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Abstract

The article relates corporate taxation to corporate investment in Slovenia during the economic crisis in a microeconometric and a microsimulation setting. Based on the error-correction model of investment behaviour, we found that investments were significantly affected by financial constraints during the economic crisis that hit the economy in 2009. Thus, only the effect of corporate income taxation on corporate investments that materializes through cash flow was active, while there is no evidence of the presence of the effect of the user cost of capital. The direct loss of budget revenues that is caused by the increased investment tax allowances since 2012 is higher than the expected increase of corporate investments related to increased tax allowances.

**JEL classification:** C23, E27, G31

**Keywords:** corporate investment, corporate income tax, corporate microsimulation, economic crisis, error-correction model, financial constraints, Slovenia
1. Introduction

Slovenia was hit by a severe economic crisis in 2009 that continued throughout the period 2010–2012. GDP per capita dropped by 7.9% in 2009, picked up slightly in 2010 (by 1.3%) and 2011 (by 0.7%), but deteriorated further in 2012 by 2.5% (SORs, 2013). Negative trends are expected to continue in the next two years (IMAD, 2013). Investments, which were stimulating the growth of the economy before the crisis, dropped by 21.6% in 2009 (IMAD, 2010; Aristovnik, 2013), and have been decreasing by 10% annually in the period 2010–2012 (IMAD, 2011; 2012).

One of the immediate measures taken by the Government of the Republic of Slovenia to stop the negative trends of corporate investments was to increase investment tax allowances (cf. Mencinger and Aristovnik, 2013). Thus the tax allowance for investments in equipment and intangible assets increased in 2009 from 20% to 30% of the invested value, with a further 10 percentage point increase introduced in 2012. An even higher increase in the tax allowance rate was introduced for investments in R&D. Specifically, in 2010 the tax allowance for investments in R&D increased from 20% to 40% of the invested value, and a huge increase to 100% of the invested value was introduced in 2012.

Furthermore, Slovenian firms are significantly more leveraged than their EU counterparts. The Bank of Slovenia (2012) reports that the debt-to-equity ratio of the Slovenian corporate sector amounted to almost 1.5 in the period 2008–2010, while the average debt-to-equity ratio in the Euro area barely exceeded 1. However, bank financing fell in 2009, as the Bank of Slovenia (2012) reports that bank loans dropped from 3,438 million EUR in 2008 to only 216 million EUR in 2009, and only 139 million EUR in 2010. Moreover, there was a negative flow of bank credit to the corporate sector in 2011 (Bank of Slovenia, 2012).

In a perfect capital market, a firm could have raised the desired financial funds, and internal and external funds would have been perfect substitutes (Modigliani and Miller, 1958). In an imperfect capital market, however, investment decisions depend on financial factors, such as the availability of internal funds and access to new funds. Having in mind the pecking order hypothesis (Myers, 1984), a firm with available internal funds may have a cost advantage and would decide to invest at a lower expected rate of return. Conversely, a firm without internal funds would have to use costlier external funds and would decide to invest only at a relatively higher expected rate of return. If the cost disadvantage of external funding is large or, in the extreme case where external funds are not available, a firm’s investments fluctuate with the availability of internal funds. Financing constraints thus significantly affect corporate investments.
The article relates corporate taxation to corporate investment in Slovenia during the economic crisis in two fundamental ways. First, we construct an econometric model of investment behaviour used to estimate the direction and size of effects of various economic determinants on investments. Based on a panel data set that covers Slovenian firms for the period 2006–2010, we are thus able to examine whether corporate income tax (among other determinants) had a statistically significant effect on investments. Second, we build a corporate microsimulation model to simulate the characteristics of corporate income taxation in the Slovenian economy. By incorporating the tax effects from the econometric model into the microsimulation setting, we are thus able to evaluate the effects of changes in corporate income tax provisions, such as tax rates and tax allowances, on the corporate income tax liability and investments of Slovenian firms in the base time period of 2009–2010.

In order to determine the effects of investment tax allowances on corporate investments of Slovenian firms, which were to a large extent financially constrained, we modelled the tax effects in our microeconometric and microsimulation setting via two different transmission channels, one being crucial for financially unconstrained firms and the other for financially constrained firms (cf. Bond and van Reenen, 2007). In financially unconstrained firms, investments should be affected by taxes mainly through the user cost of capital, while for financially unconstrained firms the effect that materializes through cash flow is expected to prevail (Simmler, 2012).

Microsimulation models are based on highly disaggregated data and capture structural differences at the level of firms. As such, they allow for precise conclusions regarding the individual financial impacts of tax reforms (Creedy, 2001). As it is essential for policy analysis that the measures of potential reforms be simulated in great detail, the methodology of adjusting profits derived under the corporate income tax law is advantageous for tax purposes, as it makes explicit the tax provisions defining the corporate income tax base (Reister et al., 2008). In particular, we focus on investment tax allowances as essential provisions of corporate income taxation that were actually amended by the Government of the Republic of Slovenia in 2012. As an additional contribution of the article, we decompose corporate income tax liability changes and investment changes based on individual policy measures.

Four main hypotheses were tested within the above modelling framework. First, we claim that Slovenian firms were financially constrained in the analysed time period to the extent that cash flow had a statistically significant effect on corporate investments. Second, due to the financial constraints of Slovenian firms only one of the two transmission channels between corporate income taxation and corporate investments...
was active, i.e. statistically significant – the effect that materializes through cash flow. Third, we examine whether corporate investments in Slovenia were affected by taxes to such an extent that they could efficiently be stimulated by more favourable corporate taxation. And fourth, we claim that the direct loss of budget revenues that has been caused by increased investment tax allowances since 2012 is higher than the related increase of corporate investments.

The outline of the article is as follows. In Section 2, we provide the microeconometric and microsimulation setting for testing the above hypotheses. In Section 3, we describe the data sources that were used in empirical modelling and present the descriptive statistics of key variables. In Section 4, we present and interpret the results of microeconometric estimation of our investment models. In Section 5, we present the results of microsimulation of the baseline and the counterfactual scenario. Section 6 summarizes the key findings and conclusions.

2. Modelling framework

The empirical framework is composed of two economic models that complement each other: (a) an econometric model of investment behaviour used to estimate the direction and size of effects of various economic determinants on investments, and (b) a corporate microsimulation model used to assess the dynamic effects of changes in the characteristics of corporate income taxation on investments. In this two-step process, the tax effects from the econometric model are built into the microsimulation model.

2.1. Empirical modelling of investment behaviour

The empirical evaluation and testing of corporate investment, as well as the effects of financial constraints on corporate investments, build on the dynamic factor demand models; structural and reduced form models. Structural models that include the Q model, the Abel and Blanchard (1986) model and the Euler-equation specification have not been very successful in characterizing the adjustment process. Since a firm’s capital cannot be adjusted costlessly and immediately and thus we cannot resort to static models, econometricians have proposed relying on a dynamic specification that is not explicitly derived as the optimal adjustment behaviour for some particular structure of adjustment costs. As argued by Bond and van Reenen (2007), a favourable interpretation of the reduced form models, such as the accelerator model and the error-
correction model, is that they represent a sound empirical approximation of a complex underlying process that generates the data\(^1\).

In this article, we opted for an error-correction model introduced to the investment literature by Bean (1981) and first used in the context of firm-level data by Bond et al. (2003). The idea of the model is to nest a long-run specification of the firm’s demand for capital within the regression model that allows a flexible specification for short-run investment dynamics to be estimated from the data.

