Gross Profit Taxation Versus Distributed Profit Taxation and Firm Performance: Effects of Estonia's Corporate Income Tax Reform

Jaan Masso, Jaanika Meriküll, Priit Vahter

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Abstract

This paper estimates the effect of the corporate tax reform in Estonia in the year 2000. This unique reform nullified the taxation of retained earnings and retained the corporate income tax only on distributed profits. The effect of the reform is identified by comparing the performance of Estonian firms that were affected with that of firms from Latvia and Lithuania, the two other Baltic states. We use firm-level financial data and the difference in differences and propensity score matching methods for our analysis. The results show that the corporate tax reform has resulted in increased holdings of liquid assets and lower use of debt financing. These developments have contributed positively to firms' survival during the recent global economic crisis. A positive effect on investment and labour productivity has also been found.

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Non-technical summary

Corporate income tax rates and their linkages with economic performance have received continuous attention in both academic literature and policy debates. Corporate profit taxation systems are undergoing continuous change internationally, characterised by a lowering of tax rates as a result of international tax competition coupled with a widening of the tax base. The studies have either looked at the variation in tax rates across countries or within a country following specific reform events to investigate the effects on international profit shifting from countries with high tax rates to those with low tax rates and on debt shifting, and the effect on investment and productivity.

The Estonian corporate income tax system introduced in the year 2000 is unique among the different taxation schemes. The reform completely abandoned the taxation of retained earnings and retained only the taxation of distributed profits, mostly dividends. In other words, the taxation of profits was postponed until the moment of distribution. A few previous studies have tried to estimate the economic effects of such reforms, either on economic growth through capital accumulation or on firms' capital structure choices and liquidity.

In this study we estimate the effect of the reform on Estonian firms' economic performance. In doing this we investigate the effects on the choice of capital structure, liquidity, investment in fixed assets and labour productivity. Because the reform changed the taxation framework for all Estonian firms, we turned to the two other Baltic States, Latvia and Lithuania, to find an appropriate control group of firms that were not subject to the reform. The three Baltic States share similar historical backgrounds, similar institutional circumstances, including the tax burden and the structure of tax income in terms of labour and capital taxation, and highly correlated business cycles. Thus we think the Latvian and Lithuanian companies form an appropriate control group for the Estonian firms. For the analysis we use the firm-level data for 1996–2009 from the international database Amadeus and the Estonian and Latvian commercial registers.

The study shows convincingly that the dynamics of several economic indicators changed in Estonia after the reform in comparison to those of Latvia and Lithuania. As a result of the reform, the share of debt in total assets decreased by about seven percentage points, despite firms' improved access to bank loans and favourable interest rates. The effect was stronger for small firms, which fits with the fact that small firms found it more difficult to access funding from outside the company in this period. While the major intention of the reform was to increase investment, according to our estimations it also led to an accumulation of liquid assets as cash and equivalents. While

higher levels of liquid assets may mean lower productive efficiency, we also found evidence that during the recent crisis in 2009 these high levels have contributed to firms' survival and to lower levels of non-performing bank loans. At the same time, also the achieved relatively lower debt financing of Estonia's firms has contributed to the firms' survival during the crisis. The reform also demonstrated positive effects on economic growth through its positive effect on investment and labour productivity, which was strongest in the services sector and among smaller companies.

While in conclusion the estimated effects of the reform were mostly positive and thereby promote consideration of the introduction of the Estonian profit taxation system elsewhere, we need to keep in mind that the study was undertaken in particular conditions and additional investigations are needed for consideration of the application of a similar profit taxation scheme in other economies. These particular conditions include a fast-growing economy, a financial system that relies on bank lending, an absence of restrictions on international capital flows and a high penetration of foreign-owned companies. However, this reform experiment in Estonia suggests that countries with similar backgrounds, characterised by high marginal returns of capital and credit-constrained small domestic firms, could significantly aid investment and long-term growth by lowering the taxation of firms' retained earnings.

Contents

1. Introduction

Corporate income tax rates and their linkages with economic performance have received continuous attention in both academic literature and policy debates. International tax competition has generally reduced the taxation of capital, which is a relatively mobile production factor, at the expense of labour, a relatively immobile production factor (Devereux et al., 2002). Falling statutory corporate income tax rates have been coupled with a widening of the tax base. Several studies have endeavoured to use these reforms to study the effect of taxes on international profit shifting (see, for example, the meta-analysis by De Mooij and Ederveen, 2008), debt shifting (for example, Egger et al., 2010), and investment and productivity (Vartia, 2008; Schwellnus and Arnold, 2008).

In this paper we estimate the effect of the Estonian corporate income tax reform of the year 2000 on the capital structure, liquidity, investment, and productivity of firms. In other words, we estimate the effect of a tax reform that shifted corporate income taxation from gross profit taxation to distributed profits taxation. The reform of 2000 introduced a system that was unique in the world, as the reform meant that firms' profits are taxed only if they are distributed to shareholders in the form of dividends, while retained earnings are untaxed. Unlike under the previous system, taxation is postponed until the moment of profit distribution.[1] This marks a difference from the trend in most countries, because the reform narrowed the tax base and left the tax rate at a relatively high level. As the law was adopted on 15 December 1999 and came into force immediately from 1 January 2000 we can assume that there was no anticipation effect because the notice period was so short and that the stimuli for changes in the behaviour of firms started in 2000, not earlier.

The government authorities expected the reform to promote investment, create new jobs and promote entrepreneurship (according to the survey of policy-makers, see Masso, Meriküll and Vahter, 2010). However, related literature shows that several additional consequences are possible, and we aim to evaluate these in our study. In addition to cross-country studies (for example, Schwellnus and Arnold, 2008), empirical investigations have also looked at the impacts of tax reforms (for example, Kari et al., 2009) on firms. The advantage of our study is the focus on the impact of quite a big change in the tax rates: the statutory tax rate on retained earnings dropped from 26% to 0% and the average implicit tax rate fell from the average 1996–1999 level of

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[1] To be more exact, until 2000 firms paying dividends paid income tax of 26/74 of the dividends paid out, but this tax could be deducted from the taxes on profits (a method similar to the imputation system). Since 2000 firms need to pay taxes only on dividends, expenses not related to commercial activities and hidden profit payouts.

10% to 5% in 2000–2006 (see European Commission, 2010 for the statistics on implicit tax rates). One earlier tax reform that was quite similar was a reform introduced in Chile in 1984 that sharply reduced the taxation of retained earnings especially, from 46% down to 10% for public companies (Hsieh and Parker, 2007). Following the argumentation of Hsieh and Parker (2007), we would expect the reform to have an especially strong effect in an economy characterised by financially constrained firms whose investments are heavily dependent on the availability of internal funding from cash flows, as was also the case in Estonia in the period under consideration (Mickiewicz et al., 2004; Masso, 2002).

We estimate the effects of the Estonian tax reform by difference in differences analysis, using the firms of the two other Baltic states, Latvia and Lithuania, as the control group for the Estonian companies[2]. The three countries have very similar historical backgrounds as all regained independence in 1991 after the dissolution of the Soviet Union and joined the EU in 2004, similar economic problems, and highly correlated business cycles, for example all three were affected seriously by the Russian economic crisis in 1999, saw rapid growth in 2001–2007 and were hit hard by the most recent global crisis in 2008–2009. This means that firms from Latvia and Lithuania should constitute an appropriate control group for Estonian companies for an estimation of the impact of the corporate income tax reform of 2000. In addition to the difference in differences analysis, the propensity score matching approach is also used to ensure the robustness of the estimated effects. We construct our firm-level database from three sources: the international firm-level database Amadeus (2000 and 2009 updates), the Estonian Commercial Register and the Latvian Commercial Register. We calculate the indicators from the firms' annual reports. While the literature has concentrated more on the effect on investment and productivity, we also look into the effects on capital structure decisions and liquidity. The effect on capital structure or dividend payments could be expected to occur relatively quickly after the reform, while the effects on investments and productivity may take longer to materialise. Hence, an estimation of the effects of the tax reform is based on two estimation periods, 1996–2003 and 1996–2008.

It is noticeable that although the system of non-taxation of undistributed profits has so far been introduced only in Macedonia in 2008 in addition to

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[2] In technical terms, the effect of the tax system is regarded as the after-tax change in the behaviour of the group of affected companies in comparison to the companies in the control group that can not be explained by the differences in the explanatory variables or general business cycles or time trends. Thus it needs to be considered that the impact of the tax system may also include other factors that changed at the time of the reform, but that could not be included in the analysis as explanatory variables. See also the section on methodology.

Estonia, it has still attracted a lot of attention from researchers. Funke (2002) and Funke and Strulik (2006) found, using a theoretical dynamic general equilibrium model of economic growth, that although the tax reform of 2000 led to higher capital accumulation and per capita GDP, welfare may have decreased due to the short-term reduction in private consumption. The theoretical modelling by Azacis and Gillman (2010) showed that the welfare of society would have increased more if the taxation of capital and labour had been more balanced. Hazak (2009) found from an empirical analysis of Estonian firm-level data, without a control group, that the tax reform increased the share of retained earnings in total assets, but that it also increased liquid assets as cash and equivalents, showing that firms still need to direct their undistributed profits to investments. A report from the OECD (2009) argued that the Estonian system of tax exemption for retained earnings may reduce the economy's ability to restructure, as it may motivate firms to keep their funds in the ongoing business instead of investing them in new growing areas. However, surveys of firms do not indicate that this is a noticeable problem (Masso et al., 2010). Other interviews with financial managers (Sander, 2003; Sander and Trumm, 2006) have indicated that corporate income tax plays only a modest role in the investment decisions of Estonia's companies, but that it is more important for profit distribution decisions.

The rest of the paper is structured as follows. Section 2 presents the data used in the empirical analysis together with some preliminary analysis. Section 3 presents our econometric methodology and how the impact of the tax reform has been identified. Section 4 presents the results of the econometric analysis by the indicators analysed, capital structure and liquidity, and investment and productivity, and provides some robustness checks. The final section concludes and covers policy implications.

