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Tax Policy, Investment, and Financial Constraints: Heterogeneous Responses to the 2013 Swedish Corporate Income Tax Reform

Simon Rothschild (23452) and Ossian van Arkel (23446)

Abstract: There is little research at the intersection of corporate income taxation, financial constraints, and investments. We seek to clarify this relationship by investigating the heterogeneous investment responses of constrained and unconstrained firms induced by the 2013 reduction in the Swedish statutory corporate income tax rate from 26.3 to 22 percent. We develop a two-period theoretical model to predict how firms in these two groups respond to tax cuts, and employ a Difference-in-Differences strategy to firm-level panel data between 2010–2017. We find that financially unconstrained firms increased their rates of investments more than constrained firms in response to the lowering of the corporate income tax rate. We contribute to the literature by developing a theoretical framework, as few others have before, and by shining light on the channels through which the heterogeneous effects seen in the data occur. Thereby, we add to the understanding of how different tax policies, depending on their design, may induce different effects. We further demonstrate the utility of using cash holdings as a proxy for financial constraints.

Keywords: Tax Policy, Investment, Financial Constraints, Cash Holdings, Investment-Cash Flow Sensitivity
JEL: H25, H32, D25, G14, G31

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Contents

1 Introduction

The corporate income tax rate is an important component of economic policy and a popular topic in political debate. It is a key factor in both government revenue—in Sweden, taxation on corporate profits constituted 6.8% of total tax revenue for the central government in 2018 (OECD, n.d.)—and of economic performance. In a 2010 study of different tax rates, the OECD found corporate income taxes to be the most harmful to economic growth. One of the pathways through which corporate income tax rates affect economic growth is investment.

Previous research on tax policy has achieved to both establish a link between taxes and investment, and to estimate the magnitude of this effect (Hanlon & Heitzman, 2010; Hassett & Hubbard, 2002). An important part of the evolution of the field has been the study of heterogeneous effects in the investment responses to tax policy among different types of firms. One source of such heterogeneity that has emerged as a recent topic is financial constraints (see e.g. Alstadsæter, Jacob, & Michaely, 2017; Becker, Jacob, & Jacob, 2013; Dobbins & Jacob, 2016; Edgerton, 2010; Zwick & Mahon, 2017). Financial constraints—which render external capital more costly, or even completely unavailable, to a firm—have been the subject of extensive study in corporate finance, dating back several decades.[1] However, the literature that combines corporate income taxation, financial constraints, and investment responses, is currently underdeveloped. In this thesis, we seek to contribute to this field by addressing the following research question:

> *How does a reduction in the statutory corporate income tax rate affect the investment behavior of financially constrained and unconstrained firms? Is there a difference in how they respond?*

Drawing on the existing literature about the relationship between financial constraints and investments, we develop a theoretical model[2] for the investment behavior of financially constrained and unconstrained firms when the tax corporate rate is lowered. In this model, both types of firms are subject to the same shocks following a tax cut: a reduction in the pre-tax required rate of return, and an increase in the post-tax cash flow from existing activities. We term these the *Required Rate of Return Effect* and the *Cash Flow Effect*, respectively.

Based on the model, we develop two propositions. First, that because financially unconstrained firms are able to raise the necessary capital to respond to the higher optimal investment level induced by the Required Rate of Return Effect, they increase their investments accordingly. Everything else equal, constrained firms cannot. Second, that because financially constrained firms are below the optimal investment level before the reduction in the corporate tax rate, they increase their investments due to the Cash Flow Effect. By definition, unconstrained firms are already at the optimal level ex-ante and, everything else equal, they do not increase their investments, even when subject to positive cash flow shocks.

From our propositions, we draw two testable hypotheses. Should the data show that unconstrained firms increase their investments more following the tax cut, then the Required Rate of Return Effect on investments is greater for unconstrained firms than is the

[1] The effect of financial constraints on investment behavior was popularized by Fazzari, Hubbard, Petersen, Blinder, and Poterba (1988), who noted that firms likely to be constrained exhibited greater investment-cash flow sensitivity.

[2] The theoretical model is an extension of Almeida and Campello (2002). We endogenize taxes to allow for the study of heterogeneous investment responses to taxation.

Cash Flow Effect on investments for constrained firms. Conversely, should the data show that constrained firms increase their investments more than unconstrained firms, then the Cash Flow Effect on investments is greater for constrained firms than is the Required Rate of Return Effect on investment for unconstrained firms.

To answer our research question and shine light on the viability of our hypotheses, we study the 2013 reduction in the Swedish statutory corporate income tax rate from 26.3 percent to 22 percent. At the time, it was considered that the Swedish corporate tax system had deteriorated in competitiveness. The tax cut was thus intended to stimulate the Swedish economy and to increase its international competitiveness.

We apply a difference-in-differences design on the *Serrano* panel data set, which consists of all private and public firms in Sweden. As the actual financial constraints firms face are not directly observable in our data, we rely on cash holdings to classify firms as constrained or unconstrained. The reasoning behind this technique is as follows. In perfect capital markets, there is no reason for firms to hold cash, as any shortfall in internal liquidity can be easily replaced by external funds. When their access to external capital markets is costly or impaired, however, firms practice precautionary savings. To the extent that this allows constrained firms to seize more investment opportunities, this behavior is value increasing (Almeida, Campello, & Weisbach, 2004; Denis & Sibilkov, 2010; Opler, Pinkowitz, Stulz, & Williamson, 1999). In contrast, precautionary savings lack value for unconstrained firms, and these firms should exhibit relatively lower cash holdings. We therefore define firms as financially unconstrained if their average liquid assets-to-total assets ratio in the years before the reform was in the bottom decile of their industry. While this technique can be sensitive to the choices made in the classification process, we perform a number of robustness checks to show that our main results are consistent across cut-off levels and classification variables.

Our empirical results show that financially unconstrained firms increased their rate of investments in capital substantially more than constrained firms following the 2013 tax cut. We estimate the magnitude of this difference to be 1.4 percentage points in our main specification, corresponding to a sizeable share of pre-reform mean investment rates for unconstrained firms. We further find evidence that there is a sharp drop in effects in the middle of the sample, suggesting a non-linear relationship between financial constraints and investment responses to tax rate changes. Added together, this is evidence in favour of our proposition regarding the presence and importance of a Required Rate of Return Effect on investments.

We offer three main contributions. First, the theoretical framework we develop adds to the sparse theory and evidence at the intersection of corporate income taxes, financial constraints, and investment responses. Second, our theoretical discussion and empirical analysis demonstrate the utility of using cash holdings as a proxy for financial constraints. Finally, our thesis adds to the understanding about how different tax policy changes, depending on their design, may induce very different effects.

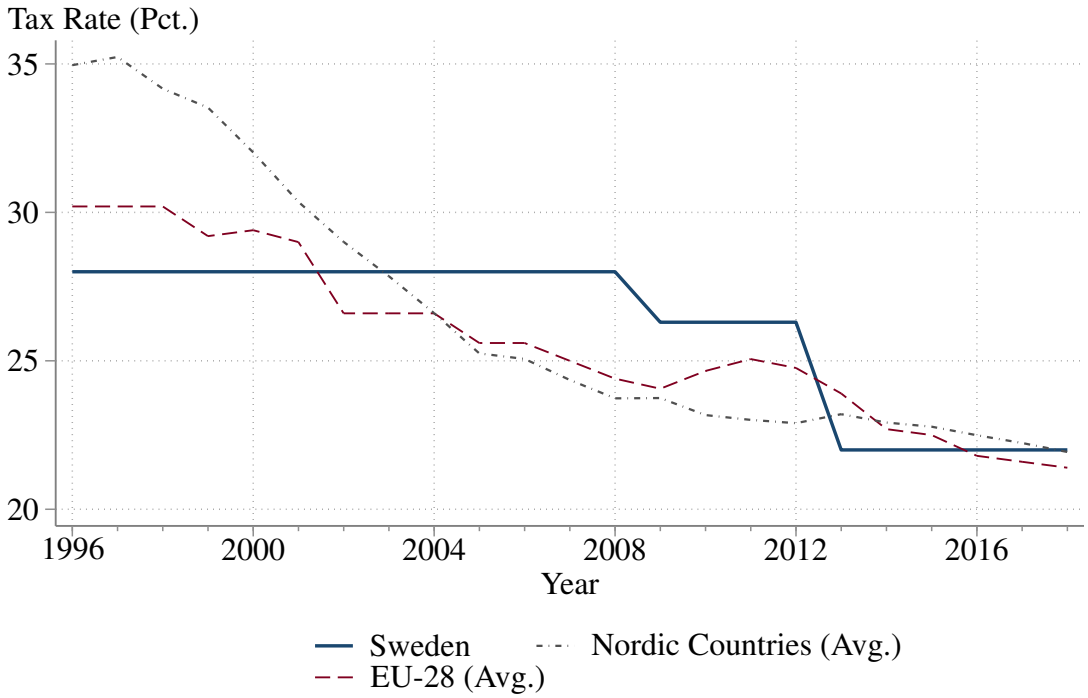
The rest of this thesis is structured as follows. Section 2 provides background on the taxation of corporate income in Sweden and the 2013 Swedish corporate income tax reform. Section 3 discusses previous research on tax policy and investment, in addition to financial constraints. Section 4 introduces our theoretical framework, derives the implications, and states our hypotheses. Section 5 outlines our empirical method. Section 6 presents the results. Section 7 discusses the implications, our contributions, and areas of future research. Finally, Section 8 provides a summary and a conclusion.

2 Background

2.1 Corporate Taxation in Sweden

The Swedish statutory corporate income tax rate applies to all limited companies, so called “aktiebolag” ("AB"), an organizational form corresponding to the American corporation, the British limited company, and the German Aktiengesellschaft. Due to previous reforms to the tax system, the taxation of corporate income in Sweden is simple in structure. In contrast to the majority of European countries, Sweden has no specific tax incentives (PwC, 2020). Thus, in principle, the effective tax treatment of corporate income is similar across firms.[3] The foundation of corporate taxation in Sweden is the corporate income tax for the AB, and the capital income tax—a payout and a capital gains tax—for its shareholders. As of 2020, these are 21.4 percent (down from 22.0 percent in 2019) and 30.0 percent respectively. These taxes apply to all AB’s, meaning there is no local taxation for corporations.

Figure 1: Corporate Income Tax Rates (Including Surcharges), 1996–2018



Notes: The Nordic Countries (Avg.) line shows the average corporate income tax rate in the five Nordic countries (Sweden, Norway, Denmark, Iceland, and Finland) over time. The EU-28 (Avg.) line shows the average rate in the EU countries (including the UK).
Source: authors’ own rendering, data from European Commisson

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Following World War II, the Swedish corporate income tax rate hovered between 50–60 percent. In 1985, the single state corporate income tax was introduced by abolishing local corporate taxes. In 1990–91, there was an extensive reform which reduced the scope

[3]Of course, tax avoidance activities might cause the effective tax rate to differ, e.g. international profit shifting. For an analysis of how corporate tax changes affect firms heterogeneously in the presence of international profit shifting, see Dobbins and Jacob (2016).

for lowering the effective corporate tax rate below the statutory rate. The previous system had been complex, and potential effects of changes had been difficult to oversee. Key components of the new system were significant reductions in statutory taxes (to 30 percent in 1991) and a broadening of the tax base through removal of various tax deferrals. Again, in 1994, the statutory tax rate was reduced to 28 percent, and to 26.3 percent in 2009 (Henrekson & Stenkula, 2015). Figure 1 above maps the statutory corporate income tax rate in Sweden over the past two decades, and compares it to other Nordic and EU countries.

2.2 The 2013 Swedish Tax Reform

In 2013, Sweden lowered the tax rate on corporate income from 26.3 percent to 22.0 percent. In the fiscal budget of that year, multiple reasons for the tax cut were given (Ministry of Finance, 2012). Overall, it was considered that the Swedish corporate tax system had deteriorated in competitiveness. Internationally, there had been a movement toward lower corporate income tax rates. Within the EU, this evolution had two explanations. First, new member states with lower rates had entered the union. Second, existing members had made downward adjustments themselves. With corporate income being relatively mobile compared to many other subjects of taxation, tax competition between states had become prevalent (Devereux, Lockwood, & Redoano, 2008).

The tax cut was a response to stimulate the economy and increase international competitiveness. As argued in the fiscal budget of 2013, there were four distinct motives for the change. First, a positive effect on productivity and employment, motivated by increased GDP per capita following a tax cut, as investment rise with a lower cost of capital (Arnold et al., 2011; Lee & Gordon, 2005). Second, increased attractiveness for multinational corporations ("MNCs"). Tax rates are a determinant for investment and the location of headquarters for MNCs, and relatively lower tax rates makes a specific country more attractive (Krugman, 1991). Third, to shield the total Swedish tax base. A relatively lower tax rate in a single country increases the incentive for firms to tax their profit in that specific country (Clausing, 2007). Finally, increased profitability from investments by Swedish firms. The corporate income tax rate is one of the factors that make up the cost of capital. A decrease implies increased profitability of available investments (Ministry of Finance, 2012).

The corporate income tax cut was accompanied by a change in the rules for interest rate deductions. It regarded limitations to firms' ability to deduct interest on internal loans to finance internal acquisitions. Using such transactions, tax could be avoided as firms deducted interest expense on group loans. The extent of avoidance could not be determined. At the time, it was estimated it could regard 3,400 firms.[4] The effect was not considered to be significant enough to offset the corporate income tax cut to such a degree that the desired effects would be lost. The motive was to increase equality in the effective tax treatment of large groups with efficient tax avoidance schemes and other firms without the ability to employ such schemes.

[4]Today, there are about 1.2 million firms in Sweden.

3 Literature Review

3.1 Research on Tax Policy

The effect of tax policy on firm investment behavior has been an important topic in both political debates and research. Around the turn of the century, the scientific consensus had moved from believing that the investment elasticity revolved around zero, to believing in an investment sensitivity to taxation (Hassett & Hubbard, 2002). An important contribution to this evolution came from Hall and Jorgenson (1967). In a neoclassical investment theory setting, they adjusted the user cost of capital (i.e. the rental price of a capital good) for corporate taxes and concluded that tax policy is an effective tool in changing the level of investment expenditures. An alternative approach to the user cost of capital framework began with Summers, Bosworth, Tobin, and White (1981), who incorporated q theory (Tobin, 1969) in the analysis. In such a setting, firms will invest as long as the ratio between the marginal value and cost of investment exceeds one (i.e. marginal q). The application of q theory in studies of the investment-tax relationship then includes a tax-adjustment. Subsequent research within both the q theory and cost of capital approaches yielded few unambiguous conclusions, something Cummins, Hassett, Hubbard, Hall, and Caballero (1994) attributed to measurement errors. However, Cummins, Hassett, and Hubbard (1996) found significant effects of tax changes on investment in 12 out of 14 studied OECD countries. A review of work leading up to the new millennia was provided by Hassett and Hubbard (2002), who concluded that, although the scientific community agreed on the existence of investment sensitivity to taxation, the magnitude of this effect was still subject to debate.