The fundamental error-correction model, outlined in Bond and van Reenen (2007) and used as a basis for the empirical analysis in this article, has the form:

\[
\frac{I_{it}}{K_{it-1}} = \varphi \frac{I_{it-1}}{K_{it-2}} + \sigma_0 \Delta y_{it} + \sigma_1 \Delta y_{it-1} + \rho (k_{it-2} - y_{it-2}) + \sum \xi_d + \mu_i + \vartheta_{it},
\]

where \(I_{it}\) denotes gross investment, \(K_{it}\) denotes the capital stock, \(k_{it}\) is the desired capital stock of the firm (in logarithms), \(y_{it}\) stands for the output of the firm (in logarithms), \(d_i\) is an indicator variable taking value 1 for a given year and 0 otherwise, \(\mu_i\) is an unobserved firm-specific effect, and \(\vartheta_{it}\) is an error term.

In the model specification (1) we assume a perfect capital market, in which a firm can raise as much finance as it desires, and where internal and external funds are perfect substitutes, meaning that the firm’s investment decisions are not related to its financial decisions (Modigliani and Miller, 1958). However, as argued by Fazzari et al. (1988), the separability between investment and financial decisions no longer holds if the capital market is not perfect. Investment decisions in this case depend on financial factors, such as the availability of internal finance and access to new finance, and corporate income taxation. This seems to be even more the case for emerging markets, as the empirical literature suggests the presence of significant financial constraints in European, Asian, and Latin American countries undergoing transition (cf. Arslan et al., 2006; Kalatzis, 2008; Konings et al., 2003; Lizal and Svejnar, 2002; Mykhayliv and Zauner, 2004; Poncet et al., 2010).

In addition, one would expect the effects of financial constraints to intensify during the current financial and economic crisis. Duchin et al. (2010) studied the effects of the subprime mortgage credit crisis in U.S. public firms and showed that corporate investment declined significantly during the crisis. They found that the decline was greatest for firms that had low cash reserves or high net short-term debt, or were

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\(^1\) However, the reduced form models compound the parameters of the adjustment process with the parameters of the expectations-formation process, and as such can be subject to Lucas (1976) critique.
operating in industries dependant on external finance. Campello et al. (2010) surveyed chief financial officers worldwide and found that financially constrained firms planned deeper cuts in tech spending, employment, and capital spending. They also burned through more cash, drew more heavily on lines of credit for fear that banks would restrict access in the future, and sold more assets to fund their operations.

To control for the effects of financial constraints on corporate investments, we include in the empirical specification (1) current and lagged values of firm’s cash flow $C_{it}$ (normalized by $K_{i,t-1}$). We thus obtain the following version of the error-correction model (cf. Črnigoj and Verbič, 2013a):

$$\frac{I_{it}}{K_{i,t-1}} = \phi \frac{I_{i,t-1}}{K_{i,t-2}} + \sigma_0 \Delta y_{it} + \sigma_1 \Delta y_{i,t-1} + \rho \left( k_{i,t-2} - y_{i,t-2} \right) +$$

$$+ \theta_0 \frac{CF_{it}}{K_{i,t-1}} + \theta_1 \frac{CF_{i,t-1}}{K_{i,t-2}} + \sum_i \xi d_i + \mu_i + \delta_i.$$  

(2)

To control for the effects of corporate income taxation directly, we also include in the empirical specification (2) the user cost of capital $ucc_{it}$ (in logarithms):

$$\frac{I_{it}}{K_{i,t-1}} = \phi \frac{I_{i,t-1}}{K_{i,t-2}} + \sigma_0 \Delta y_{it} + \sigma_1 \Delta y_{i,t-1} + \rho \left( k_{i,t-2} - y_{i,t-2} \right) + \pi_0 \Delta ucc_{it} + \pi_1 \Delta ucc_{i,t-1} +$$

$$+ \theta_0 \frac{CF_{it}}{K_{i,t-1}} + \theta_1 \frac{CF_{i,t-1}}{K_{i,t-2}} + \sum_i \xi d_i + \mu_i + \delta_i.$$  

(3)

with the parameter of the user cost of capital in the error-correction term normalized to one and thus not estimated. A measure of the user cost of capital was constructed based upon Jorgenson (1963) and Hall and Jorgenson (1967). The user cost of capital ($ucc_{i,j,t}$) for firm $i$ in industry $j$ at time $t$ is a weighted average of the firm’s asset-specific user costs ($ucc_{i,j,a,t}$) and can be expressed as (cf. Simmler, 2012):

$$ucc_{i,j,t} = \sum_{a=1}^n \alpha_{i,j}^a ucc_{i,j,a,t} = \sum_{a=1}^n \alpha_{i,j}^a \left[ \frac{p_{j,a}^t}{p_{j,j}^t} \cdot \frac{1 - m_{a,t} - z_{a,t}}{1 - \tau_t} \cdot (r_t + \delta_t) \right],$$  

(4)

where $\alpha_{i,j}^a$ is the firm-specific share of asset $a$ at time $t$, $p_{j,a}^t$ is the industry-specific purchase price at time $t$, $p_{j,j}^t$ is the industry-specific output price at time $t$, $m_{a,t}$ is the asset-specific investment tax allowance at time $t$, $z_{a,t}$ is the asset-specific tax depreciation allowance at time $t$, $\tau_t$ is the tax rate at time $t$, $r_t$ is the cost of capital at time
\( t \), and \( \delta_j \) is the assets-specific economic depreciation rate. We considered two types of assets here: buildings and equipment.

As outlined in Equation 3, corporate investments are affected by taxes through the user cost of capital. In particular, the investment tax allowances reduce the user cost of capital and thus the hurdle rate used to evaluate the profitability of the investments. This further implies lower required rate of return, more profitable investments, and more investments. As the capital market is not perfect and a firm cannot raise as much finance as it desires, there is also a tax effect that materializes through cash flow. In particular, the investment tax allowances increase the cash flow and thus the available internal funds. This further implies higher investment tax allowances, higher cash flow and thus greater internal funds available, and finally, higher investments.

Modelling the tax effect that materializes through cash flow requires disentangling the cash flow effect into the cash flow that is generated by the firm’s operations and decreased by interest paid – cash flow before taxes (\( CFBT \)), and the cash flow used for paying taxes – effective average taxes (\( EAT \)). This results in the following model specification (cf. Črnigoj and Verbič, 2013b):

\[
\frac{I_{it}}{K_{i,t-1}} = \phi \frac{I_{i,t-1}}{K_{i,t-2}} + \sigma_y \Delta y_{it} + \sigma_i \Delta y_{i,t-1} + \rho \left( k_{i,t-2} - y_{i,t-2} \right) + \pi_0 \Delta \text{cccc}_{it} + \pi_i \Delta \text{cccc}_{i,t-1} + \\
+ \theta_0 \frac{CFBT_{it}}{K_{i,t-1}} + \theta_i \frac{CFBT_{i,t-1}}{K_{i,t-2}} + \omega_0 \frac{EAT_{i,t}}{K_{i,t-1}} + \omega_i \frac{EAT_{i,t-1}}{K_{i,t-2}} + \sum_i \xi d_i + \mu_i + \theta_i. \tag{5}
\]

In the final empirical specification that was used to determine the effects of investment tax allowances on corporate investments for Slovenian firms, we suppressed the current effective average tax rate (\( EAT_{it} / K_{i,t-1} \)), as firms pay corporate income tax based on the income earned in the previous year. We also did not include the lagged value of the user cost of capital (\( \Delta \text{cccc}_{i,t-1} \)), as we would lose an additional year, resulting in a 3-year panel and a substantial loss of the explanatory power of empirical models.

