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Personal Taxes and Corporate Investment

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Abstract

In this thesis, I present empirical evidence on the effect of personal taxes on firm-level investment. Exploiting a cross-country panel that consists of 40,608 firms from a total of 115 countries in the period 1999-2013, I employ a linear regression model in which I regress five different definitions of the personal tax wedge against capital investment of firms. I find that the average investment response of firms strongly depends on the definition of the personal tax wedge. My baseline regression reveals that, if the pure personal tax rate increases, firms on average show a positive capital investment response. That is, if firms cannot shift the economic burden of personal taxes to other stakeholders, an increase in personal taxes, ceteris paribus, increases the factor price of labour and thus exerts higher pressure on corporate profits. Profit-maximising firms therefore counteract this pressure by (partially) substituting the more expensive input factor labour by capital, increasing their capital investment. This effect, however, does not hold true for alternative definitions of the personal tax wedge that additionally include social security contributions. Likewise, I obtain mixed results when testing for cross-sectional variation in capital investment responses arising from differences in relative market power, the ability to substitute input factors, and financial constraints. In this context, my thesis provides empirical evidence on the effect of personal taxes on investment behaviour at the firm level and thus adds to current literature, which mainly considers the effect of personal taxes on aggregate investment, economic growth, and total factor productivity.

Keywords: investment; personal tax; tax wedge

1. Introduction

Over the past decades, a substantial amount of literature has evolved which extensively discusses the effect of corporate taxes (e.g., Auerbach et al., 1983; Djankov et al., 2010; Dobbins and Jacob, 2016; Giroud and Rauh, 2017; Ljungqvist and Smolyansky, 2016), payout taxes (e.g., Alstadsæter et al., 2017; Becker et al., 2013; Chetty and Saez, 2010; Yagan, 2015), and consumption taxes (e.g., Jacob et al., 2018) on investment behaviour of firms[1]. The discussion on the effect of personal taxes on firm-level investment, however, is much more fragmentary and less diverse. That is, although previous literature on personal taxes does exist, evidence on the direct effect of personal taxes on firm-level investment is surprisingly scarce. For instance, one set of studies exclusively relies on macroeconomic data and draws unclear conclusions about the effect on aggregate invest-

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[1] Dobbins and Jacob (2016) provide a comprehensive overview of studies which discuss a negative effect of corporate taxes on investment, both for the macro level (e.g., Auerbach et al., 1983; Djankov et al., 2010) and the direct effect on firm-level investment (e.g., Dobbins and Jacob, 2016; Ljungqvist and Smolyansky, 2016). Similarly, the effect of payout taxes on investment levels in the light of agency issues (e.g., Alstadsæter et al., 2017; Chetty and Saez, 2010) and the allocation of investment between cash-rich and cash-poor firms (e.g., Alstadsæter et al., 2017; Becker et al., 2013; Yagan, 2015), although with mixed empirical results, has been extensively investigated. Also, Jacob et al. (2018) provide recent empirical evidence on the effect of consumption taxes on firm-level investment which complements previously inconclusive findings on the macroeconomic level (e.g., Alesina et al., 2002; Arnold et al., 2011).

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ment and economic growth[2] (e.g., Lee and Gordon, 2005). Other studies, by contrast, attempt to complement these macro-level findings by estimating the effect on total factor productivity (e.g., Arnold et al., 2011) or by employing the q approach (e.g., Alesina et al., 2002) but they show no statistically significant, robust effect on firm-level investment[3]. Thus, it appears that previous studies have unclear implications for investment responses on the firm level which creates a substantial gap in tax research.

This neglect is astonishing when considering the importance of personal taxes for fiscal budgets and their practical relevance for input factor decisions of firms. First, personal taxes are a major source of tax revenues on the fiscal level and on average contribute to approximately 25% of tax revenues in OECD countries (Organisation for Economic Co-operation and Development, 2017) which emphasises the significance of personal taxes as a policy instrument. Second, and even more severely, if firms cannot fully pass the economic burden of personal taxes onto other parties (e.g., Dyreng et al., 2017; Jacob et al., 2018), personal taxes can, ceteris paribus, distort input factor decisions on the firm level, and thus the optimal factor mix of firms by increasing the factor price of labour. When abstracting from productivity differences between factors, this 'price increase' is expected to reduce the attractiveness of the input factor labour in favour of capital, and thus likely creates pressure to substitute the more expensive input factor labour by additional capital. Considering these substantial implications, it is imperative for policy makers and managers to understand the effect of personal taxes on investment behaviour of firms.

This thesis therefore aims at bridging this gap by providing empirical evidence on the effect of personal taxes on firm-level investment and the magnitude of this effect. For this, my empirical analyses exploit a cross-country panel of non-financial, non-transportation, non-telecommunication, non-utility firms in 115 countries over the 1999–2013 period. My estimation strategy is threefold. First, following Jacob et al. (2018), I employ linear probability models to identify "country-level determinants of ...[personal] tax changes" (Jacob et al., 2018, p.15). Second, my baseline model in which I account for "observable firm and [country-level] characteristics" (Alstadsæter et al., 2017, p.75) and include firm- and deficit-interest-payment-cluster-industry-year fixed effects estimates the average investment response. Third, I test for cross-sectional variation in investment responses to analyse the impact of differences in firm characteristics such as market power, the ability to substitute input factors, and financial constraints on the responsiveness of capital investment. In all tests, five different definitions of the personal tax rate (i.e., one pure personal tax rate and four different specifications including social security contributions) are employed to investigate whether investment responses of firms differ depending on the definition of the personal tax wedge.

Interestingly, my empirical results reveal exactly that. In my baseline regression, for instance, I can only validate a positive average response of capital investment for the pure personal tax rate (although the effect size is smaller than for other taxes) whereas specifications including social security contributions are statistically insignificant. This finding supports my proposed mechanism of firms facing higher pressure to substitute labour by capital but does not confirm predictions about social security contributions having the same economic effect on factor decisions as the pure tax rate. This picture slightly changes when testing for cross-sectional variation in investment responses where results are partially ambiguous. For instance, if firms have low market power, investment reacts more strongly compared to the average investment response in case of the pure personal tax rate, but the response mostly reverses (i.e., investment reacts less strongly) when including social security contributions in the personal tax wedge. Results also appear to be mixed when testing for differences in the ability to substitute labour by capital and financial constraints. Hence, my thesis contributes to the literature by providing empirical evidence on the direct relationship between the personal tax rate and investment behaviour at the firm level, and thus illustrates the impact of policy instruments on input factor decisions and the optimal factor mix of firms.

The remaining sections of this thesis are structured in the following way. In section 2, the theoretical background is explained based on which I derive four hypotheses (i.e., one predicting the average investment response and three investigating cross-sectional variation in capital investment responses). Section 3 presents my data, methodology, and summary statistics on variables used in my baseline regression. Furthermore, I conduct a pre-analysis and check for sufficient variation in personal tax changes in section 4 on which I base my baseline regression and subsequent analyses of cross-sectional variation in section 5. I then test for robustness of my baseline results in section 6. Finally, my conclusion is presented in section 7.

2. Theoretical Background: Model and Hypothesis Development

2.1. Optimal Input Factor Mix and Personal Tax Wedge

According to economic theory, the "production function [of firms] has two input factors, capital and labor" (Dobbins and Jacob, 2016, p.8). However, since firms are an investment vehicle of their shareholders (Alstadsæter and Jacob, 2012), and thus are assumed to be profit-maximising entities, they must decide on the optimal mix of these factors to produce a certain output at minimal costs. Following Pindyck and Rubinfeld (2018), the optimal factor mix is determined

[2] Lee and Gordon (2005) admit that "the aggregate information reported ... is insufficient to draw ... conclusion[s] about ... links between [personal] tax[es] ... and growth" (p.15).

[3] Arnold et al. (2011) investigate the effect of personal taxes on industry-level entrepreneurial activity and total factor productivity but fail to do so for firm-level investment. Likewise, Alesina et al. (2002) "estimate a q type of investment equation that links investment to ... profits" (p.572) but they solely rely on aggregate measures such as "investment of the business sector ...[and] capital stock" (p.578).