In more contemporary research, Djankov, Ganser, McLiesh, Ramalho, and Shleifer (2010) find that a 10 percent increase in the effective corporate tax rate reduces the aggregate investment to GDP ratio by two percentage points. Hanlon and Heitzman (2010) note that, with regards to the elasticity of investment to the tax-adjusted user cost of capital, the consensus seems to suggest a range between -0.25 and -1. In an analysis of the Domestic Production Activities Deduction, a US tax incentive, Ohrn (2018) finds that a one percentage point reduction in the effective corporate income tax rate increases investment by 4.7 percent of installed capital, increases payouts by 0.3 percent of revenues, and decreases debt usage by 5.3 percent of total assets.

An important part in achieving the consensus on the sign and magnitude of changes to the corporate income tax rate on investment was the move from aggregate to firm-level data. Previous to this, the literature had achieved few coherent results (Hanlon & Heitzman, 2010). Methods based on firm-level data rely on heterogeneous effects across firms. One such source of heterogeneity that has risen in recent research is financial constraints. Although there is a lack of evidence on large changes to the corporate tax rate, investments, and financial constraints specifically, some evidence have been found in relation to other types of policy. On payout taxes, Becker et al. (2013) find that following a cut, firms with less internal resources increase their investments relative to firms with more internal resources. Similarly, Alstadsæter et al. (2017) find that Swedish firms with lower cash holdings increase their investment more after a dividend tax cut. Zwick and Mahon (2017) and Edgerton (2010) further investigate heterogeneous responses to changes in accelerated depreciation schemes. Faulkender and Petersen (2012) study the American Jobs Creation Act of 2004, which significantly lowered the cost of repatriating foreign earnings. They find that firms who are unable to cover investment expenses using internal

funds, and therefore finance the marginal investment using external funds, respond more strongly, thus concluding that the sensitivity to changes in the cost of capital is higher among such firms. Their interpretation is that financially constrained firms are more responsive to changes in the corporate income tax rate.

3.2 Financial Constraints

Financial constraints have long been a source of discussion in corporate finance literature. In contrast to the perfect substitution of internal and external capital suggested by the famous work of Modigliani and Miller (1958), financial constraints have been shown as influential factors worthy of careful consideration. Financial constraints can affect firms' ability to finance available investment opportunities (e.g. Hennessy & Whited, 2007), and arise from asymmetric information that makes external capital more costly than internal capital, or even completely unavailable.[5]

Some common traits of financially constrained firms have been identified in literature. They are often smaller and younger (Carpenter & Petersen, 2002). Schauer, Elsas, and Breitkopf (2019) suggest two possible reasons. First, these firms often lack the collateral to mitigate issues inherent to adverse selection. Second, they are unlikely to have a track record or reputation, which are important in accessing external financing. Further differences can be seen in capital structure, as constrained firms use less debt (Farre-Mensa & Ljungqvist, 2016; Hadlock & Pierce, 2010; Whited & Wu, 2006), and hold more cash (Denis & Sibilkov, 2010; Hadlock & Pierce, 2010; Whited & Wu, 2006). Although private firms are particularly prone to information asymmetries and therefore financial constraints (Beck, Demirgüç-Kunt, & Maksimovic, 2005; Mulier, Schoors, & Merlevede, 2016; Saunders & Steffen, 2011), most research has been performed on large, public firms.

In regards to the relation between financial constraints, tax policy, and investment, there are two primary considerations in previous research. First, that constraints are difficult to measure (see Section 3.2.1 and 3.2.2). Second, how the relationship between constraints and the sensitivity of investment to cash flow might matter for the effects of corporate income tax cuts (see Section 3.2.3). A discussion on these matters follows.

3.2.1 Measures of Financial Constraints

As financial constraints are not directly observable, a plethora of measures have been suggested. A common approach among researchers is to use pre-estimated indices. Examples of these include the KZ index[6] by Lamont, Polk, and Saaá-Requejo (2001) and Baker, Stein, and Wurgler (2003), WW index by Whited and Wu (2006), SA index by Hadlock and Pierce (2010), or the FCP index by Schauer et al. (2019) (see Appendix A.3 for further details). The KZ, SA, and FCP indices all combine qualitative, such as survey responses of firms' managers, and quantitative proxies, measurable traits of firms, for financial constraints. The topic of which measurable traits best correlate with financial

[5] One well-known financial constraint is credit rationing. Kirschenmann (2016) distinguishes between two types. Borrower rationing, that some borrowers receive no credit at all (e.g. Stiglitz & Weiss, 1981), and loan size rationing, that although all borrowers are served, these have excess demand (e.g. Jaffee & Russell, 1976).

[6] As indicated by the name, the KZ index is based on coefficients originally estimated by Kaplan and Zingales (1997).

constraints is subject to much debate. As introduced in the prelude to research on financial constraints in this thesis, most evidence point to financially constrained firms being smaller, younger, less leveraged, and more liquid. The validity and application of indices is, however, questionable. The main issue is parameter stability, which has to be assumed when indices estimated on one sample is used on another (Schauer et al., 2019). Furthermore, many of the indices have been created using data on public firms (e.g. Hadlock & Pierce, 2010; Lamont et al., 2001; Whited & Wu, 2006), for which the informational asymmetries that induce financial constraints are likely less severe. In response to this issue, more recent indices have focused on SMEs (e.g. the ASCL index by Mulier et al. 2016, and the FCP index by Schauer et al. 2019). Finally, factors chosen in many of these indices lack an intuitive relation to financial constraints. Taken together, we therefore find the usefulness of indices as measures of financial constraints to be limited.

3.2.2 Cash Holdings as an Alternative Measure of Financial Constraints

Parallel to the debate on how to measure financial constraints, is a discussion of how one might explain why firms hold cash. When capital markets are perfect, there is no reason for firms to hold cash. In case of a shortfall in internal liquidity, it can easily be replaced by external funds. A common explanation as to why firms hold cash, then, has been imperfect markets. As such, cash holdings can be a useful indication of the degree of financial constraints a firm faces, which warrants the following review of previous research. It primarily consists of two strands, the precautionary and the agency motives to cash holdings. [7]

The Precautionary Motive to Cash Holdings Opler et al. (1999) find that firms with the greatest access to capital markets, such as large firms and those with high credit ratings, tend to hold less cash compared to firms with stronger growth opportunities and riskier cash flows. In essence, firms hold cash as a precautionary measure against adverse cash shocks when external financing is costly. Furthermore, firms with good investment opportunities hold cash because adverse shocks and financial distress is more costly to them. Bigelli and Sánchez-Vidal (2012) find that firms with higher cash holdings are smaller and exhibit higher risk, traits commonly associated with being financially constrained. Using data on public companies, Whited and Wu (2006) find evidence of the notion that constrained firms practice precautionary savings. Using qualitative data to categorize firms as constrained or unconstrained, Hadlock and Pierce (2010) conclude the same. Subramaniam, Tang, Yue, and Zhou (2011) further emphasize that diversified firms hold significantly less cash than their focused counterparts. In a recent study, Clarkson, Gao, and Herbohn (2020) find that, following large improvements to factors affecting asymmetric information, firms decrease their cash holdings. Using a large international sample, they illustrate how the enforcement of new insider trading laws and the mandatory adoption of the IFRS led to larger reductions in cash holdings among financially constrained firms.

Following the precautionary motive, Almeida et al. (2004) present a model where financially constrained firms invest in cash out of cash flows when the latter increase (also known as the "cash flow sensitivity of cash"). For this behavior, they find robust support within a large sample of firms. Denis and Sibilkov (2010) explore the motivation

[7] The earliest research on cash holdings was centered around trade-offs due to transaction costs (see e.g. Baumol, 1952; Miller & Orr, 1966; Mulligan, 1997)

behind precautionary savings among financially constrained firms. They argue that higher cash holdings allow such firms to undertake positive net present value projects that would otherwise have been bypassed. Although Almeida et al. (2004) show that constrained firms are more likely to save cash out of increasing cash flows, Denis and Sibilkov (2010) point out that precautionary savings are value increasing as it allows constrained firms to utilize more investment opportunities. Han and Qiu (2007) develop the model proposed by Almeida et al. (2004) to allow for a continuous distribution of cash flows, and argue that cash holdings increase in cash flow volatility for constrained firms. Further, Bates, Kahle, and Stulz (2009) suggest that riskier cash flows can explain increasing cash ratios since the 1980s. In constrast, Riddick and Whited (2009) question the positive cash-cash flow sensitivity á Almeida et al. (2004) for constrained firms due to measurement errors in q, but still find that income uncertainty and costly external finance induce precautionary savings. Almeida, Campello, and Weisbach (2011) remark that the cash flow sensitivity of cash needs not be positive when firms have access to liquid investments other than cash.

The Agency Motive to Cash Holdings Starting with Jensen (1986), agency problems between managers and shareholders has emerged as an alternative explanation to corporate cash holdings and the propensity to save cash out of cash flow shocks.[8] It predicts that managers would rather retain cash than pay it out to shareholders, even when the firm lacks profitable investment opportunities. In a large international sample, Dittmar, Mahrt-Smith, and Servaes (2003) observe that firms in countries where shareholders rights are poorly protected hold more cash than firms in countries with good protection. Such a difference can be derived from the greater ability of majority shareholders to extract private benefits from cash holdings when protections are low. Pinkowitz, Stulz, and Williamson (2006) further emphasize that the value of cash is lower in countries with poor governance laws. Kusnadi and Wei (2011) document that firms, and especially those that are financially constrained, in countries with weak minority shareholder protection laws, are more likely to decrease cash following increases in cash flow. Harford, Mansi, and Maxwell (2008) and Dittmar and Mahrt-Smith (2007) further find that poorly governed managers spend excess liquidity more quickly.

Gao, Harford, and Li (2013) analyze differences between public and private firms in terms of agency problems and cash management. Although private firms face higher financing frictions, public firms tend to hold about twice as much cash. They attribute this disparity to higher agency costs among public firms. Nikolov and Whited (2014) investigate different types of agency issues and their effects on cash holdings. They conclude that perquisite consumption is particularly important. In contrast to others, Bates et al. (2009) find no evidence supporting the agency motive for cash holdings.

3.2.3 Corporate Income Taxation, Financial Constraints, and Investment-Cash Flow Sensitivity

At the intersection of the research into corporate income taxes, investment, and financial constraints, Dobbins and Jacob (2016) propose an interesting model. In a study of the

[8] Alternative to both the agency and precautionary motive for cash holdings, is an explanation particular to international firms. Foley, Hartzell, Titman, and Twite (2007) investigate US MNCs and find that those facing higher repatriation taxes on foreign incomes hold higher levels of cash abroad. Further research on the affect of lowering repatriation taxes is given by Faulkender and Petersen (2012). Pinkowitz, Stulz, and Williamson (2013), however, disputes the tax explanation to corporate cash holdings.

German 2008 corporate income tax cut of 10 percent, they highlight two channels through which corporate tax cuts could affect firms' investment policies. First, a decrease in the corporate income tax rate lowers the pre-tax required rate of return, thereby alleviating the underinvestment problem proposed by classical literature such as Hall and Jorgenson (1967). Second, a lower tax rate increases after-tax profit, thus increasing the cash flow available for investment. They argue that, due to a higher investment-cash flow sensitivity among financially constrained firms, such firms should respond more strongly to the windfall created by a corporate tax cut. Although investment-cash flow sensitivity carries interesting implications for research on tax policy, most research have been performed on other types of cash flow shocks. This line of research is detailed below.

Although investments and cash flows are related, the strength of the relation and the motivation for its existence is subject to debate. The notion of investment-cash flow sensitivity ("ICFS") was originally introduced by Fazzari et al. (1988) as a measure of financial constraints. Using an approach based on the "pecking order of finance" (Myers & Majluf, 1984), they pointed to a higher sensitivity to changes in internal resources among firms facing high information costs. Their core argument, in the simplest case, was as follows. When a firm's investment demand is low, capital spending can be financed by internal funds. At very high levels of investment demand, the firm will also issue new equity. In such a setting, when information costs increase, the firm becomes increasingly dependent on internal funds. Thus, we would expect the investment of firms facing high information costs to be more sensitive to changes in internal resources, most accurately approximated by cash flow. Empirically, Fazzari et al. showed that low-dividend firms exhibit greater investment sensitivity to cash flow than do high-dividend firms. When firms face high information costs, they are more inclined to retain cash than to pay it out.

An extensive debate followed Fazzari et al. (1988), originating with Kaplan and Zingales (1997). Using the same sample as Fazzari et al. (1988), they illustrate that firms that appear less financially constrained show greater sensitivities than firms that appear more constrained. In classifying firms as financially constrained or unconstrained, they add qualitative data from the firms' 10-Ks and public management discussions to the quantitative data used by Fazzari et al. (1988). They question the proposition that ICFS should increase monotonically in financing constraints. Further corroborating evidence of their results is put forward by Cleary (1999), using a large sample of firms. Rauh (2006) finds that financially constrained firms exhibit a larger ICFS. Many models examining ICFS apply some form of q theory. However, Erickson and Whited (2000) show that ICFS can be attributed to measurement errors in q, and when accounting for such errors, ICFS disappears even for financially constrained firms. Chen (2012) find that ICFS has declined over time and question the relation to financial constraints. In contrast, Lewellen and Lewellen (2016) and Ağca and Mozumdar (2017) both address measurement errors in q and find that ICFS persists. Furthermore, they find that ICFS is higher for financially constrained firms. Using SME data and employment growth as a control for investment opportunities as opposed to q, Mulier et al. (2016) also find higher ICFS for constrained firms. Further research on private firm data is provided by Schauer et al. (2019). They survey managers' own assessments of financial constraint and find that the most constrained firms exhibit lower sensitivities. They reason that managers most likely refer to financial health, meaning internal liquidity, when answering their survey. Empirically, their results point to firms with lower cash holdings as exhibiting less ICFS. In line with Guariglia (2008) they argue that the relation between financial constraints and ICFS could depend on the proxies used for constraints.

4 Theoretical Framework

Following Farre-Mensa and Ljungqvist (2016), we identify two overarching conceptual structures of financial constraints. The first is a definition based on the curvature of the external capital supply curve. The second is based on the level of the external capital supply curve, and the wedge between this curve and that of the opportunity cost of internal capital.