### 2.2. Corporate microsimulation modelling

Identifying and revealing the incentives and distributional implications of corporate income taxation is of special interest to economic agents and economic policy (Reister et al., 2008). Therefore, the existing modelling approaches that are used for the identification of tax incentives have to be supplemented by approaches revealing the impacts of taxation on future tax revenue and the distribution of the tax burden (cf. Čok et al., 2013; Stanovnik and Verbič, 2013). Microsimulation models are suitable for this
purpose. Based on strongly disaggregated data, they capture structural differences at the level of micro units, thus allowing for precise conclusions regarding the individual financial impacts of tax reforms (Creedy, 2001).

There exist plenty of microsimulation models focussing on private households, whereas the number of models using firm level data is very limited (Bardazzi et al., 2004; Ahmet, 2006). As a result, until recently corporate microsimulation models did not receive attention from wider professional audience and policy makers. This can be partially attributed to the higher complexity of corporate microsimulation models, resulting from discrepancies between commercial law and tax law, the timing-effects of corporate taxation rules, the diversity of behavioural responses, and potential intercompany relations (Reister et al., 2008). But above all, the scarce availability of micro-level tax data on corporations represents a vital constraint.

The preference started shifting towards firm-based microsimulation in 2000s with four well-documented corporate microsimulation models being employed for policy analysis: (1) the CEFM model based on Canadian tax data and information on company structure and company accounts (Robidoux and Wong, 1998; Cao and Robidoux, 1998); (2) the DIECOFIS model based on an integrated dataset comprising financial statements and survey data on Italian firms (Castelluci et al., 2003; Oropallo and Parisi, 2007); (3) the DIW Biz-Tax model based on stratified trade tax and income statistics of German firms (Fossen and Bach, 2007; Bach et al., 2008); and (4) the ZEW TaxCoMM model based on financial statements of German firms and survey data regarding tax accounting practices (Reister et al., 2008; Reister, 2009).

To focus on economic and corporate issues, it is essential for the model to comprise real developments of firms over time in the simulation process, and to integrate behavioural responses to tax reforms. In principle, microsimulation models can be either static or dynamic. Static models focus on two stages, whereas dynamic models account for the development within the microsimulation process. Furthermore, both types of models can either include or exclude behavioural responses. To adequately capture the above requirements, the microsimulation model should cover several time periods and incorporate behavioural responses, which makes such a model – at least to a certain extent – dynamic per se. To allow for a high level of flexibility, a modular set-up has proven to be an adequate approach to simulation modelling (Spahn, 1992). The modules should capture all relevant regulations and account for interdependencies (Bovi, 2003). The modular set-up permits us to account quickly for changes in tax provisions, and to promptly include or exclude specific modules. Moreover, the simulation model can easily be extended by additional features to account for additional provisions of economic systems and to simulate additional economic policy measures.
The corporate microsimulation model for Slovenia is a static simulation model with incorporated behavioural responses, which makes the model “dynamic”\(^2\). The base time period of the model covers years 2009–2010, whereas the parameters were estimated based on a 2006–2010 panel. As depicted in Figure 1, it comprises two main modules: (1) the module that statically reproduces all the variables in the base time period separately for each year; and (2) the module that incorporates the effects of corporate income tax provisions on firms’ investments. The latter module serves two important purposes: (a) it “dynamically” reproduces the investments in the base time period as a whole, and (b) it enables simulation of the effects of changes in the characteristics of corporate income taxation on firms’ investments in the base time period.

The first module reproduces all the corporate income tax items from the Corporate Income Tax Returns (DDPO), provided by the Tax Administration of the Republic of Slovenia (TARS). The programming code starts at the “top” with a firm’s revenue and expenditure for the financial year, and then progresses “down” along the lines of revenue and expenditure to the smallest details and peculiarities of the corporate income tax code. The difference between a firm’s revenue and expenditure results in a profit or loss, which is then used for calculating the corporate income tax base and the corporate income tax liability. The details change frequently between years (cf. Verbič et al., 2013), so this should be taken into account by carefully and exactly reproducing the Corporate Income Tax Returns separately for each year.

The second module introduces into the microsimulation setting the effects of corporate income tax provisions on firms’ tax liability and investments. Based on our investment model, corporate investments can be affected by the corporate income tax through two major channels: (1) the user cost of capital (\(ucct\)), and (2) the cash flow used for paying taxes, i.e. the effective average taxes (\(EATt\)). We thus distinguish between the effect of the user cost of capital, measured in expression (5) by regression coefficients \(\pi_0\) and \(\pi_1\), and the effect that materializes through cash flow, measured by regression coefficients \(\omega_0\) and \(\omega_1\). We include into our static microsimulation setting the relationship between the dependant variable \(I_t / K_{t-1}\) and: (a) explanatory variables \(\Delta ucct_t\) and \(\Delta ucct_{t-1}\) on one hand, and (b) explanatory variables \(EAT_t / K_{t-1}\) and \(EAT_{t-1} / K_{t-2}\) on the other. The corporate income tax provisions, including the investment tax allowances, can affect firms’ investments through both channels.

\(^2\) The model is not dynamic in the sense that it would enable simulation of variables over a specified time horizon based on data from the base time period, but in the sense that it enables transmission of effects from one year to another within the base time period.
As already mentioned, we pursue two purposes with this empirical framework. First, the module “dynamically” reproduces investments in the base time period as a whole by delimiting them according to different provisions of the corporate income tax code. But more importantly, by establishing a transmission of effects from one year to another within the base time period it enables a microsimulation of changes in these provisions. If we focus on investment tax allowances as essential provisions of corporate income taxation, then the effects of investment tax allowances on corporate income tax and investments that can be modelled within such an empirical framework can be divided into two groups: direct effects and indirect effects.
Figure 1: Basic modular structure of the microsimulation model

Notes: Module 2 captures the “dynamic” effects of investment tax allowances on corporate income tax and investments: Δİ represents the change of investment tax allowances, ΔCIT represents the change of corporate income taxes, whereas ΔI represents the change of gross investments. The arrows indicate the direction of change (increase / decrease) of a variable.

As depicted in Figure 1, a change (increase or decrease) of investment tax allowances in year t changes the corporate income tax base in that year (decrease or increase) and thus the corporate income tax revenues (decrease or increase). Consequently, in year t + 1
the investments change (increase or decrease) accordingly, with the change being defined by regression coefficients \( \pi_0, \pi_1, \omega_0 \) and \( \omega_1 \) from expression (5). This first phase constitutes the direct effect of a change in corporate income tax provisions.

