Tax Depreciation and Investment Decisions: Evidence from the Leasing Sector*

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Abstract:

This paper examines the investment response of finance lease firms to a change in tax depreciation rules. Using an exogenous shock in Germany, our results suggest that finance lease companies, the only organisations affected by such a change, reduce their investments following the abolition of a beneficial and long-standing tax depreciation method. We provide evidence that the exposure of finance lease firms to regulatory requirements moderates the investment effect. Additional cross-sectional tests indicate a larger investment response for finance lease firms with a product portfolio specialised in mobile assets and, in particular, office and IT assets. Our findings add to the existing contributions on the effect of tax depreciation on investment decisions and to the limited literature looking into the effect of taxation on financial institutions.

JEL classification: D22, E22, G23, G31, H32, H25

Keywords: tax depreciation, investment decisions, leasing companies

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1. Introduction

Prior literature has primarily analysed the effect of tax depreciation incentives on investment decisions of manufacturing firms. However, we know little about the investment response of leasing companies to tax incentives, despite the fact that leasing is one of the most important types of financing. In 2017, almost half of the investments in equipment and software by private firms in the United States were purchased via leases, which makes leasing the most common payment method.[1] In Europe, total new leasing volumes amount to EUR 384.1bn in 2017 with UK (EUR 101.3bn) as the largest leasing market followed by Germany (EUR 58.7bn).[2] Given the importance of leasing companies as a provider of assets, it is important to understand the effect of tax depreciation on leasing firms' investments in leased assets. In addition, compared to manufacturing firms, due to their financing function lease firms, which offer finance leases are subject to regulatory requirements in many countries (e.g., Germany, Italy, Spain and Belgium).[3] It thus remains an open empirical question how tax depreciation allowances affect lease firms' investment decisions in a regulated environment. We answer this question by investigating the effect of tax depreciation allowances on investments by finance lease firms.

The expected stimulating effect of tax depreciation deductions was investigated by many empirical studies (e.g., Hassett and Newmark, 2008; Hanlon and Heitzman, 2010). A large proportion of prior literature exploits the bonus depreciation provisions in the US as exogenous reform settings (e.g., Desai and Goolsbee, 2004; Cohen and Cummins, 2006; Hulse

[1] See, 2018 Equipment Leasing and Finance Industry Horizon Report of the Equipment Leasing and Finance Foundation (https://www.store.leasefoundation.org/cvweb/Portals/ELFA-LEASE/Documents/Products/2018%20Equipment%20Leasing%20&%20Finance%20Industry%20Horizon%20Report.pdf, last assessed June 29, 2020).

[2] See, Annual Survey 2017 of Leaseurope (http://www.leaseurope.org/uploads/documents/stats/European%20Leasing%20Market%202017.pdf, last assessed June 29, 2020)

[3] See, Global Financial Services Regulatory Guide by Baker McKenzie, November 2019 (https://globalfsrguide.bakermckenzie.com/-/media/global-financial-services-regulatory-guide/files/updated1122_global-fsr-guide.pdf?la=en, last assessed June 29, 2020). Offering finance leases is in principle an activity that requires a license. In order to become authorised, countries have various requirements that need to be satisfied, e.g., legal form, initial capital, minimum capital requirements etc.

and Livingstone, 2010; Zwick and Mahon, 2017; Ohrn, 2019). The results suggest that temporary bonus depreciation regimes incentivise investments. In line with studies on US bonus depreciation allowances, a few studies additionally provide evidence that accelerated depreciation provisions incentivise firm investments in other country-specific settings, e.g., Germany, Netherlands and United Kingdom (e.g., Wielhouwer and Wiersma, 2017; Eichfelder and Schneider, 2018; Maffini et al., 2019). However, empirical evidence on the effect of tax depreciation on firms' investments is limited in at least three ways. First, the majority of studies examine the investment response of manufacturing firms. Second, most existing studies focus on temporary tax depreciation regimes such as special bonus or discretionary tax depreciation provisions. Third, the majority of studies investigate depreciation tax incentives during economic downturns. Countries often foster the economy during economic crises by introducing such provisions simultaneously with other tax or investment incentives, resulting in potential confounding effects that limit the validity of previous results. Our paper aims to overcome these limitations and examines the investment response of leasing firms to a change in tax depreciation rules.

We do so by exploiting a German tax depreciation reform that is applicable to firms offering finance leases. Before 2013, tax authorities accepted two regular depreciation methods for tax purposes. First, the lessor could apply straight-line tax depreciation over the expected useful life of the leased asset, which is determined in tax depreciation tables issued by the Federal Ministry of Finance. Second, the lessor could apply straight-line depreciation over the lease term under consideration of the residual value provided in the lease contract.

The latter depreciation method was the preferred and most frequently applied method for tax and accounting purposes of finance lease contracts. This is because the business model of finance lease firms requires the leased asset to be financed and amortised during the non-cancellable lease term. In contrast to finance leases, this depreciation method is not common

for operating leases because the business model of operating lease firms requires that the leased asset is financed and amortised by multiple and short-term transfers of the leased asset to various lessees. With effect from 1.1.2014, the supreme tax authorities abolished lease-specific straight-line tax depreciation over the lease term.[4] Since then, when determining the depreciation deduction for tax purposes the lessor has had to apply straight-line depreciation over the expected useful life of the asset, based on the tax depreciation tables.

This setting has some valuable advantages, which, on the one hand, mitigate the limitations of prior literature. We examine a permanent and significant change in tax depreciation rules that is neither overlapped by other tax or accounting changes nor by special economic circumstances, e.g., economic downturns. On the other hand, we have a clear setting in which only finance lease companies are affected by a change in tax depreciation deductions, allowing us to investigate the investment behaviour of a specific kind of financial institution.

Based on theoretical considerations, the tax depreciation method applied affects the present value of tax depreciation deductions and hence the present value of tax payments and the cost of investment (e.g., Hall and Jorgenson, 1967; Summers, 1981; Auerbach, 1983). In addition to a reduction in the cost of capital, tax depreciation deductions can alleviate financial frictions due to imperfect markets or regulatory requirements and thus increase investments (e.g., Fazzari et al., 1988). Straight-line tax depreciation over the expected useful life of the leased asset results in a lower present value of tax depreciation deductions compared to straight-line tax depreciation over the lease term, because the expected useful life of a leased asset is longer than the lease term. However, the benefit of a shorter depreciation period in terms of net present value is dependent on the capital market interest rate. Where this interest rate is zero, clearly the difference vanishes. Considering both potential channels (cost of capital and

[4] See, e.g., Federal Ministry of Finance, IV C 6 – S 2170/08/10002:004, of February 24, 2014 and specialist information of the tax authority Hamburg, 52 – O 1000 – 003/12, Number 06/2014 (https://stbk-hamburg.de/wp-content/uploads/Fach-Info-6-2014-f%C3%BCr-StB-Kammer-15-12-14_1.pdf).

financial friction) for the investment response, we posit that the change of tax depreciation rules to a less beneficial tax depreciation regime decreases investments.

To investigate this hypothesis, we exploit the German exogenous shock setting by applying a difference-in-differences (DiD) approach. Our treatment group is defined as German companies from the finance lease sector. We manually collect financial statement data of German companies that offer finance leases from the German Federal Gazette's Company Register database. These companies can be identified because they are licensed, supervised and registered by the German Federal Financial Supervisory Authority. Our control group consists of German firms that belong to the rental sector. We collect financial data of our control firms from Bureau van Dijk's Amadeus database.

The results of our DiD analysis show that after the preferred tax depreciation over the lease term was abolished, making the less beneficial tax depreciation over the expected useful life of the asset the only applicable tax depreciation method, firms from the finance lease sector reduce their investments in tangible assets. The estimated elasticity of investments with respect to the net-of-tax cost of a unit investment is about -6, which is in line with prior literature (e.g., Ohrn, 2018). Our result is consistent when applying alternative definitions of the dependent variable and using matched samples. Further, we conduct placebo tests to challenge the validity of our exogenous shock. The results suggest that the placebo treatment effects are not statistically significant, thereby supporting our parallel trend assumption.

In addition to this analysis, we investigate whether financial frictions resulting from regulatory requirements regarding liquidity and risk management moderate the investment response of treated firms. Finance lease firms can only undertake investment decisions when they comply with these regulatory standards. However, the increase in tax payments due to a shift to the less beneficial tax depreciation allowance reduces cash flow and hence liquidity, resulting in a burden on the equity. Due to the regulatory requirements that finance lease firms

are exposed to, we predict that this decrease in liquidity and burden on equity negatively affect their investment. We conduct cross-sectional tests to examine whether our treatment effect varies with the firm's exposure to regulatory requirements. We apply four firm-level characteristics as proxies for the exposure of finance lease firms to regulatory standards. Results from our cross-sectional tests reveal a stronger treatment effect for small firms and firms with low cash and low equity that are affiliated to banks, suggesting that finance lease firms, which are particularly strongly exposed to regulatory requirements, have a stronger investment response to the change in tax depreciation methods.

In our second set of cross-sectional tests, we examine whether our treatment effect varies with business model characteristics. First, we find that the investment response of finance lease firms is stronger if their product portfolio relies heavily on leased assets for which the difference between the lease term and the expected useful life of the leased asset is high. Our results reveal that finance lease firms with a product focus on mobile assets, especially, office/IT assets, are heavily affected by the reform. Second, we find no significant treatment effect for direct lease firms of specific manufacturers, indicating that our findings cannot be explained by a decrease in demand.

Our paper contributes to the literature on the effect of tax depreciation on firms' investment behaviour. The majority of the recent literature provides evidence on manufacturing firms only or focuses on temporary tax depreciation regimes (e.g., Hassett and Newmark, 2008; Hulse and Livingstone, 2010; Wielhouwer and Wiersma, 2017; Zwick and Mahon, 2017; Eichfelder and Schneider, 2018; Ohrn, 2018; Ohrn, 2019). We add to the literature by exploiting a setting that overcomes the major limitations of prior studies. Our setting offers a permanent change in tax depreciation rules and is not confounded by other tax changes or economic factors. Therefore, we are able to identify a clearer investment response to a change in tax depreciation allowances.

Second, our study adds to the limited literature on the effect of taxation on financial institutions. Prior literature examines the effect of taxation on various decisions of banks, e.g., profit-shifting activities, capital structure choice, location decision and transparency (e.g., Huizinga et al., 2014; Merz and Overesch, 2016; Merz et al., 2017; Heckemeyer and de Mooij, 2017; Andries et al., 2017). However, previous studies do not focus on finance lease firms as a specific financial institution operating in a regulated environment. We work towards filling this gap by examining the effect of tax depreciation allowances on leasing firms' investments. In addition, we provide evidence that regulatory requirements moderate the investment effect. In this context, we answer the call for research on the effect of taxation on financial institutions (Hanlon and Heitzman, 2010).

The paper is structured as follows. In Section 2, we provide a literature review, describe the institutional background of tax depreciation rules and regulatory requirements for leasing companies in Germany, and develop our empirical prediction. Section 3 outlines the research design and describes the data. In Section 4 and 5, we present empirical findings for our baseline and cross-sectional tests. Section 6 delivers our conclusions.