2. Data

We construct a firm-level dataset of the Baltic states using information from three data sources. Data for the treatment group of Estonian firms are extracted from the Estonian Commercial Register for the earlier period of analysis until 2000 and from the Amadeus data from Bureau van Dijk for the later period. The data on the control group of Latvian and Lithuanian firms originates from the Amadeus database of Bureau van Dijk using the 2000 and 2009 updates, and is complemented by data from the Latvian Commercial Register for the earlier time period of the analysis. The Amadeus data were complemented by data from the Commercial Registers of the Baltic states, as the Amadeus data update for 2000 contains many missing observations for the variables needed for our analysis and covers only a limited number of companies from the Baltic states.

Table 1 provides an overview of the sources and the coverage of the data-set we constructed. The dataset covers a random sample of manufacturing companies and business services companies. The construction sector, public services, agriculture, mining and the energy sector are excluded. The main period of analysis is from 1996–2003. The choice of the period of analysis is driven by data availability and by the major institutional change in 2004 when the Baltic states joined the EU. The effect of EU enlargement on the national economies was naturally non-negligible and was probably idiosyncratic across countries. The data issues include a jump in the coverage of Latvian firms in the Amadeus data from 2004 and in the coverage of Lithuanian firms from 2007. This widened coverage reduces the average firm size in the samples as the sample widens mostly due to the improved coverage of small firms. We seek to control for the impact of this widening of the sample on our difference in differences estimates by using fixed effects estimation and by controlling for firm size. The main sample that covers 1996–2003, covers on average more than 40% of Estonian firms, almost 10% of Latvian firms and 3% of Lithuanian firms in the industries studied. We also investigate the effect of the tax reform over the longer period of 1996–2008. Over this time-span our dataset covers almost 50% of Estonian firms, more than 30% of Latvian firms and 10% of Lithuanian firms.

Table 1: Data sources for the analysis*, 1996–2008

	Estonia			Latvia			Lithuania	
	Commercial Register	Amadeus	Sample as share of population	Commercial Register	Amadeus	Sample as share of population	Amadeus	Sample as share of population
1996	4775	0	24.6%	713	406	4.30%	412	1.30%
1997	7716	375	36.6%	1056	656	6.50%	361	0.90%
1998	9988	448	47.9%	1591	717	7.90%	181	0.40%
1999	0	10 972	41.1%	1959	1533	11.20%	941	1.90%
2000	0	12 437	49.7%	2013	1652	10.60%	1075	2.10%
2001	0	12 392	46.0%	2032	2104	12.40%	1288	2.40%
2002	0	14 555	51.4%	1837	2723	9.70%	2618	4.90%
2003	0	16 435	54.4%	1980	3629	11.00%	3918	8.60%
2004	0	18 362	56.8%	2025	27 818	54.80%	4915	9.90%
2005	0	20 168	59.1%	0	35 900	62.40%	6872	7.20%
2006	0	22 406	59.0%	0	44 805	72.20%	8463	7.80%
2007	0	24 974	60.5%	0	52 871	81.50%	53 506	45.00%
2008	0	16 474	39.9%	0	44 525	68.60%	50 550	42.50%

Table contains only the companies for which at least the employment figure was available; the final number of companies in the regressions may vary from the numbers here due to additional controls and the exclusion of outliers.
Source: Amadeus dataset, Estonian Commercial Register, Latvian Commercial Register; total number of companies originates from Eurostat.

We start the overview of descriptive statistics by investigating the dynamics of the firm performance indicators in the aggregated statistics. Figure 1 presents Estonian, Latvian and Lithuanian firms' aggregate loans to assets and cash to assets ratios from the national statistics, and investment and productivity from Eurostat. Aggregated figures reveal that the introduction of Estonia's corporate tax reform in 2000 coincided with an increase in the cash to assets ratio and a drop in the liabilities to assets ratio. For comparison, Hsieh and Parker (2006) found similarly that the debt to assets ratio fell after the similar Chilean tax reform in 1984–1986. Investments and labour productivity were increasing throughout the period and it is difficult to detect any difference in the trends from before and after the tax reform. Regarding the similarity of trends in these indicators across countries and before the tax reform, all the indicators except for the liabilities to assets ratio showed similar trends. Considering that we use difference in differences estimation in our paper, the similarity of the trends is an important feature that strengthens our methodological approach. It must be remembered that the income tax system is expected to have a direct effect on firms' capital structure and liquidity, while the effect on investments and especially on productivity is more indirect. The argument is that while the tax rates are directly related to the average cost of capital and thereby to the optimal capital structure, investments and productivity are also dependent on many other variables, such as the presence of profitable investment opportunities.

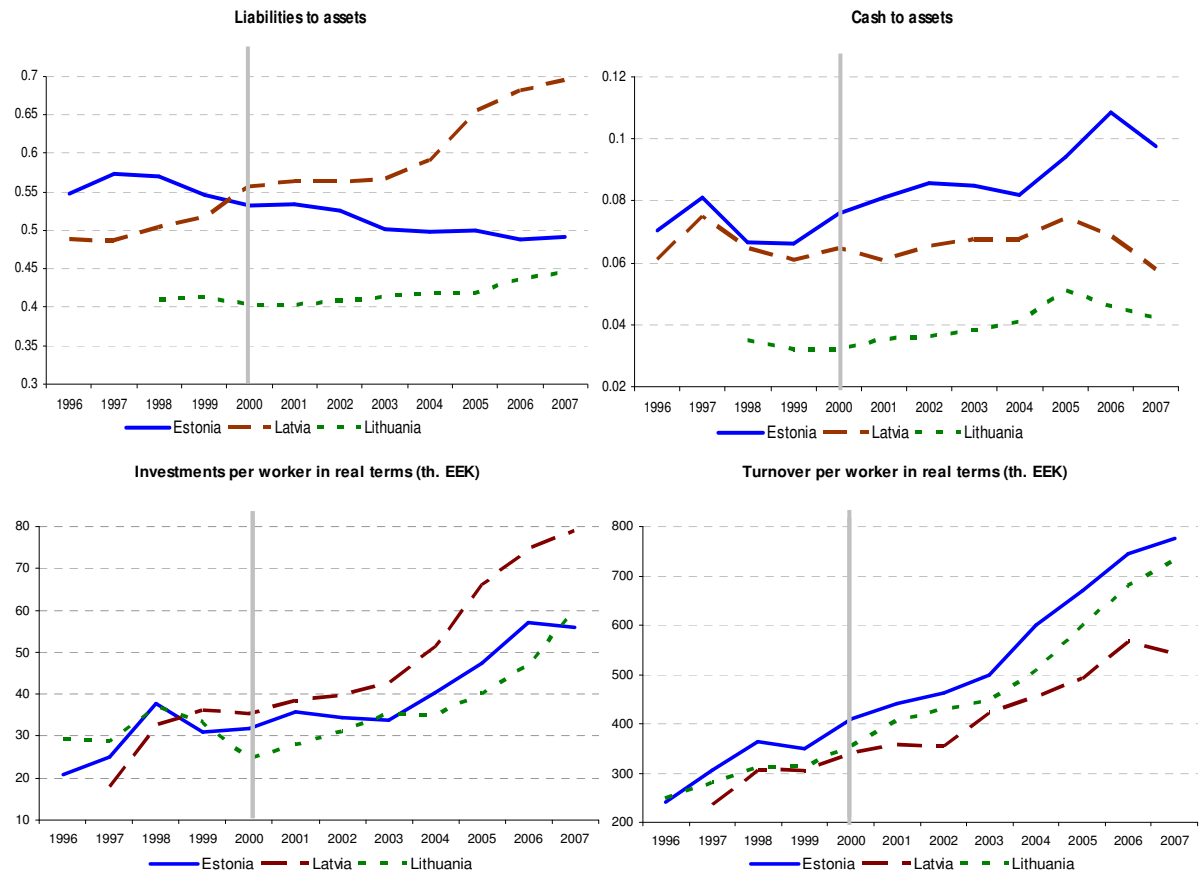Figure 1: Capital structure, liquid assets, investments and productivity in Estonia, Latvia and Lithuania during 1996–2007

Source: Liabilities to assets and cash to assets originate from the websites on business statistics from the statistical offices of individual countries. Investments and productivity are from Eurostat's structural business statistics, deflated by the GDP deflator from Eurostat national accounts.

The descriptive statistics of our constructed dataset are presented in Table 2. All the monetary variables are presented in thousands of Estonian *kroons* (EEK, 1EEK=0.064EUR) and deflated by the GDP deflator at the one-digit NACE level. All three countries maintained a fixed exchange rate over the period studied, though there have been small adjustments in the bilateral exchange rates of the three Baltic states and the data of Latvian and Lithuanian firms are converted into thousands of EEK using the yearly average exchange rate. We remove observations with extreme values for the variables from the dataset by retracting observations with a debt ratio, loans to assets ratio or cash stock below 0 or over 1 and retained earnings observations below -1 or over 1; we further exclude observations in the lowest 5% and the highest 5% of values for the investment variables and the lowest 1% and the highest 1% of values for the productivity growth rate. Investments were cleaned from outliers so extensively because the data were rather noisy.

Table 2: Definition of the variables and descriptive statistics, thousands of EEK, 1996–2008

Variable name	Definition	Average	Standard deviation	Minimum	Maximum	Number of obser- vations
Debt ratio	Liabilities to total assets	0.49	0.31	0	1	321 160
Loans to assets	The ratio of loans to total assets	0.18	0.25	0	1	315 094
Cash stock	Cash and equivalents to total assets	0.22	0.28	0	1	377 093
Retained earnings	Ratio of retained earnings and reserves to total assets	0.24	0.35	–1	1	369 306
Investment growth[1]	Growth rate of tangible fixed assets [2]	–0.63	3.00	–16.6	11.0	194 663
Investment rate[1]	Ratio of investments to the stock of tangible fixed assets	0.195	0.39	–0.75	1	98 216
Labour productivity growth[3]	Growth rate of labour productivity	0.24	1.07	–0.88	12.14	334 413
Firm size	Logarithm of number of employees	1.59	1.29	0	9.916	555 094

Notes: [1] *Indicates that observations in the lowest 5% and the highest 5% of values are excluded from the analysis.*
[2] *Investment calculation is based on tangible fixed assets and does not take into account amortisation as the data on the amortisation of control group firms was not available.*
[3] *Indicates that observations in the lowest 1% and the highest 1% of values are excluded from the analysis.*

Source: Amadeus, Estonian Commercial Register and Latvian Commercial Register firm level data.