However, due to changed investments in year \( t + 1 \), the investment tax allowances also change (increase or decrease) in year \( t + 1 \), which further affects (decreases or increases) the corporate income tax base and revenue in year \( t + 1 \). The change of investment tax allowances \( \Delta A_{t+1} \) can thus be decomposed into the effect due to changed allowance rates in the current year \( \Delta A_{t+1} (\Delta m_{t+1}) \) and the effect due to changed investments based on the previous year \( \Delta A_{t+1} (\Delta I_{t+1}) \), and further for both types of investment, \( j = 2 \):

\[
\Delta A_{t+1} = \Delta A_{t+1} (\Delta m_{t+1}) + \Delta A_{t+1} (\Delta I_{t+1}) = \sum_j \Delta A_{j,t+1} (\Delta m_{j,t+1}) + \sum_j \Delta A_{j,t+1} (\Delta I_{t+1}), \tag{6}
\]

while the change of corporate income tax liability \( \Delta CIT_{t+1} \) can likewise be decomposed into the effect due to changed investment tax allowances resulting from changed allowance rates in the current year \( \Delta CIT_{t+1} (\Delta m_{t+1}) \) and the effect due to changed investment tax allowances resulting from changed investments based on the previous year \( \Delta CIT_{t+1} (\Delta I_{t+1}) \):

\[
\Delta CIT_{t+1} = \Delta CIT_{t+1} (\Delta m_{t+1}) + \Delta CIT_{t+1} (\Delta I_{t+1}) = \sum_j \Delta CIT_{j,t+1} [\Delta A_{j,t+1} (\Delta m_{j,t+1})] + \sum_j CIT_{j,t+1} [\Delta A_{j,t+1} (\Delta I_{t+1})]. \tag{7}
\]

Consequently, in year \( t + 2 \) the investments change (increase or decrease) again. This change, \( \Delta I_{t+2} \), can also be decomposed into the effect due to changed investment tax allowances resulting from changed allowance rates in the previous year \( \Delta I_{t+2} (\Delta m_{t+1}) \) and the effect due to changed investment tax allowances resulting from changed investments based on two years ago \( \Delta I_{t+2} (\Delta I_{t+1}) \):

\[
\Delta I_{t+2} = \Delta I_{t+2} (\Delta m_{t+1}) + \Delta I_{t+2} (\Delta I_{t+1}) = \sum_j \Delta I_{j,t+2} [\Delta A_{j,t+1} (\Delta m_{j,t+1})] + \sum_j I_{j,t+2} [\Delta A_{j,t+1} (\Delta I_{t+1})]. \tag{8}
\]

This second phase constitutes the indirect effect of a change in corporate income tax provisions that emerges due to changed investment. The length of this adjustment process is defined by the length of the base time period, which is in our case two years,
and by the strength and statistical significance of the estimated regression coefficients from the empirical investment model.

Both modules enable the simulation of all the corporate income tax provisions in the base time period in Slovenia. Individual parameters of the tax code can be changed at the sectoral level or at the national level. As the microsimulation process is based on a sample of Slovenian firms, the results of the scenarios are then aggregated to the national level by using shares of sample sums in the population sums of the variables from the base time period. The simulation results can thus be reported at the firm level, the sectoral level, or the national level.

3. Data

We constructed a panel data set that covers Slovenian firms for the period 2006–2010. The database combines accounting data provided by the Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES), and data from the Survey on Corporate Gross Investments (INV-1) conducted by the Statistical office of the Republic of Slovenia (SORS). The AJPES database includes income statements and balance sheets of Slovenian firms, while the INV-1 database includes data about corporate investments and financing resources used to fund the investments and covers firms with more than 10 employees. To approximate the user cost of capital, we employed additional data that were obtained by the SORS and the Bank of Slovenia.

The AJPES database includes all Slovenian firms, as they are legally obliged to report financial statements to AJPES, whereas the coverage of the survey data in INV-1 depends on the response rate. The response rate in the period 2006–2010 amounted to some 90–93%. Analysing the descriptive statistics and various distributions of the population of firms and the sample including only the firms that participated in INV-1, we do not observe any significant differences. The firms that did not respond to the survey are approximately evenly distributed across different size groups and sectors, meaning that our panel is representative.

Combining the two databases, as well as other resources, and calculating the variables of interest, we end up with a panel that consists of 11,619 firm-year observations in the period 2007–2010. Table 1 shows the descriptive statistics (mean values and standard deviations) of the available panel. The firms in the panel generated on average roughly 16.9 million EUR of sales, 0.97 million EUR of earnings before interest and taxes, and 332 thousands EUR of net income per annum. The firms had on average 18.6 million EUR of assets and employed 119 employees.
The variables we use in our empirical models are investments, stock of capital, output, the user cost of capital, cash flow, and corporate income tax. We consider investments in property, plants and equipment, as well as intangible assets. We also try to measure investments only by taking into account investments in tangible assets, though the results remain roughly the same. The stock of capital is approximated by the book value of property, plants and equipment and in tangible assets, or only by the book value of tangible assets, depending on what is considered to represent the investments. We approximated output by the firm’s sales. To construct a measure of the user cost of capital, we considered two types of assets; buildings and equipment. We approximated the firm-specific shares of assets by the firm’s share of investments in each type of assets in total investments in fixed assets.

Table 1: Descriptive statistics of the panel (mean values and standard deviations)

<table>
<thead>
<tr>
<th>Variable</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (in EUR)</td>
<td>17,100,241</td>
<td>17,470,739</td>
<td>15,942,044</td>
<td>17,377,252</td>
<td>16,920,994</td>
</tr>
<tr>
<td>EBIT (in EUR)</td>
<td>1,005,158</td>
<td>991,312</td>
<td>923,660</td>
<td>970,907</td>
<td>971,069</td>
</tr>
<tr>
<td>Net income (in EUR)</td>
<td>4,253,997</td>
<td>386,042</td>
<td>220,070</td>
<td>186,730</td>
<td>331,833</td>
</tr>
<tr>
<td>ROA</td>
<td>0.065</td>
<td>0.051</td>
<td>0.022</td>
<td>0.027</td>
<td>0.044</td>
</tr>
<tr>
<td>Assets (in EUR)</td>
<td>17,993,711</td>
<td>18,556,917</td>
<td>18,980,708</td>
<td>20,414,440</td>
<td>18,594,678</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.240</td>
<td>0.269</td>
<td>0.321</td>
<td>0.276</td>
<td>0.268</td>
</tr>
<tr>
<td>Employees</td>
<td>124</td>
<td>117</td>
<td>115</td>
<td>112</td>
<td>119</td>
</tr>
<tr>
<td>Observations</td>
<td>2,901</td>
<td>3,089</td>
<td>2,840</td>
<td>2,789</td>
<td>11,619</td>
</tr>
</tbody>
</table>

Notes: EBIT stands for earnings before interest and taxes, while ROA represents the return on assets. Leverage ratio is calculated as the ratio of short and long-term debt to total assets. Standard deviations are reported below the mean values for each variable and year.

Source: AJPES; own calculations.

The cost of capital is approximated by the after-tax cost of debt. Despite some studies using a weighted average of the different sources of finance (Auerbach and Hassett, 1992; Chirinko et al., 1999), others argue that simplifying the proxy and resorting to the cost of debt that is easier to estimate does not influence the results. Simmler (2012), e.g., who used the after-tax cost of debt, obtained identical results as Dwenger (2009), who conducted the same tests and used a weighted average cost of capital. Besides, Simmler (2012) argues that this simplification and using the cost of debt is in line with the hierarchy of finance theory. Cummins et al. (1994) obtained the same result using a fixed required rate of return of 4% and using the firm-specific cost of debt approximated using the Compustat data on firms’ interest expense and total long-term and short-term
debt, and firms’ S&P debt rating and bond rating. Besides the time series variation, we take into account the variability of the cost of debt depending on the volume of the investments and thus the loan. In particular, we distinguish the cost of debt for loans below 1 million EUR and above 1 million EUR.

We calculated a measure of cash flow by adding back depreciation and net interest to the reported net income. To control for the effect of taxes in financially constrained firms that materializes through cash flow, we use a measure that is based on the effective average tax \((EAT_t)\) – the value of firm’s paid corporate income tax.