2. Institutional background and empirical predictions

2.1. Literature review

There is a volume of literature that examines the effect of tax incentives on firms' investment decisions (Hassett and Newmark, 2008; Hanlon and Heitzman, 2010; Dwenger, 2010). Early literature fails to provide evidence on the effect of tax incentives on investment decisions due to rather endogenous tax regime changes when employing aggregate time-series data and displays difficulties in controlling for non-tax effects on investments (Hines, 1998; Hassett and Hubbard, 2002; Dwenger, 2010). However, more recent literature uses exogenous

cross-sectional variation in the user cost of capital at firm- and asset-levels to overcome the earlier identification issues (Zwick and Mahon, 2017; Maffini et al., 2019; Ohrn, 2019).

The bonus depreciation provisions are widely exploited reform settings that were applicable in the US from the end of 2001 to the end of 2004 and from 2008 onwards. While theory predicts that bonus depreciation deductions decrease the user cost of capital and hence should increase investment (Cohen et al., 2002), little evidence exists in early literature that bonus depreciation provisions increased firms' investment (Hanlon and Heitzman, 2010). Desai and Goolsbee (2004) apply a tax-adjusted q-model with firm-level data. Although they find that investment is positively associated with the bonus depreciation allowance, the effect is rather small and does not prevent the decrease in aggregate investments.

Cohen and Cummins (2006) differentiate between assets with a long and a short tax life to investigate the effect of the bonus depreciation provision on specific asset classes. However, their results suggest only a very limited impact on investment spending. House and Shapiro (2008) show timing and substitution effects of the bonus depreciation allowances on investment, although it is unclear whether aggregate investments respond to the new depreciation regulation (Hanlon and Heitzman, 2010). Dauchy and Martinez (2008) find a significant overall effect on investment, albeit a small one. They point out that the isolation of the bonus depreciation effect from the general trend is challenging. In the same manner, Hulse and Livingstone (2010) underline that a conclusion to the effect of the bonus depreciation provisions should be reached cautiously because of the mixed and rather weak results with relatively minor outcomes.[5]

[5] In order to explain the rather mixed results of prior literature, Edgerton (2010) argues that the effectiveness of US bonus depreciation provisions was reduced because of the asymmetric tax treatment of profits and losses. In addition, the effectiveness of tax depreciation incentives may be limited because the temporary tax depreciation benefit does not directly affect accounting earnings and thus does not have financial reporting consequences, which are more important to managers (Neubig, 2006; Hulse and Livingstone, 2010; Edgerton, 2012). Results of different surveys reveal that temporary accelerated and bonus depreciation provisions do not appear to be of great importance to managers (Rose and O'Neil, 1985; Porcano, 1987; Cohen and Cummins, 2006).

However, recent studies that use predominantly comprehensive data on micro levels support the theoretical prediction that temporary bonus depreciations affect investment decisions. Zwick and Mahon (2017) compare firms in industries with mainly long-duration investments to firms in industries with mainly short-duration investments during the US bonus depreciation periods. They find an investment effect that is larger for small and cash-poor firms. Ohrn (2019) complements the results by showing that two state adopted accelerated depreciation policies (US bonus depreciation and Section 179 allowance) have a big effect on investments in the US manufacturing sector. However, each of the policies is mitigated as the other is made more generous.

In line with the latest literature on US bonus depreciation allowances, a few studies also provide evidence that accelerated depreciation provisions incentivise firm investments in other country-specific settings. Eichfelder and Schneider (2018) investigate a bonus depreciation provision for investments in eastern Germany after reunification. They find a strong effect on large firms' investments and in particular for investments in long-lived assets, although the investment increase seems to be partly driven by timing effects. Wielhouwer and Wiersma (2017) study a discretionary tax depreciation regime, which was introduced in the Netherlands during the financial crisis. They find that the more flexible tax depreciation regime increases investments but only among firms that face the highest marginal tax rate. In addition, they show that firms postpone tax depreciation when facing losses or loss carry forwards. Maffini et al. (2019) investigate the effect of accelerated depreciation allowances in the UK for small and medium sized firms by exploiting exogenous changes in the qualifying threshold for first-year depreciation allowances.[6] They find that access to more capital allowances increases firms' investments, which is mainly due to the reduction in the user cost of capital and not based on a cash flow effect.

[6] It should be noted that the change in the qualifying threshold is also relevant for claiming SME research and development tax credits.

Taken together, previous literature can provide some evidence on the effect of tax depreciation on investment in general, although prior studies have some common features, which provide only limited insights into the effects of tax depreciation on investment. Existing studies focus on temporary tax depreciation regimes such as special bonus or discretionary tax depreciation provisions. In addition, the majority of studies examine depreciation tax incentives during economic downturns and provisions that were often introduced simultaneously with other tax factors such as corporate tax rate changes or other investment incentives. Potential confounding effects in these settings limit the validity of the results.

2.2. Tax depreciation rules and regulatory requirements for leasing companies in Germany

Leasing activities can be generally split up into operating and finance leases. Operating leases are characterised by short lease terms, flexible and easy possibilities to cancel the lease contract, and multiple transfers of the leased asset to different lessees. In the case of operating lease contracts, the lessor bears the risk borne by the leased asset. This type of lease is generally used for short-term investments. In contrast to operating leases, finance leases have two essential functions: transfer of the right to use the leased asset and the financing function. Since finance leases constitute financial service activities, companies from the finance lease sector are licensed and supervised by the German Federal Financial Supervisory Authority (FFSA). According to the FFSA[7], the characteristic of finance leases is that the lessor company procures the asset in its own name and on its own account. Then, the lessor transfers the use of the asset to the lessee, who essentially finances and amortises the asset over the lease term based on the contractual formulation. Thus, the lessee bears the investment risk, and not the lessor. In addition, the lessee is contractually prohibited from cancelling the lease contract during the

[7] FFSA, Bulletin Finance Lease, January 19, 2009, (only available in German, https://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Merkblatt/mb_090119_tatbestand_finanzierungsleasing.html).

lease term. Since the financing function is the important feature of finance leases, this type of lease is used primarily for medium and long-term investments.

Besides the different business models of operating and finance lease firms, companies in the latter category are treated as financial services institutions and thus are licensed and supervised by the FFSA. Therefore, finance lease firms are subject to organisational-specific regulatory obligations, in particular the Minimum Requirements for Risk Management (MaRisk) issued by the FFSA.[8] The provisions cover general requirements for risk management and specific provisions regarding the performance of meaningful stress tests, the handling of risk concentrations, and the quality and quantity of liquidity buffers. For example, the requirements for the management of liquidity risks demand a liquidity buffer of liquid assets that is sufficient to offset negative consequences resulting from a general decline in the price of marketable assets, and a general deterioration in refinancing conditions. In contrast, operating lease firms are neither supervised by the FFSA nor subject to such regulatory requirements.

According to the German-GAAP, the attribution of leased assets depends on the beneficial ownership, which is comparable to IFRS and US-GAAP (e.g., Eisfeldt and Rampini, 2009; Bauman and Francis, 2011). Beneficial owner of the leased asset is the party bearing the majority of the opportunities and risks that the leased asset carries. Since there is no legal definition of beneficial ownership in Germany, the treatment for tax purposes, which is based on the Leasing Decrees of the German Federal Ministry of Finance, is generally applicable to lease accounting. While the lessor is undeniably the beneficial owner of the leased asset in the case of operating lease activities, resulting in the recognition of the leased asset on the balance sheet of the lessor, the beneficial ownership is ambiguous in the case of finance lease contracts.

[8] See, FFSA, Minimum Requirements for Risk Management, Circulars 15/2009 (BA) of August 14, 2009 and 11/2010 (BA) of December 15, 2010.

For this reason, the Federal Ministry of Finance defines, in particular, the necessary criteria for the attribution of leased assets to the lessor with regard to finance lease contracts.

Under the Leasing Decrees of the Federal Ministry of Finance[9], the lessor is regarded as beneficial owner of the leased asset if under a full-payout lease of mobile assets the lease term is between 40% and 90% of the expected useful life of the asset. If the lease contract contains a purchase or rental extension option, the purchase price and the aggregate rent must be higher than the book value or the lower market value. Under a partial-payout lease of mobile assets, the lessee does not finance or amortise the asset over the lease term. However, the asset is attributed to the lessor if the lessor has a right to sell the leased asset to the lessee or the lessee is bound by contract to compensate the remaining amortisation after the end of the lease term.

If the leased asset is attributed to the lessor, the lessor is required to recognise the leased asset as a non-current asset measured at acquisition costs on the balance sheet, charge depreciation, and recognise impairment losses, if applicable. Until the end of 2013, German tax authorities accepted two regular depreciation methods for tax purposes. First, the lessor could apply straight-line depreciation over the expected useful life of the leased asset, which was, and still is, determined in tax depreciation tables issued by the Federal Ministry of Finance. Second, the lessor could apply straight-line depreciation over the lease term under consideration of the residual value provided in the lease contract. We provide a simplified example in Appendix B to present the economic advantage of the tax depreciation over the lease term compared to tax depreciation over the longer expected useful life of the leased asset.

Straight-line depreciation over the lease term under consideration of the residual value was the most preferred and applied depreciation method with regard to finance lease contracts for tax and accounting purposes, because the business model of finance leases requires that the

[9] The Federal Ministry of Finance differentiates between full-payout leases (Federal Ministry of Finance, IV B/2 – S 2170 – 31/71, of April 19, 1971) and partial-payout leases (Federal Ministry of Finance, IV B/2 – S 2170 – 161/75, of December 22, 1975).

leased asset is financed and amortised over the non-cancellable lease term.[10] Since the leased asset is only attributed to the lessor if the lease term is no longer than 90% of the expected useful life of the asset, the lease term provided in the contract is always shorter than the expected useful life of the asset. With regard to the business model of finance lease companies, depreciation over the lease term allows for a better match of revenues and allocation of acquisition costs over time.

In contrast to finance leases, straight-line depreciation over the lease term is not the common tax depreciation method for operating leases. Here, the business model requires that the leased asset is not financed and amortised by a single transfer of the right to use the leased asset but by multiple, short-term transfers of the leased asset to various lessees.

With effect from 1.1.2014, the lease-specific tax depreciation method was abolished by the supreme tax authorities (see Federal Association of German Leasing Companies, 2014). Since then, the lessor has been required to apply straight-line depreciation over the expected useful life of the leased asset, based on the tax depreciation tables, when determining the depreciation deductions for tax purposes. For lease accounting purposes under the German-GAAP, the lessor can continue to apply straight-line depreciation over the lease term.

This unique change in the tax depreciation rules allows us to investigate the investment effect of tax depreciations in a setting characterised by properties that mitigate identification issues due to endogenous changes in the tax regime, for the following reasons. First, compared to prior literature this setting does not present a temporary change in tax depreciation regimes but a permanent change in applicable depreciation methods for tax purposes. Therefore, in our

[10] After the end of the lease term, finance lease firms in general sell the leased asset at the residual value. However, in the case of full-payout leases the residual value of the leased asset is zero. The revenue from the sale of the leased asset generally amounts to 4.87% of the acquisition costs (median value from an evaluation of 47,479 lease contracts of two German finance lease firms, see Oestreicher and Hillmann (2016)). Since the residual value and the revenue from the sale of the asset are of subordinate importance to our analysis due to their small magnitude, we do not take account of these values in our paper.

setting it can be ruled out that finance lease firms postponed investment in the expectation that this regulatory change was only temporary.

