be seen in Figure C.13 in the Appendix. During the planned economy, the top income shares are solely composed of labor income, since profits accrue to the unique capital owner. After the transition, income shares of both capital and labor increase in tandem, as capital begins to be remunerated and wage settings were liberalized. Based on the share decomposition in Figure C.13 the significance of capital income in the top shares grew rapidly during the last two decades, from 5 percent to 20 percent – which is in line with the USA level – among individuals in the top 1 percent. These finding are also in line with the statement that both capital and labor income factors play a significant role at increasing income inequality when market forces determine income. In the next subsection we look into this mechanism how capital and labor income creates a surge in the top income shares.

3.4.1 Capital

Capital income was significant part of the top income shares at the beginning of the 20th century. As can be seen in Figure 3.5, in the years immediately after the introduction of the personal income tax in 1914 more than half of the income of the top 0.1% originated from capital including land, buildings and financial assets. Between 1914 and 1932 the country underwent the World War, a hyperinflation episode in 1923-24, the Great Depression and a banking crises leading to a drop in the financial asset

component from 18% to below 5% (see Table C.18 in the Appendix). The overall capital income component remained around 50% during the interwar period.

Figure 3.9: Capital to GDP ratios



Note: Estimates of fixed capital to GDP, net of depreciation, based on two different methodologies and on two different sources of data (see Appendix C.8). For 1995-2010 assets are calculated at market value. For 1959-1980 half of the assets such as dwellings, roads, bridges, dams, private sector assets is valued at replacement value, while the other half is valued at book value (1968 prices, and 1976 prices).

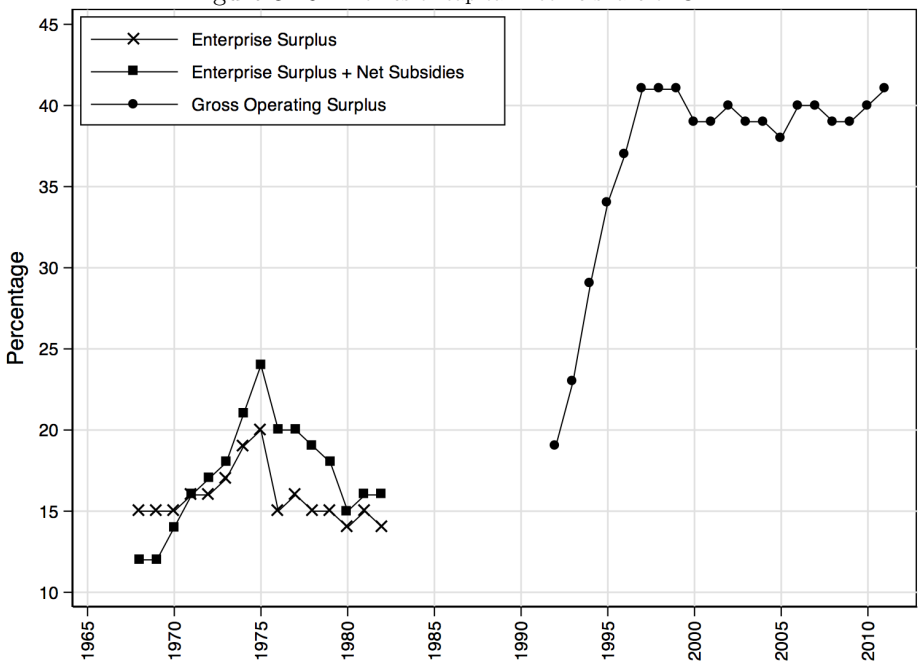
Source: Table C.23

As mentioned earlier after World War II the market economy was quickly converted into a planned economy by forced collectivization of agriculture, nationalization of the industrial companies and banks. The state owned the right to manage all productive assets and extract the profit from them. Income from private property and capital was practically eliminated. Households had limited capacity to own real or financial assets, property rights were not secured and investment possibilities were lacking.

After the transition into the market economy capital to GDP ratios adjusted quickly, and have been subject to the economy's opening to international capital flows (see Figure 3.9). Changes in fixed capital formation have been remarkable, as was the program of decentralization of property ownership rights through privatization, and the transition from a single capital owner (the State) to multiple ones (the domestic and international markets). Figure 3.10 displays that the capital income share of GDP rapidly reached levels of regularity met in market economies, illustrating also that the remuneration proportion of capital in the total gross income increased substantially.

Which segment of the income distribution benefitted the most from the decentralization of capital ownership and secure private property rights? And which fraction gained the most from the increased share of capital remuneration in the overall economy? After the transition the significance of the capital

Figure 3.10: Proxies of capital income share of GDP



Note: Proxies of capital income share of GDP, based on two different methodologies and on two different sources of data (see Appendix C.9). For 1991-2011 the series report the capital factor share (gross operating surplus of households and firms). For 1968-1982 the series report the net income the state extracted as the owner from enterprises, i.e. profit and income tax. An alternative series includes additionally also the net of production subsides and production tax.

Source: Table C.24

component including realized capital gain at the very top of the income distribution quickly recovered, reaching even the interwar levels. Those at the top top 1% and top 0.1% received respectively more than 25% and 50% of their income from capital holdings during the years preceding the recent financial crises (see Table C.19). Meanwhile the lower fractiles received much smaller shares of their income from capital. In just two decades the significance of capital income component at the very top of the distribution became supreme, reaching comparable levels even to the USA, a country with high capital income concentration.[31] It is clear from the income decomposition in Figure 3.8, that the capital income component was a strong drive behind the surge in the top income shares after the transition to the market economy. Beside capital, labor income also had a significant role in increasing top income shares, to which we turn in the next subsection.

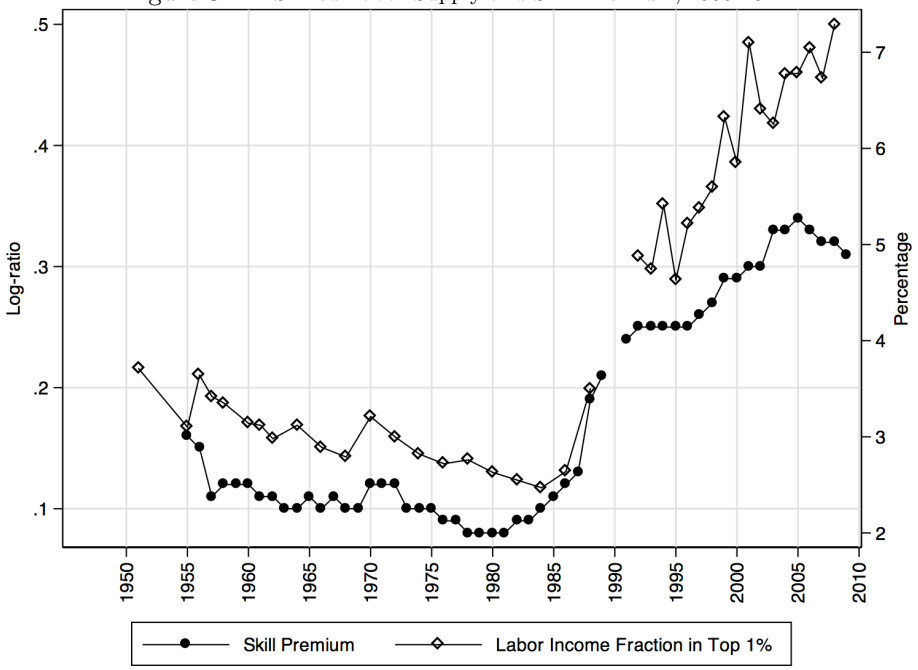
3.4.2 Labor

To shed light on the mechanism behind the increased role of labor income in the top shares, we construct a skill premium series for the period from the 1950's until recent years. We estimate the relative earning premium for skilled people with the difference of log average wages of intellectual and

[31]The capital income component including realized gains for the top 1% shares was 32.99% in Hungary, while 30.18% in the USA in 2006. See: Table C.19 for Hungarian and World Top Income Database for USA data.

manual workers, (see description in Appendix Section C.7). Figure 3.11 presents the skill premium series, comparing it the labor income fraction in the top share the comovement is noticeable. Both series have a negative overall downward trend during the most of the planned economy with a jump in 1970. The skill premium series displays an upward trend from the early 1980's that is followed by an increase in the top shares also. Both series continue to increase after the transition to the market economy.

Figure 3.11: Skilled Labor Supply and Skill Premium, 1955-2011



Note: Skilled labor supply is the percentage of the labor force with high school and university degrees, and skill premium is the ratio of log average white-collar worker wage over log average blue-collar worker wage. (See Appendix C.7 for details.)

Source: Table C.22

During the planned economy a more compressed wage distribution was favoured by ideological concepts. But as part of the New Economic Mechanism the Central Planning Bureau gave the right to state-owned enterprises to exploit some margins of compensation to workers according to productivity, in effect redistributing a fraction of any potential surplus to the middle and top management. Though this wage reform was short-lived, we see a parallel increase both at the skill premium and at the top shares exactly after the introduction of the reform in 1968. The reform was reversed within few years, followed by decreasing skill premium and top income shares. From the early 1980's wage and bonus settings of executives were delegated to enterprise level.[32] This policy shift, which marks a first step to complete liberalization of the labor market, led to an increase in the skill premium (see Figure 3.11). After the transition, evidence of skill-biased technical change is prevalent, although interrupted by labor market regulations and foreign exchange crises during the mid-2000s. Our findings are in

[32] 33/1983 Statute of Ministry 8§

line with Kézdi(2002), who based on micro data also documents a steady increase in skill premium for 1986-1995 as a consequence of inter-sectoral skill reallocation and dramatic jobs losses of the unskilled less educated people, and an even higher skill premium growth for the second half of the '90s with skill biased technological change at most sectors.

The comovement between the skill premium and the top shares suggests that wage-setting decentralization favoring the remuneration of skills also play a role in the increase of the top income shares, beside other documented forces such as increased bargaining power of top managers, decreased top tax rates (Piketty et al. (2014)), and increased importance of capital income (Piketty (2013)).

3.5 Conclusion

In this study we used individual tax statistics to construct the Hungarian top income share series for the periods prior the Second World War, and after the transition to a market economy. We complemented the series with available earning censuses in the socialized sector for the planned economy period.

We have exploited the "exogenous shock" of the planned economy and its equality by design to study questions such as the effects of market forces, i.e. the effect of decentralized capital ownership and liberalized wage settings on the top income shares; how both the incidence of state socialism, as well as the post-socialist transition have shaped the income distribution at the very top; and how quickly the shares returned back to Western-European levels after the transition into the market economy.

During the studied period between 1914 and 2008 the Hungarian top income share series followed a U-shape. The top shares were as high as in Western countries (USA, UK, France) and came from large capital structures as well as land and real-estate during the first decades of our time frame. After the Second World War, when most Western countries experienced a compression in their top shares, the Hungarian shares decreased twice as much; and remained constantly low during the four decades of state socialism. After the transition to a market economy we observed a rapid top income share adjustment; in less than a decade they increased to levels prevalent at western countries. The increase was due to a surge both in capital and labor income factors. The constructed top share estimate series suggested that both capital income via the allocation of capital holdings from the state to private owners and securing property rights; and labor income via wage-setting decentralization favoring the renumeration of skills played a significant role at increasing income inequality during market economies.

References

[50] I. Ábel and I. Székely. Household portfolios in Hungary, 1970-1990. *Discussion Paper*, (91), 1992.

[51] D. Acemoglu. Directed technological change. *The Review of Economic Studies*, 69(4), 2002.

[52] F. Alvaredo, A. B. Atkinson, T. Piketty, and E. Saez. The top 1 percent in international and historical perspective. *NBER Working Paper No. 19075*, 2013.

[53] J Árvay. A nemzeti vagyon kiszámításának főbb módszertani kérdései. *Statisztikai Szemle*, 1976.

[54] J Árvay. The net material product system (NMP) a retrospective. International Association for Research in Income and Wealth, 22nd General Conference, 1992.

[55] A. Atkinson and J. Micklewright. *Economic transformation in Eastern Europe and the distribution of income*. Cambridge University Press, Cambridge, 1992.

[56] A. B. Atkinson. Data matter. Cowles Lecture, Econometric Society, Auckland., 2002.

[57] A. B. Atkinson. Measuring top incomes: Methodological issues. In A. B. Atkinson and T. Piketty, editors, *Top incomes over the 20th century*. Oxford University Press, Oxford, 2007.

[58] A. B. Atkinson and T. Piketty, editors. *Top incomes over the 20th century*. Oxford University Press, Oxford, 2007.

[59] A. B. Atkinson, T. Piketty, and E. Saez. Top incomes in the long run of history. *Journal of Economic Literature*, 49(3-71), 2011.

[60] A.B. Atkinson. *The Changing Distribution of Earnings in OECD Countries*. Oxford University Press, Oxfords, 2008.

[61] D. Benedek and O. Lelkes. The distributional implications of income under-reporting in hungary. *Fiscal Studies*, 32, 2011.

[62] I. T. Berend. *The Hungarian Economic reforms 1953-1988*. Cambridge University Press, Cambridge, 1990.

[63] I. T. Berend and G. Ránki. *Hungary: A century of Economic Development*. Latimer Trend Company, Plymouth, 1974.

[64] A. R. Boote and J. Somogyi. *Economic Reform in Hungary Since 1968*. IMF, Washington DC, 1991.

[65] M. D. Bordo and C. M. Meissner. Do financial crises always raise inequality? some evidence from history. 2011.

[66] D. Brown, Earle J., and Á. Telegdy. The productivity effects of privatization: Longitudinal estimates from Hungary, Romania, Russia, and Ukraine. *Journal of Political Economy*, 114(1), 2006.

[67] E. Csulak. *Egyenes adók, IV. Jövedelem- és vagyonadó*. Tébe könyvkiadóvállalat, Budapest, 1925.

[68] E. Cukor. Earnings of white collar workers in recent decades. *Acta Oeconomica*, 42(3-4):303–314, 1990.

[69] Á. Darabont and P. Pozsonyi. *A Nemzeti vagyon és az állóeszközállomány 1960-1973 (National wealth and fixed capital stock)*. KSH [Központi Statisztikai Hivatal], Budapest, 1974.

[70] Á. Darabont and P. Pozsonyi. *A Nemzeti vagyon és az állóeszközállomány 1970-1978 (National wealth and fixed capital stock)*. KSH [Központi Statisztikai Hivatal], Budapest, 1979.

[71] Á. Darabont and P. Pozsonyi. *A Nemzeti vagyon és az állóeszközállomány 1979 (National wealth and fixed capital stock)*. KSH [Központi Statisztikai Hivatal], Budapest, 1980.

[72] Á. Darabont and P. Pozsonyi. *A Nemzeti vagyon és az állóeszközállomány 1980 (National wealth and fixed capital stock).* KSH [Központi Statisztikai Hivatal], Budapest, 1980.

[73] Á. Darabont and P. Pozsonyi. *A Nemzeti vagyon és az állóeszközállomány 1981 (National wealth and fixed capital stock).* KSH [Központi Statisztikai Hivatal], Budapest, 1981.

[74] F. Dell. Top incomes in Germany throughout the twentieth century: 1891-98. In A. B. Atkinson and T. Piketty, editors, *Top Incomes over the 20th Century.* Oxford University Press, 2007.

[75] J. Diamond and J. A. Robinson, editors. *Natural Experiments of History.* Harvard University Press, London, 2010.

[76] A. Eckstein. National income and capital formation in Hungary, 1900-1950. *Review of Income and Wealth*, 5(1):152–223, 1955.

[77] Ö. Éltető and Gy. Láng. Income level – income stratification in Hungary. *Acta Oeconomica*, 7, 1971.

[78] T. Erdős. The rate of growth and its new path in Hungary. *Acta Oeconomica*, 28:277–294, 1982.

[79] K. Z. Farkas and J. Pataki. Shortage of commodities and public opinion in hungary. *Acta Oeconomica*, 32, 1984.

[80] F. Fellner. *A magyar nemzeti vagyon becslése (Hungarian national wealth estimation).* Pesti Könyvnyomda-Részvénytársaság, Budapest, 1901.

[81] F. Fellner. *Ausztria es Magyarország nemzeti vagyona (National wealth of Austria and Hungary).* Pallas Részvénytársaság Nyomdája, Budapest, 1913.

[82] F. Fellner. *Az egyenes adók reformja Magyarországon [Direct Taxation Reform in Hungary].* Ráth Mór, Budapest, 1916.

[83] F. Fellner. *Az adózás jelen állása Magyarországon [The State of Taxation in Hungary].* Franklin-társulat nyomdája, Budapest, 1926.

[84] F. Fellner. *Adózás jelen állása [State of Taxation in Hungary].* Frankil-Társulat Nyomdája, Budapest, 1927.

[85] F. Fellner. *Csonka-Magyarország nemzeti vagyona (National wealth of the Trianon Hungary).* Magyar Tudományos Akadémia, Budapest, 1929.

[86] M. Fior. Financial instability in transition economies during the 1920s: The European reconstruction and Credit-Anstalt insolvency. In Karl Gratzer and Dieter Stiefel, editors, *History of Insolvency and Bankruptcy from an International Perspective.* Södertörns högskola, 2008.

[87] H. Flakierski. *Economic reform and income distribution.* M.E. Sharpe, New York, 1986.

[88] P. Földvári. Estimating income inequality from tax data with a priori assumed income distributions in Hungary, 1928-1941. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 42(3), 2009.

[89] P. Földvári. Capital accumulation and growth in Hungary, 1924-2006. *Acta Oeconomica*, 61(2), 2011.

[90] C. Goldin and L. F. Katz. *The Race between Education and Technology.* Harvard University Press, London, 2008.

[91] L. Héthy. Labor market analyses and employment planning, urban self-employment in Hungary. *World Employment Program Research WP*, 39, 1990.

[92] KSH [Központi Statisztikai Hivatal]. *Képzettség és kereset: mérnökök és technikusok, egyéb felső- és középfokú végzettségű szakemberek kereseti arányai (Education and earnings: earning ratios of engineers and technicians, and other educated professionals).* Budapest, 1966.

[93] KSH [Központi Statisztikai Hivatal]. *Foglalkoztatottság és kereseti arányok 1967 (Employment and earning ratios 1967).* Budapest, 1969.

[94] KSH [Központi Statisztikai Hivatal]. *Népgazdasági mérlegek, 1960-1970 (National balances, 1960-1970).* Budapest, 1971.

[95] KSH [Központi Statisztikai Hivatal]. *A népgazdasági mérlegrendszer módszertana (Methodology of the national account system).* Budapest, 1971.

[96] KSH [Központi Statisztikai Hivatal]. *Jövedelemelosztás a népgazdaságban (Income distribution in the economy, 1978).* Budapest, 1979.

[97] KSH [Központi Statisztikai Hivatal]. *A lakosság jövedelme és fogyasztása 1966-1980 (The income and consumption of the population 1966-1980).* Budapest, 1982.

[98] KSH [Központi Statisztikai Hivatal]. *Jövedelemelosztás a népgazdaságban 1976-1982 (Income distribution in the economy, 1976-1982).* Budapest, 1984.

[99] KSH [Központi Statisztikai Hivatal]. *A lakosság jövedelme és fogyasztása 1970-1987 (The income and consumption of the population).* Budapest, 1988.

[100] KSH [Központi Statisztikai Hivatal]. *Magyarország Nemzeti Számlái, 1991-1994 (National Accounts Hungary).* Budapest, 1996.

[101] KSH [Központi Statisztikai Hivatal]. *Magyarország népessége és gazdasága: múlt és jelen (Hungarian Population and Economy: Past and Present).* Budapest, 1996.

[102] KSH [Központi Statisztikai Hivatal]. *Magyarország Nemzeti Számlái, 1995-2007 (National Accounts Hungary).* Budapest, 2009.

[103] KSH [Központi Statisztikai Hivatal]. *Magyarország Nemzeti Számlái, 2008-2010 (National Accounts Hungary).* Budapest, 2011.

[104] KSH [Központi Statisztikai Hivatal]. *Magyarország Nemzeti Számlái, 2009-2011 (National Accounts Hungary).* Budapest, 2012.

[105] B. Igazné Prónai. *A kötelező társadalombiztosítás kialakulása, fejlődése Magyarországon [The Formation and Evolution of Social Security Contributions in Hungary].* PhD thesis, Pázmány Péter Catholic University, Budapest, 2006.

[106] S. N. Kaplan and J. Rauh. It's the market: The broad-based rise in the return to top talent. *Journal of Economic Perspectives*, 27(3), 2013.

[107] G. Kézdi. Two phases of labor market transition in Hungary: Inter-sectoral reallocation and skill-biased technological change. *BWP*, 3, 2002.

[108] E. Klug and A. Soltész. *A magyar egyenes adók [The Hungarian Direct Taxes].* Országos Iparegyesület, Budapest, 1917.

[109] E. Klug and A. Soltész. *A magyar egyenes adók [The Hungarian Direct Taxes].* Országos Iparegyesület, Budapest, 1917.

[110] I. Kovács. A hazai jövedelemeloszlás és jövedelemegyenlőtlenség mérése és elemzése személyi jövedelembevallási adatok alapján (measuring Hungarian income inequality based on personal income tax data). *Hungarian Academy of Sciences*, 9, 2010.

[111] Á. Krivoss. *Egyenesadó-rendszerünk fejlődése és a háború utáni adóztatás irányelvei [Development and Policy of Post-War Direct Taxation].* Gazdasági Jog, Budapest, 1943.

[112] J. Lánczi. *A Hadsegélyezési adó és az új jövedelemadó [Military tax and the new personal income tax].* Grill Károly Könyvkiadóvállalata, Budapest, 1916.

[113] M. Matolcsy. *A Magyarországi jövedelem- és adóteher megoszlás [The distribution of Income and Tax Burden in Hungary].* Magyar Gazdaságkutató Intézet, Budapest, 1938.

[114] M. Matolcsy and S. Varga. *The National Income of Hungary 1924/25-1936/37*. London, 1938.

[115] M. Matolocsy and S. Varga. *Magyarország Nemzeti Jövedelme [The National Income of Hungary] 1924/25-1934/35*. Magyar Gazdaságkutató Intézet, Budapest, 1936.

[116] B. Mieczkowski. *Personal and social consumption in Eastern Europe*. Praeger Publisher, New York, 1975.

[117] B. Milanovic. *Income, Inequality and Poverty during Transition form Planned to Market Economy*. The World Bank, Washington DC, 1998.

[118] Magyar Királyi Pénzügyiministerium [Hungarian Royal Finance Ministry]. *Jövedelemadóstatisztika [Income Tax Statistics]*. Magyar Királyi Állami Nyomda, Budapest, 1916, 1917.

[119] Magyar Királyi Pénzügyiminisztérium [Hungarian Royal Finance Ministry]. *Adóstatisztika, Füzet 1-12 [Tax Statistics 1-12]*. Magyar Királyi Pénzügyminiszter, Budapest, 1929-1943.

[120] B. R. Mitchell. *International Historical Statistics: Europe, 1750-2005*. Palgrave MacMillan, 2007.

[121] T. Molnárfi. *Áralakulás a két világháború között: ipari termékek ára [Price Evolution in the Interwar Period: Industrial Production Prices]*. KSH, Budapest, 1973.

[122] S. Morelli. Banking shocks and top income shares. 32nd General Conference of The International Association for Research in Income and Wealth, 2012.

[123] R. Murray Haig and L. László-Ecker. Direct taxation in Hungary. *Political Science Quarterly*, 50(1):70–106, 1935.

[124] T. Piketty. *Capital in the Twenty-First Century*. Harvard University Press, 2014.

[125] T. Piketty and E. Saez. The evolution of top incomes: A historical and international perspective. *American Economic Review*, 96(2), 2006.

[126] T. Piketty, E. Saez, and S. Stantcheva. Optimal taxation of top labor incomes: A tale of three elasticities. *American Economic Journal: Economic Policy*, 6(1), 2014.

[127] J. Roine, J. Vlachos, and D. Waldenström. The long-run determinants of inequality: What can we learn from top income data? *Journal of Public Economics*, 93, 2009.

[128] E. Saez. Reported incomes and marginal tax rates, 1960-2000: Evidence and policy implications. *NBER Working Paper No. 10273*, 2004.

[129] T. Sargent. The ends of four big inflations. In R. Hall, editor, *Inflation: Causes and Effects*. University of Chicago Press, Chicago IL, 1982.

[130] M.-S. Schulze. Patters of growth and stagnation in late nineteenth century Habsburg economy. *European Review of Economic History*, 4(311-340), 2000.

[131] M.-S. Schulze. Austria-Hungary's economy in world war i. In S. Broadberry and M. Harrison, editors, *The Economics of World War I*. Cambridge University Press, 2005.

[132] W. Swaan. Price regulation in hungary, 1967-87: a behavioural-institutional explanation. *Cambridge Journal of Economics*, 14, 1990.

[133] Gy. Takács. *Adók és illetékek lexikona*. Grill Károly könyvkiadó vállalata, Budapest, 1943.

[134] B. Tomka. The development of Hungarian banking: An international comparison, 1880-1931. *Journal of European Economic History*, 30(1):125–162, 2001.

[135] B. Tomka. Gazdasági növekedés és fogyasztás magyarországon a 20. században [Economic growth and consumption in Hungary in the 20th century]. *Korunk*, 3(4):30–45, 2010.

[136] I. Gy. Tóth. Jövedelemeloszlás a konszolidációs csomagok és a válságok közepette Magyarországon [Income distribution during the consolidation and crises period in Hungary]. In *Társadalmi riport 2010 (Society riport)*. Tárki, Budapest, 2010.

[137] A. G. Walder. Property rights and stratification in socialist redistributive economies. *American Sociological Review*, 57(4):524–539, 1992.

A Appendix for Chapter 1

A.1 Data description

The study is based on administrative tax return data located at the Hungarian Central Bank, covering the universe of double-entry bookkeeping companies for years between 2002 and 2013.[1] The dataset reports very detailed information, including figures in all cells reported on the XX29 tax form and its appendix balance sheet and profit and loss statement submitted to the National Tax and Custom Office (NAV, formerly APEH). The data structure is unbalanced panel including about 200-400 thousand observations each year. Both those firms with tax year defined as the fiscal year ending 31th December, and also those few hundred firms with tax year ending on different dates are included.

The data has been subject to cleaning containing the below steps. The two digit level **industry code** system changed in 2003 and also in 2008. Concordance tables for major NACE/TEAOR changes have been provided by the CSO.

Two main problems have to be handled with the number of **employees** data. First, decimal digit error typos, then missing data. It is assumed that the wage bill is reported more precisely and frequently compared to the number of employees data. The first problem is solved by comparing the average wage at a given firm to the average wage at similar size firms in the same industrial sector during that given year. In case of large differences (more than 30 times jump or drop) the number of employees is corrected based on the reported employment data during the preceding and succeeding year of that firm. Then the average wage dynamics is checked within the firm. In case of large changes within years, the employment data is corrected based on reported data in the neighboring years. Finally missing employment data is linearly interpolated.

Investment data is not reportable on the tax form, hence it is calculated based on the usual capital accumulation formula:

$$I_t = K_t - K_{t-1} + \delta_t$$

where K is the nominal capital amount, and δ is the accounting based amortization reported on the balance sheet. The calculated book value capital is the sum of the reported nominal tangible and intangible assets. In case if these are not reported, then capital is approximated by the net value of property, machines and intangible assets.

[1] From 2003 more than 97 percent of corporations have practiced double-entry bookkeeping in Hungary, while for years before the ratio was less than 75 percent. For the main results I only use data from years where the dataset includes more than 97 percent of all corporations.

