Corporate investment decisions under political uncertainty

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Ifo Working Paper No. 221

October 2016

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Abstract

I investigate how political uncertainty influences corporate investment decisions employing a unique panel dataset of German manufacturing firms. I use data on firms' self-reported investment realizations, plans and revisions. The firm-specific user cost of capital captures the current institutional framework, but does not reflect the uncertainty about changes in government policies firms are faced with. I therefore augment the neo-classical investment model by a measure of political uncertainty resulting from the electoral process. The results show that realized investment ratios decreased by 10.5% in years when state elections occurred relative to the average investment ratio in years with no state election. Firms however seem to anticipate electoral uncertainty already when making investment plans and hardly revise their plans. Investment revisions occur because of updated information about realized sales growth and not because of resolved electoral uncertainty. I also find that electoral uncertainty negatively influences add-on investments which face a high degree of irreversibility, while non-capacity expanding investments are not influenced by electoral uncertainty.

JEL Code: D22, D24, D72, D81, D92, C23, H25, H32, H73.
Keywords: Firm-level investment, user cost of capital, political uncertainty, elections, survey data, panel data.

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1. Introduction

On a daily basis firms are confronted with considerable uncertainty about demand for their products, costs and profitability. Uncertainty can arise from purely economic shocks such as productivity shocks or changes in tastes or economic policy shocks such as tax and regulatory reforms. Especially during election times uncertainty is high because a change in government can give rise to economic policy reforms. Political forces may well influence managerial decisions at the corporate level. If an election can potentially result in a bad outcome from a firm's perspective, the option value of waiting to commit to an irreversible investment increases. Firms "wait and see" and rationally delay investment until the policy uncertainty is resolved before they decide on new costly investments.

Consistent with neoclassical models of the optimal capital stock, empirical studies have modeled demand for capital focusing on the effects of output and the user cost of capital (UCC). Under uncertainty, the commitment of capital is, however, more expensive than the standard user cost of capital.[2] The policy debate also emphasizes that uncertain changes in the tax and regulatory framework and the market environment play a role when firms decide on their investments. The UCC captures the current institutional framework, but does not reflect the uncertainty about changes in government policies firms are faced with. When uncertainty about future government policy is pronounced, firms may postpone their investments. To deal with such unpredicted policy changes I propose to add a measure of policy uncertainty to the empirical model of the neoclassical investment theory.

I investigate how political uncertainty influences corporate investment decisions employing a firm-level dataset of German manufacturing firms that combines survey and financial accounts data. I use survey information on investment (planned and realized investment). I can calculate investment revisions which are defined as the difference

[2] The theoretical model employing a CES production function predicts a user cost elasticity of -1. Empirical studies, however, usually find estimates significantly smaller than -1.The irreversible investment theory describes why the influence of the UCC appears to be small in many empirical studies (e.g. Cummins et al. 1994) as changes in the UCC are relevant only for firms near their individual investment threshold.

between planned and realized investments. Political uncertainty is an economic risk where the future path of government policy is uncertain. Before elections occur, political uncertainty is pronounced because electoral outcomes will influence political leadership and government policies. I use federal and state elections as a measure of political uncertainty. An advantage of focusing on state elections is that, in most instances, they are exogenously determined and the timing of state elections varies between states. I include political uncertainty in addition to the firm-specific standard user cost of capital and sales growth to the neoclassical investment model. To construct the UCC variable I employ detailed information on firms' asset and debt structure, and tax burden and allowance scheme following the German tax system. The results show that electoral uncertainty at the state level decreases realized investment. Investment ratios, i.e. investment over the previous year capital stock, decreased by 10.5% in years where state elections occurred relative to the average investment ratio in years with no state election. Firms seem to anticipate electoral uncertainty already when making investment plans. Firms hardly revise their investment plans. It is conceivable that firms are aware of the risks of investing in an election year but do not make explicit calculations. Rather, they employ a rule of thumb to hold off on marginal investments that are difficult to reverse. Investment revisions occur because of updated information about realized sales growth and not because of resolved electoral uncertainty. I also find that electoral uncertainty reduces add-on investments which face a high degree of irreversibility, while non-capacity expanding investments are not influenced by electoral uncertainty.

2. Related literature

2.1 Modeling the investment decision

The purpose of investment is to reach an optimal level of capital which a firm determines by maximizing its discounted flow of future profits. Absent any frictions, a firm would achieve the optimal level of capital immediately. Adjustment costs and time-to-delivery lags are some of the factors that preclude every firm from reaching the optimal capital stock instantaneously. There are two strands of empirical studies accounting for the dynamics explicitly or implicitly (Chirinko 1993). Optimization problems explicitly

formalize the dynamic elements – expectations and adjustment cost technology – in the demand for investment. The most prominent models are the Q-model of investment (Tobin 1969), the Euler equation model (Abel 1980) and the direct forecasting model. Empirical implementation hardly corroborates the formal investment models (e.g. Fazzari et al. 1988, Schaller 1990). In contrast to explicit optimization models, expectations and adjustment costs have also been included implicitly in models of investment. The autoregressive distributed lag (ARDL) models derived by the standard neoclassical framework (Jorgenson 1963) are among the most important tools to study investment dynamics.[3] Distributed lag models rely less on theoretical guidance but have performed well empirically.[4]

In the neoclassical model, the adjustment process specifying the transition to the optimal capital stock is a function of output and price, i.e. the user cost of capital which is defined as the minimal rate of return on investment. The UCC depends on characteristics of the tax system and macroeconomic developments in capital and factor market conditions which are common to all firms. Empirical studies suggest also taking into account firm-specific variation in the tax burden or capital structure to study the effect of the UCC on investment (Chirinko et al. 1999, Hassett and Hubbard 2002, Egger et al. 2009, Dwenger 2014). Compared to the large investment literature using Q models, fewer microeconometric studies exist that focus on estimating the effect of changes in taxes and other components of the UCC. Studies using aggregate data provided little support to the view of policy makers who seem to believe in the effectiveness of tax policy and frequently change tax regulations to influence investment behavior. The limited microeconometric research shows that the firm-specific UCC is difficult to measure. Harhoff and Ramb (2001) and Dwenger (2014) examine how taxation reflected in the UCC influences investment in Germany. Using panel data from the German Bundesbank for 1987 until 1997, Harhoff and Ramb (2001) find that the UCC decreases investment. Dwenger (2014) shows that both error correction and distributed lag models

[3] Other modeling strategies, such as VAR models or natural experiments, have been of secondary importance. One exception studying German data comes from the VAR investment model of Breitung et al. (2003).

[4] Within the ARDL framework, unobservable expectations are modeled so that expectations are assumed to be based on extrapolations of past and realized values of the variables included in the model. Instead of being driven by theory, the model specification is "ad-hoc" and thus based on an empirical specification search, e.g. searching for the number of lags that fits the data best.

suggest that UCC and sales growth significantly influence investment decisions. Estimates of the user cost elasticity, however, are larger in size and match theoretical predictions more closely in the error correction model. Using the same data source as Dwenger (2014), Simmler (2012) examines whether financially constrained and unconstrained firms respond differently to corporate income taxation. Using a switching regression framework, Simmler (2012) shows that the UCC significantly influences investment decisions of financially unconstrained firms. Financially constrained firms do not base their investment decisions on the UCC but on the availability of internal finance and thus on the effective average tax rate which measures liquidity outflow through taxation. Büttner and Hönig (2015) combine balance sheet data with data from Germany's most important business cycle and firm survey for the years 1994-2007.[5] In addition to the negative effect of the UCC on investment, Büttner and Hönig (2015) find that the current and expected business conditions play an important role in investment decisions.