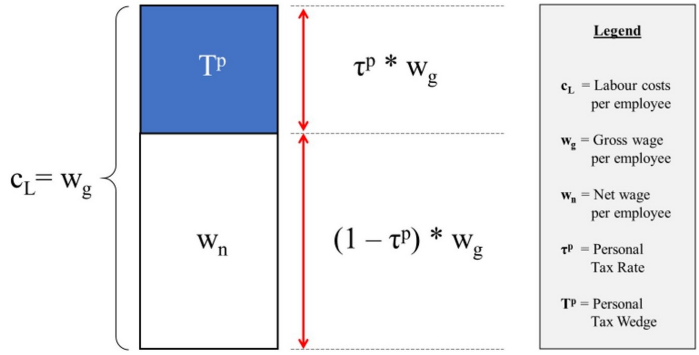

Figure 1: Personal Tax Wegde

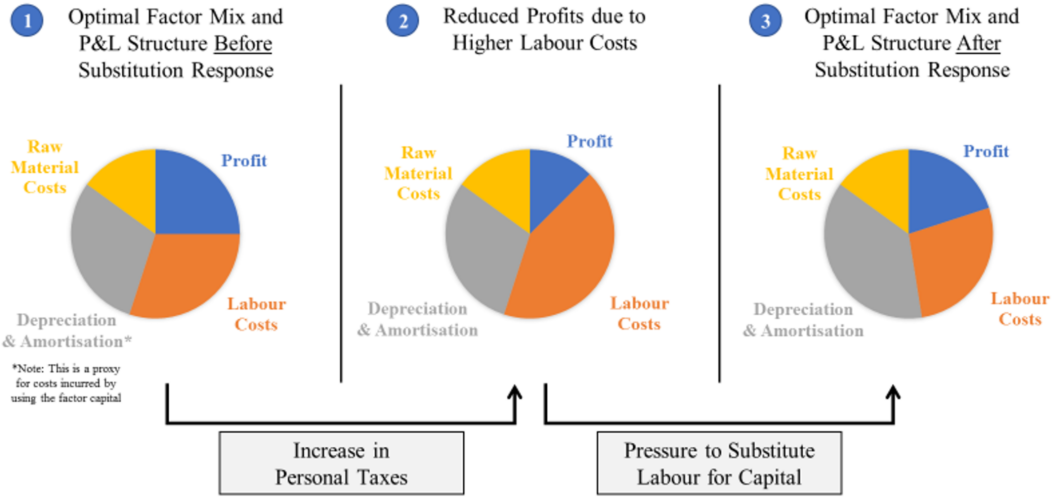

Figure 2: Substitution Response After a Personal Tax Increase

by the two criteria (a) factor productivity[4] and (b) price per input factor unit. That is, the more output a factor can produce within a certain time (i.e., the more productive a factor) for given factor price, the higher its contribution for the generation of revenues, and thus the more attractive the input factor. Likewise, the lower the price of a factor for a given productivity level, the higher the profit margin per unit of output produced, and hence the more attractive the input factor. Thus, when combining these two criteria, the optimal factor mix is a function of the relative attractiveness of input factors which can be expressed as the ratio of factor productivity to factor price[5].

Personal taxes, however, can change the optimal factor mix of firms. As illustrated in Figure 1, the "tax wedge theory" (Becker et al., 2013, p.5; see also Alstadsæter et al., 2017; Jacob et al., 2018) predicts that personal taxes drive a wedge between the factor price of labour paid by firms (c_L) and the net wage of employees (w_n). Thus, unless firms can fully shift "the economic burden, or incidence, [of personal taxes]" (Dyreng et al., 2017, p.6) to consumers via higher market prices or workers via lower net wages (Dyreng et al., 2017), personal taxes increase the factor price of labour while labour productivity remains constant[6], and thus they reduce the attractiveness of labour relative to capital.

Consequently, personal taxes exert pressure on profits, and thus force profit-maximising firms to substitute the relatively more expensive factor labour by additional capital[7]. Figure 2 visualises this relationship by using a simplified P&L structure which assumes firms to bear part of the personal tax incidence.

To conclude, personal taxes are expected to discriminate the input factor labour in favour of the input factor capital, and thus distort input factor decisions of firms[8]. Based on

[4]Factor productivity is defined as the level of output which can be produced by an input factor within a given time.

[5]For simplicity, I assume that the relative attractiveness of input factors only changes the mix of input factors whereas the level of output generated remains constant irrespective of the input factor mix. I also abstracted from other determinants of factor decisions, e.g., the availability of input factors (which is assumed to be reflected in the price) and the state of technology.

[6]I expect the higher factor price of labour not to be offset by increases in labour productivity (although this could be assumed in a world without personal taxes in which employees are paid a wage equal to their marginal productivity (Pindyck and Rubinfeld, 2018)). Thus, ceteris paribus, a tax-induced increase in the factor price of labour results in a lower attractiveness of labour relative to capital.

[7]I assume that labour and capital are, on the margin, substitutes (e.g., Dyreng et al., 2017; Jacob et al., 2018). Please refer to hypothesis one in section 2.2 for a detailed explanation. For a substitution response to be economically reasonable, capital is also assumed to have a productivity greater than zero, and firms are assumed to keep their output level constant.

[8]In a wider sense, personal taxes can be a variable not just including the

this, I develop four hypotheses on the investment behaviour of firms. In hypothesis one, I predict the average investment response. Hypotheses two, three, and four, then extend the scope of my model and capture cross-sectional variation in the responsiveness of capital investment.

2.2. Hypothesis Development

> Hypothesis 1: On average, if the economic burden of a personal tax increase is (partially) borne by firms, capital investment responds ambiguously.

Assuming supply and demand to be neither fully elastic nor inelastic (e.g., Jacob et al., 2018) in the labour market, the economic burden of a personal tax increase is shared between firms and employees (i.e., higher labour costs for firms, lower net wage for employees). At the firm level, this exerts higher pressure on profits, and thus forces profit-maximising firms to reduce costs incurred by their deployment of input factors. That is, since an increase in personal taxes directly increases the factor price of labour, firms would unambiguously try to reduce their labour intake in their production function to cut costs.

The effect on capital investment, however, is ambiguous and depends on whether labour and capital, on the margin (i.e., in marginal factor decisions), are complements or substitutes. Two channels of investment responses are hence plausible (e.g., Dyreng et al., 2017). First, like for labour, firms can respond by reducing their capital investment, too. This would allow them to "maintain their [optimal] mix of input factors" (Dobbins and Jacob, 2016, p.4), for which labour and capital, even on the margin, would be treated as complements. Second, by contrast, capital investment of firms could increase. Such a response would occur if labour and capital could be partially (i.e., to a small extent) substituted despite their overall complementarity, and thus both input factors would be substitutes on the margin. The second channel is empirically supported by Dyreng et al. (2017) showing that labour and capital, on the margin, can be substitutes.

> Hypothesis 2: After an increase in personal taxes, firms with low market power vis-à-vis their stakeholders show greater responsiveness in capital investment.

Intuitively, the personal tax incidence borne by firms (and ultimately shareholders) likely determines the magnitude of investment responses. That is, the greater (smaller) the economic burden on firms, the greater (smaller) the pressure to substitute labour by capital. Yet, previous literature suggests that "shareholders might not bear the entire economic burden [of personal taxes] ...[since a] firm's market power allows it to pass the [economic] burden to [stakeholders such as suppliers,] workers, or consumers" (Dyreng et al., 2017, p.1), and thus cross-sectional variation in investment responses may result from differences in the relative market power of firms. Since market power is a function of market demand elasticity (in the case of consumers) and supply elasticity (in the case of suppliers/workers) (e.g., Dyreng et al., 2017; Jacob et al., 2018), I present two cases in a partial equilibrium setting which show the relationship between market power and firm-level investment[9]. Also, the model of the profit-maximising firm is assumed (e.g., Dyreng et al., 2017) that will try to reduce the economic burden imposed by personal taxes.

Conceptually, it does not matter onto which stakeholder the economic burden of a personal tax increase is shifted as investment responses of firms are unambiguous in both subsequent cases. First, I consider the market power of firms vis-à-vis their employees on the cost side[10]. In this case, market power depends on the elasticity of labour supply (e.g., Dyreng et al., 2017; Jacob et al., 2018). That is, the more elastic (inelastic) the labour supply (e.g., due to high (low) education levels (e.g., Dyreng et al., 2017; Fuest et al., 2018) and correspondingly high (low) labour mobility), the lower (higher) the ability of firms to freely set wages, and thus the lower (higher) their ability to shift the economic burden of a personal tax increase to employees[11]. Subsequently, this exerts higher (lower) pressure on profits, and thus increases the (creates less) pressure to substitute the more expensive factor labour by capital which, in turn, causes investment of firms with low (high) market power to respond more (less) strongly[12] than the average investment response. Second, I consider the market power of firms vis-à-vis their consumers which is a function of the elasticity of market demand on their revenue side (e.g., Dyreng et al., 2017; Jacob et al., 2018). That is, the more (less) elastic the market demand (e.g., due to the availability of substitutes (Jacob et al., 2018), the lower (higher) the ability of firms to shift the economic burden of a personal tax increase to consumers through higher prices. Thus, this translates into higher (creates less) pressure to substitute labour by capital and is expected to result in a stronger (weaker) investment response if firms have low (high) market power.

top marginal income tax rate on labour income, τ^{ρ}, but also labour-related costs such as social security contributions which drive a wedge between w_g and w_n. These additional labour costs are effectively part of the gross wage, wg_n, and thus are expected to have the same economic effect on firm-level investment as the pure personal tax rate τ^{ρ}. Although these labour-related costs are no taxes, social security contributions will nevertheless be included in the definition of the personal tax wedge in section 5 to check whether they empirically have the same economic effect on investment.

[9] For illustration purposes, I abstract from a general equilibrium setting in which "firm[s] can simultaneously shift [their personal] tax burden to [multiple stakeholders]" (Dyreng et al., 2017, p.10).

[10] Literature suggests that "results are essentially the same [if] firms ...pass on taxes to ...suppliers through [lower] input ...prices instead of passing [them] on ...to workers [through lower wages]" (Jacob et al., 2018, p.2).

[11] Alternatively, it could be argued that the power of unions influences the ability of firms to shift the economic burden to employees. However, union power belongs to the discipline of bargaining literature (e.g., Katz, 1993) from which I abstract in my model for simplicity.

[12] The meaning of more strongly depends on the direction of the average effect. That is, if the average effect is positive (negative), I expect a stronger increase (decrease) in investment if firms have low market power.

> Hypothesis 3: After an increase in personal taxes, capital investment responds more strongly if firms can more easily substitute labour by capital.

As illustrated in Figure 2, an increase in personal taxes exerts stronger pressure on firms to substitute the more expensive input factor labour by capital[13]. This does, however, not imply that firms are able to substitute both factors to the same extent, and thus cross-sectional variation in investment responses across firms may arise from differences in the ability to substitute labour by capital (e.g., Dyreng et al., 2017). Intuitively, the degree of input factor substitutability is influenced by two elements: (a) The knowledge-intensity of the factor labour, and (b) the importance of labour and capital for the generation of value added (i.e., output produced).