Second, compared to prior literature, our investigations do not apply to a period of economic downturn, which can directly affect investment behaviour or at least confound the effect of tax depreciation deductions (e.g., Edgerton, 2010). Third, we exploit a setting not associated with a specific political goal that could lead to anticipation effects or influence certain firm behaviour. Instead, the change in depreciation rules was an administrative decision by the supreme tax authorities because the applied tax depreciation over the lease term did not correspond with the administrative interpretation of the tax law (Federal Association of German Leasing Companies, 2014). Although the Federal Ministry of Finance accepted tax depreciation over the lease term, this acceptance was subject to a regular meeting of the German Länder heads of tax department in late 2013 with a view to a possible deviation from basic depreciation principles.[11] However, we do not expect that knowledge about this meeting the result of which reached the public in February 2014 lead to anticipation effects.

Fourth, the change in the applicable tax depreciation methods was significant for the finance lease sector because the tax depreciation over the lease term was the preferred and predominantly applied depreciation method for a company operating in the finance lease sector. The German leasing sector has a new business volume of EUR 50bn per year on average, of which 90% is recognised on the balance sheet of the lessor (Federal Association of German Leasing Companies, 2012). Therefore, leasing companies have a high intensity of investment (non-current assets on the balance sheet) due to their business model. In our sample, the average ratio of tangible assets to total assets is 70%. Consequently, changes in tax depreciation rules directly affect a large part of the balance sheet. The Federal Association of German Leasing Companies (2014) highlights that the shift of tax payments to earlier years due to the less

[11] See, Federal Ministry of Finance, IV C 6 – S 2170/08/10002:004, of February 24, 2014.

beneficial tax depreciation rule affects the equity and hence restricts financing options for investments in new assets for customers.

Finally, the change does not overlap with other tax changes relevant to the leasing sector. Since we examine a change in German tax depreciation rules that affects only the German finance lease sector, different country-specific factors (such as country-specific differences in firms' investment behaviour and regulatory differences in lease tax accounting, etc.) cannot explain our results.[12]

However, a potential concern might be that the Basel III reform affects our analysis. In June 2013, the EU Capital Requirements Directive IV (CRD IV) (EU, 2013a) was published with the primary objective of implementing the Basel III regulatory framework into EU law (EU, 2013b, Recital 1 and 10). After the financial crisis, the Basel Committee on Banking Supervision (2011) agreed on a set of measures regarding capital and liquidity requirements in order to strengthen the supervision and risk management in the financial sector. Since the CRD IV applies to all banks in the EU, finance lease companies are in principle not affected by this regulation, except for leasing companies that are part of a banking group. However, we do not expect CRD IV to affect directly finance lease companies affiliated to banks in 2014, for the following reasons. First, the Basel III reform is anticipated by banks as the Basel Committee on Banking Supervision (2011) issued the regulatory standard at the end of 2010. Second, Basel III provided for relatively long transition periods. For example, the capital maintenance buffer was to be built up gradually starting in 2016 and the structural liquidity ratio and the maximum debt ratio were introduced in 2018. Third, substantial parts of the liquidity regulations of Basel III which do not have to be implemented until 2015 are already effective for finance lease firms due to the MaRisk regulation.[13]

[12] Since we examine unconsolidated German GAAP financial statements of mainly private finance lease and rental firms, it is not likely that our results are due to drafts and changes to IFRS 16.

[13] To further mitigate the concern that the CRD IV confounds our analyses, we exclude all finance lease companies affiliated to banks and re-estimate our OLS regressions (Eq. (1)) with Investment as the dependent variable for our

In sum, this setting provides us with a significant and unanticipated change in tax depreciation rules for firms operating in the finance lease sector. Furthermore, we cannot identify potential confounding effects that could affect our analysis. Therefore, we can exploit this setting to examine the effect of tax depreciation rules on investments by finance lease firms.

2.3. Hypothesis

Theoretical considerations concerning the effect of taxation on investment decisions of firms have their roots in neoclassical investment theory (e.g., Jorgenson, 1963; Tobin, 1969), as amended to encompass corporate taxation (e.g., Hall and Jorgenson, 1967; Summers, 1981). In general, a firm should invest as long as the marginal benefit of an additional investment exceeds the marginal costs of the additional investment. To measure this association, Hall and Jorgenson (1967) derive from the neoclassical investment theory the concept of the user cost of capital, in which the cost of investment is, among other influencing factors, affected by corporate taxes. In this model, corporate taxes on profits reduce the investment's cash flow and hence increases the cost of investment (e.g., Auerbach, 1983). On the other hand, allowances for tax depreciation decrease the cost of investment because tax depreciation deductions reduce the corporate income tax base (e.g., Summers, 1981).

The method of tax depreciation affects the present value of tax depreciation deductions and therefore the present value of tax payments and cost of investment. In general, the tax benefit of depreciation deductions depends on the tax rate, interest rate, depreciation period and the permitted amount of depreciation per year (Hall and Jorgenson, 1967). The change from straight-line tax depreciation based on the lease term to straight-line tax depreciation over the longer expected useful life of the asset reduces the present value of tax depreciation deductions. According to the neoclassical investment theory, higher cost of capital due to a decrease in the

full and matched sample. In tests not documented here, the results are in general consistent with our main findings, indicating that finance lease firms affiliated to banks do not drive our results.

present value of tax depreciation deductions should lead to a lower capital stock and thus to a decrease in the investment rate in the short term.

In contrast to theoretical models that assume perfect capital markets and no financial frictions (e.g., Miller and Modigliani, 1958; Hall and Jorgenson, 1967), some theoretical approaches examine investment behaviour under the assumption of incomplete and imperfect markets (e.g., Greenwald et al., 1984; Fazzari et al., 1988). In the latter theoretical approach, cash flow is considered an important determinant of firms' investment spending if internal finance has important cost advantages over external finance (e.g., Fazzari et al., 1988; Michaely and Roberts, 2011). Besides incomplete and imperfect markets, regulatory requirements regarding liquidity and capital present additional financial frictions limiting the opportunities to finance investment (e.g., Gropp et al., 2019). If a firm is financially constrained in the sense that it faces imperfect markets or regulatory requirements, less beneficial tax depreciation allowances can aggravate financial constraints and decrease investments. Considering both potential channels[14] for the investment response (i.e., cost of capital and financial frictions), we state our hypothesis as follows:

> Hypothesis: *Finance lease firms decrease their investments after the change in tax depreciation allowances to a less beneficial tax depreciation regime in 2014.*

3. Research design and data

3.1. Estimation strategy

To test our empirical predictions, we apply a difference-in-differences (DiD) estimation method. The application of the DiD approach requires the determination of a treatment and a control group. In general, the change in tax depreciation rules applies to companies from the leasing sector. However, not all lease companies are affected by the change in tax depreciation

[14] In Section 5.1, we shed more light on the financial friction channel affecting the investment response.

rules because operating and finance leases follow different business models. The business model of finance leases is that of financial services, because a finance lease is characterised by the transfer of the right to use the leased asset to a single lessee, who essentially finances and amortises the asset over the lease term. Due to this business model, prior to the administrative order in 2014, straight-line depreciation over the lease term was the most preferred and applied depreciation method in terms of tax and accounting for assets leased under a finance lease contract. Since finance lease companies are directly affected by the change in tax depreciation allowances, we use German finance lease firms as our treatment group.

The use of finance lease firms as our treatment group has two advantages. First, as mentioned in Section 2.2, almost all finance lease companies recognise the leased assets on their balance sheet because of the special attribution criteria according to the Leasing Decrees of the German Federal Ministry of Finance. Therefore, we can observe the change in investment volumes of finance lease companies during our sample period. Second, we have access to the total population of finance lease companies in Germany. Since the FFSA supervises German finance lease firms, a list of all licensed finance lease companies is publicly available. In sum, our treatment group consists of companies operating in the finance lease sector, which are registered with the German Federal Financial Supervisory Authority over the course of our sample period (2011-2015).

In contrast to finance leases, operating leases are characterised by short lease terms. Thus, multiple transfers to different lessees of the right to use the leased asset are necessary in order to amortise the asset. The business model of operating leases is that of rental services, because operating lease firms depreciate the leased asset over the expected useful life of the said asset. Therefore, our control group consists of German companies in the rental industry, including operating lease firms.

This control group has several advantages. First, the business model of renting out assets has considerable similarities with finance lease activities, which means that both industries are affected by similar economic circumstances, e.g. fluctuations in demand or competition with credit institutions. Second, companies in the rental, operating lease and finance lease sectors invest intensively in tangible assets and hence have a similar balance sheet structure. However, rental and operating lease organisations are not affected by the change in tax depreciation allowances described above, because the lease-specific tax depreciation method was applicable to leased assets and used, in particular, for assets leased by finance lease firms.

To test the effect of the change in tax depreciation rules on the investments made by finance lease companies (Hypothesis 1), we estimate the following baseline DiD model:

$$Investment_{i,t} = \beta_0 + \beta_1 Post_t \times Treatment_i + \beta_2 Controls_{i,t} + \beta_3 Year_t + \beta_4 Firm_i + \varepsilon_{i,t} \quad (1)$$

The dependent variable *Investment* is defined as the difference in tangible assets from *t* to *t-1* relative to the prior year's tangible assets (e.g., Dobbins and Jacob, 2016). Although finance lease companies are in general obliged to disclose leased assets separately from other tangible assets, we define tangible assets as the sum of leased and other tangible assets for two reasons. First, the use of tangible assets ensures better comparability between our treatment and our control group. Second, we avoid the problem of missing values if leased assets are not shown separately on the balance sheet.[15]

[15] In an additional test, we re-estimate our OLS regression but use as the dependent variable the net investment rate of leasing assets for our treated firms (instead of the sum of tangible and leasing assets) to address the concern that changes in other tangible assets drive our results. The dependent variable for our control group does not change since we have no information about potential leasing assets of rental firms/operating lease firms. The results are consistent with our main findings, indicating that our results reveal effects on leasing assets and not tangible assets (see Table A1 of the Online Appendix). However, we cannot solve a potential measurement error in the dependent variable for our control group.

We define our sample period from 2011 to 2015.[16] We use this relatively narrow sample window to reduce the likelihood that other events unrelated to the change in tax depreciation rules affect the investment decision of companies from the finance lease sector. We exploit the change in the tax depreciation regime for the finance lease sector, which has been effective and enforced by the tax authorities since the beginning of 2014, as an exogenous event. Therefore, *Post* equals 1 for 2014-2015, and 0 for 2011-2013. The indicator variable *Treatment* distinguishes between observations belonging to the treatment and control group, respectively. In line with our prediction, we expect a negative and significant estimate of our DiD coefficient (*Post x Treatment*).

We estimate Equation (1) using OLS regression and heteroscedasticity-robust standard errors clustered at the firm level (Petersen, 2009). Following recent literature, we control for firm-level characteristics to capture the ability to invest in tangible assets (e.g., Dobbins and Jacob, 2016; Jacob et al., 2019; Rauter, 2020). We include total assets (*Size*) to control for the firm's size because size can be a proxy for firm value and investment opportunities. *Leverage* controls for the capital structure, which influences investment decisions. In addition, we include *Profitability* and *Loss* in order to control for the firm's performance and potential investment opportunities. Further, we control for available cash by including *Liquidity*. Finally, to control for general time trends in investment activities and time-invariant unobservable differences in firm characteristics, we use firm and year fixed effects. Appendix A provides a description of the variables used in this study.