2.2 Investment under uncertainty

Theoretical predictions as to what extent uncertainty influences investment are ambiguous. Early studies showed that uncertainty increases investment of risk-neutral firms. Firms can exploit positive potential of uncertainty whilst insuring against bad outcomes (Oi 1961, Hartman 1972, 1976, Abel 1983, Caballero 1991). Firms need to be flexible and quick in adjusting their capital stock.[6] Other studies emphasized the so-called real options effect (McDonald and Siegel 1986, Dixit and Pindyck 1994, Abel and Eberly 1994). The idea is that firms are better off waiting for more predictable conditions when they face irreversible, costly investment decisions and when economic policy uncertainty is high. Scholars also investigate how uncertainty and financial frictions interact (Gilchrist et al. 2010, Arellano, Bai and Kehoe 2010, Pastor and Veronesi 2012). When uncertainty is pronounced, firm risk increases and borrowing costs increase as lenders

[5] The business cycle and firm survey data is used as the foundation of the ifo Business Climate Index, Germany's leading business cycle indicator.

[6] The effect applies to firms with low fixed costs (Caballero and Leahy, 1996), firms with an option to abandon a project (Roberts and Weitzman, 1981) and firms facing bankruptcy, which limits the downside risk of a project (Stiglitz and Weiss, 1981).

demand higher interest rates, i.e. a risk premium. Scholars examining the so-called risk premium effect predict that investment decreases under uncertainty. Some studies describe that uncertainty merely coincides with bad economic times as firms need to review their operation and investment strategy to survive (Bachmann and Moscarini 2011).

Scholars have investigated the nexus between firm-level investment and uncertainty empirically. Generic uncertainty faced by firms has been measured using a variety of variables, such as the volatility of stock returns, input and output prices, total factor productivity, or firm fundamentals.[7] These studies tend to find a negative effect of uncertainty, although several studies reach ambiguous results.[8] Bloom et al. (2001) find that uncertainty slows down the reaction of firms to sales shocks, but has no long-run effects on capital demand. Böhm et al. (2001) show that uncertainty increases overall investment, but decreases investment of firms in concentrated industries. Volatility measures, especially stock price volatility, may be subject to excess volatility (e.g. due to bubbles) or may be associated with greater optimism about the firms' future prospects (Bond and van Reenen 2007). To address these concerns scholars use the dispersion in expert forecasts from survey data to create measures that capture directly firms' perceived uncertainty. Guiso and Parigi (1999) and Patillo (1998) use surveys on the subjective probability distribution of firms' own demand changes. Driver et al. (2004) use a survey in which firms convey their expectations about future business conditions. Fuss and Vermeulen (2008) use a survey that provides firms' expectations about their own future demand and price changes. Instead of constructing a measure of uncertainty, Temple et al. (2001) use directly the survey answer where firms report whether demand uncertainty limits their capital expenditure.

[7] Leahy and Whited (1996), Bloom et al. (2007), Baum et al. (2008), Bloom (2009) and Panousi and Papanikolaou (2012) look at stock price volatility. Hartman (1972), Abel (1983), and Abel and Eberly (1997) measure uncertainty about future output price changes. Abel and Eberly (1994) use profit uncertainty which incorporates all shocks from both the demand and supply side such as changes in technology, tastes and prices. Von Kalckreuth (2003) and Bo (2002) use sales volatility as a proxy of uncertainty.

[8] See Carruth et al. (2000) and Bo (2001) for detailed surveys of the empirical literature.

2.3 Investment under political uncertainty

Scholars investigate the relation between policy uncertainty and corporate investment by using election years as indicators of times of high political uncertainty. Election outcomes are relevant to corporate decisions. Newly elected governments can change industry regulation, trade policy, and taxation and may affect the cost structure of firms (Hillman and Hitt 1999). If an election can potentially result in a bad outcome from a firm's perspective, the option value of waiting to invest increases and the firm may rationally delay investment until some or all of the policy uncertainty is resolved.[9] The "bad news principle" suggests that firms wait to invest in anticipation of possible negative changes in macroeconomic, taxation, or monetary policies, or in the regulatory environment in general (Bernanke 1983).[10]

Julio and Yook (2012) find evidence that firms reduce corporate investment before elections using a sample of 48 developed and developing countries. Canes-Wrone and Park (2012) show that the decline of private fixed investment before elections in ten OECD countries depends on electoral competitiveness and partisan polarization. In the US, firm investment and the quantity of home sales (a form of irreversible private investment) declines before gubernatorial elections (Jens 2013, Canes-Wrone and Park 2014, Falk and Shelton 2016). Uncertainty surrounding the legislative process, in particular about tax and monetary policy, reduces investment (Hassett and Metcalf 1999, Fernandez-Villaverde et al. 2015). Durnev (2010) examines how political uncertainty with respect to election outcomes affects firm investment response to stock prices. The sensitivity of investment to stock prices decreases in election years as the amount of information revealed in stock prices changes when future government policies are uncertain. There are also other explanations for the change of the investment response around elections. Stock prices might be less important during election times in countries where in-

[9] Postponing investment as a response to uncertainty is more than shifting investment across time as the same investment opportunity may not be available in the next period (Bernanke 1983). Uncertainty with respect to the duration of reform can impose a hefty tax on investment (Rodrik 1991).

[10] However, in some cases the election might result in good news and increase the expected return of all (mutually exclusive) investment projects the firm chooses from. It could still be optimal for the firm to delay investment if the election outcome would reorder the rankings of the individual projects in terms of expected returns. Political uncertainty is thus not required to result in negative changes but even positive changes in policies have implications for capital allocation between various investment projects and could result in an incentive for firms to delay investment. Indeed, governments frequently modify tax laws with the intent of stimulating the level of investment (Hall and Jorgenson, 1967).

terest groups, political ties and bribes are more common. Firms may try to manipulate their investment to influence election results to protect valuable political connections. Bertrand et al. (2006) find that investment of firms with politically connected CEOs increases before municipal elections in France. Politicians may also try to manipulate firm investment to increase the chance to stay in office (Nordhaus 1975). Government-owned banks might, for example, increase lending before elections (Dinc 2005, Cole 2009).

Economic policies are related to party ideology (Hibbs, 1977, Alesina, 1987, 1988). Different parties will manipulate demand, labor costs, costs of capital, and the corporate tax rate, which are all central to firm profits, differently. Rightwing parties tend to implement economic policies that are more favorable to firm profits than leftwing parties (Budge et al. 2001). Political parties even target favorable policies to different industries in order to gratify their electoral and sector-specific supporters (Bechtel and Füss 2010). The information of expected government partisanship is reflected in the prices of the stock market. Stock performance of small German firms was better when the probability of a rightwing coalition winning the 2002 federal election increased (Füss and Bechtel 2008). When a rightwing coalition was more likely to win the election, stock market volatility increased. Electoral uncertainty reduced stock market volatility.

In addition to relying only on policy uncertainty resulting from election times, the Economic Policy Uncertainty Index (EPU) constructed by Baker et al. (2015) provides a monthly measure of political uncertainty. The index is a weighted average of components measuring uncertainty related to taxation, government spending and monetary policy and count key terms related to policy uncertainty in newspaper articles. Policy-related uncertainty measured by the EPU index is negatively related to firm and industry level investment, but the relation is not uniform in a cross-section of US firms (Gulen and Ion 2012). The effect is stronger for firms with a higher degree of investment irreversibility, financially constrained firms, and for firms operating in less competitive industries and is associated with higher cash holdings and lower net debt issuance. Kang et al. (2014) find that economic policy uncertainty in interaction with firm-specific uncertainty depresses investment decisions. The effect of policy uncertainty on investment

is greater for firms that have higher firm-specific uncertainty and during recessions. Policy uncertainty, however, does not influence investment behavior of very large firms. Following the "wait-and-see" theories, the hypothesis to be tested empirically is that corporate investment is lower during periods of high political uncertainty.

