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Jaroslav Bukovina
Tomáš Lichard
Ján Palguta
Branislav Žúdel

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# Tax Reforms and Inter-temporal Shifting of Corporate Income: Evidence from Tax Records in Slovakia*

**Jaroslav Bukovina**
IFP-MF SR†

**Tomáš Lichard**
CERGE-EI‡ , VŠE§

**Ján Palguta**
UC3M**

**Branislav Žúdel**
IFP-MF SR†

## Abstract

We use administrative tax return data for all corporations in Slovakia to demonstrate how policies facilitating inter-temporal income shifting result in elevated corporate income tax (CIT) elasticity estimates. Our strategy exploits kinks in the statutory tax schedules and policy reforms of tax carry-forwards. If inter-temporal shifting is neglected, our bunching estimates imply CIT elasticity of up to 0.65, suggesting a highly sensitive tax base with respect to the marginal tax rate. However, we show that CIT elasticity drops at least 21.2-49.1% when we remove the inter-temporal shifting component. This correction significantly reduces the estimated marginal excess burden of corporate taxation.

**Key words**: corporate income tax, elasticity, inter-temporal profit shifting, bunching, tax carry-forwards

**JEL classification**: G32, H25, H26, L25

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†Institute for Financial Policy, Ministry of Finance of the Slovak Republic. Address: Štefanovičova 5, P. O. BOX 82, 817 82 Bratislava, Slovakia.

‡Center for Economic Research and Graduate Education – Economics Institute (CERGE-EI), a joint workplace of Charles University and the Economics Institute of the Czech Academy of Sciences. Address: Politických vězňů 7, 111 21 Prague, Czech Republic.

§University of Economics, Prague. Address: W. Churchill Sq. 1938/4, 13067 Prague, Czech Republic.

**Carlos III University of Madrid (UC3M), Department of Economics. Address: c/ Madrid 126, 28903 Getafe (Madrid), Spain. Correspondence email: jpalguta@eco.uc3m.es

# 1. Introduction

Following broad literature on personal income taxation (Feldstein 1999; Chetty 2009; and Saez et al. 2012), the elasticity of corporate taxable income with respect to the marginal tax rate is viewed (in the absence of external effects) as the key parameter for determining the welfare implications of corporate taxation. One approach to inferring the corporate income tax (CIT) elasticity is to estimate it directly from the amount of bunching at kinks in the corporate tax schedules (as in Devereux et al. 2014, using methods by Saez 2010; Chetty et al. 2011; Kleven and Waseem 2013). However, as pointed out in the context of Danish self-employed, bunching methods can provide upward-biased elasticity estimates if they disregard that agents may increase the size of bunching by shifting income over time (le Maire and Schjerning 2013).

In this study, we demonstrate how tax reforms that allow corporations to flexibly shift tax liability over time also increase the amount of bunching at tax kinks and raise estimates of CIT elasticity and of the marginal excess burden of corporate taxation. We provide this evidence using administrative tax return data on the population of corporate entities in Slovakia in 2010-2018. Our setting uniquely allows to express the extent of inter-temporal shifting relative to the overall corporate behavioral response to taxation. We can therefore correct estimates of CIT elasticity and of the marginal excess burden for the shifting component.

Two features of the institutional setting in Slovakia permit our analysis. The first is the existence of several kinks in the corporate tax schedule in 2014-2017. The kinks emerged after the 2014 reform introduced several categories of the *minimum tax* which companies had to pay annually, even if they had no profits in a given year. Due to the reform, the taxable income of companies with tax liability below the minimum tax amount became subject to a zero marginal tax rate. In comparison, corporations with tax liability above the minimum tax amount remained subject to flat positive marginal tax rates, like all corporations prior to the reform.

The second institutional feature introduced by the 2014 reform was that, starting from 2015, companies could carry part of their tax liability from previous years forward. Specifically, after companies calculated their tax liability and found that it is lower than the minimum tax, they needed to make an additional payment to match the minimum tax. This matching payment could be carried forward into the next fiscal years, provided that it was applied against tax liability exceeding the minimum tax. Importantly for our empirical design, companies could apply carry-forwards even after the minimum tax was abolished in 2018.

In the first step of our empirical analysis, we estimate the full behavioral response to corporate taxation. We use bunching methods by Saez (2010) and Chetty et al. (2011) which assume smooth counterfactual distributions of tax liability at the tax kinks. We also use a non-parametric histogram estimator to compare pre-2014 distributions with those observed in 2015 when companies had to pay the minimum tax and could shift income over time using tax carry-forwards.

In the second step, we estimate the amount of bunching which was purely due to income shifting. We exploit the 2018 reform which canceled the minimum tax but kept the option of carry-forwards, and contrast the pre-2014 distributions with bunching in 2018 when companies were massing at kinks only due to carry-forwards. We then re-estimate CIT elasticity and the marginal excess burden of taxation.

Our preferred non-parametric estimates suggests CIT elasticity up to 0.65 for the lowest category of non-VAT-registered companies with turnover below €500,000, which had to pay at least €480 (38.5% of all companies). [1] The CIT elasticity is around 0.34 for VAT-registered companies below the same turnover limit, which were subject to a €960 minimum tax. Finally, we find CIT elasticity of 0.05 for companies above the €500,000 limit, which had to pay at least €2,880 (the top 13.8% of companies).

[1] For comparison, the average monthly retirement pension in Slovakia was €399 in 2014. The average monthly wage in 2014 was €858 (Slovak Statistical Office 2015; Slovak Social Insurance Agency 2019).

Most importantly, we show that CIT elasticity drops at least 21.2-49.1% when we correct for the inter-temporal shifting component. Our estimates of the welfare loss relative to a mechanical increase in tax revenue should the tax rate applied above the minimum tax increase by 1% drop from 29.9% to 22.2% for the lowest corporate category when we correct the CIT elasticity for inter-temporal shifting using our most conservative estimates. Our results thus strongly support studies highlighting the relevance of inter-temporal income shifting for determining the welfare implications of taxation (Slemrod 1995; Goolsbee 2000; le Maire and Schjerning 2013; Kreiner et al. 2016; Foremny 2018).

We present further methodological results, based on which we recommend that robustness of bunching estimates should always be checked using methods based on empirical pre-reform distributions. We argue such checks are especially needed in the presence of pronounced income shifting, tax evasion or tax avoidance (observed also in the setting of Best et al. 2015; Mosberger 2016). We justify this advice by arguing that agents in our setting would bunch at zero tax liability in the absence of the minimum tax.[2] If we disregard where bunching comes from and use the cross-sectional bunching method which assumes that the excess mass originates proportionally from a wide section of the density distribution to the left of the kink, we find 60-69% lower CIT elasticity. Additionally, we show that bunching methods that shift the counterfactual density distribution to the left of the kink upwards to ensure it is based on the same population as the empirical distribution can increase the bias in CIT elasticity. Our methodological advice also extends to settings outside the taxation literature in which pre-reform distributions are key to credibly estimated counterfactuals (see, e.g., Harasztosi and Lindner 2019).

[2] We compare the tax liability distributions around the point of zero tax liability before and after the 2014 reform introduced the minimum tax. We find that the mass of companies missing at zero matches 94.2% of the excess mass at the €480 kink and corresponds to 41% of the excess mass at the €960 kink.

Our study contributes to several strands of the taxation literature. First, it adds to the surprisingly low number of studies which directly estimate CIT elasticity. The first results are from Gruber and Rauh (2007), who used U.S. industry-level panel data to estimate a CIT elasticity of 0.2 when related to the marginal tax rate on new corporate investments. This rather low estimate implies much less inefficiency than is typically attributed to CIT, but was criticized for failing to identify the margin along which corporations adjust to tax changes (Gravelle 2007). This critique also applied to Dwenger and Steiner (2012), who used German administrative data to find at least double CIT elasticity with respect to the average tax rate. The most recent study by Devereux et al. (2014) estimated CIT elasticity between 0.13 and 0.17 for UK companies with profits around the £300,000 kink and between 0.53 and 0.56 for companies around the £10,000 kink. The authors uniquely isolate the amount of shifting of corporate profits into the wage income of company managers, but like earlier studies, they do not explicitly address the inter-temporal response.

Further, we add to the literature estimating taxable income elasticities using bunching (see Kleven 2016 for a review). In this literature, two studies analyze a version of a minimum tax scheme (Best et al. 2015; Mosberger 2016) and conclude that real response to taxation can be overstated if tax avoidance and evasion are neglected in estimation. Le Maire and Schjerning (2013) do propose a dynamic extension to Saez's (2010) bunching formula based on a dynamic model of shifting that allows one to distinguish between real responses and shifting. Our non-parametric results from the histogram estimator can be viewed as complementary to their method.

Section 2 of this paper reviews the institutional background. Section 3 describes our data. Section 4 presents the strategy for estimating CIT elasticity and discusses identification. Section 5 estimates the full behavioral response to taxation. Section 6 quantifies the scope of inter-temporal income shifting. Section 7 discusses the implications for the marginal excess burden of taxation. Section 8 concludes.

## 2. Tax system and corporate income taxation in Slovakia

Slovakia is a developed market economy located in Central Europe. After the Velvet Revolution in 1989 and splitting from the former Czechoslovakia in 1993, Slovakia joined the OECD in 2000, the EU in 2004 and the Eurozone in 2009.

Governmental tax revenue in Slovakia amounted to 33% of GDP in 2017 (OECD 2018b). 11% of this revenue was from corporate taxation, 10% from personal income taxation, 43% from social security contributions and 33% from taxes on goods and services. The corporate tax is remitted annually by 190,000 companies.[3]

**Minimum tax reform.** Until 2014, Slovakia applied proportional corporate tax rate, which was constant for long periods of time (19% in 2004-2012, 23% in 2013). According to the Slovak Ministry of Finance (2018), the effective corporate tax rate was around 3.8-4.7% in 2005-2012, as the country experienced extensive tax evasion and avoidance. Around 60% of corporations used to pay zero tax in this period.

In an effort to raise the effective tax rate, Slovakia introduced a statutory *minimum tax for corporations* starting from 2014. Companies had to pay the minimum tax annually even if they had no profit (CBR 2016, 2017). The minimum tax had three levels, shown in Table 1. The lowest category, non-VAT-registered companies[4] with turnover below €500,000, had to pay at least €480 in tax annually.[5] The middle category, VAT-registered companies below the same turnover limit, were required to pay at least €960. Finally, the top category, companies with turnover above €500,000, were subject to a €2,880 minimum annual tax.[6] All taxable income above the

[3] Sole proprietorships and partnerships are not subject to the corporate tax. Profits of unincorporated firms are attributed to individual partners and taxed according to the personal income tax schedule.

[4] Corporations had to register for VAT if their turnover in the prior 12 months exceeded €49,790.

[5] The tax code used sales turnover to determine the applicable minimum tax.

[6] The tax code allowed corporations with more than 20% of handicapped employees in their workforce to pay only 50% of the usual minimum tax. In practice, this reduction was applied to a negligible number of companies. The tax code also did not require payment of the minimum tax from companies in their first year after incorporation or from corporations filing for bankruptcy or in liquidation. We account for these rules in our analysis.

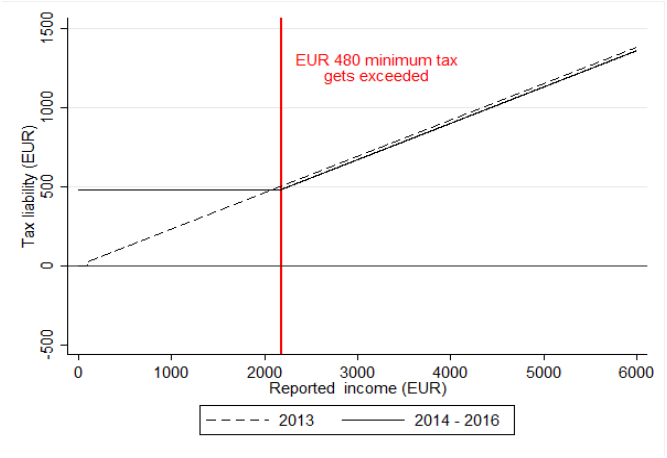
corresponding minimum tax amount was subject to a 22% tax rate in 2014-2016 and 21% in 2017. After cancellation of the minimum tax in 2018, the 21% rate applied to all corporations.

**TABLE 1 – Minimum corporate tax in 2014-2017**

| Corporate category | Turnover | Registration for Value Added Tax | Minimum tax |
|---|---|---|---|
| Lowest | Below €500,000 | No | €480 |
| Middle | Below €500,000 | Yes | €960 |
| Top | Above €500,000 | Both | €2,880 |

Figure 1 visualizes the relationship between reported income and the tax liability for companies in the lowest corporate category in 2013 compared to 2014-2016, i.e. before and after the 2014 reform introduced the minimum tax. The figure shows that the reform increased tax liability for all companies whose tax liability would otherwise be below the minimum tax amount and created a kink in the tax schedule. The tax liabilities of companies with profits above the minimum tax amount were not affected by the reform.

