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The Impact of the ACE Tax System on Corporate Investment: Evidence from a Small Economy

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Biographical Note

Marta Moreira Ribeiro was born in February 2002 in Vila Nova de Famalicão. From an early age, she demonstrated a natural affinity for both working with people and engaging with numbers.

In 2023, Marta earned her Bachelor's degree in Management at the School of Economics and Management at the University of Minho. During her undergraduate studies, Marta gained hands-on experience in accounting and later collaborated with the Bank of Portugal, where she was responsible for quality control and corporate data analysis.

As her fascination with finance deepened, Marta pursued a Master's in Finance at the School of Economics and Management of the University of Porto, beginning in September 2023. She is currently developing her career at BNP Paribas, an international institution that embodies the rigor and dynamic pace of the financial world she had long envisioned herself thriving in.

Alongside her academic and professional path, Marta's communicative nature and strong sense of social responsibility led her to take part in various volunteer initiatives, working with both children and the elderly. These experiences enriched her perspective and reminded her that while numbers may shape decisions, it is people who give them meaning.

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Abstract

A central debate in public economics and corporate finance concerns the extent to which corporate tax systems worldwide induce a bias toward debt financing over equity. This imbalance carries wide-ranging effects, not only by compromising financial stability through the encouragement of excessive corporate leverage, but also by suppressing business investment, which underpins productivity, wage increases and sustainable economic growth. This problem's frequent costs to economic efficiency and public welfare have drawn the government's attention, culminating, among other responses, in the creation of the Allowance for Corporate Equity (ACE) reform.

Through an analysis of the 2017 Portuguese ACE reform's effect on the investment patterns of non-small and medium-sized enterprises (SME) companies, this study seeks to bridge a gap in empirical research at the intersection of corporate taxation and investment. To isolate the causal impact of the reform, the study employs a difference-in-differences (DiD) approach using Spanish firms as a control group, complemented by a propensity score matching (PSM) technique to ensure comparability between treated and control units and strengthen the validity of the estimates.

The findings reveal a statistically significant increase in investment ratios among Portuguese firms following the ACE tax system, with the most pronounced effects emerging after a one-year period. These results not only align with prior evidence from other ACE-adopting countries but also contribute to the broader discourse on corporate tax policy design.

Keywords: allowances for corporate equity, corporate income taxation, investment, capital budgeting, tax policy and corporate finance.

JEL-Codes: E22, G31, G32, G38, H20, H25, H32.

Resumo

Um dos debates centrais da economia pública e das finanças empresariais refere-se ao impacto dos sistemas fiscais nas decisões de financiamento das empresas, em particular o modo como muitos regimes de tributação favorecem o recurso à dívida em detrimento do capital próprio. Este enviesamento tem consequências significativas, não só por comprometer a estabilidade financeira através do incentivo ao excessivo endividamento corporativo, mas também por desencorajar o investimento empresarial, que é essencial para a produtividade, aumento dos salários e crescimento económico do país. O impacto negativo desta distorção na eficiência económica e no bem-estar social têm motivado os governos a adotar medidas corretivas, entre as quais se destaca a criação da Remuneração Convencional do Capital Social ("Allowance for Corporate Equity (ACE)").

Este estudo pretende analisar o impacto da extensão da reforma ACE nos níveis de investimento das grandes empresas portuguesas em 2017. O objetivo é contribuir para a investigação sobre a relação entre fiscalidade empresarial e decisões de investimento, uma área pouco explorada empiricamente. Para estimar o efeito causal da reforma, é utilizada uma metodologia de diferenças-em-diferenças, onde empresas espanholas são utilizadas como grupo de controlo. Esta abordagem é complementada com uma técnica de emparelhamento ("Propensity Score Matching (PSM)"), de forma a garantir a comparabilidade entre os grupos analisados e aumentar a robustez dos resultados.

Os resultados revelam um aumento estatisticamente significativo nos rácios de investimento das empresas portuguesas após a implementação do sistema fiscal ACE, com intensificação dos efeitos observada ao fim de um ano. Estes resultados estão alinhados com a evidência empírica recolhida noutros países e contribuem para a formulação de políticas fiscais.

Palavras-Chave: allowances for corporate equity, impostos sobre o rendimento das pessoas coletivas, investimento, orçamentação de capital, política fiscal e finanças empresariais.