First, knowledge-intensive labour tasks such as R&D are difficult to automate, and thus the more knowledge-intensive the factor labour, the more difficult it is to substitute labour by capital. Consequently, firms for which knowledge and innovation (i.e., R&D) are core of their business model (e.g., consultancies or pharma firms) have a high share of knowledge-intensive labour, and thus have a lower ability to substitute labour by capital, if they can do so at all[14]. Second, the higher the importance of an input factor in a firm's production function, and hence for the generation of value added (i.e., output produced), the more difficult it is to substitute this input factor if output is to be kept constant. For example, if labour (capital) is highly productive and therefore important for the generation of output, the same output can, if at all, only be produced by a disproportionally high amount capital (labour), and hence it is relatively more difficult (easier) to be substituted by labour by capital on the margin. Thus, the greater a firm's ability to substitute labour by capital, the more strongly investment is expected to respond since firms likely show a smaller (greater) substitution response towards capital if labour is knowledge intensive (capital is important for the generation of output).

> Hypothesis 4: After an increase in personal taxes, financially constrained firms which strongly rely on internal cash flows for investment exhibit a more negative investment response.

Besides differences in relative market power and the ability to substitute input factors, previous literature suggests that cross-sectional variation in investment responses can also result from "differences in the availability of internal funds" (Jacob et al., 2018, p.5) across firms. That is, if internal cash flows are the marginal source of finance, investments in cash-constrained firms (i.e., firms with limited internal resources) are likely more prone to decreases in internal cash flows than investments in cash-rich firms (i.e., firms with abundant internal resources) (e.g., Dobbins and Jacob, 2016; Faulkender and Petersen, 2012; Fazzari et al., 1988; Jacob et al., 2018). Thus, assuming firms to bear part of the personal tax incidence, an increase in personal taxes is predicted to reduce profits, and thus internal after-tax cash flows and investments more strongly if firms are cash-constrained and "heavily [rely] on internally generated cash flows for investment" (Jacob et al., 2018, p.5). Thus, despite higher pressure to substitute labour by capital, this effect is expected to translate into a more negative investment response of financially constrained firms[15] as their availability of internal resources is more strongly affected.

3. Data, Methodology, and Summary Statistics

The data used in this thesis have largely been provided by the WHU chair of Business Taxation and stem from four main data sources. First, firm-level data on listed companies over the 1997–2013 period were retrieved from the Compustat Annual North America and Global database. Second, tax policy data were extracted from handbooks published by major auditing and tax advising firms such as KPMG, PwC, Ernst & Young, and Deloitte and are available from 1999–2013. Third, information on macroeconomic and governance indicators follow the World Bank definition and originate from the World Bank website for all countries in the dataset. Fourth and finally, I retrieved additional data on personal taxes from the OECD tax database from 2000–2013 to include social security contributions in the definition of the personal tax wedge.

Prior to merging datasets, I amended the data in several ways to increase the coverage of some variables. For instance, I added new data on Tobin's q with higher coverage across firms which were provided by the WHU chair of Business Taxation[16]. Similarly, I replaced missing data entries of the variable Income Group to increase the number of observations for the income-group-cluster used in robustness tests of my thesis[17]. In addition to the datasets provided by

[13] This assumes labour and capital to be substitutes on the margin.

[14] In this hypothesis, I abstract from recent technological developments in the field of artificial intelligence. These developments potentially increase the ability of firms to automate knowledge-intensive labour since they increasingly enable the factor capital to perform knowledge-intensive tasks (e.g., in R&D). Thus, knowledge-intensive labour could be more easily automated (and substituted by capital) in future.

[15] This corresponds to lower investment levels of financially constrained firms compared to the average investment response, irrespective of the direction (i.e., coefficient) of the average effect. Since the average effect in hypothesis one is expected to be ambiguous (i.e., both $\beta_1 < 0$ and $\beta_1 > 0$ are plausible), the investment response of financially-constrained firms is therefore predicted to be more negative (and not greater or smaller than the average effect as such a statement requires a clear prediction of the direction of the average effect).

[16] The definition of Tobin's q is the same as in Jacob et al. (2018) (i.e., the market value of equity over total assets). It was necessary to add new data on Tobin's q since the variable Market Value (denoted by mkvalt) in the provided Compustat data suffered from poor coverage. Attempts to estimate this variable via share price * number of shares as in the originally provided Compustat dataset only increased the coverage marginally.

[17] This adjustment was carried out in two steps. First, I manually replaced missing values for Argentina, Jamaica, New Zealand, and Nigeria based on World Bank data. Second, I merged new data from the World Bank website for all other 66 countries with missing data entries to the #3.1_full_codes.dta dataset. Missing countries, for instance, included Taiwan, Cyprus, Monaco, and Paraguay.

Table 1: Summary Statistics of Main Variables

This table displays summary statistics of all main variables from 1997 to 2013. Panel A presents descriptive statistics for variables on the country level. Panel B summarises descriptive statistics for variables on the firm level. Please refer to Table A.1 in the appendix for variable definitions. Notes: Summary Statistics of all firm-level variables in Panel B correspond to the winsorised version of the respective variable to eliminate the effect of outliers on my results.

Variable	N	Mean	Standard Deviation	25th percentile	Median	75th percentile
Panel A: Country-level Variables						
Tax Policy Variables						
Personal Tax	345,333	0.3972	0.0938	0.3500	0.4000	0.4641
Corporate Tax	345,954	0.3215	0.0742	0.2700	0.3300	0.3900
Consumption Tax	325,864	0.1073	0.0627	0.0519	0.1000	0.1700
Payout Tax	345,333	0.1621	0.1027	0.1000	0.1500	0.2488
Accelerated Depreciation	345,954	0.8109	0.3916	1	1	1
LCB	345,954	0.4334	0.4955	0	0	1
Group Taxation	343,328	0.5521	0.4973	0	1	1
Progressive	345,954	0.6302	0.4828	0	1	1
Extended Tax Definitions						
67% Earner	201,247	0.3685	0.1017	0.3198	0.3439	0.3939
100% Earner	201,247	0.4018	0.0936	0.3423	0.3883	0.4361
133% Earner	201,247	0.4420	0.0918	0.4093	0.4336	0.4770
167% Earner	201,247	0.4275	0.0984	0.3525	0.4340	0.4748
Macroeconomic Variables						
GDP Growth	363,902	3.5813	3.4689	1.7292	3.1400	5.1472
Ln(GDP per Capita)	363,817	9.6124	1.3841	8.6600	10.4290	10.5557
Inflation	363,902	2.7073	4.3191	0.8477	2.0327	3.7157
Deficit	269,504	-2.6679	3.9788	-4.8523	-3.1779	0.0177
Openness	304,174	0.7266	0.8649	0.2829	0.4831	0.6549
Interest Payments	279,947	0.0225	0.0123	0.0150	0.0230	0.0276
Government Debt	196,624	60.9360	37.7089	40.0881	53.5029	64.0318
Governance Indicators						
Voice and Accountability	371,022	0.6717	0.8952	0.3900	1.0100	1.3500
Political Stability	371,017	0.3316	0.8166	-0.2000	0.6000	0.9600
Government Effectiveness	371,006	1.1319	0.7665	0.4000	1.4600	1.7500
Regulatory Quality	371,006	0.9722	0.7837	0.4200	1.1900	1.6200
Rule of Law	371,022	0.9888	0.7968	0.2900	1.3300	1.6100
Control of Corruption	371,006	0.9794	0.9781	0.0500	1.2900	1.8350
Panel B: Firm-level Variables						
Investment	321,987	0.0719	0.1096	0.0139	0.0357	0.0803
Cash Holdings	338,232	0.1269	0.2727	0.0020	0.0203	0.1129
Profit	337,817	0.0268	0.2106	-0.0036	0.0517	0.1141
Leverage	369,749	0.0933	0.1563	0.0007	0.0112	0.1167
Ln(Sales Growth)	323,754	0.0876	0.4335	-0.0460	0.0730	0.2182
Sales Growth	287,128	0.4841	1.7148	-0.0637	0.1468	0.4652
Loss	370,210	0.2984	0.4576	0	0	1
Tobin's q	279,446	1.4997	3.5907	0.3319	0.6837	1.4016
Size	388,193	6.5558	3.0442	4.3872	6.3843	8.4709

the WHU chair, I retrieved and added data on geographic regions following World Bank definition from the World Bank website to construct a region-cluster later in my robustness section.

After merging datasets, I conducted general data cleaning to eliminate implausible observations. For instance, I

dropped firms with SIC codes 4000 to 4999 (i.e., utility, transportation, and telecommunication firms) and 6000 to 6999 (i.e., financial firms) since these subsets of firms likely exhibit different investment behaviour which could distort my results[18]. In addition, I excluded observations for which firms had negative total assets or for which total assets were unavailable. Likewise, I limited my baseline sample to observations with positive sales and cash holdings[19]. To eliminate bankrupt firms, I also dropped observations with a value of Common/Ordinary Equity smaller than or equal to zero and which possess a Leverage ratio greater than or equal to one. The sample was further limited to observations for which the macroeconomic variables GDP per capita, Openness, Government Debt, and Interest Payments were not negative to eliminate further implausible observations. Additionally, I conducted specific data cleanings tailored to my research question. For instance, I only included observations for which capital expenditure was greater than or equal to zero to restrict my analyses to firms with non-negative investment. Similarly, I dropped implausible tax rates with values less than zero or higher than one. I also conducted specific data cleanings in my cross-sectional variation analyses (e.g., by dropping negative (i.e., implausible) net PPE when testing for different factor substitutability across firms), but these cleanings were carried out after my baseline tests and thus do not affect the composition of my baseline sample or robustness tests. Following my data cleanings, I converted firm-level variables which were denoted in currencies other than U.S. Dollar into U.S. Dollar by using the average annual U.S. Dollar exchange rate in the corresponding year issued by the WHU Chair of Business Taxation[20]. In addition, I winsorised all non-dummy, firm-level variables and their lags below the 1st and above the 99th percentile to reduce the effect of extreme outliers on my results[21]. Overall, these adjustments result in a baseline sample comprising 42,670 firms located in 115 countries from 1997–2013[22]. Table 1 presents summary statistics on all variables used in my baseline specification after these adjustments.

