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Accounting versus real production responses among firms to tax incentives: bunching evidence from Hungary *

(Cégek adóösztönzőkre adott könyvelési és termelési válaszai: egy magyarországi adóreform tanulságai)

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Contents

Abstract

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. This paper 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.

JEL: D22, H26, H32.

Keywords: taxation, firm behavior, tax evasion and avoidance.

Összefoglaló

Az eddigi kutatási eredmények alátámasztják, hogy a vállalatok reagálnak az ösztönzőkre. Azonban továbbra is kérdés, hogy vajon ezek könyvelési, adóelkerülési vagy valódi termelési válaszok. A cikk ezeket a vállalati válaszokat vizsgálja a 2007-es elvárt jövedelem nyereségadó bevezetésekor, amely adóreform megnövelte a társasági adóalapot az alacsony profit rátájú (profit a bevétel százalékában) cégeknek. Megismétlem az eddigi eredményeket magyar adminisztratív adóbevallások panel adatbázisát vizsgálva, majd további három új eredményt mutatok be, amik inkább a könyvelési, mint a termelési válaszokat támasztják alá. Ezek közül az első, hogy termelési válaszhoz képest a cégek túl gyorsan reagáltak: a reform bevezetése után már fél évvel éles változás látható a vállalatok profit ráta eloszlásában az adóreform új ösztönzőivel összhangban. Másodszor, a termelési válaszok vizsgálata nem mutat ki szignifikáns viselkedési válaszokat. Végül, a vállalatok költségszerkezetének vizsgálatakor csak a bevallott anyagköltségekben találok nagy változást, ami az egyik legkönnyebben túlköltségelhető elem a mérlegeredmény kiszámításakor. Ez utóbbi eredmény szintén azt támasztja alá, hogy a reform hatására a vállalatok a könyvelésüket és nem termelésüket változtatták meg.

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.

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. These findings also confirm that well designed tax incentives can help reduce tax evasion.

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 (2007) for USA, Devereux et al. (2014) for United Kingdom, and Dwenger and Steiner (2008) for Germany. In a recent paper Elek and Lőrincz (2015) made the first 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 this paper 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-Rodriguez (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. (2015) 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 (2010) proposes to estimate elasticity responses based on kink points – income thresholds where marginal tax rates jumps – in the tax schedule. Kleven and Waseem (2013) 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.

2 Minimum tax scheme

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.[1] 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.[2] 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).[3] In practise according to the new regulation, the corporate income tax was levied on revenue for firms with very high reported cost ratios, and hence low (or negative) reported profit ratios, and still on profit for others.[4] 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 for a detailed data description.)

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:

$$max[y - c + \Delta, 0.02y], \tag{1}$$

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

[2] 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.

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

[4] 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).

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. Depending on the sign of the sum of the tax base modifying items the tax calculation is slightly different. Let us first consider the case when it is positive. The tax is levied on the larger of the adjusted profit or the 2 percent of the net revenue: $[y - c + \Delta]$, $[0.02y]$. The corporate income tax rate is identical on both tax bases, that is the tax liability amount is calculated as $[y - c + \Delta]\,\tau_\pi$ or $[0.02y]\,\tau_\pi = y\tau_y$, 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.

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:

$$[y - c + \Delta] = 0.02y, \tag{2}$$

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:

$$p \equiv \frac{y - c + \Delta}{y} = 0.02 \tag{3}$$

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

$$\frac{[c - \Delta]}{y} = 0.98 \tag{4}$$

Figure 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.

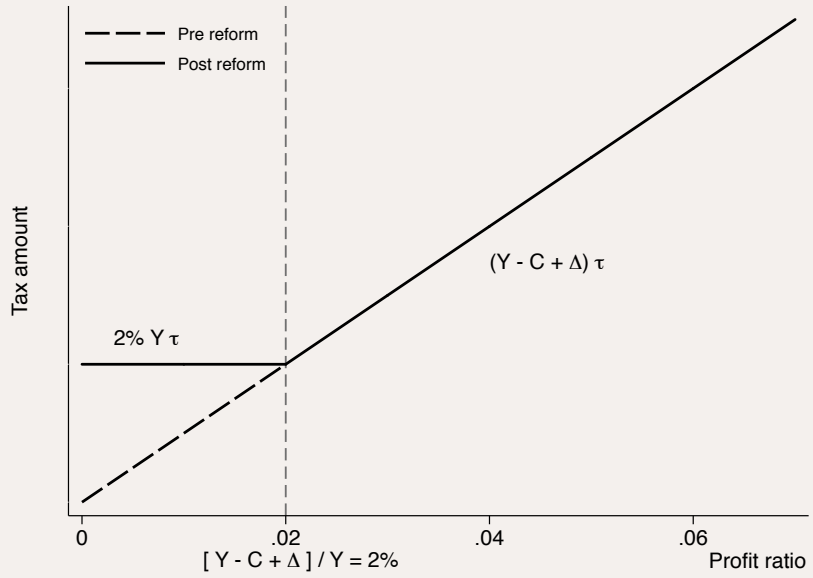
After the introduction of a minimum tax scheme firms in the revenue regime face two main incentives to shift their profit rate to the right and bunch at the threshold profit ratio. First, there is an incentive to reduce real production as after the reform they gain less marginal benefit from an additional unit of production. Assuming decreasing returns to scale, it will shift their profit ratio to the right.[5] 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.[6] 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.[7] The 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. 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. (2015) 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.

[5] 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.

[6] 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.