**FIGURE 1– Minimum tax for low-turnover, non-VAT-registered companies**




**Tax carry-forwards.** In addition to introduction of the minimum tax, the 2014 reform also allowed corporations to apply a special form of tax carry-forwards starting in 2015. Companies could subtract from their tax liability any tax payments they had

made since 2014 to match the value of the minimum tax. Two conditions had to be fulfilled. Tax carry-forwards could be applied only against tax liability exceeding the minimum tax amount in a given year. Moreover, it was possible to carry forward only tax payments from three past fiscal years or less.

Tables A.1 and A.2 in the Appendix provide two stylized examples of calculating the maximum amount of tax carry-forwards. Table A.1 examines the example of a VAT-registered company with turnover below €500,000 (which was subject to the €960 minimum tax). The table shows that if such a company had a tax liability of €680 in 2014, the company was required to make an additional payment of €960 - €680 = €280 to match the amount of the minimum tax. In the next year, provided that the company had tax liability higher than €960, which is true in our stylized example, the company could apply tax carry-forwards of up to €280 against the amount of tax liability exceeding €960. In our example, in the absence of tax carry-forwards, the company would have to pay €1,700. Therefore, its final tax liability was €1,700 - €280 = €1,420 after applying the carry-forwards.

This example illustrates how tax carry-forwards decrease the corporate tax liability in some years and generally facilitate tax optimization over time. One way of looking at their use is as shifting current profits into past fiscal periods, in which a lower marginal tax rate is applied on corporate income. We estimate the relevance of such income shifting using several empirical methods, which we describe in section 4 after discussing our data in the next section.

## 3. Data

Our analysis uses administrative tax returns data covering all Slovak corporations in 2010-2018. This confidential dataset is owned by the Financial Directorate of the Slovak Republic, which provides it to the Slovak Ministry of Finance for purposes of tax administration.

The dataset includes variables which correspond to all individual items recorded on corporate tax return forms. These tax variables include, among other things, annual information about corporate turnover, registration for VAT, taxable income, tax liability prior to applying tax carry-forwards and the minimum tax, the amount of tax carry-forwards, the amount of the minimum tax faced by a given company, and the amount of tax actually paid. Over the nine-year observation period, the data covers approximately 300,000 distinct companies.

Table 2 reports the averages of the key variables in our dataset for all companies as well as for the three corporate categories subject to different minimum tax amounts. The table shows that there is substantial heterogeneity across corporations in terms of tax paid. In particular, the top category of high-turnover companies pays, on average, around 40 times higher taxes than the middle category of VAT-registered, low-turnover companies. High-turnover companies yet make up only 13.8% of the population of companies, while the middle category accounts for 47.7%. The average tax liability of the lowest corporate category is around 55 % of the average liability paid by companies in the middle category.

Next, the table shows that the average tax liability declines slightly after companies apply tax carry-forwards. In particular, the average amount of tax carry-forwards equals around 5-8% of the corresponding minimum tax amount. The average tax liability grows again after companies account for the minimum tax, especially among companies in the bottom two corporate categories. Numerically, the average tax liability is 9.8% and 12.2% higher, respectively, for companies in the lowest and middle categories after applying the minimum tax, compared to the tax liability after tax carry-forwards but before the minimum tax is applied. The average tax bill in the top corporate category is practically unaffected by the minimum tax.

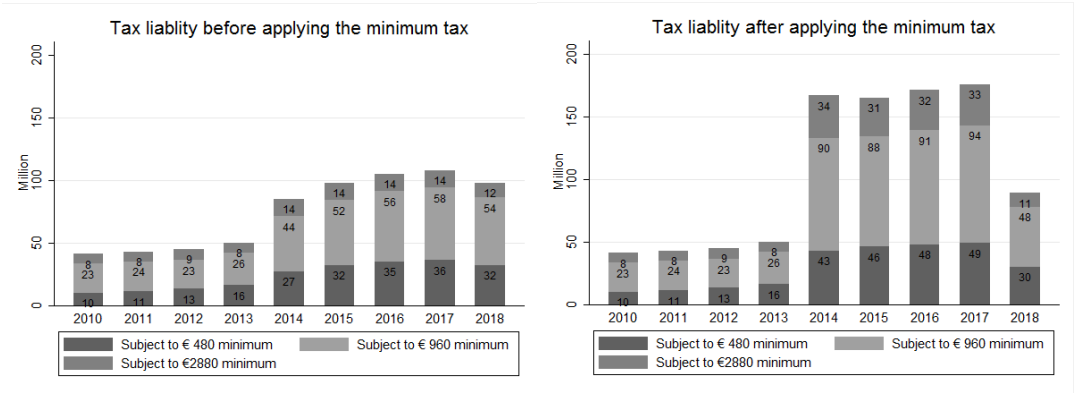
**TABLE 2 – Summary statistics**

| | All companies | Lowest category: non-VAT-registered, turnover below €500,000 | Middle category: VAT registered, turnover below €500,000 | Top category: companies with turnover above €500,000 |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Turnover | 1,126,495.8 | 20,688.9 | 107,274.3 | 7,906,257.2 |
| | [32,880,999.2] | [42,321.8] | [126,281.9] | [89,204,395.8] |
| Taxable income | 53,861.5 | 4,420.0 | 8,040.2 | 357,882.5 |
| | [1,927,865.3] | [263,805.6] | [268,797.3] | [5,193,794.9] |
| Tax liability reported prior to tax carry-forwards and applying the minimum tax | 11,087.8 | 938.6 | 1,680.9 | 73,499.2 |
| | [401,898.7] | [57,165.3] | [51,148.2] | [1,083,344.6] |
| Tax carry-forwards (2015-2018) | 74.7 | 24.7 | 76.6 | 223.6 |
| | [389.9] | [123.6] | [305.2] | [870.4] |
| Tax liability after applying carry-forwards but prior to applying the minimum tax | 11,051.2 | 926.0 | 1,644.6 | 73,393.3 |
| | [401,897.7] | [57,165.2] | [51,146.7] | [1,083,346.8] |
| Subject to €480 minimum | 38.5% | 100.0% | 0.0% | 0.0% |
| Subject to €960 minimum | 47.7% | 0.0% | 100.0% | 0.0% |
| Subject to €2880 minimum | 13.8% | 0.0% | 0.0% | 100.0% |
| Tax liability after applying the minimum tax | 11,207.4 | 1,017.3 | 1,845.4 | 73,576.0 |
| | [401,830.9] | [57,164.0] | [51,134.9] | [1,083,163.5] |
| Observations | 1,708,755 | 658,690 | 819,442 | 230,623 |

Notes: The variables are reported in euro for the 2010-2018 period in 2010 prices. The information about carry-forwards refers to 2015-2018. The information about companies being subject to a particular minimum tax refers to 2014-2017. Standard deviations are reported in parenthesis.

Figure 2 nonetheless reveals that the averages reported in Table 2 conceal sizeable growth in tax liability among corporations that pay the least amount of taxes. In particular, we observe that tax revenues approximately tripled in 2014 relative to 2013 in all three corporate categories after applying the minimum tax, if one focuses only on companies with tax liability below €4,000 (the right panel). The left panel shows that, in 2014, companies reported around 170% higher tax liability already before they applied the minimum tax compared to 2013. This revenue hike, however, disappears in 2018 after abolition of the minimum tax.

**FIGURE 2 – Government revenue from corporation taxation**




Notes: The figure shows tax revenue from corporations with tax liabilities below €4,000. The left figure shows the reported tax liability prior to applying the minimum tax and tax carry-forwards. The right figure shows tax revenue after accounting for the minimum tax and tax carry-forwards. The figures are not adjusted for different tax rates across 2010-2018. They are reported in nominal prices.

## 4. Empirical methodology for estimating CIT elasticity

In our empirical analysis, we identify CIT elasticity from the amount of bunching at the kinks in the statutory corporate tax schedule.

To formalize the exposition, we consider a tax schedule in which the marginal tax rate increases by a small amount from $t_1$ to $t_2$ at some income level $K$. Income below $K$ is therefore taxed at the rate $t_1$, while income above $K$ is subject to the tax rate $t_2$. Abstracting from any income effects, we can express the fraction of companies that choose to locate at point $K$ in response to the small hike in the marginal tax rate as $B(t_1, t_2) = \int_K^{K+\Delta z} g(z)dz$, where $g(z)$ is the density distribution of corporate taxable income when there is a constant marginal tax rate $\tau_1$ throughout the distribution, and $K + \Delta z$ is the highest level of corporate earnings from that distribution which now bunch at $K$.

Under the approximation that $g(z)$ is uniform around the kink point, Saez (2010) demonstrated that the elasticity of taxable income at the kink can be expressed as:

(1) $$\varepsilon \simeq \frac{\frac{B(t_1,t_2)}{g(K)}}{K\, ln\left(\frac{1-t_1}{1-t_2}\right)} = \frac{b(t_1,t_2)}{K\, ln\left(\frac{1-t_1}{1-t_2}\right)},$$

where $b(t_1, t_2)$ corresponds to the fraction of companies which bunch at the kink relative to the counterfactual density.

In most empirical applications, the value of $K$ and the tax rates $t_1$ and $t_2$ are known policy parameters. The last remaining step to identify CIT elasticity ε is to estimate the excess mass of corporations $b(t_1, t_2)$ bunching at $K$.

**Identification.** We employ two identification approaches to infer the amount of bunching at the tax kinks. The first approach is based on methodologies by Saez (2010) and Chetty et al. (2011) and focuses on estimating cross-sectional density distributions of corporate tax liability. The identification assumption, which underlies causal inference, is that the density distributions would be smooth in the absence of kinks in the corporate tax schedule.

A complication to credible identification arises in this approach if companies tend to bunch at round numbers located close to value of the kink. At the same time, as we show later, another complication may arise if one invokes implausible assumptions about the source of bunching at the kinks.

For these reasons, we offer a second identification strategy, which relaxes the assumption of a smooth counterfactual and makes no assumptions about the source of bunching. Instead, the method exploits the timing of tax reforms that created kinks in the marginal tax schedule by introducing the minimum tax. This approach assumes that the density distributions of tax liability after a tax reform would look the same as before the reform in the scenario in which the reform was not implemented. In other words, the strategy assumes that the underlying probability density function of tax liability would remain stationary in the absence of the reforms. We provide supportive evidence for this assumption in Figure A.1, which demonstrates that the tax liability distribution had a stable shape across years 2010 and 2013 (prior to the introduction of the minimum tax) and also across years 2013 and 2018 (prior to the introduction of the minimum tax after its abolition).

In the following text, we describe the econometric implementation of the identification methods, starting with the cross-sectional approaches.

**Estimation.** In the cross-sectional approach by Saez (2010), we estimate the excess mass of companies bunching at the tax kinks using a counterfactual distribution, i.e., how the tax liability distribution would look had there been no minimum tax and no kinks in the tax schedule. The counterfactual is estimated from the empirical density of tax liability observed outside of the range affected by bunching.

The econometric procedure takes several steps. In the first step, we plot the empirical distribution of corporate tax liability in a histogram with the minimum tax amount re-centered to zero. This means that all companies are separated into small histogram bins of a fixed width according to their tax liability.[7] In the second step, we fit a flexible high-order polynomial to the histogram excluding data within a narrow window $(Z_L, Z_U)$ around the kink. This regression can be formally expressed as follows:

$$C_j = \sum_{i=0}^{q} \beta_i . (Z_j)^i + \sum_{i=Z_L}^{Z_U} \gamma_i . \mathbf{1}[Z_j = \boldsymbol{i}] + \epsilon_j \quad (2)$$

where $C_j$ is the number of companies present in histogram bin j, $Z_j$ is the re-centered corporate tax liability in histogram bin j, and q is the order of the polynomial.

The estimate of the counterfactual distribution is defined as predicted values from Eq. (2), while omitting the contribution of the dummy variables around the kink:

$$\hat{C}_j^0 = \sum_{i=0}^{q} \beta_i . (Z_j)^i \quad (3)$$

The implied excess number of companies bunching at the tax kink is:

$$\hat{B}^0(t_1, t_2) = \sum_{i=Z_L}^{Z_U} C_j - \hat{C}_j^0 \quad (4)$$

One concern with the calculation of the excess mass in Eq. (4), pointed out by Chetty et al. (2011), is that the method by Saez (2010) potentially overestimates $\hat{B}$. This is

[7] We choose a value of the histogram bin width equal to €10. We demonstrate the robustness of our results with respect to different parametric choices of the bin width in Table A.4 in the Appendix.

because the introduction of a zero marginal tax rate for companies with income below the corresponding minimum tax kink might have induced these companies to report higher taxable income (closer to the value of the kink). The observed number of companies in each bin to the left of the new kink can thus be lower than if there had not been a kink. In this case, the estimated counterfactual would be based on an underestimate of the number of companies that would have been observed had there not been a zero marginal tax rate below the kink.