JEL-Codes: E22, G31, G32, G38, H20, H25, H32.

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List of Acronyms

ACC – Allowance for Corporate Capital

ACE – Allowance for Corporate Equity

BvD – Bureau van Dijk

CAPEX – Capital Expenditures

CBIT – Comprehensive Business Income Tax

CFT – Cash-Flow Taxes

CIT – Corporate Income Tax

D&A – Depreciation and Amortization

DEBRA – Debt-Equity Bias Reduction Allowance

DiD – Difference-in-Differences

EBIT – Earnings Before Interest and Taxes

GDP – Gross Domestic Product

ICE – Incentivo à Capitalização das Empresas

NPV – Net Present Value

OLS – Ordinary Least Squares

PSM – Propensity Score Matching

RCCS – Remuneração Convencional do Capital Social

ROE – Return on Equity

SME – Small and Medium-sized Enterprises

VAT – Value Added Tax

VIF – Variance Inflation Factor

1. Introduction

Conventional corporate income tax (CIT) systems are known to be nonneutral on financing decisions, granting tax deductibility for interest payments on debt but not for returns on equity (Klemm, 2007; Mooij, 2012; Zangari, 2014). Such asymmetries have been widely criticized for discouraging equity financing, a concern echoed in President Barack Obama's remark: "Companies are taxed heavily for making investments with equity; yet the tax code actually pays companies to invest using leverage" (Mooij, 2012).

The debt bias inherent in CIT systems contributes to excessive corporate leverage, thereby elevating firms' exposure to default risk, amplifying the consequences of economic shocks, and exacerbating the business cycle's volatility (Finke et al., 2014; Mooij, 2012; Zangari, 2014). Beyond financial stability concerns, Devereux and Freeman (1991) and Kayis-Kumar et al. (2022) also observe that debt bias may distort the prioritization of investment alternatives and ultimately dampen overall investment activity. This is particularly detrimental to public welfare, given that business investment serves as a fundamental engine of productivity, wages and economic growth (Devereux & Freeman, 1991; Hassett, 1999; Kayis-Kumar et al., 2022; Mooij, 2012; Pacheco, 2017). Its macroeconomic importance is further reinforced by Hassett (1999), who observes that sharp investment contractions have consistently coincided with major postwar recessions. These dynamics prompt consideration of whether the corporate tax system can be restructured to counteract the distortions caused by debt bias. One prominent proposal is the Allowance for Corporate Equity (ACE) reform, supported by Kayis-Kumar et al. (2022), Klemm (2007) and a growing body of literature.

Originally proposed in the 1980s by scholars such as Boadway and Bruce (1984) and Wenger (1983) and further developed by IFS Capital Taxes Group (1991), the ACE tax system allows companies to deduct a notional return on equity from their taxable income, thereby complementing the existing deductibility of interest on debt (Célérier et al., 2017; Mooij, 2012; Schepens, 2016).

> While the introduction of an ACE variant was supposed to address the discrimination of equity finance in the previous system, the ultimate policy goal clearly is not the capital structure of firms, but the real effects on investment. (Klemm, 2007)

The ACE system has been implemented in several countries and empirical studies conducted in Belgium, Italy and Brazil indicate that ACE reforms effectively increase corporate investment (aus dem Moore, 2014; Klemm, 2007; Zeli, 2018). In the Portuguese context, however, to the best of our knowledge, no such study has yet been conducted.

Known as "Remuneração Convencional do Capital Social" (RCCS), Portugal's ACE reform was introduced by the government in 2008[1]. Initially restricted to small and medium-sized enterprises (SME), this tax incentive was expanded to include all companies in 2017[2]. Therefore, this study aims to assess the impact of the ACE corporate tax reform on the investment decisions of non-SME Portuguese firms, following the 2017 policy change. Exploiting a quasi-natural experiment, the analysis adopts a difference-in-differences (DiD) methodology, using Spanish firms as a control group due to their structural and economic similarity to Portuguese firms and the absence of an ACE system in Spain. To further minimize observable differences between the treatment and control groups and reinforce the robustness of the DiD estimates, a propensity score matching (PSM) procedure will be employed, as recommended by Caliendo and Kopeinig (2008), Fredriksson and Oliveira (2019), Princen (2012) and Zeli (2018).