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

Figure 1
Minimum revenue tax schedule when the sum of tax base modifying items $(\Delta) \geq 0$



The additional difference in the Hungarian minimum tax scheme setting compared to the Pakistani one analyzed by Best et al. (2015) 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:

$$max[y - c, 0.02y]. \tag{5}$$

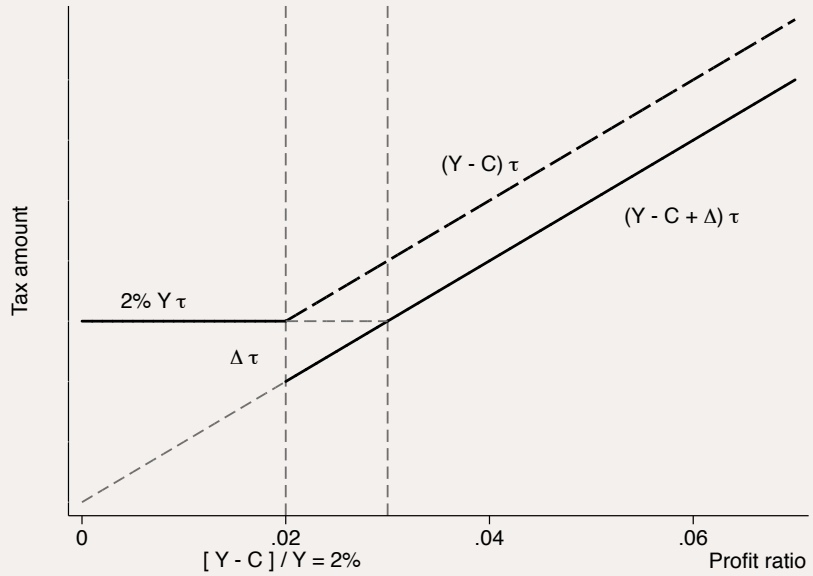
But as before, the tax is levied on the adjusted profit in the profit regime, and on the minimum amount in the revenue regime: $[y - c + \Delta]$, $[0.02y]$. So even though the regime is determined based on the operational profit, tax is levied on adjusted profit in the profit regime. This creates a 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 2. The threshold profit ratio between the revenue and profit regimes is:

$$p \equiv \frac{y - c}{y} = 0.02 \tag{6}$$

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.

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

Figure 2
Minimum revenue tax schedule when the sum of tax base modifying items $(\Delta) < 0$



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:

$$B = \int_{\pi^* - \Delta\pi^*}^{\pi^*} h_0(\pi) d\pi \simeq \bar{h_0}(\pi) \Delta\pi^*, \tag{7}$$

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 ($b$) can be backed out $b = B/\bar{h_0}(\pi)$.

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 (2010) and Kleven and Waseem (2013) for the theory on tax schedule kink and notch point created bunching responses).

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.[8]

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 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.[9] The solid grey line in figure 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.

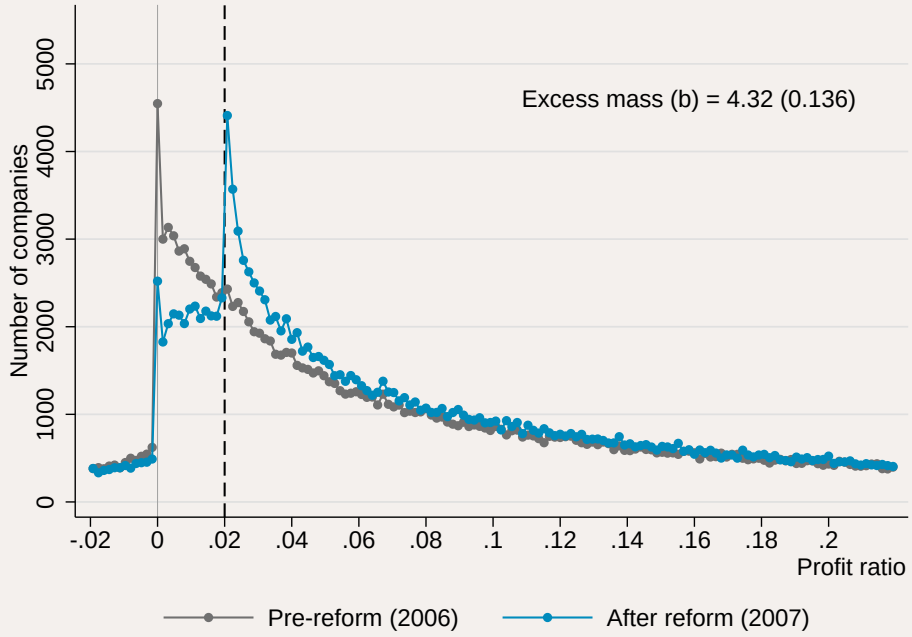
[8] The National Tax and Custom Office (NAV) yearly audit directives also confirms this reasoning as they list as one of their audit target group firms reporting profit below the profit threshold.

[9] See the detailed description of the data and data cleaning procedure in Appendix I.

Figure 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.)



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.[10] Firms affected by a higher 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 8 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.

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 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 9 , 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

[10] For 2008-09 the marginal corporate tax rate was 10 percent below 50 million HUF adjusted profit, and 16 percent 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 8, 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.

bunch right of the threshold and not diffusely around. As can be seen in Figure 3, 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 the 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 (2016) 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. Devereux 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.[11] 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 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 10 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 11 displays larger responses among small firms with at most 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.[12] As can be seen in Figure 12, 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.

[11] 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. Moreover, 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.

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

4 Evidence for accounting rather than real responses

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 behavioral reactions. This part is a novelty compared to the Best et al. (2015) 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 group 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.

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 4. The variables are normalized by balance sheet total to avoid that results might be driven by extreme

Table 1
Control and treatment group variables

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

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 8 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 shows the values of the time and treatment dummies in the regression specification.

$$y_i = \alpha + \beta_0 T_i + \beta_1 D + \beta_2 T_i D_i + \beta_j' X_{j,i} + \varepsilon_i \tag{8}$$

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.