A.2 Corporate tax system in Hungary

	Profit as shown in tax balance sheet	"operational profit"	y-c
	tax base decreasing/increasing items		Δ
$-$	loss carry forward		
$-$	donations		
$-$	R+D		
$-$	allowance for employing young, or disabled workforce		
$-$	received dividends		
$+/-$	correction for the differences in amortization calculations according to the accounting and tax legislations		
$+$	tax penalty		
$+$	received donations		
	etc.		
$=$	**Taxable income**	"adjusted profit"	y-c+Δ
$*$	statutory tax rate		τ_{Π}
$-$	tax allowances		
$=$	**Corporate income tax assessed**		

A.3 Tables and figures

Table A.1: Control and treatment group statistics

	Logit	*Logit*	*Marginal effects (dy/dx)*
Dep. variables:	Treated (=1)		
Net turnover	4.92e-05	-8.46e-05	-1.95e-05
	(0.000115)	(0.000120)	(2.77e-05)
Number of employees	0.00535***	0.00302*	0.000697*
	(0.00165)	(0.00168)	(0.000387)
Wage bill	-0.00266***	-0.00133	-0,000308
	(0.00102)	(0.00103)	(0.000238)
Immaterial assets	0.00296	0.00326	0.000754
	(0.00324)	(0.00331)	(0.000763)
Tangible assets	-0.000686***	-0.000841***	-0.000194***
	(0.000258)	(0.000273)	(6.28e-05)
Age	0.00755	0.00377	0.000870
	(0.00522)	(0.00530)	(0.00122)
Manufacturing		0.113	0.0278
		(0.116)	(0.0284)
Utilities		-0.157	-0.0380
		(0.240)	(0.0577)
Construction		-0.182	-0.0441
		(0.124)	(0.0301)
Wholesale, retail trade		-0.491***	-0.115***
		(0.115)	(0.0278)
Transportation, warehousing		-0.234	-0.0563
		(0.161)	(0.0386)
Accommodation services		0.355**	0.0882**
		(0.155)	(0.0384)
Information, communication		-0.387**	-0.0917**
		(0.167)	(0.0390)
Finance, insurance		-0.661**	-0.151**
		(0.324)	(0.0678)
Real estate		-0.301*	-0.0720*
		(0.182)	(0.0429)
Professional, scientific, and technical services		-0.484***	-0.113***
		(0.137)	(0.0322)
Administrative services		-0.365**	-0.0868**
		(0.157)	(0.0369)
Educational services		-0.398	-0.0941
		(0.265)	(0.0606)
Health		-1.066***	-0.226***
		(0.203)	(0.0388)
Arts, entertainment, recreation		-0.444**	-0.104**
		(0.226)	(0.0513)
Other services		-0.367*	-0.0871*
		(0.192)	(0.0447)
Constant	-0.560***	-0.256**	
	(0.0548)	(0.118)	
N	8 044	8 044	8 044

Note: The control group includes firms with stable profit rates, i.e. in the 2-8 per cent interval for three years (2004-2006) before the reform, and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. The control variables are in levels. The dependent variable is 0 for firms in the control group, and 1 for firms in the treatment group. All monetary variables are in million forints. The baseline reference group for the industry dummy includes firms in the Agricultural production, forestry, fishing and mining sectors. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.2: Control and treatment group statistics

	Descriptive statistics (mean)			
	Control (stable profit ratio between 2 and 8 per cent)	*Treatment (stable profit ratio between 0 and 2 per cent)*	*Difference between treatment and control group means*	*Standard error for difference between means*
Net revenue	134.6	142.1	-7.5	7.8
Operational profit	1.1	6.0	-4.9***	0.3
Number of employees	15.5	15.2	0.3	0.7
Wage bill	21.7	23.0	-1.3	1.3
Immaterial assets	0.9	0.8	0.1	0.2
Tangible assets	41.7	48.0	-6.4**	2.9
Balance sheet total	103.1	130.8	-27.8***	6.9
Capital share	42.6	48.8	-6.3*	2.9
Age	9.6	9.5	0.1	0.1
Total number of firms	4 981	3 063		

Note: All monetary variables are in million forints. Stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.3: Control and treatment group statistics

	Descriptive statistics (mean)	
	Control (stable profit ratio between 2 and 8 per cent)	*Treatment (stable profit ratio between 0 and 2 per cent)*
	Industry classification (percent)	
Agricultural production, forestry, fishing, mining	4.7	5.4
Manufacturing	18.9	26.4
Utilities	1.3	1.1
Construction	12.9	13.8
Wholesale, retail trade	28.6	22.5
Transportation, warehousing	3.57	3.5
Accommodation services	2.9	5.4
Information, communication	3.5	3.1
Finance, insurance	0.74	0.5
Real estate	2.5	2.3
Professional, scientific, and technical services	8.3	6.6
Administrative services	4.3	3.9
Educational services	1	0.9
Health	3.1	1.4
Arts, entertainment, recreation	1.5	1.2
Other services	2.2	2
Total number of firms	4 981	3 063

Table A.4: Robustness analyses: DID estimation for changes in real production (control variables normalized by balance sheet total)

Dep. variables:	*profit*	*wage bill*		*# employees*		*investment*	
$T_i = 1$ *(after reform)*	-0.447	0.0219**	0.0548***	-0.0368***	0.0197**	-0.0142***	-0.0117***
	(0.340)	(0.0094)	(0.0087)	(0.0099)	(0.0084)	(0.0023)	(0.0024)
$D_i = 1$ *(treatment group)*	-6.250***	0.0744***	0.123***	0.0971***	0.135***	-0.0087***	-0.0084***
	(0.440)	(0.0108)	(0.0112)	(0.0114)	(0.0109)	(0.0027)	(0.0031)
$T_i * D_i$ *(effect of reform)*	1.444***	0.0007	-0.0035	-0.0207	-0.0105	0.0081**	0.0088**
	(0.550)	(0.0153)	(0.0140)	(0.0161)	(0.0136)	(0.0038)	(0.0039)
Constant	12.89***	0.345***	0.0975***	0.342***	0.0851***	0.0777***	0.0699***
	(0.698)	(0.0066)	(0.0177)	(0.007)	(0.0172)	(0.0017)	(0.0049)
Controls normalized by balance sheet total	X		X		X		X
N	13 646	15 312	13 646	15 312	13 646	15 312	13 646

Note: The control group includes firms with stable profit rates, i.e. in the 2-8 per cent interval for three years before the reform (2004-2006), and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment, investment and control variables are normalized by the balance sheet total, while reported profit is not in order to look at the fiscal effect of the reform. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.5: Robustness analyses: DID estimation for changes in real production (different time periods, 2006 - 2009, 2006 - 2010)

	Time period 2006 - 2009			Time period 2006 - 2010		
Dep. variables:	*wage bill*	*employees*	*investment*	*wage bill*	*employees*	*investment*
$T_i = 1$ *(after reform)*	0.0635***	0.0448***	-0.0264***	0.0618***	0.0643***	-0.0353***
	(0.0099)	(0.0097)	(0.0025)	(0.0103)	(0.0107)	(0.0025)
$D_i = 1$ *(<threshold profit)*	0.0735***	0.0867***	-0.0103***	0.0757***	0.0871***	-0.0122***
	(0.0122)	(0.0120)	(0.0031)	(0.0128)	(0.0132)	(0.0031)
$T_i * D_i$ *(effect of reform)*	0.0125	0.0023	0.0045	0.0134	-0.0007	0.0103***
	(0.0158)	(0.0156)	(0.004)	(0.0165)	(0.0171)	(0.004)
Constant	0.129***	0.129***	0.0958***	0.117***	0.118***	0.0785***
	(0.0189)	(0.0186)	(0.0048)	(0.0195)	(0.0202)	(0.0047)
Controls	X	X	X	X	X	X
N	13 454	13 454	13 454	12 295	12 295	12 295

Note: The control group includes firms with stable profit rates, i.e. in the 2-8 per cent interval for three years before the reform, and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment and investment are normalized by the balance sheet total. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.6: Robustness analyses: DID estimation for changes in real production (control group includes firms with 2-6 % stable profit rate)

Dep. variables:	*profit*	*wage bill*		*# employees*		*investment*	
$T_i = 1$ *(after reform)*	-0.0979	0.0229	0.0769***	-0.0424***	0.0316**	-0.0162***	-0.0135***
	(0.276)	(0.0144)	(0.0135)	(0.0153)	(0.0136)	(0.0032)	(0.0034)
$D_i = 1$ *(treatment group)*	-1.941***	0.0711***	0.0764***	0.0950** *	0.0875***	-0.0109***	-0.0111***
	(0.285)	(0.0137)	(0.0140)	(0.0146)	(0.0140)	(0.0031)	(0.0035)
$T_i * D_i$ *(effect of reform)*	0.816**	0.00408	0.0029	-0.0105	0.0014	0.0093**	0.0089**
	(0.372)	(0.0194)	(0.0182)	(0.0207)	(0.0183)	(0.0044)	(0.0045)
Constant	2.849***	0.363***	0.117***	0.362***	0.125***	0.0802***	0.0980***
	(0.463)	(0.0102)	(0.0227)	(0.0108)	(0.0227)	(0.0023)	(0.0056)
Controls	X		X		X		X
N	9 959	11 155	9 959	11 155	9 959	11 155	9 959

Note: The control group includes firms with stable profit rates, i.e. in the 2-6 per cent interval for three years before the reform (2004-2006), and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment, and investment are normalized by the balance sheet total, while reported profit is not in order to look at the fiscal effect of the reform. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.7: Robustness analyses: DID estimation for changes in real production (control group includes firms with 2-10 % stable profit rate)

Dep. variables:	*profit*	*wage bill*		*# employees*		*investment*	
$T_i = 1$ *(after reform)*	-0.756***	0.0219***	0.0679***	-0.0353***	0.0331***	-0.0153***	-0.0132***
	(0.234)	(0.0073)	(0.007)	(0.0078)	(0.007)	(0.0019)	(0.002)
$D_i = 1$ *(treatment group)*	-3.949***	0.0809***	0.0806***	0.0940***	0.0863***	-0.0120***	-0.0116***
	(0.331)	(0.0097)	(0.0098)	(0.0104)	(0.0099)	(0.0025)	(0.0028)
$T_i * D_i$ *(effect of reform)*	1.607***	0.00697	0.00653	-0.0107	-0.00334	0.0089**	0.0089**
	(0.435)	(0.0137)	(0.0129)	(0.0147)	(0.0130)	(0.0036)	(0.0037)
Constant	4.867***	0.338***	0.129***	0.342***	0.138***	0.0814***	0.0969***
	(0.485)	(0.0052)	(0.0144)	(0.0055)	(0.0145)	(0.0014)	(0.0041)
Controls	X		X		X		X
N	18 780	21 173	18 780	21 173	18 780	21 173	18 780

Note: The control group includes firms with stable profit rates, i.e. in the 2-10 per cent interval for three years before the reform (2004-2006), and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment, and investment are normalized by the balance sheet total, while reported profit is not in order to look at the fiscal effect of the reform. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.8: Robustness analyses: DID estimation for changes in real production (before the reform placebo years, 2004 - 2006)

Dep. variables:	*profit*	*wage bill*		*# employees*		*investment*	
$T_i = 1$ *(after reform)*	1.020***	0.0268***	0.0435***	-0.0511***	0.0017	-0.0766***	-0.0207***
	(0.181)	(0.0091)	(0.0084)	(0.0116)	(0.0092)	(0.0035)	(0.0029)
$D_i = 1$ *(treatment group)*	-4.656***	0.0707***	0.0774***	0.104***	0.0979***	-0.0086**	-0.0120***
	(0.219)	(0.0105)	(0.0101)	(0.0133)	(0.011)	(0.004)	(0.0035)
$T_i * D_i$ *(effect of reform)*	-0.380	0.0034	-0.008	-0.0132	-0.0234	-0.0017	0.0011
	(0.290)	(0.0148)	(0.0134)	(0.0188)	(0.0146)	(0.0057)	(0.0046)
Constant	1.093***	0.325***	0.124***	0.407***	0.170***	0.157***	0.0959***
	(0.334)	(0.0065)	(0.0155)	(0.0082)	(0.0169)	(0.0025)	(0.0053)
Controls	X		X		X		X
N	11 455	16 017	11 455	16 017	11 455	16 017	11 455

Note: The control group includes firms with stable profit rates, i.e. in the 2-8 per cent interval for three years before the reform (2002-2004), and the treatment group includes firms with stable profit rates in the 0-2 per cent interval. Wage bill, employment and investment are normalized by the balance sheet total, while reported profit is not in order to look at the fiscal effect of the reform. The control variables include pre-reform lag profit, lag tax base, lag net turnover, lag employment, lag immaterial assets, lag net property, lag net machines, lag share capital, and industry code. Variables taking also negative values are yearly winsorized at the bottom 1% and at the top 99%, variables without negative values are winsorized at the top 99%. The sample in the regressions contains firms with variables that were not dropped during the winsorization process. All monetary variables are in million forints. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.9: Increased reported profit rate after tax audit and issued fines

Dep. variables:	*Change in reported profit rate (percentage point)*							
Year	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
$D_i = 1$ *(audited*	0.0423***	0.0378***	0.0257***	0.0229***	0.0104***	0.0124***	0.0186***	0.00770*
and fined)	(0.0045)	(0.0039)	(0.0035)	(0.0036)	(0.0038)	(0.0041)	(0.0041)	(0.0041)
Controls	X	X	X	X	X	X	X	X
N	151 278	206 587	209 902	217 697	220 138	226 134	230 611	236 232

Note: The dependent variable is the percentage point change in the reported profit rate (as defined by the tax law), lag audit is a dummy variable for firms that have been audited and fined before the tax year. The pre-reform control variables include profit rate, profit, tax base, net turnover, employment, net immaterial assets, net property, net machines, share capital, age, age square and two digit industry code. The sample contains firms with profit rate between -10 and 10 both in the actual tax year and the year before. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.10: Control and treatment group statistics

	Logit	*Logit*	*Marginal effects (dy/dx)*
Dep. variables:	Treated (=1)		
Net turnover	6.31e-05	9.59e-05	2.31e-05
	(0.000219)	(0.000221)	(5.33e-05)
Number of employees	-0.00682***	-0.00701***	-0.00169***
	(0.00225)	(0.00230)	(0.000553)
Wage bill	1.203	1.305	0.315
	(1.470)	(1.484)	(0.358)
Immaterial assets	-0.00535	-0.00494	-0.00119
	(0.00486)	(0.00483)	(0.00117)
Tangible assets	-0.000895**	-0.000882**	-0.000213**
	(0.000429)	(0.000438)	(0.000106)
Age	0.0186***	0.0188***	0.00452***
	(0.00352)	(0.00356)	(0.000854)
Manufacturing		0.0493	0.0120
		(0.0959)	(0.0234)
Utilities		-0.00343	-0.000836
		(0.231)	(0.0564)
Construction		0.0910	0.0220
		(0.0981)	(0.0238)
Wholesale, retail trade		0.0288	0.00700
		(0.0928)	(0.0226)
Transportation, warehousing		0.00653	0.00159
		(0.119)	(0.0290)
Accommodation services		0.256**	0.0610**
		(0.113)	(0.0271)
Information, communication		-0.0550	-0.0135
		(0.121)	(0.0297)
Finance, insurance		0.167	0.0401
		(0.200)	(0.0475)
Real estate		0.199	0.0477
		(0.129)	(0.0307)
Professional, scientific, and technical services		0.129	0.0310
		(0.104)	(0.0252)
Administrative services		-0.0375	-0.00917
		(0.117)	(0.0286)
Educational services		-0.154	-0.0380
		(0.172)	(0.0425)
Health		0.241*	0.0574*
		(0.132)	(0.0313)
Arts, entertainment, recreation		-0.0149	-0.00365
		(0.149)	(0.0365)
Other services		0.111	0.0269
		(0.138)	(0.0332)
Constant	0.268***	0.201**	
	(0.0315)	(0.0924)	
N	15 548	15 547	15 547

Note: The control group includes firms switching from below the threshold profit rate to above before the reform (from year 2005 to 2006), the treatment group include firms switching after the reform (from year 2006 to 2007). The dependent variables are in levels. All monetary variables are in million forints. The baseline reference group for the industry dummy includes firms in the Agricultural production, forestry, fishing and mining sectors. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.11: Control and treatment group statistics

	Descriptive statistics (mean)			
	Control (switch between 2005 and 2006)	*Treatment (switch between 2006 and 2007)*	*Difference between treatment and control group means*	*Standard error for difference between means*
Revenue	81.00	78.41	-2.60	3.37
Operational profit	0.46	0.42	-0.04	0.03
Number of employees	8.02	6.88	-1.14***	0.23
Wage bill	0.009	0.008	-0.001***	0.00
Immaterial assets	0.37	0.29	-0.09	0.06
Tangible assets	18.29	15.21	-3.08***	0.78
Balance sheet total	49.48	42.55	-6.94***	1.79
Capital share	18.66	15.50	-3.16***	0.78
Tax base	-0.14	-0.06	0.08	0.05
Age	7.31	7.67	0.36***	0.08
Total number of firms	6 523	9 239		

Note: All monetary variables are in million forints. Stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.12: Industry classification (percentage)

Industry classification code	*Control (switch between 2005 and 2006)*	*Treatment (switch between 2006 and 2007)*
Agricultural production, forestry, fishing, mining	3.8	3.4
Manufacturing	16.7	16.2
Utilities	0.6	0.6
Construction	13.8	14.1
Wholesale, retail trade	27.3	26.4
Transportation, warehousing	4.0	3.8
Accommodation services	4.7	5.6
Information, communication	4.0	3.7
Finance, insurance	0.8	0.9
Real estate	2.9	3.4
Professional, scientific, and technical services	8.4	9.3
Administrative services	4.9	4.2
Public administration and defence	0.0	0.0
Educational services	1.3	1.1
Health	2.6	3.2
Arts, entertainment, recreation	1.9	1.8
Other services	2.3	2.4
Total number of firms	6 523	9 239

Table A.13: Robustness analyses: Changes in reported cost structure for firms that switch their profit ratio from the 0-2 per cent interval to the 2-6 per cent (control variables normalized by balance sheet total)

			Changes in			
Dep. variables:	*Adjusted profit rate*	*Material cost*	*Other cost*	*Service cost*	*Wage cost*	*Wage benefit*
			per net turnover ratio			
$T_i = 1$ *(after reform)*	-0.002***	-0.014***	-0.000	0.000	0.005***	0.00
	(0.000)	(0.003)	(0.002)	(0.004)	(0.002)	(0.001)
Constant	0.016***	-0.016*	0.001	-0.026**	0.01*	-0.00
	(0.000)	(0.009)	(0.006)	(0.012)	(0.006)	(0.003)
Controls normalized by balance sheet total	X	X	X	X	X	X
N			14 705			

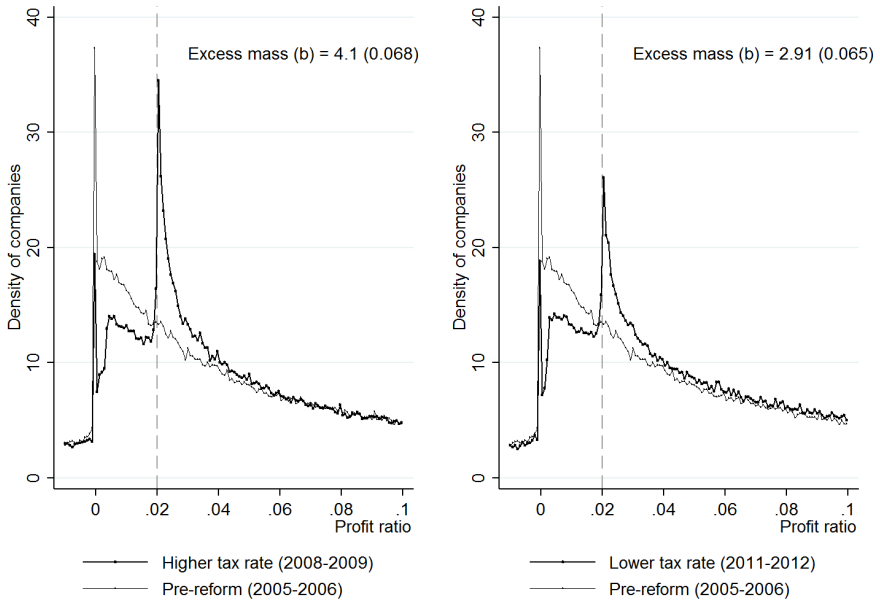
Note: All monetary control variables are normalized by the balance sheet total and includelag distance to the threshold, lag profit, lag net turnover, lag employment, lag tax base, lag immaterial assets, lag net property, lag net machines, lag share capital, age, age square and industry code. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Table A.14: Robustness analyses: Changes in reported cost structure for firms that switch their profit ratio from the 0-2 per cent interval to the 2-8 per cent

			Changes in			
Dep. variables:	*Adjusted profit rate*	*Material cost*	*Other cost*	*Service cost*	*Wage cost*	*Wage benefit*
			per net turnover ratio			
$T_i = 1$ *(after reform)*	-0.003***	-0.012***	0.002	0.001	0.003***	0.00
	(0.000)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)
Constant	0.023***	-0.019***	-0.000	-0.036***	0.018***	-0.00
	(0.000)	(0.005)	(0.003)	(0.006)	(0.003)	(0.002)
Controls	X	X	X	X	X	X
N			18 356			

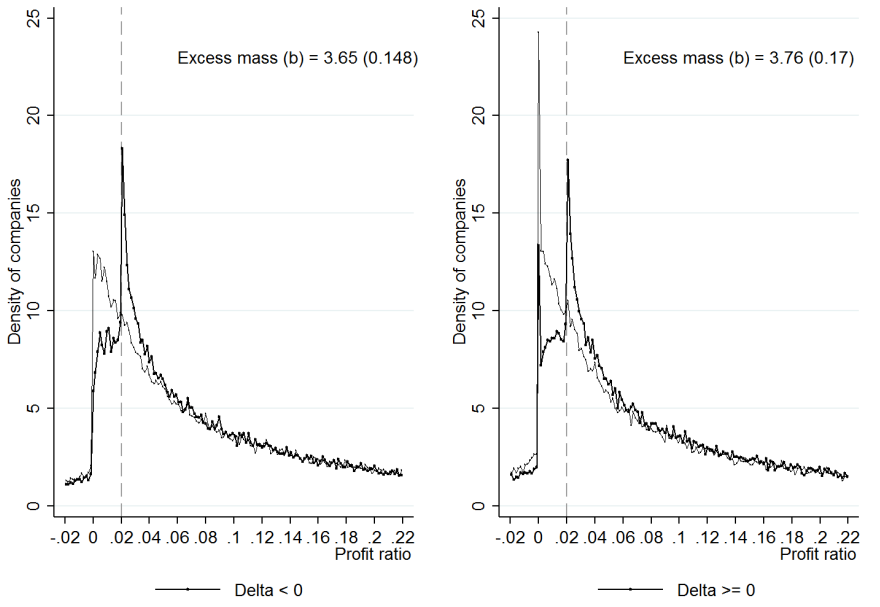
Note: The control variables include lag distance to the threshold, lag profit, lag net turnover, lag employment, lag tax base, lag immaterial assets, lag net property, lag net machines, lag share capital, age and age square. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.

Figure A.1: Firms in high and low CIT rate periods



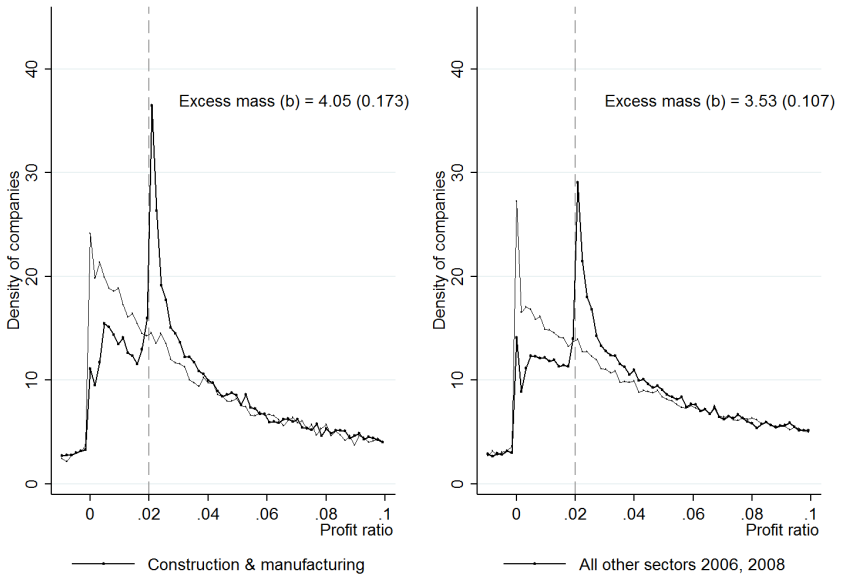
Notes: The figure presents the empirical density of firms based on their the profit rate for a high CIT rate period (2008-2009) and a lower tax rate period (2011-2012), the empirical counterfactual density is based on fiscal years 2005-2006. The bin width is 0.0008. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency after the reform and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard errors are shown in parentheses.

Figure A.2: Firms with positive and negative tax base modifying items (delta)



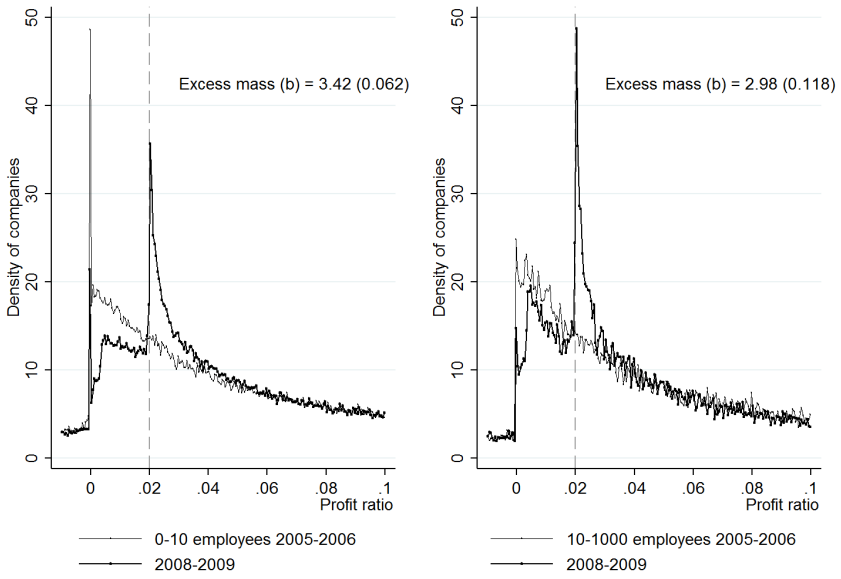
Notes: The figure presents the empirical density of firms based on their the profit rate for fiscal year 2007, the counterfactual is based on the empirical density for 2006, the last fiscal year before the introduction of the minimum tax scheme. The two groups are differentiated based on the sign of delta in 2006. The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency for 2007 and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard errors are shown in parentheses.