3. Methodology

3.1. Difference in differences (DID) analysis

This paper uses difference in differences (DID) analysis and matching methods to estimate the effects of the tax reform of 2000 in Estonia. The DID approach has been used as a baseline approach and matching method to give a robustness test. A similar DID approach is used to study the effect of corporate income tax reform by, for example, Kari et al. (2008, 2009) and Sivadasan and Slemrod (2008)[3].

The introduction of the reform had minimal anticipation effect since it was approved by the parliament of Estonia on 15 December 1999 and enforced on 1 January 2000. The law affected all Estonian firms similarly and simultaneously, although wide tax exemptions for investment in physical capital were previously available in regions outside the capital area. Even so, the pre-2000 tax system was a traditional gross profit taxation system with a tax rate of 26% and some regional exemptions, while the post-2000 tax system introduced identical redistributed profit taxation with a uniform rate of 26%. The tax rate was reduced by a few percentage points in later years, reaching 21% in 2008.

The simultaneous change for all firms makes it difficult to identify the effect of tax reform on firm performance as we have no control group left within the country to control for the developments that would have taken place anyway without the reform. We use a control group of Latvian and Lithuanian firms for this purpose. Latvia and Lithuania are the closest countries to Estonia in many terms, as they have similar historical backgrounds, similar institutional framework such as flat tax rates and a currency board, similar trade patterns, highly correlated business cycles, close geographical proximity and economies of a similar size. Latvian and Lithuanian firms make the closest possible match for Estonian firms, providing valuable material evidence for how Estonian firms would have performed if they had not faced a distributed profit taxation system. Hence, we construct our analysis on the basis that the treatment group consists of Estonian firms and the control group of Latvian and Lithuanian firms. We estimate the following standard version of the difference in differences regression model with firm fixed effects:

$$Y_{it} = \alpha_i + \gamma(Country_{EE} \times Post_{2000}) + \sum_{i=1}^{k} \beta_k X_k + \tau_t + \varepsilon_{it} , \qquad (1)$$

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[3] See e.g. Blundell and Costa Dias (2000) for a discussion of the methodologies for evaluating the impact of a policy reform.

where t indicates time, $t=1996, …, 2008$ (the main period of analysis is 1996–2003, the alternative period of analysis is 1996–2008); i indicates firms and Y_t is the dependent variable (either cash stock, debt ratio, retained earnings, investments, or labour productivity); α_i captures the firm-specific fixed effect over the time-span; X_k denotes other control variables (number of employees, tax rates) and τ_t denotes the time dummies, which control for the similar business cycle across countries. $Country_{EE}$ is a dummy variable with a value 1 for Estonian and 0 for Latvian and Lithuanian companies. $Post2000$ is a dummy variable with a value 0 before the reform in 2000 and 1 after the year of the tax reform in 2000. The coefficient γ captures the treatment effect and provides an estimate for the impact of the reform. ε_{it} is a error term with conventional properties.

Thus we consider the post-reform effect of the tax system as the post-reform change in the group of the affected, or Estonian, companies in comparison to the control group of Latvian, and Lithuanian companies that cannot be explained by the differences in explanatory variables or the general business cycle in time trends. However, it needs to be considered that the effect of the tax reform may also include other factors that changed at the time of the reform, but which we were not able to include in the analysis as explanatory variables. As was demonstrated in the previous data section, the trends in dependent variables other than the debt ratio were quite similar during the pre-reform period. This provides some assurance for our chosen approach for studying the effects. In addition, the firm-level fixed effects take into account all state, sector and firm-level factors such as management that are constant during the period studied, while the year dummies control for trends in variables, the general business cycle and technological change.

3.2. Propensity score matching

A central issue in the analysis of causal effects of policy changes is how to construct a suitable proxy for the unobserved counterfactual: how to find a suitable control group for the treatment group affected by the policy change. The control group needs to be as similar as possible to the treatment group in terms of its pre-treatment characteristics and structure (see, for example, Angrist and Pischke, 2009; Caliendo and Kopeinig, 2005). In the ideal case, with random assignment into treatment, the dynamics of productivity, investment and the other variables of the control group would show us how these variables would have evolved over time for the treatment group if there had been no policy change, or no treatment. That is, we would use data from the firms in the control group to observe how the relevant variables would have changed for firms in Estonia in the absence of the tax reform.

A standard comparison of the dynamics of Estonia's investments and productivity and the capital structure of firms after the tax reform of 2000 with the same indicators from Latvia, Lithuania or some other country would not necessarily show us the effects of the tax reform. It is possible that even without the tax reform the productivity and investments of Estonia's firms would have grown faster than elsewhere due to a variety of other determinants of productivity growth. A simple comparison of indicators within Estonia from before and after tax reform may equally not show us the causal effect of the tax reform. During the period studied a myriad of other factors could have affected these indicators in Estonia. Therefore, it is difficult to argue the presence of casual effects of the tax reform based on the time series data from Estonia alone.

One way to try to identify the effects of the tax reform is to use a matching approach to build a control group of firms that is as similar as possible to the firms in Estonia in their pre-tax reform, or pre-2000, characteristics. Assuming that such a control group can be built, and further assuming that the relevant variables of the control and treatment groups of firms would have followed the same trends over time in the absence of the tax reform, the after-tax reform differences between these two groups could be used to estimate the causal effects of the tax reform. However, even in this set-up it is difficult to identify the effects in the long term. As was pointed out earlier, a lot of changes took place in Estonia after 2000, and therefore, obviously, not all of the productivity or investment changes after 2000 compared to Latvia and Lithuania should be attributed solely to the tax reform. Thus, caution is advised when interpreting the differences of the treatment and potential control groups. The difference in differences and matching analyses yield more reliable results in shorter time periods after the policy change than in longer periods. In the difference in differences analysis we assume that the overall sample of Latvia's or Lithuania's firms provides a suitable control group. The matching analysis tests the robustness of this approach. Instead of using the whole sample of firms in Latvia and Lithuania as controls, it constructs a control group that is as similar to Estonian firms as possible during the pre-treatment year.

The most suitable way to create a control group is to use either covariate matching or propensity score matching (Caliendo and Kopeinig, 2005) to construct the control group from the pool of potential controls. Matching methods have, for example, previously been applied to study the effects of corporate tax reform in Kari et al. (2008, 2009). For covariate matching, the control group is built using the pre-treatment similarities of a potentially large number of different variables from the firms in the treatment and control groups. A more widely used alternative is propensity score matching (Leuven and Sianesi, 2003; Caliendo and Kopeinig, 2005). Rather than using

a number of different variables, the matching of treatment group firms with their counterparts from the pool of potential control units is based on a single variable, the propensity of a firm to belong to the treatment group. This variable is constructed by estimating the treatment probability for firms from both the treatment and control groups using a probit or logit model or multinomial models (Caliendo and Kopeinig, 2005).

From this probit or logit model the large number of different characteristics of the firm are combined into one, the propensity to undergo treatment and to be affected by the policy change. In our case, this variable would show the probability of the firm being affected by the tax reform. In this paper we build a proxy of the unobserved counterfactual of the tax reform by using a probit model to estimate the probability of a firm being affected by the tax reform, using data from both Estonian firms and firms from Latvia and Lithuania, countries with traditionally similar economic fundamental indicators but which did not implement a similar reform in 2000.

In order to build a control group, we use data from Latvian or Lithuanian firms for which we have productivity, investment, capital structure and other firm level indicators available from the firm level dataset we created. As predictors of the firms' propensity to be affected by the tax reform we use the following data from 1999: productivity, firm size, firm age, investment rate, business sector of the firm, ratio of loan capital to total assets, ratio of cash to assets. The propensity to be affected by the tax reform is estimated using a probit model. Instead of a number of variables, one single indicator, the propensity score, can now be used to match Estonian firms with similar firms from the overall pool of Latvian and Lithuanian firms. After we have matched each Estonian firm in our analysis with three or five similar firms from Latvia or Lithuania by using nearest-neighbour matching, we can calculate the average treatment effect on treated (ATT), as the average of the difference in the variable under consideration after 2000 between the treated group and the constructed control group. The variables compared between the treatment and control groups are indicators of capital structure, liquidity, productivity, and investment rate.

The effects of the reform (*ATT*) for each matched pair can be written in equation form as follows:

$$ ATT = E\big[Y(1)\big|T=1\big] - E\big[Y(0)\big|T=1\big] , \qquad (2) $$

where the first term on the right-hand side of the equation shows the observed indicator for an Estonian firm in the post-treatment period (*T=1*), and the second term shows the proxy for the unobserved state at time *T=1* if Estonia had not implemented the tax reform in 2000.

Technical application of propensity score matching is implemented in Stata with the command *psmatch2* (Leuven and Sianesi, 2003). We use both the *nearest neighbour* and *kernel* algorithms to implement propensity score matching. For *nearest neighbour* matching each Estonian firm's indicators are compared with the three or five Latvian or Lithuanian firms that were most similar to the Estonian firm in their characteristics in 2000. For *kernel* matching the control for each treated unit is built as a weighted average of all the potential members of the control group.

4. Results

4.1. The effect of the tax reform on capital structure and liquidity

The following analysis uses regression models with firm-level fixed effects that are estimated using the merged panel data on Estonian, Latvian and Lithuanian companies. As explained earlier, the effect of the corporate income tax reform is identified using the difference in differences approach. The main sample period studied is 1996–2003, but we also investigated the impact of the reform over the longer period 1996–2008. The main results were, however, similar for both time periods. Of course, over the longer period the effect of the reform is somewhat stronger. See the estimations for the longer sample in Appendix 1.

In the regression models, the central variable considering the impact of income tax reform on Estonian firms compared to Latvian and Lithuanian ones is "$Country_{EE} \times Post_{2000}$", which equals 1 for Estonian firms since 2000, and 0 in all other cases. In order to ensure a sufficiently large number of observations in the regressions, we have limited the list of control variables to the firm-size indicators, using a natural log of the annual average number of employees, and to country level tax rates. Adding several other control variables would reduce significantly the number of observations due to quality problems with the Latvian and Lithuanian data, especially in the pre-reform period.