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 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

Figure 4
Average employment, wage bill and investment trend

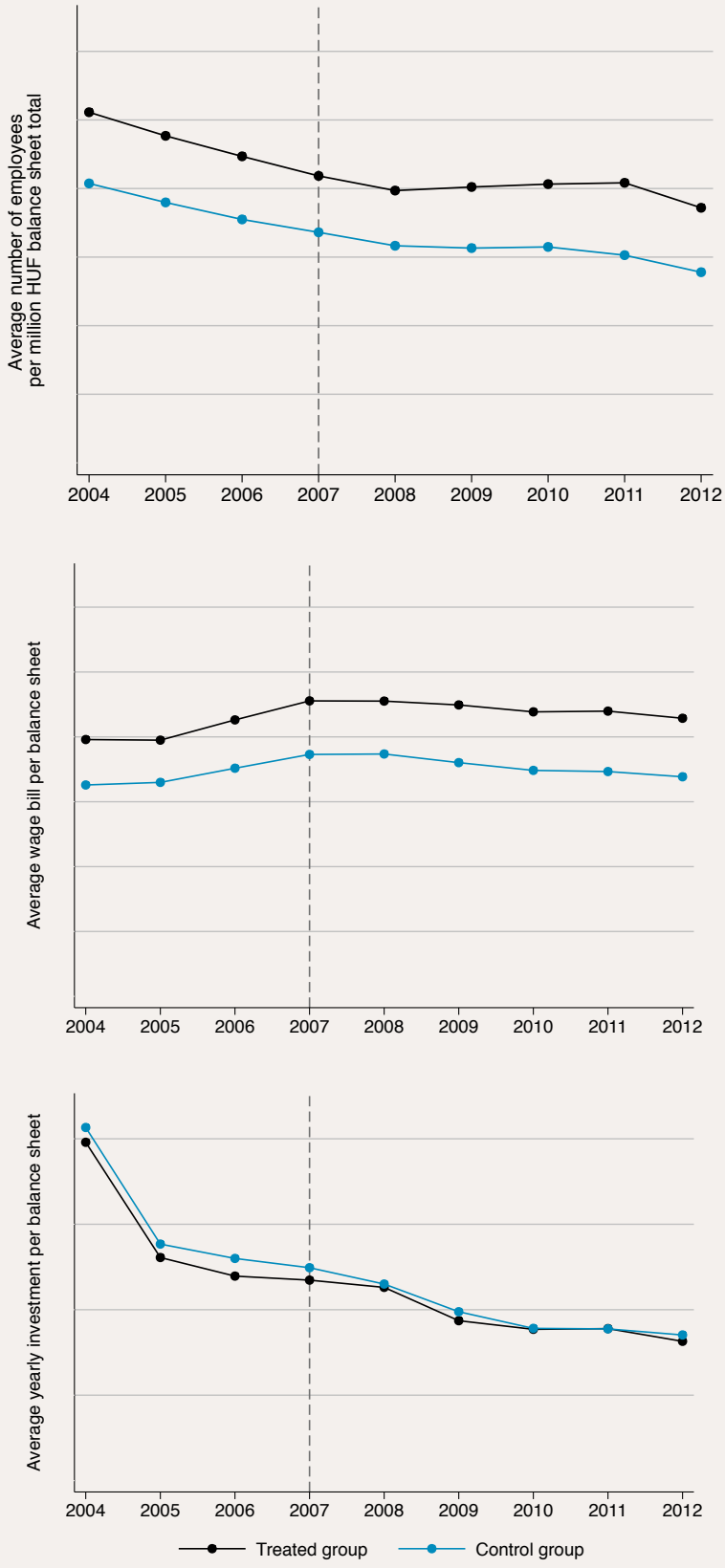


Table 2
Diff-in-diff estimation for changes in real production between 2006 and 2008

Dep. varbs.	profit		wage bill		employees		investment	
$T_i = 1$	0.571*	-0.297	0.0219**	0.0724**	-0.039***	0.035***	-0.015***	-0.0128***
(after reform)	(0.298)	(0.248)	(0.01)	(0.009)	(0.010)	(0.009)	(0.003)	(0.002)
$D_i = 1$	-4.876***	-2.968***	0.0741***	0.0760***	0.091***	0.084***	-0.0103***	-0.0103***
(treat. group)	(0.341)	(0.305)	(0.011)	(0.011)	(0.012)	(0.011)	(0.003)	(0.003)
$T_i * D_i = 1$	0.457	1.118***	0.0071	0.0063	-0.011	-0.001	0.0084**	0.0085**
(effect 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.*

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 balance 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 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 10 in the appendix). Similar robustness results with modified control groups, containing firms with stable profit rates between 2-6 and 2-10 percents, are reported in Table 11 and 12.

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 13 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 later 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.

4.2 PRESENCE OF TAX AVOIDANCE

Tax avoidance and evasion is a widespread practise in Hungary (see Balog (2014), and Benedek et al. (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.[13] 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 14 in the 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.

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 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.[14] 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.[15] 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 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

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

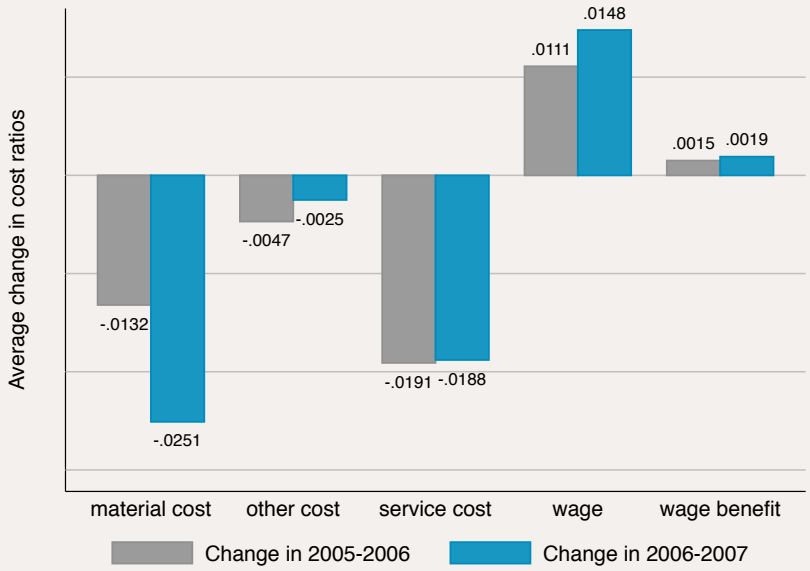
[14] As a robustness check I re-estimate the regressions with firms switching to a profit rate between 2 and 8 percent and get similar results.

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

the reported material cost ratio was reduced by 1.32 percentage point among switching firms from 2005 to 2006, while the reduction was nearly doubled from 2006 to 2007. A striking difference in the cost ratio patterns is that the reduction in reported 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 decreases in other cost items reporting, suggest accounting reporting responses behind the profit ratio changes.