In order to address this bias, we follow Chetty et al. (2011) and iteratively shift the counterfactual distribution to the left of the kink upwards until the area under the estimated counterfactual equals the area under the empirical distribution:

$$(5) \qquad C_j.\left(1+\mathbf{1}[j<Z_L]\frac{\widehat{B}^0(t_1,t_2)}{\sum_{\boldsymbol{j}=\mathbf{1}}^{Z_L} C_j}\right) = \sum_{i=0}^{q}\beta_i.(Z_j)^i + \sum_{i=Z_L}^{Z_U}\gamma_i.\mathbf{1}[Z_j=\boldsymbol{i}] + \epsilon_j$$

The estimated counterfactual then corresponds to fitted values $\hat{C}_j = \sum_{i=0}^{q}\beta_i.(Z_j)^i$ from Eq. (5) which omit the contribution of the histogram bins in the excluded range around the kink. The counterfactual allows us to define the excess mass of companies bunching at the kink: $\hat{B}(t_1,t_2) = \sum_{i=Z_L}^{Z_U} C_j - \hat{C}_j$.

We can express the estimated excess mass of companies bunching at the kink relative to the average density of the counterfactual distribution between $Z_L$ and $Z_U$ as:

$$(6) \qquad \hat{b}(t_1,t_2) = \frac{\hat{B}(t_1,t_2)}{\sum_{i=Z_L}^{Z_U}\hat{C}_j/N_j}$$

where $N_j$ is the number of bins in the excluded range.

We calculate the standard error for $\hat{b}$ using a parametric bootstrap procedure. More specifically, we draw values from the estimated vector of errors $\xi_j$ in (5) with replacement to generate a new set of bin counts and apply the above bunching methodology to calculate a new estimate of $\hat{b}^k$. We define the standard error of $\hat{b}$ as the standard deviation of the distribution of $\hat{b}^k$s.

We estimate CIT elasticity as a non-linear function of $\hat{b}$, the tax kink *K* and the relative change in the net-of-tax rate $ln\left(\frac{1-t_1}{1-t_2}\right)$ at the kink as in Eq. (1). We obtain the standard errors for this elasticity again using the bootstrap procedure.

Finally, we use the last identification method, which incorporates a time dimension into the econometric procedure. This approach, used also in Devereux et al. (2014), relaxes the assumption about the smooth density distribution of taxable income at the point of the minimum tax kink and assumes that the shape of the density distribution after the tax reform would remain the same as before the 2014 reform. More formally, we require that $g(z) = g(z \mid t)$. Under this condition, we estimate the probability density function over the finite interval $(Z_{min}, Z_{max})$ non-parametrically using the histogram estimator as follows:

$$\hat{p}_H(j) = \frac{C_{j,t_{pre-reform}}}{\sum_{Z_{min}}^{Z_{max}} C_{i,t_{pre-reform}}}, \quad (7)$$

where $C_{j,t_{pre-reform}}$ is the number of companies in the tax liability bin *j* prior to the establishment of the minimum tax. We then compute the counterfactual density as

$$\hat{C}_j = \hat{p}_H(j) \cdot \sum_{Z_{min}}^{Z_{max}} C_{i,t_{post-reform}}, \quad (8)$$

and the excess mass, CIT elasticity and standard errors as before.

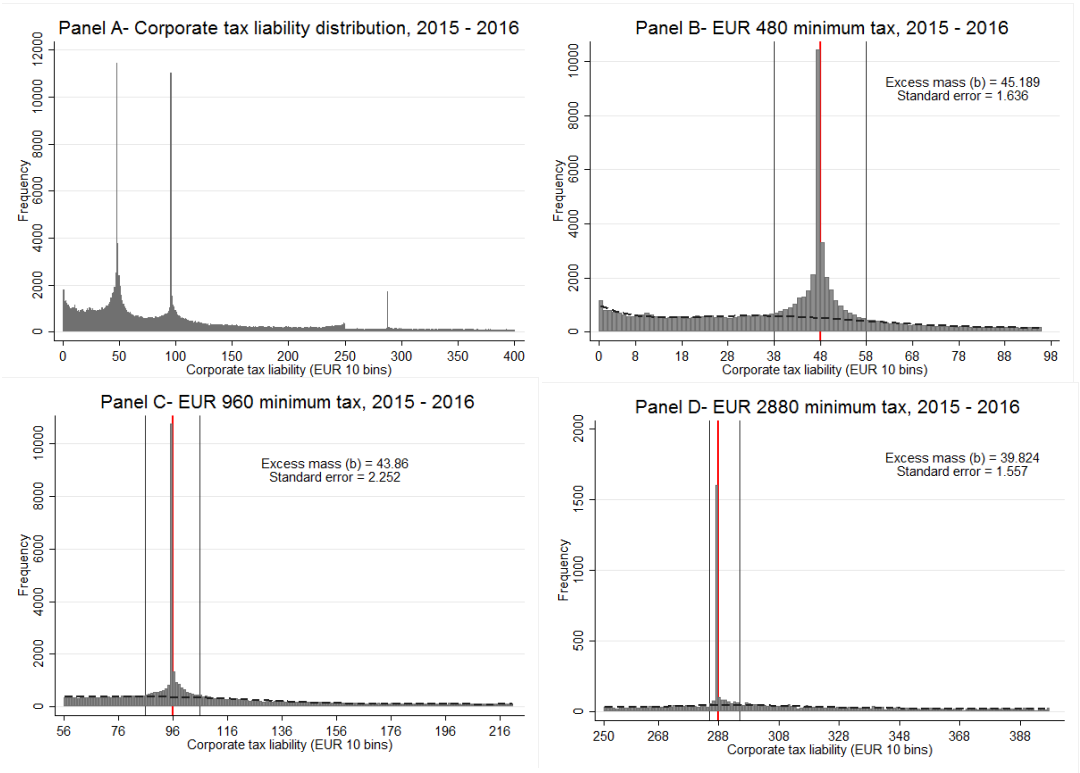
## 5. Overall corporate behavioral response to taxation

In this section, we report estimates of the overall behavioral response of companies to the kinks in the minimum tax schedule and evaluate their robustness using several approaches for constructing the counterfactual density distributions.

**Cross-sectional analysis.** Panel A in Figure 3 gives the first evidence of sharp spikes at all three values of the minimum tax kink in an otherwise declining distribution of corporate tax liability. The figure plots the histograms for 2015-2016, when companies were subject to the minimum tax and simultaneously could transfer part

of their tax liability from 2014-2015 forward.[8] The figure displays tax liability after carry-forwards, but prior to application of the minimum tax. The excess mass at the kinks is diffused around the kinks rather than forming a point mass, as it is presumably difficult to control corporate profits perfectly.[9]

**FIGURE 3 – Corporate tax liability around the minimum tax kinks**




Notes: Panel A shows the distribution of tax liability in 2015-2016 for all companies with liability below €4,000. Each bar shows the number of companies in €10 bins. Panels B, C, and D show the same distribution zoomed in around the minimum tax. In all panels, tax liabilities correspond to the liability after tax carry-forwards, but prior to application of the minimum tax. The dashed lines above the histograms are eighth-degree polynomials fitted to the empirical distribution, excluding data around the minimum tax. The excluded intervals around kinks correspond to +/- €100 for the €480 and €960 tax kinks and -€30/€70 for the €2,880 kink.

[8] We do not include 2017 in the figure, as the marginal tax rate for companies with tax liability above the minimum tax decreased in 2017 from 22% to 21%.

[9] The figure provides additional evidence of bunching below €2,500. Above this amount, companies have to send quarterly tax advances to the tax office. We do not analyze this type of bunching in our paper.

Panels B, C and D zoom in around the three minimum tax amounts (€480, €960, and €2,880). The dashed lines above the empirical distributions are the estimated counterfactuals $\hat{C}_j^0$ predicted using eighth-degree polynomials ($q = 8$) fitted according to Eq. (2), excluding observations in narrow areas around the tax kinks. [10,11] The excluded intervals are always demarcated by grey vertical lines.

The corresponding estimates of corporate bunching are reported in Table 3. This table shows that the excess mass of companies at the minimum tax amounts is equal to 4,519%, 4,386% and 3,982%, respectively, for the three corporate categories compared to the average density of companies at the kinks. Bootstrapped standard errors suggest that all bunching estimates are significant at the 1% level.

**TABLE 3 –Tax bunching and CIT elasticity estimated for 2015-2016 using cross-sectional polynomial regressions**

| | **Non-VAT-registered, turnover below €500,000** | **VAT registered, turnover below €500,000** | **Turnover above €500,000** |
|---|---|---|---|
| $\hat{\varepsilon}$ | 0.379*** | 0.184*** | 0.056*** |
| | [0.013] | [0.008] | [0.002] |
| $\hat{b}$ | 45.189*** | 43.86*** | 39.824*** |
| | [1.636] | [2.252] | [1.557] |
| $\hat{B}^0$ | 22,991 | 15,827 | 1,814 |
| N | 71,261 | 75,265 | 6,387 |

Notes: $\hat{\varepsilon}$ is the estimate of CIT elasticity with respect to the marginal net-of-tax rate at the minimum tax kink. $\hat{B}^0$ is the estimated excess number of companies at the kink, and $\hat{b}$ denotes the excess mass of companies relative to the average density at the kink. Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Using Eq. (1), we find that the corresponding CIT elasticity estimate for the lowest category of low-turnover non-VAT-registered companies at the €480 kink moves in the 95% confidence interval of 0.35-0.4. CIT elasticity for corporations in the middle category is in the interval of 0.17-0.2. Finally, the elasticity moves in the interval 0.05-

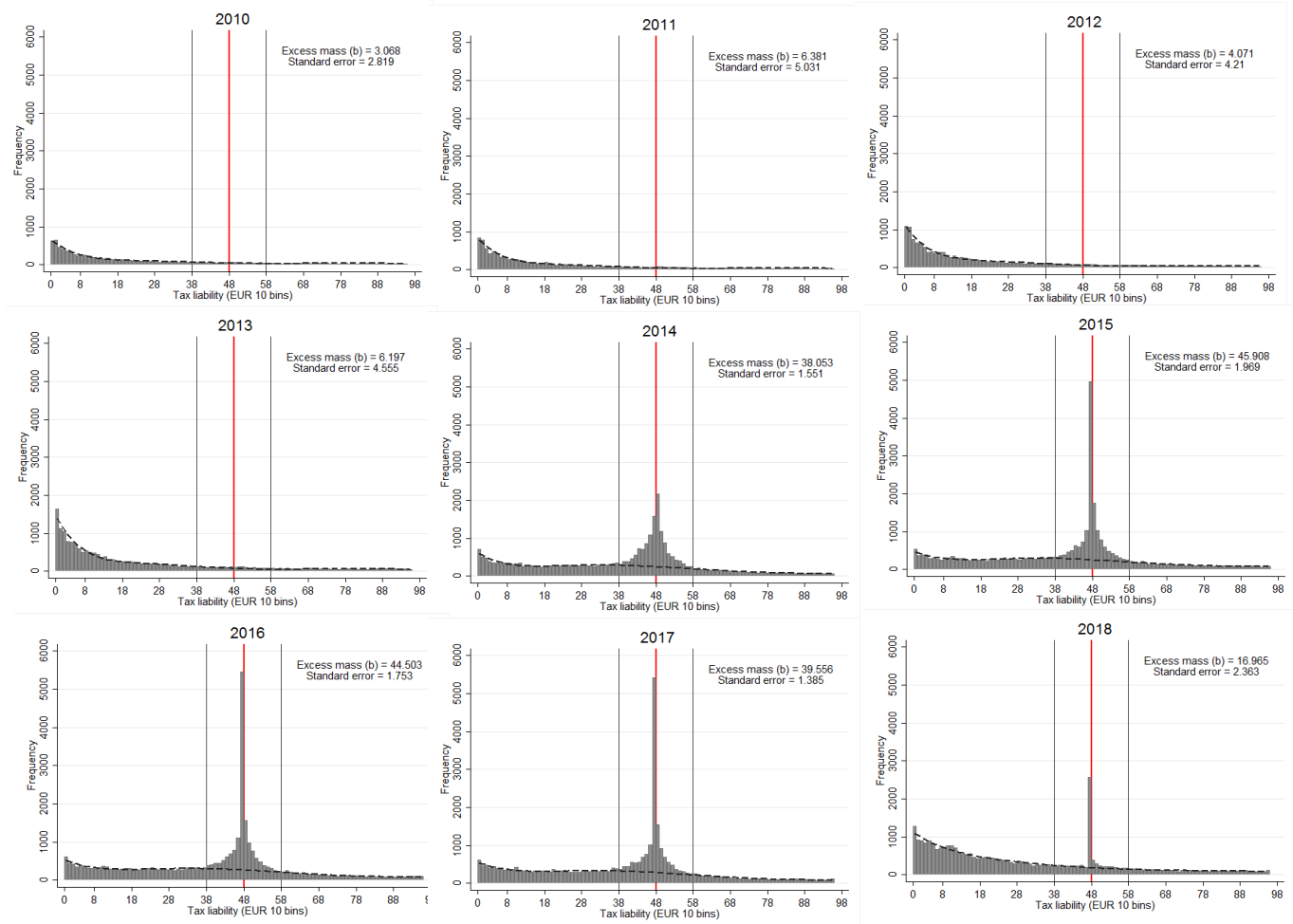
[10] The estimates are not sensitive to parametric choice of the polynomial order q nor to changes in the bin size, as demonstrated in Tables A.3 and A.4 in the Appendix.

