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Sebastian Eichfelder, Kerstin Schneider

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How do tax incentives affect business investment? Evidence from German bonus depreciation

Sebastian Eichfelder, University of Magdeburg

Kerstin Schneider, University of Wuppertal and CESifo*

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Abstract

We analyse how tax incentives in the form of accelerated depreciations (‘bonus depreciation’) affect business investment. By exploiting exogenous variation in tax regulation of a regional bonus depreciation program in the former East Germany, we identify and quantify the impact from bonus depreciation on building and equipment investments at the extensive and intensive margins in the German manufacturing industry. We observe a stronger response for building investments and from large firms. There is only weak evidence of subsidy shopping but stronger evidence of investment shifting to years with more generous bonus depreciation regulations.

Keywords: bonus depreciation, tax incentive, business taxation, heterogeneity

JEL classification: G11, H25, H32, M41

* Email: sebastian.eichfelder@ovgu.de; schneider@wiwi.uni-wuppertal.de, Gaußstr. 20, 42119 Wuppertal, Germany

The effect of taxes and tax incentives on business investment has been on the research agenda of economists for decades (e.g. Auerbach and Hassett, 1992). The question has significant relevance for policy measures in a recession as countercyclical fiscal policy typically relies on accelerated depreciations, investment tax credits, and other forms of investment tax incentives to support economic growth. Further, many OECD countries have frequently used tax instruments to encourage investment (Maffini *et al.*, 2016).

Neo-classical investment theory suggests that investment tax incentives have a positive effect on capital formation (Hall and Jorgenson, 1967; Summers, 1981; Hayashi, 1982). However, empirical identification of the causal effect of tax incentives on investment is challenging, partly because countries implement such policies in periods of economic downturn, thus, inducing endogeneity. Moreover, there is a lack of research explaining the heterogeneity of investment responses (Edgerton, 2010; Zwick and Mahon, 2017). Since average estimates can mask large cross-sectional variations, it remains unclear which types of firms and investments are most responsive to tax policies. In addition, while theoretical research discusses the relevance of taxes for the timing of investments (e.g. Dixit and Pindyck, 1994; Niemann and Sureth, 2004), empirical evidence on that topic is scarce. House and Shapiro (2008) argue theoretically that firms reschedule investments for long-lived capital goods in order to maximise the benefits from temporary investment tax incentives.

This paper contributes to the literature on the effect of accelerated depreciations on investments ('bonus depreciation'). While most studies find positive investment effects from bonus depreciation, the effectiveness of such programs is still under debate (e.g. the discussion in Ohrn, 2017).[1] We interpret a large-scale regional German investment tax incentive program as a natural experiment to empirically analyse if and to what extent bonus depreciation affects investments at the extensive and intensive margins. After German reunification, German policy

[1] Key (2008), House and Shapiro (2008), Edgerton (2012), Maffini *et al.* (2016), Zwick and Mahon (2017), Ohrn (2018*a*), and Wielhouwer and Wiersma (2018) provide evidence for a positive effect of bonus depreciation on investment. Cohen and Cummins (2006), Dauchy and Martinez (2008), Hulse and Livingstone (2010), and Edgerton (2011) do not find corresponding evidence.

was committed to supporting the rapid economic convergence of the former East and West Germany. In July 1990, Chancellor Helmut Kohl made his famous promise of ’flourishing landscapes’. However, it did not take long to realise that convergence would not happen automatically (Sinn and Sinn, 1993). Hence, policy measures were designed to create tax incentives for investments in the eastern German states. The two main policy instruments were the Development Area Law (DAL, *German: Fördergebietsgesetz*) and the Investment Subsidy Law (ISL, *German: Investitionszulagengesetz*). Unlike bonus depreciation policies in the U.S. (e.g. Ohrn, 2018*a*), DAL was unique in that it granted a bonus depreciation of up to 50% for both equipment *and* building investments. The ISL supported investments through direct and tax-exempt subsidies.

We identify the impact of the German DAL on investments in the manufacturing sector using difference-in-differences (DiD) estimation at the establishment level. We consider subsidised establishments in the former East as the treatment group and non-subsidised establishments in the former West as the control group and compare investments in the DAL treatment period (1995–1998) with investments in the period *after* expiration of the DAL (1999–2008). Thus, differing from standard DiD estimation, we compare the treatment period with the post-treatment period. At the beginning of the 1990s, industrial establishments in the former East were largely owned by the state, a legacy of the former socialist system. During the rapid transition process of the eastern German states, almost all industrial establishments were either privatised or liquidated by the end of 1994.[2] In 1995, the first year in our sample, the vast majority of establishments in the eastern German states were owned by western German firms.[3] Establishments in the East, therefore, competed with establishments in the western part of

[2] The *Treuhandanstalt* (THA) (the privatisation agency for the former East) rapidly privatised the industrial base of the former East Germany in the first years of the 1990s and basically completed the process by 1994 (Paqué, 2009, p. 46). In 1992, 1993, and 1994, 73.5%, 88.8%, and 95.4% of the stock of all *Treuhand* firms in 1994 (12,926 firms) had been either privatised or liquidated (BvS, 2003, p. 399). For more details on the transition and the THA privatisation see also Howard (2001).

[3] The main privatisation strategy of the THA was to find an experienced and established western German or international firm, while management-buy-outs were a secondary alternative (Paqué, 2009, p. 47f.). As the fraction of international investors was only about 6%, experienced firms in the former West were by far the most relevant investor group (BvS, 2003, p. 58).

Germany. Thus, we expect western German establishments to be an appropriate control group for the treated eastern German establishments.[4]

We find a positive and significant impact from the DAL on investments at both the extensive and intensive margins and estimate a range for the average treatment effects on the treated of 1.7–9.9% for equipment investment and 90.2–126.7% for building investment. Thus, we find a much stronger investment reaction for buildings—which have long standard depreciation periods—as compared to equipment. Of course, a significant part of the investment response for buildings might be due to a temporal shifting of building investments from the DAL post-treatment period to the DAL treatment period, which is in line with House and Shapiro (2008). The strong investment response for buildings rules out potential concern that our findings might be due to the privatisation and transition process of the economy in the eastern German states. In this case, we would expect a rather strong response in equipment investment to replace the outdated 'communist-era' machinery of establishments in the former East; this has also been documented in previous research (for more details on this see Paqué, 2009).[5]

We also find a much stronger investment response from medium and large firms (155.0% for building investments, 25.1% for equipment investments) as compared to small firms with 250 staff members or less (79.2% for building investments, 1.5% for equipment investments). In our view, this results from tax complexity, which affects economic decision-making (e.g. Zwick, 2018) and investment planning. Due to economies of scale in tax planning and tax compliance (Eichfelder and Vaillancourt, 2014), the burden of tax complexity is much larger

[4] Note that our approach does not require identical economic conditions in both parts of Germany, since we control for the district-level economic situation, which can affect investment activity. We also account for differences in cross-sectional characteristics using establishment fixed effects, year-fixed effects, industry-year fixed effects, and establishment controls and we rely on propensity score matching techniques to increase the similarity between the treatment and control groups. Graphical analyses provide compelling evidence for common trends in the investment activity of both groups in the post-DAL period—our reference point. We conclude that pre-matched establishments in the former West are an appropriate control group for the identification of causal DAL treatment effects.

[5] As the equipment of the East German industry was outdated at the beginning of the 1990s, new investors typically as a first step renovated the machinery park as part of their privatisation (Paqué, 2009, p. 51). Note that average investments in equipment in our data are much higher than investments in buildings (Table 3).

for SMEs. Therefore, as tax planning is more costly for small firms, we expect there to be less of an incentive for them to consider the DAL and ISL changes in their investment decisions.

Finally, we address the timing of investments in response to the DAL. We find a stronger investment reaction in the years with the highest bonus depreciation rate (50%) as compared to the years with the lower rate of 40%. Thus, a moderate reduction in the bonus depreciation rate leads to a 42.6% decline in investment response (i.e. abnormal investments) for buildings and 81.1% for equipment. This finding is consistent with the view that firms retime long-term investments to benefit from higher subsidies (House and Shapiro, 2008). However, we do not find an abnormal reduction of investment activity in 1999—the post-DAL year—due to investment shifting as suggested by Edge and Rudd (2010). Moreover, there is only weak evidence for stronger reactions by multi-establishment firms. This finding indicates that subsidy shopping for these types of firms is only of limited relevance.

Our work differs significantly from previous research and contributes to the literature in a number of ways. First, we use an exogenous policy variation, which provides us with a strong identification strategy for the causal impact of bonus depreciation policies on investment. More specifically, our analysis uses the variation in depreciation benefits between regions and across time. Relying on propensity score matching, we establish a control group, with a common trend in the post-treatment period, which allows for a causal interpretation of our results. By contrast, most existing studies use the variation in the standard depreciation period of different asset types measured on the industry level (e.g. Desai and Goolsbee, 2004; Edgerton, 2010), making their findings vulnerable to industry-specific shocks.

Second, as we have access to detailed establishment level data regarding types of investment, we are the first to estimate the impact of bonus depreciation on asset structures. We find a stronger investment response for buildings as compared to equipment. Thus, bonus depreciation seems to be especially favourable for promoting investments in long-term assets with long standard depreciation periods, as has been argued in the theoretical literature. While most studies use the industry level variation in tax benefits for different assets to identify the investment reactions of firms, empirical evidence for a stronger investment response for assets with long standard depreciation periods is still missing. In this paper, we provide such evidence. Third, apart from Zwick and Mahon (2017), we are the first to address heterogeneity in the investment response between larger and smaller firms. Zwick and Mahon (2017) focus on the additional liquidity of bonus depreciation and find a stronger reaction from small firms (which typically have higher capital constraints) as compared to medium and large firms. By contrast, we focus on tax complexity and argue that the complex and time-varying regulations defining the DAL and the ISL imposed a high planning and compliance burden, which made it harder for small firms to reap those benefits. Thus, medium and large firms with relatively small planning costs reacted considerably stronger to tax policy as compared to small firms. The apparent discrepancy between our findings and those of Zwick and Mahon (2017) can be explained by differences in the data and the empirical settings. In Germany, tax policy changes in 1999 affected both the DAL and the ISL, resulting in a complex planning problem. Thus, tax complexity is an important factor in our analysis, while in the Zwick and Mahon (2017) setting, firm level liquidity constraints play a more important role. In addition, the definition of small firms differs between the two studies. Small firms in our analysis do not have more than 250 staff members. This is in accordance with the EU definition of SMEs but different from the definition used in Zwick and Mahon (2017).[6] As a consequence, the small firms in the present paper tend to be smaller than the small firms in Zwick and Mahon (2017). Considering the large economies of scale in tax planning, this implies a stronger relevance of tax complexity in our setting. Our findings of weaker investment reactions from small firms suggest that tax complexity is an important matter to be considered for the effectiveness of tax incentive

[6] Zwick and Mahon (2017) define small firms as the smallest 30% of firms with regard to sales revenue in their sample. Since the average investment in their sample substantially exceeds the values in our data (6.8 m$ compared to 1.3 m€ per establishment and 3.1 m€ per firm in our data), we conclude that the small firms in Zwick and Mahon (2017) are in fact larger than the small firms in our analysis.

programs. This is consistent with evidence from Knittel (2007) and Kitchen and Knittel (2011) on lower take-up rates of bonus depreciation by small firms in the U.S.

Fourth, we contribute to the literature on the timing of investments (House and Shapiro, 2008; Edge and Rudd, 2010). Our findings suggest that a relevant part of the investment response could result from a retiming of already planned investments as opposed to the initiation of additional investments. This could explain the high elasticity estimates in the literature on temporary investment tax incentives (e.g. House and Shapiro, 2008; Maffini *et al.*, 2016; Zwick and Mahon, 2017), which range from 6 to 14. By contrast, estimates for the elasticity of investments to the user cost of capital are typically much lower and range from 0.25 to 1 (e.g. Auerbach and Hassett, 1992; Cummins *et al.*, 1994; Chirinko *et al.*, 1999; Bond and Xing, 2015). In contrast to Edge and Rudd (2010), we do not find an investment pothole in 1999. This is consistent with a model where investment decisions are sticky and their implementation can be delayed by unforeseen events.

We structure our paper as follows. Section 1 describes the German DAL and ISL investment tax incentives. Section 2 introduces the theoretical framework and derives the hypotheses. We describe the identification strategy and the data in Section 3. Section 4 presents the results, and Section 5 concludes. Online appendices A to F provide detailed information about the calculation of DAL benefits and variables, additional analyses, and robustness checks.

1. Development Area Law and Investment Subsidy Law

Soon after German reunification in 1990, it became apparent that the economic recovery of the former East Germany was stagnating and that the economic convergence of the former East and West Germany would not happen in the short term. Hence, fiscal policy was designed to increase incentives for investing in the eastern states. While economists argue that subsidies for equipment investment can reduce tax distortions (Judd, 1999) and stimulate growth (De Long and Summers, 1991), German policy response also subsidised building investments. The two major policy measures were the DAL and the ISL, two of the most costly German subsidies of the 1990s. For instance, in 1996 the DAL and ISL ranked first and third among all tax incentive programs with tax revenue losses of €4.7 billion and €1.3 billion, respectively. We outline the relevant regulations for the manufacturing industry.

After December 1990, the DAL bonus depreciation could be declared in the annual tax return for investments in the five eastern German states (Brandenburg, Mecklenburg-West Pomerania, Saxony, Saxony-Anhalt, and Thuringia) and Berlin. It allowed for a 50% bonus depreciation of the invested amount, provided that no other special depreciation schemes had been used (e.g. the declining balance method). The remaining 50% of book value was depreciated using the linear method with standard tax depreciation periods. The bonus depreciation could also be freely allocated over the first five years following the investment. The program was planned to expire at the end of 1996. However, in October 1995 a modification was enacted to extend the program until December 1998. Under the modification, the maximum bonus depreciation was reduced to 40% for investments in 1997 and 1998. The bonus depreciation was not restricted to specific industries or business types and was available for movable assets (with the exception of aircraft) and investments in structures including the modernisation of buildings.

The ISL was enacted at the same time as the DAL and expired at the end of 2013. It granted direct tax-exempt subsidies for businesses in the five eastern German states and Berlin. The standard subsidy rate was 12% in 1991 but after June 1994 it was lowered to 5% (10% for businesses with no more than 250 staff members and investments of up to €2.6 million). The ISL was initially planned to expire at the same time as the DAL; however, on August 18, 1997 the German legislature enacted 'ISL 1999' to prolong and adjust the program. The ISL 1999 raised the general subsidy rate to 10% and extended the program to building investments. For small firms with no more than 250 staff members, there was an increased subsidy rate of 20% for equipment investments but not for building investments. This increased rate should have partially compensated for the expiration of the DAL. Due to European anti-subsidy regulations, the increased rate and the ISL subsidies for buildings were only applicable for 'initial' investments (*German: Erstinvestition*), including the foundation or extension of an establishment, major modifications of products and production methods, and the acquisition of a business that would otherwise have been liquidated. Amendments to ISL 1999 increased subsidy rates to 12.5% (25% for small firms) for initial investments after 1999. For non-initial but fundable investments, the subsidy rates were 5% for large and 10% for small firms.