Figure 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 5, I estimate the below regression, where I also include control variables.

$$\Delta CR_i = \beta_0 + \beta_1 T_i + \beta_j' X_{j,i} + \varepsilon_i, \tag{9}$$

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

$$\Delta CR_i = \frac{c}{y_{i,t}} - \frac{c}{y_{i,t-1}}. \tag{10}$$

The logit regression in Table 17 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.

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

Table 3
Changes in reported cost structure

	Changes in								
Dep. varbs.	Profit ratio	Material cost/ turnover	Other cost/ turnover	Service cost/ turnover	Wage cost/ turnover	Wage benefit/ turnover	Depr. / turnover	Sold goods/ turnover	Sold services/ turnover
$N = 15762$	Regressions without controls								
$T_i = 1$	-0.002***	-0.012***	0.002	0.003	0.004**	0.00	-0.002*	-0.03	-0.01
(treat. group)	(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)
$N = 15548$	Regressions with controls								
$T_i = 1$	-0.002***	-0.0124***	0.002	0.001	0.004**	0.00	-0.001	-0.04	-0.005
(treat. group)	(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
$N = 15548$	Regressions with controls including industry								
$T_i = 1$	-0.002***	-0.0127***	0.002	0.001	0.004**	0.00	-0.001	-0.038	-0.005
(treat. group)	(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 includes 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.*

capital, age, age square and industry codes. The top panel of Table 3 shows the coefficients of these regressions without control variables. The grey bars in Figure 5 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 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 2 - 8 percent, and get similar results (see Table 19 in the appendix).

Table 4
Changes in reported cost structure for different years

	Changes in material cost per turnover ratio				
Dep. varbs.	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 4 displays the estimation results showing that firms decreased significantly more 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.

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 code. 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 during the profit calculation deducted accounting based depreciation, while the amount of legislation based depreciation is strictly determined by the tax code, so 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.[16] 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 6, while the solid line 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.[17] The most frequently

[16] 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.

[17] Few firms still report loss carryforward in the revenue regime after the reform was introduced. Most of them do not understand the reform as eventhough they pay the tax amount based on their revenue, they still reduce their adjusted profit with the loss carryforward, or they simply continue paying taxes based on their adjusted profit lowered with the loss carryforward, even if the 2 percent of the revenue is higher. Few of them do understand the reform, and lower their adjusted profit as they can still 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 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.)

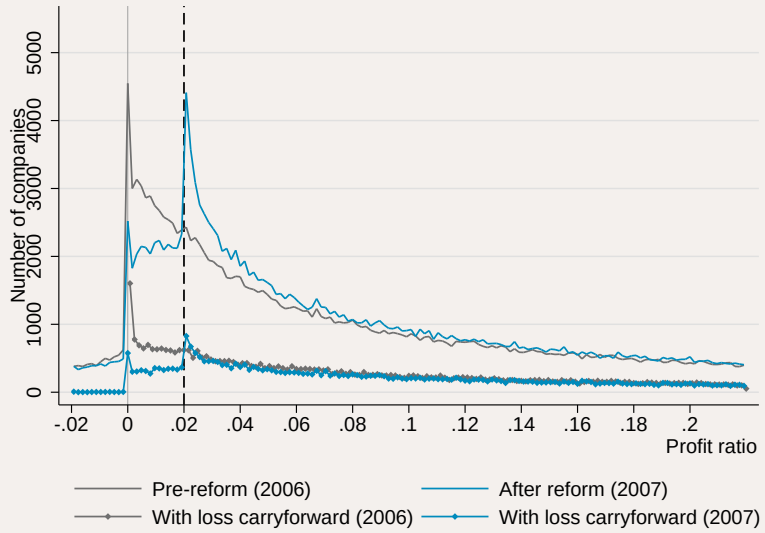
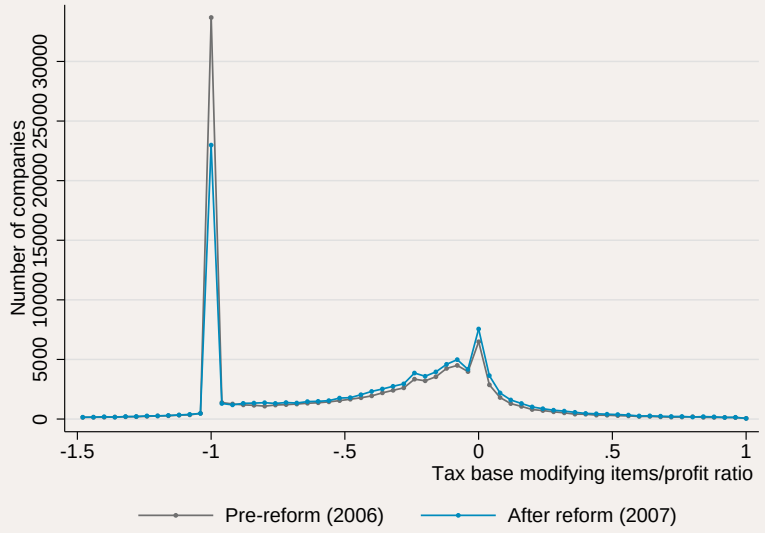


Figure 7

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 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.)



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 the profit calculation; and 2) loan impairment losses (see the empirical frequency in Figure 13 and 14 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 15, 16, 17 and 18 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 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.

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. These findings also confirm that well designed tax incentives can help reduce tax evasion.

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.

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6 Appendix

6.1 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.[18] 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:

$$I_t = K_t - K_{t-1} + \delta_t, \tag{11}$$

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.

[18] 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.

Table 5
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***		

6.2 FIGURES

Figure 8
Firms in high and low CIT rate periods

(Notes: The figure presents the empirical density of firms based on their 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.)