In Table 2 we present the mean values and standard deviations of the variables in our empirical models. The investment rate \((I_t / K_{t-1})\) amounted to almost 0.5 in 2006, but dropped to 0.4 in years 2007 and 2008, and was as low as 0.3 in years 2009 and 2010. A somewhat similar trend can be observed when analyzing the growth rate of sales \((\Delta y_t)\), which decreased from 0.17 in 2007 to as low as \(-0.10\) in 2009, when the crisis most severely hit the economy, but picked up again in 2010, when it reached 0.07. The growth rate of the user cost of capital \((\Delta ucc_t)\) is negative throughout the whole period, meaning that the user cost of capital was decreasing. This was happening in the period under investigation mainly because the investment tax allowances were increasing and the corporate income tax rate was decreasing. The cash flow rate \((CF_t / K_{t-1})\) decreased from around 0.7 in the years 2006–2008 to 0.55 and 0.54 in years 2009 and 2010, respectively. Effective average tax rate \((EAT_t / K_{t-1})\) increased from 0.1 in 2006 to 0.15 in 2007, as the tax allowance for investments in the equipment ceased to exist, but is decreasing thereafter in line with the increases of investment tax allowances and decreases of the corporate income tax rate. It amounted to 0.09 in 2010.

Table 2: Descriptive statistics of the model variables (mean values and standard deviations)

<table>
<thead>
<tr>
<th>Variable</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_t / K_{t-1})</td>
<td>0.382</td>
<td>0.395</td>
<td>0.270</td>
<td>0.250</td>
<td>0.326</td>
</tr>
<tr>
<td></td>
<td>1.245</td>
<td>1.335</td>
<td>1.844</td>
<td>1.055</td>
<td>1.402</td>
</tr>
<tr>
<td>(\Delta y_t)</td>
<td>0.173</td>
<td>0.122</td>
<td>-0.103</td>
<td>0.072</td>
<td>0.068</td>
</tr>
<tr>
<td></td>
<td>0.304</td>
<td>0.298</td>
<td>0.299</td>
<td>0.284</td>
<td>0.314</td>
</tr>
<tr>
<td>(k_{t-2} - y_{t-2})</td>
<td>-</td>
<td>-1.386</td>
<td>-1.440</td>
<td>-1.408</td>
<td>-1.387</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>1.245</td>
<td>1.268</td>
<td>1.299</td>
<td>1.265</td>
</tr>
<tr>
<td>(\Delta ucc_t)</td>
<td>-0.022</td>
<td>-0.106</td>
<td>-0.043</td>
<td>-0.204</td>
<td>-0.095</td>
</tr>
<tr>
<td></td>
<td>0.049</td>
<td>0.126</td>
<td>0.116</td>
<td>0.238</td>
<td>0.164</td>
</tr>
<tr>
<td>(CF_t / K_{t-1})</td>
<td>0.690</td>
<td>0.650</td>
<td>0.548</td>
<td>0.539</td>
<td>0.606</td>
</tr>
<tr>
<td></td>
<td>1.381</td>
<td>1.298</td>
<td>1.051</td>
<td>0.974</td>
<td>1.204</td>
</tr>
<tr>
<td>(CFBT_t / K_{t-1})</td>
<td>1.011</td>
<td>0.972</td>
<td>0.910</td>
<td>0.910</td>
<td>0.927</td>
</tr>
<tr>
<td></td>
<td>2.217</td>
<td>2.146</td>
<td>2.176</td>
<td>2.194</td>
<td>2.123</td>
</tr>
<tr>
<td>(EAT_t / K_{t-1})</td>
<td>0.145</td>
<td>0.117</td>
<td>0.089</td>
<td>0.092</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>0.416</td>
<td>0.368</td>
<td>0.309</td>
<td>0.322</td>
<td>0.357</td>
</tr>
<tr>
<td>Observations</td>
<td>2,836</td>
<td>3,029</td>
<td>2,732</td>
<td>2,653</td>
<td>11,250</td>
</tr>
</tbody>
</table>

Note: Standard deviations are reported below the mean values for each variable and year.
Source: AJPES, INV-1; own calculations.
Last, the sample was divided into subsamples according to financial constraints and firm size. We identified financially constrained firms as those with leverage exceeding the median leverage, whereas the firms with leverage below the median were regarded as financially unconstrained. Firms were additionally divided into subsamples of small, medium-sized and large firms according to the common definition of SMEs by the European Commission. These subsamples were fully exploited in the econometric estimation of investment models.

4. Econometric estimation

The error-correction models were estimated using the GMM method, the instruments used including lagged values of explanatory variables ($t - 1$ and $t - 2$). GMM controls for biases due to the unobserved firm-specific effect, as well as endogenous explanatory variables. The GMM estimator eliminates the firm-specific effects by differencing the equations, and then uses lagged values of endogenous explanatory variables as instruments. We tested the validity of the instruments used by reporting the Sargan test of overidentifying restrictions, which did not reject the null hypothesis of valid overidentifying restrictions. In Table 3, we report the regression results of the baseline error-correction model\(^3\), outlined in Equation 2.

\(^3\) In this article, only the results of most relevant model specifications are fully reported. The results of econometric specifications estimated on subsamples (taking into account financial constrains or firm size) are available in Verbič et al. (2013). The results of robustness checks based on different model specifications and different investment models are available upon request from the authors.
Table 3: Results of econometric estimation of the baseline error-correction model

<table>
<thead>
<tr>
<th>Specification</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{t-1}/K_{t-2}$</td>
<td>$-0.002147$</td>
<td>$-0.004062$</td>
</tr>
<tr>
<td></td>
<td>(0.004579)</td>
<td>(0.005143)</td>
</tr>
<tr>
<td>$\Delta y_t$</td>
<td>0.103195*</td>
<td>0.158099**</td>
</tr>
<tr>
<td></td>
<td>(0.055000)</td>
<td>(0.065461)</td>
</tr>
<tr>
<td>$\Delta y_{t-1}$</td>
<td>0.153654****</td>
<td>0.200457***</td>
</tr>
<tr>
<td></td>
<td>(0.057120)</td>
<td>(0.067184)</td>
</tr>
<tr>
<td>$k_{t-2}-y_{t-2}$</td>
<td>$-0.180577$</td>
<td>$-0.175136$</td>
</tr>
<tr>
<td></td>
<td>(0.039196)</td>
<td>(0.044531)</td>
</tr>
<tr>
<td>$CF_t/K_{t-1}$</td>
<td>0.238424****</td>
<td>0.267281***</td>
</tr>
<tr>
<td></td>
<td>(0.027224)</td>
<td>(0.026854)</td>
</tr>
<tr>
<td>$CF_{t-1}/K_{t-2}$</td>
<td>0.082708***</td>
<td>0.062252***</td>
</tr>
<tr>
<td></td>
<td>(0.024317)</td>
<td>(0.023693)</td>
</tr>
<tr>
<td>$CF_t/K_{t-1} \cdot D2009$</td>
<td>0.314135****</td>
<td>0.174889***</td>
</tr>
<tr>
<td></td>
<td>(0.045152)</td>
<td>(0.040886)</td>
</tr>
<tr>
<td>$CF_t/K_{t-1} \cdot D2010$</td>
<td>0.187032***</td>
<td>0.165983***</td>
</tr>
<tr>
<td></td>
<td>(0.054342)</td>
<td>(0.050607)</td>
</tr>
<tr>
<td>$CF_{t-1}/K_{t-2} \cdot D2009$</td>
<td>$-0.012688$</td>
<td>$-0.023748$</td>
</tr>
<tr>
<td></td>
<td>(0.032115)</td>
<td>(0.030566)</td>
</tr>
<tr>
<td>$CF_{t-1}/K_{t-2} \cdot D2010$</td>
<td>0.148998**</td>
<td>0.093100</td>
</tr>
<tr>
<td></td>
<td>(0.059590)</td>
<td>(0.057224)</td>
</tr>
</tbody>
</table>

Observations | 6,456 | 6,455 |
Firms | 2,683 | 2,682 |
Wald test | 399.43 | 363.44 |
$p$-value | 0.0000 | 0.0000 |
Sargan test | 3.6665 | 8.1632 |
$p$-value | 0.5984 | 0.1475 |

Notes: Robust standard errors are reported in parentheses below the regression coefficients. Industry dummy variables are included as explanatory variables, but not reported. Asterisk * denotes statistical significance below the 0.1 probability level, ** denotes statistical significance below the 0.05 probability level, whereas *** denotes statistical significance below the 0.01 probability level.