Compared to the DAL, the ISL assessment base was smaller and funding criteria were more rigorous. Before 1999, ISL subsidies were restricted to new movable assets with some exceptions (no low-value assets, cars, or aircrafts). After 1999, ISL subsidies were expanded to building investments, but only in the case of initial investments. Moreover, ISL funding required a formal application, which resulted in higher compliance costs. We give an overview of the most relevant regulations for both programs in Table 1.

[Table 1 about here]

Figure 1 shows the volumes of DAL and ISL subsidies measured as the annual losses in tax revenue and as the total present value of tax revenue losses. Note that the main effect from the DAL is the deferral of tax liability to the future, as higher depreciations in earlier periods reduce the potential for future depreciations. This is different for ISL, where subsidies are cash-based payments. Thus, the present value of both programs is the appropriate measure for the comparison of subsidy volumes (for computational details see Online Appendix A). As shown in Figure 1, after the DAL expired in 1999, the aggregate subsidy volume declined considerably.

[Figure 1 about here]

2. Theoretical Framework and Hypotheses

The seminal work of Hall and Jorgenson (1967) presents the framework for the impact of tax policy on business investments. According to their model, taxes and tax incentives have an impact on the effective cost of capital, expressed as the user cost of capital. Abstracting from adjustment costs, the user cost of capital is (e.g. Cohen *et al.*, 2002; Devereux and Griffith, 2003):

$$C_t = \phi_t \cdot T_t \cdot \left[\rho_t + \delta_t - E\left({}^{\Delta\phi_t}/_{\phi_t}\right)\right], \tag{1}$$

with φ_t representing the price level, ρ_t the after-tax cost of funds, and δ_t the physical rate of depreciation at time *t*. $E\left(\Delta\varphi_t/\varphi_t\right)$ describes expected changes in the price of capital goods. Therefore, $\delta_t - E\left(\Delta\varphi_t/\varphi_t\right)$ is the expected net rate of depreciation (Auerbach, 1983). The tax term is defined as

$$T_t = (1 - \tau_t \cdot Z_t - s_t)/(1 - \tau_t), \tag{2}$$

where τ_t is the tax rate on profits, s_t is the rate of direct subsidies (in our case ISL benefits), and Z_t is the present value of depreciation allowances per € invested. As we analyse the effect of taxes and subsidies in the former East relative to the West, we focus on the relative user cost of capital, RC_t, which we define as

$$RC_t = {C_t^E}/{C_t^W} = \frac{\phi_t^E \cdot T_t^E \left[\rho_t^E + \delta_t^E - E\left(\frac{\Delta\phi_t^E}{\phi_t^E}\right)\right]}{\phi_t^W \cdot T_t^W \cdot \left[\rho_t^W + \delta_t^W - E\left(\frac{\Delta\phi_t^W}{\phi_t^W}\right)\right]}. \tag{3}$$

C_t^E and C_t^W denote the user cost of capital in the East and the West, respectively. To simplify Eq. (3), we assume that the physical rate of depreciation does not depend on the location of an asset, hence, $\delta_t^E = \delta_t^W$. Considering the low transportation costs and the high degree of economic integration (e.g. in the financial market) in Germany, we abstract from differences in the pre-tax price level and in the after-tax cost of funds ($\varphi_t^E \approx \varphi_t^W$, $\rho_t^E \approx \rho_t^W$). Note that the German Federal Statistical Office does not publish regional price statistics for equipment, and regional differences in building prices are small (cf. Table A.1 in the Online Appendix). This leaves us with the effective relative tax burden of the East versus the West

$$RT_t = \frac{1-\tau_t^E \cdot Z_t^E - s_t^E}{1-\tau_t^W \cdot Z_t^W - s_t^W} \cdot \frac{1-\tau_t^W}{1-\tau_t^E}. \tag{4}$$

Smaller values of RT_t indicate higher relative tax benefits or a lower tax burden for investments in eastern German states. Note that tax rates τ_t^E and τ_t^W are not identical, since we compute average tax rates for East and West German corporations and partnerships and account for varying local business tax rates (*German: Gewerbesteuersätze*). In Table 2, we document the relative tax burden for six asset classes between 1995 and 2005 (for computational details see Online Appendix B). We abstain from providing information on the following periods (2006 to 2008) with no relevant tax law changes.

[Table 2 about here]

Table 2 shows that during the time period studied, the tax burden is lower in the eastern German states but significantly increases for most asset classes in 1999 and thereafter, just after the abolishment of the DAL. Similar to Figure 1, Table 2 shows that, with one exception, the ISL did not compensate for the expiration of the DAL. We observe an increase in the RT_t values for five classes of investments after the expiration of the DAL in 1998. For initial equipment investments, we find lower RT_t values, as ISL rates for such investments increased significantly after 1998. The reduction in the relative tax burden for initial equipment investments is moderate for large firms but stronger for small firms.[7] In all other cases, the relative tax burden from the abolishment of the DAL outweighs the changes in the ISL subsidy rates. Since the DAL reduced the average user cost of capital (Table 2), we hypothesise abnormally high investments in treated establishments. Our first hypothesis is:

H1: *DAL increased business investment in establishments in the eastern German states.*

[7] Taking into account the increase in RT_t for initial equipment investments and the reduction of RT_t for non-initial equipment investments and for non-fundable equipment investments, the average treatment effect on equipment investments is not entirely clear. However, a number of facts support the view that the tax law changes in 1998/1999 increased the average user cost of capital for equipment. (1) The ISL 1999 overcompensated expiration of the DAL for a narrowly defined category of initial equipment investments. Thus, a wide array of equipment investments did not benefit from this policy change. (2) The aggregate level of ISL subsidies for equipment investments following the expiration of DAL (€665m in 1999 and €891m in 2000) did not differ significantly from corresponding payments in preceding periods (€907m in 1997 and €645m in 1998) (see German Federal Government, 1995–1999; German Federal Ministry of Finance, 2001–2010). This suggests that after 1999, the increased ISL subsidy rates for initial investments were only relevant for a small fraction of equipment investments. (3) Compliance costs of the ISL subsidies are higher as compared to the 'simple' DAL program. This reduces the benefits of the increased ISL subsidy rates for initial equipment investments.

Further, we address the heterogeneity of the investment response. Table 2 documents a much stronger DAL tax incentive for building investments with longer standard depreciation periods. Thus, we expect especially high building investments during the DAL treatment period in the former East, which leads to our next hypothesis:

H2a: *DAL had a stronger effect on building investments.*

Table 2 shows that the expiration of DAL had a stronger effect on the user cost of capital for equipment investments of large firms. This suggests a stronger investment response as large firms did not benefit from the increased ISL rates (of up to 25%) that small firms received. However, this argument holds exclusively for investments in equipment and not for investments in structures.

A second argument for a larger investment response of large firms is tax complexity. Tax planning is complex and costly, with the marginal costs of tax planning and compliance decreasing in firm size (Gunz *et al.*, 1995; Richardson and Lanis, 2007). The combined planning and compliance costs as a fraction of sales revenue can be 10-times or even 100-times larger for small firms than for large firms (Eichfelder and Vaillancourt, 2014). Therefore, larger firms tend to spend more resources on tax planning and the optimisation of tax benefits. In line with that argument, Knittel (2007) and Kitchen and Knittel (2011) observe low take-up rates of bonus depreciations and accelerated depreciations by small U.S. businesses. We hypothesise:

H2b: *The DAL had a stronger effect on investments of large firms.*

An interesting issue is the opportunity for 'subsidy shopping'. If adjustment costs are low, investments can be shifted between different firm establishments in order to receive a higher benefit. We assume that investment adjustment costs are lower for multi- than for single-establishment firms as a consequence of their opportunities for investment shifting. We expect more subsidy shopping and a stronger investment response by multi-establishment firms:

H2c: *The DAL had a stronger effect on investments of multi-establishment firms.*

H1 to H2c refer to the average DAL effect over the entire treatment period. We further test how the DAL affected the timing of investments. As noted earlier, the DAL bonus depreciation rate was reduced from 50% in the years 1995 and 1996 to 40% in the years 1997 and 1998. We expect that the reduction of the DAL bonus depreciation rate resulted in a backdating of investment activity, which reduced investments in 1997 and 1998. This leads to our next hypothesis:

H3a: *The DAL had a smaller effect on investments in 1997—1996.*

According to the model of Edge and Rudd (2010), the expiration of a temporary investment tax incentive results in an investment pothole in the post-treatment year if adjustment costs are low and prices are sticky. The reason is that firms antedate investments in order to maximise the subsidy benefits. This fits well with House and Shapiro (2008), who use a similar argument. Following this argumentation, we hypothesise a reduction of investment activity in the year after the expiration of the DAL:

H3b: *The expiration of the DAL resulted in a reduction of investments in 1999.*

3. Identification Strategy and Data

3.1. *Identification Strategy*

We interpret the expiration of the DAL as a natural experiment. Since establishments in the western German states were not subsidised, we use them as a control group and identify the DAL effect using a difference-in-differences (DiD) estimation. An important advantage for our identification strategy is that the DAL bonus depreciation applied to almost all types of investments in the eastern states. It was not necessary to apply for DAL or to actively ‘self-select’ into the DAL program. Hence, self-selection should be of minor concern in our setting. In order to fulfil the prerequisites of DiD estimation as a valid identification strategy, we need to consider the stable unit of treatment assumption (SUTVA) and the common trends assumption. SUTVA requires that the DAL treatment does not affect the control group.

A potential concern in our analysis is that investments in western German establishments are merely redirected to establishments in the former East in order to maximise subsidy benefits (subsidy shopping). There are a number of reasons why such concerns regarding SUTVA should be of minor relevance. First, due to the larger size and predominance of the economy in the western states during the period of our study, aggregate investments in eastern Germany are only about 17% of the total investments in the former West (see also Table A2 in the Online Appendix). Thus, even if investments in the East substituted investments in the West, the effect on investments of western German establishments would have been small. Second, in addition to substituting investments in the former West Germany, there are other channels of investment activity including additional investments, diverting investments from other countries, and also the retiming of investments to benefit from the DAL. Third, in Section 4.2., we do not find any empirical evidence for investment shifting of multi-establishment firms. Thus, even for firms with the strongest opportunity of substituting investments in western establishments by investments in eastern establishments (subsidy shopping), there is no corresponding evidence. This underlines our argument that SUTVA is no matter of concern for our difference-in-differences estimation.

Regarding the common trends assumption, a potential concern might be differences in the economic development of the eastern and the western states. Note that our units of observation are business establishments in the manufacturing sector. Thus, our analysis does not require a common trend of both parts of Germany but, rather, a common trend in the investment activity of establishments in the manufacturing sector in both parts of Germany. As mentioned above, establishments in the former East in the middle of the 1990s were typically owned by West German firms. Thus, they competed with West German firms, and had access to the same production technologies. Nevertheless, we also observe differences in the observable characteristics of establishments (e.g. establishments in the former East are, on average, smaller) and economic conditions (e.g. higher unemployment rates in the East) of our treatment group and our control group. We account for these differences in three ways. First, we control for time-invariant differences between East and West German establishments using establishment fixed effects, α_i. Second, we capture differences in capital stock, productivity, and general economic conditions in the region (e.g. unemployment rates, GDP per capita) using a set of control variables, X_{it}. To account for economic shocks, we include year fixed effects, φ_t, and industry-year fixed effects, θ_{it}. Third, we apply propensity-score matching techniques to generate a pre-matched sample of similar establishments in the West to use as our control group. Provided that our results support the common-trends assumption for the post-DAL period (Section 3.2.), we test H1 by estimating our baseline model

$$I_{it} = \beta_0 + \beta_1 \cdot DiD_{it} + \gamma \cdot X_{it} + \alpha_i + \varphi_t + \theta_{it} + u_{it}. \tag{5}$$

We use four alternative dependent variables, I_{it}, for investments at the extensive and intensive margin of establishment *i* at time *t*. We measure I_{it} using either a dummy variable indicating whether a firm has invested or not (extensive margin) or using the logarithm of (positive) investment volume (intensive margin). In both specifications, we distinguish between building investment and equipment investment. Similar to Zwick and Mahon (2017), we rely on the logarithm of investment and not on investment scaled by capital stock to measure investment at the intensive margin. This can be justified on two grounds: First, the data provides no information on capital stock at the establishment level. Therefore we construct our proxy for K_{it} using information on depreciations and investments on the firm and establishment level (see Online Appendix C). If there is measurement error in the scaling variable, K_{it}, this introduces a non-additive measurement error into the dependent variable. Second, using a logarithmic specification addresses the highly skewed distribution of the investment variables (Table 3) and allows us to interpret our results as elasticities. In robustness tests (not reported), we also test a scaled specification of investment with qualitatively similar results.

Our variable of interest is DiD_{it}, which is the interaction term of a dummy variable for establishments in eastern Germany and a dummy for the DAL treatment period. DiD_{it} has a value of one if establishment *i* is in an eastern state, and the observation is before 1999. In Eq. (5), we identify the average treatment effect on the treated using β_1. Since year and establishment fixed effects are included, the dummy variables $East_i$ and $Before99_t$ are redundant. On the establishment level, our vector of controls, X_{it}, includes the logarithm of the capital stock from the preceding period, K_{it-1}, as a proxy for capital endowment. We proxy the investment potential using the ratio of revenue to the capital stock of the previous period, R_{it}/K_{it-1}. The ratio R_{it}/K_{it-1} also serves as a measure for capital constraints, since revenue is positively correlated with cash flow and cash flow is a common proxy for capital constraints (Hadlock and Pierce, 2010). Controlling for economic conditions on the district level, we also consider the unemployment rate (in percentage points), the logarithm of the price-adjusted GDP per capita, and the logarithm of the population in a district. These variables capture the major differences in economic conditions between different regions and parts of Germany.