The first definition characterizes financial constraints in terms of the effects supply frictions have on external capital supply (see Almeida & Campello, 2002; Schauer et al., 2019; Stiglitz & Weiss, 1981; Whited & Wu, 2006). The more inelastic the supply curve, the higher the cost of raising an additional unit of capital. In the limit, the curve becomes vertical and the firm is completely blocked out of external capital markets. This relates to the concept of credit rationing, a situation in which, as characterized by Stiglitz and Weiss (1981), a firm would not receive a loan even if it paid a higher interest rate.

The second definition of financial constraints considers a wedge between a firm's cost of external capital and the opportunity cost of internal capital (e.g. Fazzari et al., 1988). The difference between the external and internal curve is increasing in the informational asymmetries faced by the firm in external capital markets. A very constrained firm can only access external capital at a price that exceeds the opportunity cost of internal capital.

The latter definition is more flexible in its implications. As exemplified by Farre-Mensa and Ljungqvist (2016), whenever a firm faces an inelastic external capital supply curve, there is also a wedge between its internal and external cost of capital. However, whenever a firm faces a large wedge between its internal and external cost of capital, it does not necessarily face an inelastic supply curve. Despite this advantage, we study a model similar in design to those based on the curvature definition of financial constraints. Since our data consists primarily of SMEs, and because SMEs firms are more rationed (Kirschenmann, 2016), we consider such a model to be more descriptive of the situation faced by the firms in our sample.

4.1 Model Setup

We study firm behavior within a two-period model ($t = 1, 2$) as in Almeida and Campello (2002).[9] Their original model has been enhanced by endogenizing the corporate tax rate. This allows us to analyze the responses of constrained and unconstrained firms within this framework to shocks from the two main channels through which tax cuts are thought to affect investments: a reduction in the pre-tax required rate of return, and an increase in the post-tax cash flow from existing activities (Dobbins & Jacob, 2016). We term these the *Required Rate of Return Effect* and the *Cash Flow Effect*, respectively. We study each of these channels separately (holding the other fixed) and develop two competing propositions about how unconstrained and constrained firms should react to tax cuts.

The firm may invest I_1 in a project in Period 1. This investment subsequently yields a cash flow of $\pi(I_1) \geq 0$ in Period 2. The returns from the project are marginally diminishing in the amount invested, that is, π is a strictly concave function with $\pi'(I) > 0$ and $\pi''(I) < 0$. We further assume that the firm can dispose of the principal investment, I_1, in Period 2 for the acquisition value, net of a depreciation factor $q \in [0, 1]$. The firm has initial cash holdings $W_0 \geq 0$ at the beginning of Period 1 that may be used to finance the

[9] The original model does not consider the effects of taxes–in fact, it abstracts from taxation–but we find it to provide a useful environment for our analysis once taxes are endogenized.

investment. It may also issue debt $B_1 \geq 0$ in Period 1, which is then repaid in Period 2. The firm's Period 1 cash flow after taxes (but before dividends) thus equals

$$CF_1 = W_0(1-\tau) + B_1 - I_1, \tag{1}$$

while Period 2 cash flow after taxes (but before dividends) is given by

$$CF_2 = (1-\tau)\pi(I_1) + qI_1 - B_1, \tag{2}$$

where $\tau \in (0,1)$ is the corporate income tax rate.

We assume that the Period 2 return of the project depends on some human effort.[10] Suppose further that banks (and other external financiers) are risk-averse and unwilling to grant credit against future (possible) cash flows—they demand that every unit of capital be secured against the Period 2 market value of the underlying asset, qI_1.

A key question of interest to our theoretical framework is why two firms, with identical balance sheets, would face a different degree of financial constraints in external capital markets. Previous literature points to asymmetric information (e.g. Hennessy & Whited, 2007). We model this indirectly through an exogenous parameter ω that varies between firms, but is fixed across the two periods. Effectively, the ω parameter adjusts the amount of debt the firm can raise in Period 1, such that $B_1 \leq (1-\omega)qI_1$. We therefore think of ω as representing the unobserved, financial constraints that face different firms in the economy, limiting their access to external financing.

The final assumption is that the firm's manager maximizes the value of Period 1 and 2 dividends. We normalize cost of capital and the time value of money to 1.[11] The behavior of the firm can then be expressed as the following optimization problem:

$$\begin{aligned} \max_{I_1, B_1} \quad & V = d_1 + d_2 \\ \text{s.t.} \quad & d_1 = W_0 - I_1 + B_1 \geq 0, \\ & d_2 = (1-\tau)\pi(I_1) + qI_1 - B_1, \\ & B_1 \leq (1-\omega)qI_1. \end{aligned} \tag{3}$$

4.2 Investment Levels of Constrained and Unconstrained Firms

We start by deriving the first-best investment level according to the problem in (3), that is, the investment level when the firm is not restricted by the budget constraints:

$$\pi'(I^{FB}) = \frac{1-q}{1-\tau}. \tag{4}$$

This investment level is feasible as long as the budget constraint is met, that is

$$W_0 + (1-\omega)qI^{FB} \geq I^{FB}. \tag{5}$$

From Equation 5 above, we can derive the threshold rate ω_{max}, the highest rate at which the market value of the principal can be discounted by external financiers due to informational asymmetries (or other drivers of financial constraints):

$$\omega_{max} = 1 - \frac{W_0 - I^{FB}}{qI^{FB}}. \tag{6}$$

[10] That is, if the firm merely invests I_1 and then dissolves, the project yields no return by itself in Period 2.

[11] This is done to simplify the problem and does not change the interpretation of the differences between two firms with the same cost of capital.

If $\omega \leq \omega_{max}$, investments are equal to the first-best level, and we classify the firm as financially unconstrained. If $\omega > \omega_{max}$, the firm is financially constrained, and its investment level is given by the budget constraint:

$$I = \frac{W_0}{1 - q + \omega q}. \tag{7}$$

In the following two sections, we consider each of the channels through which a reduction in the corporate tax rate τ should affect investments (see the discussion in 3), while holding the other fixed, for constrained and unconstrained firms. First, we consider the effects of the reduction in the pre-tax required rate of return while treating Period 1 cash holdings W_0 as tax-free[12] (as in the optimization problem in Equation 3). Then, we consider the effects of the increase in post-tax cash flow by treating W_0 as pre-tax,[13] while considering $\pi(I_1)$ to be tax-free.

4.3 Heterogeneous Responses to the Required Rate of Return Effect of a Decrease in the Tax Rate

To illustrate the Required Rate of Return Effect, we consider the responses of three types of firms when the tax rate τ is decreased. W_0 is treated as post-tax, as in Equation 3.

Unconstrained Firm with $\omega < \omega_{max}$ (Firm A)

The investment level of Firm A, which is financially unconstrained, is given by $I_A = I^{FB}$, which satisfies $\pi'(I^{FB}) = \frac{1-q}{1-\tau}$. The derivative of the first-best investment level with respect to the tax rate is given by

$$\frac{\partial \pi'(I^{FB})}{\partial \tau} = \frac{1-q}{(1-\tau)^2} > 0. \tag{8}$$

Given that $\pi'(I) > 0$ and $\pi''(I) < 0$, this implies that $\frac{\partial I^{FB}}{\partial \tau} < 0$. As such, if we denote ΔI^{FB} as the increase in the first-best investment level when the tax rate is changed by $-\Delta\tau$, this implies that $\Delta I^{FB} > 0$. Depending on ω_A, Firm A may or may not be able to raise its investment level to the new first-best level. We denote the maximum amount by which Firm A can increase its investments—which is dependent on ω_A—as $\Delta I_A(\omega_A)$. We conclude that

$$\Delta I_A = \min\left\{\Delta I_A(\omega_A)\ ,\ \Delta I^{FB}\right\} > 0. \tag{9}$$

Unconstrained Firm with $\omega = \omega_{max}$ (Firm B)

Firm B is financially unconstrained. Because $\omega = \omega_{max}$, its highest possible investment level—restricted by the budget constraint—is exactly equal to the first-best investment level before the tax cut. When the tax rate is decreased, the first-best investment level increases, as shown in the section for Firm A above. Firm B is already investing at the maximum level, however, and is thus unable to increase investments. As such

$$\Delta I_B = 0. \tag{10}$$

[12] This is equivalent to saying that the tax rate changed in $t = 1$, and that retained earnings W_0 have already been taxed at the previous tax rate

[13] Effectively assuming that the tax change took place in $t = 0$

Constrained Firm with $\omega > \omega_{max}$ (Firm C)

As is the case for Firm B, Firm C's investment level is restricted by the budget constraint. As such, it is unable to increase investments when the tax rate is decreased. This implies

$$\Delta I_C = 0. \tag{11}$$

General Solution

From the analysis of Firms A–C above, we can express the generalized solution:

$$\Delta I(\tau \downarrow)_{RR} = \begin{cases} \min\left\{\Delta I_A(\omega_A)\ ,\ \Delta I^{FB}\right\} > 0, & \text{if } \omega < \omega_{max} \\ 0, & \text{if } \omega \geq \omega_{max}. \end{cases}$$

From the above, we develop our first proposition:

Proposition 1: *Because financially unconstrained firms are able to raise the necessary capital to respond to the reduction in the pre-tax required rate of return, they increase their investments. Everything else equal, constrained firms are unable to increase investment in response as they cannot raise any additional capital.*

4.4 Heterogeneous Responses to the Cash Flow Effect of a Decrease in the Tax Rate

A reduction in the corporate tax rate also effectively constitutes a cash transfer to all firms with positive net results. Next, we consider the heterogeneous impact of a tax cut on the investment behavior of constrained and unconstrained firms through this channel, the Cash Flow Effect. To do so, we treat return to investments $\pi(I_1)$ as tax-free and instead impose taxes on the cash flow of the firms, W_0. Analogously to in Equation 4, the first-best investment levels of firms now satisfy[14]

$$\pi'(I^{FB}) = 1 - q. \tag{12}$$

For firms that cannot access enough capital to invest at the first-best level, the investment level from Equation 5 (restricted by the budget constraint[15]) now becomes

$$I = \frac{W_0(1-\tau)}{1-q+\omega q} < I^{FB}. \tag{13}$$

As in the previous section, we consider the responses of a reduction in the corporate tax rate of the three firms A, B, and C.

Unconstrained Firms with $\omega \leq \omega_{max}$ (Firms A and B)

As before, Firms A and B are investing at the optimal investment level ex-ante, that is, $I_A = I_B = I^{FB}$. Because we now treat return to investments as tax-free, we have from Equation 12 that

$$\frac{\partial \pi'(I^{FB})}{\partial \tau} = 0, \tag{14}$$

[14]The second budget constraint in Equation 3 now simplifies to $d_2 = \pi(I_1) + qI_1 - B_1$.

[15]The first budget constraint is now $d_1 = W_0(1-\tau) - I_1 + B_1 \geq 0$.

that is, the pre-tax required rate of return—and thus also the first-best level of investments—is unaffected by the tax cut. Given that Firms A and B are already at the ex-ante first-best investment level, they have no profitable investment opportunities left in which to invest the effective cash transfer from the tax cut,[16] and so they do not increase their investments even when effectively being given a cash transfer from a lower rate of taxation on Period 1 internal cash flows. We conclude that

$$\Delta I_A = \Delta I_B = 0. \tag{15}$$

Constrained Firm with $\omega > \omega_{max}$ (Firm C)

Firm C has $\omega > \omega_{max}$, which means that the ex-ante investments of Firm C, I_C, are given by Equation 13. The sensitivity of the investments of Firm C to changes in the corporate tax rate is thus given by

$$\frac{\partial I_C}{\partial \tau} = -\frac{W_0}{1-q+\omega q} < 0. \tag{16}$$

It follows that Firm C's response to a reduction in the corporate tax rate of $(-\Delta\tau)$ is

$$\Delta I_C = (-\Delta\tau) \times \frac{\partial I_C}{\partial \tau} = \frac{\Delta\tau \times W}{1-q+\omega q} > 0. \tag{17}$$

General Solution

From the analysis of Firms A–C above, we can express the generalized solution:

$$\Delta I(\tau\downarrow)_{CF} = \begin{cases} 0, & \text{if } \omega \leq \omega_{max} \\ \dfrac{\Delta\tau \times W_0}{1-q+\omega q} > 0, & \text{if } \omega > \omega_{max}. \end{cases}$$

From the above, we develop our second proposition:

Proposition 2: *Because financially constrained firms are below the optimal investment level before the reduction in the corporate tax rate, they increase their investments when receiving the effective cash transfer. By definition, unconstrained firms are already at the optimal level ex-ante and, everything else equal, they do not increase their investments in response to the cash transfer.*

4.5 Conclusion From the Model

The model shown above outlines two effects which induce firms to respond to a tax cut by adjusting their investment levels. The first effect, which reduces the pre-tax required rate of return on all investments, causes unconstrained firms to increase their investments, while, everything else equal, constrained firms are unable to respond as they cannot raise the necessary capital. This results leads to the formulation of Proposition 1. The second effect, in which the lower profit tax rate boosts the same-period post-tax earnings of profitable firms, causes constrained firms to increase their investments, while, everything else

[16] To see why, consider a firm with investments $I = x$ that satisfy $\pi'(x) = 1 - q$. Suppose further that the firm decides to invest some additional amount z. Given marginally diminishing returns, the return on the additional investment is $r(z) \equiv \int_x^z \pi'(I)dI < (1-q)z$. The total, two-period net cash flow from the additional investment z is thus equal to $CF_1 + CF_2 = -z + \big(r(z) + qz\big) = (1-q)z + r(z) < 0$.

equal, unconstrained firms do nothing as they are already at their optimal investment level by definition. This effect is derived from higher investment-cash flow sensitivities among constrained firms (see Section 3). It allows us to state Proposition 2.

In other words, cutting the corporate tax rate has two main effects on investment behavior. In our model, constrained and unconstrained firms each respond to only one of these effects. The model is thus ambiguous in its prediction about whether constrained or unconstrained firms increase their investments more when the tax rate is decreased. This depends on the relative weights of the effects, which in the real world is likely to depend on factors such as the composition of firms in the two groups and their characteristics, and the general traits of the economy when the policy change is introduced. We exploit this ambiguity, in conjunction with Propositions 1 and 2, to develop two mutually exclusive hypotheses to be tested in the data.