The econometric approach we apply may raise general concerns. First, since our treated and control firms belong to different industries, they have different characteristics, which might drive the differences observed in the investment behaviour. We try to mitigate this concern by employing a matching approach. Therefore, our empirical strategy is to use a sample of

[16] Since we scale most of our controls by prior year's total assets, we include data from 2010 to calculate controls in 2011.

comparable rental and operating lease firms that we match with our finance lease firms. Using propensity score matching, we match each treated firm with a control firm based on pre-reform average values of the natural logarithm of tangible assets and all covariates used in our main DiD regression model (Eq. (1)). To avoid a sample size reduction, we use one-to-one nearest neighbour matching without replacement, which is the most common method of matching in accounting research (Shipman et al., 2017).[17]

Second, the validity of our DiD analyses hinges on the assumption that the reform is not anticipated by finance lease firms. However, anticipation of the change in tax depreciation allowances seems very unlikely because the change was an administrative order by the supreme tax authorities, which is not similar to a public legislative procedure (see Section 2.2). To mitigate this concern further, we check the parallel trend assumption of our DiD analysis by conducting placebo tests and providing yearly treatment effects in Section 4.2.

3.2. Data and sample overview

We use two different data sources to construct our sample. First, we use the Amadeus database provided by Bureau van Dijk. Amadeus contains accounting statements (i.e., balance sheets and income statements) for private firms in Europe. We use this data source to collect financial statement data of our control firms, which are German firms that belong to the rental and operating lease sectors (NACE code 7710-7739, hereafter rental firms).[18] Second, we identify and collect financial statement data relating to our treated firms. Since the Amadeus database does not contain comprehensive data on banks and financial services companies, we manually collect financial statement data of German firms from the finance lease sector, which is published in the German Federal Gazette's Company Register database. To identify

[17] Our main inferences do not change when we use a different matching strategy (e.g., one-to-two nearest neighbour matching with replacement).
[18] While the Amadeus database in principle separates finance leases (NACE code 6491) from operating leases, the database combines hiring activities and operating leases in the NACE codes 7710-7739.

companies offering finance leases, we received a list from the Federal Financial Supervisory Authority comprising all companies from the finance lease sector that were licensed and supervised by the Federal Financial Supervisory Authority over the sample period (2011-2015). During our sample period, 311 companies were licensed to carry out finance lease activities.

Appendix C outlines our sample selection process. We restrict our data to firms with unconsolidated German-GAAP financial statement data because we want to examine the investment response of each individual firm. In order to avoid confounding events and effects, we check for restructuring processes (e.g. mergers and takeovers) during the sample period.[19] A potential concern in our identification of control firms could arise because companies from the finance lease sector might be wrongly attributed to the operating lease sector in the Amadeus database. In order to address this concern, we drop all firms in our control group that have similar company names compared to the firms in our treatment group. In addition, we require firm-year observations to contain information on our dependent variable (investment) and controls (total assets, leverage, profitability, loss, and liquidity). Finally, each firm needs at least one observation before and after the reform. The final sample comprises 2,226 firm-year observations of 548 firms for the years 2011 to 2015.[20]

Panel A in Table 1 reports that out of 548 firms, 195 firms belong to the finance lease sector (treatment group) and 353 firms belong to the rental sector (control group). After applying the one-to-one nearest neighbour matching, the number of control firms drops to 195 resulting in 1,659 firm-year observations of 390 firms. Panel B in Table 1 presents summary statistics separately for treatment, full sample and matched sample control group observations

[19] We check for restructuring processes by using the database Northdata, which provides company information on German firms.

[20] Since our final sample is not balanced due to missing data, we check the robustness of our main results, following the process to balance the sample. We use the balanced sample to re-estimate our DiD regression (Eq. (1)) with Investment as the dependent variable for our full and matched sample (see Table A2 of the Online Appendix). Although the size of the balanced sample is substantially smaller, the results are in general consistent with our main findings, indicating that missing firm-year observations do not affect our results.

over the sample period 2011-2015. Since our sample size is very small, we do not correct for outliers in our analyses.[21] Appendix A lists detailed variable definitions.

[Insert Table 1 here]

Our summary statistics show that treated firms in general have a smaller net investment rate compared to control firms. With regard to the control variables, the full sample rental firms and finance lease firms have on average a similar leverage, profitability and frequency of loss occurrence. However, our full sample control firms are on average slightly smaller and have more liquidity compared to our treated firms. Our matched sample reduces the mean difference between the treated and control firms, which increases the comparability of the two groups.[22]

However, we note that differences between our treatment and control group remain. To further mitigate concerns that observable differences between our treatment and control group drive our results, we employ entropy-balancing matching (Hainmueller, 2012; see Table A4 of the Online Appendix).[23]

4. The effect of tax depreciation on firms' investment behaviour

4.1. Main results

We start our main analysis with a graphic illustration of investment rates over time. Using our full sample, Figure 1 plots the average *Investment* of firms from the finance lease

[21] In order to mitigate the concern that outliers influence our results, we winsorise all continuous variables at the 1% (99%) level and re-estimate our OLS regression (Eq. (1)) with Investment as the dependent variable for our full and matched sample (see Table A3 of the Online Appendix). The results are consistent with our main findings, indicating that outliers do not affect our results.

[22] In Appendix D, we provide summary statistics separately for treatment, full sample and matched sample control group observations over the pre-reform sample period 2011-2013. We can draw the same conclusions from the summary statistics of the pre-reform and full sample period.

[23] We employ entropy-balancing matching and re-estimate our main regressions models (Eq. (1)) with Investment as the dependent variable. By constructing weights for each control observation, entropy balancing ensures that treated and control firms are comparable in observable firm-level characteristics (Hainmueller and Xu, 2013). Our DiD results are in general consistent with our main regression results (see Table A4 of the Online Appendix).

sector (blue line) and firms from the rental sector (red line) over the years 2011-2015. We observe a parallel trend in the investment rates of finance lease and rental firms in the pre-reform period (2011-2013). While rental firms invest on average 10-11% of their tangible assets, finance lease firms invest 4-5% of their tangible assets every year. Following the administrative decree in 2014, we observe a sharp drop in the investment rate of finance lease firms, which recovers slightly in 2015. The investment rate of rental firms, on the other hand, increases slightly in the post-reform period.

[Insert Figure 1 here]

We further compare investments of finance lease and rental firms before and after the reform. Panel A of Table 2 shows that the average investment rate of finance lease firms is lower for the periods after the reform (-0.0097) than before the reform (0.0434). The time difference is significant at conventional levels (p-value < 0.01). Panel B and Panel C present the time difference in the average investment rate before and after the reform for rental firms in our full (Panel B) and matched sample (Panel C). Firms in the rental sector have on average a higher investment rate in the pre- and post-reform period. However, we find no significant time difference in investment rates for either control group, i.e., rental firms in our full or in our matched sample.

[Insert Table 2 here]

After the first indications reveal that the reform of tax depreciation allowances decreases the investment rate of finance lease firms, we test our Hypothesis 1 using our DiD approach (Eq. (1)). Table 3 reports OLS regression results for our baseline model. We estimate two

specifications for our full and matched sample: DiD model with fixed effects but without controls (Column 1 and 3), and a fully specified DiD model with fixed effects and firm controls (Column 2 and 4 as defined in Eq. (1)).

[Insert Table 3 here]

Overall, the findings in Table 3 provide the following insights. First, the estimated average treatment effect is (as predicted) negative and significant at conventional levels (p-value < 0.1) in Column 1 and 2. However, it should be noted that the magnitude of the coefficient increases slightly when we include firm-level controls in Column 2. This should not be surprising since our treatment and control group differ in some firm characteristics. Second, we find significant DiD estimators for the matched sample (Column 3 and 4), which accounts for differences in the economic activities of finance lease and rental firms. The coefficient estimates are very similar when excluding or including firm-level controls. Third, the magnitude of the coefficients is similar across the matched sample and fully specified regression based on the full sample (Column 2 to 4), which suggests that our results are robust to changes in the composition of our control group. Across all specifications, the results confirm our first hypothesis that the less beneficial tax depreciation allowances negatively affect investments of finance lease firms.

For the full sample, the coefficient is -0.0698 and statistically significant (p-value < 0.01). Our results reveal that the change to the less beneficial tax depreciation regime reduces the net investment rate in tangible assets of finance lease firms by 6.98 percentage points compared to rental firms. The economic magnitude of the DiD estimator is large. Given that the average tangible assets of a finance lease firm in the pre-reform sample are about EUR 64.8m, investments in tangible assets decrease by EUR 4.5m for each finance lease firm, on

average.[24] This quite large effect of tax depreciation on investments can be explained by the business model of companies from the finance lease sector. The main purpose of leasing companies with a focus on finance lease contracts is to buy assets, which are recognised on the balance sheet of the lessor, and lease them over a specific lease term to the lessee as agreed by contract. Consequently, the business model of companies from the finance lease sector relies heavily on the amount of leased assets. The average ratio of tangible assets to total assets is 70%, which underlines the focus on tangible assets.

We translate our results into an elasticity of investments in tangible assets with respect to the net-of-tax cost of a unit investment (following Jacob et al., 2019, and Maffini et al., 2019). Tangible assets of a finance lease firm increase, on average, by 4.3% in the pre-reform period (see Appendix D). A reduction in net investments by 6.98 percentage points means that the finance lease firm's growth factor of tangible assets decreases by 6.7% (= 0.0698 / (1+0.043)) relative to renting firms. Assuming the marginal tax rate is 30%, the discount rate is 7%, the average lease term is 4 years and the average tax depreciation period is 6 years, the change in depreciation allowances increases the net-of-tax cost of a unit investment by around 1.13% (see Appendix E). Therefore, the implied elasticity of investment with respect to the net-of-tax cost of a unit investment is about -6.

To put our depreciation allowance effect into perspective, we compare our results with the recent literature, which calculates the elasticity of investment with respect to the net-of-tax cost of a unit investment. Using changes in thresholds for first-year allowances in the UK, Maffini et al. (2019) estimate elasticities of 8.3 – 9.9 for small and medium firms. Ohrn (2018) examines the effect of the Domestic Production Activities Deduction (DPAD) in the US and calculates an elasticity around 6.5. Other studies estimate the elasticity of capital expenditure with respect to the net-of-tax cost of a unit investment. For example, Zwick and Mahon (2017)

[24] Appendix D contains descriptive statistics of tangible assets.

study US federal bonus depreciation allowances and estimate an elasticity of 7 using industry-level variations. Ohrn (2019) examines the response to US state bonus depreciation policies and estimates an elasticity of 9.55.

Our result is mostly comparable to Maffini et al. (2019) and Ohrn (2018) because both studies calculate the elasticity of investment with respect to the net-of-tax cost of a unit investment. Our result is especially in line with Ohrn (2018). However, we acknowledge that the comparison with both studies is limited since we use the net investment rate instead of investment (which equals capital expenditure scaled by lagged fixed assets) as the dependent variable.[25, 26]

Next, we test the robustness of our results by using alternative dependent variables. Since the drawback of our investment rate could be that it does not account for depreciation and changes in total assets, we employ two different investment rates to mitigate the concern that scaling effects and depreciation affect our results. First, we calculate the investment rate as the change in tangible assets scaled by the prior year's total assets (e.g., Dobbins and Jacob, 2016). Second, we employ the gross investment rate, defined as the change in tangible assets before depreciation scaled by the prior year's total assets (e.g., Bethmann et al., 2018; Jacob et al., 2019).

Table 4 reports the results from OLS regressions with our two alternative dependent variables for the full (Column 1 and 2) and matched sample (Column 3 and 4): change in tangible assets scaled by prior year's total assets (Column 1 and 3) and gross investment rate (Column 2 and 4). Overall, the results show a negative significant effect of a less beneficial tax

[25] Due to data limitations, we do not have information about capital expenditure, which prevents us from calculating elasticities for specifications similar to prior literature.