By examining the effects of corporate taxes on investment, this research contributes to the empirical literature on a longstanding and central question in public finance and development (Djankov et al., 2010; Hassett, 1999; Hubbard, 1998; Mooij, 2012). Furthermore, the analysis of the Portuguese ACE's impact on large firms' investment decisions offers valuable insights for policymakers "not only for the design of tax policy, but for economic growth in general" (aus dem Moore, 2014). The findings of this research hold particular relevance in the current legislative context[3], where governments aim to mitigate the inefficiencies and public welfare challenges of debt bias (Baert, 2024; Kayis-Kumar et al., 2022).

Following the introduction section, the structure of this study is organized as follows. Section 2 presents a review of the relevant literature and outlines the main features of the Portuguese ACE reform. Sections 3 and 4 introduce the research question and underlying hypothesis,

[1] "Lei n.º 67-A/2007 de 31-12-2007, art. 81.º", 2007.
[2] "Lei n.º 42/2016 de 28-12-2016, art. 224.º", 2016.
[3] For instance, the European Commission's proposed "Debt-Equity Bias Reduction Allowance" (DEBRA) directive aimed to address the issues of the debt-equity taxation bias by implementing an ACE-variant system across Europe, while simultaneously introducing limitations on interest deductions (Baert, 2024; Kayis-Kumar et al., 2022).

followed by a detailed explanation of the empirical methodology and the sample used in the analysis. Section 5 discusses the research results, includes robustness checks, and explores potential extensions of the analysis. Lastly, Section 6 presents the main conclusions.

2. Literature Review

2.1. Corporate Investment Behavior: From Theory to Evidence

Corporate firms are continually engaged in strategic decision-making related to financing, investment, product development and business expansion through mergers and acquisitions, all aimed at fostering corporate growth. Among these, long-term investments, particularly in fixed assets, play a crucial role in enhancing a firm's ability to compete in wider economic markets, thereby driving profitability and maximizing shareholder wealth (Farooq et al., 2022; Kouser et al., 2012; Pacheco, 2017; Rahayu, 2019). Accordingly, numerous theoretical and empirical studies have been conducted to examine the factors that influence firms' investment decisions (Farooq et al., 2022; Mendes et al., 2014; Vartia, 2008).

Fisher's (1930) neoclassical framework introduced key principles such as the "Principle of Maximum Present Value" and the "Principle of Return over Cost," advocating that investment choices should be guided by the maximization of present value and a rate of return over cost at least equal to the market interest rate. Similarly, Keynes' (1936) concept of the marginal efficiency of capital parallels this reasoning. These foundational insights culminate in the Net Present Value (NPV) rule, which asserts that investment is justified only when the present value of expected future cash flows equals or surpasses the opportunity cost of capital, and thus, at the margin, firms invest until the NPV is driven to zero (Eklund, 2013; Farooq et al., 2022). This methodology has attained a central role in corporate finance discourse, widely recognized for its theoretical rigor and normative strength in leading finance textbooks such as Brealey and Myers (2000), Copeland et al. (2005) and Damodaran (2014).

Building on the foundational perspectives of Fisher (1930) and Keynes (1936), modern investment theories have evolved significantly.

Originally proposed by Clark (1917) and later refined by Samuelson (1939) within the context of business cycles, the accelerator theory of investment offers one of the earliest frameworks. Central to this model is the premise that demand conditions are the primary determinant of investment, with firms adjusting their capital stock in response to changes in output or sales (Eklund, 2013; Fazzari et al.,1988a; Fisher, 1952; Meyer & Kuh, 1955; Vartia, 2008). Often associated with Keynesian (1936) thought, it posits that during periods of economic expansion, characterized by rising Gross Domestic Product (GDP) and income levels, firms

tend to respond to increased demand by scaling up production through heightened capital investment, seeking to capitalize on favorable conditions and maximize profitability. Conversely, economic recessions or periods marked by elevated uncertainty tend to dampen corporate investment, which, as noted by Kong et al. (2022), can significantly impair overall corporate performance (Eklund, 2013; Farooq et al., 2022; Mendes et al., 2014).