Hypothesis 1: *Unconstrained firms increase their investments more than do constrained firms because the Required Rate of Return Effect on investments is greater for unconstrained firms than is the Cash Flow Effect on investments for constrained firms.*

OR

Hypothesis 2: *Constrained firms increase their investments more than do unconstrained firms because the Cash Flow Effect on investments is greater for constrained firms than is the Required Rate of Return Effect on investment for unconstrained firms.*

5 Method

To test Hypotheses 1 and 2 above—and, more broadly, to answer our research question about how firms respond to reductions in the corporate income tax rate—we apply a Difference-in-Differences design on panel data with financial and ownership information about Swedish private and public firms between 2010 and 2017 from the Swedish House of Finance's *Serrano* database.[17]

5.1 Main Empirical Strategy

The main focus of our identification strategy is centered around heterogeneous responses of financially unconstrained and constrained firms to the 2013 reduction in the Swedish corporate income tax rate. The main variable of interest is the rate of investment in fixed assets.[18] We later expand the analysis to include other forms of responses to this tax cut, namely investments in labor, as well as whether or not the firm pays dividends and the dividends-to-fixed assets ratio. By studying these variables, we are trying to shine light on a broader question about to what degree, and through which channels, firms respond to lower taxation by adjusting their activities. We suspect that these responses are heterogeneous in financial constraints—that is, that financially constrained firms make other decisions and take other actions following tax cuts than do financially unconstrained firms.

Our main empirical strategy is as follows. Drawing on the extensive corporate finance literature about the link between precautionary cash holdings and financial constraints

[17] We use data from 2008 and 2009 to construct 2010 lagged variables.

[18] We exclude financial fixed assets, as we are interested in investments in production factors, not wealth placement.

(as discussed in Section 3), we use average cash holdings before the 2013 tax reform to classify firms as financially constrained or unconstrained. In an attempt to reduce any distortionary effects of the 2008–2009 Great Recession[19] on our results, we limit the data to observations starting in January 1, 2010. Specifically, we calculate the mean liquid assets-to-lagged total assets (henceforth referred to as "cash holdings") in each industry, and classify firms as financially unconstrained if their average cash in the pre-reform[20] period (2009–2012) was in the bottom decile of their industry. We use industry-adjusted averages to account for the fact that different industries have different cash holding norms.

We estimate the average difference in the causal effect of the tax cut on the outcome of interest between *ex-ante* financially unconstrained firms and the rest of the sample, conditional on fixed effects and controls, through the following regression:

$$Y_{it} = \delta_t + \mu_i + \alpha_{it} D_{it} + \theta_k \mathbf{X}_{k,it} + \varepsilon_{it}, \tag{18}$$

where Y_{it} is the outcome variable for firm i in year t. D_{it} is the treatment indicator. It is equal to 1 if firm i is financially unconstrained and the year t is 2013 or later. Its coefficient, α_{it}, is thus intended to capture the average difference in the causal effect of the 2013 tax cut between unconstrained firms and the rest of the sample. δ_t and μ_i capture time and firm fixed effects, respectively. These control for observed and unobserved effects that vary between firms and constant over time (firm FE) and constant between firms and that vary over time (year FE). We include a number of control variables—denoted above as $\mathbf{X}_{k,it}$, a $1 \times k$ vector of controls. These are further described in Section 5.3.3 and listed in Tables 1 and 2.

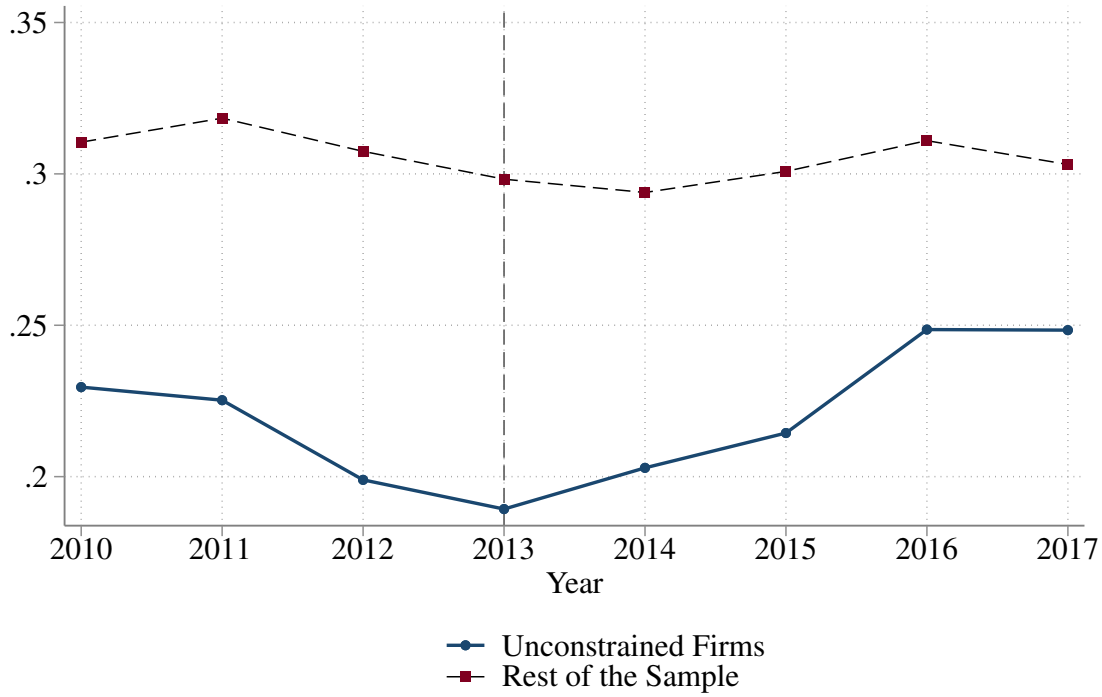
The key identifying assumption required for the causal interpretation of Equation 18 is that, conditional on controls and fixed effects, the rates of investment in capital for financially constrained and unconstrained would have followed parallel paths, were it not for the 2013 tax cut. We report graphical evidence that supports this assumption for our main variable of interest—the rate of investment in capital—in Figure 2. We observe that yearly rates of investment in capital followed relatively similar patterns for constrained and unconstrained firms in the pre-reform period. After the reform, however, on average, unconstrained firms increased their investment rates upward visibly more than constrained firms. Adding to this, we also conduct a more formal test of parallel trends—which includes controls and fixed effects—in the style of Autor (2003), reported in Table 9 in Appendix A.1. The results of this test implies that, relative to the rest of the sample, being financially unconstrained only had an effect on growth in the rate of investments after the 2013 tax reform. It thus provides further support for our parallel trends assumption.

The actual degree of financial constraints firms face are not directly observable. We use industry-adjusted cash holdings as a proxy. Another key assumption in our analysis is thus that differences in cash holdings actually are representative for differences in financial constraints. We argue that firms undertake the costly endeavour of holding cash—which may otherwise be invested to generate future profits or distributed to shareholders—for precautionary reasons. In essence, firms hold cash as a measure against adverse cash shocks when access to external financing not perfect (Opler et al., 1999). As

[19] Following the 2008–2009 crisis was the European Sovereign Debt Crisis. However, a higher degree of independence has historically benefited the Swedish economy during turbulence in the Euro area (Suni & Vihriälä, 2014).

[20] We are interested in the effect of being financially (un)constrained at the beginning of year t on investments in year t. Because of the way the values are coded, $Cash_{2012}$ represents cash holdings on December 31, 2012, while Inv_{2013} tracks investments between January 1, 2013, and December 31, 2013. As such, cash holdings during 2009–2012 are equivalent to cash holdings during January 1, 2010–January 1, 2013.

Figure 2: Mean Yearly Rates of Investment in Capital, 2010–2017



Notes: This figure plots the mean rates of investment in capital for unconstrained firms over time, and compares it to the rest of the sample. Rate of investment in capital is defined as the change in tangible and intangible fixed assets (but excluding financial assets) during the year, plus depreciation and amortization, divided by the prior year's tangible and intangible assets. Unconstrained firms are the firms whose cash holdings (liquid assets-to-lagged total assets) were in the bottom decile of their respective industry in the pre-reform period (2010–2013).

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the level of financial constraints can be characterized as the access to external financing, highly constrained firms hold more cash. For that reason, we classify firms as unconstrained if they hold very little cash relative their total assets and the standards of their industry. While we cannot rule out the possibility that high cash holdings alleviates informational asymmetries, considering the extensive support for precautionary savings in previous research (see e.g. Almeida et al., 2004; Bigelli & Sánchez-Vidal, 2012; Denis & Sibilkov, 2010; Hadlock & Pierce, 2010; Whited & Wu, 2006), we find precautionary savings to be a more likely explanation. Neither can we rule out the existence of unconstrained firms with large cash holdings. Such a situation might arise due to the agency motive for cash holdings, and has been found in large, public firms (Gao et al., 2013). However, as our sample consists almost entirely of SMEs, we expect our classification of constrained and unconstrained firms to hold in most cases.

Table 1, which compares unconstrained firms with the rest of the sample, corroborates this argument. Unconstrained firms seem to be larger and more mature, as evident from their substantially higher total assets and slower sales growth, consistent with the relationship between size and financial constraints (Hadlock & Pierce, 2010). Their lower labor expenses to total assets ratio implies that they are more capital-intensive (Garmaise, 2008). They also have higher debt-to-total assets ratios, a trait commonly associated with lower financial constraints (Farre-Mensa & Ljungqvist, 2016; Hadlock & Pierce, 2010; Whited & Wu, 2006). Finally, their working capital is one-third of the rest of the sample.

Table 1: Summary Statistics: Characteristics of Unconstrained Firms

	Unconstrained Firms			*Rest of the Sample*		
	Mean	25th	75th	Mean	25th	75th
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variables						
Investments in Capital	0.218	0.000	0.203	0.306	0.000	0.272
Investments in Labor	0.092	-0.158	0.144	0.144	-0.167	0.172
Dividends	0.027	0.000	0.000	0.054	0.000	0.058
Dividend Payer	0.194	0.000	0.000	0.356	0.000	1.000
Grouping Variables						
Cash	0.061	0.002	0.029	0.397	0.087	0.632
Avg. Cash (2009–12)	0.009	0.002	0.012	0.399	0.118	0.618
Control Variables						
EBIT	0.017	-0.015	0.060	0.079	-0.020	0.166
Loss	0.367	0.000	1.000	0.272	0.000	1.000
Sales Growth	0.128	-0.165	0.142	0.194	-0.169	0.182
ln(TA)	8.261	7.069	9.432	7.337	6.151	8.463
Debt	0.287	0.000	0.497	0.139	0.000	0.154
Labor Expenses	0.296	0.000	0.400	0.482	0.000	0.712
Working Capital	0.101	-0.092	0.331	0.375	0.092	0.662
Firm-Year Observations		260,795			2,408,047	
Unique Firm Observations		39,216			341,344	

Notes: Investments in Capital is defined as the change in tangible and intangible fixed assets (but excluding financial assets) during the year, plus depreciation and amortization, divided by the prior year's tangible and intangible assets. Investments in Labor is defined as the change in labor expenses, relative to the prior year's labor expenses. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise. Cash is defined as liquid assets, relative to last year's total assets. Avg. Cash (2009–12) denotes the average yearly liquid assets-to-lagged total assets of firms before the 2013 reform. Firms are classified as financially unconstrained if Avg. Cash (2009–2012) was in the bottom decile of their industry. EBIT is defined as lagged earnings before interest and taxes, relative to the prior year's total assets. Sales Growth is defined as lagged growth in sales, relative to the prior year's sales. Debt is defined as lagged current and non-current interest-bearing liabilities, relative to the prior year's total assets. Loss takes the value of 1 if lagged net results are below zero. ln(TA) is defined as the natural logarithm of lagged total assets. Working Capital is defined as lagged current assets minus lagged current liabilities, relative to the prior year's total assets. Labor Expenses is defined as lagged labor expenses, relative to the prior year's total assets.

On the other hand, Table 1 also exhibits some features that may be indicative of a reversed relationship between cash holdings and financial constraints. First, unconstrained firms have lower dividends-to-total assets ratios and are less likely to pay dividends. However, some caution is required when drawing conclusions from these measures. Within our sample of predominantly private firms, it does not seem unreasonable that many of the smaller and owner-managed firms pay dividends instead of salaries for tax reasons. Also, note that dividends are expressed as a ratio of total assets (for better comparability across years). For those reasons, we argue that this feature may in large part be a result of small firms paying a relatively large share of their total assets as a form of work compensation through dividends.[21] Second, we note that unconstrained firms have much lower earnings before interest and taxes (EBIT) to total assets than the rest of the sample. While this could be used to argue that firms with low cash simply do not generate enough EBIT to fill up their coffers, this could just as well be because unconstrained firms have exhausted more of their feasible investment opportunities (as argued in Section 4), and their return on capital, given marginally diminishing returns to investments, thus should be smaller than constrained firms.

As evident from the discussion above, cash holdings is not a perfect measure of financial constraints. We do, however, believe that cash holdings is the best measure we have access to in our data. A popular solution within the corporate finance literature is to use one or more "plug-and-play" indices for financial constraints as the explanatory variables (e.g. the KZ index by Lamont et al. 2001 and Baker et al. 2003, WW index by Whited and Wu 2006, SA index by Hadlock and Pierce 2010, or the FCP index by Schauer et al. 2019, see Appendix A.3). We do not, however, believe that using such an index would be appropriate in our case. The variable weights for the popular indices are typically estimated on U.S. listed firms. Several of the variables, such as the market-to-book ratio, are only available for listed firms (while our data set predominantly contains private firms), and, most importantly, even if these index weights capture the true relationships in their samples, what is true in the U.S. needs not be true in Sweden.

5.2 Alternative Specifications

Our identification strategy relies on assigning firms to either the treatment or the control group. We assign firms to the former if they had low cash holdings—and thus were financially unconstrained—in the pre-reform period and to the latter if they were not. This classification of treatment invariably relies on selecting some cut-off threshold (we use the 10th percentile in the main specification). To strengthen our analysis, and alleviate concerns that our results are dependent on the selection of this cut-off, we expand the analysis to a non-binary treatment and control group selection. First, we estimate a linear effects model in which the treatment intensity increases linearly in pre-reform cash holdings. We specify this as

$$Y_{it} = \delta_t + \mu_i + \beta_{it} C_{it} + \varphi_k \mathbf{X}_{k,it} + \epsilon_{it}, \tag{19}$$

[21] The poor informativeness of standalone dividend measures as it pertains to financial constraints is discussed by Farre-Mensa and Ljungqvist (2016). Leary and Michaely (2011) illustrate that the dividend smoothing behavior often associated with dividend paying firms, is most likely related to agency conflicts. They also note that although financial constraints may in part be a manifestation of agency problems, firms with high precautionary savings motives are more likely to be firms for which asymmetric information is a more relevant friction than agency problem.

where the treatment indicator, C_{it}, is equal to firm i's pre-reform average cash holdings if the year t is 2013 or later, and zero otherwise. The coefficient of interest, β_{it}, is thus intended to capture the marginal, causal effect of having higher cash holdings on the investment response to a reduction in the corporate tax rate. As in Equation 18, Y_{it} is the outcome variable of interest; δ_t and μ_i denote time and firm fixed effects; and $\mathbf{X}_{k,it}$ is the same $1 \times k$ vector of controls described in Section 5.3.3 below.