[11] In Figure 5, we discuss the robustness with respect to the correction method by Chetty et al. (2011), which ensures that the estimated counterfactual satisfies the integration constraint.

0.06 for the top category of high-turnover companies. All elasticities are significant at the 1% level.

**Exploiting pre-reform distributions.** A potential concern with the estimates reported so far is that they rely on the assumption of smooth counterfactual distributions of corporate tax liability at the tax kinks. We can relax this assumption by exploiting the timing of introduction of the minimum tax into the corporate tax code.

**FIGURE 4 –Annual tax liability distributions around the €480 minimum tax**




Notes: Series shown in bars are annual histograms of corporate tax liability around the €480 minimum tax kink. The liabilities include tax liability carry-forwards, but are prior to application of the minimum tax. Each bar shows the number of observations in €10 bins. The dashed lines above the histogram are eighth-degree polynomials fitted to the empirical distributions, excluding data around the minimum tax kink. The excluded intervals are demarcated by vertical solid lines.

In Figure 4, we estimate the amount of bunching annually in 2010-2018 at the €480 kink. It is clear from the subfigures that bunching appears first in 2014, that is, immediately in the first year after corporations became subject to the minimum tax. Figure A.2 in the Appendix finds the same result for the €960 kink. The amount of bunching grows in both figures in 2015 when companies gained the option to apply tax carry-forwards for the first time. Bunching then remains significant up to the end of the observation period, including in 2018 after the minimum tax was abolished, but the option of tax carry-forwards remained available. We exploit these patterns in section 6 to quantify the amount of inter-temporal income shifting.

Table 4 reports the estimates of annual bunching for all three corporate categories based on Eq. (2). The evidence agrees with graphical results in Figures 4 and A.2, suggesting no bunching at the minimum tax amounts prior to 2014. Table A.5 in the Appendix reports the corresponding CIT elasticity estimated annually for companies in all three corporate categories.

**TABLE 4 – Annual bunching, estimated using cross-sectional polynomial regressions**

| | **Non-VAT-registered, turnover below €500,000** | | **VAT registered, turnover below €500,000** | | **Turnover above €500,000** | |
|---|---|---|---|---|---|---|
| Year | Excess Mass | SE | Excess Mass | SE | Excess Mass | SE |
| 2010 | 3.068 | [2.819] | 0.409 | [1.204] | -2.059 | [1.12] |
| 2011 | 6.381 | [5.031] | -0.42 | [1.648] | 0.442 | [1.645] |
| 2012 | 4.071 | [4.21] | 0.406 | [1.364] | -1.888 | [1.162] |
| 2013 | 6.197 | [4.555] | -0.238 | [1.931] | 1.773 | [1.433] |
| 2014 | 38.053*** | [1.551] | 17.05*** | [.875] | 5.99*** | [0.773] |
| 2015 | 45.908*** | [1.969] | 38.31*** | [2.36] | 38.946*** | [2.101] |
| 2016 | 44.503*** | [1.753] | 39.215*** | [2.804] | 40.739*** | [2.477] |
| 2017 | 39.556*** | [1.385] | 41.413*** | [2.665] | 49.412*** | [2.622] |
| 2018 | 16.965*** | [2.363] | 36.273*** | [3.022] | 93.865*** | [7.573] |

Notes: The table estimates the excess mass of companies at the minimum tax kinks relative to the average density at the minimum. The excluded areas around kinks correspond to +/- €100 for the €480 and €960 kinks and -€30/€70 for the €2,880 kink. The polynomials fitted to the histogram are of eighth order. Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Based on these results, we can take advantage of the tax liability distributions observed prior to 2014 to estimate the amount of bunching using the histogram estimator from Eq. (7). We define the pre-reform distribution $C_{j,t_{pre-reform}}$ by pooling the number of companies in individual histogram bins across the pre-reform years 2010-2013. We use the same excluded intervals around the kinks as in Table 3 to facilitate comparison of estimates across the estimation methods.

**TABLE 5 – Tax bunching and CIT elasticity, estimated using pre-reform distributions**

| | Non-VAT-registered, turnover below €500,000 | VAT registered, turnover below €500,000 | Turnover above €500,000 |
|---|---|---|---|
| $\hat{\varepsilon}$ | 0.653*** | 0.339*** | 0.053*** |
| | [0.053] | [0.025] | [0.001] |
| $\hat{b}$ | 77.843*** | 80.748*** | 38.226*** |
| | [6.309] | [6.075] | [0.731] |
| $\hat{B}$ | 26,343 | 18,582 | 1,810 |
| N | 74,195 | 75,367 | 6,435 |

Notes: The table provides our preferred estimates of corporate tax bunching and CIT elasticity in 2015-2016 with respect to the marginal net-of-statutory tax rate at the minimum tax kink estimated using the 2010-2013 density distributions of corporate tax liability. $\hat{\varepsilon}$ is the CIT elasticity estimate obtained using the histogram estimator in Eq.(7). $\hat{B}$ denotes the corresponding excess number of companies at the kink, and $\hat{b}$ denotes the excess mass of companies relative to their average density at the kink. Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 reports markedly higher estimates of bunching and CIT elasticity for the bottom two corporate categories when they are based on pre-reform distributions compared to those based on the cross-sectional method. CIT elasticity is equal to 0.653, 0.339, and 0.053, respectively, for the lowest, middle and top corporate categories. All estimated elasticities are significant at the 1% level. At the same time,

the 95% confidence intervals of the estimates in the bottom two categories do not overlap with those reported in Table 3. [12, 13]

**Method comparison.** Figure 5 examines the sources of discrepancies in the estimates obtained using the cross-sectional and between-period bunching methods by comparing the estimated counterfactuals at the €480 and €960 kinks visually.[14] The dashed lines in the figure show the cross-sectional counterfactuals from Eq. (2), already displayed in Figure 3. The solid lines are the counterfactuals obtained using the histogram estimator in Eq. (7). The figure also shows counterfactuals predicted using Eq. (5) which shifts the left part of the counterfactual estimated in Eq. (2) upwards so that it satisfies the integration constraint. For every method, the figure reports CIT elasticity and bootstrapped standard errors.

The figure strongly suggests that the main difference between the counterfactuals consists of the assumed source of bunching at the kinks. While the corrected cross-sectional counterfactuals assume that the excess mass originates proportionally from the whole distribution to the left of the kinks, the pre-reform counterfactuals copy the empirical distributions prior to 2014 and suggest that the source of bunching is

[12] Checking the overlap of the confidence intervals corresponds to a conservative test of the difference in CIT elasticities estimated in Tables 3 and 5, respectively, in the likely presence of a positive covariance between the estimates in the two tables.

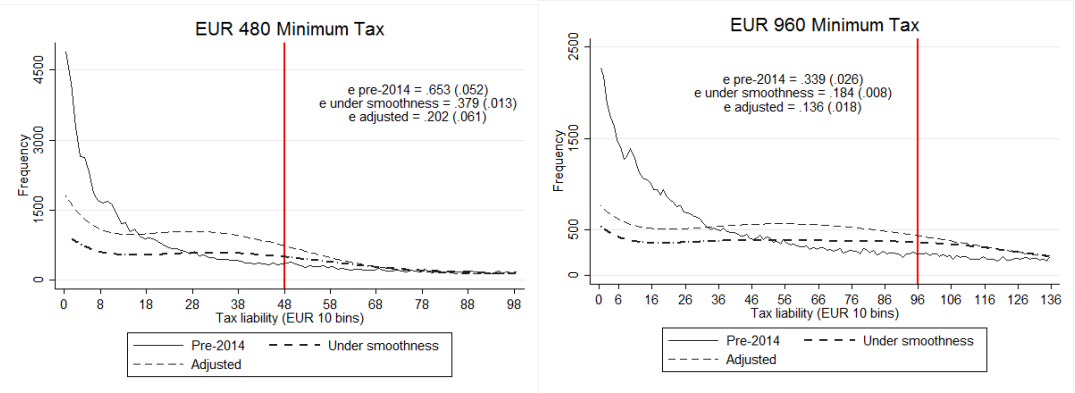
[13] Table A.6 inspects heterogeneity in the CIT elasticity across NACE categories for companies subject to the €480 and €960 minimum tax in columns (1) and (4), respectively. In the lowest corporate category, we find the highest CIT elasticity for companies in Accommodation and Food Services (0.856), followed by Transportation and Storage (0.736), and Construction (0.732). For the middle corporate category, we find the highest CIT elasticity for companies in Construction (0.376), Agriculture, Forestry and Fishing (0.305), and Wholesale and Retail Trade (0.303). We do not report CIT elasticities across NACE codes for companies subject to the €2,880 minimum tax because of the low number of observations in many of the NACE categories.

[14] Our setting does not permit comparisons of methods for estimating the counterfactuals for corporations subject to €2,880 minimum tax, as for these companies the estimated counterfactual distributions cannot include areas close to zero tax liability. The reason for this limitation is the obligation of companies with tax liability above €2,500 to pay quarterly tax advances. This additional bunching point puts a lower bound in the range of the tax liability distribution which can be used to estimate the counterfactual estimation.

around zero tax liability. This difference results in CIT elasticities that are 323% higher at the €480 kink if they are based on the pre-reform distributions. Analogously, CIT elasticities at the €960 kink are 2.49 times higher if they are based on pre-reform distributions than cross-sectional counterfactuals.[15]

Our evidence therefore suggests that CIT elasticities are notably underestimated if the empirical method for building counterfactuals assumes that bunching originates from parts of the tax liability distribution located much closer to the kinks than their more plausible source of bunching near zero.

**FIGURE 5 – Cross-sectional versus pre-reform counterfactuals, 2015-2016**




Notes: The figure compares counterfactual density distributions and CIT elasticity estimates from alternative econometric methods in 2015-2016. "*e pre-2014*" refers to elasticities obtained using Eq. (7) based on 2010-2013 distributions. "*e under smoothness*" refers to elasticity based on Eq. (2) which ignores the integration constraint. "*e adjusted*" refers to the elasticity from the bunching method in Eq. (5) which preserves the total number of corporations under the counterfactual equal to the number in the empirical distribution. Bootstrapped standard errors are presented in parenthesis.

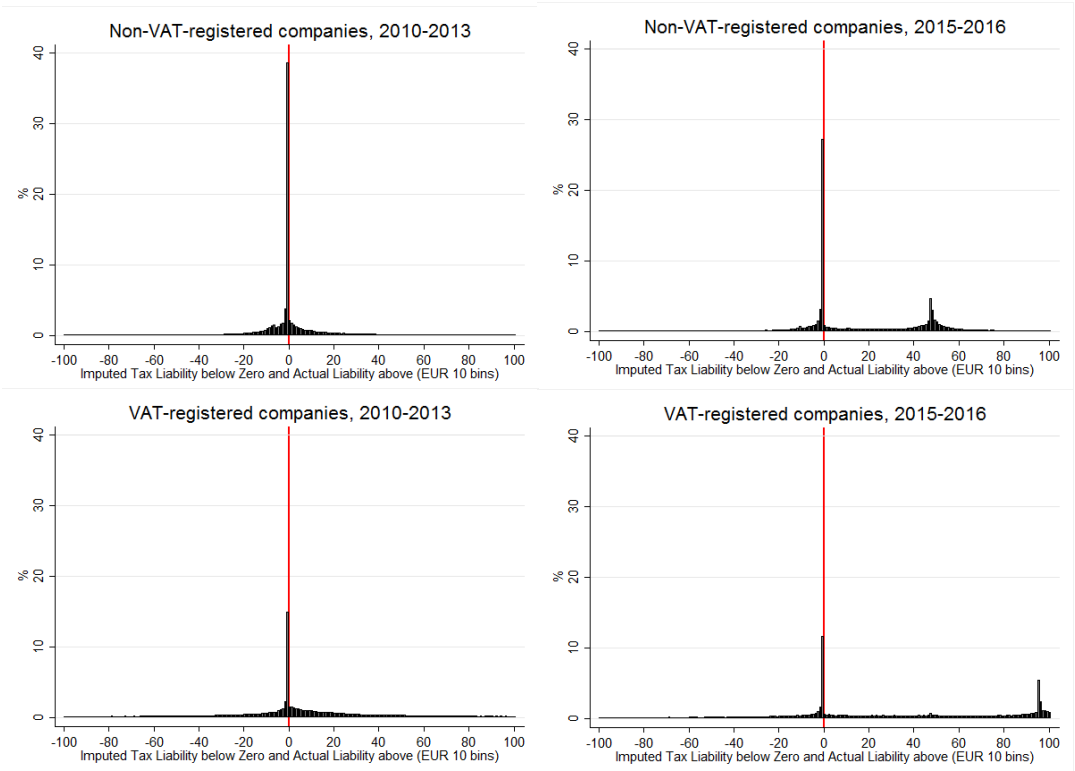
We provide further evidence in support of counterfactuals based on the pre-reform distributions of corporate tax liability by estimating the missing mass of companies at zero after the 2014 reform introduced the minimum tax. We perform this exercise to

[15] Put alternatively, CIT elasticities based on cross-sectional bunching estimators are about 60% and 69% lower for companies subject to €480 and €690 minimum tax, respectively, compared to elasticities based on pre-reform distributions.

quantify what portion of the excess mass at the minimum tax kinks can be attributed to companies moving from zero liability towards the new kinks.