Dating from the early 1960s, the prevailing thought in applied research holds that firm decisions are independent of financing considerations such as liquidity, leverage, or access to external equity since firm's capital structure is deemed irrelevant. This perspective is rooted in the seminal contribution of Modigliani and Miller (1958), which argued that under conditions of perfect and frictionless capital markets, internal and external sources of finance are considered perfect substitutes (Fazzari et al.,1988a; Mendes et al., 2014; Nguyen & Dong, 2013; Stein, 2003). When considering capital investment, this boils down to the neoclassical theory of investment, where "firms choose inputs of capital (and labour) in order to maximize the present discounted value of their income streams, with financial factors entering only through the cost of capital, which, in turn, is independent of the way the firm finances itself" (Pacheco, 2017).

Jorgenson (1963) advanced the classical Fisher investment model by embedding it within a neoclassical theory of optimal accumulation of capital. In this formulation, firms' investment behavior is decomposed into two components: replacement investment, aimed at offsetting depreciation to preserve the existing capital stock, and expansion investment, which reflects the firm's effort to align its current capital stock toward changes in its desired level. Crucially, "with perfectly competitive input and output markets, the firm's optimal demand for capital services depends ultimately on the price of output and the relative prices of various inputs, including the cost of capital" (Fazzari et al.,1988a).

Recognizing that monetary and fiscal policy also play a role, Hall and Jorgenson (1967) reformulated the user cost of capital to incorporate a proportional tax on business income. According to Hasset (1999), "the introduction of corporate taxes affects the user cost of capital in two ways. First, in the absence of tax deductions for depreciation and interest costs, an increase in the corporate income tax rate, T_c, increases the before-tax marginal product of capital necessary to yield an acceptable after-tax rate of return to investors and thereby increases the user cost. Second, a higher tax rate of corporate income increases the value of depreciation deductions and hence reduces the user cost". Therefore, firms increase

investment up to the point where the marginal return is equal to the user cost of capital (Keuschnigg & Ribi, 2013).

Jorgenson and Stephenson (1967) contended that the neoclassical theory of capital accumulation reliably explains investment behavior, with Hall and Jorgenson (1967) confirming its empirical validity at the aggregate level. However, this framework faced criticism from Eisner and his collaborators, who argued that the model's explanatory power stemmed largely from inadvertently capturing accelerator effects. When examined independently, the user cost was found to exert a negligible effect on investment (Eisner 1969; Eisner & Nadiri 1968; Hasset, 1999). This perspective was later contested by Cummins et al. (1996) and Vartia (2008), who found a statistically significant negative relationship between the user cost of capital and equipment investment.

Cummins et al. (1996), analyzing firm-level data around major U.S. tax reforms, estimated that a 10% reduction in the user cost of capital raised the equipment investment-to-capital ratio by around 6%. This effect was particularly pronounced among firms not in tax loss positions, who were more directly exposed to shifts in statutory tax rates and investment incentives. Vartia (2008) not only confirmed this negative relationship in a cross-country context but further explored the cost of capital's underlying components. The author found that a 5 percentage point reduction in the statutory corporate tax rate to 30% reduced the user cost by 2.6%, which in turn boosted the long-run investment-to-capital ratio by 1.0% to 2.6%. Similar effects were observed for enhanced depreciation allowances, with both channels having a more pronounced impact on investment in high-tax jurisdictions.

Nevertheless, Eklund (2013), Farooq et al. (2022), Smyth (1964) and Vartia (2008) point inherent limitations that undermine the theoretical coherence of the accelerator and neoclassical models. First, these frameworks rest on the assumption that firms adjust their capital stock to the desired level instantaneously and completely within each period. Second, they disregard the role of forward-looking expectations in shaping investment decisions.

A response to these issues was provided by Brainard and Tobin (1968) and Tobin (1969) through the Q-theory of investment[4], which contends that companies undertake investment when the market value of an additional unit of capital exceeds the cost of purchasing

[4] The Q-theory incorporates an "adjustment cost function of investment into the profit function" (Farooq et al., 2022), recognizing that adjustments are costly and time-consuming.

(replacement) it[5]. A major drawback on the practical theory's use is the unobservability of marginal Q, due to the inherent difficulty of measuring the value of a marginal unit of capital. To circumvent this, Hayashi (1982) demonstrated that, under specific conditions, marginal Q can be approximated by average Q ("Tobin's Q"), defined as the ratio of a firm's total market value to the replacement cost of its entire capital (Eklund, 2013; Farooq et al., 2022; Hayashi, 1982; Vartia, 2008). According to Eklund (2013), Hayashi (1982) and Nguyen and Dong (2013), this proxy has become instrumental as a measure of investment opportunities. When Tobin's Q exceeds unity, firms are incentivized to expand investment since "the replacement cost of such investment is less than the market value of installed capital" (Farooq et al., 2022). Conversely, when Q falls below one, a "negative adjustment of investment will occur" (Mendes et al., 2014).