To test H2a, which suggests a stronger DAL effect on building investments, we use the ratio of building investments to total investments as an additional dependent variable (*Building investment share*). To test hypotheses H2b and H2c, we add triple difference interaction terms, $DiD\ large_{it}$ and $DiD\ group_{it}$. $DiD\ large_{it}$ is an interaction term of DiD_{it} and a time-varying dummy variable for large firms. $DiD\ Group_{it}$ is an interaction term of DiD_{it} and a time-varying dummy variable for multi-establishment firms ($Group_{it}$). This allows differentiating the effects for large versus small firms and multi-establishment versus single-establishment firms. In addition, we add firm-type-year fixed effects, ω_{it}, to control for type-specific shocks and trends (e.g. a common trend for higher investments of large firms after 1999). Similar to industry-year fixed effects, we define firm-type-year fixed effects, ω_{it}, as a set of dummy variables for each combination of a firm type and year. Hence, we formulate the second model as

$$I_{it} = \beta_0 + \beta_1 \cdot DiD_{it} + \beta_2 \cdot DiD\, large_{it} + \beta_3 \cdot DiD\, group_{it} + \beta_4 \cdot Large_{it} + \beta_5 \cdot Group_{it}$$
$$+ \gamma \cdot X_{it} + \alpha_i + \varphi_t + \omega_{it} + \theta_{it} + u_{it}. \quad (6)$$

In Eq. (6), β_1 captures the average DAL effect, while β_2 and β_3 capture the additional effects from large and multi-establishment firms. Thus, the overall effect for large (multi-establishment) firms is the sum of β_1 and β_2 (β_3).

To test the hypotheses concerning the timing of investments, H3a and H3b, we extend the model by using DiD interaction terms for the periods 1997–1998 and 1999 in Eq. (7). As we also include DiD_{it} for the entire DAL period 1995–1998, we estimate the average treatment effect for the period 1995–1998 using the coefficient β_1. The coefficients β_2 and β_3 capture the effects for the periods with reduced subsidies and the year after the expiration of DAL.

$$I_{it} = \beta_0 + \beta_1 \cdot DiD_{it} + \beta_2 \cdot DiD\, 9798_{it} + \beta_3 \cdot DiD\, 99_{it} + \beta_4 \cdot DiD\, large_{it} + \beta_5 \cdot DiD\, group_{it}$$
$$+ \beta_6 \cdot Large_{it} + \beta \cdot Group_{it} + \gamma \cdot X_{it} + \alpha_i + \varphi_t + \theta_{it} + \omega_{it} + u_{it}. \quad (7)$$

3.2. *Data, the Common Trends Assumption, and Matching*

Our analysis uses the German AFID panel (*German: Amtliche Firmendaten in Deutschland*) for the manufacturing and mining industries from 1995–2008, which includes a number of mandatory business surveys conducted by the German Federal Statistical Office. The data can be accessed by remote data processing (Malchin and Voshage, 2009). The surveys used in this analysis are the Investment Survey, the Monthly Report, and the Cost Structure Survey for the manufacturing and mining industries.[8] The Cost Structure Survey is based on a stratified random sample of German firms in the manufacturing and mining industries with at least 20 staff members including managers and working business owners. The Investment Survey and the Monthly Report are both a census of business establishments with at least 20 staff members. While the Cost Structure Survey reports data on the firm level, the Investment Survey and the

8 In German: *Investitionserhebung bei Betrieben des Verarbeitenden Gewerbes sowie der Gewinnung von Steinen und Erden*; *Monatsbericht bei Betrieben des Verarbeitenden Gewerbes sowie der Gewinnung von Steinen und Erden*; and *Kostenstrukturerhebung bei Unternehmen des Verarbeitenden Gewerbes sowie der Gewinnung von Steinen und Erden*.

Monthly Report provide information on the establishment level. We also collect data on the district level (GDP per capita, population, unemployment rate) from RegioStat to control for regional economic conditions.[9] Hence, we have a comprehensive panel of establishments covering the period between 1995 and 2008.

Compared to firm panels from Compustat or AMADEUS, AFiD has clear advantages and some disadvantages, as well. Unlike accounting data, the Investment Survey provides very detailed information on the establishment level, which is crucial for our analysis, as we need corresponding data for a clear identification of DAL-treated investments. However, there is no explicit information on capital stock. Therefore, extending the approach of Wagner (2010), we estimate capital stock on the establishment level using information from the Cost Structure Survey (Online Appendix C). Another important advantage of our data is the detailed information regarding equipment and building investment, which is necessary for testing H2a. Finally, unlike financial accounting data, AFiD uses a confidential and mandatory survey of all business establishments in the manufacturing sector with at least 20 staff members, which reduces concerns for self-selection, missing information, and misreporting (e.g. earnings management in financial accounts).

The data comprises 691,822 establishment observations. Due to the special status of the Berlin area (see Table 1), we omit the 13,394 observations located in Berlin. We also drop 21,019 observations of mining companies. Finally, we drop 64,262 observations with incomplete information on our primary variables of interest (e.g. resulting from business restructurings). After these adjustments, our sample comprises 593,147 observations over 14 years (cf. Table A2 in the Online Appendix). Note that due to M&A and other forms of restructuring, a single establishment may be owned by more than one firm over the time period studied.

We price-adjust the data on investments, sales, and capital stocks. As the German Federal Statistical Office does not report regional producer price indices, we use the German producer

[9] https://www.destatis.de/DE/Publikationen/Thematisch/Regionales/Regiostatkatalog.html.

price index for the manufacturing industry (German Council of Economic Experts 2011, p. 409). Building prices, however, depend on local economic conditions. Since a regional subsidy like bonus depreciation can affect regional prices (Goolsbee, 1998; House and Shapiro, 2008), we use state-level building price indices for the manufacturing industry to control for price differences for building investments.[10]

The DiD estimator is contingent on the validity of the common trends assumption. In our study, the natural experiment takes place at the beginning of the sample period (1995–1998). Thus, we cannot test for a pre-treatment common trend. However, if the trends from both samples remain stable over time, a common trend in the post-treatment period after 1999 is an indicator that the common trends assumption holds. To test for common trends in the post-DAL period, we compare the logarithm of building and equipment investments (plus one additional unit to avoid undefined values) for the treatment and control groups from 1995–2008. To account for cross-sectional differences between establishments, we demean all variables using the average post-treatment-period value. Recall that we include establishment fixed effects in Eq. (5) to (7). Thus, demeaning fits our regression approach well.

Figure 2 shows the average price-adjusted and demeaned building and equipment investments for the full sample of establishments in the East and the West. For equipment investments, we observe common trends after 2000. However, the figure suggests that time trends of building investments do not fully converge in the post-treatment period. Thus, the unmatched sample of all establishments in western Germany might not be a suitable control group in the case of building investments.

[Figure 2 about here]

[10] Corresponding price indices are provided by the statistical offices of ten major federal German states. The state of Berlin has been excluded from our data. For the remaining five states (Bremen, Hamburg, Mecklenburg-West Pomerania, Rhineland-Palatinate, and Schleswig-Holstein), we rely on average building price indices for the western and the eastern German states. These average price indices are calculated using the average of existing GDP-weighted price indices for states in the former West (Baden-Württemberg, Bavaria, Hessen, Lower Saxony, North Rhine-Westphalia and Saarland) and in the former East (Brandenburg, Saxony, Saxony-Anhalt and Thuringia).

To account for that, we defer to propensity score matching (Caliendo and Kopeinig, 2008). Relying on one-to-one matching with replacement and the base year 1999, we generate a pre-matched control group that is similar to our treatment group. We match on the following variables: investment activity (as measured by the logarithm of building investment and the logarithm of equipment investment; both increased by one to avoid undefined values), establishment size and economic activity (as measured by the logarithm of sales revenue and the logarithm of the number of employees), industry,[11] firm type (single establishment firm, multi-establishment firm, multinational firm, establishment of a foreign firm), and the type of goods produced (input goods, investment goods, durables, commodities). We do not use the capital stock as a matching characteristic, as this variable has been constructed using the information on investments (for the calculation of the capital stock see Online Appendix C). We select 1999 as our base year for matching (see Online Appendix F for robustness checks when using 2000 as an alternative base year) but also consider outcome values from future periods (2000–2008) for our time-variant matching variables. In a first step, we obtain the propensity score from a probit model with DAL treatment as the dependent variable. In a second step, we use the propensity score as a matching characteristic for our one-to-one matching with replacement. To ensure a minimum common support, we drop establishments with propensity scores that are higher than the maximum (and lower than the minimum) propensity score in our control group. We end up with a final sample of 97,867 observations from 7,440 establishments. There are a total of 43,759 observations for western German establishments (control group) and 54,108 observations for eastern German establishments (treatment group).

[Figure 3 about here]

To check the common trends assumption for the matched sample, we plot the demeaned building and equipment investments for the treatment and control group of the pre-matched sample in Figure 3. We observe a strong common trend in the post-treatment period for both

[11] We use the industry classification on a two-digit level. An overview of the classification of industrial sectors in the relevant period is given by German Federal Statistical Office (2003).

types of investments and conclude that our DiD estimation strategy is appropriate for the pre-matched sample. Note that Figure 3 already provides empirical evidence for H1. For both building and equipment investments, we observe a strong reduction in investment activity in the treated establishments after 1999. We report descriptive statistics of the pre-matched sample in Table 3 (for the full sample see Table A2 in Online Appendix F).

[Table 3 about here]

On average, price-adjusted equipment investments (including zero investments) in the control group (€1,231.13 thousand) slightly exceed the values in the treatment group (€1,051.80 thousand). Average building investment is almost identical in both subsamples. Investment in land is very small and thus negligible. The percentage of establishments with positive gross investments is quite high and does not vary considerably between both samples (90.46% in the West and 90.39% in the eastern states). Establishments in the former East have a slightly higher probability of investing in buildings as compared to establishments in the western states (32.46% to 28.07%) and are more likely to be small establishments, i.e. not having more than 250 staff members. They also have lower revenues but larger capital stocks.[12]

4. Results

4.1. *Average Treatment Effects at the Intensive and Extensive Margins*

Our analysis starts with estimating the baseline model, Eq. (5), for different types of investments (buildings and equipment) at the extensive and the intensive margins. For investments at the extensive (intensive) margin, the dependent variable is a dummy variable with a value of one for establishments investing in buildings or equipment (the natural logarithm of the value of price-adjusted investments). When modelling investments at the intensive margin, we only consider observations with positive investments, thus reducing the number of observations. Our final sample includes 97,867 observations of 7,440 establishments for

[12] This is in line with representative balance sheet data provided by the German Central Bank (2001–2012), according to which the ratio of revenue to capital stock in East German firms is smaller than in the West. Unemployment rates in eastern German districts are higher and GDP-per-capita ratios are smaller than in western districts.

building and equipment investments at the extensive margin, 88,495 observations (7,410 establishments) for equipment investments at the intensive margin, and 29,845 observations (5,631 establishments) for building investments at the intensive margin.

As we are not interested in predicting investments, but explaining them, we rely on a linear probability model to estimate our regressions on investments at the extensive margin. A benefit of this model type is that we can interpret the regression coefficients as percentage point changes in the conditional average probability to invest. In unreported robustness checks, we also calculate logit regressions with virtually unchanged results. For investment at the intensive margin, we estimate the model using OLS. As our variables of interest are dummy variables and the dependent variable in these models is the logarithm of investment, our regression coefficients are roughly equal to the DAL-induced relative changes of the investment activity. To get an unbiased estimate of the relative change, we apply the formula of Kennedy (1981) and calculate the relative change as $exp\left[\hat{\beta}_i - \frac{1}{2} \cdot Var\left(\hat{\beta}_i\right)\right] - 1$. We present the regression results in Table 4. Note that establishment fixed effects and year fixed effects are included in all specifications. In Models (2), (4), (6), and (8) we also include industry-year fixed effects and additional controls. On the establishment level, we control for the logarithm of the capital stock (*Capital stock*) and the ratio of sales revenue to capital (*Revenue to capital*). On the district level, we account for the unemployment rate in percentage points (*Unemployment rate*), the logarithm of the price-adjusted *GDP per capita*, and the logarithm of the population (*Population*). We cluster heteroscedasticity-robust standard errors on the firm level, as investment decisions are made by the firm rather than the establishment. In unreported robustness checks we also calculate bootstrapped standard errors that are very close to the standard errors reported here. We report two measures for *R*-squared. While regular *R*-squared describes the proportion of the overall variation explained by the whole model (including establishment fixed effects), within *R*-squared focuses on the variation within establishments over time.

[Table 4 about here]

In Table 4, the coefficient of *DiD* is positive and significant in all models, and the effect is robust to the inclusion of additional control variables. The *DiD* coefficient is statistically significant at the one percent level for building investment (both at the extensive and intensive margin) and for equipment investment (only at the extensive margin). Thus, our evidence confirms a significant impact from the DAL on the probability of investing and the conditional volume of investments.

In the full model in column (2), we estimate a DAL treatment effect on the probability of investing of 11.3 percentage points. Compared to the average probability of investing in buildings in the former East (32.46%, Table 3), this implies an increase of building investment at the extensive margin by 34.8% (0.113/0.3246). The increase of 47.9% in building investment at the intensive margin is obtained by using the estimates in Model (4) in the Kennedy (1981) formula $\left[0.479 = \exp\left(0.394 - \frac{1}{2} \cdot 0.0709\right) - 1\right]$. Thus, the DAL increased the conditional volume of investment by almost 50%. Combining both estimates, we calculate an aggregate increase in building investments of 99.4%.[13] Thus, our regression results suggest a very strong investment response in building investments. Investments almost doubled because more establishments made investments and average size of investments increased as well.

We find a much weaker investment reaction for equipment. In Model (6) we estimate a 1.7 percentage point increase in the probability of investing. Compared to the average investment probability for equipment in Table 3, this suggests an increase of equipment investment at the extensive margin by merely 1.9%. The *DiD* coefficient in the regression on equipment investment at the intensive margin is not statistically different from zero. Thus, the aggregate significant treatment effect for equipment investment is 1.9%. Supporting H2a, we only find a

[13] The share of investors with positive building investments increases by 34.8%. In addition, the average volume of this increased number of investments also increases by 47.9%. Thus, the aggregate response is $0.994 = (1+0.348)\times(1+0.479)-1$.

moderate DAL effect for equipment investments and a much larger and statistically significant treatment effect for building investments.

Goolsbee (1998) argues that investment tax incentives increase asset prices, which dampens their impact on real investment. For our purposes, this should not be a problem, as we deflate the value of building investment at the intensive margin in all specifications of Table 4 by a regional building price index (see also Section 3.2). In additional analyses, we only find weak evidence for a relevant impact of the DAL on building prices (Online Appendix D). Another concern is the shifting of investments over time in order to benefit from the DAL—in particular in light of the strong investment response for structures of about 99.4% (House and Shapiro, 2008). We deal with this issue in more detail in Section 4.3.