With the specification in (19), we implicitly impose an equal marginal effects assumption, thus restricting the marginal effect of cash holdings on investment responses to the tax cut to be constant (Havnes & Mogstad, 2011). We believe this is a stronger assumption for our data than the common trends assumptions required for the main specification. While we argue that lower cash holdings indicate lower financial constraints, and—as we show in Section 4—that financial constraints matter for the response to a reduction in the corporate tax rate, we do not think that this response is linear in financial constraints.

In addition to the regression in (19), we therefore enhance the analysis of Regression 18 by allowing treatment intensity to vary in ten decile steps. We divide firms into deciles based on their average pre-reform, industry-adjusted cash holdings and estimate the regression

$$Y_{it} = \delta_t + \mu_i + \sum_{d=1}^{10} \gamma_{d,it} D_{d,it} + \rho_k \mathbf{X}_{k,it} + e_{it}, \quad d \neq j, \tag{20}$$

where the treatment indicator $D_{d,it}$ is a dummy that is equal to 1 if the average, pre-reform cash holdings of firm i are within the d$^{\text{th}}$ decile of i's industry. The j$^{\text{th}}$ decile is omitted from the regression. As such, the coefficient of interest, $\gamma_{d,it}$ is designed to capture the difference in the causal effect of the tax cut between the d$^{\text{th}}$ and the j$^{\text{th}}$ decile of financial constraints.

We use this specification to investigate how the marginal effects are distributed across each of the ten deciles of financial constraints. Based on the results, we adjust the cash holdings cut-off and compare the results to the baseline model in Table 7.

5.3 Data

This study uses panel data available from Swedish House of Finance's *Serrano* database, which primarily consists of firm-level financial history. The financial data in *Serrano* is gathered from financial statement data from the Swedish Companies Registration Office. Further additions include history with general company data from Statistics Sweden, bankruptcy information from the Swedish Companies Registration Office, and group data from Bisnode's group register. An attractive feature of this database is the extensive framework of rules that controls how underlying data is transformed and modified into comparable calendar year values.

Nevertheless, as tends to be the case with firm-level data, several issues in the underlying source data need to be corrected for. After excluding all observations that are not relevant to our study, such as financial data on public entities, we take several measures to clean the data. First, drawing on elementary accounting rules, we censor obviously erroneous observations. These include negative balance sheet observations, negative sales, and negative costs.[22] We also censor the observations with liquid assets that are larger

[22]Technically, costs are coded as negative values in *Serrano*. We therefore censor the few observations that have positive values for our relevant cost variables.

than total assets.[23]

When investigating the data, we notice that there are no missing values for any of the balance sheet items. There are, however, a large number of observations with zero assets that have substantial sales and operations. For income statement items, there are is a large number of missing observations. This leads us to conclude that missing values for balance sheet items are coded as zero in the underlying datasets that feed into *Serrano*. We censor observations of liquid assets that equal zero, as these likely contain all missing values in the dataset. This step is critical because of the way we classify firms as constrained or unconstrained. Given that we classify firms in the bottom decile of cash as unconstrained, we think there is a high risk that our treatment group would consist almost entirely of firms with missing values of cash if we do not correct for missing values coded as zero. If so, we would potentially be comparing the investment behavior of firms that failed to report their assets to firms that did. By removing firms with cash holdings equal to zero, we make the implicit assumption that all functioning firms have at least 1 SEK of liquid assets. While it is possible to imagine an extremely financially unconstrained firm with access to unlimited amounts of debt, free of charge, and with no delay—and thus no need for any liquid assets whatsoever—we deem it extremely unlikely that such firms would in any way affect our estimation, if they even exist. In the worst case scenario, we are restricting our sample to firms that hold at least some cash on hand. We do, however, believe this is a better alternative than having our treatment group potentially consisting entirely of missing values.

To prevent extreme—and obviously nonsensical[24]—values from skewing our results, we further censor observations outside the 1st and 99th percentiles of each variable.[25] This is a common practice in finance when working with large, firm-level data sets (see e.g. Becker et al. 2013).

In the rest of this section, we describe the variables used in the analysis. Summary statistics for all variables are reported in Table 2.

5.3.1 Dependent Variables

The main dependent variable of interest is investments in capital. This variable is intended to be roughly equivalent to the cash flow measure capital expenditures (CAPEX). Because our data consists of almost exclusively private firms—for which cash flow statements are usually neither required nor available—we have to manually construct an investment variable. We define investments in capital in year t as the the difference in capital between year t and year $t-1$, plus depreciation and amortization (which are accounting measures but not actual flows of capital), relative to capital in year $t-1$. The measure thus represents the investment rate I_t/K_{t-1}. Capital is here calculated as the sum of tangible (which are depreciated) and intangible (which are amortized) fixed assets. One interesting feature of our variable definition is that investments may take on a negative value if divestments of assets were larger than the acquisition of new assets during a year. While the cash flow-item CAPEX cannot be negative, we believe this feature of our variable adds potentially useful information to our analysis. For example, if a firm reacts to the tax cut by selling

[23] Given that total assets is the sum of all assets, and assets cannot be negative, this obviously makes no sense.

[24] Such as investment values of 800,000%.

[25] In Table 12 in the Appendix, we report the results from the baseline model when variables are winsorized and censored at the 2% and 5% levels. We find that the choice of level and technique to have a small impact on the coefficient of interest.

off half of their assets and not acquiring any new ones, our investment measure would be -0.5 while CAPEX would be 0. In that case, we argue that using CAPEX would lead to the loss of critically important information about the firm's response to the tax cut, especially when trying to estimate heterogeneous responses.

Towards the end of Section 6, to more broadly understand capital allocation following the tax cut, we expand the analysis to include three additional variables—investments in labor, dividend payouts, and a variable for whether or not a firm paid any dividends during the year. We do so for two reasons. First, some research suggests that constrained firms will prefer labor investments over capital investments (Garmaise, 2008). As such, for the correct interpretation of our results, it is important to understand whether differences in capital investment are driven by different capital allocation preferences. Second, although there is evidence of a positive effect of corporate income tax cuts on dividends (Ohrn, 2018), there is less evidence on heterogeneous effects among firms due to their level of constraints.[26] We define investments in labor in year t as the difference between labor expenses[27] for year t and year $t-1$, divided by labor expenses for year $t-1$. Further, dividends is defined as dividend payments relative to the prior year's total assets, while dividend payer is a dummy variable that takes the value of 1 if the firm pays dividends during a year; that is, if dividend payments are greater than zero.

5.3.2 Independent Variable

Similar to the approach used by e.g. Alstadsæter et al. (2017), firms are classified as financially unconstrained if their average liquid assets-to-lagged total assets in the pre-reform period (2009–2012) were in the bottom decile of their industry.[28] We create a dummy variable, named *Unconstrained*, that is equal to 1 if the firm was in the bottom decile of its industry. This technique is chosen to prevent firms from moving in and out of the groups, and to prevent the policy from impacting the assignment. We further create a dummy called *Reform* that takes the value of 1 if the year is greater than or equal to 2013. The interaction of *Unconstrained* and *Reform* is thus equivalent to D_{it} in Equations 18 and 20. As such, the coefficient of interest—α in (18), β in (19), and γ in (20)—represent the difference in the effect of the tax cut on investments between unconstrained firms and the rest of the sample.

5.3.3 Control Variables

We include a number of control variables in our main regressions that we believe may plausibly be correlated with both investments and the degree of financial constraints, and that vary across both time and firms. To avoid simultaneity bias, all variables are lagged one period.[29] Also, to alleviate concerns about a correlation between the policy and the

[26] Michaely and Roberts (2012) show that, following temporary earnings shocks, constrained firms pay out more as they are less concerned with dividend smoothing. However, to the extent that a tax cut is permanent, this evidence does not provide any direct guidance.

[27] Labor expenses includes salaries and social security expenses.

[28] The Serrano dataset groups firms into twelve "overall sectors" based on their SNI07 codes: Energy & Environment; Materials; Industrial Goods; Construction; Shopping Goods; Convenience Goods; Health & Education; Finance & Real Estate; IT & Electronics; Telecom & Media; Corporate Services; and Other.

[29] That is, we regress a set of controls in year $t-1$ on investments in year t. For example, the variable $EBIT$ is calculated as $EBIT_{t-1}/TA_{t-2}$. This is not only an econometric choice, but makes sense from a theoretical perspective as well. It is not implausible that firms make investment decisions for year $t-1$ in year $t-2$, and that such decisions are informed by what is happening at the time in year $t-2$.

controls—the "bad controls problem" (Angrist & Pischke, 2009)—we include no post-tax variables as controls.

Table 2: Summary Statistics of Main Variables

	N	Mean	sd	25th	Median	75th
Dependent Variables						
Investments in Capital	1,856,857	0.302	1.041	0.000	0.011	0.259
Investments in Labor	1,996,513	0.268	1.383	-0.158	0.025	0.225
Dividends	3,270,945	0.052	0.117	0.000	0.000	0.044
Dividend Payer	3,629,771	0.312	0.463	0.000	0.000	1.000
Grouping Variables						
Cash	2,929,744	0.390	0.390	0.062	0.269	0.634
Avg. Cash (2009–12)	2,668,842	0.361	0.337	0.073	0.266	0.578
Control Variables						
EBIT	2,953,875	0.075	0.269	-0.019	0.025	0.154
Loss	3,325,622	0.287	0.452	0.000	0.000	1.000
Sales Growth	2,351,217	0.305	1.463	-0.159	0.017	0.229
ln(TA)	3,248,283	7.260	1.828	5.996	7.182	8.454
Debt	2,973,338	0.155	0.295	0.000	0.000	0.194
Labor Expenses	2,984,407	0.454	0.692	0.000	0.123	0.660
Working Capital	2,948,403	0.345	0.482	0.044	0.329	0.653

Notes: Investments in Capital is defined as the change in tangible and intangible fixed assets (but excluding financial assets) during the year, plus depreciation and amortization, divided by the prior year's tangible and intangible assets. Investments in Labor is defined as the change in labor expenses, relative to the prior year's labor expenses. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise. Cash is defined as liquid assets, relative to last year's total assets. Avg. Cash (2009–12) denotes the average yearly liquid assets-to-lagged total assets of firms before the 2013 reform. EBIT is defined as lagged earnings before interest and taxes, relative to the prior year's total assets. Sales Growth is defined as lagged growth in sales, relative to the prior year's sales. Debt is defined as lagged current and non-current interest-bearing liabilities, relative to the prior year's total assets. Loss takes the value of 1 if lagged net results are below zero. ln(TA) is defined as the natural logarithm of lagged total assets. Working Capital is defined as lagged current assets minus lagged current liabilities, relative to the prior year's total assets. Labor Expenses is defined as lagged labor expenses, relative to the prior year's total assets.

First, we control for earnings before interests and taxes (EBIT), also called operating profit, as a share of the prior year's total assets. If a firm's operations suddenly become more profitable per capital (e.g. because of a change in management), the firm might also believe that its available future projects will yield higher returns as well, and increase their optimal investment level accordingly. Second, firms that have negative net results in a year (e.g. because of some external shock) may be more careful with investments in the following year, and we control for this by defining a dummy that is equal to 1 if the

prior year's net result was negative.[30] Third, we suspect that changes in leverage (that is, current and non-current interest-bearing liabilities relative to the prior year's total assets) may incline firms to adjust their investment rate.[31] Fourth, a firm that suddenly has access to better investment opportunities may be expected to increase investments accordingly. When studying publicly traded firms, it is common to control for this through a Tobin's q variable. We follow Schauer et al. (2019) in using sales growth as a proxy for Tobin's q for private firms. We calculate sales growth as the difference between year $t-1$ revenue and year $t-2$ revenue, relative to revenue in $t-2$. Fifth, we believe that changes in a firm's size may affect its subsequent investment rate. As is the case with leverage, an argument can be made in either direction. We control for such effects by including the natural logarithm of total assets. Finally, we control for labor intensity in production and working capital.[32] We imagine that firms which become more labor-intensive (in terms of labor expenses relative to the prior year's total assets) may lower their investments in physical capital in following periods. We also think that there may be a link between working capital (calculated as working capital relative to the prior year's total assets) and investments. Again, the direction of this link is not theoretically unambiguous,[33] but we deem it reasonable to include it in the regression.

6 Results

In this section, we present the results from the empirical strategy outlined in Section 5. It is structured as follows. First, we present the results from the DD baseline model—the main empirical specification in Equation 18. Then, we relax the binary treatment intensity design in the baseline model and report the results from a DD linear effects model (Equation 19) and a DD specification that includes the interaction terms for all ten deciles of financial constraints (Equation 20). With the latter, we allow treatment intensity to vary in ten steps, thus enabling us to more granularly investigate the distribution of the marginal effects. Based on the results of this technique, we re-estimate the baseline model results but with different cut-off levels for financial constraints. Then, to enhance our understanding of how firms responded to the tax cut, we expand the baseline model to three more outcome variables—investments in labor, dividend amount paid, and whether or not the firm pays dividends. Finally, we report the results from a number of robustness checks performed on the baseline model.

The mean values of the outcome variables analyzed in this section are presented in Table 3. We show pre-reform and post-reform average values for financially unconstrained firms (left panel) and compare them to the rest of the sample (right panel). This is perhaps the simplest way to assess Hypotheses 1 and 2.

Financially unconstrained firms generally invest less in physical and human capital

[30] Note that the corporate income tax rate is a scalar factor on profits or losses. As such it can affect the magnitude of losses or profits, but not whether or not a firm is profitable.

[31] The direction of such a response is, however, theoretically ambiguous. There is a case to be made for the firm being forced to reduce the investment rate to have enough liquidity to finance a higher interest burden. On the other hand, it may be reasonable to think that the firm may invest more because it now has more external funds. Either way, we believe it improves the accuracy of our estimates to control for such effects, whichever direction they may run in.

[32] Lagged labor is excluded from the regressions on labor investments.

[33] For example, higher working capital can both be seen as poorer financial health (which may reduce the room for more investments) or indicate that the firm will get a boost to earnings in the future, which may make higher investments plausible.

relative to their own size than does the rest of the sample. This is not that surprising, given that unconstrained firms are generally larger in our sample (see Table 1), and larger firms tend to invest at lower rates relative to their assets than do smaller firms.[34]

Table 3: Average Yearly Investments and Dividends for Unconstrained Firms Compared to the Rest of the Sample, Before and After the 2013 Tax Reform

	Unconstrained Firms		*Rest of Sample*	
	Pre-Reform (1)	Post-Reform (2)	Pre-Reform (3)	Post-Reform (4)
Investments in Capital	0.218	0.219	0.312	0.301
Investments in Labor	0.155	0.048	0.295	0.049
Dividends	0.019	0.032	0.044	0.060
Dividend Payer	0.163	0.216	0.337	0.369
Observations	106,819	153,975	961,128	1,446,907

Notes: Firms are categorized as *Unconstrained* based on their average yearly cash-to-lagged assets in the pre-reform period (2009–2012). The firms in the lowest decile liquid assets-to-lagged total assets in each industry are classified as *Unconstrained*. Investments in Capital is defined as the change in tangible and intangible fixed assets (but excluding financial assets) during the year, plus depreciation and amortization, divided by the prior year's tangible and intangible assets. Investments in Labor is defined as the change in labor expenses, relative to the prior year's labor expenses. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise. Dividends is defined as dividend payments, relative to the prior year's total assets. Dividend Payer is equal to one if the firm paid any dividends and zero otherwise.