Despite its theoretical appeal, Tobin's average Q is constrained by its reliance on stock market data, limiting its applicability to publicly listed firms. This dependence introduces further complications, as only the market value of equity is readily available, while the market value of debt is often difficult to obtain (Eklund, 2013; Fazzari et al.,1988a; Vartia, 2008). Moreover, Eklund (2013) highlighted a fundamental limitation in estimating the replacement cost of capital stock, noting that the conventional reliance on book values often yields misleading approximations. This imprecision undermines the interpretability of the market-to-book ratio, particularly for firms whose ratio hovers near unity, where performance distinctions become obscure. Nonetheless, Nguyen and Dong (2013) argued that the validity of this theorem depended on the existence of perfect capital markets. In this context, Lewellen and Badrinath (1997) have criticized conventional Tobin's Q metric as fundamentally flawed and arbitrary.

Aggarwall and Zong (2006), Stein (2003), along with an extensive body of corporate finance literature contest the notion of perfect capital markets by highlighting the frictions that characterize real-world financial interactions. Notable among these are agency costs stemming from potential conflicting interests among managers, debtholders and equityholders (Harris & Raviv, 1991; Jensen & Meckling, 1976; Jensen, 1986), as well as significant information asymmetries between corporate insiders and the capital market

[5] When expressed as a ratio, this decision rule is referred to as marginal Q, defined as the market value of an additional unit of capital divided by its replacement cost (Hayashi, 1982).

characterized by adverse selection and moral hazard (Akerlof, 1978; Holmström, 1979; Myers & Majluf, 1984). In combination with taxes, issuance, and transaction costs, these financial frictions restrict access to external financing and increase its cost relative to internal funds (Aggarwall & Zong, 2006; Bernanke & Gertler, 1989; Greenwald et al., 1984; Hubbard, 1998; Myers & Majluf; 1984; Stein, 2003). Therefore, the Modigliani and Miller (1958) assumption breaks down under imperfect capital markets.

As noted by Keuschnigg and Ribi (2013), Nguyen and Dong (2013) and Pacheco (2017), financial market inefficiencies exert a persistent influence on firms' investment behavior by not only shaping their financing choices but also potentially constraining their capacity to invest. In particular, Fazzari and Petersen (1993) and Fazzari et al. (1988a) underscored the central role of internal financial conditions, especially the availability of cash flow, as a key determinant of corporate investment decisions. This observed correlation can be interpreted as a consequence of financial constraints and laid the groundwork for the development of the Free Cash Flow theory.

Building on this perspective, studies by Bond and Meghir (1994), Lewellen and Lewellen (2016), Schaller (1993) and Yilmaz (2022) empirically found that firms tend to increase the level of investments when cash flow is strong and scale back investment when cash flow weakens. These findings are echoed in Lamont's (1997) analysis, showing that during periods of economic distress, the significant declines in cash flow and collateral value reduced corporate investment, particularly among oil industry firms.

Investment–cash flow sensitivity varies with the wedge between the costs of internal and external finance: a mechanism aptly captured by Fazzari et al. (1988a) in the following statement.

> If the cost disadvantage of external finance is small, retention practices should reveal little or nothing about investment: firms will simply use external funds to smooth investment when internal finance fluctuates, regardless of their dividend policy. If the cost disadvantage is significant, firms that retain and invest most of their income may have no low-cost source of investment finance, and their investment should be driven by fluctuations in cash flow. Fazzari et al. (1988a)

The relative costs of financing sources are closely associated with the extent of asymmetric information and agency problems, both of which are inherently shaped by firm-specific

characteristics. In particular, limited investor information can make it more difficult for smaller and/or growing firms to secure external funding, either by restricting access to credit or increasing its cost. Moreover, the scarcity of liquid assets and collateral further limits their capacity to secure debt financing. As "cash flows may be an important and sometimes unique source of funds for investment" (Pacheco, 2017), smaller firms' investment decisions become particularly sensitive to internal financing fluctuations, especially during economic downturn periods when external funding becomes scarcer and more costly (Chirinko & Schaller, 1995; Fazzari et al., 1988a; Fazzari et al., 1988b; Oliveira & Fortunato, 2006; Pacheco, 2017; Whited, 1992).