3. Data and descriptive statistics

I use an unbalanced panel of survey and balance sheet data (EBDC Business Investment Panel) for German manufacturing firms over the period 1994-2012.[11] The ifo investment survey includes firm-specific responses on realized investments and investment plans and is conducted semi-annually among 2,500 firms located in Germany. Balance sheet data is provided by the Amadeus Bureau van Dijk and Hoppenstedt databases. The databases contain annual financial reports and also provide information on firm characteristics such as firm age, number of employees and the legal form.[12]

The EBDC Business Investment Panel focuses mainly on corporate investment activity and includes both forward and backward looking statements of realized and planned investment. Each spring and autumn firms are asked about the amount invested in buildings and equipment. I focus both on realized and planned investment. In the ifo investment survey firms are asked how much they have been investing in the previous year. For my realized investment variable I use the response from the autumn survey. If no response from the autumn survey is available, I use the response from the spring survey. In addition, firms are asked to provide an estimate for their planned investment for the same year. The ifo investment survey therefore allows me to consider both realized and planned investment and the resulting investment revisions. Most of the literature dealing

[11] The ifo investment survey and balance sheet data are pre-processed and provided by the Economics & Business Data Center (EBDC) at Ludwig-Maximilians University and the ifo Institute, Munich. An overview on how survey and balance sheet information is linked is provided in Hönig (2009, 2010). For more information on the data the EBDC provides, see Seiler (2012).

[12] Financial reports are based on the accounting and earnings-statement structure of the German Commercial Code (HGB). Balance sheet variables come from unconsolidated statements from individual accounts instead of corporate group accounts.

with firm level investment considers investment ratios defined as investment over total assets in the previous year. I follow this approach. [13]

Table 1 shows summary statistics of the main variables.[14] The realized investment ratio has a mean of 0.056 and a standard deviation of 0.053. The planned investment ratio is close to the realized investment with a mean of 0.058 and a standard deviation of 0.053. I investigate the impact of political uncertainty arising from the electoral process. I use state election years as indicators of times of high political uncertainty. Newly elected governments can locally influence the regulatory environment firms operate in. The timing of state elections is predetermined by the constitution and should be independent of fiscal policy. The dates of state elections vary between the German states. During my sample period 43 state elections occurred, i.e. between two and five elections occurred in each state.[15] State governments often set the course in structural policy and infrastructure. In the state of Baden-Württemberg, for example, the newly elected coalition of the SPD and the Greens that followed the rightwing CDU government declared the phase out of nuclear energy. The change in energy policy resulted in uncertainty about energy costs for firms. I first examine the unconditional relationship between firm-level investment and electoral uncertainty. Figure 1 shows realized and planned investment in state election versus no state election years. Both realized and planned investment was on average lower in state election years than in years without state elections. I present non-parametric tests of differences in means and medians of investment between state election and no state election years in Table 2, part A. I test the difference in means with a simple t-test. The difference in medians is tested with a Wilcoxon-Mann-Whitney test. The mean investment and planned investment ratios are lower in years where state elections occurred. The t-test for the difference in means of the realized investment ratio turns out to be statistically significant, but the t-test of investment plans lacks statistical significance. The median investment and planned investment ratios are only slightly

[13] As an alternative to the survey measure of investment I also calculate capital expenditures as a proxy for investment from balance sheets. Capital expenditures are defined as the change in tangible assets, plus depreciations. The correlation between investment from the survey and capital expenditures from the balance sheet is high.

[14] The firm characteristic variables are deflated and trimmed at the 1st and 99th percentiles throughout the analysis.

[15] Note that due to data limitations the sample includes only the 11 West German states.

lower or similar in state election and no state election years and the tests of difference in medians do not turn out to be statistically significant.

I also use federal elections to measure political uncertainty. A change in government can influence industry regulation, trade policy, and taxation and may potentially affect the cost structure of firms. Figure 2 shows realized and planned investment in federal election versus no federal election years. During the sample period four federal elections took place. Both realized and planned investment was on average lower in federal election years than in no federal election years. In Table 2, part B I compare realized and planned investment in years of federal elections and years where no federal election occurred. The mean and median investment and investment plans ratios are lower in federal election years. The tests of difference in means do (marginally) not turn out to be statistically significant. The tests of difference in medians are statistically significant.

4. Empirical analysis

4.1. Empirical strategy

I model investment as a function of firm-specific investment opportunities, available resources, and electoral uncertainty:

$$\frac{I_{i.t}}{K_{i,t-1}} = \alpha_1 PU_{i,t} + \beta_1 \Delta log UCC_{i,t} + \gamma_1 \Delta log S_{i,t} + \delta_1 SE_{i,t} + \mu_{1,i} + \vartheta_{1,t} + \varepsilon_{1,i,t} \quad (1)$$

$$\frac{I^P_{i,t}}{K_{i,t-1}} = \alpha_2 PU_{i,t} + \beta_2 \Delta log UCC_{i,t} + \gamma_2 \Delta log S_{i,t-1} + \delta_2 SE_{i,t} + \mu_{2,i} + \vartheta_{2,t} + \varepsilon_{2,i,t} \quad (2)$$

where the dependent variable is realized investment *I* of firm *i* in year *t* over the previous year capital stock *K* or investment plans I^P of firm *i* in year *t* over the previous year capital stock *K*. $PU_{i,t}$ describes the measure of political uncertainty. As a first measure of political uncertainty I use the variable *State election*$_{s,t}$. The variable *State election*$_{s,t}$ assumes the value 1 if a state election takes place in state *s* a firm is headquartered in in year *t* and 0 otherwise. As a second measure of political uncertainty $PU_{i,t}$ I investigate federal elections. The variable *Federal election*$_t$ assumes the value 1 if a federal election

takes place in year t and 0 otherwise. Note that *Federal election*$_t$ varies only over time and not across firms. I therefore cannot include fixed time effects in the regression when *Federal election*$_t$ is included. I control for macroeconomic fluctuations directly and include lagged GDP growth. I also include a linear and quadratic time trend. The degree of electoral uncertainty may well depend on the political orientation of the newly elected government. As a robustness check, I also control for government ideology.[16]

The key explanatory variable in the neoclassical investment model is the UCC. $\Delta log UCC_{i,t}$ denotes the growth rate of the UCC of firm *i* in year *t*. The definition of the UCC in this study follows the approach of Büttner and Hönig (2015) which is based on the work by Jorgenson (1963), Hall and Jorgenson (1967), and King and Fullerton (1984). The UCC is defined as the minimal rate of return a firm must earn on investments before taxes. When a firm evaluates investment projects, the UCC is used as a discount rate.

The $UCC_{i,t}$ of firm *i* at time *t* is given by

$$UCC_{i,t} = \left[\frac{(1-A)}{(1-\tau)*(1+\pi)} * (\rho + \delta(1+\pi_I) - \pi_I) - \delta\right] + \Lambda * \frac{(1-\tau*\psi)*((1-\tau)*i-\rho)}{(1-\tau)*(1+\pi)} \qquad (3)$$

where the first term in squared brackets reflects the UCC when the source of finance is retained earnings and the second term reflects the difference between the UCC using retained earnings and when the investment is entirely financed with debt. τ is the effective corporate profit tax rate which can vary not only over time, but also by firm location. The municipality of a firm's headquarter determines the local business tax rate. I include the corporate tax, the solidarity surcharge and the local business tax and their interactions in the calculation of the firm-specific statutory tax rate.[17] I exploit the firm-specific information contained in the financial statement data to account for a firm's capital and asset structures. I account for a firm's capital structure by computing firm-specific, time-varying weights using the respective firm-specific share of debt to total capital λ. I calculate shares of buildings and plant/machinery as a part of a firm's tangi-

[16] The dummy variable capturing political orientation assumes the value 1 when a leftwing government, 0.5 when a mixed coalition government and 0 when a rightwing government was in office (Potrafke et al. 2016). As a leftwing government I consider SPD, SPD/Greens, SPD/Greens/SSW or SPD/Die Linke. A mixed coalition government is between SPD and CDU/CSU, CDU and Greens or CDU/FDP/Greens. A rightwing government is CDU/CSU or CDU/CSU/FDP.