To perform this analysis, we take advantage of detailed tax return data on corporate profits and losses to calculate the distribution of the "hypothetical" tax liability, even for profits below zero. In practice, we apply the tax rates valid in each fiscal period to both positive and negative values of profit (i.e. to corporate loss in case of negative profits). Using this imputed data, we plot histograms of corporate tax liability around zero before and after the introduction of the minimum tax in Figure 6 for the bottom and middle corporate categories.

**FIGURE 6 – Tax liability distributions around zero**




Notes: The figure shows tax liability distributions around zero before and after the 2014 reform. The liabilities below zero are imputed using data for companies with economic loss. The tax liabilities above zero are the actual tax liabilities. Each bar shows the percentage of observations in €10 bins.

The figure shows a pronounced drop in the share of companies massing at zero after the introduction of the minimum tax. We estimate the amount of the missing mass around zero in 2015-2016 compared to the pre-2014 distributions using the histogram estimator from Eq. (7). The estimates are reported in Table 6. According to the table, the missing mass of non-VAT-registered companies from the lowest corporate category at zero matches 94.2% of the estimated excess mass of companies at the €480 kink. The missing mass at zero for VAT-registered companies corresponds to 41.0% of their new excess mass at the €960 kink.

**TABLE 6 – Missing mass of companies at zero tax liability in 2015-2016**

| | Non-VAT-registered companies with turnover below €500,000 | | VAT-registered companies with turnover below €500,000 | |
|---|---|---|---|---|
| | Missing mass of companies at zero | % of the excess mass at the €480 kink | Missing mass of companies at zero | % of the excess mass at the €960 kink |
| | 24,809 | 94.2% | 7,617 | 41.0% |
| N | 131,545 | | 79,522 | |

Notes: The table provides estimates of the missing mass of companies at zero tax liability in 2015-2016 relative to the pre-reform distribution of corporate tax liabilities in 2010-2013. The estimates are computed for companies within +/- €50 of zero tax liability.

The amount of the missing mass at zero combined with the simultaneous and sudden emergence of bunching at the new tax kinks is strongly suggestive about the source of bunching at the kinks. Due to the more plausible assumptions about the source of bunching, we consider CIT elasticity based on pre-reform distributions to be our preferred estimates of the overall behavioral response to the corporate tax.

## 6. Inter-temporal shifting of corporate income

Thus far we have provided robust evidence of a strong behavioral corporate response to variation in the marginal tax rates at the minimum tax kinks. Nevertheless, as pointed out by le Maire and Schjerning (2013), the implied CIT elasticity can be over-estimated in case that inter-temporal income shifting generates additional bunching at the kinks. In this section, we employ three approaches to estimate the extent to which corporations shift income over time.

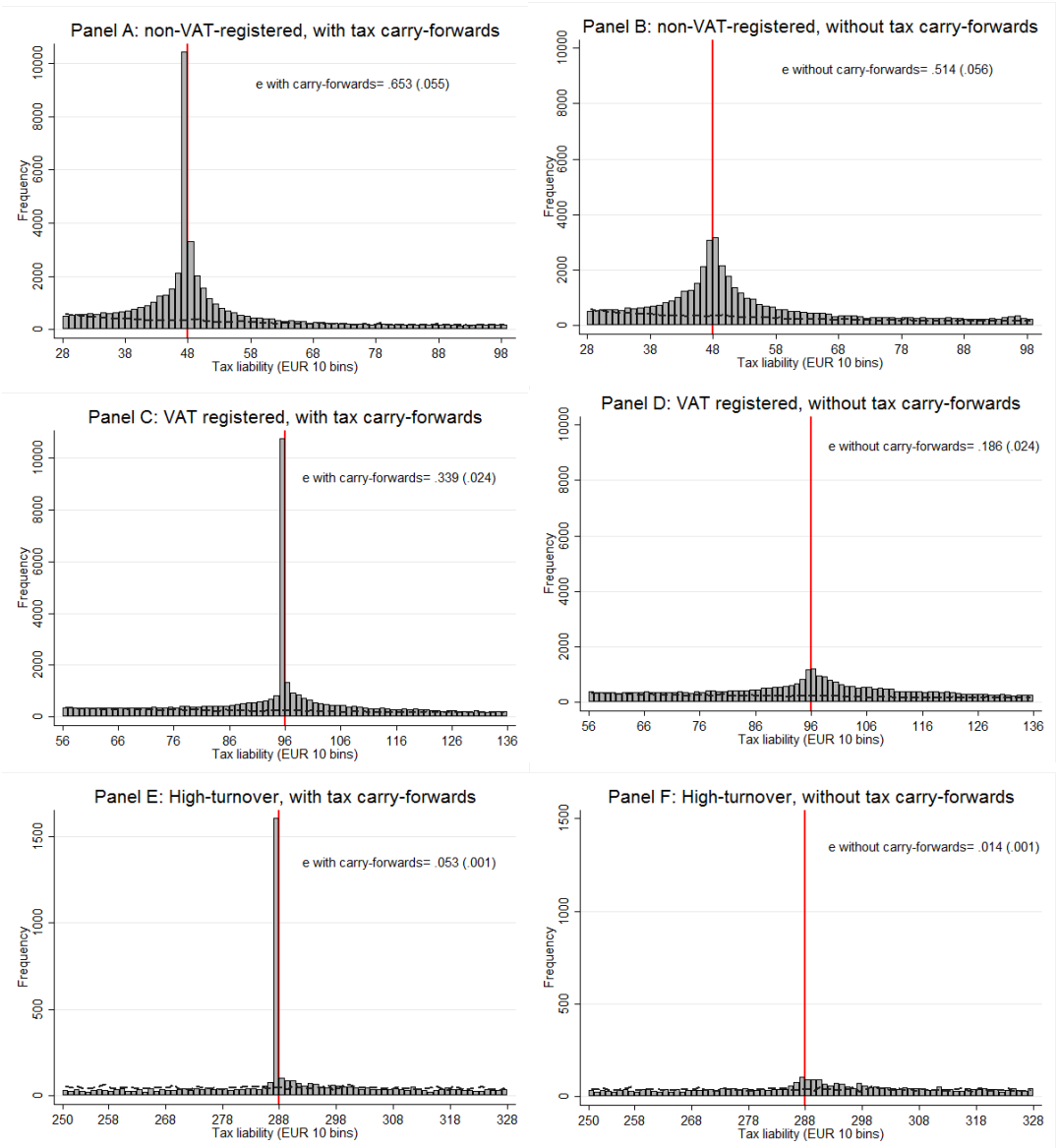
**Within-company comparisons before and after companies apply tax carry-forwards.** Perhaps the most straightforward approach is to directly compare the amount of bunching before and after companies apply tax carry-forwards in their annual tax returns. Figure 7 makes this comparison for 2015-2016, i.e. in fiscal years when companies could carry forward part of their tax liability from 2014-2015. In Panels A, C, and E, we estimate the amount of bunching after tax carry-forwards for our three corporate categories, as in our prior analyses. In Panels B, D, and F, we estimate the amount of bunching in the same years in the tax liability distributions prior to applying tax carry-forwards. To build the counterfactual, all panels rely on the pre-reform 2010-2013 distributions of corporate tax liability and the histogram estimator in Eq. (7).[16]

The figure reveals that tax distributions prior to carry-forwards in Panels B, D, and F are much flatter than those in Panels A, C, and E at all tax kinks. Table 7 reports the corresponding estimates of CIT elasticities. Column (2) shows elasticities implied from the tax liability distributions prior to carry-forwards. Column (3) compares them to the estimates of the full behavioral response, repeated in column (1).

The comparison suggests that CIT elasticities calculated from the distributions without tax carry-forwards are notably lower in all three corporate categories. The estimated CIT elasticity is 21.2% lower for the lowest category of low-turnover non-VAT-registered companies at the €480 kink (due to an estimated drop in bunching by 5,608 companies at the kink). The elasticity is 45.1% lower in the middle corporate category at the €960 kink (due to 8,398 fewer companies at the kink), and 73.6% lower for the top corporate category (due to 1,337 fewer companies at the €2,880 kink). This comparison provides the first evidence that inter-temporal income shifting is empirically relevant and sizeable especially among high-turnover companies

[16] The comparison is equivalent to using tax liability distributions without tax carry-forwards as counterfactuals for the distributions with tax carry-forwards.

**FIGURE 7 – Tax liability distributions with and without carry-forwards, estimated using 2010-13 pre-reform density distributions**




Notes: The histograms show tax liability distributions in 2015-2016 with and without carry-forwards. The values of the minimum tax are demarcated by red vertical lines. The dashed lines above the histograms are the rescaled pre-reform distributions of taxable income from 2010-2013. e is the estimated CIT elasticity for different corporate categories, with and without carry-forwards, respectively. Bootstrapped standard errors are presented in parentheses.

**TABLE 7 – Comparison of methods for estimating the extent of inter-temporal income-shifting**

| | Panel A - Overall behavioral response | Panel B - Corporate response estimated using tax distributions prior to application of tax carry-forwards | | Panel C - Corporate response of companies ineligible for tax carry-forwards | | Panel D - Corporate response after abolishing minimum tax, when tax carry-forwards remained available | | |
|---|---|---|---|---|---|---|---|---|
| | Preferred CIT elasticity estimates | CIT elasticity | % reduction compared to (1) | CIT elasticity | % reduction compared to (1) | Elasticity implied purely from inter-temporal profit-shifting | CIT elasticity adjusted for inter-temporal profit-shifting: (1)-(6) | % reduction compared to (1) |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Non-VAT-registered, low-turnover | 0.653*** [0.053] | 0.514*** [0.056] | -21.2% | 0.516*** [0.062] | -21.2% | 0.153*** [0.023] | 0.500*** [0.048] | -23.4% |
| VAT-registered, low-turnover | 0.339*** [0.025] | 0.186*** [0.024] | -45.1% | 0.258*** [0.029] | -23.9% | 0.158*** [0.009] | 0.181*** [0.023] | -46.6% |
| High turnover | 0.053*** [0.001] | 0.014*** [0.001] | -73.6% | 0.027*** [0.001] | -49.1% | 0.053*** [0.001] | 0.000 [0.000] | -100% |

Notes: CIT elasticity estimates in all panels are obtained using pre-2014 distributions of corporate tax liability and the histogram estimator from Eq. (7). Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

We arrive at the same finding in Table A.7, which reports annual estimates of the excess mass of companies at the minimum tax kinks in 2015-2018 based on the tax liability distributions prior to tax carry-forwards. The estimates are obtained using Eq. (2) so that they can be directly compared to the estimates for the same years in Table 4. The estimates prior to tax-carry-forwards are notably lower in all years, especially for high-turnover companies. The elasticities are all significant at the 1% level with the exception of 2018. This suggests that bunching in the tax distribution with tax carry-forwards in 2018 was purely due to inter-temporal income shifting.

The drawback of the within-company comparisons before and after companies apply tax carry-forwards is that companies typically choose the two tax liabilities simultaneously. The density distributions prior to tax carry-forwards therefore do not necessarily approximate what tax liability distributions would have looked like if tax forwarding had not been an option. It is plausible that the true counterfactual distributions would exhibit much more bunching than in Panels B, D, and F in Figure 7, because companies would adjust other margins of their response (e.g. they might have engaged in higher levels of tax evasion) in case they could not use costless inter-temporal shifting.

**Within-period comparisons.** We thus implement a second approach to evaluate the amount of inter-temporal shifting, which compares our main CIT elasticity estimates with those implied from the amount of bunching by companies which were ineligible to use carry-forwards in 2015. These were companies with 2014 tax liability higher than the amount of the minimum tax.[22] The identification assumption underlying this analysis is that the tax distributions for these companies approximate how all corporations would have responded to the minimum tax in the scenario in which tax carry-forwards were not available to any companies.