The descriptive statistics of liquidity and capital structure indicate that since 2000 the variables have exhibited different dynamics in Estonia from those in Latvia and Lithuania. While the share of debt financing was relatively stable in Estonia until 1999, since 2000 it has fallen considerably, as shown in Figure 1. Since 2000 Latvia and Lithuania have experienced exactly the opposite trend to Estonia, with the share of liabilities increasing and the share of equity decreasing. The fall in the use of debt financing in Estonia is even more remarkable given that firms had improved access to credit in con-

ditions of high growth in aggregate credit supply, falling interest rates and heavy competition between commercial banks (see Brixiova, Vartia and Worgotter, 2009).

Similarly, the dynamics of the liquidity indicator, the ratio of cash and equivalents to the balance sheet, have been quite different in Estonia. While the aggregate liquidity of firms in Latvia and Lithuania has been around 6% and 3% respectively throughout the studied period, in Estonia it grew from 6.6% in 1999 to 7.6% in 2000 and 10.9% in 2006. In the literature the level of liquidity has been used to test for the existence of financing or liquidity constraints, as a high correlation between investments and liquidity might indicate that firms face difficulties in raising funding from outside the firm by issuing debt or equity. Thus credit constrained firms accumulate liquidity in order to be able to take advantage of upcoming good opportunities for investment, a policy known as precautionary saving. The improved access to external finance in the period under consideration supports the hypothesis that the increased liquidity is due to the income tax reform. On the other hand higher liquidity could also be associated with lower operating efficiency among firms, because a company is not able to profit from its investment opportunities. This could also be one argument in favour of the proposition raised in OECD (2009) that the income tax reform of 2000 has aggravated reallocation and forced capital to stay in its current area of activity.

The following Tables 3–6 report the results of the regression analysis for the effect on capital structure, retained earnings and liquidity. Generally, the results from the regression analysis confirm the trends seen in the descriptive statistics. The effect of the corporate income tax reform has been estimated separately for manufacturing and services sector companies, and for small and large firms.

The effect of the tax reform on the share of liabilities in total assets is statistically and economically significant during the period 2000–2003. The share of liabilities in total assets fell in Estonia after the income tax reform by an average of 7 percentage points and the effects have been 1 percentage point larger among manufacturing companies (see Table 3). The share of loans has fallen by an average of 7.6 percentage points (Table 4). Liquidity, or liquid assets to total assets, has increased by an average of 2–3 percentage points and the effect has been almost twice as large for small firms with less than 10 employees (Table 5). The share of retained earnings and reserves has increased by 11 percentage points and once again the impact is less noticeable among larger companies (Table 6). In particular, no major impacts of the reform are noticeable in terms of liquidity and retained earnings among firms with more than 250 employees.

Table 3: The effect of the income tax reform on the ratio of liabilities to total assets, Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
Country$_{EE}$×Post$_{2000}$	–0.074***	–0.082***	–0.071***	–0.091***	–0.060***	–0.069***	–0.032
	(0.005)	(0.010)	(0.006)	(0.014)	(0.008)	(0.014)	(0.026)
Log(employment)	0.028***	0.019***	0.030***	0.031***	0.010	0.025*	0.015
	(0.003)	(0.006)	(0.003)	(0.005)	(0.009)	(0.014)	(0.019)
Log(tax rate)	–0.106***	–0.101***	–0.105***	–0.081***	–0.093***	–0.067***	–0.049
	(0.010)	(0.020)	(0.012)	(0.030)	(0.017)	(0.023)	(0.045)
Number of observations	83 841	18 654	65 187	49 104	23 497	8 886	2 353
Number of firms	26 459	5 543	20 916	17 964	8 910	2 936	605
F-stat (p-value)	152.57	34.12	120.17	98.04	35.84	6.54	1.14
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.122)
Within-group R^2	0.071	0.070	0.072	0.074	0.080	0.038	0.011

Note: Fixed effects model, standard errors corrected for heteroscedasticity are reported in the parenthesis. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

Table 4: The effect of the income tax reform on orientation to loan capital as loans/total assets ratio, Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
$Country_{EE} \times Post_{2000}$	−0.076***	−0.064***	−0.080***	−0.068***	−0.055***	−0.079***	−0.072***
	(0.005)	(0.010)	(0.006)	(0.013)	(0.009)	(0.013)	(0.023)
Log(employment)	0.011***	0.008	0.012***	0.011***	0.012	0.032**	−0.010
	(0.003)	(0.005)	(0.003)	(0.004)	(0.008)	(0.014)	(0.015)
Log(tax rate)	−0.040***	−0.021	−0.048***	−0.026	−0.053***	−0.007	0.078**
	(0.009)	(0.016)	(0.011)	(0.027)	(0.016)	(0.022)	(0.034)
Number of observations	83 841	18 654	65 187	49 104	23 497	8 886	2 353
Number of firms	26 459	5 543	20 916	17 964	8 910	2 936	605
F-stat (p-value)	180.37	35.22	146.62	119.19	32.22	7.37	2.54
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Within-group R^2	0.058	0.043	0.063	0.078	0.043	0.032	0.033

*Note: Fixed effects model, standard errors corrected for heteroscedasticity are reported in the parenthesis. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

Table 5: The effect of the income tax reform on liquidity as the ratio of cash and equivalents to total assets, Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
$Country_{EE} \times Post_{2000}$	0.021***	0.018***	0.022***	0.038***	0.020***	0.009	0.001
	(0.003)	(0.005)	(0.004)	(0.010)	(0.005)	(0.006)	(0.011)
Log(employment)	−0.025***	−0.021***	−0.026***	−0.034***	−0.020***	−0.010*	−0.011
	(0.002)	(0.004)	(0.003)	(0.004)	(0.005)	(0.005)	(0.008)
Log(tax rate)	0.016***	0.018*	0.016**	0.057**	0.011	0.001	0.020
	(0.006)	(0.009)	(0.008)	(0.025)	(0.009)	(0.010)	(0.017)
Number of observations	83 841	18 654	65 187	49 104	23 497	8 886	2 353
Number of firms	26 459	5 543	20 916	17 964	8 910	2 936	605
F-stat (p-value)	25.36	6.81	19.58	15.12	5.82	2.46	1.24
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.083)
Within-group R^2	0.010	0.011	0.010	0.010	0.008	0.008	0.013

*Note: Fixed effects model, standard errors corrected for heteroscedasticity are reported in the parenthesis. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: authors' calculations using data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

Table 6: The effect of the income tax reform on retained earnings as the ratio of retained earnings and reserves to total assets, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
Country$_{EE}$×Post$_{2000}$	0.111***	0.111***	0.112***	0.120***	0.093***	0.090***	0.017
	(0.005)	(0.010)	(0.006)	(0.014)	(0.009)	(0.014)	(0.028)
Log(employment)	0.014***	0.015**	0.014***	0.027***	0.017*	0.013	0.033
	(0.003)	(0.006)	(0.004)	(0.005)	(0.009)	(0.016)	(0.023)
Log(tax rate)	0.167***	0.152***	0.171***	0.125***	0.124***	0.079***	0.056
	(0.011)	(0.021)	(0.012)	(0.027)	(0.018)	(0.026)	(0.050)
Number of observations	83 841	18 654	65 187	49 104	23 497	8 886	2 353
Number of firms	26459	5 543	20 916	17 964	8 910	2 936	605
F-stat (p-value)	338.44	78.75	261.02	241.36	56.51	10.29	1.60
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)
Within-group R^2	0.148	0.151	0.147	0.179	0.118	0.055	0.023

*Note: Fixed effects model, standard errors corrected for heteroscedasticity are reported in the parenthesis. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

If we study the effects on liabilities over a longer time period, 2000–2008, then the estimated effects are somewhat larger than for the shorter time period (see also Appendix 1). For instance, due to the reform the share of liabilities in total assets was 12.8 percentage points lower in manufacturing and 10 percentage points lower in services during 2000–2008. A large effect over the longer time period was also found for other variables like loans/total assets, cash/assets and retained earnings/total capital.

The results point to a stronger effect from the reform on smaller companies[4]. The effect on the use of debt financing is especially strong among firms with up to 250 employees. The stronger effect on small firms' liabilities to assets and cash to assets ratios could be expected given the evidence from previous studies that the small firms in Estonia were especially subject to financing constraints (for example, Mickiewicz et al., 2004), and so the extra cash-flow due to the tax change should have affected their behaviour more. The only indicator where the reform had a stronger impact on large firms is the loans to assets ratio. While the tax reform of 2000 was correlated with a subsequent fall of 7.2% points in the loans to assets ratio of firms with more than 250 employees, this effect was up to 2 percentage points lower among smaller companies. Generally, among Estonian companies the use of loan capital increases with firm size.

The earlier study by Hazak (2009) estimated the linkage between the Estonian corporate income tax reform of 2000 and capital structure and dividend payouts using only the data from Estonian firms. Because of this, the study defined the effect of the reform simply as a shift in the average values of variables in Estonia since 2000 relative to their earlier values. The main criticism of this approach is that it does not show whether the estimated impact is due simply to the general trends in the variables studied or to the impact of other uncontrolled changes. Thus the approach taken in this study of comparing Estonian firms to Latvian and Lithuanian firms is more appropriate for identifying the effect of the reform. Additionally, we have also studied the effects across various sectors and firm-size classes. The results of our study, while different from those of Hazak (2009) because they use different data and a different control group, are still of a similar order of magnitude. The estimated impact on the liabilities to assets ratio was –7.4 percentage points in our study, while Hazak (2009) found the impact of the reform to be –12 percentage points. On the other hand, our estimated impact on liquidity was about two-fifths of that in the study by Hazak (2009) after controlling

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[4] We also tested separately the impact of the reform on relatively new firms that were younger than three years. The main difference from the whole sample is that the impact of the reform on the liabilities to assets ratio is somewhat stronger for young firms.

for the general trends in the data and using the Latvian and Lithuanian firms as a control group.