Source: AJPES, INV-1; own calculations.

The results in Table 3 show significant effects of financial constraints on investments in Slovenian firms during the last economic crisis. In both specifications the model was tested on the whole sample, where specification (1) considers investments in property, plants and equipment as well as intangible assets, while specification (2) considers only investments in tangible assets. The coefficients on the current cash flow rate ($CF_t/K_{t-1}$) and the lagged cash flow rate ($CF_{t-1}/K_{t-2}$) were positive and highly statistically significant. To assess the dynamics of the effect of financial constraints, we used two interactive terms that were obtained by multiplying the cash flow rates and the time indicator variables ($CF_t/K_{t-1} \cdot D2009$, $CF_t/K_{t-1} \cdot D2010$, $CF_{t-1}/K_{t-2} \cdot D2009$, $CF_{t-1}/K_{t-2} \cdot D2010$). The regression coefficients on these interactive terms suggest that the effect of financial constraints intensified in 2009 and was slightly alleviated in 2010, however still being significantly more intense than in 2008. Coefficients on the error-correction term ($k_{t-2}-y_{t-2}$) were correctly signed, indicating that firms on average close 18% of the gap between desired and actual capital stock per year.
The dynamics of closing the gap in financially unconstrained firms was twice as fast compared to the average, since these firms close 36% of the gap per annum (Verbič et al., 2013). The coefficient of the error-correction term for financially constrained firms had a very low value, suggesting that these firms have difficulties in closing the gap. Small firms tend to be most severely hit by the credit crunch, and also most loudly complain about the inability to obtain credit. The coefficient on the current cash flow rate \((CF_t / K_{t-1})\) in small firms amounted to 0.26, while it amounted to only 0.17 in medium-sized and large firms (Verbič et al., 2013).

**Table 4:** Results of econometric estimation of the error-correction model with incorporated tax effects

<table>
<thead>
<tr>
<th>Specification</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I_{t-1} / K_{t-2})</td>
<td>0.024897*</td>
<td>0.000010</td>
</tr>
<tr>
<td></td>
<td>(0.014136)</td>
<td>(0.011820)</td>
</tr>
<tr>
<td>(\Delta y_t)</td>
<td>0.097929**</td>
<td>0.139630**</td>
</tr>
<tr>
<td></td>
<td>(0.049713)</td>
<td>(0.061892)</td>
</tr>
<tr>
<td>(\Delta y_{t-1})</td>
<td>0.103127**</td>
<td>0.156207**</td>
</tr>
<tr>
<td></td>
<td>(0.053094)</td>
<td>(0.065575)</td>
</tr>
<tr>
<td>(k_{t-2} - y_{t-2})</td>
<td>-0.049031</td>
<td>-0.064340</td>
</tr>
<tr>
<td></td>
<td>(0.039663)</td>
<td>(0.046093)</td>
</tr>
<tr>
<td>(\Delta ucct)</td>
<td>0.017701</td>
<td>0.027230</td>
</tr>
<tr>
<td></td>
<td>(0.064308)</td>
<td>(0.080721)</td>
</tr>
<tr>
<td>(CFBT_t / K_{t-1})</td>
<td>0.234901***</td>
<td>0.239971***</td>
</tr>
<tr>
<td></td>
<td>(0.014847)</td>
<td>(0.014865)</td>
</tr>
<tr>
<td>(CFBT_{t-1} / K_{t-2})</td>
<td>0.029233</td>
<td>0.061992***</td>
</tr>
<tr>
<td></td>
<td>(0.018908)</td>
<td>(0.019645)</td>
</tr>
<tr>
<td>(EAT_{t-1} / K_{t-2})</td>
<td>-0.106202</td>
<td>-0.356959***</td>
</tr>
<tr>
<td></td>
<td>(0.092202)</td>
<td>(0.096259)</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors are reported in parentheses below the regression coefficients. Industry dummy variables are included as explanatory variables, but not reported. Asterisk * denotes statistical significance below the 0.1 probability level, ** denotes statistical significance below the 0.05 probability level, whereas *** denotes statistical significance below the 0.01 probability level.

Source: AJPES, INV-1; own calculations.

In Table 4, we report the regression results of the error-correction model with incorporated tax effects, outlined in Equation 5. As seen from Table 4, the results in support of the hypothesis that corporate investments in Slovenian firms were affected by taxes are ambiguous. In particular, they suggest that corporate investments were not affected by taxes through the user cost of capital, however, we found weak evidence (in terms of robustness) of the effect that materializes through cash flow. Namely, the coefficient of the user cost of capital (\(\Delta ucct\)) was statistically insignificant in all model
specifications, though we found a negative and statistically significant effect of the effective average tax rate \( \frac{EAT_t}{K_{t-1}} \) in model specification (2), where we consider only investments in property, plants and equipment.

We also estimated the model with incorporated tax effects on subsamples of financially unconstrained and financially constrained firms, and subsamples of small, medium-sized and large firms (Verbič et al., 2013). Again, the coefficient of the user cost of capital \( \Delta ucc_t \) was statistically insignificant, whereas we found a similarly ambiguous results for the effect of effective tax rate\(^4\).

5. Microsimulation

For constructing the corporate microsimulation model, we created a new database by merging and linking data from Corporate Income Tax Returns (DDPO) provided by the Tax Administration of the Republic of Slovenia (TARS), and the already analysed data from the Survey on Corporate Gross Investments (INV-1) conducted by the Statistical Office of the Republic of Slovenia (SORS). We thus obtained a database for the base time period 2009–2010, comprising 66,452 firms in 2009 and 68,894 firms in 2010. Based on the relevant variables of our microsimulation model, such as revenues, number of employees and taxes paid, our sample of Slovenian firms covers around two thirds of the Slovenian economy.

If the results of econometric estimation of our empirical models had allowed, it would have been sensible to include into our microsimulation model both transmission channels between corporate income taxation and corporate investments: namely, the effect of the user cost of capital and the effect that materializes through cash flow. However, as seen in the previous section, the effect of the user cost of capital was statistically insignificant, therefore we included in the model to date only the empirical relationship between corporate investments and lagged effective average taxes (cash flow used for paying taxes), both normalized by capital stock. Corporate income tax provisions, including the investment tax allowances, thus affect the investments of firms through effective average taxes with one time lag.