Figure A.3: Firms at different industrial sectors



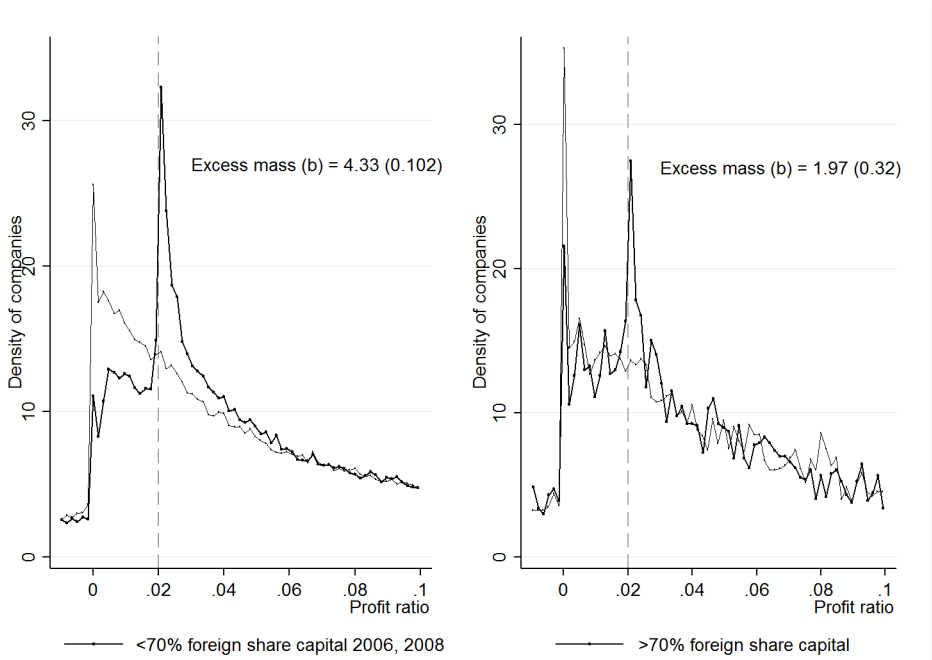
Notes: The figure presents the empirical density of firms based on their the profit rate for companies in the construction & manufacturing sectors and in all other sectors for year 2008. The empirical counterfactual density is based on year 2006.The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency after the reform and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard errors are shown in parentheses.

Figure A.4: Firms with 0-10, and 11-1000 employees



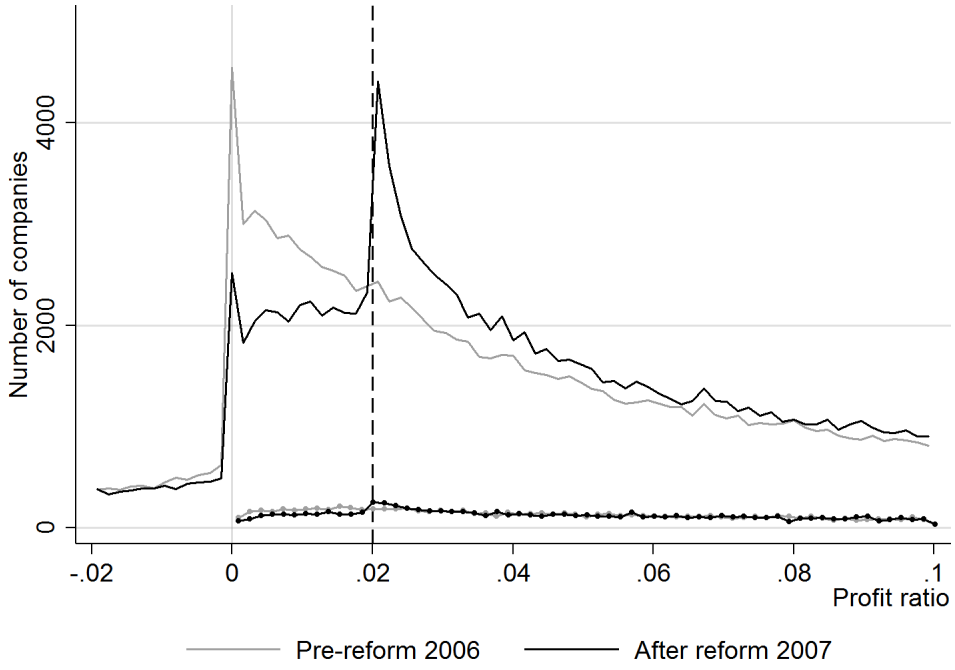
Notes: The figure presents the empirical density of firms based on their the profit rate for companies with less than 10 employees, and for companies with 11-1000 employees for year 2008-2009. The empirical counterfactual density is based on year 2005-2006. The bin width is 0.0005. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency after the reform and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard errors are shown in parentheses.

Figure A.5: Domestic versus multinational firms

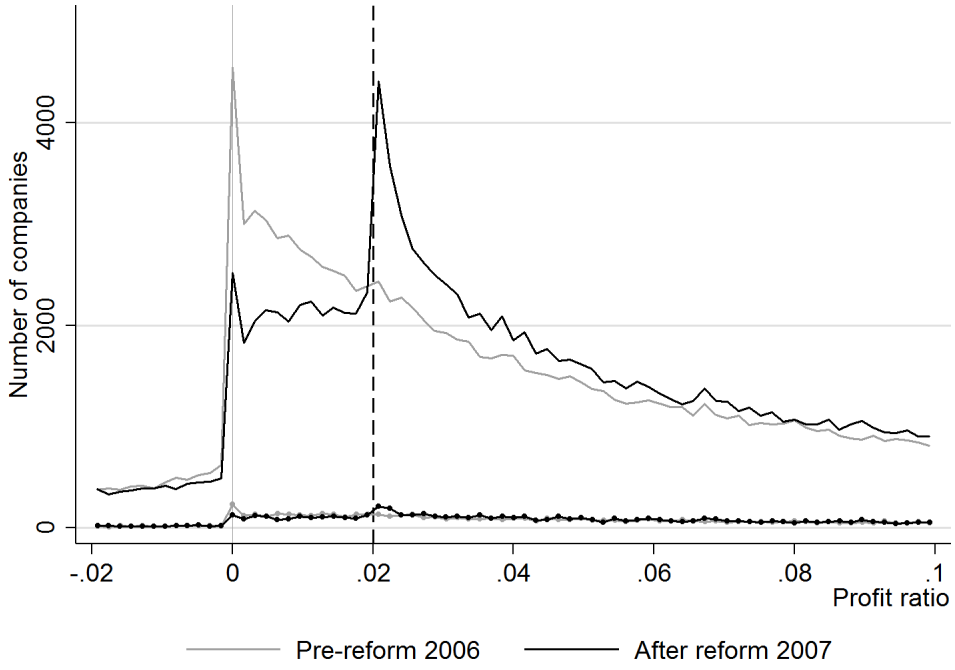


Notes: The figure presents the empirical density of firms based on their the profit rate for domestic and multinational companies for year 2008. The former are defined as firms with more than 70 percent foreign share capital, and the latter as those with less. The empirical counterfactual density is based on year 2006.The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. Excess mass b is estimated as the difference between the observed empirical frequency after the reform and the observed counterfactual frequency in the bunching range above the threshold, in proportion to the average counterfactual frequency below the threshold. Bootstrapped standard errors are shown in parentheses.

Figure A.6: All firms, and firms reporting tax base increasing item of "expenses due to given subsidies, debt assumption, released liabilities"

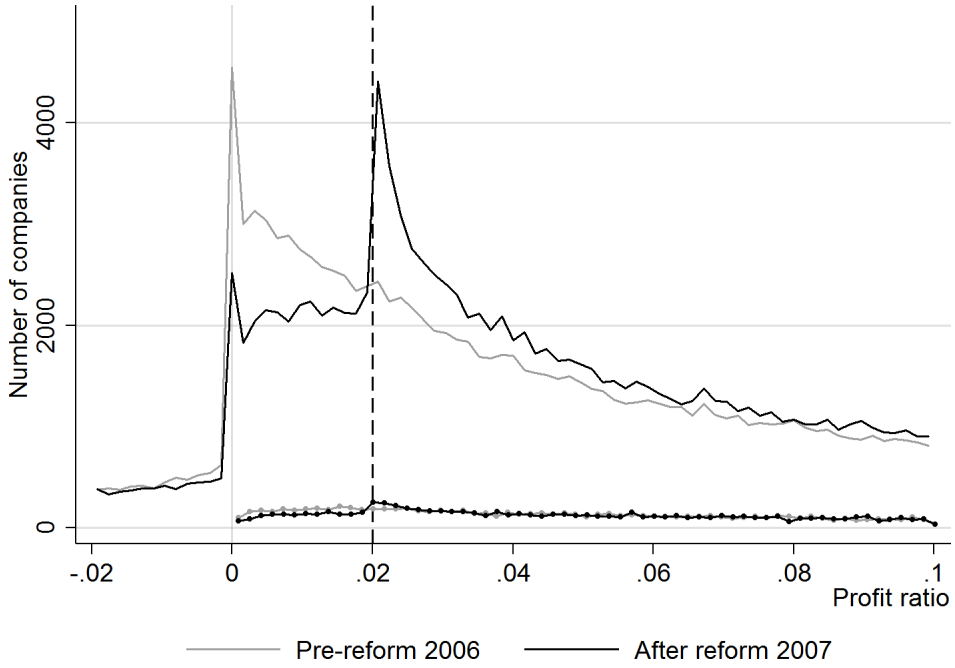


All firms, and firms reporting tax base increasing item of "loan impairment losses"

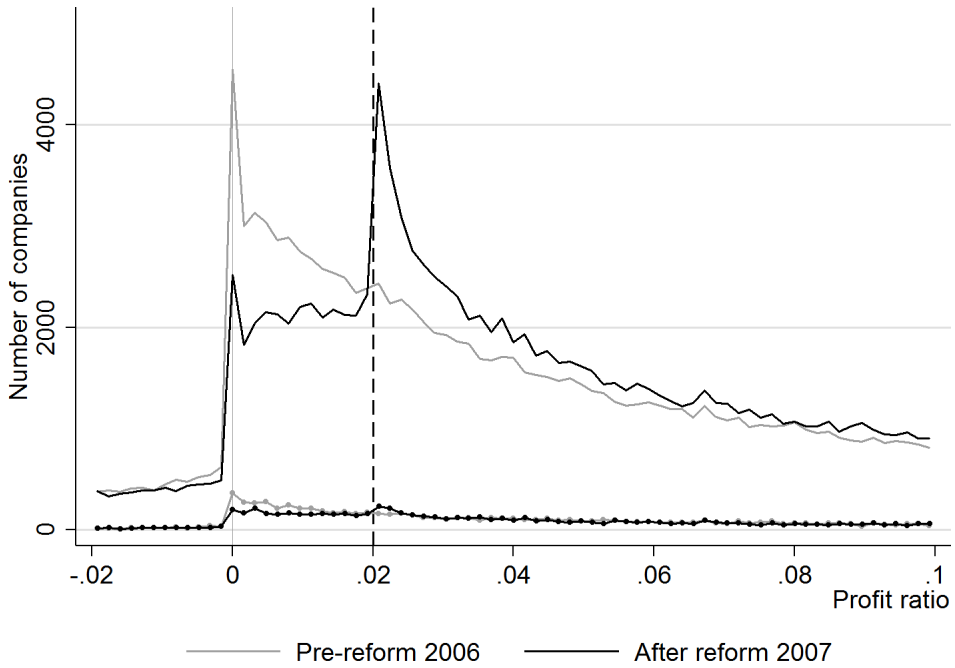


Notes: The figure presents the empirical frequency of firms based on their profit rate for fiscal year 2007. The counterfactual is the last fiscal year before the introduction of the minimum tax scheme (2006). The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. The solid line represents all firms in the profit rate range on the horizontal axis, while the dotted line represents firms with reporting tax base increasing item of "expenses due to subsidies, debt assumption, released liabilities" in the upper panel, and "loan impairment losses" in the lower panel.

Figure A.7: All firms, and firms reporting tax base decreasing item of "donation"

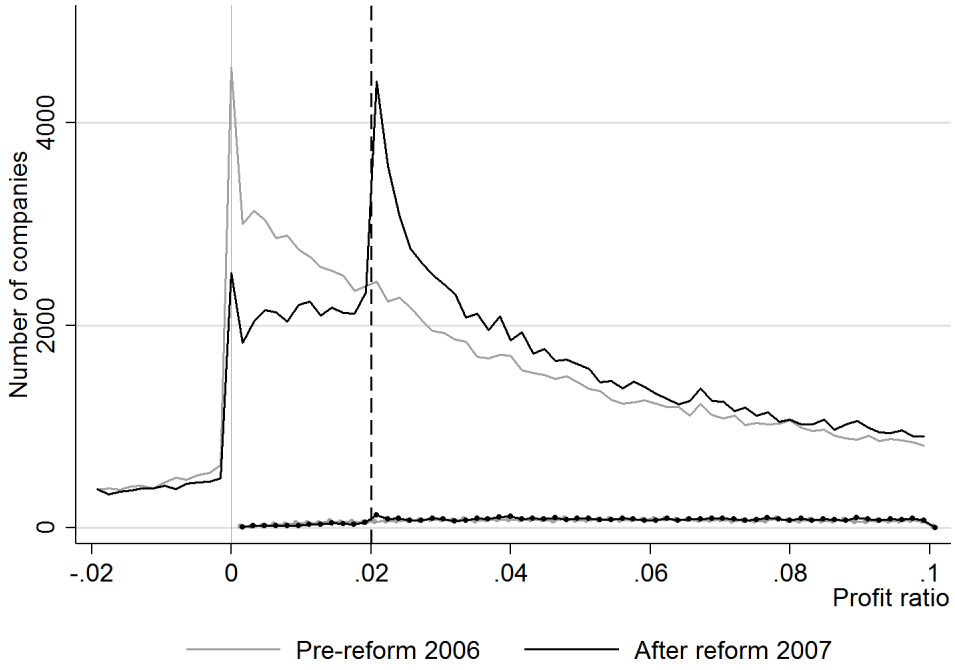


All firms, and firms reporting tax base decreasing item of "received subsidies, debt assumption and released liabilities"

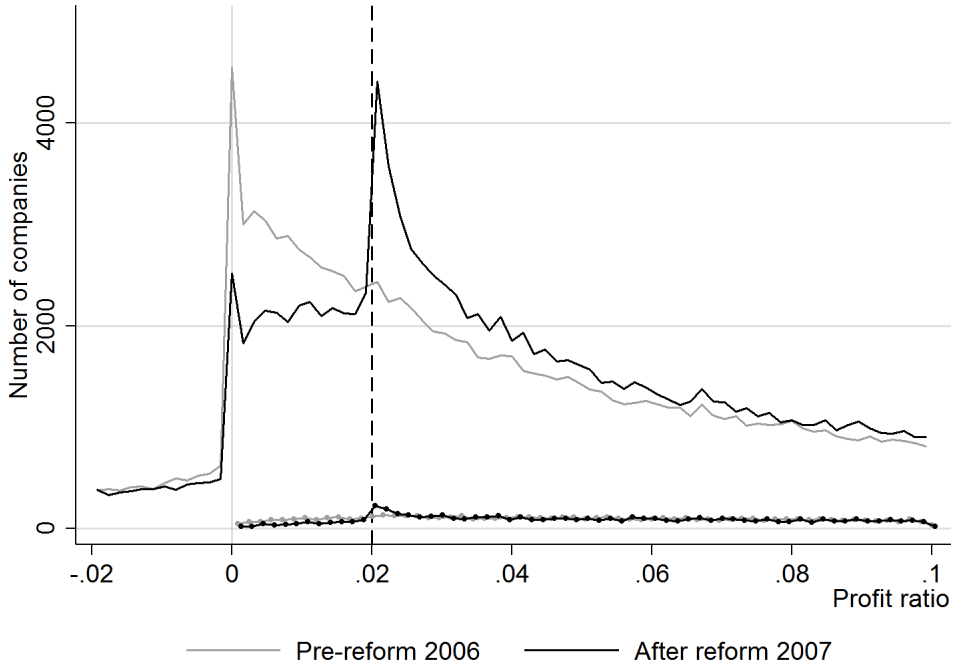


Notes: The figure presents the empirical frequency of firms based on their profit rate for fiscal year 2007. The counterfactual is the last fiscal year before the introduction of the minimum tax scheme (2006). The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. The solid line represents all firms in the profit rate range on the horizontal axis, while the dotted line represents firms with reporting tax base increasing item of "donation" in the upper panel and "received subsidies, debt assumption and released liabilities" in the lower panel.

Figure A.8: All firms, and firms reporting tax base decreasing item of "investment subsidy for small and medium size enterprises"



All firms, and firms reporting tax base decreasing item of "reserves for the purpose of future developments"



Notes: The figure presents the empirical frequency of firms based on their profit rate for fiscal year 2007. The counterfactual is the last fiscal year before the introduction of the minimum tax scheme (2006). The bin width is 0.0016. The 2 percent profit threshold is marked by a vertical dashed line; the 0 profit rate is marked by a vertical solid line. The solid line represents all firms in the profit rate range on the horizontal axis, while the dotted line represents firms with reporting tax base increasing item of "investment subsidy for small and medium size enterprises" in the upper panel, and "reserves for the purpose of future developments" in the lower panel.

10.14754/CEU.2016.02

B Appendix for Chapter 2

B.1 Tables

Table B.1: Robustness analysis 1. Income limits of the sample.

	Income range: HUF 4-8 million		Income range: HUF 5-20 million	
	(1)	(2)	(3)	(4)
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.182***	0.183***	0.211***	0.154***
	(0.064)	(0.059)	(0.059)	(0.055)
dlog(1-AETR)		-0.756***		-0.862***
		(0.171)		(0.257)
log(initial income)		-0.041*		-0.130***
		(0.024)		(0.022)
Female	-1.354***	-1.188***	-1.858***	-1.572***
	(0.300)	(0.278)	(0.387)	(0.356)
Age	-0.010	-0.016**	-0.018**	-0.018**
	(0.007)	(0.007)	(0.009)	(0.008)
Female*Age	0.054***	0.048***	0.075***	0.063***
	(0.016)	(0.014)	(0.019)	(0.018)
Age-squared	0.000	0.000	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
Female*Age-squared	-0.001***	-0.000***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Gender info missing	0.039**	0.040**	0.065***	0.068***
	(0.018)	(0.016)	(0.018)	(0.017)
Large city	0.034***	0.027***	0.041***	0.028**
	(0.011)	(0.010)	(0.013)	(0.012)
Village	-0.024*	-0.025**	-0.015	-0.021
	(0.013)	(0.012)	(0.017)	(0.016)
High capital income 2005	0.023	0.028	0.030	0.041*
	(0.021)	(0.019)	(0.024)	(0.022)
Employer tax filing 2005	0.031***	0.031***	0.046***	0.042***
	(0.010)	(0.009)	(0.013)	(0.012)
Constant	0.179	0.892**	0.311*	2.341***
	(0.140)	(0.384)	(0.165)	(0.378)
Observations	13,303	13,303	10,188	10,188
Diagnostic tests				
Exogeneity of tax rate variables (p-value)	0	0	2.47e-06	0
Kleibergen-Paap underid. test (p-value)	0	0	0	0
F-stat – first-stage reg. for (1-METR)	1028.2	550.1	1737.5	1401.6
F-stat – first-stage reg. for (1-AETR)	-	511.1	-	251.6
Kleibergen-Paap weak ident. test (F-stat)	1028	497.1	1737	231.2

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

Table B.2: Robustness analysis 2. Time period 2005-2007.

	(1)	(2)	(3)	(4)
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.126**	0.108*	0.112**	0.201***
	(0.057)	(0.061)	(0.056)	(0.059)
dlog(1-AETR)			-0.566**	-0.632***
			(0.224)	(0.227)
log(initial income)		-0.056	-0.060	-0.029
		(0.051)	(0.048)	(0.048)
Female				-0.385***
				(0.070)
Age				-0.003***
				(0.001)
Female*Age				0.008***
				(0.002)
Gender info missing				-0.052
				(0.033)
Large city				0.029**
				(0.014)
Other city				0.006
				(0.016)
Village				-0.033*
				(0.019)
High capital income 2005				0.026
				(0.027)
Employer tax filing 2005				0.075***
				(0.013)
Constant	-0.078***	0.794	0.847	0.458
	(0.006)	(0.801)	(0.744)	(0.749)
Number of observations	7,249	7,249	7,249	7,249
Diagnostic tests				
Exogeneity of tax rate variables (p-value)	3.60e-07	4.16e-07	0	0
Kleibergen-Paap underid. test (p-value)	0	0	0	0
F-stat – first-stage reg. for (1-METR)	1053.6	904.1	555.1	503.0
F-stat – first-stage reg. for (1-AETR)	-	-	358.0	346.3
Kleibergen-Paap weak ident. test (F-stat)	1054	904.1	341.6	329.8

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

Table B.3: Robustness analysis 3. Excluding atypical taxpayers.

	(1)	(2)	(3)	(4)
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.269**	0.339	0.323*	0.356**
	(0.124)	(0.210)	(0.185)	(0.181)
dlog(1-AETR)			-0.923***	-1.042***
			(0.277)	(0.284)
log(initial income)		0.033	0.024	0.036
		(0.088)	(0.077)	(0.076)
Female				-0.560***
				(0.084)
Age				-0.004***
				(0.001)
Female*Age				0.012**
				(0.001)
Gender info missing				0.057***
				(0.019)
Large city				0.040**
				(0.016)
Other city				-0.002
				(0.017)
Village				-0.015
				(0.019)
High capital income 2005				0.009
				(0.028)
Employer tax filing 2005				0.041***
				(0.013)
Constant	-0.097***	-0.615	-0.495	-0.533
	(0.009)	(1.359)	(1.202)	(1.176)
Number of observations	6,164	6,164	6,164	6,164
Diagnostic tests				
Exogeneity of tax rate variables (p-value)	2.84e-05	0.000401	0	0
Kleibergen-Paap underid. test (p-value)	0	0	0	0
F-stat – first-stage reg. for (1-METR)	2770	1028	517.1	516.7
F-stat – first-stage reg. for (1-AETR)	-	-	205	189
Kleibergen-Paap weak ident. test (F-stat)	2770	1028	203.1	186.6

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

Table B.4: Regression results for groups by gender

	(1)	(2)	(3)	(4)
Sample:	women	women	men	men
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.319**	0.291***	0.207**	0.237***
	(0.133)	(0.111)	(0.092)	(0.082)
dlog(1-AETR)		-1.253***		-0.680**
		(0.477)		(0.300)
log(initial income)	0.122	0.099	-0.053	-0.034
	(0.104)	(0.087)	(0.068)	(0.062)
Age	0.011***	0.007***	-0.004***	-0.004***
	(0.002)	(0.0202)	(0.001)	(0.001)
Large city	0.059*	0.036	0.029	0.024
	(0.030)	(0.027)	(0.021)	(0.020)
Other city	0.025	0.019	-0.003	-0.006
	(0.036)	(0.030)	(0.023)	(0.022)
Village	0.015	0.002	-0.029	-0.030
	(0.039)	(0.032)	(0.027)	(0.024)
High capital income 2005	-0.061	-0.048	0.043	0.045
	(0.060)	(0.051)	(0.033)	(0.030)
Employer tax filing 2005	0.040	0.037	0.056***	0.056***
	(0.028)	(0.024)	(0.018)	(0.017)
Constant	-2.510	-1.992	0.863	0.559
	(1.662)	(1.366)	(1.056)	(0.968)
Number of observations	2,143	2,143	4,215	4,215
Diagnostic tests				
Exogeneity of tax rate variables (p-value)	0	0	0.027	0
Kleibergen-Paap underid. test (p-value)	0	0	0	0
F-stat – first-stage reg. for (1-METR)	357.8	294.5	486.4	365.4
F-stat – first-stage reg. for (1-AETR)	-	69	-	161.4
Kleibergen-Paap weak identification test (F-stat)	357.8	56.4	486.4	157

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

Table B.5: Regression results for age groups

	(1)	(2)	(3)	(4)	(5)	(6)
Sample:	younger than 30	younger than 30	between 30 and 55	between 30 and 55	older than 55	older than 55
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.667*	0.660	0.173**	0.208***	0.334**	1.108
	(0.391)	(0.503)	(0.078)	(0.065)	(0.168)	(0.838)
dlog(1-AETR)		-0.088		-1.122***		13.305
		(2.189)		(0.238)		(12.653)
log(initial income)	0.079	0.077	-0.009	0.012	-0.005	0.271
	(0.206)	(0.231)	(0.058)	(0.050)	(0.277)	(0.631)
Female	-0.324***	-0.319**	-0.044***	-0.030**	-0.151	-0.346
	(0.051)	(0.141)	(0.016)	(0.014)	(0.160)	(0.421)
Gender info missing	0.048	0.048	0.059**	0.061***	0.209	0.560
	(0.039)	(0.039)	(0.024)	(0.022)	(0.141)	(0.496)
Age	0.001	0.000	0.001	0.000	-0.039	-0.076
	(0.013)	(0.014)	(0.001)	(0.001)	(0.037)	(0.083)
Large city	0.044	0.042	0.039**	0.029*	-0.072	0.006
	(0.047)	(0.062)	(0.018)	(0.016)	(0.091)	(0.167)
Other city	0.062	0.060	-0.001	-0.005	-0.194*	-0.476
	(0.048)	(0.069)	(0.020)	(0.018)	(0.114)	(0.392)
Village	0.010	0.009	-0.022	-0.027	-0.204	-0.590
	(0.051)	(0.061)	(0.023)	(0.020)	(0.128)	(0.555)
High capital income 2005	-0.147	-0.144	0.026	0.029	0.051	0.009
	(0.162)	(0.177)	(0.028)	(0.023)	(0.124)	(0.250)
Employer tax filing 2005	0.027	0.027	0.056***	0.055***	-0.015	-0.193
	(0.039)	(0.039)	(0.016)	(0.014)	(0.090)	(0.287)
Constant	-1.330	-1.296	-0.014	-0.360	2.209	0.576
	(3.234)	(3.675)	(0.913)	(0.779)	(5.180)	(10.422)
Number of observations	1,172	1,172	5,384	5,384	339	339
Diagnostic tests						
Exogeneity of tax rate variables (p-value)	0.187	0	0.0014	0	0.062	0.0001
Kleibergen-Paap underid. test (p-value)	0	0.0035	0	0	0.08	0.08
F-stat – first-stage reg. for (1-METR)	116.04	154.9	702.9	487	482.9	234
F-stat – first-stage reg. for (1-AETR)	-	10.3	-	221.1	-	11.26
Kleibergen-Paap weak identification test (F-stat)	116.04	4.13	702.9	216.8	482.9	1.71

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

Table B.6: Regression results for groups by income source

	(1)	(2)	(3)
Sample:	Wage income only	Not only wage income	Some capital income
Dependent variable:	dlog(tax base)	dlog(tax base)	dlog(tax base)
dlog(1-METR)	0.252**	0.235***	0.215**
	(0.111)	(0.077)	(0.106)
dlog(1-AETR)	-0.841**	-0.845**	-0.807
	(0.362)	(0.427)	(0.786)
log(initial income)	0.019	-0.026	-0.021
	(0.065)	(0.076)	(0.161)
Female	-0.987*	-2.309***	-4.449***
	(0.520)	(0.713)	(1.617)
Age	-0.012	-0.017	-0.026
	(0.012)	(0.019)	(0.026)
Female*Age	0.035	0.101***	0.206**
	(0.027)	(0.035)	(0.081)
Age-squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Female*Age-squared	-0.000	-0.001**	-0.002**
	(0.000)	(0.000)	(0.001)
Gender info missing	0.058***	0.022	0.145*
	(0.021)	(0.039)	(0.074)
Large city	0.037**	0.030	-0.024
	(0.016)	(0.020)	(0.038)
High capital income 2005		0.035	0.028
		(0.027)	(0.037)
Employer tax filing 2005	0.033*	0.067***	0.070
	(0.017)	(0.023)	(0.057)
Constant	-0.117	0.654	0.753
	(1.032)	(1.183)	(2.547)
Number of observations	4,239	2,656	714
Diagnostic tests			
Exogeneity of tax rate variables (p-value)	0	0	0
Kleibergen-Paap underid. test (p-value)	0	0	2.67e-08
F-stat – first-stage reg. for (1-METR)	203.7	472.2	470.3
F-stat – first-stage reg. for (1-AETR)	117.7	96.5	24.4
Kleibergen-Paap weak identification test (F-stat)	115.3	89.7	21.41

Note: All results are from IV estimations with robust standard errors. Robust p-values in parentheses. Asterisks mark estimated parameters that are significantly different from zero at the 1% (***), 5% (**), or 10% (*) level.