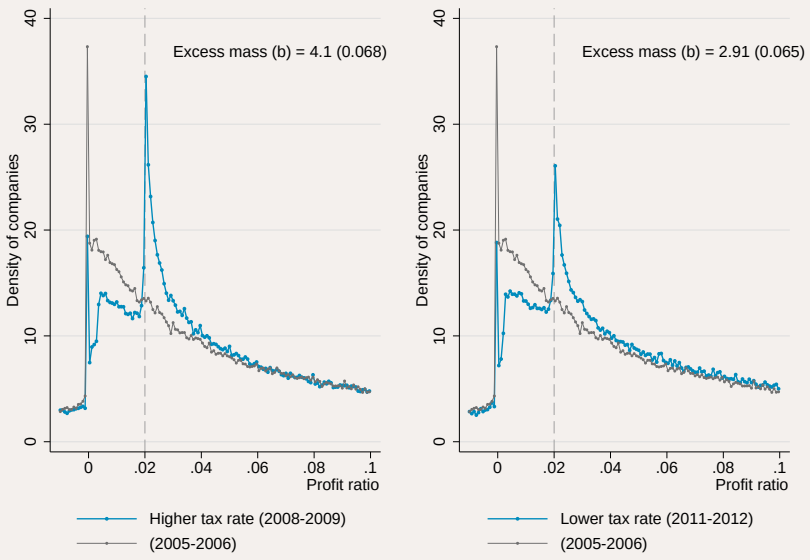


Figure 9

Firms with positive and negative tax base modifying items (delta)

(Notes: The figure presents the empirical density of firms based on their 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.)

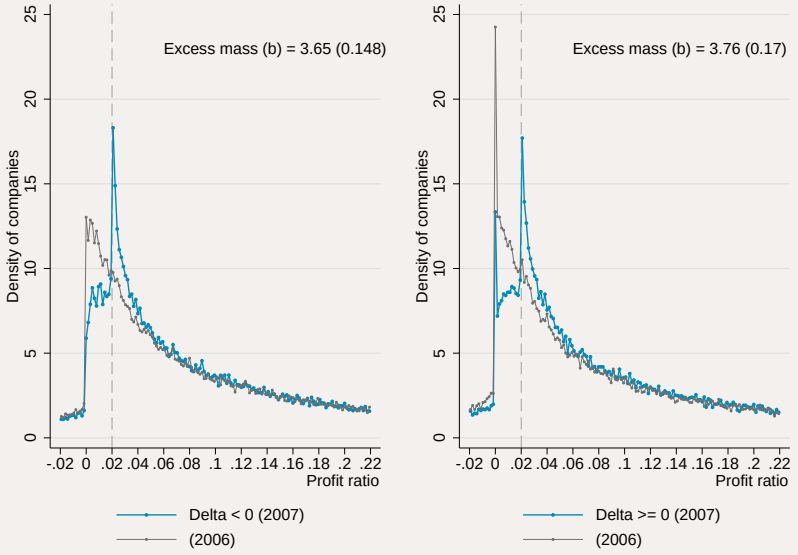


Figure 10

Firms at different industrial sectors

(Notes: The figure presents the empirical density of firms based on their profit rate for companies in the construction and 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.)

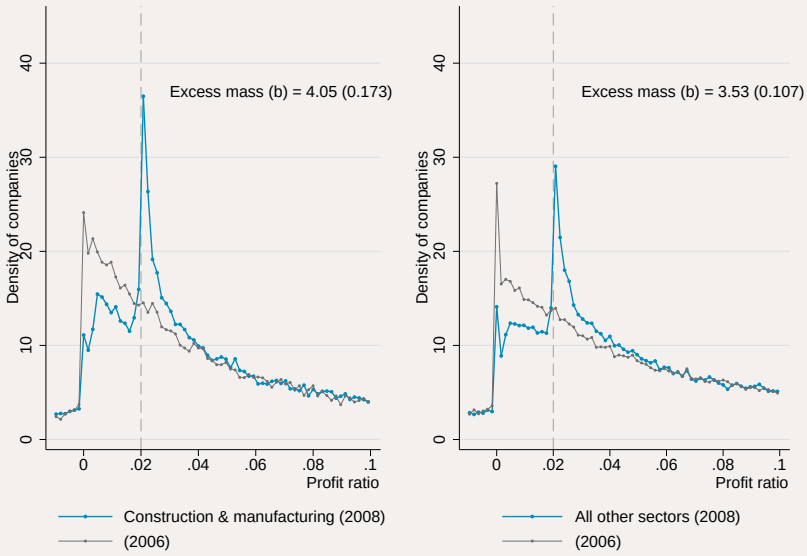


Figure 11

Firms with 0-10, and 11-1000 employees

(Notes: The figure presents the empirical density of firms based on their 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.)

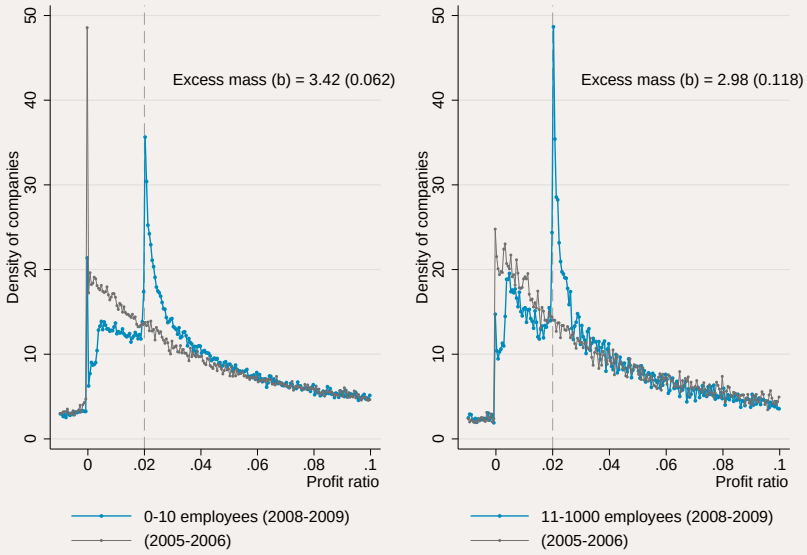


Figure 12

Domestic versus multinational firms

(Notes: The figure presents the empirical density of firms based on their 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.)