4.2. *Heterogeneity in the Investment Response*

For our heterogeneity tests, we consider *Building investment share* (the ratio of building investment to total investment) as an additional dependent variable and we add triple difference interaction terms for large firms and groups with more than one establishment as formulated in Eq. (6). In our tests of H2a to H2c, we also include dummy variables for different firm types (*Large, Group*) and for interactions of these variables with the year dummies (firm-type-year fixed effects). In Table 5, we report the results for *building investment share* in columns (1) to (4) and for investments at the extensive and the intensive margins in columns (5) to (8).

[Table 5 about here]

We find a positive and significant regression coefficient for *DiD* in all regressions on the *building investment share*, thus, confirming H2a. Therefore, the DAL had a stronger effect on building investments and increased the proportion of building investments to total investments by 5.17 percentage points for the full sample (Model 1). Given that the average share of building investments to total investments in eastern Germany was 14.6% (Table 3), this suggests an increase in the proportion of building investments of 35.4% (= 0.0517/0.146). For establishments with positive building investments (Model 3), we observe an increase of the share of building investments of 3.90 percentage points (this amounts to 26.7% of the average share of building investments in eastern Germany). The effects do not differ significantly for large or multi-establishment firms.

Confirming H2b, we find substantially higher building and equipment investments at the intensive margin for large firms. Note that the coefficient on *DiD* in Table 6 captures the causal effect for small firms, while the additional effect for large firms is captured by *DiD large*. Thus, the total effect is the sum of both effects. Applying the Kennedy (1981) formula, we estimate an increase in building investments at the intensive margin of 32.1% for small firms and an additional effect of 41.9% for large firms. As we use a logarithmic dependent variable, the total effect is 87.4% for large firms $(1.321 \times 1.419 - 1)$. For equipment investment at the intensive margin, we find a positive and significant effect of 26.0% for large firms, but no significant investment response for small firms. For investments at the extensive margin, we find no additional significant effects for large firms. As before, we calculate the aggregate investment response using the product of changes at the intensive and extensive margins reduced by one. The overall investment response for large (small) firms is 152.7% (78.1%) for building investments and of 27.5% (1.9%) for investments in equipment. Thus, large firms reacted stronger to tax incentives when making investment decisions.

We find no empirical support for H2c, suggesting stronger DAL effects for multi-establishment firms. Considering both, firm size (*DiD large*) and the effect of multi-establishment firms (*DiD group*), the coefficient of *DiD group* is never significantly different from zero.[14]

Using the estimates of Table 6, we calculate elasticities of investments for both types of firms with respect to the net of the effective tax rate, the reciprocal of the user cost of capital (see also Zwick and Mahon, 2017). As the elasticity estimates rely on assumptions regarding the calculation of the user cost of capital and the asset structure of firms (see Online Appendix E

[14] In additional unreported regressions we exclude *DiD large*. In these regressions we find positive and significant effects of *DiD group* for building investment at the intensive margin. However, this should be interpreted with caution as multi-establishment firms are also typically larger than single-establishment firms.

for technical details), they should be interpreted carefully. For large firms, we obtain elasticities of 9.3 for buildings and 10.1 for equipment. For small firms, the estimated elasticities are lower: 4.6 for buildings and 4.2 for equipment. This is in line with our empirical finding of a stronger investment response from large firms (H2a).

Considering that the literature does not calculate elasticities for different firm types, our estimates fit well with the evidence. House and Shapiro (2008) find a range of elasticities with respect to the user cost of capital of between 6 and 14, while Maffini *et al.*, (2016) report a corresponding elasticity of 8.7. Zwick and Mahon (2017) report an average unweighted elasticity estimate of 7.2 with respect to the net of the effective tax rate, and Ohrn (2018*b*) estimates an elasticity of 6.5 for the U.S. DPAD program.

4.3. *Timing of Investments*

To account for the possible retiming of investments between periods, in Eq. (7) we include interaction terms for investments in 1997–1998 (*DiD 9798*) and investments in 1999 (*DiD 99*). Recall that *DiD 9798* measures the partial effect in 1997–1998 as compared to 1995–1996. The coefficient of *DiD*, therefore, captures the DAL effect in 1995–1996, while *DiD 9798* identifies the additional effect in 1997–1998. The overall effect in 1997–1998 can be calculated from the sum of the coefficients of *DiD* and *DiD 9798*. *DiD 99* identifies a potentially delayed DAL effect (H3b) on investments in 1999 (the post-DAL year) as compared to 2000–2008.

[Table 6 about here]

Confirming H3a, the coefficient for *DiD 9798* is negative in all specifications and significantly different from zero for building investments at the extensive and intensive margins and for equipment investments at the intensive margin. Models (1) and (3) provide evidence for a positive DAL treatment effect of 13.4 percentage points on building investments at the extensive margin in 1995–1996 and of 10.3 percentage points in 1997–1998.[15] Thus, in relation

[15] Note that the inclusion of *DiD 9798* has an impact on our original *DiD* estimator. This is not unexpected, as both parameters affect the reference period. If *DiD 9798* is included, *DiD* captures exclusively captures the DAL effect for 1995 and 1996 instead of the whole DAL treatment period.

to the average probability to invest in buildings (32.46%, see Table 3), building investments at the extensive margin increased by 41.3% (= 0.134/0.3246) in 1995–1996 and by 31.8% (= 0.103/0.3246) in 1997–1998. We further estimate a positive and significant DAL effect of 64.7% (33.8%) on building investments at the intensive margin in 1995–1996 (1997–1998). For equipment investments at the intensive margin, the positive DAL effect of 9.4% for 1995–1996 is fully compensated by a negative and significant effect of the DiD interaction term for 1997–1998 (*DiD 9798*). Hence, the effect for the years 1997 and 1998 is not significant.

Considering all significant coefficient estimates on investments at the extensive and intensive margins and applying the Kennedy formula, the average total DAL treatment effects for building investments (equipment investments) is 132.7% (11.8%) in 1995–1996 and 76.4% (2.2%) in 1997–1998. In spite of a modest reduction in DAL depreciation rates from 50% in 1995–1996 to 40% in 1997–1998, we observe a strong reduction in DAL-induced investment activity as compared to 1995–1996. The DAL-induced investment response in 1997–1998 is 42.4% $[(0.764 - 1.327)/1.327)]$ smaller for building investments and 81.1% smaller for equipment investments $[(0.022 - 0.118)/0.118]$ as compared to the effect in 1995–1996.

The finding of very high investment elasticities for small changes in tax incentives is consistent with a retiming of investments. As suggested by House and Shapiro (2008), firms will shift their long-term investments (e.g. building investments) into the period with the maximum subsidy benefit. Our results for *DiD 9798* provide some evidence of the retiming of investments to maximise subsidy benefits. From this perspective, the strong DAL effects on building investments as well as the high elasticity estimates for temporary investment tax incentives, found in this paper and in the literature, can be partly attributed to the retiming of previously planned investments, i.e. they cannot be exclusively accredited to additional investments.

The regression coefficient of *DiD 99* has alternating signs depending on the specification and is not significantly different from zero in most regressions. Thus, we do not find empirical support for an investment pothole in 1999 (H3b). We even observe a significantly higher investment probability for building investments (at the extensive margin) of 2.1 percentage points in Model (1). An explanation for this effect could be a delayed DAL treatment effect if not all DAL-induced building investments were completed by the end of 1998, hence still resulting in abnormally high building investments in 1999. Note that construction times of buildings can take time and delays are a common problem. Therefore, the positive point estimate on *DiD 99* suggests that not all firms were able to shift their investment activity completely into the treatment period.

4.4. *Robustness Checks*

To test the robustness of our results (for more details and results see Online Appendix F), we perform regressions for the unmatched original sample and a pre-matched sample based on the year 2000. These robustness checks virtually confirm our main findings discussed in Sections 4.1 to 4.3. Using the unmatched sample including all establishments in western Germany (Table A3), we estimate an overall DAL effect of 90.2% for building investments and 9.8% for equipment investments. Further, we find positive and significant DAL effects on equipment investments at the intensive margin, which is not the case when using the pre-matched sample. In Table A4 we report the results from a pre-matched sample based on the year 2000. The total average treatment effect is 126.7% (9.9%) for building (equipment) investments. Taking into account all estimates shown in this paper including the robustness checks (Tables A3 and A4), we end up with a DAL average treatment effect on the treated that ranges from 90.2–126.7% for buildings and 1.7–9.9% for equipment.

We did additional robustness checks that are not reported in detail.[16] (1) We included lagged control variables to test if the control variables measuring regional economic development and firm characteristics could be endogenous. There is no evidence suggesting that either the lagged regional or lagged establishment control variables have any relevant impact on the estimated treatment effect. (2) Since one might argue that *revenue per capital stock* is not sufficient to

[16] We can provide corresponding results upon request.

control for capital constraints (for capital constraints and investments see Hadlock and Pierce, 2010), we also test models that include EBITDA per capital (as a measure of cash flow), interest per capital (as a measure of debt ratios), and the legal form of the firm (as a measure of financing opportunities). This information is not available for all observations, thus, causing our sample size to shrink by about 50%. The inclusion of additional controls does not significantly affect our results. (3) In our main specifications we use the logarithm of investments as our measure for investment at the intensive margin. When using investments scaled by capital stock as an alternative dependent variable, we still find a significant and positive impact from *DiD* on equipment and—especially—building investments. (4) In our baseline approach, we define investment as depreciable gross investment on the establishment level. Our results are also robust when estimating cross checks to account for leased investments. (5) As an alternative to firm-clustered standard errors, we use bootstrapped standard errors to account for the propensity score matching of our control group. This results in almost no change in our standard error estimates and significance levels.

5. Conclusion

Using high-quality establishment level data, we analyse the impact of bonus depreciation on business investment in Germany after reunification by exploiting the exogenous variation in tax regulations. Relying on DiD estimation and pre-matched samples, we identify a significant impact of bonus depreciation on investments made by businesses in the manufacturing industry. We observe much larger investment reactions for structures as compared to equipment and for firms with more than 250 staff members. There is only weak evidence of subsidy shopping by firms with more than one establishment. We do, however, find evidence of investment shifting to the years with the more generous bonus depreciation rules (1995 and 1996), but we do not find evidence for an investment pothole in the post-treatment year 1999.

Finally, we discuss potential limitations. Despite the exogenous policy variation and the unique database, establishments in the former East and West are no random samples. Thus, one might speculate that the observed investment effects result from the transition process of the eastern German economy. However, this concern can be disregarded for two reasons. First, transition processes suggest gradual changes in investment activity and, therefore, cannot explain the massive structural change in investment activity after 1998, which we find in our data (e.g. Figure 2, Figure 3). Second and even more relevant, the transition process cannot explain why we find much larger investment reactions for building investments (estimates range from 90.2% to 126.7%) as compared to equipment (estimates range from 1.7% to 9.9%). By contrast, the strong difference in the responses for different asset types supports the conjecture of House and Shapiro (2008), who argue that investments are retimed in order to maximise benefits. A further limitation of our analysis is that it does not consider the effects of investment incentives on welfare and economic growth. Those issues should be addressed in future research.

Online Appendices

Online Appendix A: Present Value of DAL Benefits

A.1. *Calculation of DAL Present Value*

We calculate the DAL present value as the sum of the tax savings from bonus depreciation during the first year plus the present value of remaining depreciations in the future, and minus the present value of the 'fastest' alternative depreciation scheme without bonus depreciation. As we calculate the DAL benefit from the perspective of a given period *t*, we do not account for changes in taxes and the after-tax cost of funds in future periods (e.g. for the reduction of corporate income tax rates resulting from the German tax reform 1999/2000/2001). Taking into account that German tax rates declined after 1998, we calculate a lower-bound estimate of the ex-post DAL benefit, because the value of depreciation benefits increases with the tax rate. We also do not account for the possibility of future tax losses that would reduce the present value of future tax depreciation.[17] We assume that the DAL bonus depreciation is fully utilised in the first year and the investment is executed in the middle of the year. The present value of DAL benefits is then equal to

$$PV_t = \tau_t \cdot \Phi_t \cdot \left(\beta_t + (1-\beta_t) \cdot \sum_{t+x}^{t+X} \frac{\delta reg_{t+x}}{(1+\rho_{\tau t})^{x-1}} - \sum_{t+x}^{t+X} \frac{\delta alt_{t+x}}{(1+\rho_{\tau t})^{x-1}} \right), \tag{A1}$$

where Φ_t denotes the total sum of DAL-funded depreciations in the eastern German states in a given year *t*, τ_t the average tax rate in *t*, $\rho_{\tau t}$ the after-tax cost of funds in *t*, and *x* an index for following depreciation years. The bonus depreciation rate of a given period (ranging from 40% to 50%) is denoted β_t. Thus, $(1-\beta_t)$ is the remaining book value to be depreciated by the regular scheme. The parameters $0 \le \delta reg_{t+x} \le 1$ and $(0 \le \delta alt_{t+x} \le 1)$ describe the allocation of depreciations under the regular scheme and the alternative scheme respectively.

[17] In case of a tax loss, the remaining depreciation volume does not result in a reduction of the tax burden (the tax payment is zero anyway), but increases the loss carryforward. Thus, future losses might decrease the present value of the remaining depreciation volume.

German tax instalments are affected by depreciation allowances. In line with Cohen *et al.* (2002), we therefore reduce the number of discounting periods *x* by one. Subsidy reports of the German Federal Government (German Federal Government, 1995–1999; German Federal Ministry of Finance, 2001–2010) do not report the total amount of depreciations Φ_t, but only the amount of tax losses resulting from bonus depreciation $\tau_t \cdot \Phi_t \cdot \beta_t$. We use this information to calculate $\tau_t \cdot \Phi_t$.

A.2. *After-Tax Cost of Funds*

An important aspect affecting the present value of depreciation allowances is the after-tax cost of funds. Using the definition of weighted average costs of capital (WACC) (see Hulse and Livingstone, 2010; Frank and Shen, 2016), after-tax costs of funds in a given period *t* can be written as

$$\rho_{\tau t} = \rho_{dt} \cdot d \cdot \left(1 - \tau_{t*}\right) + \rho_{et} \cdot \left(1 - d\right). \tag{A2}$$

In (A2), ρ_{dt} denotes the pre-tax cost of debt capital at time *t*, ρ_{et} the cost of equity capital, and d the—for simplicity, this is a constant—fraction of debt capital. The tax deductibility of interest payments on the firm level is included in the tax rate τ_{t*} accounting for the limited tax-deductibility of interests for long-term debt with regard to the German local business tax (*German: Gewerbesteuer*).