B.2 The derivation of the income effect

In the main specifications we followed Bakos et al. (2008) in the operationalization of the income effect. Their solution is a slight variant of that by Gruber and Saez (2002), the difference being a minor step of approximation. In explaining the difference we somewhat extend the exposition of Bakos et al. (2008).

The starting point of the theory is an optimizing agent who has an income supply function $y = y((1-\tau), R)$, where τ is the marginal tax rate and R is virtual income. Virtual income is defined, in a non-linear tax schedule, by the expression $y - T(y) = R + (1+\tau)y$, where $T(y)$ is the total tax due at income level y. The agent's response to a tax change can be written as:

$$dy = -\frac{\partial y}{\partial(1-\tau)}d\tau + \frac{\partial y}{\partial R}\partial R$$

Introducing the uncompensated tax price elasticity $\beta^u = [(1-\tau)/y] / [\partial y/\partial(1-\tau)]$, the income effect $\phi = (1-\tau)\partial y/\partial R$ and the compensated tax price elasticity $\beta = \beta^u - \phi$ we obtain:

$$\frac{dy}{y} = -\beta\frac{\partial\tau}{1-\tau} + \phi\frac{dR - yd\tau}{y(1-\tau)}$$

Most studies estimate this equation in a log-log specification, replacing dy/y by $log(y_2/y_1)$ and $(-d\tau/(1-\tau))$ by $log\,[(1-\tau_2)/(1-\tau_1)]$. Before Gruber and Saez (2002) the income effect was mostly assumed to be zero. They, in contrast, did include the income effect in the estimation by approximating the last term $(dR - yd\tau)/(y(1-\tau))$ with $log\,[(y_2 - T_2(y_2))/(y_1 - T_1(y_1))]$. As they note in a footnote on page 10 they use the approximation $y(1-\tau) \approx y - T(y)$ to obtain this form. We can thus reconstruct their derivation as follows:

$$\frac{dR - yd\tau}{y(1-\tau)} \approx \frac{d\,[y - T(y)]}{y(1-\tau)} \approx \frac{d\,[y - T(y)]}{y - T(y)} \approx log\frac{y_2 - T_2(y_2)}{y_1 - T_1(y_1)}$$

We can derive the approximation of Bakos et al. (2008) "backwards", i.e., starting from the resulting form and reaching the original expression, as follows:

$$d\,log\left(\frac{y-T(y)}{y}\right) = d\,log\left(\frac{R+y-y\tau}{y}\right) = \frac{dR+dy-dy\tau}{R+y-y\tau} - \frac{dy}{y} \approx \frac{dR+dy-\tau dy-yd\tau}{y(1-\tau)} - \frac{dy}{y} = \frac{dR-yd\tau}{y(1-\tau)}$$

Here the first equality follows from the definition of virtual income R; the second equality follows from total differentiation; the third step uses, in the denominator, the same approximation that Gruber and Saez also use $(R + y - y\tau = y - T(y) \approx y(1-\tau))$; while the last step is just a subtraction.

The difference between both approximations is slight. Total differentiation in the derivation of Bakos et al. means that in that step they allow y to change as well as the tax rates. In contrast, the first step in the derivation of Gruber and Saez, as reconstructed here, holds exactly only if income is constant; it is an approximation if income changes.

Clearly, both approximations are legitimate. In this paper we choose the approximation of the income effect as derived by Bakos et al. for two reasons. First, while this form is reached using a crucial approximating step Gruber and Saez also uses, it appears to us that altogether it is reached after fewer approximating steps. Second, we find it aesthetically appealing to measure both the substitution and the income effect by the change of an easily interpretable tax rate, i.e., by the change of the marginal and average net-of-tax rate, respectively.

C Appendix for Chapter 3

C.1 Introduction

This appendix describes the data sources and income definitions used in the construction of the income share estimates, as well as the adopted measurement methodology. As it is the case with previous research on the evolution of top income shares, the timeframe of our paper extends to multiple decades. In a marked distinction with the rest of the literature, our paper concerns a national boundary that has experienced significant institutional changes and whose comparative analysis yields the support of our reasoning. Our timeframe is bracketed by highly consequential events such as the dissolution of Austria-Hungary under the treaties of St. Germain and Trianon, the two World Wars, the establishment of the People's Republic of Hungary in 1949, and finally the transition to a market economy.

We assemble primary data from historical statistics and administrative sources. We use the tax system and its generated income tax statistics as a measurement instrument for the upper tail of the income distribution for the periods prior to the Second World War, and after the transition to a market economy. We use the available earning censuses in the socialized sector from the period of the People's Republic of Hungary up to the transition to the Republic of Hungary, a period that we will be referring to as the planned economy period. Allowing for the varying definitions of income included in our data sources, we construct homogeneous aggregates to establish comparability between periods and we define the top income shares accordingly.

In Section 2, we present a historical account of the evolution of the income tax system for the periods 1914-1940 and 1989-2008, the available tax statistics, and then explain the use we made of them. We document the relevant income concept in the tax code, the income tax statistics, and the adjustments we introduced in order to homogenize the top income share estimates. In Section 3, we discribe the available earning censuses we use to estime the top shares for the planned economy period. Section 4, 5 and 6 contain the detailed description of the tax units, income control and price index.

A detailed account of the various data sources is presented at the end of the Appendix.

C.2 Income Tax Statistics, 1914-2008

C.2.1 19th Century Historical Account

The short-lived revolutionary government of Lajos Kossuth introduced an income tax in almost immediately in 1848 as part of the reforms known as "March laws." A conspicuous characteristic of the system of direct taxation prior to this period concerning the top of the income distribution was that the numerous and wealthy nobility retained a tax exemption status established during the Middle Ages. The enactment of Act VIII by the revolutionary government of 1848 under the headline "on the common sharing of burdens" ("*a közös teherviselésről*") manifests a change in this situation, leaving future assemblies to legislate on the precise nature of the newly born tax system.[1] However, due to the overthrow of the revolutionary government an income tax that adheres to this law never came into effect.

The Habsburg Tax Reform of 1850 brought into effect a personal wage earnings (*kereseti adó*) and personal income tax (*jövedelemadó*), along with an array of direct taxes on land (*földadó*), built property (*házadó*), on capital gains (*tőkekamatadó*) and a corporate income tax (*vállalati adó*). This

[1] See Krivoss (1946), pp. 9-10, Murray-Haig, R. and L. László-Ecker (1935)

system evolved after the Constitutional Reforms of 1867 as necessitated by the new administrative arrangement of the Dualist system, which establishes Austria-Hungary as a customs and monetary union with independent national fiscal mechanisms.

Direct taxation evolved in tandem with the new forms of property and wealth as a result of early industrialization and the imperative of the construction of the national state. The first tax system free of Austrian influences was established during the 1875 direct tax reform, with "earnings tax" (*kereseti adó*) similar to the *Classensteuer* in Prussia, see Dell (2007). This earnings tax categorized people in "classes" and levied taxes accordingly. Day laborers, servants and agricultural workers belonged to Class I and paid fixed per capita tax amounts. Taxes levied in Class II were structured as surtaxes on owners of property and land, as well as those receiving either capital income or annuities. Taxpayers receiving personal income from industrial, commercial, mining and liberal professional activities belonged to Class III and were obliged to report to the tax authorities the total amount of income retrospectively for the past three years. Class IV included employees with a pay-as-you-earn scheme, similar to the Prussian *Lohnsteuer* system. Statistics produced by the administration of these direct taxes exist, but they are not in a form amenable to our estimation strategy.

C.2.2 Austria-Hungary (1914-1915)

A comprehensive, progressive personal income tax is introduced in the Hungarian Kingdom in 1909 with a tax reform during the premiership of Sándor Wekerle. Along with some minor revisions in 1912, it constitutes the relevant income tax code for the beginning of our timeframe, namely the income years 1914-1915 during Austria-Hungary.[2]

The first effective income year of this modern personal income tax was the year 1914 for net income above 20,000 crowns. This threshold was subsequently reduced to 10,000 crowns in fiscal year 1917. The progressivity of the general income tax rate was rather obtuse, ranging from 0.5% to 5% over 74 brackets (see Figure C.1).[3]

We use the two installments of the *Jövedelemadóstatisztika* income tax statistics published by the Hungarian Royal Ministry of Finances (1916, 1917) for income years 1914 and 1915, respectively. We use the figures that document total net tax base and tax levied on tax units across the sixty-four provinces of Hungary, and the eight provinces of the autonomous Kingdom of Croatia-Slavonia along with the port of Fiume and its suburbs, which together constitute a region that fell under the jurisdiction of the Hungarian Kingdom at the time. Population and income control totals for this period are referring to the same geographical area.

In the relevant tax code, declared income is defined as gross income net of expenses, depreciation, and maintenance costs. The total net tax base is formed by further subtracting other direct taxes from the reported income, as well as interest expenses, pension policies and war aid contributions, etc. The published tax tables include net income subject to tax (*vallomást adók*) as well as "income declared at a first instance" (*első fokon adóval megterheltek*), i.e., the total income assessed by regional ad hoc tax auditing committees appointed to assess in retrospect for the past year the income declared of incomplete, missing, or tax filings of contestable credibility.[4]

[2]See Murray-Haig and László-Ecker (1935), p. 71, Fellner (1926), p. 3, Fellner (1916), pp. 50-61

[3]The low progressivity of the tax code at a time of war is compatible with the historical fact that the bulk of the war expenditure was met by seignorage, apart from a minimal one-off special tax levy in income years 1914, see Sargent(1982).

[4]The committee members were selected in order to represent all taxpayer groups including the Chamber of Commerce, industrialists and lawyers, liberal professionals, land, real estate and capital owners and were required to possess information on the income and wealth conditions of the citizens living that area. They were entitled to invite tax experts and witnesses to their meetings, question the taxpayers on their income and expenses and check their business balances.

The total income above the threshold of 20,000 crowns had to be reported in five different categories separately, roughly corresponding to the various sources of income, in order to assess different deductible items and to form the net tax base. Category I includes income from land used in agriculture and forestry (*földbirtokból*), whereas Category II concerns income from built property and real estate (*házbirtokból*). Both of these comprise declared net rental income or net imputed rents based on the average rent in the area. Category III is applied to income from industrial, commercial, and similar activities (*ipari, kereskedelmi, és egyéb kereseti foglalkozásokból*), as well as income from business activity (self-employment) in the corresponding sectors, and income assessed according to the earnings schedule of the income tax (*kereseti adó*) including remunerations of business executives. Category IV includes capital income and annuities (*tőkevagyonból és vagyonjogokból*), interest income from royalties, savings, securities, dividends, as well as income from capital placements held domestically and abroad. Income declared for tax purposes includes various capital income items, such as the ones above as well as the imputed value of in-kind income that was paid by lessees of land plots. Category V includes income from wages and salaries (*szolgálati illetményekből ellátásokból*), remunerations of employees in the public and the private sector, pensions, including bonuses and excluding executive compensation.[5]

We proceed to the following adjustments of the income tax data, in order to form the appropriate figures for our final estimates. First, in terms of fiscal units (taxpayers), we remark that the individuals who were not permanent residents of the Hungarian Kingdom, or did not live at least four months in Hungary during year t-1 for a given fiscal year t, had to pay taxes on the tripled amount of their actual land and property income realized in a given fiscal year, pertinent to income Categories I and II. Accordingly, we subtract the number of non-residents from the total number of taxpayers assigned to each bracket of the tax statistics by using Sections IV and VII of the published statistics, respectively, for income years 1914 and 1915. Second, the income tax statistics depict, per brackets, the total net tax base i.e. total declared income minus tax exempt income and deductions including other direct taxes, paid interest, and life insurance policies. We hence adjust the tax base figures using the total country-level ratio of the total reported income over the net tax base. Also the income of non-residents multiplied by a factor of three was excluded to produce the tax base.

The regulations in effect for 1914-1915 report income from executive compensation (*tantieme*) as part of Category III, while for years 1932-1940 it was reported as a separate category. To have consistent income categories between the 1914-1915 and 1927-1940 periods, we separate executive compensation from Category III based on the tantieme income fraction in fiscal year 1932, the next available year with income composition data.

C.2.3 Interwar Period (1927-1940)

Changes in the tax code during the interwar period reflect the stabilization program of the League of Nations, namely the taming of the hyperinflation episode that ensued from wartime imbalances. These fiscal imbalances led to an increase in the different direct tax rates and introduced a steep progressivity of the general income rates from 1927 on, ranging from 1% to 40%[6] with a tax-free threshold of 1,000

The lists containing the calculated income and wealth taxes for each taxpayer were displayed at the town hall. Meanwhile the taxpayers had the possibility to appeal against the tax amount declarations for 15 days, a procedure that gave rise to a second instance. (See Klug and Soltész (1917) for a detailed description, and the tax manual of Lánczi (1916) for an actual tax return of fiscal year 1915).

[5] Although the wage bill of the members of the administration (civil servants, and members of the military and civil guard (*csendőr*) was tax exempt, the income tax statistics do contain data on the declared income of the members of administrative corps whose total income exceeded the income reporting threshold; see Klug and Soltész (1917) pp. 162-163.

[6] 10 percent higher augmented tax rates applyed to singles, and those with solely one family member.

pengő; see Figure C.1. Currency conversion took place after the stabilization of 1925-1926, when the Hungarian crown (korona) was replaced by the pengő. Apart from the higher tax rates, the income concept of the income tax introduced in 1909 remained virtually unchanged. This tax code produced several installments of the *Adóstatisztika Füzetek* income tax statistics published by the Hungarian Finance Ministry and corresponding to income years 1927 and 1930-1940.[7]

The following paragraphs describe the adjustments we undertake on the *Adóstatisztika Füzet* income tables.

Income Assessment Methods The first adjustment relates to figures reported separately in different but comparable distribution tables, and under different income assessment methods. The tax income statistics for the income period 1927-1940 contain income figures assessed for tax purposes in two broad categories, namely (i) income "adopted" with no modification or, alternatively, income subject to "previously fixed" taxes *(rögzített adók)*, and (ii) newly assessed income (*nem rögzített adók*). Taxpayers with declared gross income less than 10,000 pengő and declared wealth less than 200,000 pengő at year t were treated in a fast-track manner by the tax authorities, who "adopted" legally the taxpayer's income and wealth for the subsequent year t+1 as an income subject to "fixed" taxation. In this case, the taxpayer did not have to file a tax return in the subsequent year, unless the declared income was significantly revised either upwards or downwards, at which point, the income was considered as "newly assessed".[8] Newly assessed, non-fixed income included two categories: income above the 10,000 pengő threshold that could not be fixed (*nem rögzíthető*) and income below 10,000 pengő that was not yet fixed (*rögzíthető*) due to incomplete tax year or because it was the first year to be assessed.

For income years 1932-1935 the very few taxpayers and their income in the first broad income bracket (0-10.000 pengő) in the newly assessed "non-fixable" *(nem rögzíthető)* income table are divided up into detailed brackets based on the assumption that their income distribution is the same as the "previously fixed" (*rögzített*) and "not yet fixed" (*rögzíthető*) income parts of the table with detailed income brackets below 10.000 pengő. Taxpayers and their income in the lowest newly assessed non-fixable bracket were distributed to specific brackets by keeping the adjusted mean income in the empirical mean level. We distributed the income and taxpayer figures into a consolidated table in order to increase the precision of the interpolation scheme, thereby increasing the number of brackets of the overall distribution. No such adjustment was undertaken for the income years 1936-1940, as the tables are amenable to consolidation.

Income Sources Concerning the different income categories that add up to the tax base, the statistics are reported in two different formats. For 1932-1934 all income of an individual is assigned to solely one income category corresponding to his main income source, while for 1935-1940 the various income sources of an individual are assigned to that specific income categories.[9] This change in reporting format does not influence the total estimated shares. To get comparable income compositon estimates between the two reporting formats, we adjusted the 1932-1934 income components by assuming same composition in 1934 and 1935, and keeping the relative changes for the years prior.

[7] Földvári(2009) estimates Gini coefficients based on the same tax table statistics by assuming different overall income distributions. He also calculates the share of income accruing to all taxpayers present at the tax tables, but these ad-hoc top shares are not comparable between the years, as the calculated top shares refer to different percentages of the population varying between 5% and 9.1% in different years. Further difference includes that Földvári compares household tax units reported at the tax tables to a total population denominator, and not to a tax unit denominator.

[8] A taxpayer was called to revise the amount of "adopted" income for tax purposes in the case where the taxpayer changed occupation, location, or at will. If a taxpayer declared income over an incomplete fiscal year t, then this could not be taken as an "adopted" income by the tax authority in the subsequent year t+1. See Takács (1943), pp. 483-486 for the details.

[9] E.g. During 1932-1934 capital income of an employee is reported at employment income category, while from 1935 his capital and employment incomes are reported separately at the capital and employment categories respectively.

The general tax statistics tables depict income from the following categories of income under both reporting formats. Category I includes income from land (*földbirtok*), while Category II includes income from built property and real estate (*háztulajdonból*). Income depicted in the 1914-1915 statistics as Category III is now reported separately; such as income from crafts in Category III (*iparosok*), industrial income in Category IV (*gyárosok*), trade income in Category V (*kereskedők*), income from mine ownership in Category VI (*bánya tulajdonosok*), income from liberal professions such as doctors in Category IX (*orvosok*), lawyers in Category X (*ügyvédek*) and other liberal professionals in Category XI (*egyéb értelmi szabad foglalkozásúak*). Finally, the share of profits accruing to management (tantième income) is reported in Category XII (*tantiemet élvezők*).

Category VII and VIII include income from activity using any rented property. Category XIII includes income from salaried employment (*szolgálati viszonyban lévők*). Capital income is reported in Category XIV including interest from royalties, savings, securities, dividends, and including income from wealth or rights that were not taxed neither by land, property, earnings, mining or corporate tax. Category XV is applied to income from annuities and the imputed value of in-kind (produce) income paid by lessees of cultivating lands, that was reported as capital income in the previous tax code.

To have consistent income categories between the 1914-1915 and 1927-1940 periods, we make the following adjustments.[10] Income Category VII contains reported income from activity using rented lands (*földhaszonbérlők*), which was included in Category I in the tax code of the previous years, whereas Category VIII includes income from activity using any other rented property (*egyéb haszonbérlők*), which belonged to Category III previously. Both of these categories of income can be designated as lessee income. For 1932-33 these two categories are reported jointly for the income proceeds of activity using rented land and other rented property, while for later years they are reported separately. We divided up the jointly reported lessee income for 1932-1933 based on the ratio of these two income sources in the 1934 tax statistics, at an approximate ratio of 10:1.

The regulations in effect for 1914-1915 report income from annuities and in kind income and work in exchange of renting small lands (*szolgálmány*) as capital income, while for the years 1934-1940 it was reported separately under Category XV. [11] Hence, for the years 1934-1940 in order to have comparable income composition, we added the income figures from Category XV to the capital income category. For 1932-1933 this is reported as residual income in the various Categories. We extract this part of income from the residual income category based on the 1934 ratios and incorporate it to the capital income Category for the years 1932-1933.

Tax Base In several series of income tax statistics, both total declared income net of expenses and total net tax base, i.e. total declared income minus deductible items including tax-exempt income, other direct taxes, paid interest, life insurance and pension policies are reported on the tax statistics by total tax base brackets. We inflate the tax base brackets with the average deductions using the figures of the total declared income and tax base in the respective brackets, in the following manner:

$$\text{Adjusted Income Bracket Bound} = \text{Tax Base Barcket Bound} +$$
$$\text{(Total Reported Income-Tax Base)/Number of Taxpayers in the Barcket}$$

[10] Table C.11 reports the comparison of income categories between the two periods.

[11] See Klug (1927) p. 87, Act VII of 1909, §1 "On capital income and annuities taxation" (*tőkekamat és járadékadó*), and Act 50.000, §20 of the Ministry of Finance (PM) in 1927

We undertake this adjustment for income years 1927 and 1932-1940. For income year 1927, we use the nearest such breakdown from income year 1932. For 1930-1931 no bracket inflation is needed as the income is reported by total declared income brackets.

Geographical Area As a consequance of the war territorial expansion Hungary annexed additional territiories in several phases during income years 1938-1940. For this latter period all taxpayers residing within the actual enlarged border are reported together in the income tax statistics. As the available income control total refers to the after World War I Trianon treaty area of the country during the total period of 1927-1940, we exclude taxpayers at the annexed territories from the income tables with the following adjustment procedure.

The *Adóstatisztika Füzetek* for the years of 1938-1940 report also the number of taxpayers at each of the old and newly annexed counties and larger cities by two broad income brackets (below and above 10.000 pengő). Based on these figures we calculate the ratios of taxpayers residing at the newly annexed and at the total enlarged territory of the country, and exclude these ratios of taxpayers and reported income from the overall income tables, respectively for the two broad income brackets and years.

During the first phase of annexation in 1938 not only distinct counties were annexed, but also new territories were added to several northern counties already located within the country. Taxpayers at the old and newly annexed parts of each of these counties are reported separately in the year of 1938. However for later years, when their borders remained unaltered, taxpayers at the old and annexed parts are reported jointly. To be able to calculate the ratios between the old and annexed parts we assume that the proportion of taxpayers remained the same.

C.2.4 Post-Transition (1992-2008)

The present day income tax code was introduced by Act VI of 1987 and was modified after the transition by Act XC of 1991. The declared total income comprises two categories: "comprehensive income" (*összevont adóalap*) and "separately taxed income" (*különadózó jövedelmek*).

During the period of our timeframe the comprehensive income is taxed progressively with the number of tax brackets gradually varying between seven and two, and top marginal rates between 48% to 36%; see Figure C.2, Figure C.3 and Figure C.4 for the evolution of marginal statutory tax rates. Declared income in the comprehensive category is structured along three main income subcategories: (i) income from dependent activity, mainly wages and salaries; (ii) income from independent activity such as self-employment, income from the exercise of a liberal profession, and small-scale agricultural income; (iii) and other income such as income earned abroad, tax-exempt income such as pensions, scholarships, and maternity benefits.

The separately taxed income is formed as a schedular tax on capital income items, with different flat tax rates applied to separate categories of capital income, such as dividends, capital gains, and profit from private businesses.

There is an extensive withholding system in place. Both the personal income tax and payroll taxes (employee social security contributions) are withheld at the enterprise level; employees only receive their net earned income from dependent salaried activity. Employees have to decide whether they want to submit their income report independently, thereby adding other income items e.g. from property. In either case, the employer forwards withheld taxes to the tax authorities.[12]

[12]The taxpayers have to obligatory self report their income several cases, for instance if the taxpayer has mainly separately taxed income, if the employer declines the request of the taxpayer to forward the tax application form, or if the taxpayer's main occupation is self-employment, or the taxpayer has no employer at the last day of the tax year, and

We use two categories of data sources for this period.

1. Administrative micro-data for the income years 1992-2008. For income years 1992-2002, the data consist of a random sample of 0.5% of tax filings reported by the employers, and an additional 1% sample of all tax reports submitted directly by the taxpayers themselves. For income year 2003 a random sample of 1% and 2% respectively for the previous groups. For income years 2004-2008, the data consist of a random sample of 8-10% of the universe of all tax filings.

2. Income Tax Statistics for income years 1996-2001. These are tabulated income tax statistics obtained by the Information Technology Department of the Hungarian Tax Authorities (Sztadi), which depict declared income and total number of taxpayers per total income bracket, containing the comprehensive income and separately taxed income, for the universe of tax filings.[13]

For both sources, the income concept is gross income before deductions, employee's payroll and personal income taxes, but after employers' payroll taxes. The micro-data contain the complete information reported on a tax filing, while the tabulated data contain information on the comprehensive and separately taxed income totals. The two data sources contain the same information, in two different degrees of aggregation; in particular, the aggregate tables do not contain the different income sources that are declared in a tax filing.

In order to construct a long series of estimates of the composition of the top income shares, we estimate the top income shares based on the administrative microdata source. Figure C.12 presents the estimated shares based on both the micro data sample and the aggregate income tax statistics tables.

C.2.5 Realized Capital Gains

Capital gains of selling property as a non-business activity were tax exempt after the introduction of the personal income tax in 1914, and remained tax exempt also during the interwar period. Income from realized financial capital gains are not specified as taxable capital income in the tax regulations.[14]

After the transition into the market economy realized capital gains from selling real estate and movable property had to be reported as part of the 'comprehensive' income, while after 1995 it became part of the 'separately taxed' income. The realized financial gains were reported as 'separately taxed' income. Based on the detailed micro data we can estimate the top shares excluding and including realized capital gains for the period of 1992-2008. The total income denominator of the latter series includes the total amount of the reported realized capital gains.

if he determines his cost deductions based on expenses.

[13]The Hungarian Tax Authorities publish tabulated income tax statistics bracketed by the first broad category of income (comprehensive income) for income years 1998-2010. For the period 2004-2010 the tax statistics include the separately taxed income (pertinent to capital income items); however, they are published in a form that is not amenable to our estimation strategy, since they rank the separately taxed income according to brackets that refer to the comprehensive income. Similar data sources are published by the Data Repository of the Hungarian Tax Authorities (TEIR) for the period 1992-2009.

[14]Klug, p. 166, 1925/500 §9 Financial Ministry Statute

C.2.6 Top marginal tax rates

For 1914-1940 period we compute the top marginal tax rates based on the income statistics tables as follows. First, we take the general income tax rate corresponding to the estimated mean income in a given top percentile (see Figure C.1). Then we further add the different schedular surtaxes by assuming that the marginal income earned by the taxpayer has the same composition as the mean income in that percentile (see Table C.25 for the surtax rates). For income from built property we assume that half of that is located at Budapest and the other half at rural centers. Earnings income was taxed under a progressive schedular tax, hence we use the actual highest tax rate for the top tax rate caluclation. We do not include the wealth surtax in the calculation.

The present day declared total income contains two main categories: the "comprehensive income" part taxed by a progressive personal income tax, and the "separately taxed" income part including mainly capital income items taxed with various flat schedular tax rates. To compute the top marginal tax rate we again assume that the marginal forint income has the same composition as the mean income in that top percentile. For example if the mean reported income in the top 1 percent comprises 70% comprehensive income with a corresponding t_1 top marginal personal income tax rate, 15% dividend income and 15% capital gain income with a t_2 , t_3 corresponding flat schedular tax rates respectively, then the estimated top marginal tax rate is $t = 0,7 * t_1 + 0,15 * t_2 + 0,15 * t_3$. (See Figure C.5 for the top marginal tax rate series.)