4.2. Capital structure, liquidity and firm survival during the crisis

The main result from the analysis of the previous section is that firms have at least to some extent accumulated their retained earnings in the form of liquid assets instead of investing them in productive assets, although the latter approach was not in fact the aim of the reform. Clear shifts in capital structure in favour of equity financing have also been detected. While these trends may have lowered efficiency, the possible positive side is that the changes induced by the income tax reform may have helped Estonian companies to cope relatively better than Latvian and Lithuanian companies with the recent economic crisis of 2008–2010. This idea is prompted by the fact that although the non-performing loans of Estonian banks have been at relatively low levels throughout the post-communist period compared to those of other Eastern European countries, due to the relatively successful functioning of the financial sector, non-performing loans have increased during the latest crisis at a much more modest rate.

Despite the equally dramatic downturn in all the Baltic economies in 2009, in which GDP dropped in real terms by 14% in Estonia, 15% in Lithuania and 18% in Latvia, the IMF finds that the share of non-performing loans in the private sector increased from the end of 2008 to 2009 in Estonia from 1.9% to 5.2%, but in Latvia from 3.6% to 16.4% and in Lithuania from 4.6% to 19.4% (see Purfield and Rosenberg, 2010). At the same time the gross fixed liabilities of the non-financial companies in Estonia were about 90% of GDP while in Latvia they were more than 60%, and in Lithuania 40%. Although the lower level of non-performing loans has been explained by stricter risk management practices and different accounting practices in Estonia (Purfield and Rosenberg, 2010), part of the story could be also the improved liquidity and reduced levels of debt caused by the income tax reform. On the other hand, accounting practices may also have been affected by the income tax reform, as is indicated by the improved prudence of the data reported in financial reports. For example, it has been shown that in 2000 the profitability of Estonian companies increased considerably, even after controlling for the recovery of economic growth after the recession in 1998–1999 that was caused by the Russian financial crisis (Masso et al., 2010).

Given the above, we look at what the effect of the corporate income tax reform of 2000 on the performance of firms during the economic crisis may have been. In particular, we look at the effect on firm survival, or the proba-

bility that a company operating in 2008 remained active in 2009. An active company has been here defined as one that has either positive sales, a positive number of employees or positive labour costs, that is, at least one of these conditions should hold. As expected, the exit of firms increased during the crisis from 10% to 15%. We look at two different indicators, all exits and, more specifically, bankruptcies[5]. That is because the firm demographics during the crisis may also have been affected by voluntary liquidations. For example, there is a lot of anecdotal evidence of cases where an old business organisation goes bankrupt and a new one is established operating in the same location and the same industry and with the same owners.

Table 7 presents the results of the probit model for firm survival, estimated for both the pre-crisis (2005–2007) and crisis (2008) periods. The dependent variable is the probability that a firm active in one year is still active one year later. Following from the literature, we have included the age and size of the firm in the list of controls. These are positively related to firm survival, given the sub-optimal size of most new companies and their lack of market experience. The correlation between firm size and age is probably behind the insignificant value of the firm size variable in many regressions. We have also added the Lerner index and control for foreign ownership[6]. In order to facilitate the interpretation and presentation of the results, the table reports the marginal effects for the average firm size and presents only coefficients of the variables relevant from the purpose of this paper.

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[5] The authors are grateful to Oliver Lukason for providing the data on bankruptcies.

[6] We have also tested for the relevance of interaction terms of firm size with liquidity and indebtedness to the regressions. This extension gave qualitatively similar results to the ones reported in Table 7.

Table 7: Probit models for firm exits over the subsequent year

Variables	2008			2005–2007		
	(1)	(2)	(3)	(1)	(2)	(3)
	Marginal effects for firm of average size					
Liquidity	–0.115***	–0.099***	–0.095***	–0.009	–0.002	–0.004
Liabilities	0.133***			0.065***		
Loans	0.023***			0.015***		
Short-term loans		0.038***			0.057***	
Long-term loans		0.032***			0.001	
Short-term liabilities			0.043***			0.051***
Long-term liabilities			0.029***			0.007**
No of obs.	10 603	10 603	12 722	29 360	29 360	35 197
Log-likelihood	–3648.7	–3769.4	–4454.3	–6261.9	–6385.6	–7599.9
Pseudo R2	0.060	0.028	0.041	0.054	0.035	0.052

*Notes: Dependent variable equals 1 if the firm goes bankrupt, zero otherwise. Table reports the marginal effects. Table does not report the results on controls as firm age and size and their squared terms, Lerner index and foreign ownership. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from Estonian Commercial Register.

With the liquidity variables it can be seen that while higher liquidity before the crisis was either positively or insignificantly correlated with firm exit, perhaps because higher liquidity could be related to lower efficiency, then during the economic crisis liquidity has had a strong negative relationship with the probability of exit, and especially among the smaller companies. In some specifications not reported here the interaction variable of liquidity and firm size was statistically significant. The relationship is also economically significant: 10 percentage points more liquidity is associated with a lower probability of firm exit by 1 percentage point. On the other hand, a higher ratio of liabilities or debts to total assets increases the probability of firm exit, especially during the crisis. These two results for liquidity and indebtedness confirm the indirect positive impact of the tax reform on company viability in Estonia during the crises. We also experimented with the interaction of the foreign ownership dummy with liquidity and indebtedness, but these results were statistically insignificant. Among the other controls, the foreign ownership dummy is positive, but statistically insignificant; the same applies to the Lerner index, measured as sales minus labour costs minus intermediate inputs divided by sales. The results with the model for bankruptcies were mostly similar, but the value of the liquidity variable for before the crisis being positive in the models for bankruptcies and negative in the model for all exits could indicate that bankruptcies could be a more appropriate measure here[7]. In general we may thus say that during the economic crisis high liquidity and a low debt burden became more important for firm survival.

4.3. The effect of the tax reform on investment and productivity

This section investigates the effect of Estonia's corporate income tax reform of 2000 on the investment and productivity of firms. There are some difficulties that complicate the impact of taxes on investment and productivity. Investments tend to be very volatile across firms and within firms and many authors do not find any statistically significant effects of tax reform on investments (Kari et al., 2009). Furthermore, the quality of investment data is often low, including large variations in the variable and with many outliers in firm-level databases. As investments have wide variations it is also difficult to implement an outlier elimination scheme based on the variation amplitude of investments. Another problem with investment data comes from their stationarity. Despite their volatile nature, investments are often also highly persistent. To counter the stationarity problem we have taken the growth rates

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[7] For instance, during the boom years it was standard practice for real estate firms to liquidate themselves after the developed real estate was sold.

of the investment variable instead of its levels. We control for outliers by excluding the highest 5% and the lowest 5% of the values of the variable from a particular sample under investigation[8]. It must also be borne in mind that our investment variable does not include information on depreciation and is just a year-to-year change in the capital stock. Our capital stock is based only on tangible fixed assets. These limitations are made due to the extremely low data coverage for depreciation and intangible fixed assets before 2000 in the Amadeus data. However, the latter at least probably does not cause any large errors as intangible fixed assets make up only 2.5% of total fixed assets in our data.

Table 8 presents the results of the effect of the tax reform on investment growth rates. The set of control variables includes employment growth and logarithmic statutory tax rates. We find that the reform had a statistically significant effect on investment growth, with the effect stronger in services and for smaller firms. The pre-reform sample size is quite small and disentangling firms by size group produces sensitive estimates (see also the insignificant F-test results). The reform effect is quantitatively quite large as the investment growth was 0.37 percentage points higher between 2000–2003 due to the tax reform. The descriptive statistics in Table 2 show that the mean investment growth over the whole sample is –0.63 with a standard deviation of 3, so we see that this growth rate is actually not very large given the wide variation in investment growth. Putting this effect in terms of the current sample, it is equivalent to a change from an average value of –0.63 to one of –0.26, which corresponds to a move from the 55th percentile to the 66th percentile. Hsieh and Parker (2007) also found quite a strong effect on investments from the Chilean retained earnings tax reduction, with a tax reduction of almost 50% leading to a 4.5% increase in investments in the first year after the reform.

We also investigate the effect of the reform on the investment rate. Table 9 presents these results. Again we exclude observations with the lowest 5% and highest 5% of the values of the investment rate from the sample as outliers. The results again indicate a statistically significant effect from the reform on the investment rate, and the effect is stronger for services and for smaller firms. The tax reform has increased the investment rate by 0.203 percentage points, regarding the average investment rate for the sample being 0.195, this corresponds to an increase from the 58th percentile to the 71st percentile. Again the economic effect on investment is quite strong.

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[8] We also excluded the lowest 1% and the highest 1% of the values of investment from the sample, which gave quantitatively similar results with somewhat larger standard errors.

Table 8: The effect of the income tax reform on the investment growth rate; Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manu–facturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
Country$_{EE}$×Post$_{2000}$	0.378***	0.303	0.353**	0.417*	0.445	0.374	0.369
	(0.122)	(0.200)	(0.153)	(0.219)	(0.291)	(0.307)	(0.602)
Log(tax rate)	–0.538*	–0.827	–0.498	–0.174	–0.502	0.264	–1.495
	(0.325)	(0.531)	(0.405)	(0.712)	(0.616)	(0.771)	(1.075)
Employment growth rate	0.252***	0.396**	0.218**	0.201	0.135	0.720**	–0.248
	(0.093)	(0.189)	(0.107)	(0.129)	(0.205)	(0.357)	(0.678)
Number of observations	52 730	12 568	40 162	29 025	16 372	5 721	1 607
Number of firms	18 520	4 060	14 460	11 819	6 390	2 118	496
F-stat (p-value)	6.818	4.423	4.253	4.948		1.485	0.605
	(0.000)	(0.000)	(0.000)	(0.000)	~	(0.148)	(0.793)
Within-group R^2	0.002	0.006	0.003	0.004	0.003	0.007	0.007

Note: the lowest 5% and the highest 5% of the values for the investment growth rate between 1996–2003 are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

Table 9: The effect of the income tax reform on the investment rate; Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
$\text{Country}_{EE} \times \text{Post}_{2000}$	0.203***	0.190***	0.208***	0.198***	0.232***	0.170***	0.096**
	(0.013)	(0.019)	(0.017)	(0.027)	(0.031)	(0.026)	(0.038)
Log(tax rate)	0.019	–0.127***	0.091***	0.037	0.103**	–0.064	–0.179***
	(0.026)	(0.038)	(0.034)	(0.095)	(0.048)	(0.050)	(0.065)
Employment growth rate	0.133***	0.140***	0.130***	0.109***	0.166***	0.207***	0.183***
	(0.009)	(0.016)	(0.011)	(0.014)	(0.017)	(0.027)	(0.040)
Number of observations	65 132	15 957	49 175	34 714	20 904	7 463	2 044
Number of firms	21 394	4 734	16 660	13 428	7 691	2 608	579
F-stat (p-value)	148.6	72.88	89.91	38.80	5.4e+09	52.09	117.66
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Within-group R^2	0.055	0.096	0.046	0.030	0.056	0.181	0.429