We observe that the average rate of investments in capital for financially unconstrained firms is virtually unchanged between the pre and post-reform periods, while we see a reduction among the rest of the sample. This provides some initial support for Hypothesis 1, implying that the Required Rate of Return Effect is greater than the Cash Flow Effect. We further notice that, while both groups reduced their rate of investment in labor, the magnitude of this drop was much smaller for unconstrained firms in relative terms than for the rest of the sample, again providing initial support for Hypothesis 1.

6.1 Baseline Model

In this section, we investigate Hypotheses 1 and 2 by using a DD-design, as specified in Equation 18, to compare the change in the rate of investment in capital for financially constrained and unconstrained firms following the 2013 reduction in the Swedish statutory corporate income tax rate from 26.3 to 22 percent. We define firms as financially unconstrained if their average rate of liquid assets-to-lagged total assets ("cash holdings") was in the bottom decile of their industry in the pre-reform period (2009–2012). The main results from the baseline model in Equation 18 are presented in Table 4 below. We report heteroskedasticity-robust standard errors clustered at the firm level here and throughout the rest of the thesis.

In Panel (1), we present the outcome of the model with firm and year fixed effects, but without control variables. The coefficient of interest suggests that on average, condi-

[34] Given marginally diminishing returns, everything else equal, firms with less capital (i.e. firms that have invested less) can be expected to grow at faster rates.

Table 4: Baseline Model: The Difference in Investment Responses to the Tax Cut

	Investments in Capital	
	(1)	(2)
Unconstrained × Reform	0.062***	0.014**
	(0.005)	(0.006)
Controls		✓
Firm Fixed Effects	✓	✓
Year Fixed Effects	✓	✓
R^2	0.005	0.027
Observations	1,582,677	1,420,540

Notes: Robust standard errors clustered at the firm level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

tional on firm and year fixed effects, financially unconstrained firms increased their rate of investment in capital by 6.2 percentage points more than the rest of the sample because of the tax cut. When including control variables in the regression (which are specified in Section 5.3.3), the magnitude of this difference decreases to 1.4 percentage points, see Panel (2). This is still a substantial difference, considering that the pre-reform mean rate of investments in capital for unconstrained firms was 21.8 percentage points, see Table 4. The baseline model thus adds to the initial evidence in support for Hypothesis 1 from Table 3, that is, that the Required Rate of Return Effect on investment for unconstrained firms was greater than the Cash Flow Effect on investment for constrained firms.

6.2 Linear Effects Model

In this section, we allow treatment intensity to increase linearly in pre-reform cash holdings, as specified in Equation 19. We thereby impose an equal marginal effects assumption (Havnes & Mogstad, 2011). The results of this specification are reported in Table 5 below.

Table 5: Linear Effects Model: The Sensitivity of Investment Responses to the Tax Cut to Pre-Reform Cash Holdings

	Investments in Capital	
	(1)	(2)
Pre-Cash × Reform	-0.203***	-0.033***
	(0.008)	(0.009)
Controls		✓
Firm Fixed Effects	✓	✓
Year Fixed Effects	✓	✓
R^2	0.005	0.027
Observations	1,582,677	1,420,540

Notes: Robust standard errors clustered at the firm level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The result of the specification with fixed effects, but without any control variables, is reported in Panel (1) of Table 5. The coefficient of interest is −0.203. In Panel (2), we report same result of the same specification when control variables are added. This decreases the coefficient to −0.033. As the interpretation of these coefficients are less straightforward than in the baseline model, we provide an illustrative example. Suppose that Firm A is facing extremely high financial constraints and that, on average, for the years between 2010 and 2013, its beginning-of-year cash holdings were exactly equal to the prior year's total assets:

$$\bar{C}_A \equiv \frac{1}{4} \times \left(\sum_{t=2009}^{2012} \frac{LA_{A,t}}{TA_{A,t-1}} \right) = 1,$$

where LA are liquid assets and TA are total assets. Suppose further that the unconstrained Firm B faces no financial constraints whatsoever, and thus held zero cash between 2010 and 2013, meaning that $\bar{C}_B = 0$. If so, the coefficient in Panel (2) of Table 5 suggests that, everything else equal, the reduction in the corporate tax rate would cause Firm B to increase its rate investment in capital by 3.3 percentage points more than Firm A. In other words, while requiring a different assumption and interpretation, the linear effects model adds to the support for Hypothesis 1 previously found in the baseline model.

By using the 2009–2012 average cash holdings listed in Table 1, we can calculate an estimate to provide some indication of the degree to which the coefficient from the full linear effects model (−0.033) matches the baseline model coefficient (0.014) from Table 5. Before the reform, mean cash-to-assets was 0.009 within the group of unconstrained firms and 0.399 within the rest of the sample. This implies that the difference in the mean pre-reform cash-to-lagged assets ratio between the average unconstrained firm and the average constrained is equal to −0.39. If we scale the coefficient of −0.033 by this factor, we get an implied diff-in-diff coefficient of $0.033 \times 0.39 = 0.013$. We note that this is very similar to the coefficient of 0.014 reported in the Baseline Model in Table 4.

6.3 Decile DD Model

While our theoretical model and previous literature induce us to think that the relationship between cash holdings and investments should be closer to the cut-off model implicitly assumed in Section 6.1 than the linear model from Section 6.2, there is no intuitively obvious answer to the question of exactly where to set the cut-off between unconstrained and constrained firms in terms of their cash holdings. Thus far in our analysis, we have used the first cash decile as the cut-off. In this section, we analyze the entire distribution of deciles, apart from the 6$^{\text{th}}$ (we also show the results of omitting the 5$^{\text{th}}$ decile). By estimating the regression in Equation 20, we can report the estimated effect for every decile but the omitted one, and then compare the average effect on firms in each decile with the average effect on firms within the omitted decile. The results of this strategy are presented in Table 6.

Table 6: Effect of the 2013 Corporate Income Tax Rate Cut on Investments: Coefficients of the Interactions Between Deciles of Firms in Terms of Cash Holdings and the Reform

	Investments in Capital		
	(1)	(2)	(3)
1^{st} × Reform	0.066***	0.025***	0.004
	(0.008)	(0.008)	(0.008)
2^{nd} × Reform	0.058***	0.027***	0.006
	(0.008)	(0.008)	(0.008)
3^{rd} × Reform	0.043***	0.018**	-0.003
	(0.008)	(0.008)	(0.008)
4^{th} × Reform	0.032***	0.013	-0.008
	(0.008)	(0.008)	(0.008)
5^{th} × Reform	0.030***	0.021**	0.000
	(0.008)	(0.008)	(.)
6^{th} × Reform	0.000	0.000	-0.021**
	(.)	(.)	(0.008)
7^{th} × Reform	-0.026***	-0.013	-0.034***
	(0.009)	(0.009)	(0.009)
8^{th} × Reform	-0.033***	0.005	-0.016*
	(0.009)	(0.010)	(0.009)
9^{th} × Reform	-0.056***	0.001	-0.020*
	(0.010)	(0.011)	(0.010)
10^{th} × Reform	-0.115***	0.038***	0.017
	(0.012)	(0.014)	(0.013)
Controls		✓	✓
Firm Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
F-statistic[a]	61.197	4.606	4.606
p-value[b]	0.000	0.000	0.000
R^2	0.005	0.027	0.027
Observations	1,582,677	1,420,540	1,420,540

Notes: Robust standard errors clustered at the firm level in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[a]: Tests the hypothesis that all interaction terms are jointly equal to zero.

[b]: p-value of the F-statistic.

The first coefficient of Table 6, 1st × Reform, is comparable to the coefficient previously estimated from the baseline model in Table 4. The coefficients for the interactions between each decile and the reform treatment dummy in turn represent the difference in the average effect of the 2013 tax cut on the rate of investment between firms within that decile and the firms belonging to the omitted cash decile (5th or 6th). We further test the hypothesis that the interaction terms are jointly equal to zero, that is $H_0 : \beta_1 = \beta_2 = ... = \beta_6 = 0$, where β_i is the coefficient of the interaction between i^{th} decile and the reform dummy variable. The F-statistic and p-values from this test are reported in Table 6.

In Panel (1), the results of the estimation in Equation 4, but without controls, are reported. Among the coefficients, we observe a decreasing trend that is relatively linear in financial constraints (represented as belonging to a higher decile), apart from the top decile, for which the estimated effect drops sharply compared to the rest of the distribution.

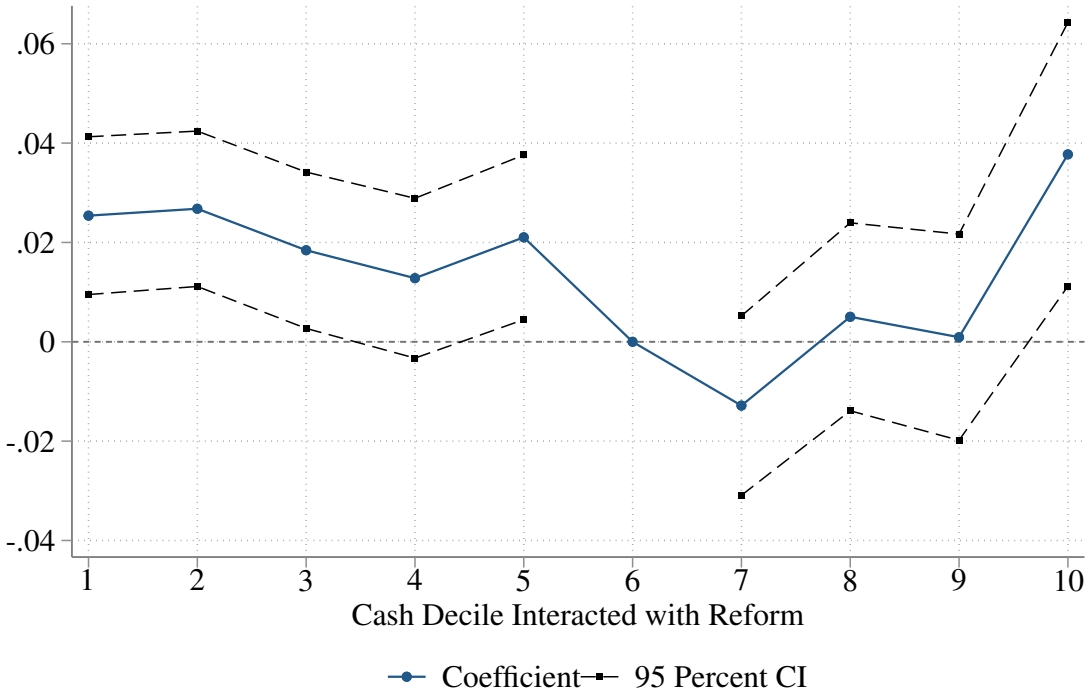
In Panel (2), the result of same specification, but with controls, is reported. The distribution of coefficients now looks very different. There seems to be a sharp difference between the 5th and 6th Decile interactions, while the interaction terms for 1st–5th Deciles and for the 6th–9th Deciles are nearly indistinguishable from others in the same group. To shine further light on this result, we re-estimate the same specification, but with the 5th Decile omitted instead of the 6th, in Panel (3). We see that the interaction terms with Deciles 1–4 are indistiguishable from Decile 5, while those with Deciles 6–9 are substantially lower.

Curiously, the interaction term for the 10th Decile in Panel (2) is large (0.038) and has the opposite sign of the equivalent coefficient in Panel (1). The coefficient for the 10th Decile in Panel (2) suggests that, compared to firms in the 6th Decile, firms in the 10th Decile increased their investments by 3.8 percentage points more in response to the tax cut. From Panel (3), we see that the coefficient of this interaction term is not significantly different from the coefficient for the 5th (which is in turn not significantly different from the 1st–4th). The conclusion from the models with controls in Table 6 is thus that the investments of firms in the bottom half and the top decile of the sample, in terms of average pre-reform cash-to-lagged assets, responded very similarly to the tax cut, while the 6th–9th increased investments significantly less (and by similar margins). This result is presented graphically in Figure 3 below, which maps the coefficients from Table 6, Panel (2), along with their respective 95% Confidence Intervals.

Proposition 1 of our theoretical model in Section 4 predicts that, when the tax rate is lowered, the pre-tax required rate of return decreases, which in turn causes the optimal investment level to shift upwards. Unconstrained firms shift their investments up to the new optimal level, while constrained firms will be unable to change their investment level because they cannot access more capital. The behavior of the first nine deciles is in line with this prediction. If we suppose that the bottom half of the sample is relatively unconstrained, while the top half is constrained, we should see the group of unconstrained firms increase their investments by significantly more than the group of constrained firms, while there should be little differences within each group.

This is exactly what Figure 3 shows. That is, with the exception of the 10th Decile. In fact, the top decile is behaving almost exactly like an unconstrained firm would be expected to. One possible explanation for this is that firms with the highest levels of cash are in fact financially unconstrained. In Sections 3 and 5, we discuss two possible explanations for why a firm would have very high cash holdings. The first is that the firm has

Figure 3: Plotting the Coefficients From Table 6, Panel (2)



Note: This figure plots the coefficients from Panel (2) in Table 6, along with 95% confidence intervals.

access to (next to) no external capital, and thus has to finance investments and cover possible liquidity shortfalls from cash flow volatility in coming periods (almost) exclusively with its own savings, which prompts the firm to hoard cash on the balance sheet. On the other hand, a firm having a lot of cash relative to its own size could also be seen as a sign that the firm is subject to agency problems. While the general relationship of the first explanation has been widely proved in previous research on cash holdings and financial constraints, this does not necessarily rule out agency problems. In fact, some argue that the relationship between cash holdings and constraints is U-shaped, and that firms with very low and very high levels of cash are likely financially unconstrained (see Guariglia, 2008). To draw on a well-known example, Apple Inc. is known for having a lot of cash on hand, but few would argue that Apple is unable to raise external capital. In other words, there is a case to be made that some mature, solid, and financially unconstrained firms hoard cash due to agency problems (Gao et al., 2013). If so, Proposition 1 in our model in Section 4 predicts that these extremely cash-rich firms should shift their investments up to the new *ex-post* optimal level when the corporate tax rate is decreased.