C.3 Earnings Statistics (1951-1988)

C.3.1 Labor Income

For the planned economy we use the tables reporting the distribution of earnings series found in the Statistical Yearbooks for the period 1951-1968, and published subsequently up to 1988 in the Employment and Earnings Ratios (*Foglalkoztatottság és kereseti arányok*) by the Central Statistical Office (KSH). The frequency of the earnings statistics is irregular, with the earliest available table referring to 1951. For the period 1955-1962 the censuses were collected yearly, while from 1962 onwards they were published every two years.[15]

The statistics depict the share of employees in the official sector belonging to specific gross earning brackets based on the employment censuses of state-owned enterprises conducted by the State. As a result of the reforms of 1968, the official sector underwent several changes as a grouping of statistical units. Earnings statistics refer to workers employed at state-owned enterprises and state-owned farm establishments of the State sector (*Állami szektor*) for the period 1951-1968, and state-owned enterprises, state-owned farms, and at cooperatives in the broader Socialist sector (*Szocialista szektor*) for the rest of the timeframe. From 1982, employees in private ventures having a legal entity were also included in the tables. In the earnings statistics referring to the period prior to 1978, the employees include both full time and part-time workers, whereas after 1978 they only include full-time employees.

The statistics depict the distribution of gross monthly earnings, including bonuses, allowances, in-kind benefits, and benefits from profit sharing. The income concept is gross earnings before deduction of the employer social security contributions for the entire period of 1951-1986, and for 1988 also

[15]The earnings statistics publications were retrieved by the sources cited in Atkinson and Micklewright (1992). For income year 1966, we discovered a refined bracket distribution.

before the deduction of taxes levied under the newly introduced personal income tax. [16] The wage part of the gross earnings figure refers to the actual wage payment in September of a given year for the entire period, except for the 1955-56 statistics, which refers to the wage payment dispensed in June. The monthly gross income figure includes one twelfth of the year-end bonus, and one-ninth of other additional earnings (bonuses, allowances, in kind benefits, benefit from profit sharing received between January and September. Wage supplements (*kiegészítő*) were included in the gross earnings concept after 1980. (See KSH (1976), p. 150; and Atkinson & Micklewright (1992) p. 92 in the book.)

As the tables report only the frequencies of workers for a number of gross monthly earnings brackets, we multiply these percentages with the figures of the total number of employees at the socialist sector to compute the absolute number of workers. We adjust the monthly bracket figures to yearly ones by multiplying by twelve.

The earnings statistics before 1970 refer to employment in the State sector. In order to establish comparability for the entire timeframe of the planned economy, we explicitly assume that the distribution of earnings in the Socialist sector (including State and Cooperative sectors) at the top coincides with the distribution of earnings at the State sector. Supporting evidence for this choice is provided by statistics tables published by the KSH on average earnings of employees with specific university degrees employed either at the State or the Cooperative sectors at the year of 1963 and 1967 showing similar earnings amounts. (See Table C.13 and Table C.14)

During the last decade of the era, from 1981 the state permitted the operation of new forms of private enterprises in order to improve the supply of goods and services. The earning tables include people employed at private enterprises having independent legal entity, however they exclude workers at organization forms without legal entity. Most likely it does not affect the estimation of the very top income shares, as only 1 percent of all active earners had their main jobs at private enterprises without legal entity status.[17] Lacking information on income from second jobs could possibly downward bias the estimation of the lower percentile top shares (e.g. of the top 10%), but it was not prevalent for those at the very top of the earning distribution to have second jobs.

C.3.2 Capital Income

The tables contain earnings data without any capital income. Households' financial asset portfolios were very simple containing cash, and deposits, savings, loans and mortgages at the National Savings Bank (OTP) or at the Saving Cooperatives (Takarékszövetkezet). The standardized products, conditions and interest rates were all centrally regulated. Practically unchanged nominal interest rate with high inflation resulted in negative real interest rates for several years. Moreover the prospect of a deposit confiscation by the state was always a possibility. Owner occupied housing stock was the most important real asset. But neither rental income, nor capital gain were part of the household income as both the rental and secondary property markets were practically non-existent.[18] Notwithstanding, we provide an upper bound estimation on possible capital income as a robustness check that confirms capital income was negligible among the top 1% compared to market economy era.

We construct the upper bound estimate as follows. There is available information on total capital

[16] To estimate comparable shares we add to the constructed income denominator the total personal income tax amount collected by the government in 1988. See 1989 XXIV.1§ appendix.

[17] See: Héthy (1990), pp. 2-7, 31-32. In 1986 413.000 people were working at the three major forms of small undertakings without legal entity such as Economic Work Partnership within Enterprises (EWPEs), Specialized Groups of Industrial and Servicing Co-operatives, and Economic Work Partnership of Private Persons (EWPPPs), however only 51.000 of them had their main job in these small undertakings.

[18] Ábel, Székely (1992), pp. 2-3, 8-10, 23

income in the national accounts for the years of 1960 and 1965-1988. These aggregated yearly capital income figures contain income from lottery income, interest, land rental, insurance and government loan lottery (a lottery for government bond repayments). The nature of the income sources suggests less concentration at the top. Even though, we assume that, as an upper bound estimation, during this period the top 1% received the same share of the total capital income as in 1992 (16% including capital gains also). Hence we add 16% of the actual national account capital income data to the earnings income accruing to the top 1% and re-estimate their shares based on this figure. For the years where no capital income data is available in the national accounts, we either linearly interpolate or assume it was the same amount as the nearest available year. With this extreme 16% upper bound assumption we get an upper limit for the capital income component, see Figure C.9.

C.4 Income Units

For fiscal years 1914-1940, the tax unit is broadly defined as an enlarged family dwelling under the same housing [Act X. §3 of 1909; Klúg and Soltész (1917) p. 159; Fellner (1927) pp. 12, 14.]. In particular, the tax unit consists of either a single individual or a couple with dependent persons, with the head of the family being the major income earner. Dependent persons are considered those related to the head of the family by blood or marriage (grandparents, children, grandchildren, in-laws) and not by contract (e.g. servants and domestics), provided that they are economically dependent on the head of the family. Tax statistics from this period report the aggregate income of the couple and dependent persons, adding up to form total family income.

We approximate the number of households as the total number of population above 15 minus the number of married women for the appropriate demographic groups at the province level reported in decennial censuses. Due to the changes in administrative boundaries, population exchanges, and considerable migration flows as a consequence of the treaties after World War I, it is impossible to interpolate between the censuses bracketing the years between 1910 and 1920. An estimate is obtained under the implicit assumption of constant yearly population growth between the censuses of years 1900 and 1910 at each province, and by extrapolating these province level growth rates for the period between 1910 and 1919. To improve the estimate, we adjust the figures in order to account for the total war casualties reported in Schulze (2005, p. 81, Table 3.5) by subtracting the number of yearly war casualties. For the interwar period, we obtain an estimate by linearly interpolating the appropriate figures from the censuses of 1920, 1930, 1941, and 1949. We use the census figures consistently referring to the Trianon borders of the country, in order to be consistent with the income control total and income table figures.

For the period of the planned economy and the period after the transition we retain a population total that consists of the total population above 15 years from the Historical Demographic Yearbooks (*Történeti Demográfia Évkönyvek*); see Table C.6 for detailed sources of these data.

C.5 Prices

We assemble data from several published series in order to construct a CPI that honors a currency unit's worth from 1913 to today, given that historical statistics on CPI indices for Hungary are rare and often incomplete.

After the end of the First World War, the two parts of Austria-Hungary secluded their respective

currency banknotes in circulation. In Hungary, this conversion takes the form of a transition from the Austro-Hungarian crown to the "krone" (*korona*), that experienced an acute inflationary episode. The stabilized krone gave its place to the pengő in January 1926, on a parity of 1:12,500. Again, the hyperinflation episode after the end of the Second World War prompted another currency change. The present-day forint was introduced in August 1946 with a conversion rate of 1:400,000 quadrillion pengő.

Due to the hyperinflation episodes that occur in the period of study, we choose to provide complementary evidence from unofficial but actual price indices that are closer to actual price movements. For the period 1913-1924, we use the cost of living series published by the Bulletin of the Trade Union (*Szakszervezeti értesítő*) found in Molnárfi (1973). It is calculated on the basis of the subsistence minimum consumption of 23 goods and services for a five-member working class family. This series partially overlaps and exhibits the same rate of growth during 1921-1924 with the Pester Lloyd index in Molnárfi (1973), which is constructed as a non-weighted average of 57 goods and services. We use the Pester Lloyd index for the years 1924-1940, and we use the cost of living in Budapest index in Mitchell (2007) from 1940 to 1950. For the period 1950-1960, we use the historical series from KSH (1996). Finally, we use the official CPI index published by the KSH from 1960 up to today. Table C.1 gives the sources of the data used.

C.6 Income Denominator

To construct an income denominator, first we assemble a GDP series during the period of study denominated in current prices. We also compute personal income totals for the years when this statistics are available. For the years when this statistic is not available, we proxy the total personal income by assuming it is the same fraction of the GDP as in the neighboring years.

C.6.1 Gross Domestic Product

We assemble data on total income during the period of study denominated in current prices. There exist no consistent figures in actual currency rates for national income in the interwar period, due to the change in currency and the hyperinflation episodes. Estimates reported in Mitchell (2007), whose source is the Maddison project, are denominated in Geary-Khamis exchange rates and not in current prices.

We use the series reported in Schulze (2005) for the years 1913-1918 that consist of estimates of the gross domestic product in the 64 provinces of the Hungarian part of Austria-Hungary, Fiume, and the provinces of Croatia-Slavonia, while the provinces in the regions of Bosnia and Herzegovina are excluded; consistenly the income tables are referring to the same geographical area.[19] The estimates in 1913 constant crowns were converted in current prices using the price index constructed previously in Section C.5 of this Appendix.

For the periods 1925-1942 and 1947-1949 we use the measure of net national product at factor cost in Eckstein (1955) in current prices. To get an output measure in market prices we inflate the figures by 5% based on the estimate of indirect tax amount in the year of 1935 in Matolcsy (1938).[20] We further inflate this estimate with an estimate of capital depreciation of 5% to obtain the gross national

[19] In turn, Schultze (2005) expands the estimates in Schultze (2000) that use a reliable methodology to estimate the trends in GDP growth of Austria-Hungary in the late 19th century.

[20] Matolcsy (1938), p. 95, p. 105

product figures. An implicit assumption in producing the estimate is that the installed capital base, albeit expanding, was relatively modest compared to the European West. Moreover, the difference between GNP and GDP is not large in countries with small capital flows with foreign countries, and this is the case for Hungary in this period as documented by Tomka (2001).

The Eckstein figures are computed for calendar periods July 1st year t to June 30th year t+1 while the fiscal year in aggregate tax tables is calendar years. To correct the inconsistency we linearly interpolate between the net national income figures to get calendar year figures. These output figures consistently refer to the Trianon borders of Hungary for the period between 1925 and 1949, while from 1938 a territorial expansion took place as a consequance of the war. In order to get consistent top income share estimates we exclude taxpayers at the annexed territories from the income tables.

For the years 1950-1960 we use the Net Material Product series published by KSH, an accounting concept that does not include the contribution of "unproductive" services to national income. We correct the series of KSH by using the average fraction of the KSH official GDP and NMP published by Mitchell (2007) between 1961-1988, and apply it to the period 1950-1960 (1.23%).

For the period of 1961-1990 we use the official GDP data published by KSH under the modern SNA definition. From 1991 up to today, we use the official Eurostat GDP index. Table C.2 gives the sources of data used.

C.6.2 National Income Accounts

For the period between 1914 and 1940 we use the 73% of our GDP series as a proxy for the personal income. We get the 73% shares as the Matolcsy, Varga (1936)[21] total individual household income series available only for the period of 1925-1935 are roughly 77% of our GDP figures, and then we take the 95% of this 77% ratio to account for missing incomes in the tax reports.

We compute a personal income total defined as the sum of labor income, social security contributions (including pension, unemployment benefits, family allowances, maternity benefit, scholarship grants, other social benefits) and an amount of capital income (such as lottery, interest, insurance) from the national income accounts data calculated by the Central Statistical Office for 1960, and for 1965-1987. We want this total to be the definition of the total personal income denominator during the entire planned economy period to get consistency across the three periods. We proxy the total personal income when this statistical series are not available (1951-1959, 1961-1964), by assuming it is the same fraction of the GDP as in the neighboring years (1960 and the average of 1960 and 1965, respectively). We add the total personal income amount received by the government to the constructed income denominator in 1988 when the personal income tax was newly introduced.[22]

For the 1991-2010 period we use national income accounts data calculated by the Central Statistical Office. Our constructed personal income total contains the wages and salaries (Item D.11 including cash and in kind), mixed income[23] (Item B.3), property income including net interest (Item D.41), dividend (Item D.421), property income attributed to insurance policy holders (Item D.44) (e.g. income received from insurance enterprises or pension funds), rental income (Item D.45), state social contribution (pension, sickness pay, unemployment benefits, family allowances, maternity benefit) and scholarships and grants. We adjust the mixed income to tax evasion, and include only the third in the income denominator as self-employed report on average only third of their income in Hungary based

[21] Matolcsy (1936) p. 97 Table 61

[22] See 1989 XXIV.1§ appendix.

[23] Mixed income at the national accounts includes income from independent small scale activities where it is impossible to separate income from labor and capital.

on Benedek, Lelkes (2011). We add the realized capital gain amounts based on the official summary tables of the Tax Authorities containing items corresponding to the actual tax regulations.

For this recent period we also compute a total personal income denominator as the sum of the households net disposable income (Item B.6.n) and paid taxes (Item D.5), minus the 5% of the net disposable income to account for fixed capital consumption. The difference between the personal income denominators calculated by these two methods is less than 5 percent in each year.

Table C.3 gives the sources of data used.

C.7 Skill Supply and Skill Premium

We proxy the skill supply in each year with the percentage of people completed secondary school or university in the population. The available census data depicts the number of people with degrees in each ten years (1920, 1930, 1941, 1949, 1960, 1970, 1980, 1990, 2001, 2011). We estimate the skill supply between the census years based on the central statistical office time series of individuals graduating each year for the years between 1950-2012 and with linear interpolation for the years before this period (1920-1949). See sources in Table C.8.

We estimate the relative wage premium for skilled people with the difference of log average wages of intellectual and manual workers. The average wage series is assembled based on various *KSH Statistical Yearbooks* (see sources in Table C.7).

For the interwar period the statistical yearbooks cite the number of administrative and engineer functionary (*igazgatási és műszaki tisztviselő, altiszt*) and workers on the 1st October each year for the mining metallurgy (*bányászat*) and industrial (*gyáripar*) sectors. Also the total yearly wage bill including cash and in kind benefits are reported separately, allowing us to calculate average earnings for the skilled and unskilled workers. For 1921-1926 the earnings are reported in golden crown, while for 1927-1942 they are in pengő, and in 1947 in forint. From 1935 onwards also functionaries working at the headquarter of the companies are included in the wage and employee statistics.[24]

For 1955-1975 the KSH computed the average wage separately for workers, administrative workers and skilled technicians – the latter two groups representing the non-manual workers, while for the period from 1975 the statistical tables cite manual (*fizikai munkás*) and non-manual (*szellemi munkás*) average wages. Comparing the skill premium in 1975 based on the two definitions gives practically the same result. For the years prior 1967 KSH published wage data only in the state industry and construction sectors, while from 1968 onwards wages from the total socialist industry and construction sectors are reported.

From 1967 (except for the years of 1978-1979) wage data in the state agricultural sector (*állami gazdaság*), while from 1975 wage data in the cooperative agricultural sector (*termelőszövetkezet*) is reported also separately. We compute the main wage premium series based on the industry and construction sector, and report also separate series containing the state agricultural sector (from 1967) and the total agricultural sector (from 1975) that are showing similar trends.[25] The wage concept is gross wage including allowances and premiums for 1954-1969, and from 1970 gross earnings including

[24] Földvári (2011), also used the wages of administrative and manual workers at the industrial sector from these statistical yearbooks to estimate yearly return to education based on skill premiums between two groups with an average 8 years of education difference. Our approach is different as we are interested in an overall skill premium, that is why we include also the engineer functionaries, and managerial employees. Also our estimates are based on data from all listed sectors to cover a broader segment of the society.

[25] After computing the skill premium series for the period of 1955-1988, we found Cukor(1990) estimating similar series based on the same Statistical Yearbook wage data. Her paper additionally provides detailed estimates on different level managerial earning premiums for 1976-1988.

also benefits from profit sharing fund (year end bonus, profit premium, profit allowance).[26]

For the years after the transition all sectors of the economy are depicted at the average wage tables in the Statistical Yearbooks. After the transition till 1998 only those full time employees at enterprises with more than 10 employees, and from 1999 those employees working at enterprises with more than 4 employees are depicted in the statistics. The statitics report gross earnings before deduction of the employee social security contribution and the personal income tax. See skill supply and skill premium figures at Table C.22.

C.8 Net capital stock per output ratio

To proxy the relative non-financial capital stock amount in the economy we construct the net stock of fixed assets and GDP ratio. According to the SNA the net stock of fixed assets is defined as produced assets that are used repeatedly in the production process for more than one year. These includes the market value of dwellings, other non-residential buildings (e.g schools, hospitals, factory and office buildings) and structures (e.g. motorways, roads, railways, dams), transport equipment (public transportation, cars, railways), machinery and equipment (factory or office machinery, equipment and computers, television and communication equipment, medical instruments, furniture), cultivated assets (including animals, fruit plantations, vineyards and all land improvement, but not the value of the land), and intangible assets (e.g computer software). Inventories, valuables (e.g. jewellery, precious metals) and consumer durables not used for production (such as cars and furniture) are not part of the fixed asset. We construct the series for the three periods corresponding to the top shares, namely first part of the 20th century, planned economy and the years after the transition to the market economy.

As early as the beginning of the last century Fellner estimated national wealth for the periods of 1899/1901, 1911/1913 and 1927/1928. His extensive calculation includes data on the market value of the following assets: cultivated land, mines, dwellings, industrial and governmental buildings, transport and communication equipment (i.e roads, bridges, railways, ships, cars, public transportation vehicles, telegraph and cable system, post offices) and movable goods (machinery, animals, inventories, stock of crop, furniture, precious metals and jewellery). To have comparable data between the periods, from Fellner's stock of movable goods estimate we exclude the value of inventories at firms, stock of crop, furniture, valuable precious metals and jewellery.[27]

For the planned economy we use the yearly balance of fixed asset net of depreciation figures published by KSH for the period of 1959-1980. The figures are referring to year-end holdings and includes holdings that worth more than 5000 forint and has more than 3 years lifespan.[28] The KSH estimates include dwellings, public and industrial buildings, structures (roads, bridges, dam), cultivated assets (plantations, land improvement, but livestock is excluded), machinery, equipment, transportation and communication equipment, other equipment, vehicles in the material and in the service (personal, health, culture, social) sectors. We add the stock of animals published in the inventory tables to get consistent series with the Fellner and the SNA figures.

Figures are net of depreciation, but prices are reflecting the book value (i.e original purchase price) increased with price subsidies as in other socialist countries, and are re-evaluated in every 6-8 years (re-evaluations took place in 1968 and 1976). Hence the stock data is actually a mixture of different year prices referring to when the purchase took place. Due to the re-evaluation the 1968 and 1976 stocks are reported at replacement cost, while in the years just after the re-evaluation the book value is close

[26] SY 1956, p 70, SY 1968, p 88 , SY 1970, p 102

[27] The 1898 amount is calculated by assuming it is the same ratio of movable goods as in 1910.

[28] A nemzeti vagyon és az eszközállomány (National wealth and fixed capital stock), KSH: 1974, 1979, 1980, 1981

to the market value, and in later years the book value starts lagging behind. There is no need for large corrections if the investment price index is low, which was on average only yearly 2 percent according to Árvay (1976). He also calculates that in 1976, already 8 years after the previous re-evaluation, the book value of fixed assets was only 10 percent less than the re-evaluated replacement value in that year. This estimate provides an upper bound - 5% of book value - for the actual replacement value in 1980 (latest year we have data for) four years after the last re-evaluation.

An additional argument in favor of that the gap between the reported KSH value and replacement value of fixed assets is not large is that only half of the assets were valued at book value, while the other half mainly containing dwellings, roads, bridges, dams, private sector was reevaluated each year based on replacement cost (investment price index).

After the transition Hungary abandoned the Material Product System and joined the UN System of National Accounts. For the period of 1995-2010 we use the market value net fixed asset stock figures from the official national account volumes. For 1991-1994 no stock of assets data are available, only the gross fixed capital formation of new assets. (see sources in Table C.9).

The denominator of the calculated ratio is the GDP series. See the yearly figures of the fixed capital per GDP series at Table C.23.

C.9 Operating Surplus

To proxy the relative share of renumeration of capital in the overall economy we construct an operating surplus ratio series. For the period of 1991-2011 this series is equivalent to the capital factor share of the factor price GDP based on official national account figures. The GDP at factor prices (i.e the price the producer receives) equals the GDP at market prices (i.e the price the consumer pays) minus the net amount of taxes and subsidies on the production and imports (items D.2, D.3).

$$B2.n(HH) + B2.n(financial\,corp) + B2.n(nonfinancial\,corp) + K.1 + D.1(HH) + B3.n(HH) = \\ = GDP - (D.2 - D.3) = factor\ price\ GDP$$

The capital factor share corresponds to the net operating surplus (B.2 n) of the household sector (income from property), and of the non-financial and financial corporation sectors, plus the depreciation (K.1). While the labor factor share equals the wages and salaries (D.1). We compute the depreciation as the difference between the GDP and NDP. For the net mixed income (B.3n) of the household sector containing income of small enterprises, self-employed and household production we assume the same capital and labor composition as estimated for the total economy excluding this income.

For 1991-1994 only gross operating surplus (B.2g) and gross mixed income (B.3g) are published in the national accounts. Based on the below identity and our assumption of same capital and labor share for mixed income, we can calculate the capital share as the ratio between the gross operational surpluses and the GDP at factor prices.

$$B2.g(HH) + B2.g(financial\,corp) + B2.g(nonfinancial\,corp) + D.1(HH) + B3.g(HH) = \\ = GDP - (D.2 - D.3) = factor\ price\ GDP$$

Due to the peculiarity of state ownership structure the concept of operating surplus is not consistent between the planned and market economies. During the planned economy the state played the role of

the ultimate owner reaping the surplus of the enterprises via the profit and income tax (*nyereség és jövedelemadó*). The state also provided production subsidies (*termelési támogatás*) for those enterprises operating in less advantageous conditions and extracted income (*termelési elvonás*) from those with better conditions.[29] To get a comparable proxy for capital factor share, we compute the ratio of the net income the state extracted as the owner from the enterprises - profit and income tax, and the net of production subsides and production tax - and the GDP. For the period of 1968-1982 the Statistical Office published these figures on taxes and subsidies covering all enterprises, cooperatives and private small scale activities both in the material and non-material sectors.[30] (see sources in Table C.10, and the actual figures at Table C.24).

[29]We did not include the turnover tax (*forgalmi adó*) and price subsidies (*árkiegészítés*) in the calculation as the state used these measures to influence consumer demand and to achieve social policy targets and not to extract money from the enterprise.

[30]For a detailed description of the generation of income and primary allocation of income see Népgazdasági mérlegrendszer módszertana (1973), pp 108-126.

C.10 Data sources

Table C.1: Sources of CPI

Period	Series	Sources
1913-1924	Szakszervezeti értesítő Cost of Living	Molnárfi (1973), pp. 410-411, Table 1, col9
1924-1940	Pester Lloyd Cost of Living	Molnárfi (1973), pp. 424-425, Table 5, col14
1940-1950	Cost of Living	Mitchell (2007), pp. 963, Table H2, col11
1950-1960	CPI	KSH (1996), p. 207, Table 5, col 9
1960-2012	CPI (Official)	KSH Official Statistics (available online)

Table C.2: Sources of GDP

Period	Series	Sources
1913-1918	GDP	Schulze (2005), p. 83, Table 3.8
1925-1942, 1947-1949	NNP (net national product)	Eckstein (1955), p. 165, Table 1
1950-1960	NMP (net material product)	KSH (1996), p. 94, Table 2, col 2
1961-1988	NMP (net material product)	Mitchell, pp. 1021, 1029, col 1
1961-1990	GDP	KSH (1996), p. 96, Table 2, col 2
1991-2012	GDP	Eurostat

Table C.3: Sources of income denominator

Period	Income denominator	Source
1960-1974	wage	A lakosság jövedelme és fogyasztás 1966-1980 (Ksh, Bp, 1982), p8, Table1.1, col2
	social transfer	A lakosság jövedelme és fogyasztás 1966-1980 (Ksh, Bp, 1982), p16, Table61/a, col10
	gross capital income	A lakosság jövedelme és fogyasztás 1966-1980 (Ksh, Bp, 1982), p19, Table7.1, col8
1975-1987	wage	A lakosság jövedelme és fogyasztás 1970-1987 (Ksh, Bp, 1988), p12, Table2.1, col2
	social transfer	A lakosság jövedelme és fogyasztás 1970-1987 (Ksh, Bp, 1988), p21, Table7.1/a, col8
	gross capital income	A lakosság jövedelme és fogyasztás 1970-1987 (Ksh, Bp, 1982), p24, Table8.1, col8
1992-2010	wage, mixed, ownership income	Magyarország Nemzeti Számlái (KSH): Table 5.2. A háztartások jövedelemszámlái, D.11, B.3.n, D.4,
	social transfers	Magyarország Nemzeti Számlái (KSH): Table 5.5 A társadalmi juttatások folyó áron
	realized asset/financial capital gains	Apeh Table 4

Table C.4: Sources of income tax statistics

Income Year	Income tax statistics	Income components	
1914	p 12-13, line 10, p96-97, line 10		Jövedelemadósztatisztika, Magyar Királyi Állami Nyomda, Bp, 1916
1915	p 12-13, line 10, p55-56, line 10		Jövedelemadósztatisztika, Magyar Királyi Állami Nyomda, Bp, 1917
1927	pp 124-125, line 15		Adóstatisztika, Füzet 1, Magyar Királyi Pénzügyminisztérium, Bp, 1929
1930	p 133, col 2-3		Adóstatisztika, Füzet 2, Magyar Királyi Pénzügyminisztérium, Bp, 1932
1931	p 120, col 2-3		Adóstatisztika, Füzet 3, Magyar Királyi Pénzügyminisztérium, Bp, 1933
1932	pp 212-213, col 1, 3, 10	pp 181, 183, 185, 187, 189, 191, 193, 195, 197, 199, 201, 203, 205, 207, col 9-10	Adóstatisztika, Füzet 4, Magyar Királyi Pénzügyminisztérium, Bp, 1934
1933	pp 230-231, col 1, 3, 10	pp 186, 189, 192, 195, 198, 201, 204, 207, 210, 216, 219, 222, 225, col 1-2	Adóstatisztika, Füzet 5, Magyar Királyi Pénzügyminisztérium, Bp, 1935
1934	pp 174-175, col 18, pp 176- 177, col 18, p 178 col 7	pp 176-177, col 2-19	Adóstatisztika, Füzet 6, Magyar Királyi Pénzügyminisztérium, Bp, 1936
1935	p 222, col 1, pp 224-225, col 17, pp 226-227, col 6	pp 224-225, col 2-19	Adóstatisztika, Füzet 7, Magyar Királyi Pénzügyminisztérium, Bp, 1938
1936	p 270, col 1, pp 272-273, col 18, pp 274-275, col 8	pp 272-273, col 2-19	Adóstatisztika, Füzet 8, Magyar Királyi Pénzügyminisztérium, Bp, 1938
1937	p 270, col 1, pp 272-273, col 18, pp 274-275, col 8	pp 272-273, col 2-19	Adóstatisztika, Füzet 9, Magyar Királyi Pénzügyminisztérium, Bp, 1940
1938	p 250, col 1, pp 252-253, col 18, pp 254-255, col 8	pp 252-253, col 2-19	Adóstatisztika, Füzet 10, Magyar Királyi Pénzügyminisztérium, Bp, 1941
1939	p 288, col 1, pp 290-291, col 18, pp 292-293, col 8	pp 290-291, col 2-19	Adóstatisztika, Füzet 11, Magyar Királyi Pénzügyminisztérium, Bp, 1942
1940	p 278, col 104, p 288, col 104, pp 270-271, col 2-4, pp 280-281, col 2-4, p 278, col 104, p 288, col 104	pp 272-273, col 29-48, pp 282–283, col 29-48	Adóstatisztika, Füzet 12, Magyar Királyi Pénzügyminisztérium, Bp, 1943
1992-2008	administrative micro data sample		