[26] We note that we use an interest rate of 7% for the determination of the elasticity to be comparable with the prior literature. However, the average effective interest rate of German banks granting loans for new businesses up to EUR 1 million over our sample period is 3.08% (https://www.bundesbank.de/statistic-rmi/StatisticDownload?tsId=BBK01.SUD124&its_csvFormat=en&its_fileFormat=csv&mode=its). Employing this interest rate and re-calculating our elasticity results in an elasticity of -10.8, which is very much in line with the result of Maffini et al. (2019). Therefore, we acknowledge that our initial elasticity underestimates the effect of the change in tax depreciation allowances on investments.

depreciation regime on the investments of companies from the finance lease sector, which is consistent with the results of Table 3.

[Insert Table 4 here]

4.2. Placebo tests

Since one crucial assumption of our identification approach using DiD analyses is the parallel trend in our treatment and control group, we assess the robustness of our results by challenging the validity of our exogenous shock. Thus, we conduct placebo tests by re-estimating our baseline regression (Eq. (1)) in two versions. First, we use a restricted sample period from 2011 to 2013 and apply a pseudo-reform in 2013. Second, we use a restricted sample period from 2011 to 2012 and define the placebo treatment date as the year 2012. If the parallel trend assumption is satisfied for the treatment and control group observations, we expect the DiD coefficient estimators of the pseudo-reform settings to be insignificant.

The results of both placebo tests are reported in Table 5. We test both placebo treatment dates with the full (Column 1 and 3) and matched sample (Column 2 and 4). The results suggest that the placebo treatment effects are not statistically significant, supporting the validity of our DiD analyses.

[Insert Table 5 here]

To further check the validity of the parallel trend assumption in our setting, we plot the point-estimates based on a version of our baseline model (Eq. (1)), in which we replace the DiD indicator (Post x Treatment) with a series of four separate DiD indicator variables, each marking one year over the period between 2011 and 2015. We omit the indicator for the year 2013

because this year serves as a benchmark. The purpose of this test is to check whether our dependent variable has a trend and the difference in the trends between the treated and control group is significant in the pre-reform period. Since the parallel trend assumption requires that our dependent variable remains constant and parallel between both groups, we expect that the point-estimates in the pre-reform period are insignificant.

Figure 2 provides point-estimates and two-tailed 90% confidence intervals for our treated versus control firms. The results in Figure 2 suggest that the yearly treatment effects in the pre-reform period (2011-2013) are insignificant, which provide support for the parallel trends in our sample. These findings are consistent with results of our placebo tests.

[Insert Figure 2 here]

5. Heterogeneity in investment effects

5.1. Firm-level variation in the exposure to regulatory requirements

In Section 2.3, we identify two channels affecting the investment response: cost of capital and financial friction. Since finance lease firms face financial frictions due to regulatory requirements, we investigate in this section whether the latter channel is verifiable. The notion behind this channel relies on the impact that regulatory requirements have on financing opportunities. As outlined in Section 2.2, finance lease firms have to fulfil regulatory requirements regarding liquidity and risk management. Consequently, they can only undertake investment decisions when they comply with these regulatory standards.

Since the change to the less beneficial tax depreciation regime shifts the tax-deductible expenses to the end of the lease contract, the lessor has higher tax payments until the end of the lease term. However, an increase in tax payments due to a shift to the less beneficial tax depreciation allowance reduces cash flow and hence liquidity, resulting in a burden on the

equity.[27] Due to the regulatory requirements that finance lease firms are exposed to, this decrease in liquidity and burden on equity negatively affect their investment.

We examine this channel by conducting cross-sectional tests analysing whether our treatment effect predictably varies with the firm's exposure to regulatory requirements measured by firm characteristics that capture these standards. We predict that firms more exposed to regulatory requirements have a stronger investment response to the change in tax depreciation allowances. We apply four different firm-level characteristics as proxies for the exposure of finance lease firms to regulatory standards.

Table 6 reports the results for our cross-sectional tests based on our full sample. We use our baseline DiD approach (Eq. (1)). However, to capture cross-sectional variation in the baseline treatment effect, we interact binary conditional variables with the DiD estimator *Post x Treatment*. We estimate DiD models with fixed effects and firm controls.

[Insert Table 6 here]

First, we distinguish between finance lease firms with high and low cash in the pre-reform period, respectively (e.g., Zwick and Mahon, 2017; Jacob et al., 2019). We use cash as a proxy for liquidity, which is one of the most important regulatory requirements. Therefore, we predict that firms with low cash in the pre-reform period have a stronger investment response. *Cash* is defined as cash and equivalents (including receivables from credit institutions) scaled by the prior year's total assets. *High (low) cash* is an indicator variable equal to 1 if a finance lease firm's average *Cash* in the pre-reform period is higher (lower) than the 25th percentile across all treated firms in the pre-reform period.

[27] In general, banks do not provide loans for the settlement of tax payments.

Second, we compare the investment response of finance lease firms with high and low equity, respectively. Since equity is essential to comply with the risk management requirements, we expect a larger investment response for firms with low equity. We define *high (low) equity* as an indicator variable equal to 1 if a finance lease firm's equity ratio in the year prior to the reform is higher (lower) than the 25th percentile across all treated firms in the year prior to the reform.[28]

Third, we distinguish between small and large finance lease firms, respectively (e.g., Dobbins and Jacob, 2016). Prior literature shows that small firms' growth is limited by the amount of internal finance, which is why small firms rely more heavily on internal funds (e.g., Carpenter and Petersen, 2002). Since internal funds, which are also needed to fulfil the regulatory standards, are an important financing possibility, we expect smaller firms to have a stronger investment response. We define *large (small)* as an indicator variable equal to 1 if the total assets of a finance lease firm in the year prior to the reform are higher (lower) than the average of total assets across all treated firms in the year prior to the reform.

Fourth, we compare the investment response of finance lease firms that are an affiliate of a bank *(bank)* with finance lease firms without an affiliation with a bank *(no bank)*. Since a banking group is subject to stronger liquidity and equity requirements (e.g., due to reforms proposed by the Basel Committee on Banking Supervision), we expect that bank-owned finance lease firms have a stronger reaction to the tax depreciation reform.

Consistent with our predictions, we find a stronger treatment effect for small firms and firms with low cash and low equity that are affiliated to banks. The difference in coefficient estimates is statistically significant at conventional levels (except for Column 2). Therefore, our

[28] In order to mitigate the concern that the legal form of the finance lease firm affects our results due to a different determination of equity, we re-estimate our OLS regression (Eq. (1)) with Investment as the dependent variable for our full and matched sample and investigate whether the treatment effect varies with the legal form (see Table A5 of the Online Appendix). The results show that the coefficient estimate for corporations has a similar magnitude and statistical power compared to partnerships suggesting that the legal form does not affect the investment response of finance lease firms.

results suggest that finance lease firms, which are particularly strongly exposed to the regulatory requirements, have a stronger investment response to the change in tax depreciation methods. In Table A7 of the Online Appendix, we re-estimate our cross-sectional tests based on our matched sample. The results are robust and consistent with our findings in Table 6.[29]

5.2. Firm-level variation in business models

In our second set of cross-sectional tests, we examine whether our treatment effect predictably varies with firm-level characteristics that capture the business model of finance lease firms. We collect all information on a finance lease firm's business model by using the firm's annual report in the year prior to the reform and checking the company website. Using the collected information, we can conduct several cross-sectional tests. We use our baseline DiD approach (Eq. (1)). However, to capture the cross-sectional variation in the baseline treatment effect, we again interact binary conditional variables with the DiD estimator *Post x Treatment*. We estimate DiD models with fixed effects and firm controls for our full and matched sample.

First, we examine whether the product focus affects the investment response of finance lease firms. Since the change in the tax depreciation regime causes an extension of the depreciation period, we expect that the investment response of finance lease firms is stronger if their product portfolio heavily relies on leased assets for which the difference between the lease term and the useful life of the leased asset is high. We gather information on the difference between the lease term and useful life of the leased asset for different asset classes from

[29] However, we note that the tax depreciation effect should be predominant if firms have profits (e.g., Wielhouwer and Wiersma, 2017). To analyse this pattern, we re-estimate our OLS regression (Eq. (1)) with Investment as the dependent variable for our full and matched sample and investigate whether the treatment effect varies with profit and loss situations (see Table A6 of the Online Appendix). The results show that the coefficient estimate for profitable firms is significant while the coefficient estimate for loss firms is not significant, suggesting that the change in tax depreciation allowances affects predominantly the investment response of profitable and not loss-making firms. However, the coefficient estimates are not statistically different.

Oestreicher and Hillmann (2016), which we use to formulate our predictions.[30] Table 7 reports the results for our cross-sectional tests capturing the variation in the firm's product portfolio.

[Insert Table 7 here]

In Panel A of Table 7, we test two specifications for the full and matched sample. First, we distinguish between finance lease firms with a product focus on mobile assets and finance lease firms with a product focus on immobile assets, respectively (Column 1 and 3). Since immobile assets (e.g., buildings) are long-lived assets, which are leased over a long period, we expect that finance lease firms with a focus on mobile assets (e.g., machinery) have a stronger investment response to the tax depreciation reform. Second, we further split the product focus on mobile assets into finance lease firms with a diverse portfolio of mobile assets and finance lease firms with a specialised portfolio of mobile assets (Column 2 and 4). We expect that finance lease firms with a diverse portfolio of mobile assets react less strongly to the reform because the diversity of the assets should reduce the overall effect of the reform.

Consistent with our predictions, we find a significant treatment effect for finance lease firms with a product focus on mobile assets in the full and matched sample while the treatment effect is not significant for finance lease firms with a product focus on immobile assets. In addition, we find a significant treatment effect for finance lease firms with a specialised focus on a particular asset class in the full and matched sample. We find only weak evidence for finance lease firms with a diverse product portfolio of mobile assets in the full sample and even

[30] In Oestreicher and Hillmann (2016), we analyse 85,604 lease contracts of two important German finance lease companies with a diverse product portfolio. About 54,919 lease contracts offer information on the lease term and expected useful life of the leased asset for tax purposes. In a descriptive analysis, we show which product classes should be predominantly affected by the German tax depreciation reform, i.e., have the largest difference between the lease term and expected useful life of the leased asset.

no significant effect in the matched sample. However, the difference in coefficient estimates is not statistically significant at conventional levels in Panel A.

In Panel B of Table 7, we further split finance lease firms with a specialised product focus on a particular asset class into the following different product classes: office/IT, industry, medicine, agriculture and vehicles. The order of the listed product classes complies with a decrease in the difference between the lease term and expected useful life of a leased asset, which means that leased office/IT assets have the largest while vehicles have the smallest difference between the lease term and the expected useful life of the leased asset. Column 1 and 2 report the results for the full and matched sample, respectively. Consistent with our prediction, the results suggest that finance lease firms with a product focus on office/IT assets have a large and significant investment response to the reform. We present the difference in coefficient estimates to the coefficient estimate of finance lease firms with a focus on office/IT products. The difference in coefficients is significant for the product classes with the smallest difference between the lease term and expected useful life of the leased asset (i.e., agriculture and vehicles). In line with Panel A, we find again a weak effect of finance lease firms with a diverse product portfolio of mobile assets, which is again not significant in the matched sample.