6.4 Re-Specification of the Baseline Model

Drawing on the discussion in Section 6.3 above, we re-estimate the baseline model from Section 6.1, but with alternative classification schemes for whether firms are financially unconstrained or not. The results are presented in Table 7 below.

Panel (1) of Table 7 reports the result from the baseline model in Section 6.1. In Panel (2), we re-estimate the same model but include the interaction term for the 10^{th} Decile to "partial out" its effects on the baseline model. We see that the coefficient is largely

unaffected (increasing from 1.4 to 1.5 percentage point), indicating that the distortionary effects of the top decile possibly consisting of mostly unconstrained firms are small in the baseline model. In Panel (3), we define firms in the bottom half of average pre-reform cash holdings as unconstrained. The coefficient of interest now jumps from 1.4 percentage points in the baseline model to 1.9, more than a 35 percent increase. Finally, in Panel (4), as proposed towards the end of Section 6.1, we assume that firms that are in the bottom half or in the top decile of average pre-reform cash holdings are unconstrained. The coefficient now jumps to 2.4 percentage points, close to a 70 percent increase from the baseline model.

Table 7: Re-Specifying the Baseline Model Definition of Unconstrained Based on the Decile DD Regression

	Investments in Capital			
	(1) Baseline Model	(2) With 10th Decile Interaction	(3) Bottom Half of Sample	(4) Bottom Half or 10th Dec.
1st × Reform	0.014**	0.015***		
	(0.006)	(0.006)		
10th × Reform		0.028**		
		(0.012)		
(1st–5th) × Reform			0.019***	
			(0.004)	
(1st–5th | 10th) × Reform				0.024***
				(0.004)
Controls	✓	✓	✓	✓
Firm Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
R^2	0.027	0.027	0.027	0.027
Observations	1,420,540	1,420,540	1,420,540	1,420,540

Notes: Robust standard errors clustered at the firm level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.5 Additional Output Variables

Finally, we expand the baseline model by estimating it for the rate of investment in labor, as well as for the dividends-to-assets ratio and a dummy variable for whether or not the firm pays any dividends. Being unconstrained is now, once again, defined as belonging to the bottom decile of the dataset in terms of average pre-reform, industry-adjusted liquid assets-to-lagged total assets. The results are presented in Table 8.

The coefficient from the baseline model is presented in Panel (1) of Table 8. In Panel (2), the model is estimated for the rate of investment in labor, defined as the growth in labor expenses relative to the prior year's level. Finally, Panels (3) and (4) show the results for dividends, with the former presenting dividends over lagged assets and the former the probability of paying dividends.

Table 8: Effects of the 2013 Corporate Income Tax Rate Cut—Other Outcome Variables

	Investments		Dividends	
	(1) Capital	(2) Labor	(3) Ratio	(4) Prob.
Unconstrained × Reform	0.014**	0.037***	-0.006***	0.031***
	(0.006)	(0.004)	(0.000)	(0.002)
Controls	✓	✓	✓	✓
Firm Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
R^2	0.027	0.033	0.025	0.027
Observations	1,420,540	1,545,880	1,943,961	1,956,547

Notes: Robust standard errors clustered at the firm level in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

From Panels (1) and (2), we infer that unconstrained firms increased their investments in the two main factors of production, capital and labor, more than constrained firms because of the 2013 Swedish tax cut. This alleviates the potential concern that the difference in responses to investments in capital was driven by different investment preferences of constrained and unconstrained firms—that is, that constrained firms increased their rate of investments in labor instead of in capital. This evidence thus further strengthens the argument in favor of Hypothesis 1.

When it comes to dividends, we (somewhat surprisingly) find that constrained firms raised their dividends more than unconstrained firms following the 2013 tax cut (Panel 4). While the coefficient is small (-0.006), it is not unsubstantial[35] relative to the pre-reform mean for unconstrained firms (0.019, see Table 3). On the other hand, the share of firms paying dividends increased substantially more for unconstrained than for constrained firms. One possible explanation (which is further discussed in Section 5) is that constrained firms, which are generally smaller, use dividend payments as substitutes for wages to a larger extent than unconstrained firms. If so, the effective cash transfer from the reduction in the tax rate may cause managers of small, closely held, constrained firms to increase their own salaries slightly (which increases dividends-to-total assets more for constrained firms), while larger, unconstrained firms that previously did not pay dividends may have used the transfer to distribute some small dividends to shareholders. However, from the test for parallel trends, reported in Appendix A.1, we cannot rule out that the dividend effect is caused by events prior to the tax reform. We therefore reject the parallel trends hypothesis for dividends, and thus we cannot draw any conclusions about whether the estimated effects for dividends are true differences in differences or caused by factors unrelated to the 2013 tax cut.

6.6 Robustness Checks

In this section, we discuss the four robustness tests conducted to assess the sensitivity of the results above to some of the choices made in our empirical specifications. The corresponding tables are available in Appendix A.1. First, we report the results of a

[35]Note that dividends are expressed as the share of lagged total assets. This helps explain the low magnitudes of the cofficient and standard errors.

formal test of the parallel trends assumption for our output variables. Second, we assess the baseline model's sensitivity to the choice of classification scheme for whether or not firms are financially unconstrained. We start by reporting the results from the baseline model when each of the bottom five cash deciles are used as the cut-off. We additionally re-estimate the model when using three other variables, with precedence in the corporate finance literature, to classify firms as financially unconstrained or not.

6.6.1 Parallel Trends

We start by formally testing for parallel trends in our data, the key identifying assumptions for our empirical strategy. In the spirit of Autor (2003), we exploit the fact that we have data on multiple periods before and after the tax change to estimate the following regression for each of the four outcome variables studied in Table 8:

$$Y_{it} = \delta_t + \mu_i + \sum_{l=2}^{1} \beta_{-l} D_{it} + \sum_{m=0}^{4} \beta_m D_{it} + \psi \mathbf{X}_{itk} + \eta_{it}, \tag{21}$$

where Y_{it} is the outcome variable. δ_t and μ_i capture year and firm fixed effects, respectively. The D_{it} terms represent the interactions between being financially unconstrained and each year. Pre-reform years are denoted by lags l, while post-reform years are represented by leads m. Finally, $\mathbf{X}_{k,it}$ is the regular $1 \times k$ vector of controls.[36]

The results of (21) above are reported in Table 9 in Appendix A.1. From the table, we assess the parallel trends hypothesis $H_0 : \beta_{-1} = \beta_{-2} = 0$. As both lags are economically and statistically insignificant, we fail to reject the hypothesis for our investment variables of interest. This is consistent with the notion of parallel trends in the data and provides support for our key identifying assumption that, had it not been for the 2013 tax cut, the investment rates of constrained and unconstrained firms would have developed in similar patterns. However, we reject the null for dividend ratio (Panel 3) and for the dividend payer dummy (Panel 4). We therefore cannot rule out that the effects we observe for dividends in Table 8 were caused by events exogenous and prior to the 2013 tax cut.

6.6.2 Sensitivity of Results to the Classification Technique for Constrained and Unconstrained Firms

Next, we assess the robustness of our baseline model results to the techniques used to assign firms to the treatment group of financially unconstrained firms. Table 10 in Appendix A.1 shows the sensitivity of the baseline model's coefficient of interest to the threshold cash decile for unconstrained firms. In Panel (1), the firms in the bottom decile of average, industry-adjusted pre-reform cash holdings are classified as unconstrained. This is the main baseline model result previously showed in Table 4. In Panel (2), firms in the bottom two deciles are unconstrained; in Panel (3), the bottom three deciles; and so on. The table suggests that our results are very robust to the choice of decile cut-off—the coefficient of interest barely changes between the first and the fifth decile.

In addition, Table 11 presents re-estimated baseline model results for the two measures of financial constraints proposed by Hadlock and Pierce (2010). They argue that financially constrained firms tend to be younger and smaller. As a final robustness check,

[36] Lagged labor costs are excluded from the group of control variables in the regression with investments in labor.

we test whether our results are consistent with defining unconstrained firms as the oldest firms (Panel 1), the largest firms (Panel 2), and the oldest and largest firms (Panel 3) in the sample. We find that, while these variables produce coefficients of larger magnitude, the direction of the effect of being financially unconstrained is the same.

Based on Tables 10 and 11, we argue that our results are robust to the exact definition used to identify constrained firms, and that this supports our choice of classification technique.

7 Discussion

An important factor in the evolution of tax research has been the presence of heterogeneous effects among firms (Hanlon & Heitzman, 2010). One source of such heterogeneity that has emerged as a more recent topic is financial constraints. However, in the context of corporate income taxation, financial constraints and investment, the literature is underdeveloped in terms of both theory and evidence. In this thesis, we seek to contribute to the development of both.

We survey the literature and analyze firms in a model economy, and then set out to answer how a reduction in the statutory corporate income tax rate affects the investment behavior of financially constrained and unconstrained firms, and whether there is a difference in how they react. We find that in our sample, the reduction in the corporate income tax rate led to financially unconstrained firms increasing their investments by between 1.4 and 2.4 percentage points more than constrained firms.

Although we cannot answer to the whether the stated objectives of the 2013 Swedish tax reform were achieved, as these primarily were concerned with increasing FDI and aggregate investment—areas outside of the scope of this thesis—we argue that important policy lessons can be drawn on other matters. Albeit somewhat of a simplification, as pertains to corporate investments, we imagine two general objectives for policy makers considering whether to lower a corporate tax. The first objective is that a reduced tax burden has some positive effect on overall investments. While we are not able identify whether or not the 2013 Swedish tax cut had any such positive effect with our empirical strategy—nor does it really concern the research question we seek to answer—it seems theoretically plausible that it did. At the very least, it is hard to imagine lower taxes having a *negative* effect on investments, and the notion of a positive effect seems to have wide support in previous literature. The second objective—which lays much closer to the core of what we are studying—is to achieve some sort of distributional effect between firms with a positive impact on the average return to aggregate investments. Given that tax savings leads to a loss of government revenue, we image that policy makers will want to maximize the return to investment—which may yield government revenue and/or other societal benefits in the future. Any tax policy then, may therefore be more attractive if the investment effects are concentrated among constrained firms. Everything else equal, these are presumably further from their optimal investment level *ex-ante* than unconstrained firms and thus, given marginally diminishing returns, will produce a higher future societal benefit of an additional dollar invested than would an equivalent unconstrained firm. However, given our result that unconstrained firms increased investments more, we find no evidence for such a distribution effect following cuts to the corporate income tax rate in our data.

As the literature on corporate income tax rate changes, investments, and financial constraints leaves much to desire, there is little previous theory and evidence to which we

can relate our results. This is why we develop a theoretical model in the spirit of Almeida and Campello (2002). Some evidence is provided by Faulkender and Petersen (2012), who suggest that financially constrained firms increased investments more following a decrease in repatriation taxes with the American Jobs Creation Act of 2004, a US tax incentive. They argue that the reform only created what we refer to as the Cash Flow Effect in our theoretical framework, similar to the investment-cash flow effect extensively studied in previous literature (Fazzari et al., 1988; Kaplan & Zingales, 1997; Lewellen & Lewellen, 2016; Mulier et al., 2016; Rauh, 2006; Schauer et al., 2019). The investment effects of the American Jobs Creation Act of 2004 were therefore concentrated among constrained firms, the attractive feature of tax policy discussed above. This highlights the fact that different types of tax policy can induce different relative effects. We therefore argue that our thesis constitutes a meaningful contribution to a still-scarce field of research on what we believe to be an important, secondary effect of changes in corporate taxation.

Apart from our contribution within the research of tax policy and investment, we also add to the corporate finance literature on financial constraints. As important determinants of firm investment and capital structure (e.g. Denis & Sibilkov, 2010; Farre-Mensa & Ljungqvist, 2016; Hennessy & Whited, 2007), these have received much attention. By investigating whether and how heterogeneous responses to tax policy depend on financial constraints, we shine further light on their relationship to investments. To the extent that tax competition between countries continues, we believe further work on the heterogeneous investment responses to corporate income tax shocks would provide a meaningful area of focus for research on investments and financial constraints.

Given the few previous theories and lack of evidence within the field of corporate taxation, financial constraints, and investments, we next engage in a more technical discussion about the implications of our results as they relate to our theoretical model. By this, we would like to highlight possibilities and limitations of our approach. In our model, both constrained and unconstrained firms are subject to the same shocks following a tax cut: a reduction in the pre-tax required rate of return and an increase in the post-tax cash flow from existing activities. However, we propose that the investment of the financially unconstrained firm is sensitive to the former, while the investment of financially constrained firms is sensitive to the latter. From these propositions, we develop two testable hypotheses. From Hypothesis 1 it follows that if unconstrained firms increase their investments more than do constrained following the tax cut, then the Required Rate of Return Effect on investment is greater for unconstrained firms than is the Cash Flow Effect on investments for constrained firms. Conversely, from Hypothesis 2 it follows that if constrained firms increase their investments more than do unconstrained firms, then the Cash Flow Effect on investments is greater for constrained firms than is the Required Rate of Return Effect on investments for unconstrained firms. Our Difference-in-Differences design allows us to assess these two hypotheses. In support of Hypothesis 1, we find evidence that unconstrained firms increased their rates of investments in capital and labor—the two main factors of production—more than did constrained firms in response to the 2013 Swedish tax cut. The question, then, is which conclusions we can actually draw from this finding. In our model, the lower required rate of return increases the optimal investment level for two firms identical in every aspect but their financial constraints. From the data, we find that unconstrained firms increased their investments more. Following Hypothesis 1, we could conclude that to the extent that the tax cut increased the cash flows from existing activities for constrained firms, it was not large enough to allow them to exploit the newly profitable opportunities.

However, Hypothesis 1—on which this conclusion relies—depends on the Required Rate of Return to have no impact whatsoever on the investment behavior of constrained firms. In addition, the boost to internal earnings from the Cash Flow Effect is not allowed to affect unconstrained firms, everything else equal. While true in the simplified environment of our model, these seem like very strong assumptions for a real-world economy. For example, while we abstract from cost of capital in the model, a boost to internal earnings would likely lower the average cost of capital for both constrained and unconstrained firms in the real-world economy, thus also affecting their optimal investment level. Then, the previous conclusion no longer holds.

Although Propositions 1 and 2 may not hold perfectly outside of our model, the general direction of the relationships still seem plausible and the assumptions they rely on have support in previous literature. That is, we would still expect financially unconstrained firms to be more responsive to the higher optimal investment level, and for constrained firms to exhibit higher investment-cash flow sensitivities. If so, the implication of our DD coefficient would be that:

> The difference in how much more the investment behavior of unconstrained firms responded to the Required Rate of Return Effect than constrained firms, was larger than the difference in how much more the investment behavior of constrained firms responded to the Cash Flow Effect than unconstrained firms.