*Note: observations with the lowest 5% and the highest 5% of the values for the investment rate between 1996–2003 are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

We go further by investigating the effect of the reform on labour productivity[9]. Labour productivity is measured as turnover per number of employees, as we did not have data on working hours or value added. As with investments, there are also many problems involved in investigating the impact of the reform on productivity. There are problems related to the stationarity of the productivity data and we investigate the impact on productivity growth to control for that. Equally, employment growth may be endogeneous in the explanatory side, because for example more productive firms could grow faster. To control for the endogeneity of employment growth, we lag this explanatory variable by one year, which somewhat reduces the number of observations. A positive point is that with the productivity variable, there is much less noise in productivity, so less restrictive schemes are needed to exclude outliers. Table 10 presents the effect of the reform on labour productivity. The reform has a statistically significant effect on productivity growth; the productivity growth rate has increased by 0.134 percentage points over the four years after the reform. As with the effect on investment, the effect of the reform on productivity is stronger in business services and among smaller firms. Putting these numbers on a relative scale we observe again an economically quite large effect, from the average productivity growth rate of 0.266 to 0.400, corresponding to an increase from the 72nd percentile to the 79th percentile.

4.4. Robustness tests

4.4.1. Matching analysis

We check the robustness of the main results of the difference in differences analysis with propensity score matching. Whereas the difference in differences analysis used all the firms from the pool of possible controls as control units, this approach enables us to construct what should be a more suitable proxy for the counterfactual case of there having been no tax reform in Estonia. It builds a control group by concentrating on only those firms in Latvia and Lithuania that are as similar as possible[10] to the Estonian firms.

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[9] We investigate the effect on labour productivity instead of total factor productivity (TFP) as the set of variables needed for TFP calculations is essentially missing from the pre-reform dataset. This mostly concerns missing data on intermediate consumption and value added.

[10] Meaning they are similar in terms of their characteristics during the pre-reform period.

Table 10: The effect of the income tax reform on labour productivity growth; Estonia, Latvia and Lithuania, 1996–2003

	Whole sample	Manufacturing	Business services	Number of employees:			
				1–9	10–49	50–249	250>=
Country$_{EE}$×Post$_{2000}$	0.133***	0.096*	0.144***	0.199**	0.068	0.032	0.123***
	(0.033)	(0.053)	(0.041)	(0.078)	(0.063)	(0.054)	(0.039)
Log(tax rate)	–0.286***	–0.419***	–0.214***	–0.411**	–0.145*	0.006	–0.180***
	(0.070)	(0.126)	(0.078)	(0.189)	(0.087)	(0.123)	(0.069)
Employment growth rate	0.297***	0.182***	0.328***	0.411***	0.216***	0.255***	0.299***
	(0.023)	(0.042)	(0.028)	(0.035)	(0.032)	(0.055)	(0.024)
Number of observations	50 686	11 970	38 716	28 267	15 427	5 420	49 132
Number of firms	16 706	3 603	13 103	10 560	5 783	1 936	16 390
F-stat (p-value)	71.75	32.29	47.97	25.21		30.23	55.19
	(0.000)	(0.000)	(0.000)	(0.000)	~	(0.000)	(0.000)
Within-group R^2	0.152	0.295	0.107	0.025	0.048	0.531	0.077

*Note: observations with the lowest 1% and the highest 1% of values for the productivity growth rate between 1996–2003 are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

The estimates of the effects of the tax reform seen in the post-treatment difference between the treated and control groups from the matching analysis are given in Tables 11–13, and are shown separately for the samples of manufacturing and services sector firms. As with the analysis in the previous sections, the effects on capital structure, liquidity, investment and productivity are shown.

We have carried out the propensity score matching using both the *nearest neighbour* and *kernel* algorithms. The results of the nearest neighbour and kernel matchings indicate similar results, so we present here only the results from *kernel* matching.

The difference between the post-2000 indicators of the Estonian and Latvian or Lithuanian firms can show us the effects of the tax reform only if the difference between the Estonian firms and the constructed control group is not significant in the pre-treatment period, 1999 in our analysis. Unfortunately, as is evident from the tables of descriptive statistics in Annex 2, this is not the case.

The difference between the control group and the treatment group diminishes to a very large extent once we construct the control group using the score for the propensity to be affected by the reform. However, several key variables are still statistically significantly different between the companies in Estonia and their constructed control group in 1999, even after the propensity score-based matching of firms has been done (see Annex 2). For the productivity and liquidity indicators, this difference is still statistically significant even after firms have been matched according to their similarities. Among the key variables being observed, the difference is not significant in 1999 for (retained earnings and reserves)/total assets, and liabilities/total assets.

As the propensity score matching approach was not able to produce a control group that was very similar to the Estonian firms, the results from the following tables, with the exception of the capital structure variables, need to be interpreted with a degree of caution, as they may not show just the causal effects of the tax reform but may also reflect pre-treatment differences and the effects of other variables. One possible explanation for the differences between the treatment and control groups could be that the sample of Latvian and Lithuanian firms included fewer small companies than did the sample of the Estonian companies.

The sign and significance of the effects or correlations estimated by the matching approach confirm the previous findings from the difference in differences analysis. For the liquidity and capital structure indicators, the magnitude of the estimated effect is also quite similar in size to that found by

the difference in differences approach. In the following Tables 11–13, the coefficient of the effect of the tax reform indicates for each variable the difference between the treatment group and the constructed control group in the given year. Table 11 shows the estimates of the effects on liquidity and capital structure in the services sector, while Table 12 covers the manufacturing sector. Table 13 shows separately the effects on productivity and investment in both sectors.

Table 11: The effect of the income tax reform on capital structure, liquidity and retained earnings in the services sector. The results of matching analysis. Period of study, 1996–2004

| Variable: | The treatment effect (the average of the indicator in the treatment group minus the average of the indicator in the control group) | | | |
	2000	2001	2002	2003
Liabilities/Total assets	–0.102***	–0.10***	–0.133***	–0.169***
	(0.029)	(0.028)	(0.028)	(0.027)
Debt/Total assets	0.001	–0.063***	–0.079***	–0.044***
	(0.015)	(0.014)	(0.015)	(0.016)
Cash/Total assets	–0.005	0.037***	0.056***	0.047***
	(0.015)	(0.013)	(0.014)	(0.015)
(Retained earnings+ Reserves)/ Total assets	0.093***	0.127***	0.15***	0.186***
	(0.026)	(0.027)	(0.026)	(0.026)

*Note: results of propensity score matching analysis based on merged data from firm level datasets of Amadeus, Lursoft and the Estonian Commercial Register. Data from Estonia, Latvia and Lithuania. Treatment group: Estonian firms; control group: a similar subset of firms from Latvia and Lithuania. Method: propensity score matching kernel matching, the results of the nearest neighbour matching algorithm are similar. Standard errors of estimates are given in parentheses. The treatment effect is calculated as the post-reform difference between the values of the indicators of the treated and control groups. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Table 12: The effect of the income tax reform on capital structure, liquidity and retained earnings in the manufacturing industry. The results of matching analysis. Period of study, 1996–2004

Variable:	The treatment effect (the average of the indicator in the treatment group minus the average of the indicator in the control group)			
	2000	2001	2002	2003
Liabilities/Total assets	–0.044	–0.073*	–0.086**	–0.063
	(0.041)	(0.039)	(0.039)	(0.038)
Debt/Total assets	–0.014	–0.10***	–0.054***	–0.024
	(0.022)	(0.024)	(0.024)	(0.02)
Cash/Total assets	–0.006	0.044***	0.037***	0.049***
	(0.016)	(0.013)	(0.014)	(0.016)
(Retained earnings+ Reserves)/ Total assets	0.046	0.062	0.122***	0.133***
	(0.049)	(0.047)	(0.047)	(0.049)

*Note: results of propensity score matching analysis based on merged data from firm level datasets of Amadeus, Lursoft and the Estonian Commercial Register. Data from Estonia, Latvia and Lithuania. Treatment group: Estonian firms; control group: a similar subset of firms from Latvia and Lithuania. Method: propensity score matching kernel matching, the results of the nearest neighbour matching algorithm are similar. Standard errors of estimates are given in parentheses. The treatment effect is calculated as the post-reform difference between the values of the indicators of the treated and control groups. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Table 13: The effect of the income tax reform on investment and productivity. The results of matching analysis. Period of study, 1996–2004

	Variable:	The treatment effect (the average of the indicator in the treatment group minus the average of the indicator in the control group)			
		2000	2001	2002	2003
Manufacturing:	Investment rate	0.031	0.083**	0.112***	0.06
		(0.025)	(0.039)	(0.04)	(0.039)
Services:	Investment rate	0.136***	0.101***	0.096	–0.046
		(0.032)	(0.038)	(0.089)	(0.103)
Manufacturing:	Productivity growth	–0.14	0.017	0.160	0.160
		(0.103)	(0.039)	(0.118)	(0.121)
Services:	Productivity growth	0.008	–0.006	0.038	0.038
		(0.029)	(0.025)	(0.029)	(0.029)

*Note: results of propensity score matching analysis based on merged data from firm level datasets of Amadeus, Lursoft and the Estonian Commercial Register. Data from Estonia, Latvia and Lithuania. Treatment group: Estonian firms, Control group: a similar subset of firms from Latvia and Lithuania. Method: propensity score matching kernel matching, the results of the nearest neighbour matching algorithm are similar. Standard errors of estimates are given in parentheses. The treatment effect is calculated as the post-reform difference between the values of the indicators of the treated and control groups. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

An example of the effects is that according to the results in Table 11, the share of cash in the assets of a services firm in Estonia in 2001 was on average 3.7 percentage points higher than that in the similar control group of firms from Latvia and Lithuania. By the next year, this difference had reached 5.6 percentage points. The increase in the gap after 2000, coupled with the insignificant difference in the gap with the constructed control group in 1999, indicates the effect of the tax reform in Estonia. A simple conclusion from Tables 11 or 12 is that the effect on capital structure and liquidity depends crucially on the year. The effect is larger on the data of the services sector and when more time has passed since the reform. For cash to assets, the effect seems to materialise after 2001, but not earlier. Whereas the share of liabilities to assets among services sector firms in Estonia in 2001 was about 10 percentage points lower than it was in the constructed control group from Latvia and Lithuania, by 2003 this difference had grown to about 17 percentage points. This, again, suggests significant effects from the tax reform in Estonia.