For the purpose of this article, we developed two scenarios: (a) the baseline scenario that reproduces all the variables in the base time period 2009–2010, and (b) one counterfactual scenario that enables simulation of the effects of changes in the characteristics of corporate income taxation on firms’ investments in the base time

\(^4\) For example, we found a statistically significant (and negatively signed) coefficient of the effective tax rate \( \frac{EAT_t}{K_{t-1}} \) for financially unconstrained firms in some specifications, but not in others.
period. All values of variables hereinafter are aggregated from our sample of firms to the population representing the Slovenian economy. Despite the aggregation process, the deviations of simulated values from the actual values at the national level were below 0.1% for all relevant variables of our microsimulation model.

The counterfactual scenario enables simulation of changes in investment tax allowances that were actually implemented by the Government of the Republic of Slovenia in 2012, but were not backed, at least to our knowledge, by any study or treatise of consequences of such measures. Namely, the allowance for investments in equipment and intangible assets and the allowance for investments in R&D, which are by far the most important to firms, were substantially increased by 2012. The allowance for investments in equipment and intangible assets increased from 30% in 2009 and 2010 to 40% of invested funds of this type in 2012, while the allowance for investments in R&D increased from 20% in 2009 and 40% in 2010 to 100% of invested funds of this type in 2012. Both are still limited by the corporate income tax base, though, but can be transferred to five future tax periods if not used in full. All other provisions of the corporate income tax code remain unchanged in the counterfactual scenario.

The baseline scenario reveals that the gross investment of Slovenian companies amounted to 5.4 and 4.7 billion EUR in years 2009 and 2010, respectively (see Table 5). Approximately half of these funds were invested into construction works and land improvement, approximately one third into machinery, equipment and cultivated assets, and the remainder into vehicles and intangible fixed assets. Moreover, Slovenian companies claimed 80.4 and 83.3 million EUR of allowances for investments in equipment and intangible assets and 48.8 and 93.6 million EUR of allowances for investments in R&D in years 2009 and 2010, respectively (Table 5). The value of their corporate income tax liability amounted to 621.6 and 624.7 million EUR, respectively.

Table 5: Values of variables from the corporate income tax returns and survey on corporate gross investments in the base time period, in thousand EUR

<table>
<thead>
<tr>
<th>Microsimulation variable</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporate revenue</td>
<td>80,928,955</td>
<td>85,432,856</td>
</tr>
<tr>
<td>Corporate expenditure</td>
<td>79,503,092</td>
<td>84,096,796</td>
</tr>
<tr>
<td>Gross investment</td>
<td>5,430,186</td>
<td>4,674,498</td>
</tr>
<tr>
<td>– Construction works and land improvement</td>
<td>2,907,295</td>
<td>2,361,740</td>
</tr>
<tr>
<td>– Machinery, equipment and cultivated assets</td>
<td>1,808,888</td>
<td>1,700,289</td>
</tr>
<tr>
<td>– Vehicles</td>
<td>444,634</td>
<td>344,163</td>
</tr>
<tr>
<td>– Intangible fixed assets</td>
<td>269,369</td>
<td>268,306</td>
</tr>
<tr>
<td>Allowances for investments in equipment and intangible assets</td>
<td>80,383</td>
<td>83,302</td>
</tr>
<tr>
<td>Allowances for investments in R&amp;D</td>
<td>48,826</td>
<td>93,626</td>
</tr>
<tr>
<td>Corporate income tax base</td>
<td>2,987,092</td>
<td>3,149,985</td>
</tr>
<tr>
<td>Corporate income tax liability</td>
<td>621,639</td>
<td>624,747</td>
</tr>
</tbody>
</table>

Source: DDPO, INV-1; own calculations.
Further analysis of the database reveals that in 2010 only 953.6 million EUR or 20.4% of gross investments were employed for investment tax allowances\(^5\); of which 415.6 million EUR were employed for allowances for investments in equipment and intangible assets and 537.9 million EUR for allowances for investments in R&D.

The counterfactual scenario reveals the direct and indirect effects of the increase in investment tax allowances on corporate income tax and investments, as illustrated in Figure 1. As reported in Table 6, the allowances for investments in equipment and intangible assets increase by 32.5% in 2009, whereas the allowances for investments in R&D increase by as much as 312.7%. A disproportionate increase of the latter allowance was expected, as the allowance rate for investments in R&D increases by 60-80 percentage points, while the allowance rate for investments in equipment and intangible assets increases by only 10 percentage points in the counterfactual scenario (and in the Slovenian economy since 2012).

Table 6: Simulation of investment tax allowances in the base time period, counterfactual scenario, variables in thousand EUR

<table>
<thead>
<tr>
<th>Microsimulation variable</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline allowances for investments in equipment and intangible assets</td>
<td>80,383</td>
<td>83,302</td>
</tr>
<tr>
<td>Simulated allowances for investments in equipment and intangible assets</td>
<td>106,530</td>
<td>112,784</td>
</tr>
<tr>
<td><strong>Change of allowances for investments in equipment and intangible assets</strong></td>
<td><strong>26,157</strong></td>
<td><strong>29,482</strong></td>
</tr>
<tr>
<td>– due to changed allowance rate in the current year</td>
<td>–</td>
<td>27,178</td>
</tr>
<tr>
<td>– due to changed investments based on the previous year</td>
<td>–</td>
<td>2,305</td>
</tr>
<tr>
<td>Baseline allowances for investments in R&amp;D</td>
<td>48,826</td>
<td>93,626</td>
</tr>
<tr>
<td>Simulated allowances for investments in R&amp;D</td>
<td>201,508</td>
<td>221,346</td>
</tr>
<tr>
<td><strong>Change of allowances for investments in R&amp;D</strong></td>
<td><strong>152,682</strong></td>
<td><strong>127,719</strong></td>
</tr>
<tr>
<td>– due to changed allowance rate in the current year</td>
<td>–</td>
<td>117,409</td>
</tr>
<tr>
<td>– due to changed investments based on the previous year</td>
<td>–</td>
<td>10,310</td>
</tr>
<tr>
<td><strong>Combined change of investment tax allowances</strong></td>
<td><strong>178,839</strong></td>
<td><strong>157,201</strong></td>
</tr>
<tr>
<td>– due to changed allowance rates in the current year</td>
<td>–</td>
<td>144,587</td>
</tr>
<tr>
<td>– due to changed investments based on the previous year</td>
<td>–</td>
<td>12,615</td>
</tr>
</tbody>
</table>

**Source:** DDPO, INV-1; own calculations.

Consequently, the corporate income tax base and the corporate income tax liability both decrease in aggregate by 6.0% in 2009 (see Table 7). As Slovenian firms pay lower corporate income taxes in 2009, the effect that materializes through cash flow causes an increase in gross investments (first of all) in 2010 by 3.7% (see Table 8). Within this increase, gross investments employed for allowances for investments in equipment and intangible assets increase by 2.1% and gross investments employed for allowances for

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\(^5\) By the term “investments employed for investment tax allowances” we mean investments that both qualify for investment tax allowances and are actually declared by the firms to obtain the allowances.
investments in R&D increase by 4.9%. This first phase constitutes the direct effect of a change in investment tax allowances on corporate investments of firms.

In 2010, the combined investment tax allowances increase by 88.9%, but can now be decomposed into the effect due to changed allowance rates in 2010, amounting to 92.0% of the total change, and the effect due to changed investments in 2010 (based on 2009), amounting to the remaining 8% of the total change (see Table 6). The investment tax allowances thus also increase in 2010 due to increased investments (with a one-year lag). Within the combined investment tax allowances increase, the allowances for investments in equipment and intangible assets increase in 2010 by 12.7% more, while the allowances for investments in R&D increase by 16.3% less than in 2009.