Column (4) in Table 7 reports CIT elasticities for companies which could not have applied carry-forwards in 2015. Column (5) compares these estimates to the overall behavioral response in column (1). We find that the drop in CIT elasticity equals 21.2%, 23.9%, and 49.1%, respectively, for the three corporate categories. Even our second approach for quantifying the amount of shifting thus indicates a pronounced inter-temporal response, though quantitatively lower, at least for companies at the €960 and €2,880 kinks, compared to the estimated extent of shifting implied by our

[22] Of all companies with tax liability below €4,000 in 2014, 16.3% of companies subject to the €480 minimum tax paid more than the minimum tax. The shares of companies subject to the €960 and €2.880 tax that paid more than the minimum tax were 14.6% and 10.2%, respectively.

earlier method. This drop agrees with our earlier intuition that companies might have exhibited more bunching at the kinks if they had not had the option of costless forwarding of tax liability from previous years.

Still, the concern with this calculation is that companies with tax liability above the minimum tax amount in 2014 might have chosen to report this liability based on expectations of their own economic performance. In such cases, the estimated counterfactual may not necessarily serve as the best approximation for how other companies would have behaved if tax carry-forwards had not been available.

**Between-period comparison.** Finally, we employ a third method to infer the extent of inter-temporal shifting, which consists of comparing the pre-reform 2010-2013 distributions to the amount of bunching observed in 2018, when companies were massing at the kinks purely due to tax carry-forwards, as the minimum tax had already been abolished. The underlying assumption is that the pre-2014 distributions would have remained stationary until 2018 in the absence of the interim tax reforms. We have confirmed the plausibility of this assumption in Figure A.1.

Column (6) in Table 7 reports CIT elasticities of 0.153, 0.158, and 0.053, for the lowest, middle and top corporate categories, respectively, which can be attributed solely to inter-temporal shifting. All elasticities are significant at the 1% level. Column (7) subtracts these elasticities from the overall behavioral corporate response in column (1), showing that the elasticity estimates drop to 0.5, 0.181, and 0 when they are adjusted for inter-temporal shifting. Column (8) expresses this drop as a percentage of the total corporate behavioral response. We find that the CIT elasticity estimates drop by 23.4%, 46.6%, and 100%, respectively, for the lowest, middle and top corporate categories.[23]

[23] Table A.6 uses the same between-period comparisons as Table 7 in Panel D to inspect variations in the adjustment to CIT elasticity due to inter-temporal shifting across NACE categories. For the corporate category subject to the €480 minimum tax, column (3) indicates that the greatest reduction in CIT elasticity occurred for companies in Wholesale and Retail Trade (-34.6%), Transportation and

In sum, each of our three methods suggests pronounced shifting of corporate income over time, which leads to elevated estimates of tax bunching and of CIT elasticity. The extent of this shifting is such that it should not be overlooked in applied work.

## 7. Marginal excess burden of corporate taxation

In this section, we examine the implications of neglecting inter-temporal shifting in estimation of the marginal excess burden (MEB) of corporate taxation. First, we revise the conceptual framework by Saez et al. (2012) which allows estimation of the MEB as if in the top tax bracket above the minimum tax kink. We present the framework both without contemplating the possibility of income shifting and when we allow for it. We then estimate the MEB and calculate how much it changes once we correct our CIT elasticity estimates for inter-temporal shifting.

**Benchmark framework without income shifting.** To calculate the MEB of corporate taxation, we consider a situation with a constant marginal tax rate $\tau$ above a given level of reported corporate income $\bar{z}$. In our setting, this tax rate corresponds to the rate on companies which earn income implying tax liability above the minimum tax kink. We further assume that corporate income depends on net-of-tax rate $(1-\tau)$. We assume that there are N corporations with taxable income above $\bar{z}$ when the marginal tax rate is $\tau$. We denote by $z^m(1-\tau)$ the average income reported by those N corporations, as a function of the net-of-tax rate. The aggregate elasticity of the taxable income implying tax liability above the minimum tax amount is thus defined as $e = \left[\frac{\partial z^m}{\partial(1-\tau)}\right]\left[\frac{1-\tau}{z^m}\right]$.

We now suppose the government increases the marginal tax rate $\tau$ by a small amount $d\tau$ while keeping the minimum tax amount fixed. We can contemplate two effects on

Storage (-34.4%), and Human Health and Social Work Activities (-34.0%). For the middle category subject to the €960 minimum tax, the reduction in CIT elasticity was the greatest for companies in Real Estate Activities (-79.5%) and Wholesale and Retail Trade (-63.7%), as shown in column (6).

government revenue. First, there is a "mechanical" increase in revenue due to the fact that corporations face a higher tax rate on incomes above $\bar{z}$. We define this mechanical effect as:

(9) $$dM \equiv N(z^m - \bar{z})d\tau > 0.$$

The mechanical effect can be viewed as the projected increase in tax revenue in the absence of behavioral responses to the tax change.

Second, the increase in the tax rate produces a behavioral response that reduces the average reported income for N corporations by $dz^m = -ez^m d\tau/(1-\tau)$. A change in the reported income of $dz^m$ changes the tax revenue by $\tau dz^m$. The aggregate change in tax revenue due to the behavioral response is therefore equal to:

(10) $$dB \equiv -Nez^m \frac{\tau}{1-\tau} d\tau < 0.$$

Summing up the mechanical and behavioral effects, we can express the total change in tax revenue due to the tax change as:

(11) $$dR = dM + dB = N(z^m - \bar{z})[1 - e\frac{z^m}{z^m - \bar{z}}\frac{\tau}{1-\tau}]d\tau.$$

We denote the ratio $\frac{z^m}{z^m - \bar{z}}$ as $a$. If the top tail of the corporate taxable income distribution is Pareto distributed, then parameter $a$ does not vary with $\bar{z}$ and is exactly equal to the Pareto parameter. Using the definition of $a$, we can rewrite the effect of the small tax reform on tax revenue as:

(12) $$dR = dM\left[1 - \frac{\tau}{1-\tau}ea\right].$$

Formula (12) shows that the fraction of the tax revenue lost due to the behavioral response, which is the second term in the square bracket, is a simple function increasing in the tax rate $\tau$, CIT elasticity $e$, and the parameter ratio $a$.

According to the envelope theorem, the utility loss measured in monetary terms due to the small tax change $d\tau$ is exactly equal to the mechanical effect $dM$. Applying

formula (12) and because $dR = dM + dB$, we can express the MEB per one monetary unit of extra tax raised as:

(13) $$-dB/dR = \frac{ea\tau}{1 - \tau - ea\tau}.$$

This means that for each extra euro raised, the government imposes an extra cost equal to $-dB/dR > 0$ on taxpayers. We will compare the MEB implied by (13) to the MEB implied by the calculation when we allow for shifting of corporate income into other fiscal periods.

**Framework with inter-temporal shifting.** To see the implications of inter-temporal shifting, we assume that a fraction $s < 1$ of the corporate income that disappears from the corporate tax base following the tax rate increase $d\tau$ is shifted to the tax base in another fiscal period, in which it is taxed, on average, at tax rate $t$. A behavioral response now generates a tax revenue change equal to $(\tau - st)dz$. As a result, the change in tax revenue due to the behavioral response becomes:

(14) $$dB = -Nez^m \frac{\tau}{1-\tau} d\tau + Nez^m \frac{st}{1-\tau} d\tau.$$

Thus, formula (12) for the effect of a small tax reform on total tax revenue becomes:

(15) $$dR = dM + dB = dM \left[1 - \frac{\tau - st}{1-\tau} ea\right].$$

Finally, the MEB expressed in terms of extra tax collected in the presence of income shifting can be written as:

(16) $$-dB/dR = \frac{ea(\tau - st)}{1 - \tau - ea(\tau - st)}.$$

**MEB estimates.** Our empirical setting allows us to estimate the marginal excess burden at the minimum tax kink by combining the relevant CIT elasticities from sections 5 and 6 above. We always report both the estimates of the MEB calculated according to (13) when we do not consider the possibility of inter-temporal shifting and according to (16) when we account for the shifting response.

In Figure 8, we report the values of the parameter ratio $a$ calculated annually in 2010-2018 at the income levels corresponding to the minimum tax amounts for companies with tax liability below €200,000. We find that the ratio $a$ is stable in time at the €2,880 kink and equals around 1.1. For the €480 and €960 kinks, the values of $a$ increase slightly from around 1.18 in 2010-2013 to around 1.25 in 2014-2017. For calculating the MEB, we choose $a$ from 2015-2016 when companies were subject to minimum tax, could apply tax carry-forwards, and had to pay the marginal tax rate of 22% on all income above the income threshold corresponding to the minimum tax.

**FIGURE 8 – Parameter ratio $a$**


Notes: The figure shows values of the parameter ratio $a$ at the levels of income corresponding to the minimum tax amounts. The ratio $a$ is calculated as the average taxable income above the income level corresponding to the minimum tax amount $\bar{z}$, $z^m$, divided by the difference between $z^m$ and $\bar{z}$: , $\frac{z^m}{z^m - \bar{z}}$.

Using our preferred CIT elasticity estimates from Table 5 which is equal to 0.653 for companies subject to the €480 minimum tax, we estimate the fraction of the welfare loss relative to the mechanical increase in tax revenue around 29.9% under the assumption that companies do not shift income to other years. The estimated welfare loss relative to the mechanical increase in tax revenue drops to 22.2% when we apply CIT elasticity of 0.516 from Panel C in Table 7, which corresponds to the elasticity most conservatively adjusted for income shifting in the bottom corporate category.[24]

[24] CIT elasticity estimates adjusted for profit-shifting suggest that companies at the €480 minimum tax kink shift 4.7% of their income into other periods. The elasticities at the €960 and €2,880 kinks, respectively, suggest 5.3% and 10.8% of corporate income is shifted into other years.

Our estimates of the MEB unadjusted for profit-shifting are thus very close to those of Devereux et al. (2014) for basic-rate corporate taxpayers in the U.K. with income around the £10,000 kink, should the tax rate in the relevant tax bracket increase by 1%. Our estimates are, however, much lower if we account for inter-temporal shifting, including when we apply the most conservative adjustment for shifting.

We come to a similar conclusion if we calculate the MEB of taxation for the middle category of companies subject to the €960 minimum tax. Using our preferred CIT elasticity of 0.339 unadjusted for profit shifting, we find the welfare loss relative to the mechanical increase in tax revenue equal to around 13.6% should the tax rate rise by 1%. The estimated MEB drops to around 10.0% when we consider CIT elasticity of 0.258, which is corrected for inter-temporal shifting using our most conservative adjustment for companies in the middle corporate category.

Finally, we estimate the marginal deadweight loss at around 1.7% for companies in the top category should the tax rate above the €2,280 kink increase by 1%. The MEB is around 0.8% after adjusting CIT elasticity for inter-temporal shifting.

## 8. Conclusion

We use administrative tax return data on the population of corporations in Slovakia to estimate what portion of the overall corporate behavioral response to taxation can be attributed to shifting of corporate profits over time. We show that, after removing the shifting component, estimated CIT elasticity and the marginal excess burden of corporate taxation fall substantially.

We quantify CIT elasticity using several approaches. We apply cross-sectional bunching methods by Saez (2010) and Chetty et al. (2011) to construct counterfactual distributions of corporate tax liability at kinks in the statutory tax schedules. Next, we use a non-parametric histogram estimator to predict the counterfactual using empirical distributions of tax liability observed before a tax reform introduced new kinks in the tax schedules at the minimum corporate tax amounts.

Using our preferred approach, we estimate CIT elasticity of up to 0.65 for the lowest corporate category of non-VAT-registered companies. The elasticity for high-turnover companies (the top 14% of the sample) is around 0.05. Our estimates agree with results in earlier literature, which found low CIT elasticity for large corporations in the U.S and the U.K. (Gruber and Rauh 2007, Devereux et al. 2014) and higher elasticities for small companies with plausibly less formal natures.

Most importantly, we show that inter-temporal shifting of corporate profits significantly increases the amount of bunching at tax kinks and the corresponding estimates of CIT elasticity and of the marginal excess burden of corporate taxation. Our estimates of the welfare loss relative to a mechanical increase in tax revenue should the tax rate applied above the minimum tax increase by 1% dropped from 29.9% to 22.2% for the lowest corporate category when we correct the CIT elasticity for inter-temporal shifting using our most conservative estimates. The marginal deadweight loss is around 1.7% for companies in the top category if income-shifting is not considered and drops to around 0.8% after we adjust CIT elasticity for profit-shifting using our most conservative approach.

To properly interpret our results, note that our study does not preclude other types of corporate behavioral responses to taxation; we focus mainly on inter-temporal shifting. Other responses may include shifting of corporate income into the wage income of company managers (as in Devereux et al. 2014), outright tax evasion (as in Best et al. 2015) and extensive margin responses.