In addition to the product focus, we examine whether the leasing-specific business characteristic of direct leases affects the investment response of finance lease firms. Direct lease is business model in which manufacturers use finance leases to promote their products. This specific business characteristic allows us to address a potential concern in our research design. Since finance leases present a financial services function, the business of finance lease firms is highly demand-related, which means that finance lease firms only invest in assets if they enter into a contract with a lessee about the leased asset. Thus, observing a negative investment response after the change in tax depreciation regimes could reflect merely a decline in demand and not a response to the reform. To investigate potential demand effects, we distinguish

between finance lease firms that are direct lease firms of a specific manufacturer and finance lease firms without an affiliation with a manufacturer, respectively. Direct lease firms of manufacturers are highly reliant on the customers' demand for the product range of the specific manufacturer because direct lease firms serve only as an additional distribution channel. A decline in demand should thus immediately result in a decrease in investment by direct lease firms, while the change in the tax depreciation regime should not have a significant effect on investment because direct lease firms are only a channel to directly distribute and finance products of their affiliated companies.

Table 8 reports the results for our cross-sectional tests. The findings reveal an insignificant treatment effect for direct lease firms of specific manufacturers, indicating that a decrease in demand cannot explain the findings in our main analysis. However, the difference in coefficient estimates is not statistically significant at conventional levels.

[Insert Table 8 here]

6. Conclusion

In this paper, we examine the investment response of companies from the finance lease sector to a change in tax depreciation rules. We find that finance lease companies reduce their investments after a German administrative order in the beginning of 2014 changed the applicable tax depreciation method from the previous more beneficial straight-line tax depreciation over the lease term to the less beneficial straight-line tax depreciation over the longer expected useful life of the leased asset. In addition, we predict and find that the regulatory requirements to which finance lease firms are exposed moderate the investment effect. Further cross-sectional tests indicate that the business model affects the investment response. We find a stronger treatment effect for finance lease firms with a product portfolio

that heavily relies on leased assets for which the difference between the lease term and the expected useful life of the leased asset is high. Our results reveal that finance lease firms with a product focus on mobile assets and especially office/IT assets are heavily affected by the reform.

Our results are subject to limitations. First, we cannot observe the applied tax depreciation method of firms from the operating lease and finance lease sector. However, based on their business models and legal requirements with regard to the attribution of leased assets to the lessor we assume that finance lease companies applied the more favourable tax depreciation over the lease term prior to the administrative order while this was not the common depreciation method for operating lease firms. Despite the lease-specific depreciation preferences, we cannot fully rule it out that companies from the finance and operating lease sector could have applied other tax depreciation methods. However, this would bias our results against finding investment effects.

Second, our inferences rely on the parallel trend assumption. Although we plot the yearly point estimates in Figure 2, which do not suggest a violation of the parallel trend assumption, we cannot completely rule out the possibility of confounding effects affecting our inferences. However, our fixed-effects structure, matching design and thorough sample selection should increase the confidence that our identification strategy mitigates time trends and firm-specific confounding effects in our setting.

Third, we exploit only one exogenous shock, which allows us to examine the sector-specific investment effect of finance lease firms in Germany. Therefore, internal validity increases at the expense of external validity. However, we expect that our results are at least generalisable to other countries in Europe because the German leasing market and the regulatory requirements are comparable to other countries in Europe.

Despite these potential limitations, our paper provides novel evidence on the effect of tax depreciation allowances on investments of finance lease firms, which are financial institutions operating in a regulated and supervised environment. In addition, we extend the general literature on tax depreciation and investment by exploiting a setting that overcomes the major limitations of prior studies. We are hence able to identify a clearer investment response to tax depreciation. Further, our study reveals that regulatory requirements regarding liquidity and risk management are an important moderator of the investment response of regulated firms.

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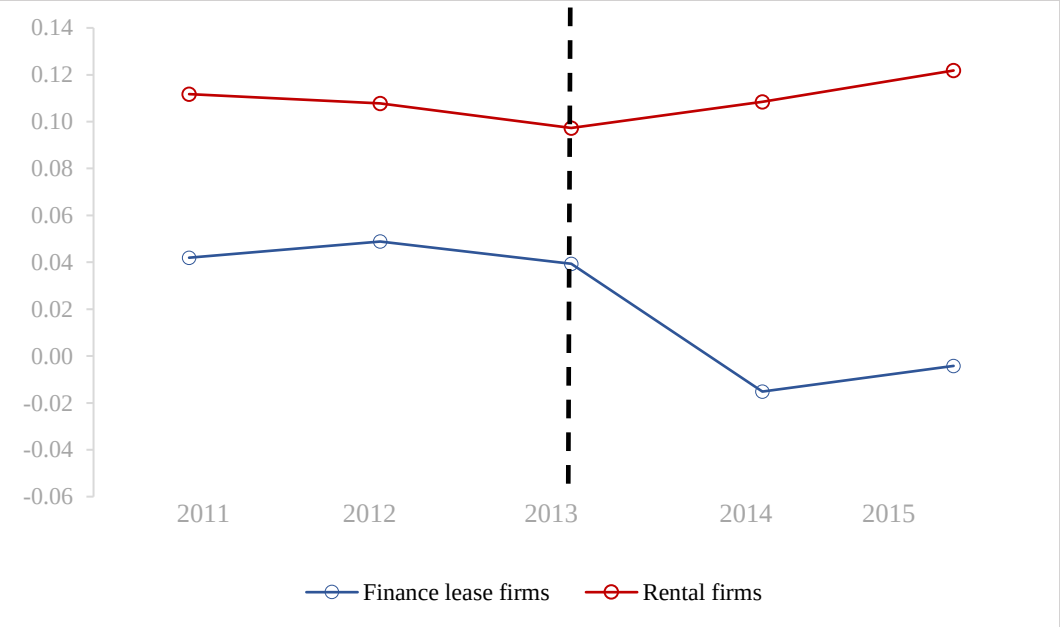
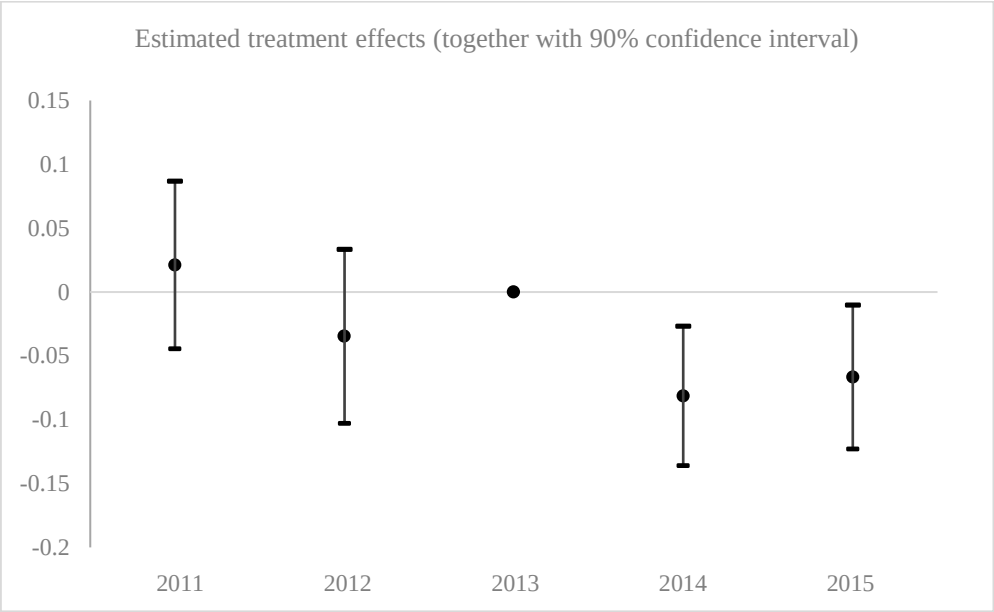
Figure 1
Graphic illustration of investments over time



This figure provides visual evidence that pre-reform trends in investments are similar while the reform of tax depreciation allowances results in a significant decrease in the investment of finance lease firms. The figure plots the average investment in % of finance lease firms (blue line) and rental firms (red line). Investment is defined in Appendix A. The dashed vertical line highlights the year prior to the reform.

Figure 2
Treatment effects over time



This figure plots the yearly treatment effects. The point-estimators are generated by estimating the following regression model: $Investment_{it} = \beta_0 + \beta_1 2011_t \times Treatment_i + \beta_2 2012_t \times Treatment_i + \beta_3 2014_t \times Treatment_i + \beta_4 2015_t \times Treatment_i + \beta_5 Controls_{it} + \beta_6 Year_t + \beta_7 Firm_i + \varepsilon_{it}$. Since we omit the DiD indicator for the year 2013, this year serves as the benchmark year.

Table 1
Sample description

Panel A: Sample distribution

	Full sample		Matched sample	
	Number of firm-year observations	**Number of firms**	**Number of firm-year observations**	**Number of firms**
Treatment group	927	195	927	195
Control group	1,299	353	732	195
Total	*2,226*	*548*	*1,659*	*390*

Panel B: Summary statistics over the period 2011-2015

	N	Mean	StDev	P50	Min	Max
Treatment group						
Investment	927	0.0220	0.2896	0.0035	-0.6898	4.0512
Liquidity	927	0.0007	0.0072	0.0000	0.0000	0.1877
Size	927	10.0241	1.8133	9.9699	5.3270	13.9484
Leverage	927	0.6172	0.3491	0.6442	0.0000	2.4416
Profitability	927	0.0318	0.0785	0.0155	-0.3454	0.6980
Loss	927	0.1931	0.3949	0.0000	0.0000	1.0000
Full sample control group						
Investment	1,299	0.1082	0.3689	0.0232	-0.7885	3.0672
Liquidity	1,299	0.0922	0.1188	0.0449	0.0000	0.6457
Size	1,299	8.5800	1.7554	8.6045	4.3820	13.1019
Leverage	1,299	0.5246	0.3599	0.5191	0.0000	2.3487
Profitability	1,299	0.0891	0.1275	0.0593	-0.3298	0.8024
Loss	1,299	0.1424	0.3496	0.0000	0.0000	1.0000
Matched sample control group						
Investment	732	0.0816	0.3348	0.0091	-0.7885	2.3117
Liquidity	732	0.0260	0.0409	0.0120	0.0000	0.4789
Size	732	8.7833	1.753	8.8100	4.5109	13.1019
Leverage	732	0.5770	0.3692	0.5783	0.0000	1.9337
Profitability	732	0.0685	0.1129	0.0458	-0.3125	0.6409
Loss	732	0.1831	0.3870	0.0000	0.0000	1.0000

This table provides the sample description. Panel A outlines the sample distribution of our full and matched sample. Panel B provides summary statistics for the treatment, full and matched sample control group over the period 2011-2015. All variables are defined in Appendix A. In order to calculate the control variables in 2011, which are scaled by prior year's total assets, we use data from 2010, which we not include in our sample period.