Table C.5: Sources of earnings census statistics

Income Year	Earnings census statistics	Sources
1951	p 113 T19	Statisztikai Évköny 1971, KSH, Bp, 1972
1955	p 69 T16	Statisztikai Évköny 1957, KSH, Bp, 1959
1956	p 69 T16	Statisztikai Évköny 1957, KSH, Bp, 1959
1957	p 69 T16	Statisztikai Évköny 1957, KSH, Bp, 1959
1958	p 73 T20	Statisztikai Évköny 1958, KSH, Bp, 1960
1960	p 59 T15	Statisztikai Évköny 1966, KSH, Bp, 1967
1961	p 84 T16	Statisztikai Évköny 1968, KSH, Bp, 1969
1962	p 84 T16	Statisztikai Évköny 1968, KSH, Bp, 1969
1964	p 84 T16	Statisztikai Évköny 1968, KSH, Bp, 1969
1966	p 60 T16	Statisztikai Évköny 1966, KSH, Bp, 1967
1968	pp 122-123 T7	Foglalkoztatottság és kereseti arányok 1970, KSH, Bp, 1972
1970	pp 198-199 T9 row 33	Foglalkoztatottság és kereseti arányok 1970, KSH, Bp, 1972
1972	pp 236-237 T11 row 33	Foglalkoztatottság és kereseti arányok 1972, KSH, Bp, 1974
1974	pp 136-137 T9 row 33	Foglalkoztatottság és kereseti arányok 1974, KSH, Bp, 1976
1976	pp 78-79 T20 row 39	Foglalkoztatottság és kereseti arányok 1976, KSH, Bp, 1978
1978	pp 18-19 T9	Foglalkoztatottság és kereseti arányok 1984, KSH, Bp, 1986
1980	p 26 T20 lower part col 2	Foglalkoztatottság és kereseti arányok 1980, KSH, Bp, 1981
1982	p 72 T5.13	Foglalkoztatottság és kereseti arányok 1984, KSH, Bp, 1986
1984	pp 22-23 T11 row 30	Foglalkoztatottság és kereseti arányok 1986, KSH, Bp, 1987
1986	pp 100-101 T21 row 39	Foglalkoztatottság és kereseti arányok 1986, KSH, Bp, 1987
1988	pp 64-65 T11 r39	Foglalkoztatottság és kereseti arányok 1988, KSH, Bp, 1989

Table C.6: Sources of population denominator

Period 1900-1949	Definition of Tax Base:	Total Adult Population minus Married Women		Sources
	Total Civilian Population	*Underaged Population (< 15 yrs)*	*Total Number of Married Women*	
Census Year 1900	pp. 7-9, Table 2, Col. 30	pp. 126-128, Table 15, Col. 5	pp. 201-203, Table 20, Col. 15	Magyar Kiralyi Központi Statisztikai Hivatal (1907) A Magyar Szent Korona Országainak 1900. Évi Népszámlálása, Harmadik Rész: A Népesség Részletes Leirása. Pesti Könyvnyomda-Részvénytársaság, Budapest.
Census Year 1910	p. 12,18, Table 5, Col. 5	p. 74-75, Table 9, Col. 4	p. 110-111, Table 14, Col. 4	Magyar Királyi Központi Statisztikai Hivatal (1916) A Magyar Szent Korona Országainak 1910. Évi Népszámlálása, Ötödik Rész: Részletes Demográfia. Pesti Könyvnyomda-Részvénytársaság, Budapest.
Census Year 1920	p. 8, Table 6, Sum of Col. 3, 4	p. 34, Table 9, Col. 4	p. 58, Table 16(b), Col. 4	Központi Statisztikai Hivatal (1928) 1920 évi népszámlálás, 5. kötet: Részletes Demográfia. Pesti Konyvnyomda-részvénytársaság , Budapest
Census Year 1930	p. 234, Table 20, Col. 5	p. 220, Table 18, Col. 8,11,14	p. 234, Table 20, Col. 10	Központi Statisztikai Hivatal (1936) 1930. évi népszámlálás, 5. kötet: Részletes Demográfia. Stephaneum Nyomda Részvénytársaság, Budapest
Census Year 1941	p. 4, Table 1, Col. 3	p. 5 Table 1, Col. 46	p. 6, Table 2, Col. 12	Központi Statisztikai Hivatal (1947): 1941. évi népszámlálás, Demográfia adatok. Stephaneum Nyomda Részvénytársaság, , Budapest
Census Year 1949	p. 294, Table 4, Col. 2	p. 294, Table 4, Col. 3	p. 311, Table 8, Col. 5	Központi Statisztikai Hivatal (1950): 1949. évi népszámlálás, 9. kötet: Demográfiai Eredmények. Állami Nyomda, Budapest
1914-1918	Total Number of War Casualties			Schulze, M.-S. (2005) Austria-Hungary's economy in World War I, in Broadberry, S., and M. Harrison (eds), The Economics of World War I. Cambridge University Press.
Period 1950-2010	Definition of Tax Base:	*Total Population Above 15 yrs*		KSH: Demografia Evkonyv, 2010, CD

Table C.7: Sources of skill premium

Skill premium	Source
	Average wage of skilled and unskilled workers
1955	SY 1949-1955, p88, row43,p91, row 23,43,44, SY 1956, p 105, col 2,3,6,7
1956	SY 1956, p77, row 46, p 105, col 2,3,6,7
1957	SY 1957, p92, col4-6, p96, col4-6, p130, T.3 col 4,6,7,9,11,12,13
1958	SY 1958, p96,col4-6, p100, col4-6, p142, T.3 col 4,6,7,9,11,12,13
1960	SY 1960, p96,col4-6, p102, col4-6, p138, T.5 col 4,6,7,9,11,12,13
1962	SY 1962, p94,col4-6, p146, T.6 col 4,6,7,9,11,12,13
1964	SY 1964, p84,col2-4, p96,col2-4, p128, T.6 col 4,6,7,9,11,12,13
1967	SY 1967, p92, T.8,col2-4, p98, T.14, ,col2-4, p126, T.6 col 4,6,7,9,11,12,13
1968	SY 1968, p116, T.10, col2-4, p125, T.19,col2-4, p157, T.9 col 4,6,7,9,11,12,13
1969	SY 1969, p116, T.10, col2-4, p131, T.21, col2-4, p163, T.9 col 4,6,7,9,11,12,13
1970	SY 1975, p141, T.17, col2-4, p147, T.23 ,col7-9, p190, T.22 col 3-5 , 11-13
1971	SY 1971, p150, T.11, col2-4, p157, T.18 ,col7-9, SY 1973 p217 T14 col 5-7, 10-12
1972	SY 1972, p170, T.14, col2-4, p177, T.21 ,col7-9, SY 1973 p217 T14 col 5-7, 10-12
1973	SY 1973, p168, T.14, col2-4, p175, T.21 ,col7-9, p217 T14 col 5-7, 10-12
1974	SY 1975, p141, T.17, col2-4, p147, T.23 ,col7-9, p190, T.22 col 3-5 , 11-13
1975	SY 1975, p141, T.17, col7-9, p147, T.23, col7-9, p190, T.22 col 3-5, 7-9, 11-13
1976	SY 1976, p137, T.17, col2-4, p143, T.23, col7-9, SY 1977, p218, T23., col8
1977	SY 1977, p170, T.19, col3-5, p175, T.24, col7-9, p218, T23., col9
1978	SY 1978, p178, T.19, col3-5, p183, T.24, ,col7-9, SY 1979, p230, T23, col8,9
1979	SY 1979, p180, T.19, col3-5, p185, T.24, col7-9, p230, T23, col8,9
1980	SY 1980, p184, T.19, col2-4, p189, T.24, col7-9, p234, T23, col9
1981	SY 1981, p127, T.9.22, col2-4, p132, T.9.27, col7-9, p152, T10.17, col4
1982	SY 1982, p120, T.9.23, col2-4, p125, T.9.28, col7-9, p146, T10.19, col5
1983	SY 1983, p123, T.9.25, col2-4, p128, T.9.30, col7-9, p149, T10.20, col6
1984	SY 1984, p121, T.9.25, col2-4, p126, T.9.30, col7-9, p144, T10.20, col7
1985	SY 1985, p121, T.8.25, col2-4, p126, T.8.30, col7-9, p144, T9.17, col6
1986	SY 1986, p114, T.8.17, col5, p131, T9.17, col6
1987	SY 1987, p115, T.8.17, col6, p133, T9.17, col6
1988	SY 1988, p108, T.8.18, col6, p108, T8.19, 2-3, p127, T9.15, col6, T9.16, col2-3
1989	SY 1989, p105, T.8.17, col6, p105, T.8.18, col4, p120, T9.13, col6, T9.14, col5-6
1991-1995	SY 1995, p75, T.4.14. col 2,4
1996-2000	SY 2000, p90, T.4.12. col 2,4
2001-2006	SY 2006, p72, T.3.1.12. col 2,4
2008-2012	KSH Stadat T2.1.36., row A-S, T2.1.37., row A-S

SY: Statistical Yearbook

Table C.8: Sources of skill supply

Skill supply	Sources
	Population
1920	1920. évi népszámlálás, 5. kötet, p. 8, table 6, sum of col 3, 4
1930	1930. évi népszámlálás, 5. kötet, p. 234, table 20, col 5
1941	1941. évi népszámlálás, Demográfia adatok, p. 4, table 1, col 3
1949-2010	KSH STADAT 1.1 Népesség, népmozgalom, col 2
	# of high school and university graduates of the population in the census
1920-2011	Népszámlálás online, Table 30.1.6 col2, Table 30.1.11 col2
	Yearly number of new high school and university graduates
1949-1959	SY 1964, p360, T1.4, col3,6
1960-2010	KSH STADAT 2.5, col 15, 17

Table C.9: Sources of fixed capital stock

Year	Sources	
	Mine, real estate, transportation, movable goods	
1989	Fellner (1901)	pp. 19-23
1910	Fellner (1913)	pp. 47-49, 67
1927-1928	Fellner (1929)	pp. 54-56, 71
	Stock of assets, animals	
1959-1972	A Nemzeti vagyon és az állóeszközállomány 1960-1973 (KSH, Bp, 1974)	pp. 30-31 T9/row 18, pp. 36-37 T15/row 6
1969-1978	A Nemzeti vagyon és az állóeszközállomány 1970-1978 (KSH, Bp, 1979)	p. 114 rows 13, p. 20 T16/ row 2
1979	A Nemzeti vagyon és az állóeszközállomány 1979 (KSH, Bp, 1980)	p. 25 T3, p. 26 T4
1980	A Nemzeti vagyon és az állóeszközállomány 1980 (KSH, Bp, 1980)	p. 21 T3, p. 22 T4
1981	A Nemzeti vagyon és az állóeszközállomány 1981 (KSH, Bp, 1981)	p. 21 T3, p. 22 T4
	Stock of fixed assets net of depreciation	
1995-2007	Magyarország Nemzeti Számlái, 1995-2007 (2009), Bp KSH	pp. 880-892 T8.2.2
2008	Magyarország Nemzeti Számlái, 2008-2010 (2011), Bp KSH	p. 217 T8.2.2
2009-2010	Magyarország Nemzeti Számlái, 2009-2011 (2012), Bp KSH	p. 225 T8.2.2, p. 227 T8.2.4

Table C.10: Sources of operational surplus

Year	Source	
	Profit and income tax, production subsidies, production tax	
1968-1969	Népgazdasági mérlegek 1960-1970, (KSH, Bp, 1971)	pp. 180-181 T7.7, pp. 182-183 T7.8
1970-1975	Jövedelemelosztás a népgazdaságban 1978, (KSH, Bp, 1979)	pp. 22-23 T10, pp. 24-25 T11, pp. 26-27 T12 pp. 28-29 T13, pp. 30-31 T14, pp. 32-33 T15
1976-1982	Jövedelemelosztás a népgazdaságban 1976-1982, KSH, 1984	pp. 16-17 T1.9/col 18, pp. 18-19 T1.10/col 18, pp. 20-21 T1.11/col 18, pp. 22-23 T1.12/col 18 pp. 24-25 T1.13/col 18, pp. 26-27 T1.14/col 18 pp 28-29 T1.15/col 18
	Gross operating surplus of households, financial and non financial corporations, wages and salaries, mixed income	
1991-1994	Magyarország Nemzeti Számlái, 1991-1994 (1996), Bp KSH	pp. 108-109 T 4.3, pp. 116-117 T 4.5.2, pp. 150-151 T 6.3
1995-2007	Magyarország Nemzeti Számlái, 1995-2007 (2009), Bp KSH	pp. 346-358 T 3.2.1, pp. 372-384 T 3.3.1, pp. 530-542 T 5.2
2008	Magyarország Nemzeti Számlái, 2008-2010 (2011), Bp KSH	p. 102 T3.3.1, p. 106 T3.5.1, p. 158 T5.2
2009-2011	Magyarország Nemzeti Számlái, 2009-2011 (2012), Bp KSH	p. 108 T3.31, p. 112 T3.5.1, p. 166 T5.2

Table C.11: Income component categories, 1914-1940

	Income categories 1914-1915		Income categories 1932-1940
I	Land and forestry	I	Land
		VII	Land lessee income
II	Built property, real estate	II	Built property, real estate
III	Industrial, commercial activities	III	Crafts
		IV	Industrial income
		V	Trade
		VI	Mine ownership
		VIII	Other lessee income
		IX	Doctors
		X	Lawyers
		XI	Other liberal professionals
IV	Capital income	XIV	Capital income
		XV	Annuities, value in kind
V	Employment income	XIII	Employment income
		XII	Tantiem income

Table C.12: Income source definition: labor, capital, mixed income

Period	Wages and Salaries (Labor Income)	Rents, Interest, Dividends (Capital Income)	Mixed Income
1914-1915,1932-1940	remunerations of employees in the public and the private sector, pensions, including bonuses and executive compensation	income from land, actual and imputed rent, dividends, income on capital holdings, annuities, interest from savings, securities, royalties	income from business activity in industrial, commercial and other sectors, income from liberal professons
1951-1988	monthly earnings, including bonuses, allowances, in-kind benefits, and benefits from profit sharing	lottery, interest, insurance	
1992-2008	labor related income such as wages and salaries, bonus, in kind benefit, stock option, and employee stock, taxable cost compensations, pension, unemployment and maternity benefit, scholarship	interest, rent, general dividends, dividends received through partnership, annuity, realized capital gains from selling property, movable goods, rights or financial assets	self-employed and partnership income, liberal profession, agricultural income

C.11 Tables and figures

Table C.13: Average earnings of employees with specific degrees employed at the state or cooperative sectors at the year of 1963.

	State sector		Agricultural cooperatives		Commerce in cooperatives	
	avg earning	# employees	avg earning	# employees	avg earning	# employees
mechanical engineer	3651	32573	3283	98	3268	12
agrarian engineer	2870	8274	3599	1844	2577	54
other university degrees	2731	108651	3352	697	2682	898
mechanical technician	2553	74553	2676	694	2433	93
agrarian technician	1994	8408	2730	3026	2066	186
other high school degrees	1865	276331	2259	8069	2019	7840
TOTAL	*2277*	*508790*	*2603*	*14428*	*2093*	*9083*

Source: Képzettség és kereset (1966), p. 64, Table 1

Table C.14: Average earnings of employees with specific degrees employed at the state or cooperative sectors at the year of 1967

	State sector		Cooperatives	
	avg. earning	*# employees*	*avg. earning*	*# employees*
TOTAL university degree	*2910*	*164090*	*3479*	*6280*
mechanical engineer	3568	36306	3315	570
science	3093	3633	2614	13
agrarian engineer	2943	8728	3775	3287
vet	3216	2642	3154	101
economist	3216	9894	3409	822
lawyer	3171	13505	2974	1179
doctor	3241	19402		
pharmacist	2518	5031	2167	3
teacher	2268	47886	2837	126
liberal arts	2781	2307	2976	44
other university graduates	2923	14756	2963	135
TOTAL vocational technician	*1969*	*21607*	*2710*	*3861*
mechanical vocational technician	2638	5807	2790	344
agrarian vocational technician	2311	2076	2641	3006
economist vocational technician	2630	2572	3094	489
teacher vocational technician	1710	11152	2290	22
TOTAL university or vocational technician	*2734*	*185697*	*3186*	*10141*
TOTAL secondary education	*2228*	*210019*	*2329*	*24334*
mechanical technician	2619	76896	2607	2953
agrarian technician	2052	10154	2737	7171
economist technician	1985	83225	2064	13665
teacher technician	1924	39744	2105	545
TOTAL secondary or tertiary education	*2523*	*395716*	*2581*	*34475*

Source: Foglalkoztatottság és kereseti arányok 1967 (1969) p. 93, Table 3.2 and p. 94, Table 3.3

Table C.15: CPI, Population, Tax units, GDP, Income denominator, 1913-1949

Year	CPI *2010=100*	Population *(thousand)*	Tax unit denominator *(thousand)*	GDP current prices in million *(korona 1913-1918 pengő 1925-1947 forint 1948-)*	Income denominator current prices in million *(korona 1913-1918 pengő 1925-1947 forint 1948-)*	Income denominator /tax units in current prices *(korona 1913-1918 pengő 1925-1947 forint 1948-)*	Income denominator / GDP	Real GDP /population *2010=100*
1913	0.26	21 459	9 468	9 952	7 265	767	0.73	6.75
1914	0.38	21 559	9 467	12 204	8 909	941	0.73	5.55
1915	0.55	21 622	9 429	18 229	13 307	1 411	0.73	5.78
1916	0.78	21 909	9 613	22 818	16 657	1 733	0.73	5.00
1917	1.28	22 112	9 713	32 863	23 990	2 470	0.73	4.35
1918	1.95	22 342	9 838	43 992	32 114	3 264	0.73	3.78
1919	6.10							
1920	12.32	7 980	3 894					
1921	16.76	8 051	3 947					
1922	67.74	8 122	3 999					
1923	1382.64	8 193	4 051					
1924	4174.91	8 263	4 103					
1925	3610.65	8 334	4 155	5 927	4 327	1 041	0.73	
1926	0.24	8 405	4 207	6 258	4 569	1 086	0.73	11.85
1927	0.24	8 476	4 259	6 295	4 596	1 079	0.73	11.39
1928	0.25	8 547	4 311	6 774	4 945	1 147	0.73	11.65
1929	0.24	8 618	4 363	7 022	5 126	1 175	0.73	12.57
1930	0.22	8 688	4 416	6 589	4 810	1 089	0.73	12.66
1931	0.22	8 746	4 450	5 815	4 245	954	0.73	11.25
1932	0.21	8 803	4 483	5 188	3 788	845	0.73	10.47
1933	0.20	8 861	4 517	4 931	3 600	797	0.73	10.45
1934	0.20	8 918	4 551	4 967	3 626	797	0.73	10.62
1935	0.21	8 975	4 585	5 243	3 828	835	0.73	10.62
1936	0.21	9 033	4 619	5 681	4 147	898	0.73	11.43
1937	0.21	9 090	4 653	6 035	4 405	947	0.73	11.72
1938	0.21	9 148	4 687	6 333	4 623	986	0.73	12.41
1939	0.21	9 205	4 721	6 998	5 109	1 082	0.73	13.24
1940	0.25	9 263	4 755	7 881	5 753	1 210	0.73	12.84
1941	0.30	9 320	4 789	9 195	6 712	1 401	0.73	12.48
1942	0.34	9 306	4 793	11 386	8 312	1 734	0.73	13.31
1943	0.41	9 291	4 798					
1944	0.51	9 277	4 802					
1945		9 262	4 806					
1946	0.95	9 248	4 810	14 283	10 426	2 168	0.73	6.06
1947	1.07	9 234	4 814	18 920	13 812	2 869	0.73	7.16
1948	1.12	9 219	4 818	26 248	19 161	3 977	0.73	9.49
1949	1.19	9 205	4 822	34 597	25 256	5 237	0.73	11.84

Source: Table C.1, Table C.2, Table C.3, Table C.6

Table C.16: CPI, Population, Tax units, GDP, Income denominator, 1950-2010

Year	CPI	Population	Population denominator	GDP *current prices*	Income denominator excl. capital gains	Income denominator /tax units in current prices	Income denominator excl. capital gains / GDP	Income denominator incl. capital gains	Real GDP / population
	2010==100	*(thousand)*	*(thousand, >15 yrs)*	*(million forint)*	*(million forint)*	*(forint)*		*(million forint)*	*2010=100*
1950	1.26	9 293	6 980	57 179	36 014	5 160	0.63		18.31
1951	1.52	9 383	7 040	80 337	50 601	7 187	0.63		21.09
1952	2.13	9 463	7 094	90 813	57 199	8 063	0.63		16.86
1953	2.12	9 545	7 148	102 059	64 282	8 993	0.63		18.86
1954	2.02	9 645	7 204	105 294	66 320	9 206	0.63		20.24
1955	2.00	9 767	7 261	115 979	73 050	10 061	0.63		22.21
1956	1.98	9 883	7 334	101 523	63 944	8 719	0.63		19.41
1957	2.03	9 829	7 273	131 991	83 135	11 430	0.63		24.77
1958	2.04	9 850	7 301	135 275	85 203	11 670	0.63		25.26
1959	2.01	9 913	7 364	157 727	99 344	13 491	0.63		29.65
1960	2.02	9 961	7 432	174 178	109 706	14 762	0.63		32.36
1961	2.04	10 007	7 481	185 256	116 533	15 578	0.63		33.95
1962	2.05	10 052	7 535	195 404	122 917	16 313	0.63		35.48
1963	2.04	10 074	7 597	205 613	129 339	17 024	0.63		37.47
1964	2.05	10 108	7 673	216 140	135 961	17 719	0.63		39.10
1965	2.06	10 140	7 749	214 987	135 061	17 430	0.63		38.50
1966	2.09	10 166	7 823	237 449	146 017	18 664	0.61		41.92
1967	2.09	10 203	7 900	256 757	156 568	19 819	0.61		44.99
1968	2.09	10 244	7 967	281 078	167 830	21 067	0.60		49.20
1969	2.12	10 284	8 047	312 352	181 228	22 521	0.58		53.73
1970	2.14	10 322	8 146	332 548	199 698	24 516	0.60		56.24
1971	2.19	10 352	8 227	360 847	211 519	25 710	0.59		59.67
1972	2.25	10 378	8 290	390 960	225 866	27 245	0.58		62.69
1973	2.32	10 410	8 334	429 006	246 772	29 612	0.58		66.37
1974	2.37	10 442	8 366	448 948	270 983	32 391	0.60		68.00
1975	2.46	10 501	8 390	481 477	292 694	34 886	0.61		69.89
1976	2.58	10 563	8 406	527 572	312 497	37 177	0.59		72.49
1977	2.68	10 615	8 413	580 585	342 854	40 755	0.59		76.39
1978	2.80	10 660	8 410	628 336	368 539	43 824	0.59		78.70
1979	3.05	10 687	8 400	680 873	400 380	47 662	0.59		78.13
1980	3.33	10 709	8 368	721 031	437 735	52 309	0.61		75.70
1981	3.48	10 705	8 356	779 912	472 052	56 489	0.61		78.29
1982	3.72	10 695	8 348	847 871	507 716	60 818	0.60		79.69
1983	4.00	10 671	8 350	896 367	551 654	66 063	0.62		78.71
1984	4.33	10 640	8 354	978 456	607 790	72 756	0.62		79.56
1985	4.63	10 599	8 359	1 033 658	666 323	79 714	0.64		78.84
1986	4.88	10 560	8 361	1 088 800	724 051	86 594	0.66		79.14
1987	5.30	10 509	8 363	1 226 370	793 812	94 922	0.65		82.46
1988	6.12	10 464	8 371	1 440 364	932 327	114 301	0.65		84.21
1989	7.16	10 421	8 386	1 722 833					86.45
1990	9.23	10 375	8 244	2 089 313					81.71
1991	12.46	10 373	8 291	2 498 319					72.38
1992	15.32	10 374	8 327	2 942 668	1 963 036	235 730	0.67	1 998 626	69.31
1993	18.77	10 365	8 352	3 548 262	2 318 805	277 629	0.65	2 366 690	68.29
1994	22.30	10 350	8 366	4 364 811	2 655 263	317 383	0.61	2 710 193	70.80
1995	28.58	10 337	8 376	5 727 829	3 405 408	406 579	0.59	3 460 892	72.59
1996	35.32	10 321	8 376	7 011 167	4 052 532	483 837	0.58	4 138 756	72.00
1997	41.79	10 301	8 372	8 691 899	4 843 088	578 459	0.56	4 921 900	75.60
1998	47.76	10 280	8 364	10 280 904	5 740 329	686 344	0.56	5 844 588	78.39
1999	52.54	10 253	8 347	11 443 475	6 442 534	771 823	0.56	6 559 387	79.54
2000	57.69	10 222	8 326	13 089 047	7 334 230	880 885	0.56	7 552 189	83.10
2001	62.99	10 200	8 508	15 103 898	8 444 576	992 510	0.56	8 672 169	88.01
2002	66.33	10 175	8 515	17 119 415	9 671 332	1 135 834	0.56	9 960 906	94.96
2003	69.45	10 142	8 509	18 838 254	10 736 888	1 261 876	0.57	11 115 939	100.13
2004	74.17	10 117	8 511	20 822 396	11 901 087	1 398 380	0.57	12 148 636	103.89
2005	76.84	10 098	8 518	22 018 283	12 692 442	1 490 099	0.58	12 921 758	106.23
2006	79.84	10 077	8 523	23 675 850	13 739 516	1 612 025	0.58	14 088 300	110.17
2007	86.23	10 066	8 537	24 991 847	14 594 144	1 709 616	0.58	14 965 592	107.80
2008	91.49	10 045	8 537	26 545 649	15 407 063	1 804 825	0.58	15 578 647	108.15
2009	95.33	10 031	8 538	25 622 866					100.32
2010	100.00	10 014	8 537	26 747 662					100.00

Source: Table C.1, Table C.2, Table C.3, Table C.6

Table C.17: Top income share estimates, 1914-2008

	Top income share estimates excl. realized capital gains					Top income share estimates incl. realized capital gains				
	10%	5%	1%	0.1%	0.01%	10%	5%	1%	0.1%	0.01%
1914				7.281	2.908					
1915				7.329	3.57					
1927			17.771	7.476	2.745					
1930				5.434	1.724					
1931		27.066	15.234	5.742	1.771					
1932		27.071	15.196	5.417	1.589					
1933		26.911	15.026	5.197	1.479					
1934		27.13	14.784	5.057	1.437					
1935		27.578	14.548	5.176	1.5					
1936		26.105	14.511	5.232	1.595					
1937		25.537	14.735	5.339	1.573					
1938		25.733	15.048	5.458	1.689					
1939		25.36	14.929	5.445	1.629					
1940		26.011	15.233	5.632	1.747					
1951	21.648	12.994	3.707	0.554	0.081					
1955	19.459	11.381	3.104	0.47	0.071					
1956	23.34	13.56	3.643	0.523	0.075					
1957	21.924	12.757	3.423	0.51	0.076					
1958	22.017	12.688	3.354	0.491	0.072					
1960	19.996	11.516	3.137	0.487	0.076					
1961	19.79	11.403	3.119	0.488	0.076					
1962	19.121	10.984	2.977	0.459	0.071					
1964	19.325	11.187	3.123	0.503	0.081					
1966	19.156	10.97	2.894	0.419	0.061					
1968	18.049	10.398	2.79	0.421	0.064					
1970	20.114	11.716	3.213	0.496	0.077					
1972	18.996	11.032	3.004	0.451	0.068					
1974	18.275	10.56	2.815	0.403	0.058					
1976	17.74	10.199	2.715	0.394	0.057					
1978	17.642	10.187	2.763	0.416	0.063					
1980	16.968	9.738	2.632	0.403	0.062					
1982	16.657	9.567	2.552	0.378	0.056					
1984	15.286	8.878	2.474	0.396	0.064					
1986	15.691	9.205	2.637	0.44	0.073					
1988	17.7	10.902	3.498	0.687	0.135					
1992	25.616	17.071	6.507	1.527	0.39	26.417	17.903	7.227	1.952	0.508
1993	25.73	17.276	6.801	1.887	0.608	26.355	17.972	7.428	2.21	0.716
1994	27.237	18.294	7.103	1.579	0.296	27.467	18.614	7.431	1.786	0.396
1995	25.341	17.245	7.056	1.894	0.514	25.47	17.444	7.284	2.073	0.6
1996	25.832	17.907	7.74	2.412	0.761	26.975	19.005	8.617	3.033	1.093
1997	26.607	18.595	7.905	2.2	0.611	27.087	19.056	8.189	2.298	0.642
1998	26.809	18.876	8.156	2.414	0.718	27.459	19.507	8.576	2.621	0.803
1999	28.154	19.817	8.538	2.467	0.705	30.04	21.603	9.966	3.442	1.198
2000	28.312	20.07	8.94	2.686	0.809	29.911	21.592	9.992	3.142	0.989
2001	29.468	21.02	9.532	3.237	1.17	30.692	22.187	10.248	3.512	1.269
2002	29.153	20.641	9.002	2.67	0.781	30.479	21.846	9.561	2.79	0.806
2003	29.585	20.766	8.904	2.689	0.824	30.933	22.055	9.648	2.94	0.907
2004	28.744	20.171	8.749	2.82	0.95	29.435	20.877	9.263	3.1	1.13
2005	30.384	21.637	9.833	3.434	1.289	31.306	22.53	10.486	3.848	1.554
2006	31.303	22.237	10.082	3.544	1.35	32.573	23.492	11.092	4.285	1.857
2007	33.518	23.73	10.495	3.373	1.104	34.815	25.005	11.532	4.072	1.49
2008	32.124	22.499	9.648	3.027	1.002	33.139	23.56	10.729	3.996	1.67

Notes: The table reports the percentage of total income received by each of the top groups. At the first five columns taxpayers are ranked by gross income (excluding realized capital gains); income excludes capital gains and fractiles are defined by total income excluding capital gains. At the last five columns taxpayers are ranked by gross income (including realized capital gains); income includes capital gains and fractiles are defined by total income including capital gains.