[17] See the Appendix, for details on the German corporate tax system.

ble assets in order to obtain firm-specific depreciation rates δ, rates of capital allowances ψ and net present values of depreciation allowances *A*. The present value of allowances *A* depends on the type of asset, the respective depreciation rate and the allowance scheme. I take two types of assets into account: buildings and plant/machinery. I follow the German tax law and use straight-line depreciation for buildings and the declining-balance method for machinery.[18] Following Devereux et al. (2002) and Yoo (2003), I assume a rate of economic depreciation for machinery of δ^M = 12.25% and δ^B = 3.61% for buildings. I include annual data on nominal interest *i* and inflation rates for consumer goods π and investment goods π_I.[19] The tax-adjusted nominal discount rate is denoted by ρ. The firm-specific variance of the UCC comes from location-specific taxation and differences in the firms' financial structure and asset mix.

The second key explanatory variable in the neoclassical investment model is firms' revenue growth. $\Delta log S_{i,t}$ denotes the growth rate of revenues. I take revenues from the ifo investment survey.[20] When making investment plans, however, revenue growth is not yet observed by the firm and firms only know revenue growth of the year *t-1*. Firms must forecast sales growth. Firms' expectations about future sales growth are denoted by $SE_{i,t}$. I measure firms' expectations about future sales growth directly from the ifo investment survey. Corporations are asked how their investment activities will be influenced by their sales expectation. The variable $SE_{i,t}$ assumes the value 2 if investments are strongly positively influenced, 1 if investments are slightly positively influenced, 0 if investments are not influenced, -1 if investments are slightly negatively influenced or -2 if investments are strongly negatively influenced by sales expectations.

[13] In case of declining-balance depreciation I calculate *A* as $\frac{\tau\psi(1+\rho)}{\psi+\rho}$. In case of straight-line depreciation *A* is defined as $\frac{\tau\psi(1+\rho)}{\rho}\left(1-\frac{1}{(1+\rho)^n}\right)$ where *n* is the number of years for which depreciation allowances can be claimed. According to the tax law, *n* is 25 years until the year 2000 and 33.3 years since 2001.

[19] Nominal interest rates are taken from the OECD. Inflation rates for consumer and investment goods are provided by the Federal Statistical Office. The base year is 2010.

[20] The correlation of revenues from the ifo investment survey and balance sheet data is high. I use the variable from the ifo investment survey because data availability is better.

μ_i and ϑ_t describe fixed firm and fixed time effects. Fixed time effects capture macroeconomic fluctuations. Fixed firm effects capture time-invariant differences across firms. $\varepsilon_{i,t}$ denotes the error term.

An additional explanatory variable that is often included in the neoclassical investment model is cash flow. I also test specifications of the investment model including cash flow. I scale cash flow by the beginning-of-period total assets. In the empirical literature alternative explanations for the possible interpretation of significant cash flow effects exists. Cash flow can reflect the presence of financing constraints. Cash flow, however, could also be a proxy for (omitted) future profitability variables (Kaplan and Zingales 1997, 2000).

I estimate the baseline model by using panel OLS with standard errors robust to heteroskedasticity (Huber/White/sandwich standard errors; see Huber 1967; White 1980, 1982; Stock and Watson 2008).

4.2. Regression results

Table 3 shows the regression results for the baseline panel data model including state elections. In Columns (1) to (3) I estimate the model for realized investment. In Column (1) I include only state elections as an explanatory variable. In Column (2) I estimate the neoclassical investment model. In addition to the state elections variable I include revenue growth, the firm-specific UCC growth and sales expectation variables. In Column (3) I add the cashflow ratio. I repeat the estimations for investment plans in Columns (4) to (6) and for investment revisions in Columns (7) to (9).

State elections are negatively associated with the investment ratio. The coefficient of state election is negative and statistically significant at the 1% level in Columns (1) to (3). The numerical meaning of the coefficient of state election in Column (2) is that in state elections years the investment ratio decreases on average by 0.006. In terms of magnitudes, the coefficient translates into a 10.5% reduction in investment ratios relative to the average investment ratio in no state election years (0.057). The coefficient of the variable revenue growth has a positive sign and is statistically significant in Columns (2) to (3). The coefficient of the variable sales expectation has a positive sign and

is statistically significant at the 1% level in Columns (2) to (3).The coefficient of the variable UCC growth has a negative sign and is also statistically significant at the 1% level in Columns (2) to (3). The numerical meaning of the coefficient of UCC growth is that when UCC growth increases by one standard deviation (0.252) the investment ratio decreases by 0.013. I include the cashflow ratio in Column (3). The coefficient of the cashflow ratio is positive and is statistically significant at the 1% level. The magnitude of the coefficients is similar for investment plans. The coefficient of state elections is negative but slightly fails statistical significance at the 10% level in Columns (5) and (6). The coefficient of lagged revenue growth and sales expectation are positive and statistically significant. The coefficient of UCC growth is negative and statistically significant. The coefficient of the lagged cashflow ratio is positive and is statistically significant.

My findings indicate that electoral uncertainty reduces both realized and planned investment, but the reduction in investment is only statistically significant for realized investment. I regress investment revisions, defined as the planned investment ratio minus the realized investment ratio, on the same explanatory variables to test for the hypothesis of equal coefficients in the realized and planned investment estimations. If the hypothesis cannot be rejected, all coefficients should not be statistically different from zero. None of the coefficients turn out to be statistically significant in Columns (8) and (9), except revenue growth. I can therefore not reject the hypothesis that the other coefficients on realized and planned investments are equal. Electoral uncertainty seems to have the same impact on realized investment and on investment plans. If corporate investment decisions are fully determined at the time of planning, i.e. investment plans are simply carried out, then investment revisions should be zero. In my sample investment revisions are on average small. The mean of investment revisions is 0.002. Investment revisions however vary across firms as the standard deviation of investment revisions is 0.025. For some firms and years investment revisions may well be substantial. Firms however seem to revise their investments because of updated information about realized revenue growth. Firms seem to be aware of the risks of investing in an election year and anticipate electoral uncertainty already when making investment plans. It may well be that firms do not make explicit calculations, but rather employ a rule of thumb to hold

off on marginal investments that are difficult to reverse. It is conceivable that firms simply game out the worst-case political scenario and ensure that the plan is robust to its occurrence without estimating the probabilities.

Table 4 shows the regression results for the baseline panel data model including both federal and state elections. As before, in Columns (1) to (3) the model is estimated for realized investment. In Column (1) I include only federal and state elections as explanatory variables and time trends. In Column (2) I estimate the neoclassical investment model including federal and state elections. In Column (3) I include lagged GDP growth. I repeat the estimations for investment plans in Columns (4) to (6) and for investment revisions in Columns (7) to (9).