Table 2
Univariate time difference analysis

Panel A: Treatment group (N = 927)			
	Pre-Reform (2011 - 2013)	Post-Reform (2014 - 2015)	Time difference
	Mean	Mean	
Investment	0.0434	-0.0097	0.0530***
			(0.0193)
Panel B: Full sample control group (N = 1,299)			
	Pre-Reform (2011 - 2013)	Post-Reform (2014 - 2015)	Time difference
	Mean	Mean	
Investment	0.1046	0.1133	-0.0086
			(0.0208)
Panel C: Matched control group (N = 732)			
	Pre-Reform (2011 - 2013)	Post-Reform (2014 - 2015)	Time difference
	Mean	Mean	
Investment	0.0664	0.1027	-0.0363
			(0.0251)

We report the average investment rate (Investment) of the treatment (Panel A), full sample and matched control group (Panel B and C) before and after the reform of tax depreciation allowances. The last column shows the results from the t-test that the average investment rate before the reform equals the average investment rate after the reform. All variables are defined in Appendix A.

Table 3
Effect of tax depreciation on investment

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
Post x Treatment	-0.0437*	-0.0698***	-0.0673**	-0.0632**
	(0.0264)	(0.0256)	(0.0309)	(0.0283)
Size		-0.194***		-0.192***
		(0.0442)		(0.0481)
Leverage		0.759***		0.714***
		(0.0813)		(0.0950)
Profitability		0.303**		0.0720
		(0.147)		(0.135)
Loss		-0.0153		-0.0214
		(0.0268)		(0.0266)
Liquidity		-0.0852		0.993*
		(0.214)		(0.550)
Controls	None	Included	None	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.142	0.384	0.152	0.411
N	2,226	2,226	1,659	1,659

The dependent variable is Investment. The table reports two different specifications for the full and matched sample: (1) and (3) regression with fixed effects but without firm-level controls, and (2) and (4) fully specified regression with fixed effects and firm-level controls. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table 4
Effect of tax depreciation on investment: Alternative dependent variables

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
Dependent variable:	Inv_TA	Inv_Depr	Inv_TA	Inv_Depr
Post x Treatment	-0.0338***	-0.0365**	-0.0323**	-0.0343**
	(0.0127)	(0.0142)	(0.0158)	(0.0158)
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.487	0.657	0.481	0.674
N	2,226	1,935	1,659	1,508

The dependent variable is change in tangible assets scaled by prior year's total assets (Inv_TA) in Column 1 and 3 and the gross investment rate in Column 2 and 4. The table reports fully specified regressions with fixed effects and firm-level control for the full and matched sample. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table 5
Placebo treatment tests

	Full sample	Matched sample	Full sample	Matched sample
	(1)	(2)	(3)	(4)
	Sample period: 2011-2013		Sample period: 2011-2012	
2012 x Treatment			-0.0355	-0.0296
			(0.0351)	(0.0396)
2013 x Treatment	0.00280	0.0418		
	(0.0378)	(0.0374)		
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.351	0.399	0.330	0.396
N	1,224	924	690	528

The dependent variable is Investment. The table reports placebo treatment tests for two sample periods: 2011-2013 in Column 1 and 2, and 2011-2012 in Column 3 and 4, in which we define a placebo treatment date as the year 2013 (Column 1 and 2) and 2012 (Column 3 and 4). For both sample periods we test two specifications: (1) and (3) placebo test with fixed effects and firm controls based on the full sample, and (2) and (4) placebo test with fixed effects and firm controls based on the matched sample. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table 6
Cross-sectional findings: Exposure to regulatory requirement

	Full sample			
	(1)	(2)	(3)	(4)
Post x treatment x high cash	-0.0485*			
	(0.0262)			
Post x treatment x low cash	-0.132***			
	(0.0422)			
Post x treatment x high equity		-0.0562**		
		(0.0271)		
Post x treatment x low equity		-0.110***		
		(0.0388)		
Post x treatment x large			-0.0249	
			(0.0335)	
Post x treatment x small			-0.0828***	
			(0.0281)	
Post x treatment x bank				-0.120***
				(0.0356)
Post x treatment x no bank				-0.0518*
				(0.0275)
F-test for differences [p-value]	[0.041]	[0.159]	[0.096]	[0.053]
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.385	0.384	0.384	0.385
N	2,226	2,226	2,226	2,226

The dependent variable is Investment. We use our full sample. Regression models include additional interaction terms based on conditional variables to assess the cross-sectional variation in the baseline treatment effect. The following conditional variables are used: (1) high cash (low cash) equals 1 if the average cash of a finance lease firm, which is defined as cash holdings including receivables from credit institutions scaled by prior year's total assets, is above (below) the 25th percentile across the treated firms in the pre-reform period; (2) high equity (low equity) equals 1 if equity scaled by prior year's total assets of a finance lease firm is above (below) the 25th percentile across the treated firms in the year prior to the reform; (3) large (small) equals 1 if total assets of a finance lease firm are above (below) the mean across the treated firms in the year prior to the reform; (4) bank (no bank) equals 1 if a finance lease firm is (not) an affiliate of a bank. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table 7
Cross-sectional findings: Product portfolio

Panel A: General product focus

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
Post x treatment x mobile	-0.0704***		-0.0641**	
	(0.0263)		(0.0290)	
Post x treatment x immobile	-0.0618		-0.0509	
	(0.0403)		(0.0360)	
Post x treatment x specialised		-0.0659**		-0.0604**
		(0.0278)		(0.0303)
Post x treatment x diverse		-0.0815*		-0.0733
		(0.0429)		(0.0446)
Post x treatment x immobile		-0.0618		-0.0509
		(0.0403)		(0.0360)
F-test for differences [p-value]	[0.825]		[0.684]	
F-test for differences [p-value]				
specialised vs. diverse		[0.720]		[0.766]
specialised vs. immobile		[0.918]		[0.775]
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.384	0.383	0.410	0.410
N	2,226	2,226	1,659	1,659

Table 7 (continued)

Panel B: Detailed product focus

	Full sample		Matched sample	
	(1)		(2)	
	Coefficient estimate (s.e.)	Difference to office/IT [p-value]	Coefficient estimate (s.e.)	Difference to office/IT [p-value]
Post x treatment x office/IT	-0.184**		-0.176**	
	(0.0772)		(0.0766)	
Post x treatment x industry	-0.112	[0.588]	-0.106	[0.590]
	(0.112)		(0.111)	
Post x treatment x medicine	-0.0680	[0.189]	-0.0617	[0.186]
	(0.0490)		(0.0506)	
Post x treatment x agriculture	0.0427	[0.006]	0.0486	[0.006]
	(0.0404)		(0.0416)	
Post x treatment x vehicles	-0.0379	[0.054]	-0.0335	[0.054]
	(0.0262)		(0.0292)	
Post x treatment x immobile	-0.0608	[0.129]	-0.0498	[0.097]
	(0.0403)		(0.0359)	
Post x treatment x diverse	-0.0812*	[0.223]	-0.0730	[0.210]
	(0.0429)		(0.0446)	
Controls	Included		Included	
Year fixed effects	Included		Included	
Firm fixed effects	Included		Included	
Adj. R^2	0.384		0.412	
N	2,226		1,659	

The dependent variable is Investment. We use our full (Panel A, Column 1 and 2 and Panel B, Column 1) and matched sample (Panel A, Column 3 and 4 and Panel B, Column 2). Regression models include additional interaction terms based on conditional variables to assess the cross-sectional variation in the baseline treatment effect. The following conditional variables are used in Panel A: (1) mobile (immobile) equals 1 if a finance lease firm's product focus is on mobile (immobile) assets; (2) we further split mobile assets into specialised (diverse), which equals 1 if a finance lease firms offers mainly products for a specific sector (wide range of products). The following conditional variables are used in Panel B: (1) office/IT equals 1 if a finance lease firm's product focus is on office/IT assets; (2) industry equals 1 if a finance lease firm's product focus is on machinery and equipment; (3) medicine equals 1 if a finance lease firm's product focus is on medical products; (4) agriculture equals 1 if a finance lease firm's product focus is on agricultural products; (5) vehicles equals 1 if a finance lease firm's product focus is on vehicles; (6) immobile equals 1 if a finance lease firm's product focus is on immobile assets; (7) diverse equals 1 if a finance lease firm offers a wide range of products from different sectors. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table 8
Cross-sectional findings: Manufacturer ownership

	Full sample	Matched sample
	(1)	(2)
Post x treatment x manufacturer	-0.0533	-0.0496
	(0.0396)	(0.0412)
Post x treatment x no manufacturer	-0.0732***	-0.0660**
	(0.0271)	(0.0297)
F-test for differences [p-value]	[0.615]	[0.678]
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.384	0.410
N	2,226	1,659

The dependent variable is Investment. We use our full and matched sample. Regression models include additional interaction terms based on a conditional variable to assess the cross-sectional variation in the baseline treatment effect. We include the conditional variable manufacturer (no manufacturer), which equals 1 if a finance lease firm is (not) a direct lease firm of a specific manufacturer. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Appendix A

Variable definitions

Variable	Description	Source
Investment measures		
Investment	Change in tangible assets (including leasing assets) scaled by prior year's tangible assets (≙ net investment rate)	Amadeus/hand-collected
Inv_Depr	Change in tangible assets (including leasing assets) before depreciation scaled by prior year's total assets	Amadeus/hand-collected
Inv_Leasing	Change in leasing assets scaled by prior year's leasing assets for treated firms; change in tangible assets scaled by prior year's tangible assets for control firms	Amadeus/hand-collected
Inv_TA	Change in tangible assets (including leasing assets) scaled by prior year's total assets	Amadeus/hand-collected
Other firm characteristics		
Leverage	Total debt scaled by prior year's total assets	Amadeus/hand-collected
Liquidity	Cash and equivalents scaled by prior year's total assets	Amadeus/hand-collected
Loss	Dummy variable, which equals 1 if prior year's profit/loss before taxes is negative	Amadeus/hand-collected
Profitability	Profit/loss before taxes scaled by prior year's total assets	Amadeus/hand-collected
Post	Dummy variable equal to 1 for 2014 and 2015, and 0 otherwise	Constructed
Size	Natural logarithm of prior year's total assets	Amadeus/hand-collected
Treatment	Dummy variable equal to 1 if the firm is a company from the finance lease sector, and 0 if the firm belongs to the rental or operating lease sector	Constructed

Appendix B

Simplified example of tax depreciation methods

Panel A: Straight-line depreciation over the expected useful life of the leased asset

		t_1	t_2	t_3	t_4
	Depreciation	166.66	166.66	166.66	166.66
	Loss on sale				333.36
a.	Tax benefit from depreciation	50.00	50.00	50.00	150.00

Panel B: Straight-line depreciation over the lease term considering a residual value

		t_1	t_2	t_3	t_4
	Depreciation	250.00	250.00	250.00	250.00
	Loss on sale				0
b.	Tax benefit from depreciation	75.00	75.00	75.00	75.00

Panel C: Liquidity effect

a.-b.	Difference in the tax benefit	-25.00	-25.00	-25.00	75.00
	Present value of difference in tax benefits	-8.39			

This table presents the liquidity effect (Panel C) that results from a comparison between the tax benefit of two tax depreciation methods based on a simplified example. The following assumptions are made for the example: the acquisition cost of the leased asset is EUR 1,000, the expected useful life of the leased asset is six years, the lease term is four years, the residual value and market value of the leased asset at the end of the lease term are EUR 0[31], the tax rate of the lessor is 30% and the interest rate is 7%. Panel A presents the tax benefit from depreciation if straight-line tax depreciation over the expected useful life of the leased asset is applied. Panel B presents the tax benefit from depreciation if straight-line tax depreciation over the lease term under consideration of the residual value of the leased asset at the end of the lease term is applied.

[31] Due to the business model of finance lease firms, the residual value and sales price of the leased asset are of subordinate importance to our analysis. For simplification purposes, we assume both values to be zero.