4. Pre-Analysis: Linear Probability Model and Variation in Personal Tax Rate Changes

Prior to running regressions on corporate investment behaviour, my data on personal tax rates must fulfil two fundamental conditions. First, my independent variable of interest (i.e., the personal tax rate) must exhibit a sufficiently large degree of variation in my sample. Otherwise, my causal inference would be limited to a few selected events and could barely be generalised to all countries available in my dataset (Jacob et al., 2018). Fortunately, my cross-country panel of 115 countries provides a solid source of tax rate variation as personal taxes change 217 times from 1999 to 2013 (thereof 76 increases and 141 decreases). Even when abstracting from personal tax changes of less than two percentage points, 121 changes can still be observed (thereof 43 increases and 78 decreases). Consequently, my dataset shows a sufficiently large variation of the personal tax rate and fulfils the first condition.

Second, changes in the personal tax rate must be exogenous to allow for clear causal inference. This is especially critical since my baseline regression assumes changes in the personal tax rate to be entirely exogenous. Otherwise, I would only "observe a spurious correlation" (Jacob et al., 2018, p.15) instead of a causal relationship between personal taxes and investment. Analogously to Jacob et al. (2018), I therefore address endogeneity concerns by running a linear probability model showing whether changes in the personal tax rate are related to the business cycle or other economic conditions. In the model, I include the six macroeconomic determinants GDP Growth, Ln(GDP per capita), Inflation, Deficit, Openness, and Interest Payments on government debt as regressors[23] (Jacob et al., 2018). Likewise, I also use country fixed effects and region-year fixed effects to capture time invariant effects at the country level and limit comparable countries to their counterparts within the same World Bank region (Jacob et al., 2018).

Table 2 displays results of my linear probability model. In columns (1) and (2), I model whether macroeconomic determinants affect the probability of personal tax changes by more than 2.0 percentage points. As the dependent variable, I use a dummy equal to one if personal taxes are increased (column 1) or decreased (column 2). In addition,

[18] Asker et al. (2011), for instance, argue that financial firms and utility firms are subject to different regulation affecting their investment policy. Similarly, companies in the transportation and telecommunication sector mostly tend to be formerly state-owned and, due to their business model, I expect them to possess a substantial amount of fixed assets with correspondingly high capital expenditure. It is therefore plausible to assume that these subsets of firms differ substantially in their investment behaviour compared to all other firms included in the sample (and thus could distort my results).

[19] Please note that cash holdings are defined as the sum of cash holdings and short-term investments because short-term investments are assumed to be as liquid as cash. Please refer to Table A.1 in the appendix for exact variable definitions.

[20] Some firm-level variables such as EBIT, sales, or total assets were already denoted in USD. Therefore, I excluded these variables from the currency conversion process.

[21] I refrained from winsorising my tax policy variables and country-level data from the World Bank since these are official statistics. Similarly, the appended data on Tobin's q were already winsorised and hence excluded from the winsorisation process.

[22] Since data on tax policy variables are only available from 1999–2013, the sample is ultimately restricted to 40,608 firms from 1999–2013 in subsequent regressions. If social security contributions are included in the definition of the personal tax wedge, the sample further shrinks to 25,874 firms as data on social security contributions are only available for OECD countries from 2000–2013.

[23] In the excel file 2. LPM Results Edited.xls, three specifications of this model were used. In specification (1), I additionally included Government Debt as a regressor but abstracted from it in specifications (2) and (3). Also, specifications (1) and (3) are restricted to the same 410 observations, whereas specification (2) considers 743 observations. I therefore reported specification (2) to avoid distorted results due to a poor coverage of Government Debt. This is supported by similar results (both magnitude and significance) in specifications (1) and (3) indicating that omitting Government Debt is unlikely to cause an omitted variable bias.

Table 2: Linear Probability Model Results

This table presents results of my linear probability model. In columns (1) and (2), I model macroeconomic determinants which affect the probability of changes in the personal tax rate by more than 2.0 percentage points. The magnitude of these changes are modelled in columns (3) to (5). Please refer to Table A.1 in the appendix for definitions of explanatory variables. I further include country fixed effects and region-year fixed effects in all specifications. This table also reports robust standard errors clustered at the country level in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Probability of		Magnitude of		
	Tax Increase	Tax Decrease	Tax Change	Tax Increase	Tax Decrease
	(1)	(2)	(3)	(4)	(5)
GDP Growth	-0.0025	-0.0054	0.0000	-0.0014	-0.0116
	(0.0031)	(0.0058)	(0.0006)	(0.0031)	(0.0070)
Ln(GDP per Capita)	-0.0948	0.1222	0.0114	0.1483	0.2556
	(0.1236)	(0.2334)	(0.0218)	(0.1906)	(0.2674)
Inflation	0.0010	0.0038	0.0000	0.0007	0.0015
	(0.0014)	(0.0023)	(0.0002)	(0.0013)	(0.0027)
Deficit	-0.0015	0.0092	-0.0005	-0.0130*	0.0072
	(0.0037)	(0.0062)	(0.0004)	(0.0068)	(0.0078)
Openness	0.0879	-0.1711	-0.0024	0.0332	0.0022
	(0.1100)	(0.1574)	(0.0187)	(0.1406)	(0.1820)
Interest Payments	1.0763	0.9006	0.1096	5.0101*	-0.5837
	(1.6420)	(1.9015)	(0.1674)	(2.9223)	(3.4237)
Observations	743	743	743	743	743
Country FE	Yes	Yes	Yes	Yes	Yes
Region-Year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	-0.012	-0.048	-0.106	0.134	0.073

the magnitude of all 217 personal tax changes is modelled in the remaining columns. In column (3), the dependent variable is denoted by the change in the personal tax rate. In columns (4) and (5), I interact this change with a dummy for a tax increase and tax decrease, respectively (e.g., Jacob et al., 2018).

Overall, based on my dataset, changes in the personal tax rate appear to be mostly exogenous since four macroeconomic variables are not significant. In addition, the probability and the magnitude of personal tax changes seem to be mostly unaffected by economic conditions except for the magnitude of personal tax increases. This is indicated by significant coefficients for Deficit and Interest Payments in column (4). That is, if the budget deficit increases (e.g., in recessions), policy makers tend to increase personal taxes less strongly, thereby limiting the adverse effect of personal taxes on economic growth. Furthermore, policy makers tend to increase personal taxes more strongly to finance higher interest payments which, for example, could be a result of formerly high budget deficits. Considering these results, I define quartiles of Deficit and Interest Payments for each year and create a deficit-interest-payment-cluster-industry-year fixed effect for my baseline regression. This assures that firms in countries with personal tax changes are compared to a control group which is subject to similar economic conditions in terms of budget deficit and interest payments.

5. Main Empirical Analysis and Results

In this section, I estimate the causal effect of a change in the personal tax rate on investment at the firm level. To accomplish this, I structured this section into two main parts. First, the average effect on investment is analysed in my baseline model using the cross-country panel of 115 countries from 1999 to 2013 (2000 to 2013 for social security contributions). Second, I examine cross-sectional variation in investment responses due to cross-sectional differences in firm characteristics such as (a) market power vis-à-vis stakeholders, (b) different degrees of input factor substitutability, and (c) the presence of financial constraints.

5.1. Baseline Regression

To estimate the average effect of personal taxes on corporate investment behaviour, I construct the following linear regression model based on the estimation method of ordinary least squares:

$$\begin{aligned}\text{Inv}_{i,j,t} =& \alpha_0 + \beta_1 \text{Personal Tax}_{j,t} + \delta_1 \Gamma_{j,t} + \delta_2 T_{j,t} + \\ & \delta_3 \Phi_{i,j,t-1} + \alpha_i + \alpha_{g,k,t} + \epsilon_{i,j,t} \end{aligned} \quad (1)$$

My dependent variable is Investment of firm i located in country j in year t. Consistent with previous literature (e.g., Jacob et al., 2018), I approximate my dependent variable with capital expenditure over lagged total assets. My independent variable of interest is the personal tax rate which is denoted by Personal $\text{Tax}_{j,t}$. I employ five different definitions

of the personal tax rate. First, the top marginal income tax rate on labour income is used to analyse the effect of the pure personal tax rate on investment. Second, I extend this definition and include social security contributions. Doing so, I consider four different income classes of employees in OECD countries, which are expressed as a percentage of the average wage earned in a respective country-year[24].