In Column (1) the coefficients of the federal election and state election variables have a negative sign and are statistically significant. When I add the variables of the neoclassical investment model in Column (2), the coefficient of the variable state election has a negative sign and is statistically significant at the 1% level. The coefficient of the variable federal election does not turn out to be statistically significant. The coefficient of the variable revenue growth has a positive sign and is statistically significant at the 5% level in Columns (2) to (3). The coefficient of the variable sales expectation has a positive sign and is statistically significant at the 1% level in Columns (2) to (3).The coefficient of the variable UCC growth has a negative sign and is also statistically significant. In the next specification in Column (3), the coefficients of lagged GDP growth has the expected positive sign and is statistically significant at the 5% level. The magnitude of the coefficients is similar for investment plans. The coefficient of state elections is negative in Columns (4) to (6) but does not turn out to be statistically significant for investment plans. The coefficient of federal elections is negative and statistically significant in Columns (4) and (6). The other explanatory variables have the expected signs. I test whether the coefficients in the realized and planned investment estimations are equal by regressing the same explanatory variables on investment revisions. None of the coefficients turns out to be statistically significant, except the coefficients of revenue growth and lagged GDP growth in Columns (8) and (9). Firms did not observe revenue growth

and lagged GDP growth when making their plans. It is conceivable that investment revisions are explained by the updated information on revenue and GDP growth. Firms however seem to take electoral uncertainty already into account when making investment plans.

4.3. Robustness tests

I submitted my results to rigorous robustness tests using different samples and specifications of my regressions. None of these robustness tests indicate any severe fragility of my results.

It is conceivable that the results are driven by individual states. Inferences do not change when I re-estimate equations (1) and (2) and exclude an individual state, one at a time (Jackknife test).

I estimate a dynamic version of my baseline specification to deal with potential endogeneity. I employ the system GMM methodology as in Arellano and Bover (1995) and Blundell and Bond (1998). Differences of the explanatory variables serve as instruments for the equation in levels, and lagged levels are used as instruments for the equation in first differences. I assume electoral uncertainty to be exogenous. The other explanatory variables are considered as predetermined. I reduce the number of instruments and thereby avoid potential over-fitting problems by limiting the lags to 1 and 2. I correct t-statistics for small sample bias, using Windmeijer's correction (2005). Table 5 shows the results. The results do not change qualitatively and are robust to the alternative specification.

Elections may not be exogenous to fiscal policy because (unobserved) variables, such as crises or social unrest, can influence the timing of elections and fiscal policy (Shi and Svensson 2006). The timing of regular elections is predetermined by the constitution and should be independent of fiscal policy. Therefore I re-estimate the regressions for state elections and distinguish between regular and early state elections.[21] Table 6 shows the regression results. The coefficient of regular state elections is negative and

[21] For empirical evidence on political business cycles that distinguish between regular and early elections, see e.g. Potrafke (2010), Julio and Yook (2012), Mechtel and Potrafke (2013), Reischmann (2016).

statistically significant at the 1% level in the estimation for realized investment. The coefficient of early state elections does not turn out to be statistically significant. In the estimation for planned investment regular and early state elections do not turn out to be statistically significant. In the estimation for investment revisions the coefficient of regular state elections is positive and statistically significant at the 5% level.

The magnitude of the decline in investment around an election should be related to the uncertainty created by an election. I examine to what extent the degree of electoral uncertainty has an effect on firms' investment behavior. The degree of electoral uncertainty may well depend on the political orientation of the newly elected government. If the incumbent government is market-friendly, then firms might view the election outcome as either neutral when the incumbent remains in power or negative when the incumbent loses (Julio and Yook 2012). Using wordscore analysis of election manifestos and coalition agreements, Bräuninger and Debus (2012) measure how market-friendly a government's economic policy position is. I include the market-friendliness of economic policy of the incumbent government as an additional explanatory variable in my model. The coefficient (not shown) does however not turn out to be statistically significant. I also include an interaction of the state election variable with the market-friendliness of economic policy of the incumbent government in the empirical model. The coefficient of the interaction term is negative which is in line with the prediction that investment cycles are likely to be deeper when a market-friendly government is in power in the state election year, but the coefficient does not turn out to be statistically significant. When I use a dummy variable capturing the political orientation of the government (leftwing government, mixed coalition, rightwing government) instead of the market-friendliness of economic policy measure as an additional explanatory variable or in the interaction term the coefficients do not turn out to be statistically significant either.
The degree of political uncertainty also depends on the ex ante predictability of the election outcome. Pre-electoral polling data directly focus on election outcome expectations (Berlemann and Markwardt 2001, 2006). In Germany polling before elections includes the so-called Sunday question: "For which party would you vote if there was a general election next Sunday?" I calculate a measure that captures the distance of the market-

friendliness of economic policy between the actual and the predicted parliament from the polling data.[22] The coefficient of distance of market-friendliness of economic policy of the predicted and the actual parliament is negative but does not turn out to be statistically significant when included in the regression model. I also calculate the distance of market-friendliness of economic policy of the newly elected and the incumbent and the newly elected and predicted parliament. Including those measures in the model does not yield significant results. The results corroborate that firms use a rule of thumb to be cautious in electoral years.

I examine whether investments consist of different capital goods that vary in their degree of irreversibility and are thus differently influenced by uncertainty. I therefore categorize investments according to their purpose. Investments are divided into add-on, rationalization and replacement investments. Add-on investments are capacity expanding and often include the set-up of a new production site. Add-on investments thus face a high degree of irreversibility because of high sunk costs and should be more sensitive to uncertainty. Rationalization and replacement investments on the other hand entail a low degree of irreversibility as firms' capacities are not expanded and planning costs are lower. I run separate regressions for realized and planned add-on, rationalization and replacement investments. Table 7 shows the regression results. The coefficient of state elections is indeed negative and statistically significant only for realized add-on investments.

5. Conclusion

The relationship between politics and economic outcomes is a topical issue in the public debate. In particular, the incentives and uncertainties associated with possible changes in policy after a new government has been elected have implications for the behavior of

[22] In particular, I first calculate the market-friendliness of economic policy of the predicted parliament by weighting the market-friendliness of economic policy measure of each party with the predicted vote shares from the polls. I then calculate the market-friendliness of economic policy of the actual parliament by weighting the market-friendliness of economic policy measure of each party with the actual vote shares. Lastly, I calculate the difference of the market-friendliness of economic policy of the predicted and the actual parliament.

both corporations and politicians. I examined the effects of political uncertainty on the investment behavior of firms in the context of elections. Elections can influence industry regulation, monetary and trade policy, and taxation and may potentially affect the cost structure of firms. Firms may delay investment until uncertainties resulting from elections resolve. I employed survey data of investment realizations, plans and revisions from German manufacturing firms and estimated a neoclassical investment model. I employed detailed information on firms' asset and debt structure, and tax burden and allowance scheme following the German tax system to construct firm-specific cost of capital. The UCC captures the current institutional framework, but does not reflect the uncertainty about changes in government policies firms are faced with. Therefore I augmented the neoclassical investment model with political uncertainty resulting from elections. I focused on state elections because the timing is exogenously determined and varies by states. The results showed that electoral uncertainty at the state level decreases realized investment. Investment ratios decreased by 10.5% in years when state elections occurred relative to the average investment ratio in years with no state elections. Firms however seemed to anticipate electoral uncertainty already when making investment plans. Firms hardly revised their investment plans. It is conceivable that firms were aware of the risks of investing in an election year but did not make explicit calculations. Rather, they employed a rule of thumb to hold off on marginal investments that are difficult to reverse. Investment revisions occurred because of updated information about realized sales growth and not because of resolved electoral uncertainty. The political orientation of the newly elected government and the predictability of the election outcome did not influence corporate investment decisions. I also found that electoral uncertainty negatively influenced add-on investments which face a high degree of irreversibility, while non-capacity expanding investments were not influenced by electoral uncertainty.