Regardless of which of Hypothesis 1 or the weaker conclusion above is more correct, this theoretical discussion illustrates the need for further research on how much these effect differ and in which situations they do so. Our results do not imply that, if the corporate income tax rate is decreased, unconstrained firms will increase their investments more than constrained firms in any situation. To predict such behavior, a deeper understanding of the effects is needed.

Of course, the value of the insights outlined in this discussion also depend on the internal and external validity of the empirical analysis. These are addressed in the next section.

7.1 Validity

Our research question and our theoretical model asks questions and makes predictions about financially constrained and unconstrained firms. However, as pointed out throughout the thesis, financial constraints are not directly observable, at least not from our perspective. For that reason, we rely on cash holdings as a proxy for financial constraints.

By using a proxy variable, there is potentially a gap between what we are actually measuring—the effect of having low cash-to-assets *ex-ante* on the investment response to a tax cut—and the interpretation and conclusions we draw from these findings, which are concerned with financial constraints. The external validity of our findings therefore relies first and foremost on the argument we make for the relationship between cash holdings and financial constraints. Without establishing that link, even if the rest of the analysis were sound, our results would merely imply that firms with low cash holdings increased investments more.

As we point out in Section 3, the notion that cash holdings are increasing in external financing constraints is not necessarily true for all firms. The precautionary motive for cash holdings have wide support in previous research (Almeida et al., 2004; Bigelli &

Sánchez-Vidal, 2012; Denis & Sibilkov, 2010; Hadlock & Pierce, 2010; Whited & Wu, 2006), and is intuitively sound. Although there are exceptions, such as agency problems in public firms inducing higher cash holdings than in private (Gao et al., 2013), our classification of constrained and unconstrained firms holds for the majority of firms in an economy. Based on the summary statistics of key variables, we further argue in Section 5 that the data we study is broadly consistent with this theory.

The bottom line is this. While high cash holdings is likely not a perfect proxy for financial constraints, there is no such perfect measure, at least not that we know of.[37] Given the data that we analyze, we do, however, believe that cash holdings is the *best available* measure to draw inference about the relationship between financial constraints and investment responses to taxation. And while we cannot be certain beyond any doubt that low cash holdings equal low financial constraints, we believe that it is significantly more likely than not—given previous literature and the properties of the data—that we have captured, at the very least, the direction and general magnitude of the difference in investment responses to taxation between financially constrained and unconstrained firms in our sample.

Although we find our coefficient to be relatively stable across different specifications, we have to make strong assumptions about the functional form of the marginal effects of treatment on investments for each of the specification. While the DD regression with cash deciles allows us to map the distribution of effects to some degree, we cannot state conclusively which assumption lies closest to the truth. We do, however, believe that we can state with some confidence that the point estimate likely lays somewhere between 1.4 and 2.4 percentage points. A possible area of further research would be to more closely investigate the functional form of the marginal effects, perhaps by using non-parametric methods.

The next question of validity, relates to whether or not our sample is representative for the larger population. If we consider the relevant population to be Swedish limited liability firms, this is very straight forward, given that our sample is essentially the entire population. The degree to which our findings for (mostly) private, Swedish firms, can be extrapolated to other economies is more complex. While we believe that one clear contribution of our thesis is its addition to the relatively small body of firm-level research on Swedish corporations, we recognize that there is a difference between the Swedish economy and other economies. Importantly, as mentioned in Section 2, Sweden has one of the most streamlined and uniform tax systems in the world. However, although aggregate effects may differ depending on the setting and economy, we hypothesize that the underlying mechanisms would hold in other cases as well.

Finally, as pertains to the relative relationship between the two, contradicting causal channels through which we argue that the corporate tax rate influences investments—this is individual to each economy and each period in time. In other words, even if we choose to believe that unconstrained firms increased their investments more because of the 2013 Swedish tax cut than did constrained firms, the relationship could very well have been different in another country and/or another year. Because we only observe the "sum" of the two effects in our data, we cannot say conclusively that our effect holds for all

[37] In fact, we believe there is an argument to be made that some strains of corporate finance literature are trying, almost to a fault, to estimate the perfect index weights to create the perfect measure of financial constraints. While these indices are important and interesting sources of research on their own, we do not believe the practice of taking these weights for universal truths, to be applied on any data set and situation, is superior to using imperfect proxies.

situations. This is another limitation to the external validity of the thesis. Following this, we believe that a key area of further research would be to isolate these two effects from each other and to assess the strengths and determinants of each of the channels separately.

8 Conclusion

In this thesis, we study firm investment responses to the 2013 reduction in the Swedish statutory corporate income tax rate from 26.3 to 22 percent. Using a difference-in-differences design on panel data with privately and publicly held Swedish firms, we investigate whether the tax cut had heterogeneous effects on the rates of investment for financially constrained and unconstrained firms.

We find evidence that financially unconstrained firms increased their rates of investment in capital by between 1.4 and 2.4 percentage points more than the rest of the sample, depending on the scheme to classify firms as unconstrained or not. This difference persists for investments in labor, as well as when other classification schemes are employed. The results provide evidence that the reduction in the tax rate affected the investment behavior of financially constrained and unconstrained firms differently. We further find evidence of non-linear effects, with a sharp cut-off around the middle of the sample.

In addition to these empirical findings, we develop a theoretical model to suggest two main channels through which reductions in the corporate tax rate induces firms to increase investments: a reduction in the pre-tax required rate of return—thereby increasing the optimal investment level—and an increase in the post-tax cash flows from existing activities—thus increasing cash flow available for investment. We further propose that the investment of unconstrained firms is relatively more sensitive to the former, and that the investment of constrained firms is relatively more sensitive to the latter. Our results indicate that the effect of the reduction in the pre-tax required rate of return on the investment of unconstrained firms was larger than the effect of the increase in the post-tax cash flows of existing activities was on the investment of constrained firms. We conclude that although the tax cut may have increased the optimal investment level for all firms, only financially unconstrained firms were able to obtain the necessary capital to pursue all these new investment opportunities. To the degree that the post-tax cash flow from existing activities were boosted this was not enough to allow constrained firms to completely adjust to the new optimal investment level.

Our analysis offers three main contributions. First, the theoretical framework we develop adds to the sparse theory and evidence at the intersection of corporate income taxes, financial constraints, and investment responses, as we outline two main channels through which taxes may induce different investment responses from constrained and unconstrained firms. Second, our theoretical discussion and empirical analysis demonstrate the utility of using cash holdings as a proxy for financial constraints. Finally, our thesis adds to the understanding about how different tax policy changes, depending on their design, may induce very different effects.

A Appendix

A.1 Robustness Checks

Table 9: Effects of the 2013 Corporate Income Tax Rate Cut: Regressions With Leads and Lags Interacted With Unconstrained

	Investments		Dividends	
	(1) Capital	(2) Labor	(3) WC	(4) Ratio
2 Years Prior	0.011	-0.007	0.000	-0.001
	(0.009)	(0.007)	(0.000)	(0.002)
1 Year Prior	0.008	-0.004	0.002***	0.007**
	(0.010)	(0.008)	(0.000)	(0.003)
Year of Reform	0.015	0.026***	0.001	0.025***
	(0.010)	(0.008)	(0.001)	(0.003)
1 Year After	0.021**	0.029***	-0.004***	0.025***
	(0.010)	(0.008)	(0.001)	(0.003)
2 Years After	0.016	0.040***	-0.009***	0.031***
	(0.010)	(0.008)	(0.001)	(0.004)
3 Years After	0.030***	0.037***	-0.012***	0.032***
	(0.011)	(0.009)	(0.001)	(0.004)
4 Years After	0.023**	0.035***	-0.003***	0.058***
	(0.010)	(0.009)	(0.001)	(0.004)
Controls	✓	✓	✓	✓
Firm Fixed Effects	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓
R^2	0.027	0.033	0.025	0.028
Observations	1,420,540	1,545,880	1,943,961	1,956,547

Notes: Robust standard errors clustered at the firm level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Baseline Model Result at Different Cash Holdings Thresholds

	Definition of Unconstrained by Cash Decile				
	(1) <10%	(2) <20%	(3) <30%	(4) <40%	(5) <50%
Unconstrained × Reform	0.014**	0.017***	0.016***	0.015***	0.019***
	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
Controls	✓	✓	✓	✓	✓
Firm Fixed Effects	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓
R^2	0.027	0.027	0.027	0.027	0.027
Observations	1,420,540	1,420,540	1,420,540	1,420,540	1,420,540

Notes: Robust standard errors clustered at the firm level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Baseline Model Result with Three Alternative Definitions of Unconstrained

	Investments in Capital		
	(1) Uncons: Old	(2) Uncons: Large	(3) Uncons: Old and Large
Unconstrained × Reform	0.028***	0.085***	0.090***
	(0.006)	(0.005)	(0.009)
Controls	✓	✓	✓
Firm Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
R^2	0.028	0.022	0.022
Observations	1,584,756	1,603,714	1,603,714

Notes: Robust standard errors clustered at the firm level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Baseline Model Result at 2% and 5% Levels of Censoring and Winsorizing

	Baseline	Censoring		Winsorizing	
	1% Cens.	2%	5%	2%	5%
Unconstrained × Reform	0.014**	0.017***	0.009***	0.016***	0.013***
	(0.006)	(0.004)	(0.003)	(0.005)	(0.003)
Controls	✓	✓	✓	✓	✓
Firm Fixed Effects	✓	✓	✓	✓	✓
Year Fixed Effects	✓	✓	✓	✓	✓
R^2	0.027	0.031	0.029	0.041	0.049
Observations	1,420,540	1,341,706	990,394	1,491,842	1,491,842

Notes: Robust standard errors clustered at the firm level in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.2 Definition of Variables

Investments in Capital: Change in tangible and intangible fixed assets (but excluding financial assets) during the year, plus depreciation and amortization, divided by the prior year's tangible and intangible assets.
Investments in Labor: Change in labor expenses, relative to the prior year's labor expenses.
Dividends: Dividend payments, relative to the prior year's total assets.
Dividend Payer: Dummy variable, equal to one if the firm paid any dividends and zero otherwise.
Cash: Liquid assets, relative to last year's total assets.
Avg. Cash (2009–12): Average yearly liquid assets-to-lagged total assets of firms before the 2013 reform.
EBIT: Lagged earnings before interest and taxes, relative to the prior year's total assets.
Sales Growth: Lagged growth in sales, relative to the prior year's sales.
Debt: Lagged current and non-current interest-bearing liabilities, relative to the prior year's total assets.
Loss: Dummy variable, equal to one if lagged net results are below zero.
ln(TA): Natural logarithm of lagged total assets.
Working Capital Lagged current assets minus lagged current liabilities, relative to the prior year's total assets.
Labor Expenses: Lagged labor expenses, relative to the prior year's total assets.

A.3 Indices Measuring Financial Constraints

KZ Index

Using the coefficients estimated by Kaplan and Zingales (1997), Lamont et al. (2001) construct the "KZ index". The higher the index, the more severe the financial constraints. It includes five accounting ratios, cash flow to total capital (negative loading), the market-to-book ratio as an approximation of q (positive), debt to total capital (positive), dividends to total capital (negative), and cash holdings to capital (negative). Using this measure, they find evidence suggesting that financial constraints affect firm value, that the severity of constraints varies over time, and that financially constrained firms earn lower returns than unconstrained firms. [38]

WW Index

Within the research of financial constraints and asset returns, Whited and Wu (2006) propose an alternative approach. They question the parameter stability of previous measures both across firms and time, in addition to the use of q due to likely measurement errors. To solve issues inherent to the KZ index, they rely on a structural model, and use the estimated coefficients to form the "WW index". The ratios and their effect on the index are cash flow to assets (negative), a dummy for whether the firm pays a dividend (negative), long-term debt to total assets (positive), size (negative), industry sales growth (positive) and firm sales growth (negative). In contrast to Lamont et al. (2001), they find a risk premium associated with financial constraints (albeit non-significant).

[38] A modified version of the KZ index is presented by Baker et al. (2003). They drop the market-to-book ratio and find that the coefficients on the remaining four variables remain approximately the same.

SA Index

Similar to Kaplan and Zingales (1997), but with critique of Lamont et al. (2001) and the KZ index, Hadlock and Pierce (2010) combine quantitative and qualitative data. Using ordered logit models, only cash flow and leverage are consistently significant with a sign in line with the KZ index. For q and dividends, the coefficients flip signs across estimated models and are in many cases insignificant. Further in contrast to the KZ index, they find that cash holdings generally display a positive and significant effect on financial constraints. This would suggest that constrained firms hold cash as a precaution. They also suggest an alternative to the KZ index, the "SA index" comprising of size (negative), squared size (positive), and age (negative). The appeal of these variables, they argue, is that they are less endogenous than many other sorting variables, and their results appear to show that many common variables are in fact proxies for firm size and/or age.

ASCL Index

In a review of the common indices (e.g. the KZ, WW, and SA index) Farre-Mensa and Ljungqvist (2016) find that none of them is appropriate in measuring financial constraints as firms classified as constrained do not in fact act as if they were (e.g. have no difficulty in obtaining credit when their demand for it increases). In a similar spirit, Mulier et al. (2016) propose an alternate index. Many other measures have been based on US public firms, and Mulier et al. therefore contributes by basing their results on a sample of unquoted SMEs in Nordic, Western, and Eastern European countries. Further in contrast to other measures, their "ASCL index" does not require subsequent users to rely on parameter estimates from the initial study. Rather, the index is calculated by relating key financial figures of a firm to the industry median. Specifically, the ASCL index is computed using a firm's size (below median indicates constrained), age (below median), cash flows (below median), and leverage (above median).

FCP Index

In a further review of previous measures, Schauer et al. (2019) survey managers' assessments of their firms' degrees of financial constraint and create a "true" measure. When comparing that measure to previous indices (e.g. KZ, WW, SA, and ASCL indices), they find that 15 percent of the firms in their sample of private German manufacturing firms are on average incorrectly classified as being constrained. They propose alternative index, termed "FCP", which comprises of size (negative loading), interest coverage (negative), ROA (negative), cash holdings (negative). They argue the superiority of this measure in four points. First, using survey data to identify financially constrained firms leads to a more precise calibration of the measure. Second, their sample includes private firms which are particularly prone to information asymmetries and therefore financial constraints (Beck et al., 2005; Mulier et al., 2016; Saunders & Steffen, 2011). Third, their index is constructed using variables less subject to potential problems of endogeneity. For example, firms' leverage and payouts are factors which are strategically determined by firms, and are thus likely conditioned on whether a firm is subject to financial constraints. Lastly, many other measures focus on factors that proxy for external financial constraints, while their FCP index also includes internal financing constraints.

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