To account for variables which could affect investment other than personal taxes, I include three control vectors in my baseline regression. First, I account for country-level factors in vector $\Gamma_{j,t}$ which comprises the macroeconomic variables GDP Growth, Ln(GDP per Capita), Inflation, Deficit, and Interest Payments as well as the governance indicators Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption as defined by the World Bank (e.g., Jacob et al., 2018). Variables with poor coverage such as Openness or Government Debt, however, were excluded to increase the number of observations in my regression[25]. Second, my control vector $T_{j,t}$ contains a set of tax policy variables including Accelerated Depreciation, LCB, Group Taxation, and Progressive[26] analogous to Jacob et al. (2018). To address concerns that changes in the personal tax rate coincide with changes in other tax rates, I additionally include other tax rates such as Consumption Taxj,t, Payout Taxj,t, and Corporate Taxj,t in the tax policy variable vector $T_{j,t}$ (e.g., Jacob et al., 2018). Doing so enables me to isolate the effect of personal tax changes on firm-level investment. Third and finally, I include control variables on the firm level via vector $\Phi_{i,j,t-1}$. In this vector, I account for Cash Holdings, Profit, Leverage, Ln(Sales Growth), Tobin's q, Size, and Loss analogous to previous investment literature[27] (e.g., Baker et al., 2003; Cummins et al., 1996; Dobbins and Jacob, 2016; Jacob et al., 2018). All firm-level controls are lagged by one period to eliminate concerns about endogeneity (Dobbins and Jacob, 2016).

Furthermore, my baseline model includes two fixed effects. Firm fixed effects α_i, for instance, capture time-invariant factors at the firm level which potentially affect investment behaviour (e.g., Dobbins and Jacob, 2016; Jacob et al., 2018). Likewise, I include [group]-industry-year fixed effects $\alpha_{g,k,t}$, where [group] is a substitute for the deficit-interest-payment-cluster and individual industries are denoted by the subscript k[28]. Hence, firms experiencing a personal tax change in country j are compared to a control group which is operating in the same industry k and subject to similar economic conditions in terms of budget deficit and interest payments in year t. Since firms in country j are subject to the same tax system, my baseline regression employs heteroskedasticity-robust standard errors clustered at the country level.

Recalling hypothesis one in section 2, I expect the aggregate effect of personal taxes on capital investment to be ambiguous. That is, although an increase in personal taxes unambiguously increases the factor price of labour, thus making labour relatively more unattractive, capital investment of firms can respond in two ways. First, firms could treat labour and capital as complements. Thus, firms would reduce capital investment analogously to the more expensive factor labour to maintain their optimal input factor mix as determined by their production function (Dobbins and Jacob, 2016). Second, previous studies demonstrated that labour and capital can be substitutes on the margin (e.g., Dyreng et al., 2017). That is, firms partially substitute the more expensive factor labour by capital, and hence increase their capital investment even though taxes increase[29]. I thus make no prediction on the sign of my coefficient β_1 as $\beta_1 < 0$ and $\beta_1 > 0$ are both plausible.

Table 3 presents my baseline results. In column (1), I use the top marginal income tax rate on labour income as my independent variable of interest. Columns (2) to (5) employ extended definitions of the personal tax rate which include social security contributions. Surprisingly, capital investment responses depend on the definition of personal taxes. That is, although coefficients of personal taxes are mostly positive across all five specifications, only the coefficient of the pure personal tax rate (hereafter: pure tax rate) is significant[30]. Vice versa, all specifications including social security contributions on average have no effect on firm-level investment due to insignificant coefficients. These results have two implications. First, for the pure tax rate, my results confirm empirical findings of prior studies (e.g., Dyreng et al., 2017)

[24] These alternative definitions follow the definition of the OECD tax database and are conceptually no taxes. However, I nevertheless expect social security contributions to have the same economic effect on investment as the pure personal tax rate.

[25] Please refer to Table 1 in section 3 for an overview of the coverage of main variables. My baseline results are robust to including Openness as an additional control variable when using the deficit-interest-payment-cluster-industry-year fixed effect of my baseline specification. Please refer to the excel file 3. Baseline Results Edited.xls for detailed results.

[26] Dreßler and Overesch (2013), for instance, discuss that LCB and Group Taxation influence investment behaviour of firms. Besides, I expect Accelerated Depreciation and Progressive to affect investment decisions and risk-taking of firms, respectively. A dummy for loss carry forwards has not been included in my model as all countries allow for loss carry forwards in the sample period.

[27] This set of firm-level controls is included for several reasons. Cash Holdings and Profit are used since cash-rich or more profitable firms invest more due to a higher availability of internal resources (e.g., Dobbins and Jacob, 2016; Faulkender and Petersen, 2012; Fazzari et al., 1988; Lamont, 1997). Likewise, smaller firms are expected to have better opportunities for investment (e.g., Carpenter and Petersen, 2002; Dobbins and Jacob, 2016). To measure growth opportunities, I also include Ln(Sales Growth) and Tobin's q. (e.g., Dobbins and Jacob, 2016; Jacob et al., 2018). Besides, a dummy for losses is added to respect that firms with negative pre-tax income are likely to invest less (Dobbins and Jacob, 2016).

[28] My baseline results are not robust to replacing [group]-industry-year fixed effects by region-industry-year fixed effects and income-group-industry-year effects. Please refer to Table 7 in section 6 for results.

[29] Consistent with my hypothesis development, I abstract from productivity differences between the two input factors as corresponding estimates are difficult to obtain (e.g., Dyreng et al., 2017).

[30] Consistent with previous literature on corporate taxes (e.g., Dobbins and Jacob, 2016), dividend taxes (e.g., Alstadsæter et al., 2017) and consumption taxes (e.g., Jacob et al., 2018), coefficients on other tax rates are almost always significant and their sign is negative.

Table 3: Baseline Results

This table presents my regression results on investment behaviour from 1999 to 2013. The dependent variable is Investment. I use five different specifications of the personal tax rate. In column (1), the top marginal income tax rate on labour income is used. In Columns (2) to (5), this definition is extended and includes social security contributions for different income classes of employees in OECD countries for the 2000-2013 period. Please refer to Table A.1 in the appendix for definitions of independent variables. I further include firm fixed effects and [group]-industry-year fixed effects in all specifications, where [group] is a substitute for the Deficit-Interest-Payment-cluster. This table also reports robust standard errors clustered at the country level in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Personal Tax	0.0367*				
	(0.0213)				
67% Earner		0.0003			
		(0.0367)			
100% Earner			0.0129		
			(0.0243)		
133% Earner				-0.0268	
				(0.0308)	
167% Earner					0.0258
					(0.0327)
Corporate Tax	-0.0471	-0.0958***	-0.0981***	-0.0970***	-0.0973***
	(0.0355)	(0.0325)	(0.0326)	(0.0319)	(0.0309)
Consumption Tax	-0.4256***	-0.5755***	-0.5758***	-0.5673***	-0.5823***
	(0.0604)	(0.0835)	(0.0826)	(0.0819)	(0.0851)
Payout Tax	-0.0094	-0.0165*	-0.0172*	-0.0172*	-0.0182*
	(0.0140)	(0.0095)	(0.0095)	(0.0092)	(0.0094)
Cash Holdings	0.0200***	0.0176**	0.0176**	0.0176**	0.0176**
	(0.0068)	(0.0068)	(0.0068)	(0.0068)	(0.0068)
Profit	0.0196*	0.0106	0.0106	0.0106	0.0106
	(0.0105)	(0.0103)	(0.0103)	(0.0103)	(0.0103)
Leverage	-0.0438***	-0.0415***	-0.0415***	-0.0415***	-0.0415***
	(0.0077)	(0.0074)	(0.0074)	(0.0073)	(0.0074)
Ln(Sales Growth)	0.0032**	0.0033*	0.0033*	0.0033*	0.0033*
	(0.0015)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Tobin's q	0.0020*	0.0032**	0.0032**	0.0032**	0.0032**
	(0.0011)	(0.0012)	(0.0013)	(0.0013)	(0.0013)
Size	-0.0186***	-0.0172***	-0.0172***	-0.0172***	-0.0172***
	(0.0025)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
Loss	-0.0089***	-0.0082***	-0.0082***	-0.0082***	-0.0081***
	(0.0014)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Accelerated Depreciation	0.0023	0.0037*	0.0035*	0.0041*	0.0034
	(0.0024)	(0.0019)	(0.0018)	(0.0022)	(0.0020)
LCB	0.0057*	0.0124***	0.0128***	0.0120***	0.0124***
	(0.0031)	(0.0027)	(0.0030)	(0.0029)	(0.0026)
Group Taxation	-0.0053	0.0039	0.0036	0.0040	0.0039
	(0.0074)	(0.0070)	(0.0072)	(0.0070)	(0.0074)
Progressive	-0.0035	-0.0060	-0.0057	-0.0058	-0.0054
	(0.0059)	(0.0042)	(0.0039)	(0.0042)	(0.0039)
GDP Growth	0.0009***	0.0011**	0.0011**	0.0011**	0.0011**
	(0.0002)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Ln(GDP per Capita)	-0.0120	-0.0958***	-0.0978***	-0.0990***	-0.0940***
	(0.0165)	(0.0289)	(0.0287)	(0.0289)	(0.0288)
Inflation	0.0002	0.0002	0.0002	0.0002	0.0002
	(0.0002)	(0.0005)	(0.0004)	(0.0004)	(0.0005)

(Continued)

Table 3—continued

Deficit	0.0010**	0.0009	0.0009	0.0009	0.0009
	(0.0004)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Interest Payments	0.2739	0.5349**	0.5299***	0.5660***	0.5226***
	(0.1862)	(0.1983)	(0.1796)	(0.1966)	(0.1816)
Voice and Accountability	-0.0116*	-0.0297**	-0.0295**	-0.0285*	-0.0297**
	(0.0063)	(0.0144)	(0.0144)	(0.0151)	(0.0144)
Political Stability	0.0056	0.0195***	0.0188***	0.0192***	0.0201***
	(0.0046)	(0.0035)	(0.0033)	(0.0034)	(0.0038)
Government Effectiveness	0.0125	0.0234***	0.0232***	0.0226***	0.0235***
	(0.0086)	(0.0055)	(0.0058)	(0.0057)	(0.0056)
Regulatory Quality	0.0054	0.0101	0.0112	0.0090	0.0117
	(0.0077)	(0.0073)	(0.0072)	(0.0080)	(0.0078)
Rule of Law	-0.0073	-0.0263*	-0.0268*	-0.0248*	-0.0271*
	(0.0120)	(0.0134)	(0.0134)	(0.0139)	(0.0138)
Control of Corruption	0.0099	0.0157**	0.0168**	0.0171**	0.0151**
	(0.0060)	(0.0069)	(0.0080)	(0.0072)	(0.0069)
Observations	158,760	125,582	125,582	125,582	125,582
Firm FE	Yes	Yes	Yes	Yes	Yes
(Group)-Industry-Year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.552	0.594	0.594	0.594	0.594

showing that labour and capital are substitutes on the margin. Second, firm-level investment responses depend on the definition of the tax wedge, and thus I cannot confirm expectations about social security contributions having a similar economic effect as the pure tax rate. Yet, I would like to caution that the second implication may result from the composition of my data since data on social security contributions are only available for OECD countries. It is therefore advisable to further test this result in future studies once additional data are available.