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Figure 1: Investment in state election and no state election years

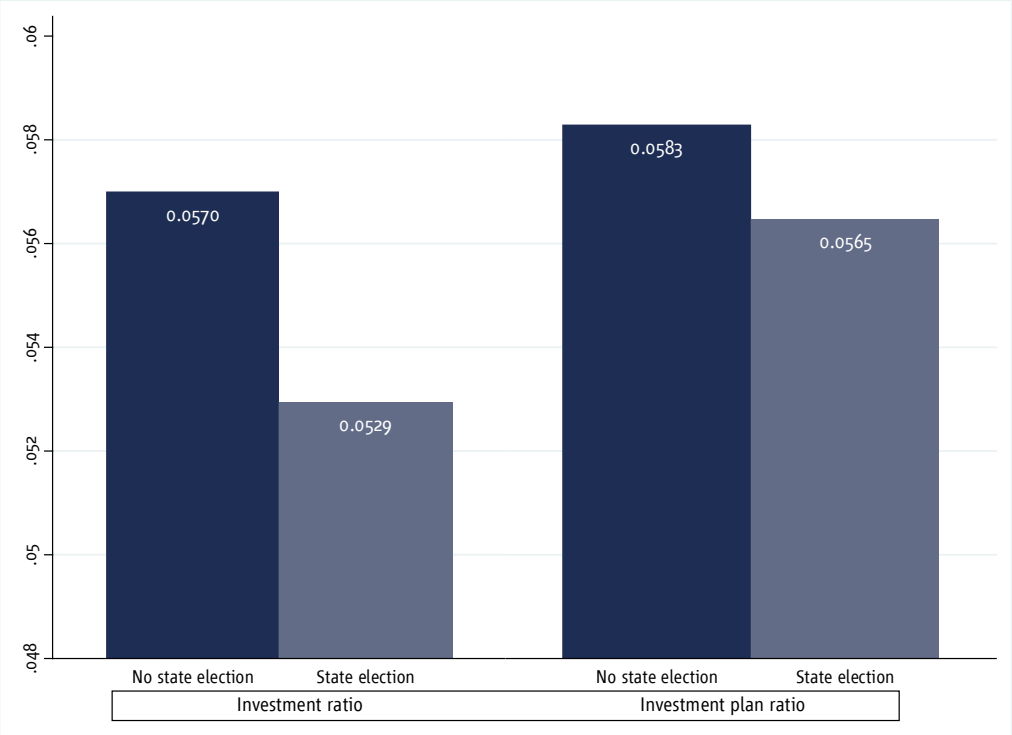

Figure 2: Investment in federal election and no federal election years

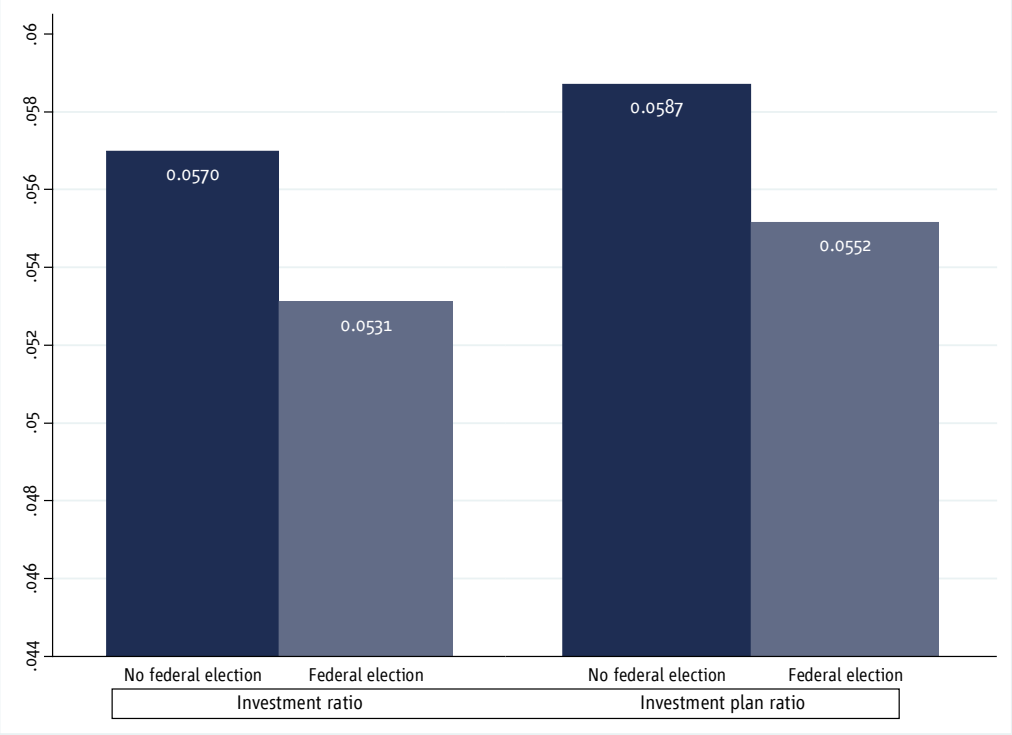

Table 1: Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min.	Max.
Investment ratio	2833	0.056	0.053	0.000	0.377
Investment plans ratio	2669	0.058	0.053	0.000	0.386
Investment revisions	2669	0.002	0.025	-0.270	0.222
State election	2833	0.222	0.416	0.000	1.000
Regular state election	2833	0.209	0.407	0.000	1.000
Early state election	2833	0.013	0.114	0.000	1.000
Federal election	2833	0.231	0.422	0.000	1.000
Revenue growth	2833	0.011	0.239	-2.499	2.599
Sales expectation	2492	0.295	1.225	-2.000	2.000
UCC growth	2833	-0.105	0.252	-1.661	0.500
Cashflow ratio	2749	0.081	0.077	-0.221	0.357
GDP growth	2833	1.456	2.321	-5.100	4.200
Investment ratio: Add-on	1003	0.075	0.061	0.001	0.370
Investment ratio: Rationalization	691	0.047	0.043	0.001	0.377
Investment ratio: Replacement	1039	0.043	0.042	0.000	0.351
Investment plans ratio: Add-on	936	0.076	0.063	0.001	0.386
Investment plans ratio: Rationalization	656	0.049	0.042	0.001	0.370
Investment plans ratio: Replacement	1006	0.046	0.044	0.000	0.354
Investment revisions: Add-on	936	0.002	0.029	-0.126	0.222
Investment revisions: Rationalization	656	0.002	0.022	-0.270	0.109
Investment revisions: Replacement	1006	0.003	0.023	-0.201	0.196

Note: The variable "Investment ratio" is defined as realized investment over total assets in the previous year. The variable "Investment plans ratio" is defined as planned investment over total assets in the previous year. "Investment revisions" are defined as the planned investment ratio minus the realized investment ratio. The variable "State election" assumes the value 1 if a state election takes place in state *s* a firm is headquartered in in year *t* and 0 otherwise. "Regular state election" is a dummy variable that takes the value 1 if a regular state election took place and 0 otherwise. "Early state election" is a dummy variable that takes the value 1 if an early state election took place and 0 otherwise. The variable "Federal election" assumes the value 1 if a federal election takes place in year *t* and 0 otherwise. "Revenue growth" denotes the growth rate of firm revenues. The variable "Sales expectation" assumes the value 2 if investments are strongly positively influenced, 1 if investments are slightly positively influenced, 0 if investments are not influenced, -1 if investments are slightly negatively influenced or -2 if investments are strongly negatively influenced by sales expectations. "UCC growth" denotes the growth rate of the firm-specific UCC. For details on the calculation of the UCC, see Section 4.1 and the Appendix. The variable "Cashflow ratio" is defined as cashflow over total assets in the previous year. "GDP growth" denotes the growth rate of GDP. Investment ratios, investment plans ratios and investment revisions are categorized according to their purpose. Investments are divided into "add-on", "rationalization" and "replacement" investments.