To approximate the cost of debt capital ρ_{dt} for a given year *t*, we use average long-term interest rates published by the German Central Bank (*German: Deutsche Bundesbank*).[18] This can be justified by the fact that investments are generally financed by equity and long-term debt, while short-term debt is more relevant for operational business. The average interest rate between

[18] Since the definitions of reported interest rates of the German Central Bank change over time, we rely on a number of different proxies for the cost of debt capital. For 1997 to 2002 we use average interest rates for business credits ranging from €500,000 to €5m (BBK01.SU0509). For 2003 and thereafter, we use interest rates for credits to corporations exceeding €1m and a duration of more than 5 years (BBK01.SUD129). For the period from 1991 to 1996, we use floating long term mortgage interest rates (BBK01.SU0049) as business interest rates are not available. We use ‘overlapping’ periods with more than one possible proxy of interest rates to adjust all interest rates to a consistent definition over the whole period, using interest rates from 1997 to 2002 as our reference point (BBK01.SU0509).

1995 and 2008 was 6.07%. The average fraction of debt capital is taken from representative balance sheet statistics of the manufacturing industry, which are also provided by the German Central Bank (2001–2012). In line with Hulse and Livingstone (2010), we focus on the ratio of long-term debt to equity. Therefore, we assume that short-term debt and accruals result from operational business and do not affect the after-tax cost of funds of long-term business investment. We do not observe strong changes in d during our sample period. Therefore, we use a fixed average value of $d = 0.3439$.

In contrast to the cost of long-term debt, the cost of equity is not published by the German Central Bank. While there are a number of proxies for ρ_{et}, there is no generally accepted definition of this variable. Botosan *et al.* (2011) describe 10 alternative proxies with a positive and significant correlation with future realised returns; we rely on the mean of these 10 proxies for equity cost as reported by Botosan *et al.* (2011). It should be noted that the values of ρ_{et} are based on U.S. data instead of German data. However, this should not be a severe problem, as Hail and Leuz (2006) do not find evidence for strong differences in the equity cost of capital in both countries. Nevertheless, we reweight equity cost by the corresponding differences reported in Hail and Leuz (2006) and obtain an average cost of 11.0%. To obtain average values per year, we relate this value to the average cost of long-term debt and obtain a ratio of 1.814. Thus, average ρ_{et} can be approximated by $\rho_{dt} \cdot 1.814$. This is very close to the relationship between ρ_{dt} and ρ_{et} of 1.8 as assumed by Hulse and Livingstone (2010).

The tax rate τ_{*t} is a weighted effective tax rate with respect to the deduction of interest expenses of business establishments in eastern Germany. To calculate τ_{t*}, we account for the distribution between profits generated by corporations (taxed at corporate income tax rates) and by self-employed businesses and partnerships (taxed at personal income tax rates). The fraction of profits generated by corporations is approximated by the corresponding distribution of revenue as documented in the VAT statistics of the German Federal Statistical Office. To calculate the effective tax rate of corporations (partnerships), we use the corporate income tax rate (the maximum marginal personal income tax rate) for accumulated business profits of a given year. We further consider the solidarity tax surcharge (*German: Solidaritätszuschlag*) and the average local business tax rate (*German: Gewerbesteuer*) of the eastern German states. We account for the fact that local business tax payments were deductible from taxable income until 2007. In addition, we account for the local business tax credit for partnerships (*German: Gewerbesteueranrechnung*) and the add-backs of long-term debt for the German local business tax (*German: Hinzurechnungen*).

A.3. *Depreciation Regulations*

To calculate the parameters $0 \leq \delta reg_{t+x} \leq 1$ and $0 \leq \delta alt_{t+x} \leq 1$ in (A1), we rely on the depreciation regulations of the German income tax code for different asset classes as well as the distribution of real investments between buildings and equipment for a given year (see German Federal Statistical Office, 2010, Tables 2.1, 3.1 and 4.1).

In the 1990s new buildings were generally depreciated over a period of 25 years. For investments after 2000, these depreciation periods for new business buildings were increased to 33.3 years. For the modernisation (extension, improvement) of old buildings, longer depreciation periods of 40 and 50 years (depending on the construction date of the building) were in force. We use the average fraction of new buildings as reported in the German building statistics of the corresponding period[19] to construct weights for old and new buildings. For modernisations, we assume that one half of investments are depreciated over 40 and the other half over 50 years.[19]

Furthermore, we account for declining depreciation schemes for new buildings and modernisations as documented in § 7 Section 5 of the German income tax code. These alternative depreciation schemes were available if (1) the new building was constructed, or an

[19] We rely on the number of constructed non-residential buildings in the former East (new buildings versus modernisations during the period from 1993 to 1999, which was relevant for the Development Area Law).

old building was modernised, with a building application before January 1994 or January 1995, respectively, or (2) the building was purchased before January 1994 or January 1995, respectively. As buildings are constructed after the building application has been submitted, we assume that declining depreciation schemes are available for two years after the expiration date (100% in the first year after the abolition and 50% in the second year).

There is no data on average tax depreciation periods for equipment investment in Germany. Therefore, we assume an average depreciation period of seven years as documented by Devereux *et al.* (2009). In the 1990s, the depreciation rate of the declining balance method for movable assets was 30%. Hence, we assume that all equipment investments use the declining balance method, as long as corresponding depreciations are 'higher' than the alternative linear depreciations. Note that the declining balance method was not available if the bonus depreciation was utilised. Therefore, the consideration of these programs reduces to some extent the relative benefit of bonus depreciation.

Online Appendix B: Calculation of the Relative Tax Burden

As denoted by Eq. (4), the relative tax burden of investments in eastern German establishments can be written as

$$RT_t = \frac{1-\tau_t^E \cdot Z_t^E - s_t^E}{1-\tau_t^W \cdot Z_t^W - s_t^W} \cdot \frac{1-\tau_t^W}{1-\tau_t^E}, \qquad \text{(A3)}$$

where τ_t^E, Z_t^E and $s_t^E \left(\tau_t^W, Z_t^W, s_t^W\right)$ denote the tax rate on profits, the present value of depreciations per € invested, and the effective ISL subsidy rate for eastern (western) Germany in a given period, respectively. As introduced in Online Appendix A, τ_t^E and τ_t^W are based on weighted tax rates of partnerships and corporations including taxes on income, the solidarity tax surcharge, and the local business tax. To calculate τ_t^E $\left(\tau_t^W\right)$, we use average local business tax multipliers (*German: Hebesätze*) for the eastern and western German states. Z_t^E and Z_t^W are calculated as in Online Appendix A. The after-tax costs of funds of (Online Appendix A2) are used to compute discounted values of depreciation allowances.

We account for the fact that applications for ISL subsidies are generally related to investments of the preceding year. Therefore, the effective subsidy rate s_t^E is defined as the nominal ISL rate discounted by one period. As shown in Table 1, the ISL rate for equipment investment of large firms was 5% (small firms 10%) from 1995 to 1998, 10% (small firms 20%) in 1999, and 12.5% (small firms 25%) thereafter. Regarding building investment, funding rates were zero before 1999 and 10% (12.5%) for initial investments in 1999 (after 1999). In this case, there were no increased rates for firms with no more than 250 staff members. There was also a higher subsidy rate of 8% for equipment investments of all firms before 1997 if investments had been initiated before June 1994. We assume that this is relevant for 50% of investments in 1995 and 0% thereafter. Correspondingly, we assume that the increase of funding rates in 2000 (from 10.0% to 12.5%) was relevant for 50% of businesses in that period and for 100% thereafter. Note that s_t^W is zero, as ISL subsidies were restricted to investments in the eastern states. In addition, there was a funding gap for investments initiated before August 25, 1997 and completed after December 31, 1998. For simplicity, we do not consider this aspect in our calculations. This can be justified by the fact that this funding gap was not expected by owners and managers.

Online Appendix C: Calculation of the Capital Stock

Our calculation is based on an approach developed by Wagner (2010), who uses depreciation values for tax purposes reported in the Cost Structure Survey, information on the composition of investments from the Investment Survey, and average depreciation periods for different asset classes (buildings and equipment) to compute capital stocks. Our method extends the approach of Wagner (2010) in a number of ways. We compute the capital stock as follows:

$$K_{i,t-1} = [D_{it} \cdot (\alpha_{it}{}^{E} \cdot P_t^E + \alpha_{it}{}^{B} \cdot P_t^B) - I_{it}^N] \cdot \frac{1}{2}, \qquad \text{(A4)}$$

where $K_{i,t-1}$ is the capital stock at the end of the previous period (or beginning of the current period) of the firm *i*, D_{it} is the depreciation of *i* in *t*, $\alpha_{it}{}^{E}$ is the fraction of equipment investment of a given year, $\alpha_{it}{}^{B}$ the fraction of building investment in that year, and P_t^E $\left(P_t^B\right)$ the average depreciation period for equipment (building) investments in Germany in *t*.

Multiplying the sum of depreciations with the average depreciation period yields the investment value at the beginning of the operating period. To account for depreciations after the beginning of the operating period of an asset, we divide this value by two. Therefore, we assume that half of the average operating period has expired for each asset. This implies further that price-adjusted depreciations are approximately evenly distributed over time. Note that investments in *t* have a positive effect on D_{it}. If investments are executed in the middle of the year, D_{it} should rather be a measure of the capital stock in the middle of the period instead of the beginning of the period. To account for that aspect, we deduct 50% of net investments I_{it}^N (defined as gross investment minus disinvestment) of firm *i* in time *t*.

The depreciation period P_t^E for equipment is assumed to be 7 years (see Online Appendix A as well as Devereux *et al.*, 2009). For new buildings, the regular periods are 25 years (for old buildings it is 40 to 50 years). For simplicity, we do not account for declining depreciation schemes for buildings. This can be justified by the fact that declining schemes increase the present values of depreciation allowances, but not the average depreciation over the depreciation period. The composition of different asset classes is estimated by the distribution of investments $\alpha_{it}{}^{E}$ and $\alpha_{it}{}^{B}$ of the relevant industry in our data, with $\alpha_{it}{}^{E} + \alpha_{it}{}^{B} = 1$. To account for measurement error, we calculate average values for $\alpha_{it}{}^{E}$ and $\alpha_{it}{}^{B}$ by year, industry, business size (large firms compared to small firms with up to 250 staff members) and region (eastern versus western part).

The tax depreciation period for new buildings increased to 33.3 years in 2001, while depreciation periods for modernisations remained unchanged. The increased depreciation period is only relevant for new instalments. Thus, considering economic growth and declining depreciation schemes of preceding periods, we assume a declining adaptation process of the average depreciation period per firm over 25 years with $D_{2000+x} = D_{2000} + \Delta \cdot \sqrt{\frac{x}{25}}$, where D_{2000} denotes the average depreciation period in 2000 (29 years on average for old and new buildings), x the number of years after 2000 and Δ the increase in the average depreciation period resulting from the reform.

The computation of the capital stock may be affected by measurement error in D_t . This is especially a problem in the case of a high variation of tax depreciations over time, implying a fluctuating capital stock. To account for that problem, we rely on estimated capital stocks of future periods to obtain a more consistent estimate of the capital stock of preceding periods. We use this ‘count-back’ method, because the first years of our data base are more relevant for the investigation of DAL benefits. Hence, we define the capital stock of the preceding period as the capital stock of the following period plus investments and minus depreciations and disinvestments in *t*.

In addition to fixed assets, and extending the approach of Wagner (2010), we consider leased investments as increasing the effective capital-in-kind. We rely on data from the Investment Survey to compute the ratio of leased assets to fixed assets by year, industry, business size and region (western versus eastern part of Germany). The value of fixed assets of each firm is multiplied by one plus the computed ratio.

A drawback of our data is that depreciation volumes of the Cost Structure Survey are only available on the firm level, while our research relies on establishment data. Therefore, we allocate depreciations to the establishment. We compute the ratio of the capital stock to the number of employees by year, industry, business size (large firms compared to small firms with up to 250 staff members) and region (establishments in the West and establishments in the East). Using these ratios, we allocate the firms’ capital stock to the establishments.

Online Appendix D: DAL and Building Prices

Goolsbee (1998) finds evidence that investment tax incentives increase asset prices, which dampens their impact on real investment. While studies on bonus depreciation do not provide support for such pricing effects (House and Shapiro, 2008; Edgerton, 2011; Zwick and Mahon, 2017), we account for that by deflating building investment at the intensive margin by a regional building price index (see also Section 3.2). Using building price indices from states in the East and the West, we calculate weighted building price indices for both parts of Germany and report the results in Table A1.

[Table A1 about here]

We find only weak pricing effects. Using 2005 as reference year, the building price index in eastern Germany in the treatment period (1995–1998) exceeds the index for western Germany on average by 3.0 percentage points, while it is slightly lower than the western German index in the post-treatment period (1.2 percentage points). Even if one were to assume that this change in the difference of the building price indices is exclusively the result of the DAL, this suggests a DAL treatment effect of 4.2 percentage points (estimated by the difference in the differences of 3.0 and minus 1.2) or 4.4% of the building price level in 1999. This is minor if compared to our estimated average response for real building investments of 99.4% that we calculate in Section 4.1.

Online Appendix E: Calculation of Investment Elasticities

Following Zwick and Mahon (2017), we calculate investment elasticities with respect to the net of the effective tax rate $1-\tau_{\varepsilon}$ (in the following NETR), respectively the reciprocal of the tax term of the user cost of capital. For the calculation of the effective tax rate, we rely on the same assumptions as for the calculation of the relative tax burdens in Table 2 (for details see Online Appendix B). Consistent with our regression approach, we focus on the relative tax benefit of establishments in eastern Germany. Thus, we rule out any other tax law changes affecting establishments in both parts of Germany equally. We define the additional relative tax incentive of eastern German establishments during the treatment period as the difference between the average relative NETR in the treatment period and the average relative NETR in the post-treatment period. Thus, the change in the relative tax incentive of eastern German establishments is

$$\Delta NETR = \overline{NETR}_{TREAT} - \overline{NETR}_{POST} \,, \tag{A5}$$

with $NETR_t = \frac{1-\tau_t^W \cdot Z_t^W - s_t^W}{1-\tau_t^E \cdot Z_t^E - s_t^E} \cdot \frac{1-\tau_t^E}{1-\tau_t^W}$. We calculate $\Delta NETR$ for large and small firms for three classes of buildings and equipment as also documented by Table 2: 1a) initial building investment, 1b) new buildings (no initial investment), 1c) modernisation of buildings (no initial investment), 2a) initial equipment investment, 2b) non-initial equipment investment, and 2c) non-fundable equipment investment. To calculate the aggregate average $\Delta NETR$ for small and large firms, we make assumptions about the average distribution of these six different types of investments. Note that there are no official statistics on initial investments according to ISL or the fundability of assets.