Based on these findings, a one-percentage-point increase in the pure tax rate on average increases capital investment by 0.037 percentage points (pp) of lagged total assets[31] which confirms that, when abstracting from productivity differences between factors, personal taxes increase the pressure on firms to substitute labour by capital on the margin. Compared to the sample average of my dependent variable Investment, this implies a relative increase of 0.51%[32]. For better interpretation, I convert this relative change into an implied elasticity of 0.20[33] suggesting that personal taxes are of high economic relevance for investment decisions even though their magnitude is, in absolute terms, smaller compared to corporate taxes (between –0.4 and –0.5 as in Giroud and Rauh (2017)) and consumption taxes (between –0.24 and –0.29 as in Jacob et al. (2018); numbers are based on the draft from December 2017). Besides, since the sign of β_1 is positive, the effect of personal taxes on firm-level investment works in the opposite direction compared to other tax rates[34].

Overall, my baseline results confirm that on average labour and capital are substitutes on the margin even though an effect is only observed for the pure tax rate. In the following, I therefore test for cross-sectional variation in investment responses due to differences among firms in their (a) market power vis-à-vis stakeholders, (b) substitutability of input factors, and (c) financial constraints to check whether my baseline results also hold for hypotheses two, three, and four.

5.2. Cross-Sectional Variation I: Market Power vis-à-vis Stakeholders

Based on Dyreng et al. (2017) and Jacob et al. (2018), variation in capital investment responses can result from differences in the relative market power of firms, and thus their ability to shift away the economic burden of personal taxes from their shareholders. This can be explained by different labour supply (market demand) elasticities faced by firms.

[31] In Table 3, I obtain a beta of 0.0367 for the average effect of personal taxes on investment. However, all tax rates in my dataset are defined between zero and one (e.g., a rate of 37% is denoted by 0.37). Thus, I multiplied the tax rate by 100 (i.e., 0.37 * 100 = 37) to interpret the beta with respect to a one-percentage-point increase in the tax rate (e.g., from 37% to 38%). Simultaneously, I divided my beta by 100 to keep the term β_1 * Personal $\text{Tax}_{j,t}$ constant, thus obtaining a transformed beta of 0.000367 which equals an average change in investment by 0.0367pp.

[32] The relative change of investment is defined as the quotient (β_1 / Inv_μ) of the transformed beta (i.e., 0.000367) and the sample average of Investment. In numbers, this implies (0.000367 / 0.0719) * 100% = 0.51%.

[33] The implied elasticity is defined as the percentage change of investment over the percentage change of the personal tax rate (%Δ Inv / %Δ Personal Tax). Following Jacob et al. (2018), I therefore divide the relative effect by the percentage increase of the personal tax rate. In numbers, this implies 0.51% / (0.01 * 100% / 0.3972) where 0.3972 is the sample average of the pure personal tax rate.

[34] For completeness, relative effects and implied elasticities of all five specifications are presented in Table A.2 in the appendix.

Table 4: Market Power vis-à-vis Stakeholders, Low Profit Margin

This table presents my regression results on investment behaviour from 1999 to 2013. The dependent variable is Investment. I use five different specifications of the personal tax rate. In columns (1) and (2), the top marginal income tax rate on labour income is used. In columns (3) to (10), this definition is extended and includes social security contributions for different income classes of employees in OECD countries for the 2000-2013 period. Please refer to Table A.1 in the appendix for definitions of independent variables. Further, I interact each tax policy variable with a dummy equal to one if a firm is below the median EBIT-to-sales ratio in a given country-year (Low Profit Margin). I also include firm fixed effects and [group]-industry-year fixed effects, where [group] is a substitute for the Deficit-Interest-Payment-cluster. For all even specifications, [group]-industry-year fixed effects are replaced by country-industry-year fixed effects. This table also reports robust standard errors clustered at the country level (columns (1) and (2)) or country-industry level (columns (3) to (10)) in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Notes: In columns (3) to (10), standard errors are clustered at the country-industry level to ensure a sufficient number of clusters. Besides, I omit the variable Interest Payments in all even columns due to collinearity (i.e., columns in which the country-industry-year fixed effect is used).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Personal Tax	0.0242									
	(0.0226)									
Personal Tax × Low Profit Margin	0.0267**	0.0259**								
	(0.0119)	(0.0113)								
67% Earner			-0.0011							
			(0.0291)							
67% Earner × Low Profit Margin			-0.0090	-0.0134						
			(0.0097)	(0.0099)						
100% Earner					0.0262*					
					(0.0153)					
100% Earner × Low Profit Margin					-0.0216**	-0.0300***				
					(0.0091)	(0.0092)				
133% Earner							-0.0241			
							(0.0245)			
133% Earner × Low Profit Margin							0.0041	-0.0013		
							(0.0116)	(0.0118)		
167% Earner									0.0406*	
									(0.0221)	
167% Earner × Low Profit Margin									-0.0200**	-0.0229**
									(0.0092)	(0.0094)
Observations	157,967	157,261	124,888	124,588	124,888	124,588	124,888	124,588	124,888	124,588
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Group)-Industry-Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Country-Industry-Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R-squared	0.556	0.561	0.599	0.602	0.599	0.602	0.599	0.602	0.599	0.602

That is, the more elastic a firm's labour supply (market demand), the lower the ability to pass on the personal tax incidence to workers (consumers), and hence the more of the economic burden of personal taxes is borne by firms, and ultimately, shareholders. This likely translates into higher pressure to substitute the more expensive factor labour by capital.

Hence, higher personal taxes exert higher pressure on profits, and thus are expected to affect investment responsiveness more strongly if firms have low market power. Following previous literature, I proxy a firm's market power by its EBIT margin[35] (e.g., Jacob et al., 2018; Lerner, 1934) and add the dummy Low Profit Margin which is equal to one if a firm is below the median EBIT-to-sales ratio in a given country-year[36] (e.g., Jacob et al., 2018). I subsequently interact Low Profit Margin with all tax policy variables (i.e., Personal $\text{Tax}_{j,t}$ and control vector $T_{j,t}$) to infer whether firms with low market power respond more strongly compared to the average investment response.

Results are presented in Table 4. Interestingly, it appears that investment responsiveness of firms with low market power is ambiguous and varies with the definition of the tax wedge, too. In column (1), for instance, the interaction with the pure tax rate has a positive coefficient suggesting that firms with low market power increase their capital investment by 0.027pp of lagged total assets more strongly after an increase in personal taxes compared to the average investment response[37]. In relative terms, this corresponds to a substantial increase in investment responsiveness by 110%[38] relative to the average investment response if firms have low market power. Consequently, it seems that firms facing highly elastic labour supply (market demand) bear more of the economic burden of personal taxes through lower profits, and thus are exposed to higher pressure to substitute labour by capital, which confirms my hypothesis.

Surprisingly, however, the direction of the marginal effect mostly reverses if social security contributions are included in the definition of the tax wedge, thereby contradicting my hypothesis. The negative coefficients in columns (5) and (9) indicate that investment of firms with low market power responds less strongly by 0.022pp and 0.020pp of lagged total assets, respectively, compared to the average investment response. This equals a considerable decrease in investment responsiveness by 82% and 49% if firms have employees earning the average wage and 167% of the average wage, respectively. It therefore appears that, once social security contributions are considered, reduced profits translate into less resources available for investment, and thus capital investment of firms with low market power responds less strongly (Jacob et al., 2018). Yet, the negative marginal effect cannot be generalised to all income classes of employees since interaction terms in columns (3) and (7) are insignificant[39].

Finally, all results hold when comparing high- versus low-margin firms within the same industry in the same country (i.e., by replacing deficit-interest-payment-cluster-industry-year fixed effects by country-industry-year fixed effects). Thus, my results are likely not caused by "broader policy changes ... or other unobservable characteristics [within industry k] in ... country [j in year t]" (Jacob et al., 2018, p.21). To conclude, relative market power determines the personal tax incidence borne by firms and consequently their capital investment responses to personal tax changes. Yet, investment responsiveness of firms with low market power is ambiguous and depends on the definition of the tax wedge. That is, if the pure tax rate is used, firms with low relative market power show stronger investment responsiveness to personal tax changes compared to the average investment response. Conversely, investment of firms with low market power mostly responds less strongly compared to the average investment response once social security contributions are considered in the tax wedge[40].