### Table 7: Simulation of corporate income tax base, corporate income tax and corporate income tax liability in the base time period, counterfactual scenario, variables in thousand EUR

<table>
<thead>
<tr>
<th>Microsimulation variable</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline corporate income tax base</td>
<td>2,987,092</td>
<td>3,149,985</td>
</tr>
<tr>
<td>Simulated corporate income tax base</td>
<td>2,808,253</td>
<td>2,992,783</td>
</tr>
<tr>
<td><strong>Change of corporate income tax base</strong></td>
<td><strong>–178,839</strong></td>
<td><strong>–157,202</strong></td>
</tr>
<tr>
<td>Baseline corporate income tax</td>
<td>626,809</td>
<td>629,645</td>
</tr>
<tr>
<td>Simulated corporate income tax</td>
<td>589,252</td>
<td>598,205</td>
</tr>
<tr>
<td><strong>Change of corporate income tax</strong></td>
<td><strong>–37,556</strong></td>
<td><strong>–31,440</strong></td>
</tr>
<tr>
<td>Baseline corporate income tax liability</td>
<td>621,639</td>
<td>624,747</td>
</tr>
<tr>
<td>Simulated corporate income tax liability</td>
<td>584,083</td>
<td>593,307</td>
</tr>
<tr>
<td><strong>Change of corporate income tax liability</strong></td>
<td><strong>–37,556</strong></td>
<td><strong>–31,440</strong></td>
</tr>
<tr>
<td>– due to changed investment tax allowances resulting from changed allowance rates in the current year</td>
<td>–</td>
<td>–28,917</td>
</tr>
<tr>
<td>– due to changed investment tax allowances resulting from changed investments based on the previous year</td>
<td>–</td>
<td>–2,523</td>
</tr>
</tbody>
</table>

Source: DDPO, INV-1; own calculations.

This increase of investment tax allowances again decreases the corporate income tax base and revenue in 2010. Namely, the corporate income tax base and the corporate income tax liability both decrease in aggregate by 5.0% (see Table 7). Some 92.0% of the change in corporate income tax liability is due to changed investment tax allowances resulting from changed allowance rates in 2010, and some 8% is due to changed investment tax allowances resulting from changed investments in 2010 (based on 2009).

Consequently, due to the effect that materializes through cash flow investments again increase in 2011, but less so than in 2010. Namely, the combined increase of gross investments employed for investment tax allowances amounts to 24.2% less than in 2010 (see Table 8). Within the combined change of gross investments, gross investments employed for allowances for investments in equipment and intangible assets increase in 2011 by 39.4% less than in 2010, while gross investments employed

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6 Due to the contraction of the Slovenian economy and decreased investment spending, the increase of combined investment tax allowances is smaller in 2010 than in 2009 in spite of this additional effect.
for allowances for investments in R&D increase by 19.6% less than in 2010. This second phase constitutes the indirect effect of a change in investment tax allowances on firms’ corporate investments.

Finally, let us summarize the aggregate effects of changes in investment tax allowances that were actually implemented by the Government of the Republic of Slovenia in 2012. As seen from Table 7, the increase in allowance rates for investments in equipment and intangible assets and for investments in R&D decreases the corporate income tax liability of Slovenian firms in a two-year period (2009–2010) by 69.0 million EUR. As seen from Table 8, lower corporate income tax liability enables (with a time lag) an increase in gross investments, which nevertheless amounts in a two-year period (2010–2011) to only 56.2 million EUR. The direct loss of budget revenues is thus higher than the related increase of corporate investments. Based solely on the results of our microsimulation model backed by an estimated error-correction investment model, the policy measure of substantially increasing investment tax allowances for Slovenian firms does not seem to be economically justified. Establishing whether the policy measure would have a positive impact on budget revenues at least dynamically is beyond our modelling capabilities at the moment, though in such a case the investment multiplier should be substantially higher than 1.0.

Table 8: Simulation of gross investments employed for investment tax allowances in 2010 and 2011, counterfactual scenario, variables in thousand EUR

<table>
<thead>
<tr>
<th>Microsimulation variable</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline gross investments employed for allowances for investments in equipment and intangible assets</td>
<td>355,132</td>
<td>–</td>
</tr>
<tr>
<td>Simulated gross investments employed for allowances for investments in equipment and intangible assets</td>
<td>362,540</td>
<td>–</td>
</tr>
<tr>
<td>Change of gross investments employed for allowances for investments in equipment and intangible assets</td>
<td>7,408</td>
<td>4,491</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed allowance rates in the previous year</td>
<td>–</td>
<td>4,140</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed investments in the previous year</td>
<td>–</td>
<td>351</td>
</tr>
<tr>
<td>Baseline gross investments employed for allowances for investments in R&amp;D</td>
<td>503,771</td>
<td>–</td>
</tr>
<tr>
<td>Simulated gross investments employed for allowances for investments in R&amp;D</td>
<td>528,324</td>
<td>–</td>
</tr>
<tr>
<td>Change of gross investments employed for allowances for investments in R&amp;D</td>
<td>24,553</td>
<td>19,750</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed allowance rates in the previous year</td>
<td>–</td>
<td>18,156</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed investments in the previous year</td>
<td>–</td>
<td>1,594</td>
</tr>
<tr>
<td>Combined change of gross investments employed for investment tax allowances</td>
<td>31,961</td>
<td>24,241</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed allowance rates in the previous year</td>
<td>–</td>
<td>22,296</td>
</tr>
<tr>
<td>– due to changed corporate income tax liability resulting from changed investments in the previous year</td>
<td>–</td>
<td>1,945</td>
</tr>
</tbody>
</table>

Source: DDPO, INV-1; own calculations.
6. Concluding remarks

The article relates corporate taxation to corporate investment in Slovenia during the economic crisis in a microeconometric and a microsimulation setting. Based on the error-correction model of investment behaviour, we found that Slovenian firms’ investments were significantly affected by financial constraints during the period of economic crisis that hit the economy in 2009. The effect of financial constraints intensified in 2009 and was slightly alleviated in 2010, though it was still significantly more intense than before the crisis hit the economy. The results indicate that financial constraints have significant effect in both more and less levered firms, though corporate investments were more severely affected in firms that operate with above-average leverage.

The results in support of the hypothesis that corporate investments were affected by corporate income taxation are ambiguous. We modelled the tax effects via two different transmission channels, one being crucial for financially unconstrained firms and the other for financially constrained firms. As Slovenian firms were to a large extent financially constrained, only one of the two transmission channels between corporate income taxation and corporate investments proved to be statistically significant. Namely, the effect of the user cost of capital was statistically insignificant, while we found weak evidence (in terms of robustness) of the effect that materializes through cash flow. This poses reasonable doubts on whether corporate investments can be efficiently stimulated by more favourable corporate taxation.

We thus simulated the increases in investment tax allowances that were actually implemented by the Government of the Republic of Slovenia in 2012. It turned out that the direct loss of budget revenues that is caused by the changes in investment tax allowances since 2012 is higher than the expected increase of corporate investments related to increased investment tax allowances. However, to be able to give any definite conclusions on whether the policy measure of substantially increasing the investment tax allowances for Slovenian firms is economically justified, we will have to employ a general equilibrium model. Only a general equilibrium model linked to the microsimulation model will be able to capture the effects of additional investments on production, employment, value added, and related additional budget revenues.
References


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