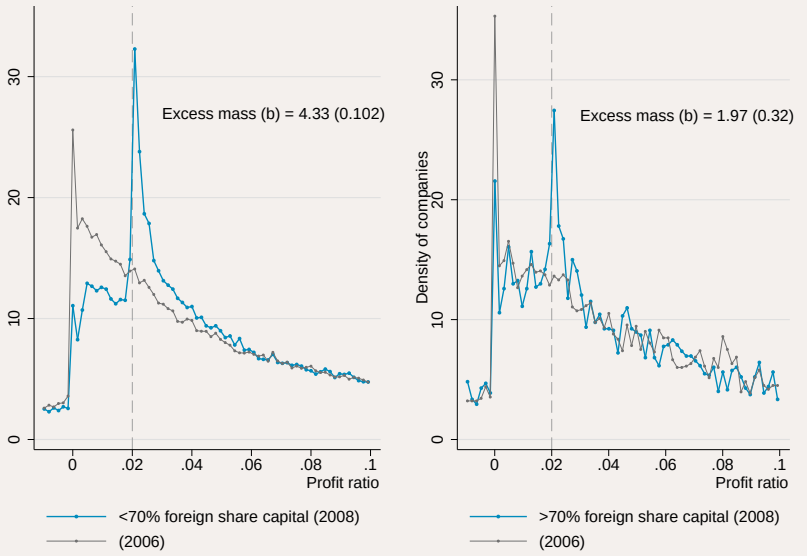


Figure 13

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

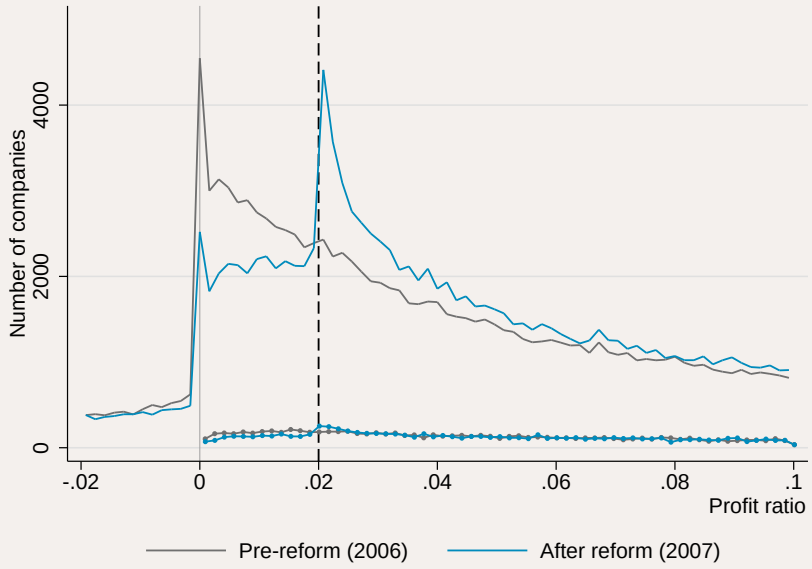
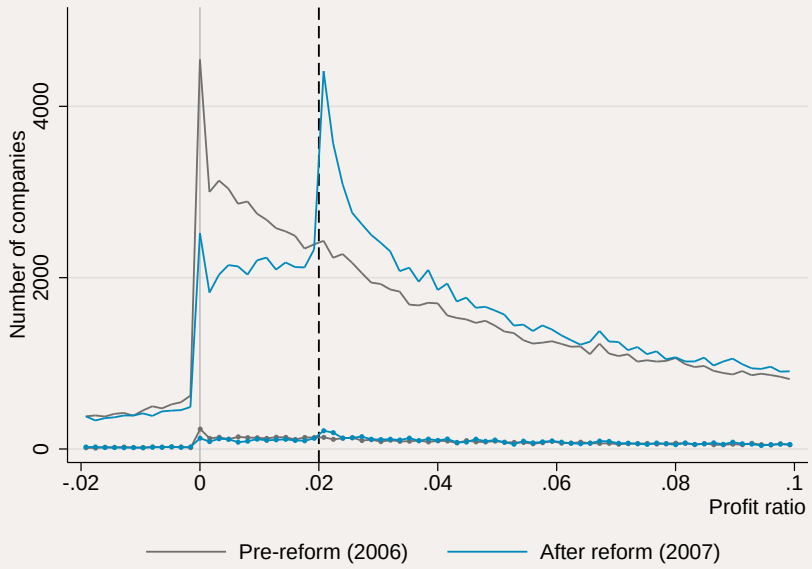


Figure 14

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 "loan impairment losses".)



6.3 TABLES

Figure 15

All firms, and firms reporting tax base decreasing item of "donation"

(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".)

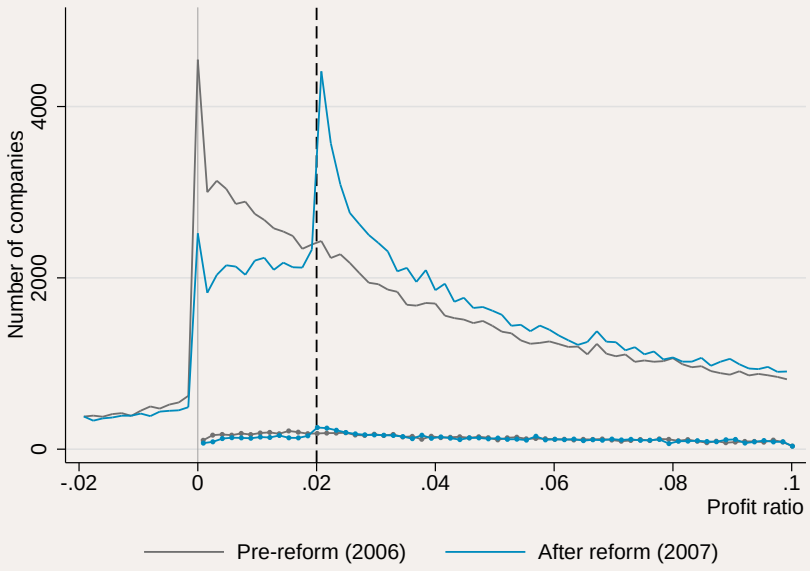


Figure 16

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 "received subsidies, debt assumption and released liabilities".)