The effects seem to take longer to materialise in the manufacturing industry, as in 2000 none of the indicators in Table 12 were significantly different in Estonia from those in the constructed control group. Differences that could be interpreted as effects of the reform seem to appear after 2001. The result that the effect of the reform seems to be lagging further behind in manufacturing could be caused by investment in the manufacturing industry sometimes needing longer planning before implementation than it does elsewhere.

Table 13 shows the results of the matching analysis with productivity and the investment ratio as the outcome variables. The difference between the investment rates of the treatment group and control group is statistically significant both before and after 2000. For this reason, it is difficult to make strong conclusions about the causal effects of tax reform on the investment ratio using this approach. However, there is a post-2000 increase in the gap in the investment ratio between the treated and control groups in manufacturing. Again, this may be due to the positive effect of tax reform. We cannot find significant effects of the tax reform on productivity with this approach, as the post-treatment difference between Estonian firms and the constructed control group is not statistically significant.

4.4.2. Placebo treatment in difference in differences (DID) analysis

This section seeks to test whether the results of the DID analysis in the above sections were just a coincidence and whether we could find similar effects across some placebo treatment groups. We construct similar country and structural break interaction dummies for five placebo treatments: 1) post-

1998 for Estonia, 2) post-1999 for Estonia, 3) post-2001 for Estonia, 4) post-2002 for Estonia, and 5) post-2003 for Estonia.

Table 14 presents the results for the impact of these placebo treatment dummies on the set of variables being investigated. The table gives a summary of the results. Only the values of the estimated parameter for "CountryEE×Post-Year" of the specification in equation (1) are reported, with each cell of the table corresponding to one regression. The placebo treatment dummies often become statistically significant, especially those placebo treatment dummies that are close to the actual date of launch of the reform. The impact on the investment growth rate was strongest after the actual reform, while the impact on the investment rate and productivity growth rate was strongest before the actual reform was launched. The strong effect on the investment rate and productivity growth before the reform could be a result of the introduction of the deduction of investments in material fixed assets to the regions outside the capital area in 1998 and 1999. The large values of the placebo dummies one year after the launch of the reform probably comes from the sluggish reaction of firms to the reform in their tax timing or optimisation. However, as the placebo treatment effect becomes small or insignificant after 2003, the placebo treatment experiment indicates like the matching experiment that the reform had quite a strong economic effect.

4.4.3. Controlling for implicit tax rates

This paper uses a relatively simple difference in differences estimation strategy with a small number of control variables. The two main controls are firm size or employment growth and statutory tax rates. Nevertheless, the reform left the statutory tax rate on distributed profits unchanged even though the zero tax rate on retained earnings lowered substantially the overall tax burden of companies in Estonia. Not controlling for the overall reduction in the tax burden may lead us to estimate the effect of a tax burden reduction rather than the change in taxation scheme from gross profit taxation to distributed profits taxation. This section tests whether the impact of the reform estimated above was a simple effect of the reduction in the tax burden or of the shift in the taxation scheme.

Table 14: Placebo treatment effect on capital structure, liquidity, retained earnings, investment rate and productivity growth; Estonia, Latvia and Lithuania, 1996–2003

Dependent variable	$\text{Country}_{EE} \times \text{Post}_{1998}$	$\text{Country}_{EE} \times \text{Post}_{1999}$	$\text{Country}_{EE} \times \text{Post}_{2000}$	$\text{Country}_{EE} \times \text{Post}_{2001}$	$\text{Country}_{EE} \times \text{Post}_{2002}$	$\text{Country}_{EE} \times \text{Post}_{2003}$
Liabilities/total assets	–0.038**	–0.052***	–0.074***	–0.064***	–0.035***	–0.013***
	(0.018)	(0.015)	(0.005)	(0.005)	(0.006)	0
Loans/total assets	–0.054***	–0.068***	–0.076***	–0.108***	–0.066***	0.039***
	(0.018)	(0.015)	(0.005)	(0.005)	(0.006)	0
(Cash and bank accounts)/total assets	0.015*	0.010	0.021***	0.016***	0.003	–0.001
	(0.008)	(0.007)	(0.003)	(0.003)	(0.003)	(0.003)
(Retained earning and reserves)/total assets	0.031	0.045***	0.111***	0.104***	0.081***	0.034***
	(0.019)	(0.016)	(0.005)	(0.005)	(0.006)	(0.004)
Investment growth rate		0.225	0.372***	0.408***	–0.313*	0.063
	~	(0.140)	(0.122)	(0.112)	(0.166)	(0.142)
Investment rate	0.698***	0.303***	0.203***	0.073***	0.092***	–0.054***
	(0.016)	(0.015)	(0.013)	(0.011)	(0.015)	(0.012)
Productivity growth rate		0.211***	0.134***	–0.010	0.030	–0.079***
	~	(0.051)	(0.033)	(0.030)	(0.041)	(0.026)

Note: [1] *indicates that the lowest 5% and the highest 5% of values are excluded from the sample as outliers.* [2] *indicates that the lowest 1% and the highest 1% of values are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

The dynamics of the statutory and implicit tax rates of the Baltic states are presented in Figure 2. The statutory tax rates have been reduced in all three countries quite significantly, which is in line with taxation trends internationally. The implicit tax rates are fairly U-shaped, which captures somewhat the effect of a business cycle but also the effect of changes in the tax base. For example, it is clearly visible that the 2000 tax base reform in Estonia led to a halving of implicit tax rates, while implicit tax rates started to increase after 2001 and have almost reached their pre-reform level in spite of the reductions in the statutory tax rate. Another interesting stylised fact is that the implicit tax rates of Estonia and Lithuania have had quite similar dynamics, but while the movement of the Estonian tax burden has mostly been driven by changes in the tax base[11], the Lithuanian tax burden has been moved by changes in statutory tax rates.

Table 15 presents the difference in differences estimation results when we control for logarithmic implicit tax rates instead of logarithmic top statutory tax rates. The table reports a summary of the results, with only the values of the parameter for "CountryEE×Post2000" of the specification in equation (1) reported, where each cell of the table corresponds to one regression. However, the results are quite similar to those presented earlier, suggesting that the reform has reduced debt financing, and increased liquid assets, retained earnings, investments and productivity. As in the estimations presented earlier, the impact of the reform is stronger on small firms' liquidity, investments and productivity. The impact of the reform becomes somewhat larger on the capital structure and liquidity indicators and smaller on investments and productivity. However, in general controlling for a reduction in the tax burden provides a result that is robust to the above findings that the shift from gross profit taxation to distributed profits taxation has a strong impact on firms' capital structure, liquidity and performance.

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[11] We call the Estonian year 2000 corporate income tax reform here a change in the tax base as the taxable corporate income narrowed from gross profits to distributed profits. However, the implicit tax rate calculations of Eurostat capture the overall tax burden keeping the tax base definition constant over time.
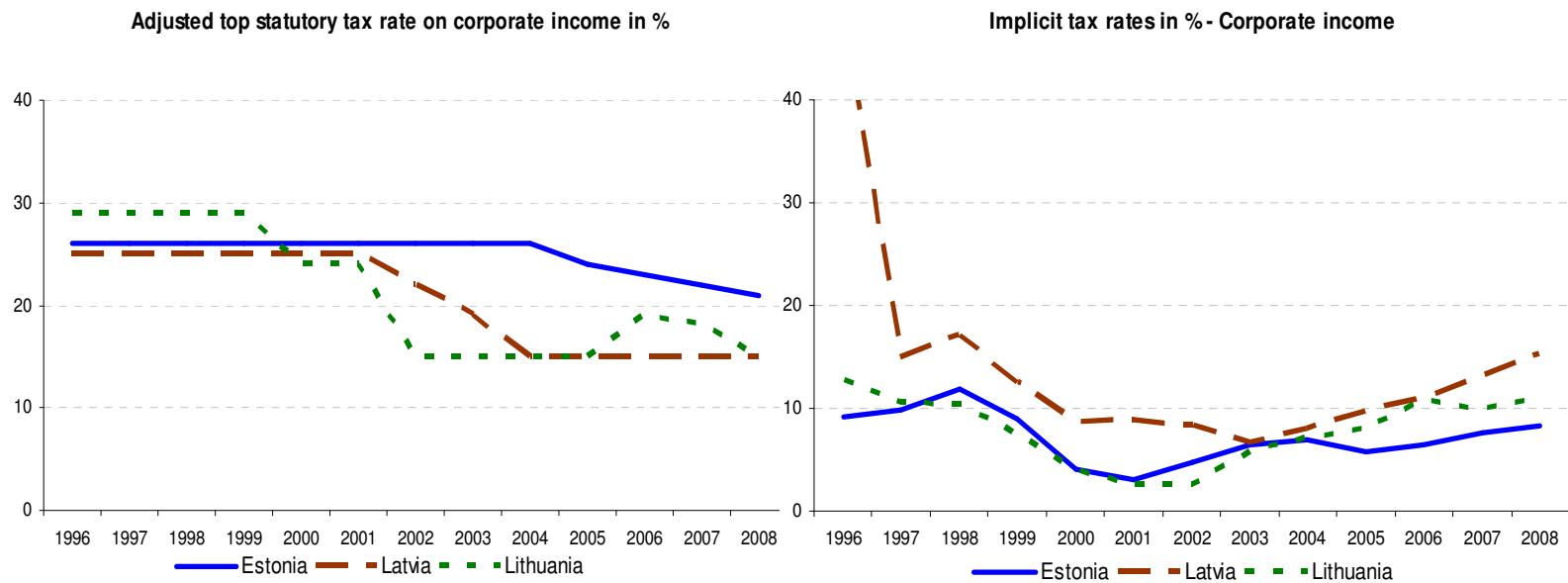
Adjusted top statutory tax rate on corporate income in %

Implicit tax rates in % - Corporate income

Figure 2: Statutory and implicit corporate income tax rates in Estonia, Latvia and Lithuania during 1996–2008

Source: European Commission (2010).