As extensions of an establishment are considered as initial investment according to ISL, the majority of building constructions should be initial investments. Hence, in case of the aggregate volume of building investments, we assume that the majority (55%) are initial investments. Corresponding to the German building statistics, about 20% of building investments are modernisations. We regard the remainder (25% of building investments) as constructions, but not as initial investments (e.g. extensions of buildings, major enhancements of buildings). In case of equipment investments, we assume that the majority (55%) are replacement investments and are therefore not considered as initial investments. This is consistent with the empirical observation that the increased funding rates of the ISL 1999 did not result in a significant increase in aggregate ISL subsidy payments (see footnote 7). As most equipment in the manufacturing sector was fundable (e.g. machines), we assume that non-fundable equipment is only 1/5 of the remaining equipment investments. Thus, the remainder (4/5) falls on fundable initial equipment investments.

Online Appendix F: Robustness Checks

As a first set of (reported) robustness tests, we perform regressions for the unmatched sample, consisting of 593,147 observations (496,715 observations of West German establishments and 96,432 observations of eastern German establishments). Descriptive statistics of this unmatched sample reveal considerable differences between establishments in the two parts of Germany. For example, establishments in the western part are much larger and their investments are higher. Table A2 provides descriptive statistics for this original unmatched dataset containing information on all available western establishments.

[Table A2 about here]

In Table A3, we provide regression results for the unmatched sample. It turns out that the results are in line with our analysis using the pre-matched baseline sample. Different from Table 4, we now find significant average DAL effects on equipment investment at the intensive margin and significantly higher investments at the extensive and the intensive margin in the post-treatment year 1999. Considering both, investments at the extensive and at the intensive margins, we estimate the overall DAL effect on investment with 90.2% for buildings and 9.8% for equipment. We also confirm our findings regarding the heterogeneity and the timing of investments. However, different from Table 6, we find positive and significant effects of *DiD 99* for all dependent variables suggesting that there were still abnormally high investments in the post-treatment year 1999 (no investment pothole).

[Table A3 about here]

In Table A4, we report regression results, using 2000 instead of 1999 as alternative matching base year. As descriptive statistics do not largely differ from our baseline sample (see Table 3), we abstain from reporting corresponding results. Again, the robustness check confirms our baseline regression approach. Similar to Table 4, we observe a statistically significant impact on average investment at the intensive margin. The quantitative estimates are widely in line with our baseline results.

[Table A4 about here]

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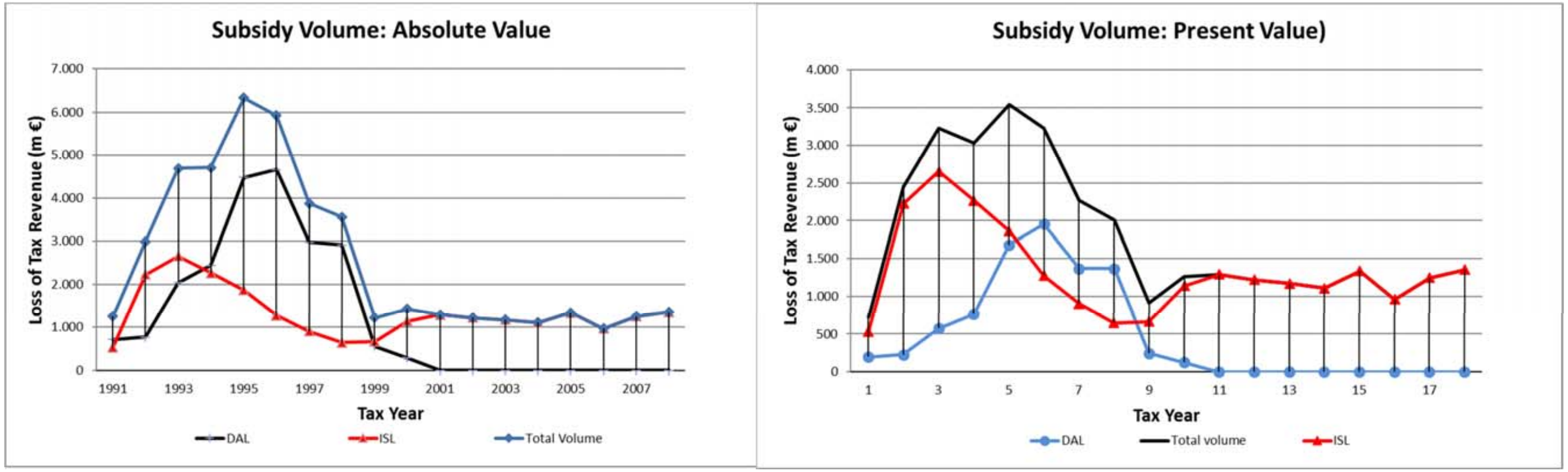
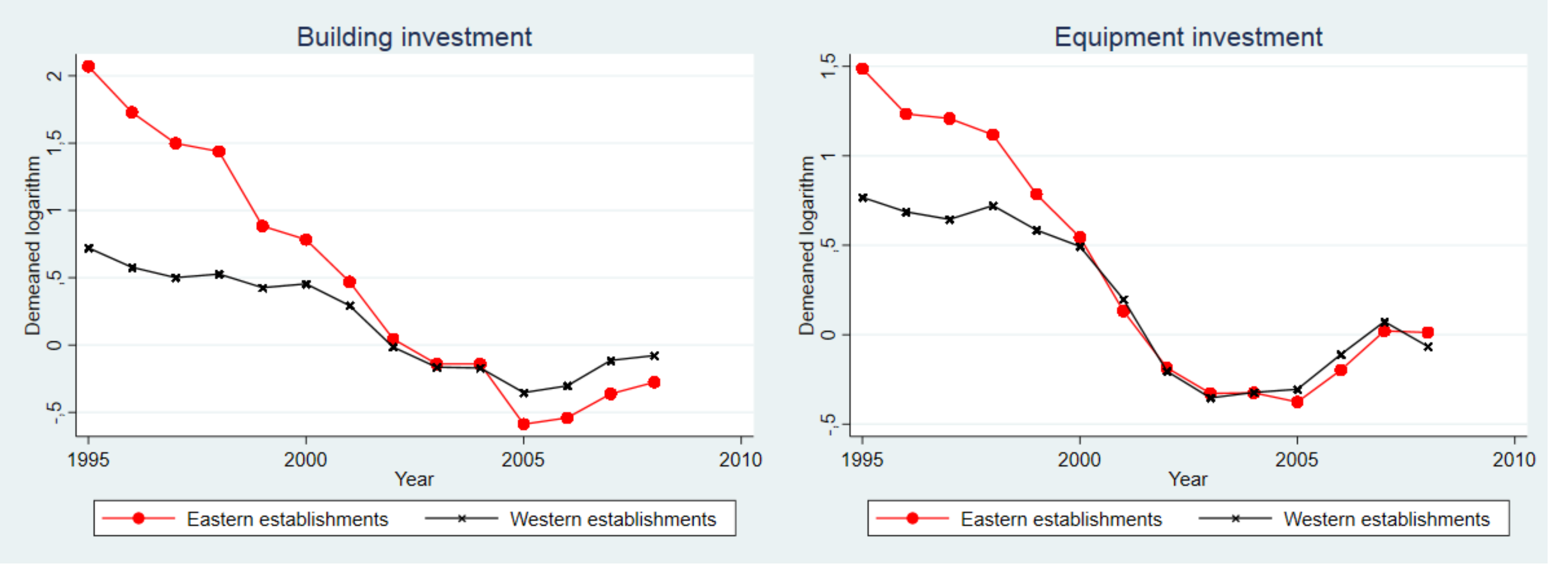
Figures and Tables

Figure 1: *Subsidy Volume of the DAL and the ISL*



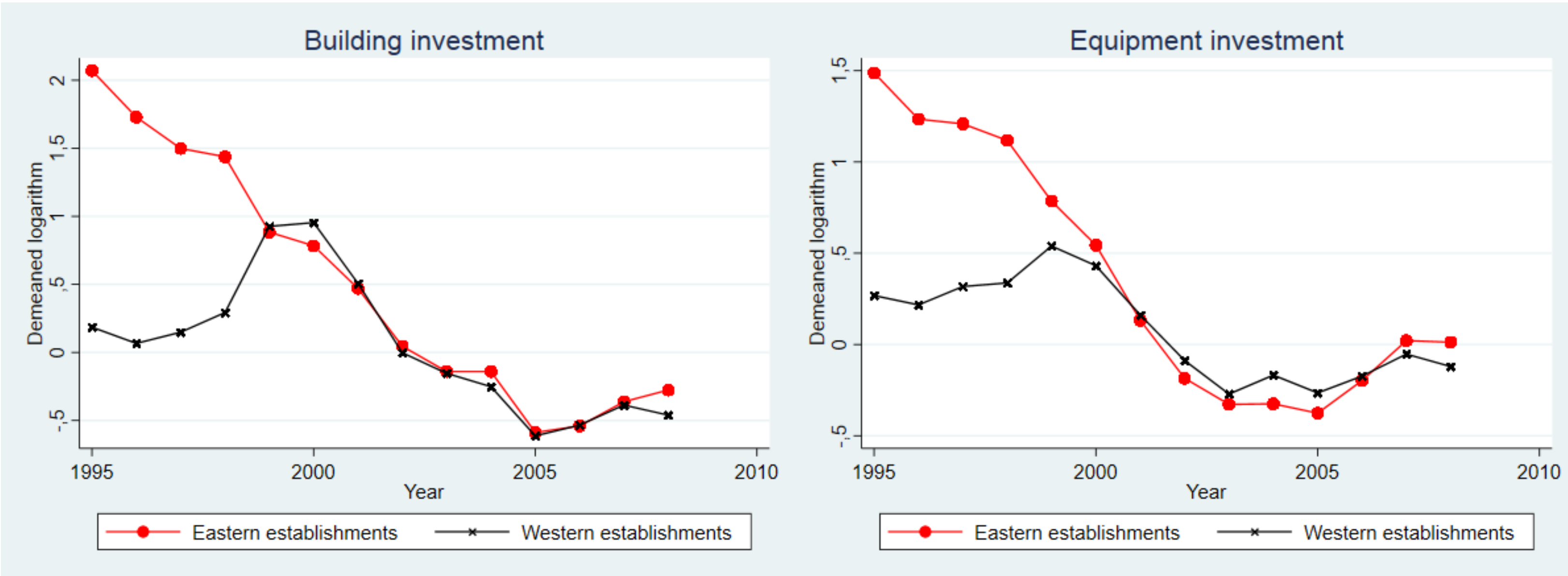
Notes. Based subsidy reports of the German Federal Government (see German Federal Government, 1995–1999; German Federal Ministry of Finance, 2001–2010) and own calculations (see Online Appendix A).

Figure 2: *Demeaned Investments: Unmatched Full Sample*



Notes. AFiD panel industrial units of the manufacturing industry; own calculations.

Figure 3: *Demeaned Investments: Pre-Matched Sample*



*Notes.*AFiD panel industrial units of the manufacturing industry; own calculations.

Table 1: *Investment Tax Incentives for eastern Germany 1995-2013*

	Development Area Law (DAL)	Investment Subsidy Law (ISL)
Validity period	01.01.1991 to 31.12.1998 with amendments and revisions	01.01.1991 to 31.12.2013 [a] with amendments and revisions
General rates	50% (1991 to 1996); 40% (1997 to 1998)	12% (1991 to June 1992); 8% (July 1992 to June 1994); 5% (July 1994 to December 1998) [c]; 10% (1999); 12.5% (2000 to 2009); 10% (2010); 7.5% (2011); 5% (2012); 2.5% (2013) [b]
Increased rates	N.A.	+ 5% (small firms; 1995 to 1998); twice the general rate except for building investments (small firms; 1999 to 2013); + 2.5% (border areas; 2001 to 2009)
Special regional regulations	N.A.	Berlin: Reduced validity periods (Berlin West); reduced rates under certain conditions (1996 to 2012)
Assessment base	Movable assets (excluding aircraft); Immovable assets; modernisation of buildings	New and movable assets (excluding low-grade assets, aircraft, cars); new and immovable assets (since 1999); restriction to initial investments with a reduced rate of 5% for fundable but non-initial equipment investment and no funding for non-initial building investment (since 1999)
Formal requirements	Tax return	Formal application

Notes.[a] The last amendment of the law (ISL 2010) expired at the end of 2013. [b] Take-up of the subsidy might be restricted for key (sensitive) sectors like the steel industry, ship building, automotive industry, agriculture. [c]The investment subsidy rate was at 8% until the end of 1996 for investments that started before July 1994.

Table 2: *Relative Tax Burden (in %)*

	Large Businesses											Small and Medium Businesses										
Investment type	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Initial building investment	81.1	77.2	81.6	82.2	86.2	86.9	86.3	85.1	84.7	84.8	84.8	81.1	77.2	81.6	82.2	86.2	86.9	86.3	85.1	84.7	84.8	84.8
New buildings (non-initial investment)	81.1	77.2	81.6	82.2	98.3	98.3	98.1	98.4	98.4	98.4	98.3	81.1	77.2	81.6	82.2	98.3	98.3	98.1	98.4	98.4	98.4	98.3
Modernisations (non-initial investment)	81.0	74.0	78.9	79.4	98.0	98.0	98.0	98.3	98.2	98.3	98.1	81.0	74.0	78.9	79.4	98.0	98.0	98.0	98.3	98.2	98.3	98.1
Initial equipment investment	83.3	86.2	88.6	88.7	82.5	81.2	81.6	81.6	81.0	81.5	81.8	77.4	77.4	79.7	79.8	65.6	63.0	63.7	63.6	62.5	63.4	64.1
Non-initial equipment investment	83.3	86.2	88.6	88.7	90.9	91.3	92.3	99.5	99.5	99.6	99.5	77.4	77.4	79.7	79.8	82.5	83.2	85.2	92.3	92.1	92.3	92.4
Non-fundable equipment investment	94.4	95.0	97.4	97.6	99.4	99.4	99.4	99.5	99.5	99.6	99.5	94.4	95.0	97.4	97.6	99.4	99.4	99.4	99.5	99.5	99.6	99.5

Notes. Relative tax burden for investments in the eastern German states compared to the western German states. The calculation relies on Eq. (3). For details see the Online Appendix B.