Source: Computations by authors.

Table C.18: Decomposition of top income shares, 1914-1940

	Employment	Business	Land	Real estate	Capital	Other	Employment	Business	Land	Real estate	Capital	Other
	Top 0.01%						Top 0.1%					
1914							6.11	31.54	26.63	16.88	17.77	1.07
1915							4.50	45.59	24.07	11.79	13.51	0.54
1932	12.66	11.43	21.00	43.29	4.82	6.80	19.67	16.42	14.67	42.38	4.18	2.68
1933	16.84	19.35	28.02	28.59	2.41	4.80	20.16	18.42	16.35	37.10	4.63	3.34
1934	16.78	22.52	29.56	22.13	6.73	2.28	23.05	21.82	17.96	31.14	4.38	1.65
1935	16.78	22.52	29.56	22.13	6.73	2.28	23.05	21.82	17.96	31.14	4.38	1.65
1936	13.88	21.80	37.02	18.69	6.62	1.99	20.14	23.53	21.87	28.54	4.08	1.85
1937	14.31	27.25	34.18	16.84	4.95	2.47	19.14	27.52	21.22	26.44	3.58	2.09
1938	15.22	25.50	34.56	15.64	7.67	1.40	19.36	27.91	22.41	22.86	6.01	1.45
1939	17.58	31.41	29.39	12.64	7.28	1.70	21.53	32.30	19.83	19.13	5.54	1.66
1940	9.55	42.98	29.29	8.85	6.59	2.75	15.61	42.59	18.85	15.14	5.55	2.26
	Top 1%						Top 5%					
1932	30.45	20.56	12.36	32.19	2.34	2.11	26.99	23.53	20.96	25.25	1.50	1.78
1933	31.27	21.76	11.90	28.90	3.15	3.01	27.01	24.57	18.65	25.30	2.02	2.45
1934	34.40	23.48	12.55	25.59	2.72	1.26	29.77	25.05	17.36	24.53	2.12	1.16
1935	34.40	23.48	12.55	25.59	2.72	1.26	29.77	25.05	17.36	24.53	2.12	1.16
1936	31.94	25.03	14.53	24.55	2.48	1.48	28.67	26.57	18.93	22.54	1.87	1.42
1937	30.92	27.17	14.67	23.36	2.32	1.56	27.14	28.77	19.49	21.31	1.78	1.51
1938	29.25	28.34	15.88	21.48	3.78	1.28	25.77	30.14	20.59	19.50	2.70	1.30
1939	29.85	30.96	14.84	19.29	3.67	1.40	26.33	31.85	19.83	17.99	2.67	1.33
1940	26.42	37.20	13.91	16.98	3.63	1.86	25.68	35.64	17.97	16.31	2.66	1.74

Notes: The table reports the income decomposition of total income received by each of the top groups. Taxpayers are ranked by gross income (excluding realized capital gains); and fractiles are defined by total income excluding capital gains. Labor income includes remunerations of employees in the public and the private sector, pensions, bonuses and excludes executive compensation. Business income includes income from business activity in industrial, commercial and other sectors, income from liberal professons and remunerations of business executives. Land is income form land. Real estate is actual and imputed rent. Capital income includes income from capital holdings, dividends, annuities, interest from savings, securities, royalties.

Source: Computations by authors.

Table C.19: Decomposition of top income shares including realized capital gains, 1992-2008

	Labor	Business	Dividend	Realized Gains (Financial)	Realized Gains (Real)	Other Capital	Labor	Business	Dividend	Realized Gains (Financial)	Realized Gains (Real)	Other Capital
				Top 0.01%						Top 0.1%		
1992	36.55	21.23	0.21	42.01	0	0	44.92	20.89	1.54	32.64	0	0
1993	34.53	19.61	19.65	26.1	0.1	0	38.52	22.86	15.27	23.28	0.08	0
1994	55.14	18.82	7.86	17.77	0.41	0	56.1	20.19	7.1	16.25	0.37	0
1995	38.01	19.15	30.02	11.51	0.6	0.72	38.01	19.15	30.02	11.51	0.6	0.72
1996	45.12	13.89	20.04	15.84	5.04	0.07	45.12	13.89	20.04	15.84	5.04	0.07
1997	51	22.89	16.22	3.33	5.92	0.64	51	22.89	16.22	3.33	5.92	0.64
1998	55.34	11.4	21	6.67	5.24	0.35	55.34	11.4	21	6.67	5.24	0.35
1999	55.08	6.28	12.82	16.66	7.4	1.76	55.08	6.28	12.82	16.66	7.4	1.76
2000	53.01	11.81	12.86	6.96	13.61	1.76	53.01	11.81	12.86	6.96	13.61	1.76
2001	63.09	3.27	11.73	5.17	9.96	6.78	63.09	3.27	11.73	5.17	9.96	6.78
2002	62.85	5.31	14.57	1.23	12.75	3.28	62.85	5.31	14.57	1.23	12.75	3.28
2003	59.29	2.83	15.41	5.6	12.97	3.9	59.29	2.83	15.41	5.6	12.97	3.9
2004	47.18	2.56	33.9	13.15	2.68	0.55	52.94	2.69	29.5	10.1	4.17	0.6
2005	38.47	2.83	37.78	12.81	4.08	4.04	42.76	2.7	35.1	10.89	4.6	3.95
2006	39.04	5.98	30.08	20.06	3.55	1.28	41.53	5.64	28.87	18.49	4.01	1.46
2007	36.7	2.35	35.21	16.03	7.44	2.27	36.7	2.35	35.21	16.03	7.44	2.27
2008	38.65	5.01	25.01	26.83	2.23	2.26	40.38	4.92	24.57	25.62	2.23	2.28
				Top 1%						Top 5%		
1992	67.37	18.11	0.96	13.43	0.12	0	79.39	12.84	0.65	6.97	0.14	0
1993	63.87	18.09	5.22	12.65	0.17	0	78.39	12.69	2.46	6.27	0.19	0
1994	72.86	15.04	4.37	7.53	0.21	0	81.88	11.53	2.39	3.99	0.22	0
1995	63.49	16.26	14.32	5.2	0.21	0.52	77.82	11.62	7.12	2.83	0.15	0.46
1996	60.43	11.92	13.35	9.39	4.84	0.06	74.61	8.77	7.38	5.19	3.95	0.1
1997	65.69	16.56	9.67	2.23	5.53	0.32	77.98	11.54	5.1	1.26	3.93	0.19
1998	65.16	9.81	15.5	4.45	4.82	0.26	78.31	7.1	8.2	2.49	3.78	0.12
1999	63.44	6.3	9.82	10.94	8.04	1.46	75.74	5.41	5.72	5.3	6.58	1.26
2000	58.52	9.84	11.55	5.28	13.37	1.44	72.74	6.98	6.66	2.62	9.69	1.3
2001	69.29	3.39	8.61	3.07	11.31	4.34	78.33	3.63	4.97	1.59	8.46	3.02
2002	66.98	4.84	10.22	1.14	14.15	2.68	75.92	4.41	5.86	0.75	11.08	1.99
2003	64.75	3.14	10.81	3.77	14.31	3.22	76.42	2.95	5.86	1.75	10.87	2.16
2004	73.1	2.07	13.9	3.96	6.61	0.35	84.03	1.8	7.23	1.89	4.8	0.26
2005	64.62	2.35	19.32	4.25	6.71	2.74	78.01	2.19	10.41	2.02	5.45	1.91
2006	63.49	3.52	16.85	7.69	6.54	1.91	77.03	2.93	9.29	3.76	5.48	1.51
2007	58.33	2.39	23.1	6.88	7.21	2.09	74.09	2.51	12.97	3.38	5.55	1.51
2008	67.94	3.44	14.69	10.19	1.66	2.08	81.89	3.05	7.69	4.73	1.15	1.49
				Top 10%								
1992	83.66	10.63	0.52	5.04	0.15	0						
1993	83.26	10.28	1.77	4.55	0.15	0						
1994	85.39	9.76	1.72	2.94	0.19	0						
1995	82.78	9.38	5.13	2.16	0.13	0.43						
1996	79.89	7.46	5.49	3.95	3.11	0.09						
1997	82.49	9.46	3.77	0.99	3.1	0.19						
1998	82.76	6.19	6.13	1.87	2.96	0.09						
1999	80.55	4.83	4.4	3.87	5.21	1.14						
2000	78.11	6.05	5.13	1.93	7.59	1.19						
2001	82.31	3.55	3.86	1.19	6.61	2.48						
2002	80.55	4.06	4.41	0.6	8.69	1.69						
2003	81.26	2.8	4.38	1.28	8.47	1.81						
2004	87.72	1.67	5.33	1.37	3.69	0.22						
2005	82.75	2.07	7.76	1.47	4.37	1.59						
2006	81.9	2.67	6.94	2.76	4.43	1.29						
2007	79.64	2.42	9.71	2.48	4.49	1.26						
2008	85.89	2.85	5.67	3.38	0.96	1.25						

Notes: The table reports the income decomposition of total income received by each of the top groups. Taxpayers are ranked by gross income (including realized capital gains); and fractiles are defined by total income including capital gains. Labor includes labor related income such as wages and salaries, bonus, in kind benefit, stock option, and employee stock, taxable cost compensations, pension, unemployment and maternity benefit, scholarship. Business is self-employed and partnership income, liberal profession, agricultural income. Dividend includes general dividends, and dividends received through partnership. Real capital gain is realized gain from selling property, movable goods, rights. Financial capital gain is realized gain from selling financial assets. Other capital income includes any other taxable capital income such as rent, annuities and interest not taxed at the source.

Source: Computations by authors.

Table C.20: Decomposition of top income shares excluding realized capital gains, 1992-2008

	Labor	Business	Dividend	Other Capital	Labor	Business	Dividend	Other Capital
	Top 0.01%				Top 0.1%			
1992	60,18	39,81	0	0,01	66,35	31,72	0	1,94
1993	44,89	26,02	0	29,09	52,32	28,89	0	18,78
1994	69,32	22,11	0	8,58	69,45	23,49	0	7,06
1995	42,79	21,31	0,84	35,06	42,79	21,31	0,84	35,06
1996	55,85	18,08	0,09	25,98	55,85	18,08	0,09	25,98
1997	55,38	25,78	0,61	18,24	55,38	25,78	0,61	18,24
1998	62,2	13,14	0,41	24,24	62,2	13,14	0,41	24,24
1999	71,67	8,49	2,42	17,42	71,67	8,49	2,42	17,42
2000	65,76	15,37	2,2	16,67	65,76	15,37	2,2	16,67
2001	73,98	3,94	8,06	14,02	73,98	3,94	8,06	14,02
2002	72,64	6,25	3,88	17,23	72,64	6,25	3,88	17,23
2003	71,98	3,51	5	19,5	71,98	3,51	5	19,5
2004	55,86	2,95	0,66	40,53	62,74	2,93	0,69	33,63
2005	46,18	3,45	4,76	45,61	51,31	3,2	4,56	40,93
2006	50,81	7,93	1,54	39,72	54,62	7,07	1,85	36,46
2007	47,39	3,09	2,78	46,74	48,53	3,09	2,77	45,61
2008	54,51	6,92	3,13	35,45	57,12	6,5	3,09	33,28
	Top 1%				Top 5%			
1992	78,62	20,28	0	1,1	85,71	13,62	0	0,66
1993	74,03	20,12	0	5,85	84	13,39	0	2,61
1994	79,3	16,1	0	4,6	85,61	11,94	0	2,45
1995	67,12	17,2	0,55	15,13	80,2	12,01	0,47	7,33
1996	70,76	13,81	0,07	15,36	82,29	9,6	0,1	8,02
1997	71,85	17,61	0,32	10,21	82,42	12,06	0,19	5,32
1998	72,4	10,59	0,28	16,73	83,71	7,5	0,13	8,66
1999	78,51	7,81	1,86	11,82	86,11	6,07	1,42	6,4
2000	72,85	11,61	1,8	13,74	83,28	7,82	1,46	7,44
2001	81,18	3,96	5,02	9,84	87,3	3,97	3,3	5,43
2002	79,71	5,57	3,08	11,65	86,46	4,87	2,2	6,48
2003	79,78	3,75	3,81	12,66	87,73	3,31	2,42	6,54
2004	82,14	2,3	0,38	15,18	90,15	1,92	0,27	7,66
2005	73,11	2,63	3,01	21,25	84,49	2,36	2,04	11,11
2006	74,58	4,05	2,16	19,22	85,08	3,21	1,62	10,08
2007	68,49	2,78	2,37	26,36	81,6	2,75	1,62	14,04
2008	77,25	3,9	2,32	16,53	87,04	3,24	1,58	8,14
	Top 10%							
1992	88,38	11,08	0	0,54				
1993	87,45	10,7	0	1,85				
1994	88,21	10,02	0	1,76				
1995	84,72	9,61	0,44	5,24				
1996	86,03	7,98	0,1	5,89				
1997	86,08	9,81	0,2	3,91				
1998	87,02	6,48	0,09	6,41				
1999	88,68	5,27	1,24	4,81				
2000	86,5	6,61	1,29	5,6				
2001	89,36	3,82	2,66	4,16				
2002	88,9	4,44	1,85	4,81				
2003	90,14	3,05	2	4,81				
2004	92,44	1,75	0,23	5,58				
2005	87,95	2,18	1,68	8,19				
2006	88,34	2,87	1,37	7,41				
2007	85,72	2,6	1,33	10,36				
2008	89,81	2,97	1,3	5,92				

Notes: The table reports the income decomposition of total income received by each of the top groups. Taxpayers are ranked by gross income (excluding realized capital gains); and fractiles are defined by total income excluding capital gains. Labor includes labor related income such as wages and salaries, bonus, in kind benefit, stock option, and employee stock, taxable cost compensations, pension, unemployment and maternity benefit, scholarship. Business is self-employed and partnership income, liberal profession, agricultural income. Dividend includes general dividends, and dividends received through partnership. Other capital income includes any other taxable capital income such as rent, annuities and interest not taxed at the source.

Source: Computations by authors.

Table C.21: Decomposition of top income shares, 1914-2008.

	Labor	Mixed labor	Capital	Labor	Mixed labor	Capital	Upper bound capital estimate
	Top 0.1%			Top 1%			
1914	0.44	2.30	4.54				
1915	0.33	3.34	3.66				
1932	1.07	0.89	3.46	4.63	3.12	7.44	
1933	1.05	0.96	3.19	4.70	3.27	7.06	
1934	1.17	1.10	2.79	5.09	3.47	6.23	
1935	1.19	1.13	2.85	5.00	3.42	6.13	
1936	1.05	1.23	2.95	4.63	3.63	6.25	
1937	1.02	1.47	2.85	4.56	4.00	6.18	
1938	1.06	1.52	2.88	4.40	4.26	6.38	
1939	1.17	1.76	2.51	4.46	4.62	5.85	
1940	0.88	2.40	2.35	4.02	5.67	5.54	
1951	0.55			3.71			0.54
1955	0.47			3.10			0.37
1956	0.52			3.64			0.43
1957	0.51			3.42			0.33
1958	0.49			3.35			0.32
1960	0.49			3.14			0.25
1961	0.49			3.12			0.29
1962	0.46			2.98			0.30
1964	0.50			3.12			0.34
1966	0.42			2.89			0.36
1968	0.42			2.79			0.38
1970	0.50			3.21			0.37
1972	0.45			3.00			0.39
1974	0.40			2.82			0.45
1976	0.39			2.72			0.39
1978	0.42			2.76			0.41
1980	0.40			2.63			0.42
1982	0.38			2.55			0.45
1984	0.40			2.47			0.54
1986	0.44			2.64			0.59
1988	0.69			3.50			0.57
1992	0.88	0.41	0.67	4.87	1.31	1.05	
1993	0.85	0.51	0.85	4.74	1.34	1.34	
1994	1.00	0.36	0.42	5.41	1.12	0.90	
1995	0.79	0.40	0.89	4.62	1.18	1.48	
1996	1.37	0.42	1.24	5.21	1.03	2.38	
1997	1.17	0.53	0.60	5.38	1.36	1.45	
1998	1.45	0.30	0.87	5.59	0.84	2.15	
1999	1.90	0.22	1.33	6.32	0.63	3.02	
2000	1.67	0.37	1.11	5.85	0.98	3.16	
2001	2.22	0.11	1.18	7.10	0.35	2.80	
2002	1.75	0.15	0.89	6.40	0.46	2.70	
2003	1.74	0.08	1.11	6.25	0.30	3.10	
2004	1.64	0.08	1.38	6.77	0.19	2.30	
2005	1.65	0.10	2.10	6.78	0.25	3.46	
2006	1.78	0.24	2.26	7.04	0.39	3.66	
2007	1.49	0.10	2.48	6.73	0.28	4.53	
2008	1.61	0.20	2.19	7.29	0.37	3.07	

Notes: The table reports the income decomposition of total income received by each of the top groups. For 1914-1940 income excludes capital gains and fractiles are defined by total income excluding capital gains. For 1951-1988 income includes earnings only and fractiles are defined by total income including capital income, but excluding capital gains. See description for upper bound capital estimate for 1951-1988 in Section 3.2. For 1992-2008 income includes capital gains and fractiles are defined by total income including capital gains. See definition of labor, capital and mixed labor income in Table C.12.

Source: Computations by authors.

Table C.22: Skill premium and skill supply, 1920-2011.

Year	Log wage premium industry, mining	% high school, university degree
1920		0.026
1921	0.250	0.027
1922	0.276	0.027
1923	0.322	0.028
1924	0.410	0.028
1925	0.474	0.029
1926	0.502	0.029
1927	0.452	0.030
1928	0.436	0.031
1929	0.443	0.031
1930	0.476	0.032
1931	0.490	0.031
1932	0.527	0.031
1933	0.544	0.031
1934	0.528	0.031
1935	0.531	0.030
1936	0.500	0.030
1937	0.505	0.030
1938	0.482	0.029
1939	0.482	0.029
1940	0.449	0.029
1941	0.450	0.029
1942		0.030
1943		0.031
1944		0.032
1945		0.034
1946		0.035
1947		0.036
1948		0.037
1949		0.039
1950		0.041
1951		0.043
1952		0.045
1953		0.047
1954		0.049

Year	Log wage premium			% high school, university degree
	industry, construction	+ state agriculture	+cooperative agriculture	
1955	0.155			0.051
1956	0.154			0.053
1957	0.113			0.056
1958	0.120			0.058
1959	0.119			0.060
1960	0.115			0.062
1961	0.114			0.067
1962	0.110			0.072
1963	0.097			0.077
1964	0.098			0.083
1965	0.105			0.088
1966	0.104			0.093
1967	0.111	0.116		0.098
1968	0.104	0.111		0.104
1969	0.104	0.106		0.109
1970	0.124	0.125		0.114
1971	0.120	0.121		0.120
1972	0.116	0.117		0.126
1973	0.104	0.105		0.132
1974	0.102			0.138
1975	0.096	0.098	0.110	0.144
1976	0.092	0.094	0.101	0.150
1977	0.085	0.087	0.095	0.156
1978	0.079			0.162
1979	0.078			0.168
1980	0.081	0.083	0.091	0.174
1981	0.084	0.086	0.094	0.179
1982	0.085	0.088	0.097	0.183
1983	0.092	0.096	0.106	0.188
1984	0.096	0.100	0.115	0.192
1985	0.109	0.113	0.122	0.196
1986	0.121	0.124	0.132	0.201
1987	0.132	0.136	0.143	0.205
1988	0.187	0.191	0.199	0.210
1989	0.213	0.213		0.214

Year	Log wage premium	% high school, university degree
1990		0.219
1991	0.238	0.226
1992	0.249	0.234
1993	0.247	0.242
1994	0.254	0.249
1995	0.253	0.257
1996	0.247	0.265
1997	0.260	0.273
1998	0.273	0.280
1999	0.287	0.288
2000	0.294	0.296
2001	0.297	0.304
2002	0.302	0.313
2003	0.325	0.323
2004	0.326	0.332
2005	0.336	0.342
2006	0.331	0.352
2007	0.319	0.361
2008	0.322	0.371
2009	0.312	0.380
2010	0.302	0.390
2011	0.294	0.400

Notes: Skill supply is the percentage of people completed secondary school or university at the total population. Skill premium is the ratio of log average wages of non-manual and manual workers. For 1920-1941 average wages cover industrial and mining metallurgy sectors. For 1955-1989 average wages cover industry and construction sectors, while from 1967 an alternative series is reported covering additionaly the state agricultural sector, and from 1975 both the state and the cooperative agricultural sectors. For 1992-2011 average wages cover all sectors of the economy.

Source: Table C.7 and Table C.8

Table C.23: Fixed capital stock to GDP, 1898-2010.

Year	Fixed capital stock per GDP			
	Market value	Market/1968 book value	Market/1976 book value	Market value
1898	2.45			
1910	2.78			
1927	3.11			
1959		2.82		
1960		2.65		
1961		2.56		
1962		2.49		
1963		2.45		
1964		2.42		
1965		2.46		
1966		2.34		
1967		2.26		
1968		2.44		
1969		2.32	2.60	
1970		2.36	2.67	
1971		2.42	2.66	
1972		2.41	2.66	
1973			2.62	
1974			2.71	
1975			2.78	
1976			2.72	
1977			2.64	
1978			2.62	
1979			2.61	
1980			2.63	
1995				4.62
1996				4.79
1997				4.73
1998				4.55
1999				4.81
2000				4.69
2001				4.45
2002				4.13
2003				3.99
2004				3.83
2005				3.82
2006				3.87
2007				3.92
2008				3.92
2009				4.26
2010				4.18

Notes: Net stock of fixed non-financial capital assets includes dwellings, other non-residential buildings (e.g schools, hospitals, factory and office buildings) and structures (e.g. motorways, roads, railways, dams), transport equipment (public transportation, cars, railways), machinery and equipment (factory or office machinery, equipment and computers, television and communication equipment, medical instruments, furniture), cultivated assets (including animals, fruit plantations, vineyards and all land improvement, but not the value of the land), and intangible assets (e.g computer software). For 1989, 1910, 1927 and 1995-2010 assets are calculated at market value. For 1959-1980 half of the assets such as dwellings, roads, bridges, dams, private sector assets is valued at replacement value, while the other half is valued at book value (column 2 at 1968 prices, and column 3 at 1976 prices).

Source: Table C.9

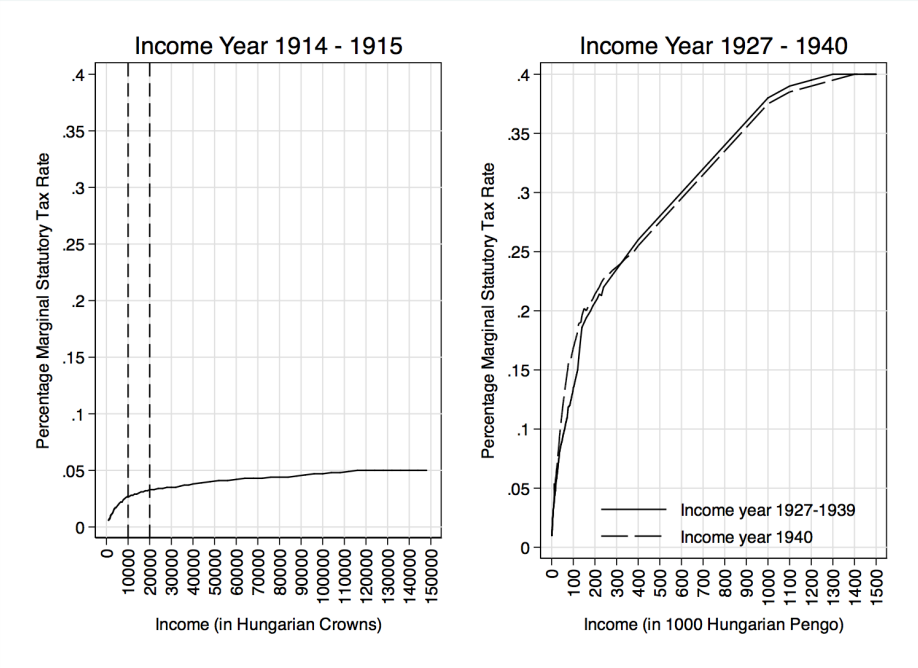
Table C.24: Proxies of the capital income share of GDP, 1968-2010.