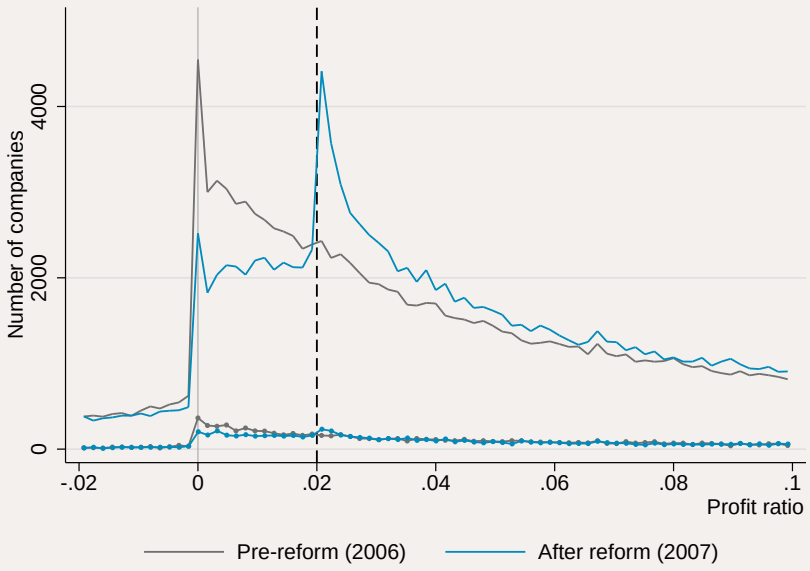


Figure 17

All firms, and firms reporting tax base decreasing item of "investment subsidy for small and medium size enterprises"

(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".)

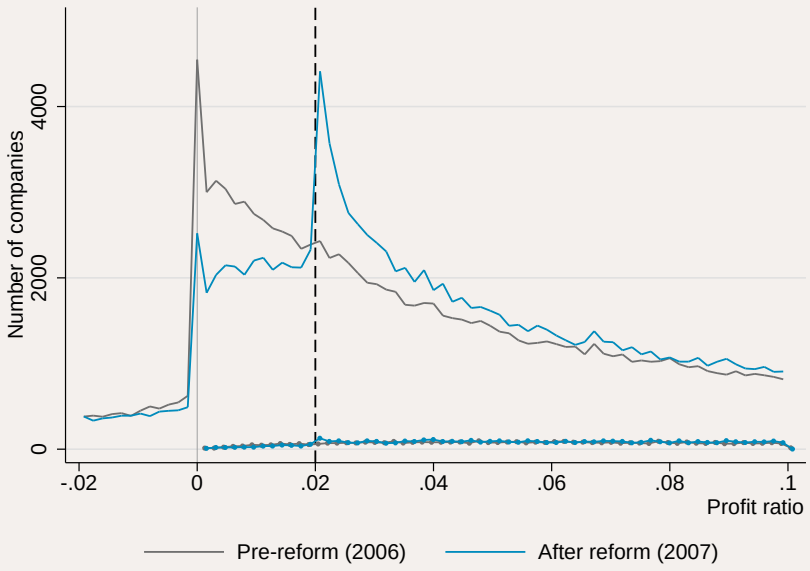


Figure 18

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 "reserves for the purpose of future developments".)

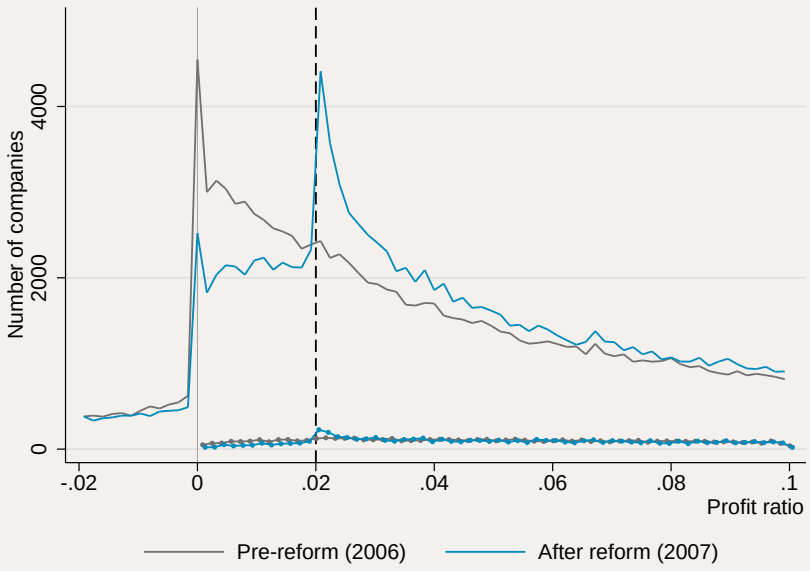


Table 6
Control and treatment group statistics

	Descriptive statistics (mean)			
Dep. varbs.	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: 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. All monetary variables are in million forints. Stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.*

Table 7
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	0.05	0.05
Manufacturing	0.19	0.26
Utilities	0.01	0.01
Construction	0.13	0.14
Wholesale, retail trade	0.29	0.23
Transportation, warehousing	0.04	0.03
Accommodation services	0.03	0.05
Information, communication	0.04	0.03
Finance, insurance	0.01	0.00
Real estate	0.03	0.02
Professional, scientific, and technical services	0.08	0.07
Administrative services	0.04	0.04
Educational services	0.01	0.01
Health	0.03	0.01
Arts, entertainment, recreation	0.02	0.01
Other services	0.02	0.02
Total number of firms	4 981	3 063

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.

Table 8
Control and treatment group statistics

	Logit	Logit	Marginal effects (dy/dx)
Dep. varbs.	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
		(0.203)	(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)	

*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. N=8044*

Table 9
Robustness analyses: DID estimation for changes in real production (control variables normalized by balance sheet total)