5.3. Cross-Sectional Variation II: Substitutability of Labour and Capital

Although an increase in personal taxes increases the factor price of labour, and thus the pressure to substitute labour by capital, the degree of factor substitutability likely varies across firms (e.g., Dyreng et al., 2017). I therefore examine cross-sectional variation in investment responsiveness due to differences in the substitutability of input factors. There are two explanations for this phenomenon. First, the more knowledge-intensive the factor labour, the more difficult it is to substitute labour by capital since knowledge-intensive labour (e.g., R&D) is mostly difficult to automate. Thus, firms with knowledge-intensive labour are expected to substitute labour by capital to a lower degree, if at all. Second, the higher the importance of an input factor in a firm's production function, and hence for the generation of output,

[35] I acknowledge that labour supply (market demand) elasticity is influenced by factors such as education of workers (availability of substitutes) (e.g., Dyreng et al., 2017; Jacob et al., 2018) which could serve as alternative proxies for market power. However, I abstracted from these factors for two reasons. First, these factors are not available in my dataset. Second, a firm's profit margin can be interpreted as the result of market power and thus is a conceptually correct proxy.

[36] Alternatively, I could identify low-margin firms within the same industry using a country-industry-year distribution for Low Profit Margin. However, this would marginalise firms with relatively low profit margins in high-margin industries as low-margin firms although, in absolute terms, they are high-margin firms and vice versa. Thus, I ignore differences in the profitability of firms within the same industry and only account for differences in profitability within the same country. This also applies to subsequent tests in sections 5.3 and 5.4.

[37] This finding is in line with previous studies suggesting that labour and capital can be substituted on the margin (e.g., Dyreng et al., 2017).

[38] I compute the relative effect to better interpret the magnitude of the marginal effect. Following Jacob et al. (2018), the relative effect is defined as the combined effect (i.e., average plus marginal effect) over the average effect minus one. In numbers this implies ((0.0267+0.0242)/0.0242) – 1. This calculation also applies to all other relative effects presented in subsequent analyses.

[39] Results for all interaction terms are robust to using a tercile or quartile split. See excel file 4. Market Power Results Edited.xls for results.

[40] Please note that I did not interpret average effects in this section since my research question exclusively examines whether low-margin firms respond differently from the average investment response. This also applies to subsequent analyses in sections 5.3 and 5.4.

Table 5: Substitutability of Input Factors, High Capital-to-Output Ratio

This table presents my regression results on investment behaviour from 1999 to 2013. The dependent variable is Investment. I use five different specifications of the personal tax rate. In columns (1) and (2), the top marginal income tax rate on labour income is used. In columns (3) to (10), this definition is extended and includes social security contributions for different income classes of employees in OECD countries for the 2000-2013 period. Please refer to Table A.1 in the appendix for definitions of independent variables. Further, I interact each tax policy variable with a dummy equal to one if a firm is in the top quartile of the (net-)PPE-to-sales distribution in a given country-year (High K-to-Output). I also include firm fixed effects and [group]-industry-year fixed effects, where [group] is a substitute for the Deficit-Interest-Payment-cluster. For all even specifications, [group]-industry-year fixed effects are replaced by country-industry-year fixed effects. This table also reports robust standard errors clustered at the country level (columns (1) and (2)) or country-industry level (columns (3) to (10)) in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Notes: In columns (3) to (10), standard errors are clustered at the country-industry level to ensure a sufficient number of clusters. Besides, I omit the variable Interest Payments in all even columns due to collinearity (i.e., columns in which the country-industry-year fixed effect is used).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Personal Tax	0.0493**									
	(0.0229)									
Personal Tax × High K-to-Output	-0.0447	-0.0491								
	(0.0482)	(0.0492)								
67% Earner			-0.0166							
			(0.0287)							
67% Earner × High K-to-Output			0.0718***	0.0565***						
			(0.0206)	(0.0213)						
100% Earner					0.0041					
					(0.0152)					
100% Earner × High K-to-Output					0.0424**	0.0281				
					(0.0176)	(0.0184)				
133% Earner							-0.0421*			
							(0.0246)			
133% Earner × High K-to-Output							0.0598***	0.0463**		
							(0.0219)	(0.0228)		
167% Earner									0.0111	
									(0.0223)	
167% Earner × High K-to-Output									0.0733***	0.0591***
									(0.0190)	(0.0194)
Observations	157,999	157,296	124,897	124,598	124,897	124,598	124,897	124,598	124,897	124,598
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Group)-Industry-Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Country-Industry-Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R-squared	0.559	0.564	0.602	0.604	0.601	0.604	0.602	0.604	0.602	0.604

the more difficult it is to substitute this input factor. For instance, if labour (capital) is highly productive and therefore important for the generation of output, firms likely show a smaller (greater) substitution response from labour to capital as labour is relatively more difficult (easier) to be substituted by capital on the margin. Thus, I expect firms to show a smaller (greater) investment response if labour is knowledge intensive (capital is of high importance for the generation of output). Since proxies for labour suffer from poor coverage[41], I limit the empirical analysis to my second prediction and define the dummy High K-to-Output[42] which is equal to one if a firm is in the top quartile of the net-PPE-to-sales distribution in a given country-year. Subsequently, I interact each tax policy variable with High K-to-Output to estimate whether investment of firms responds more strongly if capital is important for the generation of output.

Table 5 presents my empirical results. Interestingly, the interaction term of High K-to-Output and the pure tax rate is insignificant whereas all specifications which include social security contributions in the tax wedge show (highly) significant, positive interaction terms. Thus, when including social security contributions in the personal tax wedge, responsiveness of capital investment increases between 0.042pp and 0.073pp of lagged total assets (depending on the income class of employees) compared to the average investment response if capital is important for the generation of output in firms, which is in line with my hypothesis. The economic magnitude of this is substantial for two reasons. First, in columns (5) and (9), investment responds more strongly to personal tax changes by factor ten and almost factor seven, respectively, if capital is important for output generation. Second, the positive marginal effect outweighs the negative average effect in columns (3) and (7) which results in a positive net effect of 0.055pp and 0.018pp of lagged total assets, respectively[43]. Finally, the significance and magnitude of my results are mostly robust if country-industry-year fixed effects are included, and thus unobservable country-industry-year characteristics likely do not influence my results (Jacob et al., 2018). The sole difference in this case is that the marginal effect in column (6) is about half the magnitude and thus insignificant[44].

To summarise, the positive marginal effect is consistent with my hypothesis when including social security contributions in the tax wedge, and the magnitude of this marginal effect is substantial. In other words, responsiveness of capital investment increases if capital is of high importance for the generation of output in firms. Yet, my hypothesis does not hold for the pure tax rate since, for this definition of the personal tax wedge, investment does not respond differently compared to the average investment response if capital is important for the generation of output in firms.

5.4. Cross-Sectional Variation III: Financial Constraints

Recalling hypothesis four in section 2, cross-sectional variation in investment responses can arise from "differences in the availability of internal funds" (Jacob et al., 2018, p.5). That is, if internal cash flows are the marginal source of finance for investments, investments in cash-constrained firms are likely more prone to decreases in internal cash flows than investments in cash-rich firms (e.g., Dobbins and Jacob, 2016; Faulkender and Petersen, 2012; Fazzari et al., 1988; Jacob et al., 2018). In other words, when personal taxes increase, internal cash flows, and thus the availability of resources for investment is expected to decrease more strongly if firms face financial constraints and heavily use internal funds for investments (Jacob et al., 2018). Hence, despite higher pressure to substitute labour by capital, these firms are expected to show a more negative investment response (i.e., lower investment levels) compared to the average investment response. Based on Jacob et al. (2018), I include the dummy Low Cash Flow in my regression which is equal to one if a firm is in the bottom quartile of the cash-holdings-to-total-assets distribution in a given country-year. I also interact each tax policy variable with Low Cash Flow as done in previous analyses.

Results in Table 6 indicate that investment responsiveness of financially constrained firms depends on the definition of the tax wedge as well. For example, the interaction term in column (1) has a positive but insignificant coefficient implying that investment of financially constrained firms does not respond differently than the average investment response if the tax wedge only comprises the pure tax rate, and thus my hypothesis does not hold for this specification[45]. Contrarily, when including social security contributions in the tax wedge, interaction term coefficients are mostly negative and, in columns (3) and (7), significant. Thus, if firms employ workers earning 67% and 133% of the average wage, investment of financially constrained firms responds more negatively by 0.026pp and 0.024pp of lagged total assets, respectively, compared to the average investment response, which

[41] My baseline sample only has 128,016 observations for R&D expenditure if values for the personal tax rate are not missing. Using R&D expenditure as a proxy for labour could therefore limit the interpretation of results towards a smaller subset of firms.

[42] High K-to-Output is an alternative proxy for the importance of capital for output generation since estimates for factor productivities are difficult to obtain. Intuitively, I assume that a high proportion of fixed assets on a firm's balance sheet corresponds to a greater importance of capital in the production function, and thus for the generation of output. Yet, factor decisions are based on the ratio of factor productivity to factor price, and hence I acknowledge that it is conceptually reasonable but practically difficult to include a proxy for factor productivity.

[43] I did not compute the relative effect in this case since the marginal effect outweighs the average effect, and thus the relative effect cannot be interpreted. Instead, I present the net effect which equals the sum of the average effect and the marginal effect.

[44] Results are robust to using a tercile split but differ if a median split is used. In the latter case, interaction term coefficients are mostly positive but only significant in columns (9) and (10). This indicates that the median may not be an ideal threshold value. See excel file 5. Substitutability Results Edited.xls for results.