Year	Enterprise profit tax share	Enterprise profit tax + net production subsidies share	Gross operating surplus (firms, HH, mixed income) share
1968	0.15	0.12	
1969	0.15	0.12	
1970	0.15	0.14	
1971	0.16	0.16	
1972	0.16	0.17	
1973	0.17	0.18	
1974	0.19	0.21	
1975	0.20	0.24	
1976	0.15	0.20	
1977	0.16	0.20	
1978	0.15	0.19	
1979	0.15	0.18	
1980	0.14	0.15	
1981	0.15	0.16	
1982	0.14	0.16	
1991			0.24
1992			0.19
1993			0.23
1994			0.29
1995			0.34
1996			0.37
1997			0.41
1998			0.41
1999			0.41
2000			0.39
2001			0.39
2002			0.40
2003			0.39
2004			0.39
2005			0.38
2006			0.40
2007			0.40
2008			0.39
2009			0.39
2010			0.40

Notes: For 1991-2011 the series report the capital factor share (gross operating surplus of households and firms). For 1968-1982 the series report a proxy as the net income the state extracted as the owner from enterprises, i.e. profit and income tax. An alternative series at column 2 includes additionaly also the net of production subsides and production tax.

Source: Table C.10

Figure C.1: Statutory tax rates for income years 1914-1940.



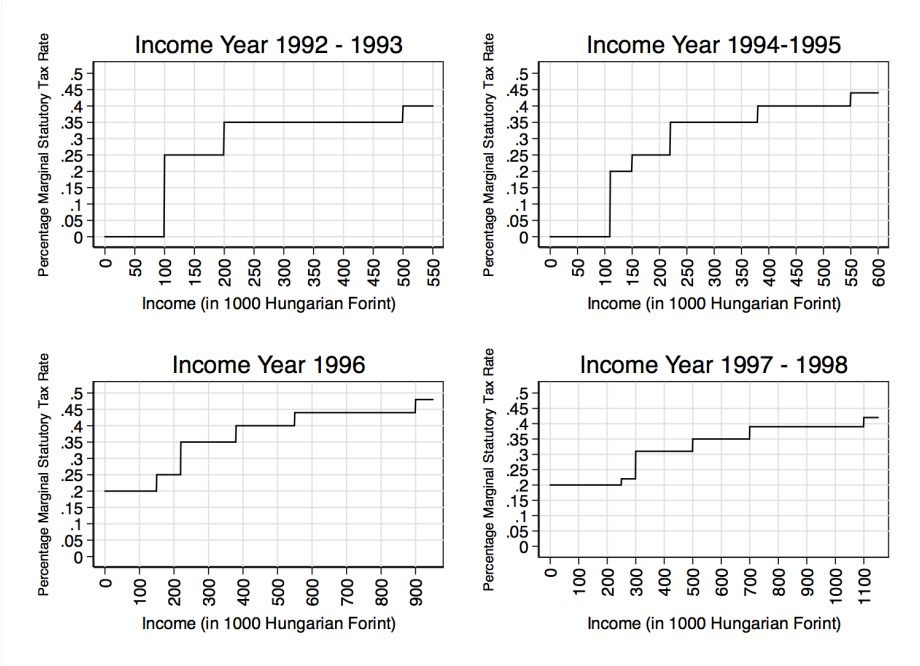
Notes: Reporting threshold was above 20.000 Crowns at income years 1914-1916, and 10.000 Crowns after 1917.
Source: 1909. X. 24§, 1927. V. 15§, 1940. XXII. 36§

Table C.25: Schedular surtax rates for income years 1914-1915, 1927-1940.

		Income Years 1914-1915	
	Schedules	*Tax rates*	*Legislation*
I.	Income from Land	20% (based on the cadaster of the agricultural land in the property registry, not on income)	1909 V
II.	Income from Built Property	16% (Budapest), 14% (urban centers), 11% (rural areas) on imputed and acual rent	1909 VI
III.	Earnings	1%-3% above 800 K income	1912 LIII
IV.	Capital, annuity	5% (10% for some exemptions)	1909 VII
V.	Wealth	0,12-0,5% above 50.000 K	1916 XXXII
		Income Years 1927 - 1940	
I.	Income from Land	20% (based on the cadaster of the agricultural land in the property registry, not on income)	1929 XXIII
II.	Income from Built Property	24% (Budapest), 20% (urban centers), 15% (rural areas) on imputed and acual rent	1922 XXII
		20% 18% 15%	1927 V
		17% 16% 14%	1929 II
III.	General earnings tax	5% (on income from industrial, commercial and business activity, liberal professions)	1925 PM 300 /18
IV.	Earnings of employees	0,5-7,5% above 80 K monthly employment earnings	1927 V
V.	Wealth	0,1-1% above 4000K (1% above 16 million K)	1924 PM 51.000
		0,1-1% above 5000K (1% above 20 million K)	1927 PM 50.000

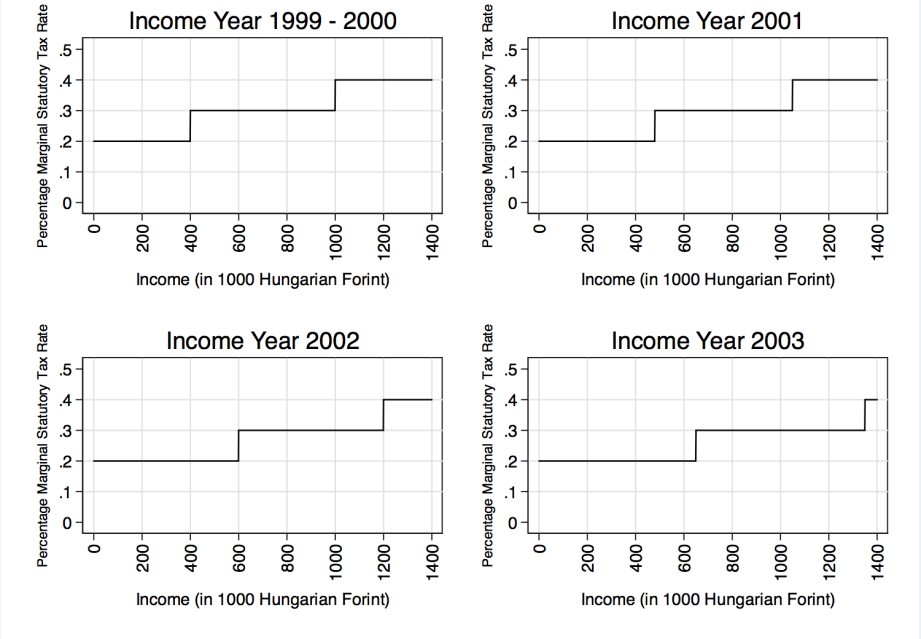
Notes: see Appendix C, Section 2.2 and 2.3 for a description of the tax system during 1914-1940.
Source: Compiled from the relevant legislation.

Figure C.2: Statutory income tax rates for income years 1992 - 1998.



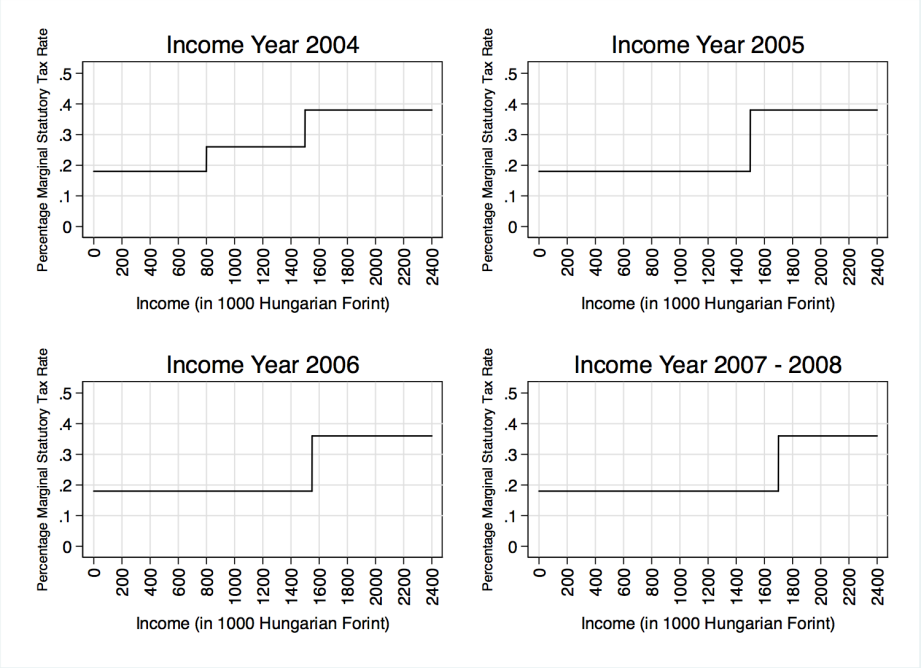
Source: NAV (Hungarian Tax Authorities) website.

Figure C.3: Statutory income tax rates for income years 2000 - 2003.



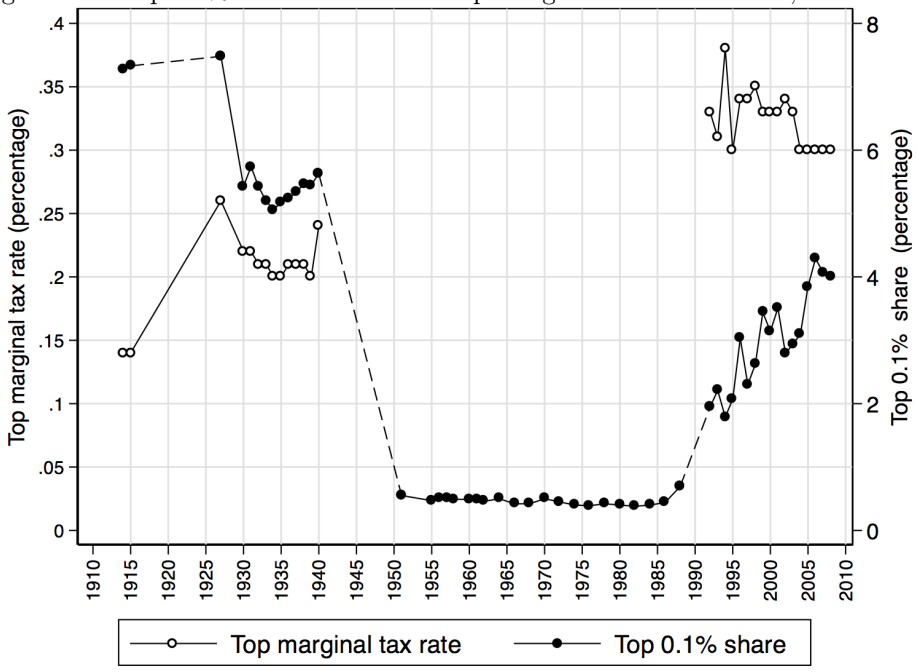
Source: NAV (Hungarian Tax Authorities) website.

Figure C.4: Statutory income tax rates for income years 2004 - 2008.



Source: NAV (Hungarian Tax Authorities) website.

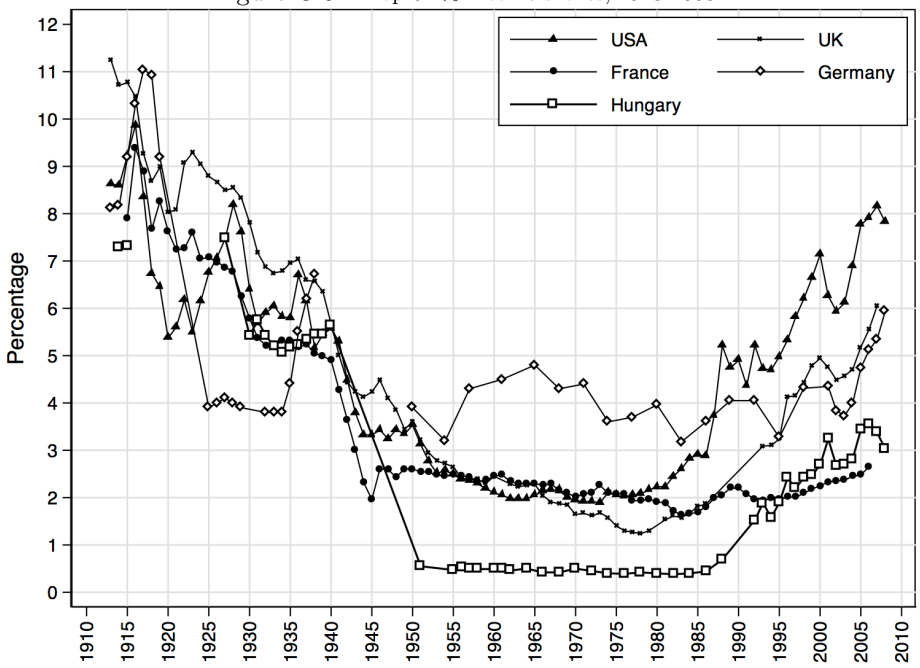
Figure C.5: Top 0.1% income share and top marginal income tax rate, 1914-2008.



Note: For construction of the top marginal tax rates see Section C.2.6. The top 0.1% income share series for 1914-1940 excludes capital gains, for 1992-2008 includes, and for 1951-1988 it is based on earning tables.

Source: Authors' computation using tax returns data and tax return law. For top 0.1% share series see Table C.17.

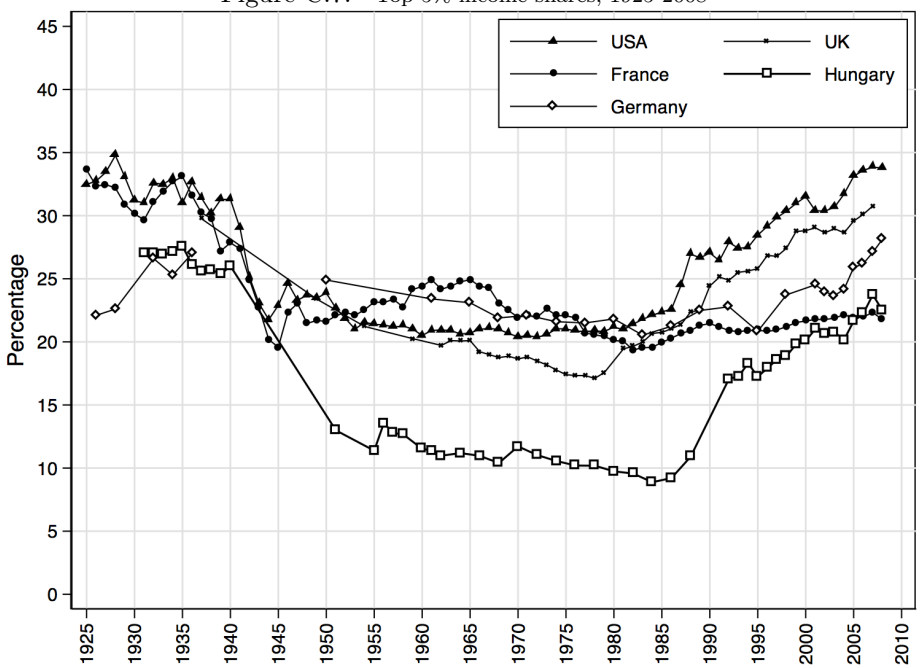
Figure C.6: Top 0.1% income shares, 1913-2008



Note: The shares are reported without realized capital gains, with total income denominators excluding realized capital gains.

Source: Table C.17, and World Top Income Database.

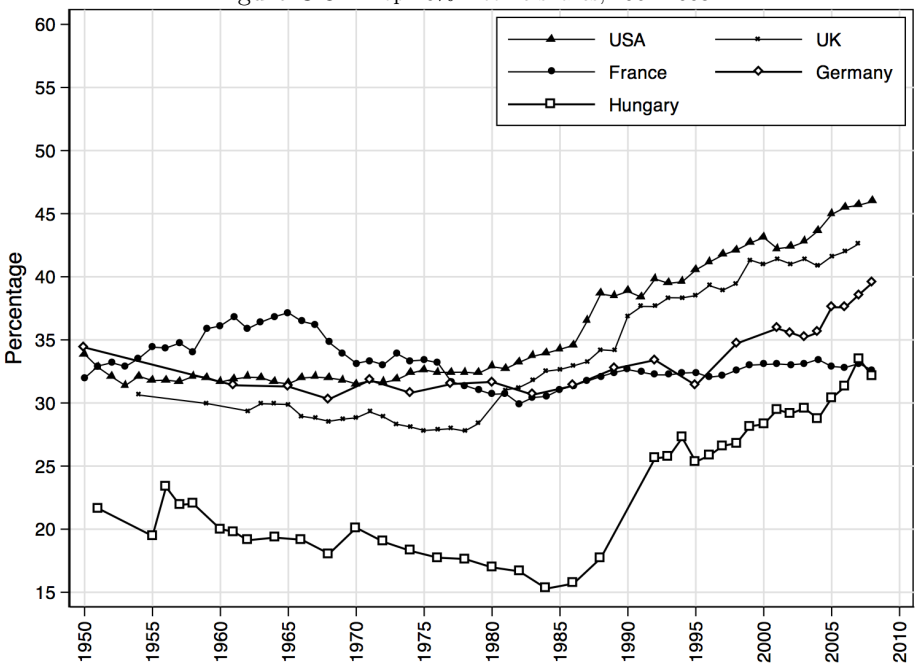
Figure C.7: Top 5% income shares, 1925-2008



Note: The shares are reported without realized capital gains, with total income denominators excluding realized capital gains.

Source: Table C.17, and World Top Income Database.

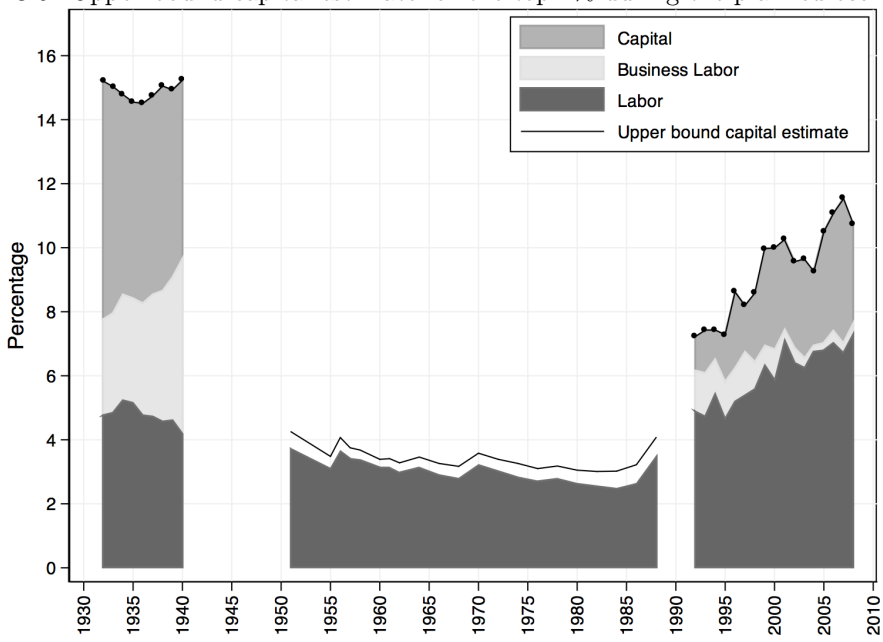
Figure C.8: Top 10% income shares, 1951-2008



Note: The shares are reported without realized capital gains, with total income denominators excluding realized capital gains.

Source: Table C.17, and World Top Income Database.

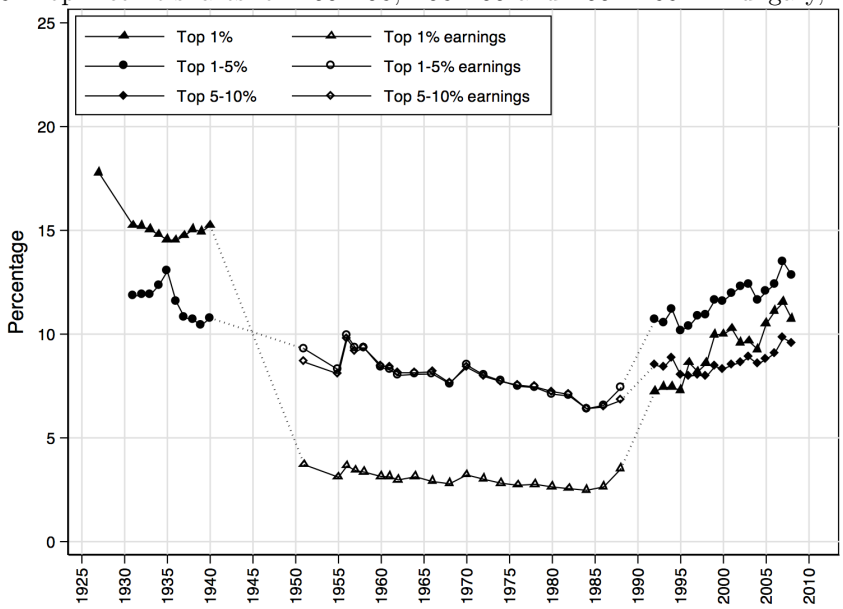
Figure C.9: Upper bound capital estimate for the top 1% during the planned economy.



Note: Capital: income from capital assets, land and buildings, for 1992-2008 also realized capital gains are included. Labor: wages and salaries and other employment income. Business: mixed income. See Table 11 for detailed income categories.

Source: Table C.21

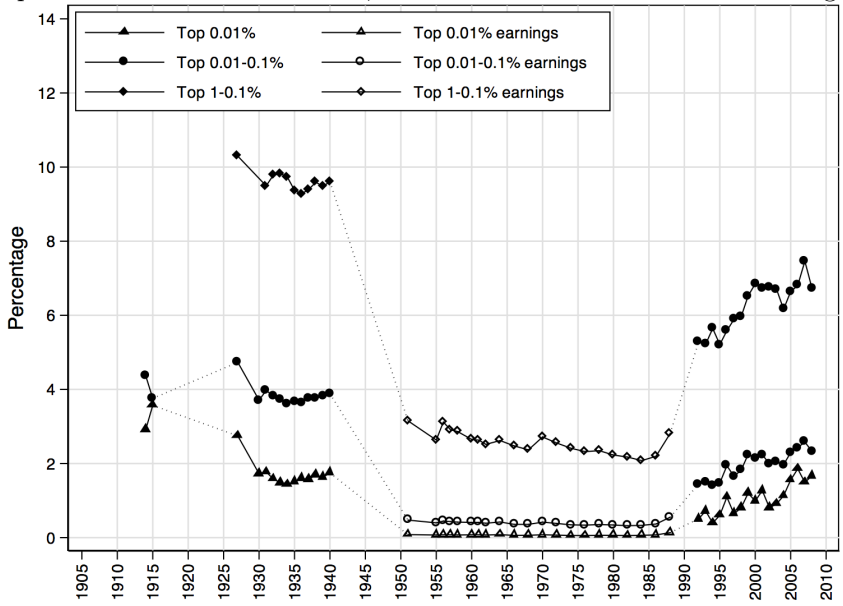
Figure C.10: Top income shares for P99-P95, P95-P99 and P99-P100 in Hungary, 1927-2008.



Note: Percentage of total income received by each of the top groups. Income is defined before taxes and excludes capital gains for 1927-1940, and includes capital gains for 1992-2008. For 1951-1988 income is based on earning tables. For 1927-1988 the fractiles are defined by total income excluding realized capital gains, and for 1992-2008 including realized capital gains also. (For details see Appendix chapter C.2, C.3 and C.6.)

Source: Table C.17

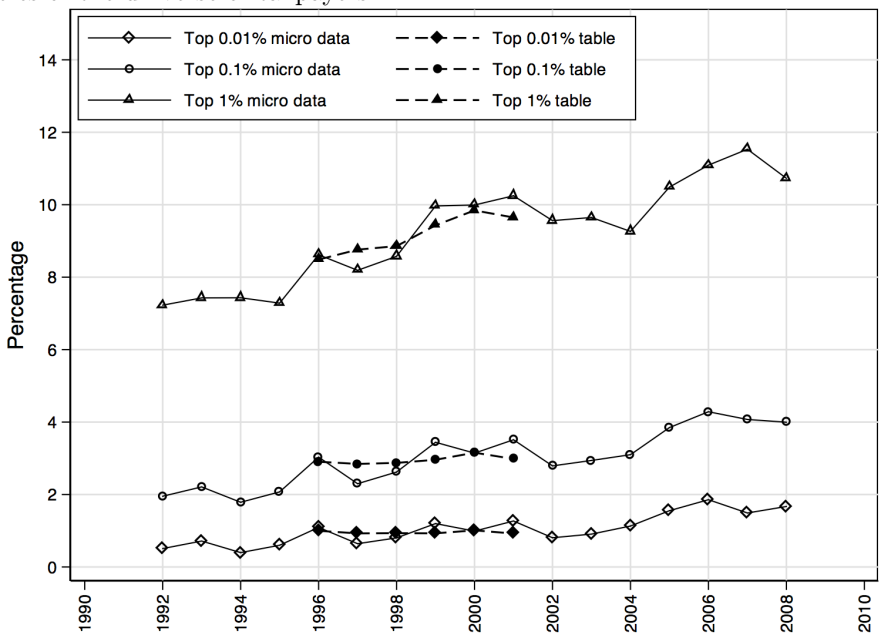
Figure C.11: Top income shares for P99-P99.9, P99.9-P99.99 and P99.99-P100 in Hungary, 1914-2008.



Note: Percentage of total income received by each of the top groups. Income is defined before taxes and excludes capital gains for 1927-1940, and includes capital gains for 1992-2008. For 1951-1988 income is based on earning tables. For 1927-1988 the fractiles are defined by total income excluding realized capital gains, and for 1992-2008 including realized capital gains also. (For details see Appendix chapter C.2, C.3 and C.6.)

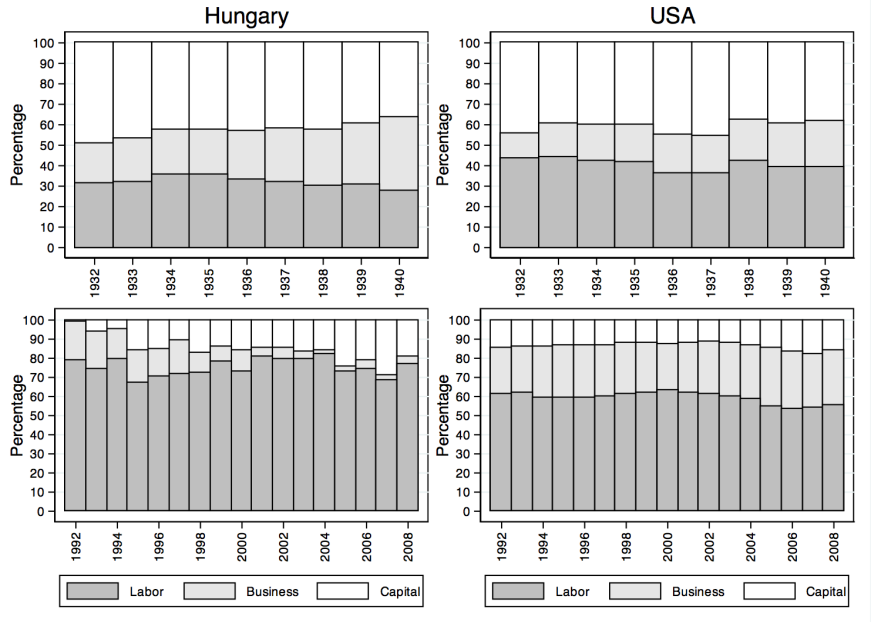
Source: Table C.17

Figure C.12: Top share estimates based on the administrative micro data sample and the administrative aggregate tables of the universe of taxpayers.



Note: Both series include realized capital gains.

Figure C.13: Top 1 percent share decomposition.



Note: The sum of all sources add up to 100%. Fractile is defined by total income excluding capital gains. Components are expressed in percentage of total income (excluding capital gains).

Source: Hungary: Table C.20, USA: World Top Income Database