Dep. varbs.	profit	wage bill		employees		investment	
$T_i = 1$	-0.447	0.0219**	0.0548***	-0.0368***	0.0197**	-0.0142***	-0.0117***
(after reform)	(0.340)	(0.0094)	(0.0087)	(0.0099)	(0.0084)	(0.0023)	(0.0024)
$D_i = 1$	-6.250***	0.0744***	0.123***	0.0971***	0.135***	-0.0087***	-0.0084***
(treat. group)	(0.440)	(0.0108)	(0.0112)	(0.0114)	(0.0109)	(0.0027)	(0.0031)
$T_i * D_i = 1$	1.444***	0.0007	-0.0035	-0.0207	-0.0105	0.0081**	0.0088**
(effect of reform)	(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	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 10
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. varbs.	wage bill	employees	investment	wage bill	employees	investment
$T_i = 1$	0.0635***	0.0448***	-0.0264***	0.0618***	0.0643***	-0.0353***
(after reform)	(0.0099)	(0.0097)	(0.0025)	(0.0103)	(0.0107)	(0.0025)
$D_i = 1$	0.0735***	0.0867***	-0.0103***	0.0757***	0.0871***	-0.0122***
(< threshold profit)	(0.0122)	(0.0120)	(0.0031)	(0.0128)	(0.0132)	(0.0031)
$T_i * D_i = 1$	0.0125	0.0023	0.0045	0.0134	-0.0007	0.0103***
(effect of reform)	(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 11
Robustness analyses: DID estimation for changes in real production (control group includes firms with 2-6 % stable profit rate)

Dep. varbs.	profit	wage bill		employees		investment	
$T_i = 1$	-0.0979	0.0229	0.0769***	-0.0424***	0.0316**	-0.0162***	-0.0135***
(after reform)	(0.276)	(0.0144)	(0.0135)	(0.0153)	(0.0136)	(0.0032)	(0.0034)
$D_i = 1$	-1.941***	0.0711***	0.0764***	0.0950***	0.0875***	-0.0109***	-0.0111***
(treat. group)	(0.285)	(0.0137)	(0.0140)	(0.0146)	(0.0140)	(0.0031)	(0.0035)
$T_i * D_i = 1$	0.816**	0.00408	0.0029	-0.0105	0.0014	0.0093**	0.0089**
(effect of reform)	(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 12
Robustness analyses: DID estimation for changes in real production (control group includes firms with 2-10 % stable profit rate)

Dep. varbs.	profit	wage bill		employees		investment	
$T_i = 1$	-0.756***	0.0219***	0.0679***	-0.0353***	0.0331***	-0.0153***	-0.0132***
(after reform)	(0.234)	(0.0073)	(0.007)	(0.0078)	(0.007)	(0.0019)	(0.002)
$D_i = 1$	-3.949***	0.0809***	0.0806***	0.0940***	0.0863***	-0.0120***	-0.0116***
(treat. group)	(0.331)	(0.0097)	(0.0098)	(0.0104)	(0.0099)	(0.0025)	(0.0028)
$T_i * D_i = 1$	1.607***	0.00697	0.00653	-0.0107	-0.00334	0.0089**	0.0089**
(effect of reform)	(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	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 2-10 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 13
Robustness analyses: DID estimation for changes in real production (before the reform placebo years, 2004 - 2006)

Dep. varbs.	profit	wage bill		employees		investment	
$T_i = 1$	1.020***	0.0268***	0.0435***	-0.0511***	0.0017	-0.0766***	-0.0207***
(after reform)	(0.181)	(0.0091)	(0.0084)	(0.0116)	(0.0092)	(0.0035)	(0.0029)
$D_i = 1$	-4.656***	0.0707***	0.0774***	0.104***	0.0979***	-0.0086**	-0.0120***
(treat. group)	(0.219)	(0.0105)	(0.0101)	(0.0133)	(0.011)	(0.004)	(0.0035)
$T_i * D_i = 1$	-0.380	0.0034	-0.008	-0.0132	-0.0234	-0.0017	0.0011
(effect of reform)	(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 14
Increased reported profit rate after tax audit and issued fines

Dep. varbs.	Change in reported profit rate (percentage point)							
Year	2004	2005	2006	2007	2008	2009	2010	2011
$D_i = 1$	0.0423***	0.0378***	0.0257***	0.0229***	0.0104***	0.0124***	0.0186***	0.00770*
(audited and fined)	(0.0045)	(0.0045)	(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. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.*

Table 15
Control and treatment group statistics

	Descriptive statistics (mean)			
Dep. varbs.	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	6 522	9 239		

*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 includes firms switching after the reform (from year 2006 to 2007). All monetary variables are in million forints. Stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.*

Table 16
Industry classification (percentage)

	Descriptive statistics (mean)	
	Control (switch bw 2005 and 2006)	Treatment (switch bw 2006 and 2007)
Industry classification	percent	
Agricultural production, forestry, fishing, mining	0.038	0.035
Manufacturing	0.167	0.162
Utilities	0.006	0.006
Construction	0.138	0.141
Wholesale, retail trade	0.273	0.264
Transportation, warehousing	0.040	0.038
Accommodation services	0.047	0.056
Information, communication	0.040	0.037
Finance, insurance	0.008	0.009
Real estate	0.029	0.034
Professional, scientific, and technical services	0.084	0,093
Administrative services	0.049	0.042
Educational services	0.013	0.011
Health	0.026	0.032
Arts, entertainment, recreation	0.019	0.018
Other services	0.023	0.024
Total number of firms	6 522	9 239

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 includes firms switching after the reform (from year 2006 to 2007).

Table 17
Control and treatment group statistics

	Logit	Logit	Marginal effects (dy/dx)
Dep. varbs.	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**

*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 includes firms switching after the reform (from year 2006 to 2007). 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. (N=15547)*

Table 18

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 are also normalized by balance sheet total)

	Changes in					
Dep. varbs.	Adjusted profit rate	Material cost/ turnover	Other cost/ turnover	Service cost/ turnover	Wage cost/ turnover	Wage benefit/ turnover
$T_i = 1$	-0.002***	-0.014***	-0.000	0.000	0.005***	0.00
(after reform)	(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	X	X	X	X	X	X
(N)	14 705					

*Note: All monetary control variables are normalized by the balance sheet total and 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, age square and industry code. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.*

Table 19

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. varbs.	Adjusted profit rate	Material cost/ turnover	Other cost/ turnover	Service cost/ turnover	Wage cost/ turnover	Wage benefit/ turnover
$T_i = 1$	-0.003***	-0.012***	0.002	0.001	0.003***	0.00
(after reform)	(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)	18356					

*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, age square and industry code. Standard errors are shown in parentheses and stars indicate statistical significance level. * = 10% level, ** = 5% level, *** = 1% level.*

MNB Working Papers 3

Accounting versus real production responses among firms to tax incentives: bunching evidence from Hungary

Budapest, September 2016