Next, note that our analysis exploits the institutional setting of Slovakia, which imposed rather strict rules on shifting corporate income over time. During our observation period, Slovak companies could carry-forward tax liability only from the past three years, but from 2014 at the earliest. Moreover, it was only possible to apply carry-forwards against tax liability exceeding the minimum tax amounts in corresponding years. The regulations on tax shifting are much less strict in most other

countries, as shown in Table A.8 (OECD 2018a). In the US, for instance, companies can carry-forward tax liability from the 20 past years and may also use tax carry-backs to some extent. Numerous OECD countries do not limit the number of years from which companies can carry-forward their tax liabilities. The scope of income shifting can be much more pronounced in countries with less strict tax regimes.

Finally, it is worth noting that our estimates rely on an upward-trending time period in the Slovak economic cycle (2014-2018). The accumulation of tax losses in our setting may have been further limited by this circumstance and one could expect greater distortions in the estimated CIT elasticity and the marginal excess burden of taxation, if income shifting had been possible over a longer time horizon including periods of both economic booms and busts.

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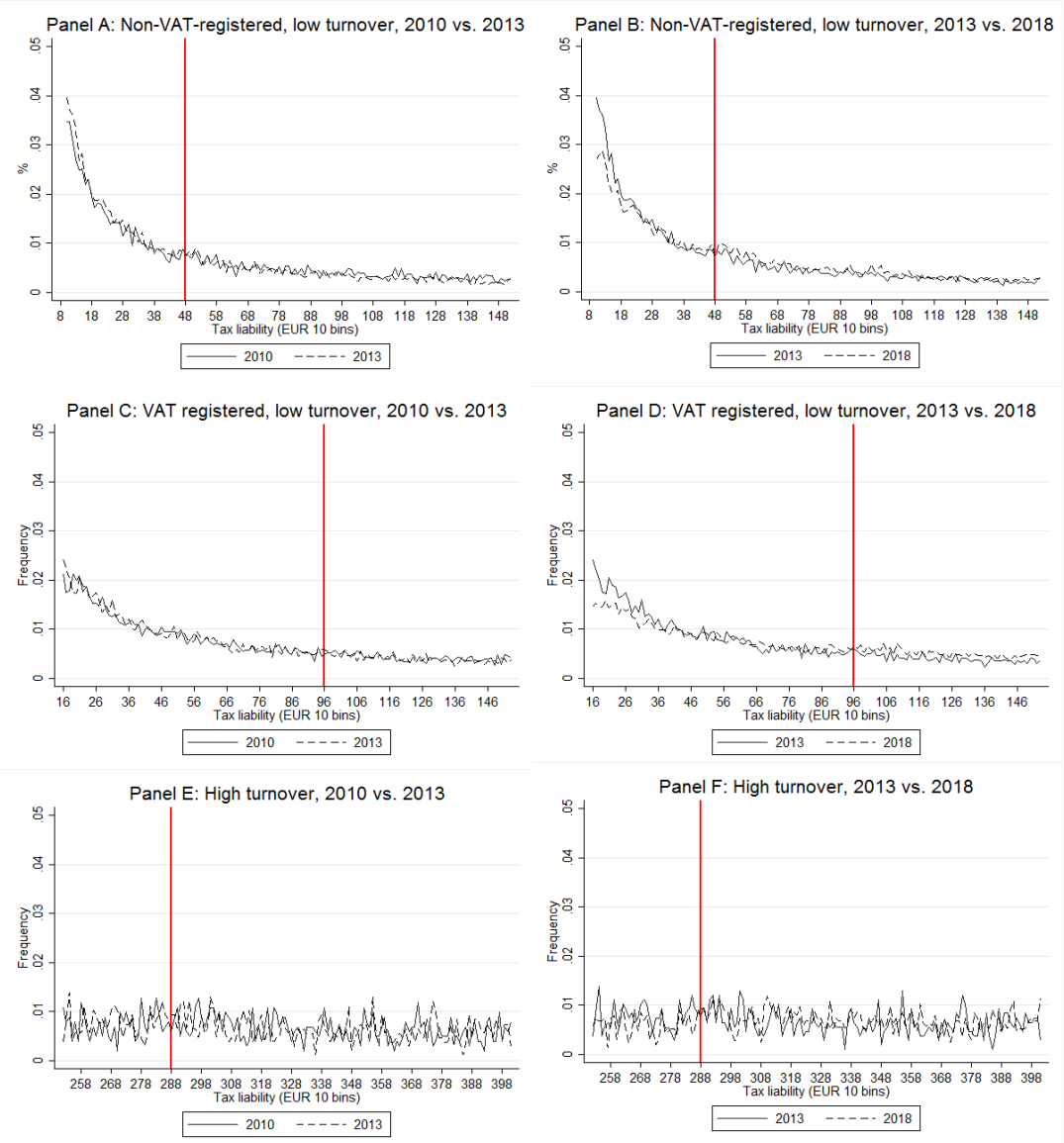
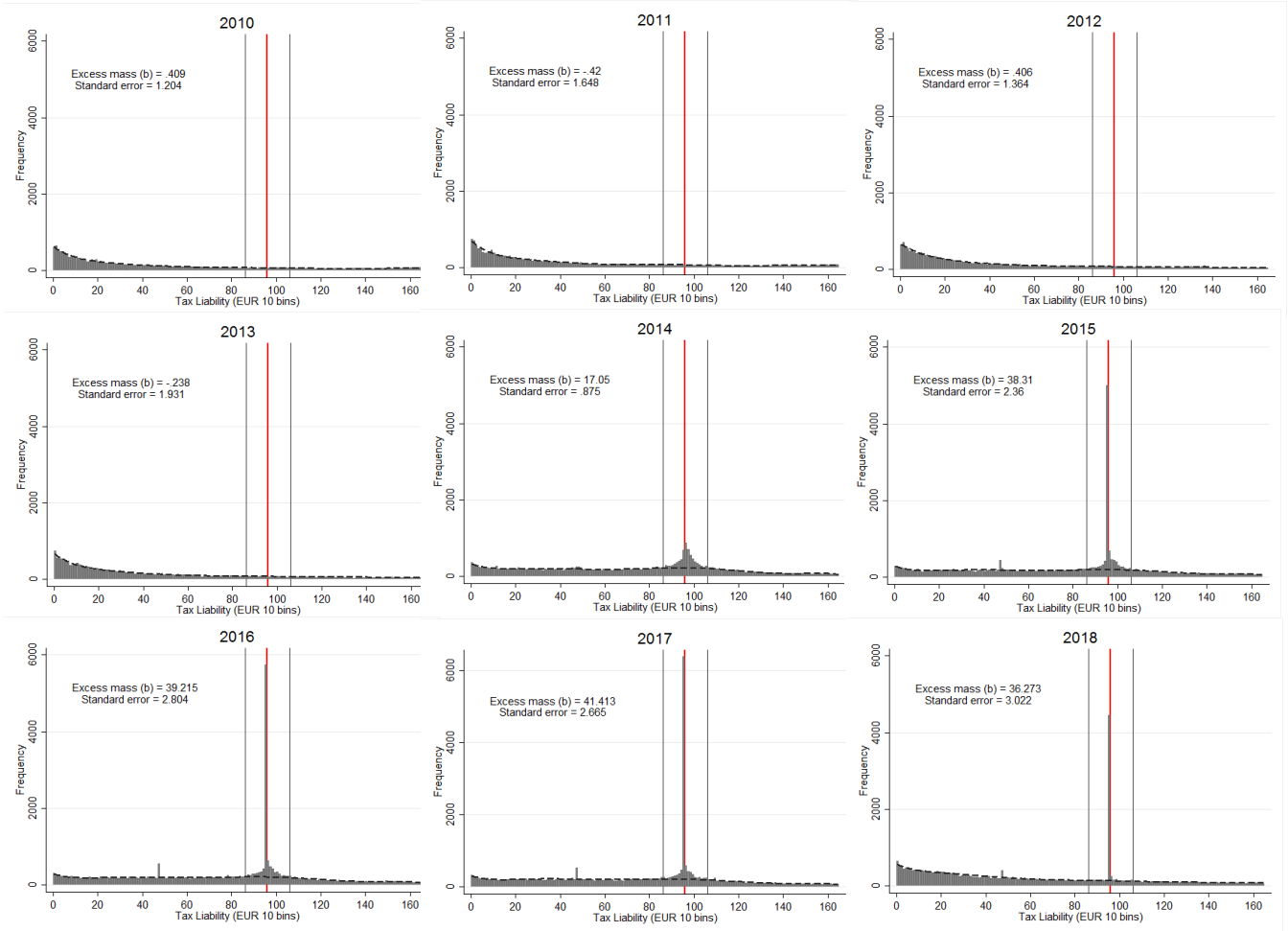
# Online appendix (not for journal publication)

## FIGURE A.1– Stationarity of corporate tax liability density distributions




Notes: The figure visually compares the empirical histograms of corporate tax liability across years. Panels A and B compare the distributions for low-turnover, non-VAT-registered companies across 2010 vs. 2013, and 2013 vs. 2018, respectively. Panels C and D make the comparisons across the same years for low-turnover, VAT registered companies, and Panels D and E for high-turnover companies. The density distributions are adjusted so as to have equal numbers of observations across the time periods compared. The red vertical lines are the values of the minimum tax applied on each category in 2014-2017. The histograms are drawn using bins of €10 width.

**FIGURE A.2– Annual tax liability distributions around the €960 minimum tax kink**




Notes: Series shown in bars are annual histograms of corporate tax liability around the €960 minimum tax kink. The tax liabilities displayed include tax carry-forwards but are prior to application of the minimum tax. Each bar shows the number of observations in €10 bins. The dashed lines above the histograms are eighth-degree polynomials fitted to the empirical distributions, excluding observations around the value of the minimum tax. The excluded intervals are demarcated by vertical solid lines.

**TABLE A.1 – Accounting for tax carry-forwards (example 1)**

| Tax period t | VAT registration | Sales turnover | Tax liability prior to the application of the minimum tax and tax carry-forwards | MT | Non-negative difference between (4) and (5) | $BP_t$ | $BP_{t-1}$ | $BP_{t-2}$ | $BP_{t-3}$ | Tax liability carry-forwards applied in t | Tax paid |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| 2014 | Yes | < €500,000 | 680 | 960 | 0 | 280 | - | - | - | 0 | 960 |
| 2015 | Yes | < €500,000 | 1,700 | 960 | 740 | 0 | 280 | - | - | 280 | 1,420 |
| 2016 | Yes | < €500,000 | 750 | 960 | 0 | 210 | 0 | 0 | - | 0 | 960 |
| 2017 | Yes | < €500,000 | -2,300 | 960 | 0 | 960 | 210 | 0 | 0 | 0 | 960 |
| 2018 | Yes | < €500,000 | 2500 | 960 | 1,540 | 0 | 960 | 210 | 0 | 1,170 | 1,330 |

Notes: MT – minimum tax, $BP_t$ – balance payment to match the value of the minimum tax in period t. Source: Financial Directorate of the Slovak Republic (2015).

**TABLE A.2 – Accounting for tax carry-forwards (example 2)**

| Tax period t | VAT registration | Sales turnover | Tax liability prior to the application of the minimum tax and tax carry-forwards | MT | Non-negative difference between (4) and (5) | $BP_t$ | $BP_{t-1}$ | $BP_{t-2}$ | $BP_{t-3}$ | Tax carry-forwards applied in t | Tax paid |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| 2014 | No | < €500,000 | 250 | 480 | 0 | 230 | - | - | - | 0 | 480 |
| 2015 | No | < €500,000 | 300 | 480 | 0 | 180 | 230 | - | - | 0 | 480 |
| 2016 | No | < €500,000 | 450 | 480 | 0 | 30 | 180 | 230 | - | 0 | 480 |
| 2017 | No | < €500,000 | -500 | 480 | 0 | 480 | 30 | 180 | 230 | 0 | 480 |
| 2018 | No | < €500,000 | 700 | 480 | 220 | 0 | 480 | 30 | 180 | 220 | 480 |

Notes: MT – minimum tax, $BP_t$ – balance payment to match the MT in tax period t. Source: Financial Directorate of the Slovak Republic (2015).