Appendix C

Sample selection

Selection criteria		Number of firms	Number of observations
Panel A: Treatment group			
	German companies from the finance lease sector, which are registered by the Federal Financial Supervisory Authority from 2011 to 2015, with published unconsolidated annual financial statements in the German Federal Gazette's Company Register database	311	1,555
Excluding:			
(1)	Firms with restructuring processes (e.g. mergers) during the sample period	(35)	(175)
(2)	Observations with missing values for my dependent and control variables	(72)	(435)
(3)	Firms without financial data of the net investment rate at least one year prior and after the reform	(9)	(18)
	Final sample of treated firms	195	927
Panel B: Control group			
	German firms in Bureau van Dijk's Amadeus database belonging to the rental sector (NACE code: 7710-7739)	9,784	48,920
Excluding:			
(1)	Firms with consolidated or non-German-GAAP financial data	(7)	(35)
(2)	Firms with similar company names compared to companies from the finance lease sector	(16)	(80)
(3)	Firms with restructuring processes (e.g. mergers) during the sample period	(4)	(20)
(4)	Observations with missing values for my dependent and control variables	(8,756)	(47,097)
(5)	Firms without financial data of the net investment rate at least one year prior and after the reform	(648)	(389)
	Final sample of control firms	353	1,299
Final sample of treated and control firms:		**548**	**2,226**

This table provides details on the sample selection process for our treated (Panel A) and control firms (Panel B). Our primary data sources are the German Federal Gazette's Company Register database for our treated firms and the Bureau van Dijk's Amadeus database for our control firms. Dependent and control variables are defined in Appendix A.

Appendix D

Sample statistics over the period 2011-2013

	N	Mean	StDev	P50	Min	Max
Treatment group						
Investment	553	0.0434	0.3325	-0.0009	-0.5863	4.0512
Liquidity	553	0.0005	0.0036	0.0000	0.0000	0.0695
Size	553	10.0219	1.8030	9.9806	5.3270	13.8670
Leverage	553	0.6227	0.3602	0.6460	0.0000	2.4416
Profitability	553	0.0282	0.0719	0.0149	-0.3454	0.5839
Loss	553	0.2170	0.4126	0.0000	0.0000	1.0000
Total assets (in EUR 1,000)	553	98,572	191,483	21,687	313	1,142,128
Tangible assets (in EUR 1,000)	553	64,820	138,554	1,2465	0.0262	889,141
Full sample control group						
Investment	769	0.1046	0.3431	0.0190	-0.7592	1.6973
Liquidity	769	0.0916	0.1177	0.0448	0.0000	0.6457
Size	769	8.4802	1.7591	8.4884	4.3944	13.1019
Leverage	769	0.5321	0.3583	0.5191	0.0000	2.0387
Profitability	769	0.0913	0.1268	0.0591	-0.2817	0.8024
Loss	769	0.1378	0.3450	0.0000	0.0000	1.0000
Matched sample control group						
Investment	426	0.0664	0.3045	0.0007	-0.7147	1.6458
Liquidity	426	0.0198	0.0224	0.0112	0.0000	0.1175
Size	426	8.7005	1.7598	8.7227	4.5109	13.1019
Leverage	426	0.5827	0.3684	0.5891	0.0000	1.8712
Profitability	426	0.0657	0.1034	0.0404	-0.1836	0.6409
Loss	426	0.1901	0.3929	0.0000	0.0000	1.0000

This table provides summary statistics of the treatment, full and matched control group for the pre-reform period 2011-2013. All variables are defined in Appendix A. In order to calculate the control variables in 2011, which are scaled by prior year's total assets, we use data from 2010, which we not include in our sample period.

Appendix E

We define z as the present value of tax savings from tax depreciation deductions for an increase in investments by one unit (Maffini et al., 2019). The marginal tax rate (τ) is 30%, which equals in general the total tax burden of corporations. Following recent literature, we assume that the interest rate (r) is 7% (e.g., Zwick and Mahon, 2017; Maffini et al., 2019; Ohrn, 2019). Further, we assume that the average lease term is 4 years and the average tax depreciation period is 6 years. We base our assumptions on a study by Oestreicher and Hillmann (2016) in which they analysed 85,604 lease contracts of German firms from the finance lease sector.

Before the reform, the present value of tax savings due to straight-line tax depreciation based on the lease term (D_{pre}) can be expressed as

$$z_{pre} = \tau \sum_{t=1}^{4} \frac{D_{pre}}{(1+r)^t} = \tau \sum_{t=1}^{4} \frac{0.25}{(1+r)^t} = 0.8468\tau$$

After the reform, straight-line depreciation over the useful life of the asset is the only applicable depreciation method. However, since finance leases require that the leased asset is financed and amortised over the non-cancellable lease term, finance lease firms sell their assets after the lease term to an anticipated residual value, which we assume to be zero for simplification (see Section 2.2 and Appendix B). The present value of tax savings due to straight-line tax depreciation based on the useful life of the asset (D_{post}) can be expressed as

$$z_{post} = \tau \sum_{t=1}^{4} \frac{D_{post}}{(1+r)^t} + \frac{\tau(1-\sum_{t=1}^{4} D_{post})}{(1+r)^4} = \tau \sum_{t=1}^{4} \frac{0.167}{(1+r)^t} + \frac{0.333\tau}{(1+r)^4} = 0.8188\tau$$

Therefore, the change in the present value of tax savings from tax depreciation deductions for an increase in investments by one unit is -0.033 ($= dz/z = -0.028\tau/0.8468\tau$), which complies with a decrease of the present value of tax depreciation deductions for a unit investment by around 3.3%. Given the assumption that the marginal tax rate is 30%, the change in tax depreciation allowance should increase the net-of-tax cost of a unit investment, 1 – z, by around 1.13% ($= d(1-z)/(1-z) = 0.028 \times 0.3/(1-0.8468 \times 0.3)$).

Online Appendix for

Tax Depreciation and Investment Decisions:

Evidence from the Leasing Sector

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Table A1
Robustness tests: Alternative dependent variable

	Full sample	Matched sample
	(1)	(2)
Dependent variable:	Net investment rate of leasing assets (Inv_Leasing)	
Post x Treatment	-0.0645**	-0.0563*
	(0.0272)	(0.0300)
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.361	0.374
N	2,128	1,561

The dependent variable is the net investment rate of leased assets for our treated firms and Investment for our control group. The table reports fully specified regressions with fixed effects and firm-level controls for the full and matched sample. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A2
Alternative regression specification: Balanced sample

	Full sample	Matched sample
	(1)	(2)
Post x Treatment	-0.0457	-0.0696*
	(0.0294)	(0.0353)
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.345	0.329
N	1,245	930

The dependent variable is Investment. The table reports fully specified regressions with fixed effects and firm-level controls for the full and matched sample. We use a balanced sample. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A3
Alternative regression specification: Winsorising

	Full sample	Matched sample
	(1)	(2)
Post x Treatment	-0.0529**	-0.0530**
	(0.0223)	(0.0246)
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.404	0.449
N	2,226	1,659

The dependent variable is Investment. The table reports fully specified regressions with fixed effects and firm-level controls for the full and matched sample. We winsorise all continuous variables at the 1% (99%) level. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A4
Entropy balancing matching

	(1)	(2)
Post x Treatment	-0.0418	-0.0627**
	(0.0276)	(0.0258)
Controls	None	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.152	0.362
N	1,830	1,830

This table provides the results of our baseline regression based on a matched sample. We employ entropy-balancing matching. We match on first differences of all firm-level covariates (size, leverage, profitability, liquidity, loss) and the natural logarithm of tangible assets in the year before the reform. The entropy balancing method calculates weights, which we use to re-estimate our main regression model (Section 4.1). The dependent variable is Investment. The table reports two different specifications: (1) regression with fixed effects but without firm-level controls, and (2) fully specified regression with fixed effects and firm-level controls. The main variable of interest in the multivariate models is the interaction term Post x Treatment, capturing the difference-in-differences effect. The interaction term Post x Treatment equals 1 for treated firm observations (companies from the finance lease sector) in the post treatment period 2014-2015 and 0 otherwise. All variables are defined in Appendix A. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A5
Cross-sectional findings: Legal form

	Full sample	Matched sample
	(1)	(2)
Post x Treatment x corporation	-0.0698**	-0.0635**
	(0.0284)	(0.0305)
Post x Treatment x partnership	-0.0696**	-0.0622*
	(0.0318)	(0.0347)
F-test for differences [p-value]	[0.995]	[0.968]
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.539	0.410
N	2,226	1,659

The dependent variable is Investment. We use our full and matched sample (Column 1 and 2). Regression models include additional interaction terms based on a conditional variable to assess the cross-sectional variation in the baseline treatment effect. We include the conditional variable corporation (partnership), which equals 1 if the finance lease firm has a legal form that is equivalent to a limited liability company (partnership). All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A6
Cross-sectional findings: Loss situation

	Full sample	Matched sample
	(1)	(2)
Post x treatment x profit	-0.0681***	-0.0635**
	(0.0257)	(0.0288)
Post x treatment x loss	-0.0781	-0.0617
	(0.0553)	(0.0548)
F-test for differences [p-value]	[0.853]	[0.972]
Controls	Included	Included
Year fixed effects	Included	Included
Firm fixed effects	Included	Included
Adj. R^2	0.384	0.410
N	2,226	1,659

The dependent variable is Investment. We use our full and matched sample (Column 1 and 2). Regression models include additional interaction terms based on a conditional variable to assess the cross-sectional variation in the baseline treatment effect. We include the conditional variable profit (loss), which equals 1 if the average profit/loss before taxes in the pre-reform period is positive (negative). All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.

Table A7
Cross-sectional findings: Exposure to regulatory requirements, matched sample

	Matched sample			
	(1)	(2)	(3)	(4)
Post x treatment x high cash	-0.0421			
	(0.0290)			
Post x treatment x low cash	-0.125***			
	(0.0433)			
Post x treatment x high equity		-0.0501*		
		(0.0298)		
Post x treatment x low equity		-0.102**		
		(0.0399)		
Post x treatment x large			-0.0188	
			(0.0352)	
Post x treatment x small			-0.0760**	
			(0.0306)	
Post x treatment x bank				-0.113***
				(0.0372)
Post x treatment x no bank				-0.0454
				(0.0299)
F-test for differences [p-value]	[0.041]	[0.171]	[0.095]	[0.049]
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included
Adj. R^2	0.413	0.411	0.411	0.412
N	1,659	1,659	1,659	1,659

The dependent variable is Investment. We use our matched sample. Regression models include additional interaction terms based on conditional variables to assess the cross-sectional variation in the baseline treatment effect. The following conditional variables are used: (1) high cash (low cash) equals 1 if the average cash of a finance lease firm, which is defined as cash holdings including receivables from credit institutions scaled by prior year's total assets, is above (below) the 25th percentile across the treated firms in the pre-reform period; (2) high equity (low equity) equals 1 if equity scaled by prior year's total assets of a finance lease firm is above (below) the 25th percentile across the treated firms in the year prior to the reform; (3) large (small) equals 1 if total assets of a finance lease firm are above (below) the mean across the treated firms in the year prior to the reform; (4) bank (no bank) equals 1 if a finance lease firm is (not) an affiliate of a bank. All regression models have standard errors that are heteroscedasticity-robust and clustered at the firm level. Reported values: coefficient (standard errors) and *** (**) (*) indicate significance levels at 1% (5%) (10%), two-tailed.