Table 3:*Descriptive Statistics by Region: Matched Sample*

Panel A: Establishments in both parts of Germany (N=97,867)	Mean	Std. Dev.	Median
Real investments (thousands €)			
Gross investment (*thousands* €)	1,322.48	14,052.59	159.86
Building investment (*thousands* €)	181.03	1,561.08	0.00
Equipment investment (*thousands* €)	1,131.98	13,007.41	134.84
Land investment (*thousands* €)	9.47	165.07	0.00
Fraction of establishments with positive investments (%)			
Gross investment	90.80	28.90	100.00
Equipment investment	90.42	29.43	100.00
Building investment	30.50	46.04	0.00
Land investment	5.42	22.64	0.00
Control variables			
Large (>250 staff members) (%)	16.47	37.09	0.00
Capital stock (*thousands* €)	5,803.45	32,819.96	1,987.30
Revenue (millions €)	27.64	462.36	5.71
Revenue per capital (%)	4.10	10.18	2.97
GDP per capita (thousands €)	21.32	8.09	19.66
Population (1,000)	203.46	153.95	147.87
Unemployment rate (%)	13.95	5.71	14.30

Table 3 cont.

Panel B: Establishments in the western German states (N=43,759)	Mean	Std. Dev.	Median
Real investments (thousands €)			
Gross investment (thousands €)	1,423.88	18,845.22	151.56
Building investment (thousands €)	180.81	1,811.03	0.00
Equipment investment (thousands €)	1,231.13	17,483.07	132.09
Land investment (thousands €)	11.95	219.91	0.00
Fraction of establishments with positive investments (%)			
Gross investment	90.80	28.90	100.00
Equipment investment	90.46	29.37	100.00
Building investment	28.07	44.93	0.00
Land investment	4.66	21.07	0.00
Control variables			
Large (>250 staff members) (%)	17.90	38.33	0.00
Capital stock (thousands €)	5,500.45	40,011.25	1,723.50
Revenue (1,000,000 €)	36.56	682.42	6.10
Revenue per capital (%)	4.81	14.35	3.66
GDP per capita (thousands €)	25.98	9.14	23.93
Population (thousands)	265.87	188.47	213.05
Unemployment rate (%)	8.72	2.96	8.30
Panel C: Establishments in the eastern German states (N=54,108)	**Mean**	**Std. Dev.**	**Median**
Real investments (thousands €)			
Gross investment (thousands €)	1,240.47	8,363.84	167.42
Building investment (thousands €)	181.21	1,324.91	0.00
Equipment investment (thousands €)	1,051.80	7,669.30	137.50
Land investment (thousands €)	7.46	100.82	0.00
Fraction of establishments with positive investments (%)			
Gross investment	90.80	28.90	100.00
Equipment investment	90.39	29.47	100.00
Building investment	32.46	46.82	0.00
Land investment	6.04	23.82	0.00
Control variables			
Large (>250 staff members) (%)	15.32	36.02	0.00
Capital stock (thousands €)	6,048.49	25,562.90	2,212.89
Revenue (millions €)	20.43	99.58	5.44
Revenue per capital (%)	3.52	4.47	2.46
GDP per capita (thousands €)	17.54	4.38	16.53
Population (1,000)	152.98	91.88	132.18
Unemployment rate (%)	18.18	3.46	18.10

Notes. AFiD panel for establishments in the manufacturing sector in Germany; the pre-matched sample is based on the following matching characteristics: investment activity (as measured by the logarithm of building investment and the logarithm of equipment investment; both increased by one to avoid undefined values), establishment size and economic activity (as measured by the logarithm of sales revenue and the logarithm of the number of employees), industry, firm type, and the type of goods produced (for more detail see also Section 3.2); own calculations.

Table 4: *Investment at the Intensive and Extensive Margin*

Type of Investment	Buildings				Equipment			
Margin	Extensive margin		Intensive margin		Extensive margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	**0.116*****	**0.113*****	**0.404*****	**0.394*****	**0.0213*****	**0.0170*****	**0.0451**	**0.0203**
	(0.00824)	**(0.00855)**	**(0.0675)**	**(0.0709)**	**(0.00498)**	**(0.00521)**	**(0.0289)**	**(0.0282)**
Capital stock		0.0753***		0.445***		0.0444***		0.649***
		(0.00563)		(0.0481)		(0.00380)		(0.0217)
Revenue per Capital		0.000176		0.00395**		-6.47e-05		0.00727*
		(0.000255)		(0.00177)		(0.000286)		(0.00390)
Unemployment Rate		0.000222		-0.0454***		-0.000510		-0.0158***
		(0.00140)		(0.0133)		(0.000897)		(0.00476)
GDP per capita		-0.0355		0.130		-0.0331**		-0.0612
		(0.0249)		(0.241)		(0.0159)		(0.0865)
Population		-0.00481		0.0330		0.0115*		0.0258
		(0.0104)		(0.111)		(0.00673)		(0.0379)
Constant	0.241***	-0.449	11.32***	3.241	0.885***	0.435**	12.02***	2.884***
	(0.00441)	(0.286)	(0.0537)	(2.858)	(0.00321)	(0.182)	(0.0161)	(1.033)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year FE	NO	YES	NO	YES	NO	YES	YES	YES
Observations	97,867	97,867	29,845	29,845	97,867	97,867	88,495	88,495
Establishments	7,440	7,440	5,631	5,631	7,440	7,440	7,410	7,410
R-squared	0.407	0.413	0.397	0.409	0.365	0.369	0.675	0.688
Within R-squared	0.0291	0.0382	0.0174	0.0362	0.00484	0.0113	0.0171	0.0560

Notes: OLS regressions with establishment fixed effects and clustered standard errors on the establishment level (in parentheses). For building (equipment) investment at the extensive margin (Models 1, 2, 5, 6), the dependent variable is a dummy variable with a value of one for an establishment *i* with positive building (equipment) investments in *t*. For building (equipment) investment at the intensive margin (Models 3, 4, 7, 8), the dependent variable is the logarithm of positive building (equipment) investments of establishment *i* in *t*. *DiD* is an interaction term of a dummy variable for establishments in eastern German states and a dummy variable for the DAL treatment period (1995–1998). *Capital stock* is the logarithm of capital stock of establishment *i* and *Revenue per capital* is the ratio of sales revenue to the capital stock. *Unemployment rate* is the unemployment rate of the district of establishment *i* in *t* in percentage points. *GDP per capita* (*Population*) is the logarithm of the gross domestic product per capita (the number of inhabitants) of this district; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: *Heterogeneity of Investment Decisions*

Type of investment	Building investment share				Buildings		Equipment	
Margin	Extensive margin sample		Intensive margin sample		Extensive margin	Intensive margin	Extensive margin	Intensive margin
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	**0.0517*** **	**0.0513*** **	**0.0390*** **	**0.0372*** **	**0.113*** **	**0.282*** **	**0.0107***	**-0.0213**
	(0.00412)	**(0.00475)**	**(0.00879)**	**(0.0112)**	**(0.00969)**	**(0.0842)**	**(0.00584)**	**(0.0304)**
DiD large		**-0.00433**		**-0.00525**	**0.00143**	**0.364** **	**-0.000870**	**0.234*** **
		(0.0104)		**(0.0181)**	**(0.0249)**	**(0.169)**	**(0.0133)**	**(0.0766)**
DiD group		**-0.00603**		**-0.00389**	**-0.0244**	**0.0354**	**0.0183**	**-0.123**
		(0.0124)		**(0.0237)**	**(0.0273)**	**(0.199)**	**(0.0163)**	**(0.133)**
Large		0.00811		0.0168	0.0395	0.152	-0.0440***	-0.114
		(0.0106)		(0.0196)	(0.0253)	(0.175)	(0.0133)	(0.0752)
Group		-0.0180		-0.0128	-0.0445*	-0.277	-0.0417**	-0.0775
		(0.0119)		(0.0243)	(0.0267)	(0.212)	(0.0175)	(0.0916)
Capital stock	0.0151***	0.0162***	-0.0143**	-0.0171***	0.0755***	0.449***	0.0464***	0.665***
	(0.00267)	(0.00281)	(0.00600)	(0.00652)	(0.00579)	(0.0529)	(0.00409)	(0.0232)
Revenue per	0.000279	0.000283	-5.33e-06	-9.50e-06	0.000180	0.00394**	-4.59e-05	0.00730*
Capital	(0.000199)	(0.000199)	(9.20e-05)	(9.30e-05)	(0.000250)	(0.00177)	(0.000276)	(0.00388)
Unemployment	-0.000371	-0.000331	-0.00121	-0.00134	0.000603	-0.0403***	-0.000216	-0.0153***
	(0.000672)	(0.000679)	(0.00161)	(0.00165)	(0.00142)	(0.0135)	(0.000904)	(0.00480)
GDP per capita	-0.00654	-0.00824	0.0274	0.0235	-0.0400	0.138	-0.0338**	-0.0516
	(0.0122)	(0.0123)	(0.0303)	(0.0306)	(0.0250)	(0.243)	(0.0160)	(0.0867)
Population	0.000449	0.00107	0.0206	0.0194	-0.00346	0.0278	0.0118*	0.0336
	(0.00503)	(0.00503)	(0.0136)	(0.0137)	(0.0104)	(0.113)	(0.00672)	(0.0380)
Constant	-0.0879	-0.0925	-0.0398	0.0615	-0.424	3.300	0.417**	2.482**
	(0.142)	(0.143)	(0.369)	(0.374)	(0.287)	(2.884)	(0.183)	(1.042)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-type-year FE	NO	YES	NO	YES	YES	YES	YES	YES
Observations	88,865	88,865	29,845	29,845	97,867	29,845	97,867	88,495
Establishments	7,411	7,411	5,631	5,631	7,440	5,631	7,440	7,410
R-squared	0.234	0.235	0.423	0.424	0.414	0.411	0.370	0.689
Within R-squared	0.0209	0.0219	0.0125	0.0141	0.0395	0.0402	0.0131	0.0580

Notes: OLS regressions with establishment fixed effects and clustered standard errors on the establishment level (in parentheses). For building investment share the dependent variable is the share of building investments to total investments. In these regressions, we consider either establishments with positive aggregate investments (Models 1, 2) or only establishments with positive building investments (Models 3, 4). For building (equipment) investment at the extensive margin (Models 5, 7), the dependent variable is a dummy variable with a value of one for an establishment *i* with positive building (equipment) investments in *t*. For building (equipment) investment at the intensive margin (Models 6, 8), the dependent variable is the logarithm of positive building (equipment) investments of establishment *i* in *t*. *DiD* is an interaction term of a dummy variable for establishments in the eastern German states and a dummy variable for the DAL treatment period (1995–1998). *DiD Large* is an interaction term of a dummy variable for firms with at least 250 staff members (*Large*) and *DiD*. *DiD Group* is an interaction term of a dummy variable for firms with more than one establishment (*Group*) and *DiD*. *Capital stock* is the logarithm of capital stock of establishment *i* and *Revenue per capital* is the ratio of sales revenue to the capital stock. *Unemployment rate* is the unemployment rate of the district of establishment *i* in *t* in percentage points. *GDP per capita* (*Population*) is the logarithm of the gross domestic product per capita (the number of inhabitants) of this district; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: *Timing of Investment*

Type of Investment	Buildings				Equipment			
Margin	Extensive margin		Intensive margin		Extensive margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	**0.134*** **	**0.136*** **	**0.504*** **	**0.405*** **	**0.0202*** **	**0.0137* **	**0.0901** **	**0.0470**
	(0.0119)	**(0.0129)**	**(0.101)**	**(0.113)**	**(0.00715)**	**(0.00764)**	**(0.0375)**	**(0.0399)**
DiD 9798	**-0.0308*** **	**-0.0319*** **	**-0.202* **	**-0.230** **	**-0.00626**	**-0.00592**	**-0.104*** **	**-0.107*** **
	(0.0113)	**(0.0118)**	**(0.104)**	**(0.111)**	**(0.00636)**	**(0.00653)**	**(0.0357)**	**(0.0365)**
DiD 99	**0.0213** **	**0.0290*** **	**-0.0828**	**-0.0990**	**-0.00425**	**-0.00408**	**0.0410**	**0.0227**
	(0.00991)	**(0.0103)**	**(0.0906)**	**(0.0958)**	**(0.00605)**	**(0.00617)**	**(0.0324)**	**(0.0334)**
DiD large		**0.000887**		**0.360** **		**-0.00101**		**0.233*** **
		(0.0249)		**(0.169)**		**(0.0133)**		**(0.0765)**
DiD group		**-0.0235**		**0.0417**		**0.0185**		**-0.119**
		(0.0273)		**(0.198)**		**(0.0163)**		**(0.133)**
Large		0.0406		0.169		-0.0438***		-0.109
		(0.0252)		(0.175)		(0.0133)		(0.0752)
Group		-0.0368		-0.222		-0.0404**		-0.0530
		(0.0268)		(0.214)		(0.0176)		(0.0920)
Capital stock	0.0759***	0.0762***	0.447***	0.449***	0.0444***	0.0464***	0.651***	0.667***
	(0.00564)	(0.00580)	(0.0481)	(0.0529)	(0.00381)	(0.00410)	(0.0218)	(0.0232)
Revenue per	0.000178	0.000183	0.00398**	0.00396**	-6.42e-05	-4.54e-05	0.00728*	0.00731*
Capital	(0.000256)	(0.000251)	(0.00177)	(0.00177)	(0.000286)	(0.000276)	(0.00391)	(0.00388)
Unemployment	0.00139	0.00177	-0.0382***	-0.0332**	-0.000338	-6.81e-05	-0.0119**	-0.0118**
rate	(0.00149)	(0.00150)	(0.0142)	(0.0143)	(0.000957)	(0.000961)	(0.00509)	(0.00510)
GDP per capita	-0.0241	-0.0274	0.153	0.159	-0.0331**	-0.0338**	-0.0302	-0.0270
	(0.0252)	(0.0253)	(0.244)	(0.246)	(0.0161)	(0.0161)	(0.0877)	(0.0878)
Population	-0.00378	-0.00252	0.0407	0.0357	0.0117*	0.0120*	0.0292	0.0367
	(0.0104)	(0.0104)	(0.111)	(0.113)	(0.00674)	(0.00673)	(0.0380)	(0.0381)
Constant	-0.597**	-0.585**	2.820	2.914	0.430**	0.413**	2.461**	2.135**
	(0.292)	(0.293)	(2.898)	(2.921)	(0.185)	(0.187)	(1.050)	(1.058)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-type-year FE	NO	YES	NO	YES	YES	YES	YES	YES
Observations	97,867	97,867	29,845	29,845	97,867	97,867	88,495	88,495
Establishments	7,440	7,440	5,631	5,631	7,440	7,440	7,410	7,410
R-squared	0.413	0.414	0.409	0.411	0.369	0.370	0.688	0.689
Within R-squared	0.0383	0.0396	0.0364	0.0404	0.0114	0.0131	0.0561	0.0581