**TABLE A.3 - Specification checks – Choice of the polynomial order**

| | Non-VAT-registered, turnover below €500,000 | VAT registered, turnover below €500,000 | Turnover above €500,000 |
|---|---|---|---|
| | Order of the Polynomial: $9^h$ | | |
| $\hat{\varepsilon}$ | 0.383*** | 0.17*** | 0.053*** |
| | [0.014] | [0.008] | [0.002] |
| $\hat{B}^0$ | 23,069 | 15,421 | 1,797 |
| | Order of the Polynomial: $8^{th}$ | | |
| $\hat{\varepsilon}$ | 0.379*** | 0.184*** | 0.056*** |
| | [0.013] | [0.008] | [0.002] |
| $\hat{B}^0$ | 22,991 | 15,827 | 1,814 |
| | Order of the Polynomial: $7^{th}$ | | |
| $\hat{\hat{\varepsilon}}$ | 0.384*** | 0.191*** | 0.057*** |
| | [0.011] | [0.008] | [0.002] |
| $\hat{B}^0$ | 23,088 | 16,023 | 1,823 |
| N | 71,261 | 75,265 | 6,387 |

Notes: $\hat{\varepsilon}$ denotes CIT elasticity estimated using Eq. (2) and $\hat{B}^0$ denotes the excess number of companies at the value of the minimum tax. Bootstrapped standard errors are presented in brackets. The bin size always corresponds to €10. The excluded area around the value of the minimum tax is kept constant across specifications with different polynomial orders. *** p<0.01, ** p<0.05, * p<0.1

**TABLE A.4 - Specification checks – Choice of bin size**

| | Non-VAT-registered, turnover below €500,000 | VAT registered, turnover below €500,000 | Turnover above €500,000 |
|---|---|---|---|
| | Size of histogram bin: €10 | | |
| $\hat{\varepsilon}$ | 0.379*** | 0.184*** | 0.056*** |
| | [0.013] | [0.008] | [0.002] |
| $\hat{B}^0$ | 22,991 | 15,827 | 1,814 |
| | Size of histogram bin: €20 | | |
| $\hat{\varepsilon}$ | 0.381*** | 0.187*** | 0.053*** |
| | [0.016] | [0.009] | [0.002] |
| $\hat{B}^0$ | 23,121 | 15,951 | 1,782 |
| | Size of histogram bin: €30 | | |
| $\hat{\varepsilon}$ | 0.364*** | 0.18*** | 0.054*** |
| | [0.017] | [0.009] | [0.003] |
| $\hat{B}^0$ | 22,808 | 15,705 | 1,775 |
| N | 71,261 | 75,265 | 6,387 |

Notes: $\hat{\varepsilon}$ denotes CIT elasticity estimated using Eq. (2) and $\hat{B}^0$ denotes the excess number of companies at the value of the minimum tax. Bootstrapped standard errors are presented in brackets. The order of the polynomial is always eight. The excluded area around the value of the minimum tax is kept constant across specifications with different bin sizes. *** p<0.01, ** p<0.05, * p<0.1

**TABLE A.5 – CIT elasticity estimated from the repeated cross-sectional polynomial regressions, annually**

| | Non-VAT-registered, turnover below €500,000 | | VAT registered, turnover below €500,000 | | Turnover above €500,000 | |
|---|---|---|---|---|---|---|
| Year | CIT elasticity | SE | CIT elasticity | SE | CIT elasticity | SE |
| 2010 | 0.03 | [0.028] | 0.002 | [0.008] | -0.003 | [0.002] |
| 2011 | 0.063 | [0.043] | -0.002 | [0.009] | 0.001 | [0.003] |
| 2012 | 0.04 | [0.037] | 0.002 | [0.009] | -0.003 | [0.002] |
| 2013 | 0.049 | [0.036] | -0.001 | [0.007] | 0.002 | [0.002] |
| 2014 | 0.319*** | [0.014] | 0.071*** | [0.004] | 0.008*** | [0.001] |
| 2015 | 0.385*** | [0.015] | 0.161*** | [0.01] | 0.054*** | [0.003] |
| 2016 | 0.373*** | [0.015] | 0.164*** | [0.012] | 0.057*** | [0.003] |
| 2017 | 0.35*** | [0.012] | 0.183*** | [0.013] | 0.073*** | [0.003] |
| 2018 | 0.15*** | [0.021] | 0.16*** | [0.014] | 0.138*** | [0.012] |

Notes: The table reports the estimates of CIT elasticity from cross-sectional polynomial regressions in Eq. (2), estimated annually in 2010-2018. The estimates in 2010-2013 are calculated as if the kinks in the tax schedule introduced in 2014 for each corresponding corporate category had already existed. The excluded areas around the (hypothetical) kinks correspond to +/- €100 for the €480 and €960 kinks and €-30/€70 for the €2,880 kink. The polynomials fitted to the histogram are eighth order. Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE A.6 – Heterogeneity in the extent of inter-temporal shifting, by industry**

| | Lowest corporate category: Non-VAT-registered, low-turnover | | | Middle corporate category: VAT- registered, low-turnover | | |
|---|---|---|---|---|---|---|
| | Overall CIT elasticity | Adjusted for inter-temporal shifting | % reduction compared to (1) | Overall CIT elasticity | Adjusted for inter-temporal shifting | % reduction compared to (4) |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| A - Agriculture, Forestry and Fishing | 0.548*** [0.044] | 0.397*** [0.033] | -27.55% | 0.305*** [0.018] | 0.134*** [0.012] | -56.07% |
| C – Manufacturing | 0.652*** [0.05] | 0.515*** [0.041] | -21.01% | 0.254*** [0.016] | 0.136*** [0.013] | -46.46% |
| F - Construction | 0.732*** [0.064] | 0.564*** [0.051] | -22.95% | 0.376*** [0.022] | 0.203*** [0.018] | -46.01% |
| G - Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles | 0.673*** [0.053] | 0.440*** [0.041] | -34.62% | 0.303*** [0.018] | 0.11*** [0.013] | -63.70% |
| H - Transportation and Storage | 0.736*** [0.06] | 0.483*** [0.046] | -34.38% | 0.281*** [0.018] | 0.125*** [0.014] | -55.52% |
| I - Accommodation and Food Service Activities | 0.856*** [0.07] | 0.604*** [0.060] | -29.44% | 0.291*** [0.021] | 0.136*** [0.016] | -53.26% |
| J- Information and Communication | 0.44*** [0.036] | 0.299*** [0.028] | -32.05% | 0.275*** [0.018] | 0.115*** [0.012] | -58.18% |
| K - Financial and Insurance Activities | 0.489*** [0.037] | 0.420*** [0.000] | -14.11% | - | - | - |
| L- Real Estate Activities | 0.649*** [0.051] | 0.442*** [0.037] | -31.90% | 0.268*** [0.016] | 0.055*** [0.012] | -79.48% |
| M - Professional, Scientific and Technical Activities | 0.49*** [0.036] | 0.357*** [0.031] | -27.14% | 0.251*** [0.015] | 0.105*** [0.012] | -58.17% |
| N - Administrative and Support Service Activities | 0.669*** [0.052] | 0.476*** [0.041] | -28.85% | 0.256*** [0.015] | 0.123*** [0.012] | -51.95% |
| P - Education | 0.58*** [0.051] | 0.409*** [0.040] | -29.48% | 0.214*** [0.02] | 0.089*** [0.013] | -58.41% |
| Q - Human Health and Social Work Activities | 0.191*** [0.009] | 0.126*** [0.009] | -34.03% | - | - | - |
| R - Arts, Entertainment and Recreation | 0.639*** [0.047] | 0.466*** [0.039] | -27.07% | - | - | - |
| S - Other Service Activities | 0.779*** [0.064] | 0.597*** [0.054] | -23.36% | 0.237*** [0.026] | 0.118*** [0.020] | -50.21% |

Notes: CIT elasticity estimates in all panels are obtained using pre-2014 distributions of corporate tax liability and the histogram estimator from Eq. (7). Bootstrapped standard errors are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE A.7 – Excess mass of companies at the minimum tax kinks in the tax liability distribution without tax carry-forwards, estimated annually**

| | Non-VAT-registered, turnover below €500,000 | | VAT registered, turnover below €500,000 | | Turnover above €500,000 | |
|---|---|---|---|---|---|---|
| Year | Estimated Excess Mass | SE | Estimated Excess Mass | SE | Estimated Excess Mass | SE |
| 2015 | 27.739*** | [1.579] | 12.425*** | [0.748] | 6.027*** | [0.795] |
| 2016 | 25.199*** | [1.277] | 11.016*** | [0.647] | 6.333*** | [0.983] |
| 2017 | 20.685*** | [1.114] | 10.472*** | [0.594] | 4.638*** | [0.844] |
| 2018 | 1.944 | [1.464] | 1.099 | [0.736] | 1.532 | [1.508] |

Notes: The table reports estimates of the excess mass of companies relative to their average density at the minimum tax kinks in tax distribution without carry-forwards. The estimates were obtained using Eq. (2). The excluded areas around kinks are as in Table 4. The order of the polynomial is always eight. Bootstrapped standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE A.8 – Loss Carry-over Provisions in 2015: Country comparison (OECD, 2018a)**

| Country | Carry-Forward | Carry-Back | Limit to Deductibility of Tax Losses |
|---|---|---|---|
| Australia | Unlimited | 0 | |
| Austria | Unlimited | 0 | Reduction of max. 75% of taxable income per year |
| Belgium | Unlimited | 0 | |
| Canada | 20 | 3 | |
| Chile | Unlimited | Unlimited | |
| Costa Rica | 3 | 0 | (1) |
| Czech Republic | 5 | 0 | |
| Denmark | Unlimited | 0 | |
| Finland | 10 | 0 | |
| France | Unlimited | 1 | Deductions above €1 million are restricted to 50% of taxable income per year |
| Germany | Unlimited | 1 | Deductions above €1 million are restricted to 60% of taxable income per year |
| Greece | 5 | 0 | |
| Hungary | 5 | 0 | Reduction of max. 50% of taxable income per year (2) |
| Iceland | 10 | 0 | |
| Ireland | Unlimited | 1 | |
| Israel | Unlimited | 0 | |
| Italy | Unlimited | 0 | Max. 80% of taxable income (100% for losses referring to the first 3 years) (3) |
| Japan | 10 | 0 | (4) |
| Luxembourg | Unlimited | 0 | |
| Mexico | 10 | 0 | |
| Netherlands | 9 | 1 | |
| Norway | Unlimited | 0 | |
| Poland | 5 | 0 | Max. 50% of accumulated tax losses per year |
| Portugal | 12 | 0 | Reduction of max. 70% of taxable income per year |
| Singapore | Unlimited | 1 | |
| Slovak Republic | 4 | 0 | Max. 25% of accumulated tax losses per year |
| Slovenia | Unlimited | 0 | Reduction of max. 50% of taxable income per year |
| South Africa | Unlimited | 0 | |
| Spain | Unlimited | 0 | Max. 60% (2016) and 70% (2017+) of the taxable base before the capitalization reserve per year (5) |
| Sweden | Unlimited | 0 | (6) |
| Switzerland | 7 | 0 | |
| Turkey | 5 | 0 | |
| UK | Unlimited | 1 | |
| USA | 20 | 2 | |

Notes: (1) In Costa Rica, carry-forwards are limited to 3 years for industrial and 5 years for agricultural companies. (2) In Hungary, taxpayers operating in the agricultural sector may deduct the amount of the deferred loss from the pre-tax profit of the preceding two tax years; however, the deduction cannot exceed 30% of the taxable income of the respective tax year. (3) In Italy, net operating losses can be carried forward for an unlimited number of years up to 80% of the corporate taxable income in the tax period of utilization of the losses (100% if losses are referred to the first three years of business and

relate to a new production activity). (4) In Japan, tax loss related deductions of large companies are restricted to 65% of taxable income in 2016, this limit is further reduced to 50% starting from fiscal year 2017. (5) In Spain, deductibility of tax losses is limited to a maximum of 60% (2016) and 70% (2017+) of the taxable base before the capitalization reserve provided for in Article 25 of the Corporate Income Tax Law and before offsetting any negative tax bases. Recently, in the case of large companies, Royal Decree Law 3/2016, of 2nd December, as regards taxable periods beginning from 1st January 2016, reduced the upper limits to offset negative tax bases as follows: (i) The limit shall be 50% where in the 12 previous months, at the beginning of the taxable year, the net turnover is at least € 20 million, but less than €60 million; (ii) the limit shall be 25% where in the 12 previous months, at the beginning of the taxable year, the net turnover is at least €60 million. (6) In Sweden the tax allocation reserve allows firms to put up to 25 per cent of pre-tax income into an untaxed reserve for up to six years. The funds from the tax allocation reserve can be used to quit against losses that occur in a later year. The tax allocation reserve thus allows some carry-back of losses.

**Abstrakt**

S využitím administrativních dat z formulářů daňových přiznání právnických osob prokazujeme, že veřejné politiky, které umožňují přesouvání zdanitelných příjmů v čase, vedou k nadhodnocenému odhadu daňové elasticity příjmu. Naše identifikační strategie využívá zlomy v daňových sazbách a daňovou reformu, která zavedla možnost přenosu daňové povinnosti do následujících let. Kdybychom nezohlednili tuto možnost přesunů zdanitelných příjmů, odhadli bychom elasticitu zdanitelného příjmu až na úrovni 0,65, což by indikovalo vysoce citlivý základ daně vzhledem k změnám v mezní sazbě. Když ale upravíme metodu odhadu o možnost přesunu příjmů v čase, odhadnutá elasticita se sníží až o 21,2-49,1%. Tato korekce vede taky k významnému snížení odhadu mezního nadměrného břemena daně z příjmů právnických osob.

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