Table 2: Investment under political uncertainty

A: State election & no state election years

Investment ratio	**Obs.**	**Mean**	**Median**	**Std. Dev.**
No state election	2204	0.057	0.040	0.054
State election	629	0.053	0.038	0.049
Difference		0.004	0.002	
Difference Test (t-stat/z-score)		1.693	1.239	
Difference Test (p-value)		0.091	0.215	
Investment plans ratio	**Obs.**	**Mean**	**Median**	**Std. Dev.**
No state election	2068	0.058	0.043	0.054
State election	600	0.056	0.043	0.048
Difference		0.002	0.000	
Difference Test (t-stat/z-score)		0.751	-0.109	
Difference Test (p-value)		0.453	0.913	

B: Federal election & no federal election years

Investment ratio	**Obs.**	**Mean**	**Median**	**Std. Dev.**
No federal election	2178	0.057	0.040	0.054
Federal election	655	0.053	0.038	0.051
Difference		0.004	0.002	
Difference Test (t-stat/z-score)		1.640	1.940	
Difference Test (p-value)		0.101	0.052	
Investment plans ratio	**Obs.**	**Mean**	**Median**	**Std. Dev.**
No federal election	2045	0.059	0.043	0.053
Federal election	623	0.055	0.042	0.052
Difference		0.003	0.001	
Difference Test (t-stat/z-score)		1.425	1.887	
Difference Test (p-value)		0.154	0.059	

Note: The z-score for difference in medians is calculated using the Wilcoxon-Mann-Whitney test.

Table 3: Investment around state elections

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Investment ratio			Investment plans ratio			Investment revisions		
State election	-0.005***	-0.006***	-0.006***	-0.003*	-0.003	-0.003	0.002*	0.002	0.002
	(0.005)	(0.000)	(0.001)	(0.078)	(0.135)	(0.163)	(0.080)	(0.144)	(0.205)
Revenue growth		0.010**	0.007*					-0.008***	-0.008***
		(0.012)	(0.062)					(0.003)	(0.006)
Lagged revenue growth					0.011**	0.009*		0.002	0.004
					(0.015)	(0.056)		(0.413)	(0.239)
Sales expectation		0.006***	0.005***		0.006***	0.006***		-0.000	-0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.802)	(0.473)
UCC growth		-0.051***	-0.056***		-0.052***	-0.043**		0.003	0.007
		(0.000)	(0.000)		(0.008)	(0.023)		(0.768)	(0.573)
Cashflow ratio			0.085***						-0.003
			(0.000)						(0.805)
Lagged cashflow ratio						0.056***			0.008
						(0.003)			(0.469)
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2833	2492	2420	2669	1931	1880	2669	1931	1842
Firms	531	506	501	522	436	430	522	436	425
R^2 (overall)	0.024	0.071	0.132	0.027	0.075	0.117	0.008	0.016	0.013
R^2 (within)	0.068	0.121	0.130	0.062	0.117	0.114	0.011	0.025	0.025

Note: OLS with standard errors robust to heteroskedasticity (Huber/White/sandwich standard errors). *p*-values in parentheses ; ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table 4: Investment around federal and state elections

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Investment ratio			Investment plans ratio			Investment revisions		
State election	-0.003*	-0.005***	-0.005***	-0.001	-0.002	-0.002	0.002	0.002	0.002
	(0.076)	(0.004)	(0.003)	(0.354)	(0.392)	(0.190)	(0.124)	(0.175)	(0.154)
Federal election	-0.004**	-0.002	-0.002	-0.003**	-0.003*	-0.004**	0.001	-0.001	-0.002
	(0.019)	(0.197)	(0.235)	(0.046)	(0.088)	(0.013)	(0.639)	(0.285)	(0.199)
Revenue growth		0.008**	0.009**					-0.008***	-0.008***
		(0.022)	(0.013)					(0.004)	(0.003)
Lagged revenue growth					0.008*	0.008**		-0.000	0.002
					(0.054)	(0.037)		(0.942)	(0.444)
Sales expectation		0.006***	0.006***		0.005***	0.006***		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)		(0.967)	(0.829)
UCC growth		-0.012***	-0.009**		-0.011***	-0.020***		0.001	-0.003
		(0.002)	(0.042)		(0.004)	(0.000)		(0.719)	(0.415)
Lagged GDP growth			0.001**						-0.001***
			(0.042)						(0.003)
Second lag of GDP growth						0.002***			0.000
						(0.001)			(0.656)
Linear time trend	-0.001	0.000	0.000	-0.000	-0.000	-0.000	0.001	0.001	0.001**
	(0.515)	(0.885)	(0.992)	(0.948)	(0.815)	(0.726)	(0.282)	(0.124)	(0.046)
Quadratic time trend	-0.000	-0.000**	-0.000*	-0.000*	-0.000	-0.000	-0.000	-0.000	-0.000**
	(0.158)	(0.044)	(0.078)	(0.079)	(0.114)	(0.189)	(0.414)	(0.131)	(0.035)
Fixed time effects	No	No	No	No	No	No	No	No	No
Fixed firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2833	2492	2492	2669	1931	1931	2669	1931	1931
Firms	531	506	506	522	436	436	522	436	436
R^2 (overall)	0.014	0.057	0.058	0.016	0.058	0.065	0.000	0.007	0.010
R^2 (within)	0.049	0.098	0.099	0.042	0.091	0.099	0.002	0.009	0.014

Note: OLS with standard errors robust to heteroskedasticity (Huber/White/sandwich standard errors). *p*-values in parentheses ; ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table 5: System GMM estimations for investment around state elections

	(1) Investment ratio	(2) Investment plans ratio	(3) Investment revisions
State election	-0.004*	-0.001	0.002*
	(0.058)	(0.682)	(0.054)
Lagged investment ratio	0.284***		
	(0.000)		
Lagged investment plans ratio		0.273***	
		(0.000)	
Lagged investment revisions			-0.043
			(0.375)
Revenue growth	0.013*		-0.015**
	(0.071)		(0.042)
Lagged revenue growth		0.008	-0.000
		(0.105)	(0.932)
Sales expectation	0.010***	0.008***	-0.002
	(0.000)	(0.001)	(0.210)
UCC growth	-0.088***	-0.090***	0.011
	(0.000)	(0.000)	(0.556)
Fixed time effects	Yes	Yes	Yes
Observations	1919	1845	1840
Firms	433	417	415
Instruments	199	199	199
AR(1) p-value	0.000	0.000	0.000
AR(2) p-value	0.914	0.229	0.564
Hansen J p-value	0.621	0.556	0.439

Note: System GMM as in Arellano and Bover (1995) and Blundell and Bond (1998). Differences of the explanatory variables serve as instruments for the equation in levels, and lagged levels are used as instruments for the equation in first differences. I assume electoral uncertainty to be exogenous. The other explanatory variables are considered as predetermined. I reduce the number of instruments and thereby avoid potential over-fitting problems by limiting the lags to 1 and 2. I correct t-statistics for small sample bias, using Windmeijer's correction (2005). *p*-values in parentheses ; ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table 6: Investment around regular and early state elections