Table 15: Difference in differences estimates with implicit tax rates control instead of statutory tax rates; Estonia, Latvia and Lithuania, 1996–2003

Dependent variable	Whole sample	Manufacturing	Business services	Firms with up to 50 employees
Liabilities/total assets	–0.100***	–0.108***	–0.096***	–0.098***
	(0.005)	(0.011)	(0.006)	(0.007)
Loans/total assets	–0.084***	–0.070***	–0.089***	–0.083***
	(0.005)	(0.010)	(0.006)	(0.007)
(Cash and bank accounts)/total assets	0.025***	0.023***	0.026***	0.031***
	(0.003)	(0.005)	(0.004)	(0.004)
(Retained earning and reserves)/total assets	0.153***	0.152***	0.155***	0.159***
	(0.006)	(0.011)	(0.006)	(0.007)
Investment growth rate	0.216*	0.097	0.191	0.466***
	(0.119)	(0.196)	(0.151)	(0.160)
Investment rate	0.208***	0.170***	0.222***	0.219***
	(0.012)	(0.018)	(0.017)	(0.019)
Productivity growth rate	0.074**	0.001	0.102**	0.118**
	(0.033)	(0.055)	(0.040)	(0.055)

Note: [1] *indicates that the lowest 5% and the highest 5% of values are excluded from the sample as outliers.* [2] *indicates that the lowest 1% and the highest 1% of values are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

5. Conclusions

This article studied the possible effect of the Estonian corporate income tax reform of the year 2000 on firms' capital structure, liquidity, investments and productivity. For the analysis we constructed a firm-level database of Estonian, Latvian and Lithuanian companies for the period of 1996–2009 using data from commercial registers and the Amadeus database. In order to identify the effect of the reform, we used both difference in differences and propensity score matching analysis, in which Latvian and Lithuanian firms were used as the control group for the treatment group of Estonian companies. The reason for the choice of control group was that the three countries should be similar in terms of their history, institutions, business cycles and similar factors, so it is appropriate to compare the Estonian firms with Latvian and Lithuanian ones.

The results show that after the corporate income tax reform the share of liabilities in total assets decreased in Estonia by about 7 percentage points, and this effect has been about 1 percentage point stronger among small companies with up to 50 employees than among larger companies. The share of loan capital in total assets has fallen on average by 7 percentage points. The

share of cash and equivalents in assets, which we use as our indicator of liquidity, has increased by 2–3 percentage points; in the group with up to 50 employees the effect on liquidity was about twice as large as it was among larger firms. The share of undistributed profits and reserves in total capital has grown by 11 percentage points and once again the effect is stronger among the smaller companies. In total we can summarise that the reform has affected smaller companies somewhat more in the share of loans and liabilities in total assets, and significantly more for liquid assets and reinvested earnings. This result was to be expected given the previous evidence on the importance of liquidity constraints for small firms in particular in Estonia.

The positive effect of having extra cash in hand is not necessarily self-evident. An alternative implication derived from the presence of agency costs could be that if the share of debt in a firm's capital structure decreases, and there are also less dividend pay-outs, then there is less market discipline, and more potential for agency problems (Jensen and Meckling, 1976), meaning that the firm's managers could act in their own interests, misuse funds and fail to make productive investments, because there is a free cash flow that remains after the financing of positive net present value investments (Jensen, 1986). The problem is probably less severe in small firms, as there the management and ownership coincide more often. A more refined check could come from using data from Amadeus on owners and managers to see if the estimated effect is different where these coincide. On top of this, the Estonian economy in the period under review was characterised by strong growth, so it is very probable that the firms had positive NPV investment opportunities and the presence of free cash flows was less likely.

The higher accumulation of liquid assets has both positive and negative consequences. Although the improved liquidity could be beneficial (as was shown by Hazak, 2009), the downside of it is the tendency for the funds to be kept in low-risk assets rather than invested in machinery and equipment. The post-reform change in the capital structure may have helped the Estonian companies to cope better with the economic crisis that started in 2008 than the Latvian and Lithuanian firms did, because in the conditions of an abruptly shrunken credit supply and an economic contraction Estonian companies had less debt financing and more liquid assets. The estimation of firm survival using data from the Estonian commercial register showed that especially during the crisis higher liquidity and lower debt financing have been associated with a higher probability of company survival. The IMF study on the economic performance of the Baltic states during the crisis (Purfield and Rosenberg, 2010) showed that during the crisis the share of overdue loans in Estonia has remained at one-third of the levels in Latvia and Lithuania at 6% compared to almost 20% in 2010.

Concerning the effect on investments, the investment growth rate rose in Estonia after the reform by 0.37 percentage points more than it did in Latvia and Lithuania as a cumulative impact over the four years following the reform. The effect on the investment rate given as the ratio of investments to capital was also high at 20 percentage points. Regarding the impact of the reform on labour productivity measured as turnover per employee, labour productivity grew in Estonia by 13 percentage points more than it did in Latvia and Lithuania during the four years following the reform. The effect on investments and productivity has been strongest in the services sector and among smaller companies. The latter finding is in accordance with the impact of the reform on capital structure and liquidity, which indicated a more positive effect on small firms. In this study we did not distinguish between investments in different kinds of capital, but in the survey (Masso et al., 2010) firms mostly said that the reform did not change the structure of their investments, but rather helped to increase their size, so that they could buy better and more expensive machinery for example.

We also performed various robustness tests of our difference in differences estimation. The propensity score matching and difference in differences analyses reached qualitatively similar conclusions. However, the propensity score matching indicates that the constructed control group of Latvian and Lithuanian firms is not statistically significantly different from the control group of Estonian firms in the pre-treatment period in terms of liabilities to assets and retained earnings to assets. This means that for the rest of the variables we cannot exclude that these developments would have taken place anyway without the reform. The experiment with the placebo treatment of artificial reform dummies also provides support for our estimates, for example the effect of the placebo dummy for three years after the reform becomes quantitatively very small and often statistically insignificant. Controlling for the effect of implicit tax rates instead of statutory ones again provides robust results. Hence, we observe these significant reform effects as being due to the shift from gross profits taxation to distributed profits taxation and not due to the reduction in the overall tax burden of corporations.

We conclude that the effect of the reform was manifested more clearly in capital structure and liquidity and less clearly in investments and productivity. While it is difficult to quantify the reform effect and disentangle it from the effect of other simultaneous changes, especially in terms of investments and productivity, this reform may be presumed to have contributed widely to the alleviation of credit constraints, modernisation of production technology, growth in productivity and faster catching-up with high-income economies. This all makes the experiment to shift profit taxation from gross profits to distributed profits worth considering in other countries that are catching-up or

countries that plan to reduce the tax burden of capital and target change in firms' capital structure and investments.

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Appendix 1: The difference in differences estimation results of the effect of corporate income tax reform over the longer sample, Estonia, Latvia and Lithuania, 1996-2008

Dependent variable	Whole sample	Manufacturing	Business services	Firms with up to 50 employees
Liabilities/total assets	–0.108***	–0.128***	–0.100***	–0.097***
	(0.005)	(0.010)	(0.006)	(0.006)
Loans/total assets	–0.095***	–0.088***	–0.097***	–0.094***
	(0.005)	(0.009)	(0.006)	(0.006)
(Cash and bank accounts)/ total assets	0.044***	0.037***	0.046***	0.046***
	(0.003)	(0.005)	(0.003)	(0.003)
(Retained earnings and reserves)/total assets	0.152***	0.165***	0.147***	0.148***
	(0.005)	(0.010)	(0.006)	(0.006)
Investment growth rate[1]	0.344***	0.148	0.355***	0.418***
	(0.098)	(0.160)	(0.125)	(0.132)
Investment rate[1]	0.215***	0.159***	0.231***	0.228***
	(0.011)	(0.017)	(0.015)	(0.017)
Productivity growth rate[2]	0.104***	0.037	0.125***	0.168***
	(0.032)	(0.048)	(0.042)	(0.049)

Note: [1] *indicates that the lowest 5% and the highest 5% of values are excluded from the sample as outliers.* [2] *indicates that the lowest 1% and the highest 1% of values are excluded from the sample as outliers. Fixed effects model, standard errors corrected for heteroscedasticity are reported in parentheses. Year dummies included. *, ** and *** indicate statistical significance at the 1%, 5% and 10% levels respectively.*

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.

Table reports a summary of the results, where only the values of the parameter for "CountryEE×Post2000" of the specification in equation (1) are reported, with each cell of the table corresponding to one regression.

Appendix 2: Quality of propensity score matching of firms: average indicators in 1999. Treatment group = firms in Estonia. Control group = firms in Latvia and Lithuania, either the whole sample or the matched firms only.

Variable	Sample	Treated group	Control group	T-test of difference of means of the treated group and control group	p>|t|
Cash to assets ratio	Standard sample (all firms)	0.158	0.076	11.32	0.00
	Matched sample	0.126	0.149	–5.54	0.00
Liabilities/total assets	Standard sample	0.487	0.523	–6.44	0.00
	Matched sample	0.476	0.463	1.23	0.207
Ln (labour productivity)	Standard sample	12.886	13.554	–13.60	0.00
	Matched sample	13.042	13.375	–13.51	0.00
Ln (employees)	Standard sample	2.068	3.54	–28.40	0.00
	Matched sample	2.236	2.478	–9.10	0.00
(Retained earnings + reserves)/total assets	Standard sample	0.259	0.293	–3.96	0.00
	Matched sample	0.260	0.265	–0.93	0.353
Ln (machinery and equipment)	Standard sample	12.829	15.219	–28.12	0.00
	Matched sample	13.094	13.788	–15.27	0.00
Ln (sales)	Standard sample	14.953	17.094	–33.08	0.00
	Matched sample	15.278	15.853	–19.85	0.00

Note: All firms, including both the manufacturing and services sectors.

Source: firm level data from the Amadeus database, Estonian Commercial Register and Latvian Commercial Register.