[45] Interestingly, the average effect coefficient of the pure tax rate in Table 6 has a similar magnitude as in my baseline specification, and this result holds for all quantile splits. Besides, the p-value of this average effect is 0.107, and thus close to being significant at the 10% level.

Table 6: Financial Constraints, Low Cash Flow

This table presents my regression results on investment behaviour from 1999 to 2013. The dependent variable is Investment. I use five different specifications of the personal tax rate. In columns (1) and (2), the top marginal income tax rate on labour income is used. In columns (3) to (10), this definition is extended and includes social security contributions for different income classes of employees in OECD countries for the 2000-2013 period. Please refer to Table A.1 in the appendix for definitions of independent variables. Further, I interact each tax policy variable with a dummy equal to one if a firm is in the bottom quartile of the cash-holdings-to-total-assets distribution in a given country-year (Low Cash Flow). I also include firm fixed effects and [group]-industry-year fixed effects, where [group] is a substitute for the Deficit-Interest-Payment-cluster. For all even specifications, [group]-industry-year fixed effects are replaced by country-industry-year fixed effects. This table also reports robust standard errors clustered at the country level (columns (1) and (2)) or country-industry level (columns (3) to (10)) in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Notes: In columns (3) to (10), standard errors are clustered at the country-industry level to ensure a sufficient number of clusters. Besides, I omit the variable Interest Payments in all even columns due to collinearity (i.e., columns in which the country-industry-year fixed effect is used).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Personal Tax	0.0345									
	(0.0211)									
Personal Tax × Low Cash Flow	0.0097	0.0086								
	(0.0155)	(0.0157)								
67% Earner			0.0049							
			(0.0296)							
67% Earner × Low Cash Flow			-0.0255**	-0.0293**						
			(0.0114)	(0.0121)						
100% Earner					0.0115					
					(0.0158)					
100% Earner × Low Cash Flow					0.0053	0.0043				
					(0.0113)	(0.0121)				
133% Earner							-0.0218			
							(0.0247)			
133% Earner × Low Cash Flow							-0.0244*	-0.0273*		
							(0.0134)	(0.0142)		
167% Earner									0.0257	
									(0.0222)	
167% Earner × Low Cash Flow									-0.0049	-0.0051
									(0.0103)	(0.0108)
Observations	158,748	158,044	125,577	125,278	125,577	125,278	125,577	125,278	125,577	125,278
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Group)-Industry-Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Country-Industry-Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R-squared	0.552	0.558	0.594	0.597	0.594	0.597	0.594	0.597	0.594	0.597

Table 7: Robustness to Different Fixed Effects and Inclusion of Additional Controls

This table presents the robustness of my regression results on investment behaviour from 1999 to 2013. The dependent variable is Investment. I use five different specifications of the personal tax rate. In columns (1) and (2), the top marginal income tax rate on labour income is used. In columns (3) to (10), this definition is extended and includes social security contributions for different income classes of employees in OECD countries for the 2000-2013 period. Please refer to Table A.1 in the appendix for definitions of independent variables. I include firm fixed effects in all specifications but replace [group]-industry-year fixed effects by region-industry-year fixed effects (even columns) and income-group-industry-year fixed effects (odd columns). This table also reports robust standard errors clustered at the country level in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Personal Tax	0.0090	-0.0025								
	(0.0286)	(0.0202)								
67% Earner			0.0057	-0.0006						
			(0.0316)	(0.0326)						
100% Earner					0.0081	-0.0055				
					(0.0194)	(0.0143)				
133% Earner							0.0175	-0.0428		
							(0.0288)	(0.0261)		
167% Earner									0.0753**	-0.0290
									(0.0355)	(0.0277)
Observations	158,831	158,834	125,650	125,671	125,650	125,671	125,650	125,671	125,650	125,671
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Country Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Group)-Industry-Year FE	No	No	No	No	No	No	No	No	No	No
Region-Industry-Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Income-Group-Industry-Year	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R-squared	0.552	0.550	0.592	0.590	0.592	0.590	0.592	0.590	0.592	0.590

confirms my hypothesis. The economic magnitude of this is substantial in two ways. First, investment responsiveness of financially constrained firms increases by 112% relative to the negative average effect in column (7). Second, in column (3), the negative marginal effect considerably outweighs the positive average effect yielding a combined negative net effect of –0.021pp of lagged total assets. Like in section 5.3, however, these results cannot be generalised across all income classes of employees since interaction terms in columns (5) and (9) are insignificant, and thus investment of financially constrained firms does not respond differently than the average investment response in these specifications[46]. Lastly, the significance and magnitude of my results are robust if country-industry-year fixed effects are included, and thus my results are not caused by unobservable country-industry-year characteristics (Jacob et al., 2018).

To conclude, financially constrained firms only respond more negatively if social security contributions are considered in the tax wedge, but this result cannot be generalised to all income classes of employees. Thus, my results are partially in line with results obtained for corporate taxes (e.g., Dobbins and Jacob, 2016) and consumption taxes (e.g., Jacob et al., 2018).

6. Robustness of Baseline Results

There are two main concerns about my baseline results. First, it could be argued that these are driven by the choice of my control group (i.e., comparable countries) in my cross-country panel. In other words, the deficit-interest-payment-cluster derived in my linear probability model may not be an ideal fixed effect although it compares firms in one country to a control group of firms in countries with similar economic conditions in terms of budget deficit and interest payments. Second, one could doubt whether my baseline specification accounts for all relevant variables which have an impact on firm-level investment. Thus, my baseline results could arguably suffer from omitted variable bias. To address these concerns, I modify my baseline regression in two ways. First, I define control groups differently by replacing deficit-interest-payment-cluster-industry-year fixed effects by region-industry-year fixed effects and income-group-industry-year fixed effects. Doing so, I group comparable countries in seven geographic regions and four income groups as defined by the World Bank. Second, I include Openness as an additional country-level control which I previously omitted in my baseline due to poor coverage.

Table 7 displays results of my robustness test. Overall, it appears that my baseline results are not robust to modifications of fixed effects, and thus, highly dependent on the set of comparable countries used as a control group. Specifically, I observe two patterns. First, when employing region-industry-year fixed effects, all coefficients are positive, but their magnitude and significance differ substantially from my baseline results. For instance, magnitudes of the average effect of the pure tax rate and the 100% Earner have substantially decreased, and the average effect of the pure tax rate becomes insignificant. Contrarily, all other definitions of personal taxes become (substantially) more positive, and in case of the 167% Earner, statistically significant. Thus, it can still be proved that labour and capital are substitutes on the margin, but this only holds statistically for the 167% Earner. Second, the sign of β_1 fully reverses (i.e., turns negative) for all personal tax definitions when using income-group-industry-year fixed effects. However, the hypothesis that labour and capital are complements on the margin cannot be proved since all coefficients are statistically insignificant across all specifications in which income-group-industry-year fixed effects are used.

Importantly, these results are not driven by the inclusion of Openness for two reasons. First, results are similar in magnitude and significance if additional country-level controls are not included but fixed effects are substituted by region- and income-group-industry-year fixed effects. Second, even if deficit-interest-payment-cluster-industry-year fixed effects are not replaced by alternative fixed effects, baseline results are robust to the inclusion of Openness[47]. To conclude, my baseline results appear to be ambiguous since I cannot eliminate concerns that these are potentially driven by the definition of my control group.

7. Conclusion

In this thesis, I present empirical evidence on the effect of personal taxes on firm-level investment by exploiting personal tax changes in my international panel data of 115 countries from 1999 to 2013. My findings are based on a linear regression model in which five different definitions of the personal tax wedge are regressed against capital investment of firms. Interestingly, my results show that investment responses differ depending on the definition of the personal tax wedge. In my baseline regression, firms on average show a positive capital investment response if personal taxes increase, but this effect can only be validated for the pure personal tax rate. Likewise, I obtain mixed results when testing for cross-sectional variation in capital investment responses due to differences in relative market power, the ability to substitute input factors, and financial constraints. My baseline results also vary strongly depending on the control group used, and thus are not robust to the inclusion of different fixed effects.

The positive average capital investment response can be explained by the higher substitution pressure faced by firms. That is, if firms bear part of the economic burden of personal taxes, an increase in personal taxes, ceteris paribus, increases

[46] Results are robust to using a tercile or median split. Please refer to the excel file 6. Fin Constraints Results Edited.xls for detailed results.

[47] Tables are not included in this thesis. Please refer to the excel files 3. Baseline Results Edited.xls and 7. Robustness FE Controls Edited.xls for detailed results.

the factor price of labour, and thus exerts higher pressure on corporate profits. Profit-maximising firms therefore counteract this pressure by (partially) substituting the more expensive input factor labour by capital. This mechanism, however, does not explain why including social security contributions in the personal tax wedge triggers a different capital investment response of firms compared to the pure personal tax rate. Yet, since the composition of my data may have caused this difference, it is advisable to test this result in future studies once additional data on social security contributions are available.

Eventually, my results have one potential implication for managers and policy makers. That is, personal taxes increase the factor price of labour, and thus affect decisions on the optimal input factor mix of firms. Further, when abstracting from productivity differences between factors, this 'price increase' likely discriminates the input factor labour, and thus labour-intensive firms, while favouring the factor capital, and thus capital-intensive firms. However, since input factor decisions are also a function of input factor productivities, my results cannot fully confirm this prediction since they only consider changes in the factor price. It is therefore reasonable to include estimates for labour and capital productivity in future studies before making clear policy recommendations and reform proposals. Thus, the results of this thesis can rather be understood as a first step towards reaching this goal and need to be further investigated in future theses.

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