	(1) Investment ratio	(2) Investment plans ratio	(3) Investment revisions
Regular state election	-0.007***	-0.003	0.003**
	(0.000)	(0.181)	(0.020)
Early state election	0.001	-0.005	-0.015
	(0.928)	(0.435)	(0.104)
Revenue growth	0.010**		-0.008***
	(0.014)		(0.003)
Lagged revenue growth		0.011**	0.002
		(0.014)	(0.387)
Sales expectation	0.006***	0.006***	-0.000
	(0.000)	(0.000)	(0.720)
UCC growth	-0.051***	-0.052***	0.003
	(0.000)	(0.007)	(0.781)
Fixed time effects	Yes	Yes	Yes
Fixed firm effects	Yes	Yes	Yes
Observations	2492	1931	1931
Firms	506	436	436
R^2 (overall)	0.071	0.075	0.018
R^2 (within)	0.121	0.117	0.032

Note: OLS with standard errors robust to heteroskedasticity (Huber/White/sandwich standard errors). *p*-values in parentheses ; ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Table 7: Investment around state elections by investment types

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Investment ratio			Investment plans ratio			Investment revisions		
	Add-on	Rationalization	Replacement	Add-on	Rationalization	Replacement	Add-on	Rationalization	Replacement
State election	-0.014***	-0.005	-0.001	-0.006	-0.002	0.001	0.004	-0.001	-0.000
	(0.001)	(0.210)	(0.567)	(0.158)	(0.637)	(0.795)	(0.302)	(0.587)	(0.966)
Revenue growth	0.012	0.003	0.006				-0.008	-0.001	-0.012***
	(0.334)	(0.624)	(0.165)				(0.468)	(0.851)	(0.001)
Lagged revenue growth				0.030***	-0.001	0.000	0.013	0.002	0.001
				(0.008)	(0.903)	(0.922)	(0.123)	(0.573)	(0.685)
Sales expectation	0.006***	0.004**	0.003***	0.006**	0.003*	0.004***	0.001	-0.000	0.001
	(0.001)	(0.024)	(0.002)	(0.011)	(0.060)	(0.001)	(0.512)	(0.685)	(0.236)
UCC growth	-0.085***	-0.057*	-0.001	-0.040	-0.042	-0.029	0.026	0.001	-0.022
	(0.002)	(0.063)	(0.942)	(0.181)	(0.109)	(0.344)	(0.273)	(0.931)	(0.177)
Fixed time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed firm effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	855	621	957	676	466	747	676	466	747
Firms	285	237	325	240	180	263	240	180	263
R^2 (overall)	0.118	0.032	0.058	0.107	0.028	0.059	0.023	0.053	0.032
R^2 (within)	0.164	0.141	0.131	0.145	0.124	0.117	0.066	0.107	0.056

Note: OLS with standard errors robust to heteroskedasticity (Huber/White/sandwich standard errors). *p*-values in parentheses ; ***, **, and * denote significance at the 1%, 5%, and 10% levels.

Appendix

A.1 Calculation of the UCC and the German corporate tax system

The UCC depends on taxation as earnings from investments are taxed and the tax system provides certain allowances for investment projects. Firms in Germany are subject to various income taxes. The corporate income tax and the solidarity surcharge are federal taxes and are thus the same for all firms and vary only over time. The local business tax is set at the municipality level. I include all three taxes and their interactions in the calculation of the firm-specific statutory tax rate. Table A1 shows the tax parameters employed in the calculation.

Corporate income tax rates declined over the observation period. Fundamental changes in the tax system occurred: Until 2000 the tax-credit method applied to corporate income, but in 2001 the system was replaced by the half-income method (Tax Relief Act 2001). The reform implied the replacement of the two separate tax rates on retained earnings (which varied between 45% and 40%) and distributed profits (30%) by a lower uniform tax rate of 25%.[23] In the corporate tax reform of 2008, the tax rate was further reduced from 25% to 15%. The solidarity surcharge for Eastern Germany was introduced in 1991 and has varied since then between 0% and 7.5%.

The effective local business tax rate at time *t* is given by

$$\tau_{LB} = b \, \frac{c_z}{100}$$

where c_z is the collection rate in percent set in each municipality *z*.[24] I take information on collection rates by municipalities from the German Federal Statistical Office. The basic federal rate b is set at 5% until 2007 and at 3.5% from 2008 on. Until 2007, the local business tax is self-deductible as a business expense. Therefore I divide τ_{LB} by $1 + b \, \frac{c_z}{100}$ for the period 1994-2007. The local business tax payment is deductible from the corporate tax base until 2007. Since 2008 the deductibility of the local business tax was abolished for corporations.

[23] The corporate income tax rate was temporarily increased to 26.5% in 2003.

[24] Collection rates range between 200% and 500%. Some small municipalities even choose values of up to 900%. Since 2004 the statutory minimum level of the collection rate is 200%.

To account for deterioration, the tax system provides depreciation allowances.[25] In Germany depreciation allowance schemes differ by asset types. While property with buildings is depreciated on a straight-line basis, fixed tangible assets could be depreciated according to the declining-balance method until 2007. Firms were allowed to change from the declining-balance to the straight-line method if firms benefited from the second method. The rates of depreciation are set in the German income tax law.

I account for the fact that firms use internal and external funds for investment. Firms' financial costs differ, depending on the source of finance used for an investment project. As preferential tax treatment of debt exists, firms face a cost advantage of using debt. I assume that revenues increase during the time of investment and decline in the next period when debt is repaid (Devereux 2004). I calculate the increase in revenues by $(1-\tau\psi)$. When debt obligations are repaid, profits reduce by $\frac{((1-\tau)*i-\rho)}{(1-\tau)*(1+\pi)}$. The two terms together capture the reduction in the UCC which arises from the deductibility of interest payments. I weigh the whole term with a firm's debt-to-capital ratio λ. The overall UCC is weighted by the cost of retained earnings and the cost of debt.[26]

[25] There is no investment tax credit in Western Germany.

[26] I only distinguish between two sources of finance: retained earnings and debt. I do not account for new equity as a third source of finance as suggested by King and Fullerton (1984). New equity as a source of finance plays a negligible role for the firms in the sample.

Table A1: Corporate tax parameters

Year	Corporate income tax rate on retained (distributed) profits in %	Solidarity surcharge in %	Avg. collection rate for local business tax in %	Avg. local business tax rate in %
1994	45 (30)	0	372	18.60
1995	45 (30)	7.5	376	18.80
1996	45 (30)	7.5	383	19.15
1997	45 (30)	7.5	387	19.35
1998	45 (30)	5.5	390	19.50
1999	40 (30)	5.5	389	19.45
2000	40 (30)	5.5	389	19.45
2001	25	5.5	385	19.25
2002	25	5.5	386	19.30
2003	26.5	5.5	387	19.35
2004	25	5.5	388	19.40
2005	25	5.5	389	19.45
2006	25	5.5	391	19.55
2007	25	5.5	389	19.45
2008	15	5.5	388	13.58
2009	15	5.5	387	13.55
2010	15	5.5	390	13.65
2011	15	5.5	392	13.72
2012	15	5.5	393	13.76

Note: Separate corporate income tax rates for retained earnings and distributed profits (in brackets) existed until 2000. Since 2001, both rates are replaced by a uniform corporate income tax rate. In 1994 no solidarity surcharge existed. The average municipal collection rates are taken from the Federal Statistical Office. The average local business tax rate is given by $\tau_{LB} = b \frac{c}{100}$ where b is 5% until 2007 and 3.5% from 2008 on and c is the unweighted average collection rate of all municipalities in a given year.
Source: Corporate Income Tax Act, Solidarity Surcharge Act, Trade Tax Act, Federal Statistical Office: Fachserie 14 Reihe 10.1, own calculations.

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