Notes**:** OLS regressions with establishment fixed effects and clustered standard errors on the establishment level (in parentheses). For building (equipment) investment at the extensive margin (Models 1, 2, 5, 6), the dependent variable is a dummy variable with a value of one for an establishment *i* with positive building (equipment) investments in *t*. For building (equipment) investment at the intensive margin (Models 3, 4, 7, 8), the dependent variable is the logarithm of positive building (equipment) investments of establishment *i* in *t*. *DiD* is an interaction term of a dummy variable for establishments in eastern German states and a dummy variable for the DAL treatment period (1995–1998). *DiD 9798* is an interaction term of a dummy variable for the years 1997–1998 and *DiD*. *DiD 99* is an interaction term of a dummy variable for establishments in the eastern German states and a dummy variable for 1999. *DiD Large* is an interaction term of a dummy variable for firms with at least 250 staff members (*Large*) and *DiD*. *DiD Group* is an interaction term of a dummy variable for firms with more than one establishment (*Group*) and *DiD*. *Capital stock* is the logarithm of capital stock of establishment *i* and *Revenue per capital* is the ratio of sales revenue to the capital stock. *Unemployment rate* is the unemployment rate of the district of establishment *i* in *t* in percentage points. *GDP per capita* (*Population*) is the logarithm of the gross domestic product per capita (the number of inhabitants) of this district; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A1: *Building Price Indices: Manufacturing Sector*

Survey year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Index eastern Germany	97.9	98.1	97.3	96.3	95.0	94.7	94.1	94.3	95.3	97.8	100.0	102.5	110.4	114.6
Index western Germany	93.9	94.2	93.9	94.5	94.7	95.9	96.7	96.9	97.2	98.4	100.0	102.3	109.6	113.6

Weighted average building price indices for the manufacturing sector in the eastern and western German states. We calculate the indices from GDP-weighted price indices in the manufacturing sector as reported by the Statistical State Offices for the western German federal states (Baden-Württemberg, Bavaria, Hessen, Lower Saxony, North Rhine-Westphalia and Saarland) and the eastern states (Brandenburg, Saxony, Saxony-Anhalt and Thuringia). Due to the specific economic and legal conditions in Berlin, we do not account for price developments in that area. There are no corresponding price indices available for Bremen, Hamburg, Mecklenburg-West Pomerania, Rhineland-Palatinate or Schleswig-Holstein.

Table A2: *Descriptive Statistics by Region: Unmatched Full Sample*

Panel A: Establishments in both parts of Germany (N = 593,147)	Mean	Std. Dev.	Median
Real investments (thousands €)			
Gross investment (*thousands* €)	1,125.69	10,997.84	110.45
Building investment (*thousands* €)	130.31	1,472.09	0.00
Equipment investment (*thousands* €)	987.62	10,091.26	98.93
Land investment (*thousands* €)	7.76	265.54	0.00
Fraction of establishments with positive investments (%)			
Gross investment	86.15	34.54	100.00
Equipment investment	85.77	34.93	100.00
Building investment	20.73	40.54	0.00
Land investment	3.31	17.88	0.00
Control variables			
Large (>250 staff members) (%)	18.27	38.64	0.00
Capital stock (*thousands* €)	5,173.80	26,308.17	1,634.00
Revenue (millions €)	30.26	300.96	5.81
Revenue per capital (%)	501.69	1,140.32	366.26
GDP per capita (*thousands* €)	25.35	9.85	23.30
Population (*thousands*)	275.02	241.07	203.52
Unemployment rate (%)	10.35	4.58	9.10

Table A2 cont.

Panel B: Establishments in the western German states (N= 496,715)	Mean	Std. Dev.	Median
Real investments (thousands €)			
Gross investment	1,147.02	11,357.39	112.45
Building investment	125.71	1,379.91	0.00
Equipment investment	1,013.26	10,445.72	102.65
Land investment	8.06	286.72	0.00
Fraction of establishments with positive investments (%)			
Gross investment	86.31	34.38	100.00
Equipment investment	85.95	34.75	100.00
Building investment	19.36	39.51	0.00
Land investment	2.97	16.98	0.00
Control variables			
Large (>250 staff members) (%)	19.25	39.43	0.00
Capital stock (*thousands €*)	5,274.29	27,218.72	1,607.43
Revenue (*millions €*)	33.24	326.94	6.29
Revenue per capital (%)	535.10	1,226.51	395.48
GDP per capita (*thousands €*)	26.84	9.91	24.40
Population (*thousands*)	298.64	253.57	242.73
Unemployment rate (%)	8.85	2.98	8.40
Panel C: Establishments in the eastern German states (N = 96,432)	Mean	Std. Dev.	Median
Real investments (thousands €)			
Gross investment	1,015.80	8,918.28	98.45
Building investment	154.00	1,876.33	0.00
Equipment investment	855.59	8,019.73	81.87
Land investment	6.21	101.27	0.00
Fraction of establishments with positive investments (%)			
Gross investment	85.36	35.35	100.00
Equipment investment	84.83	35.64	100.00
Building investment	27.78	44.79	0.00
Land investment	5.04	21.87	0.00
Control variables			
Large (>250 staff members) (%)	13.19	33.84	0.00
Capital stock (*thousands €*)	4,656.17	20,994.16	1,765.87
Revenue (*millions €*)	14.94	79.20	3.91
Revenue per capital (%)	333.17	464.09	228.20
GDP per capita (*thousands €*)	17.64	4.47	16.60
Population (*thousands*)	153.38	92.70	132.16
Unemployment rate (%)	18.06	3.51	18.10

Notes. AFiD panel industrial units (unmatched full sample) of the manufacturing industry; own calculations.

Table A3: *Robustness Checks: Unmatched Full Sample*

Type of investment	Building investment				Equipment investment			
Margin	Extensive margin		Intensive margin		Extensive margin		Intensive margin	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	**0.0858*** **	**0.115*** **	**0.375*** **	**0.451*** **	**0.0352*** **	**0.0414*** **	**0.0536*** **	**0.0877*** **
	(0.00520)	**(0.00776)**	**(0.0475)**	**(0.0722)**	**(0.00355)**	**(0.00508)**	**(0.0179)**	**(0.0256)**
DiD 9798		**-0.0332*** **		**-0.196*** **		**-0.0154*** **		**-0.163*** **
		(0.00669)		**(0.0673)**		**(0.00447)**		**(0.0229)**
DiD 99		**0.0584*** **		**0.144** **		**0.0237*** **		**0.0698*** **
		(0.00608)		**(0.0639)**		**(0.00450)**		**(0.0213)**
DiD large		**0.0120**		**0.461*** **		**-0.00152**		**0.384*** **
		(0.0149)		**(0.118)**		**(0.00991)**		**(0.0530)**
DiD group		**-0.0124**		**-0.157**		**0.0101**		**0.0430**
		(0.0138)		**(0.133)**		**(0.0111)**		**(0.0628)**
Large		0.0574***		0.0381		-0.0622***		-0.236***
		(0.00833)		(0.0807)		(0.00537)		(0.0274)
Group		-0.0446***		-0.112		-0.0114**		-0.0245
		(0.00740)		(0.0782)		(0.00568)		(0.0278)
Capital stock	0.0672***	0.0656***	0.417***	0.414***	0.0680***	0.0737***	0.772***	0.800***
	(0.00231)	(0.00236)	(0.0308)	(0.0334)	(0.00210)	(0.00223)	(0.0132)	(0.0140)
Revenue per	0.000309**	0.000314**	0.00381**	0.00364**	0.000500***	0.000483***	0.00598**	0.00592**
Capital	(0.000143)	(0.000143)	(0.00163)	(0.00158)	(0.000184)	(0.000178)	(0.00247)	(0.00245)
Unemployment	0.000802	0.00222***	-0.0339***	-0.0180*	-0.00148***	-0.000851	-0.00637**	-0.000934
	(0.000695)	(0.000729)	(0.00874)	(0.00947)	(0.000564)	(0.000596)	(0.00289)	(0.00307)
GDP per capita	-0.0274**	-0.0170	0.184	0.264*	-0.0205**	-0.0170*	0.0448	0.0737
	(0.0111)	(0.0111)	(0.140)	(0.141)	(0.00882)	(0.00886)	(0.0548)	(0.0553)
Population	-0.0146**	-0.0135**	0.0435	0.0610	0.000492	0.00170	0.0259	0.0345
	(0.00643)	(0.00646)	(0.0887)	(0.0895)	(0.00516)	(0.00517)	(0.0259)	(0.0260)
Constant	-0.350***	-0.456***	2.726	1.709	0.0684	-0.0578	-0.295	-1.109*
	(0.135)	(0.136)	(1.793)	(1.826)	(0.111)	(0.112)	(0.646)	(0.657)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-type-year FE	NO	YES	NO	YES	YES	YES	YES	YES
Observations	593,147	593,147	122,947	122,947	593,147	593,147	508,747	508,747
Establishments	70,323	70,323	31,955	31,955	70,323	70,323	65,492	65,492
R-squared	0.444	0.445	0.482	0.483	0.471	0.472	0.714	0.714
Within R-squared	0.0202	0.0212	0.0201	0.0219	0.0129	0.0148	0.0532	0.0547

Notes: OLS regressions with establishment fixed effects and clustered standard errors on the establishment level (in parentheses). For building (equipment) investment at the extensive margin (Models 1, 2, 5, 6), the dependent variable is a dummy variable with a value of one for an establishment *i* with positive building (equipment) investments in *t*. For building (equipment) investment at the intensive margin (Models 3, 4, 7, 8), the dependent variable is the logarithm of positive building (equipment) investments of establishment *i* in *t*. *DiD* is an interaction term of a dummy variable for establishments in the eastern German states and a dummy variable for the DAL treatment period (1995–1998). *Capital stock* is the logarithm of capital stock of establishment *i* and *Revenue per capital* is the ratio of sales revenue to the capital stock. *Unemployment rate* is the unemployment rate of the district of establishment *i* in *t* in percentage points. *GDP per capita* (*Population*) is the logarithm of the gross domestic product per capita (the number of inhabitants) of this district; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: *Robustness Checks: Alternative Matching Year*

Type of investment	Building investment				Equipment investment			
Margin	Extensive margin		Intensive margin		Extensive margin		Intensive margin	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	**0.128*** **	**0.156*** **	**0.489*** **	**0.553*** **	**0.0315*** **	**0.0286*** **	**0.0605** **	**0.0753* **
	(0.00855)	**(0.0129)**	**(0.0744)**	**(0.121)**	**(0.00538)**	**(0.00768)**	**(0.0274)**	**(0.0396)**
DiD 9798		**-0.0317*** **		**-0.199* **		**-0.00296**		**-0.121*** **
		(0.0117)		**(0.117)**		**(0.00676)**		**(0.0365)**
DiD 99		**0.0974*** **		**0.0851**		**0.0105**		**0.131*** **
		(0.0104)		**(0.102)**		**(0.00639)**		**(0.0343)**
DiD large		**0.0232**		**0.328* **		**-0.0106**		**0.336*** **
		(0.0247)		**(0.173)**		**(0.0140)**		**(0.0770)**
DiD group		**0.00615**		**0.173**		**0.0261**		**0.0512**
		(0.0271)		**(0.227)**		**(0.0177)**		**(0.123)**
Large		0.0446*		0.181		-0.0394***		-0.135*
		(0.0246)		(0.180)		(0.0142)		(0.0738)
Group		-0.0525**		-0.151		-0.0332**		-0.198**
		(0.0243)		(0.209)		(0.0167)		(0.0854)
Capital stock	0.0800***	0.0792***	0.489***	0.496***	0.0405***	0.0431***	0.653***	0.671***
	(0.00571)	(0.00589)	(0.0493)	(0.0542)	(0.00386)	(0.00415)	(0.0210)	(0.0224)
Revenue per	0.00354***	0.00348***	0.0310***	0.0314***	0.00158***	0.00152***	0.0239***	0.0239***
Capital	(0.000642)	(0.000645)	(0.00610)	(0.00601)	(0.000434)	(0.000426)	(0.00498)	(0.00492)
Unemployment	-0.000532	0.00165	-0.0358***	-0.0252*	-0.000235	0.000230	-0.0109**	-0.00593
	(0.00137)	(0.00147)	(0.0135)	(0.0144)	(0.000878)	(0.000937)	(0.00466)	(0.00498)
GDP per capita	-0.0329	-0.00503	0.0597	0.165	-0.0194	-0.0163	-0.0596	0.0137
	(0.0247)	(0.0251)	(0.242)	(0.247)	(0.0161)	(0.0163)	(0.0879)	(0.0885)
Population	-0.0160	-0.0129	-0.0409	-0.0290	0.00368	0.00503	0.0232	0.0335
	(0.0101)	(0.0101)	(0.107)	(0.108)	(0.00672)	(0.00673)	(0.0356)	(0.0356)
Constant	-0.407	-0.741**	3.994	2.670	0.443**	0.363*	2.713***	1.598
	(0.283)	(0.291)	(2.819)	(2.896)	(0.186)	(0.191)	(1.029)	(1.049)
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Industry-year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-type-year FE	NO	YES	NO	YES	YES	YES	YES	YES
Observations	100,458	100,458	30,543	30,543	100,458	100,458	90,820	90,820
Establishments	7,794	7,794	5,803	5,803	7,794	7,794	7,764	7,764
R-squared	0.419	0.420	0.407	0.409	0.370	0.371	0.693	0.694
Within R-squared	0.0353	0.0376	0.0360	0.0393	0.00912	0.0108	0.0505	0.0536

Notes: OLS regressions with establishment fixed effects and clustered standard errors on the establishment level (in parentheses). For building (equipment) investment at the extensive margin (Models 1, 2, 5, 6), the dependent variable is a dummy variable with a value of one for an establishment *i* with positive building (equipment) investments in *t*. For building (equipment) investment at the intensive margin (Models 3, 4, 7, 8), the dependent variable is the logarithm of positive building (equipment) investments of establishment *i* in *t*. *DiD* is an interaction term of a dummy variable for establishments in the eastern German states and a dummy variable for the DAL treatment period (1995–1998). *Capital stock* is the logarithm of capital stock of establishment *i* and *Revenue per capital* is the ratio of sales revenue to the capital stock. *Unemployment rate* is the unemployment rate of the district of establishment *i* in t in percentage points. *GDP per capita* (*Population*) is the logarithm of the gross domestic product per capita (the number of inhabitants) of this district; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Sloane, Corinna Treisch

Kontaktadresse:
Prof. Dr. Caren Sureth-Sloane, Universität Paderborn,
Fakultät für Wirtschaftswissenschaften,
Warburger Str. 100, 33098 Paderborn,
www.arqus.info, Email: info@arqus.info

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