In contrast, mature firms tend to exhibit lower investment–cash flow sensitivity (Almeida et al., 2005; Fazzari et al., 1988a). Nevertheless, Pacheco (2017) argues that in the presence of capital market imperfections, the potential financial distress and direct costs (underwriting and administrative fees) associated with using external finance can lead even larger firms to rely more heavily on cash flows as a source of finance.

Kadapakkam et al. (1998) and Kaplan and Zingales (1997) challenged the prevailing consensus in the literature by demonstrating that investment exhibits the greatest cash flow sensitivity among firms that are least financially constrained. Complementing this, Gatchev et al. (2010) provide evidence from a multiequation model showing that firms facing cash flow shortfalls tend to sustain their investment levels by borrowing. Erickson and Whited (2000) further argue that the observed sensitivity of investment to cash flow in regressions that include Tobin's Q, as in Fazzari et al. (1988a) and related studies, is largely driven by measurement error in Q, and that this relationship disappears once the errors are properly addressed. However, even after correcting for measurement error in Q, Lewellen and Lewellen (2016) find that investment–cash flow sensitivities remain relevant for U.S. firms from 1971 to 2009, particularly among those that are more financially constrained.

In the presence of corporate taxes, there may be an additional effect on the firm's level of corporate investment through the cash flow channel, independent of the taxes' impact on the user cost of capital and marginal Q[6]. This occurs because taxes reduce after-tax earnings,

[6] Contemporary analyses of the effects of taxation on investment often follow the logic of the frictionless neoclassical model, where policy interventions influence investment demand by altering the user cost of capital. Likewise in the Q theory framework, "changes in investment tax credits or depreciation allowances alter the equilibrium value of marginal q" (Fazzari et al.,1988b). In both approaches, a firm's financial structure is

thereby limiting the internal funds available to finance future investments. This effect is particularly pronounced when the cost disadvantage of external finance is substantial, potentially preventing firms from fully capitalizing on profitable investment opportunities and earning above-normal returns on marginal investments (Fazzari et al.,1988a; Fazzari et al., 1988b; Hubbard, 1998; Keuschnigg & Ribi, 2013). According to Keuschnigg and Ribi (2013), even low tax rates can cause substantial welfare losses when firms face financing constraints, highlighting the critical role of tax policy in shaping investment behavior through changes in average tax burdens.

2.2. Rethinking Corporate Taxation: The ACE Approach

Most CIT systems worldwide have traditionally favored debt over equity as a way to fund investments. This is largely because interest payments on debt are deductible from corporate taxable profits as a cost, whereas return on equity, including shareholder dividends and capital gains, are generally not deductible (Hebous & Ruf, 2017; Klemm, 2007; Mooij, 2012; Zangari, 2014). This asymmetric tax treatment results in what is commonly referred to as a "debt bias", which Mooij (2012) highlighted as a source of concern due to its potential to generate "significant inequities, complexities and economic distortions".

Most notably, debt bias may lead to firms' excessive indebtedness, which can heighten the risk of default, amplify the effects of economic downturns, and expose firms to greater vulnerability in business-cycle fluctuations, partly due to elevated bankruptcy costs (Finke et al., 2014; Mooij, 2012; Zangari, 2014). Such tax-induced bias may also discourage investment, as highly indebted firms often cut back more sharply, especially during economic downturns. It can also distort investment choices by causing a misallocation of capital towards less productive or inefficient assets. Therefore, "weak investment contributes to low productivity growth and the low wage growth that this engenders" (Kayis-Kumar et al., 2022), ultimately reducing overall economic efficiency and public welfare (Barrela et al., 2022; Devereux & Freeman, 1991; Kayis-Kumar et al., 2022; Mooij, 2012).

The debt bias may also encourage multinational firms to shift profits from high to low-tax jurisdictions by strategically increasing debt funding in countries with high corporate tax rates and using equity funding in low-tax countries. This tax planning strategy is further enabled

assumed to be irrelevant, and investment is not constrained by the availability of finance (Fazzari et al.,1988a; Fazzari et al.,1988b; Hubbard, 1998).

by mismatches in how countries define debt and equity, particularly through the use of hybrid financial instruments that blur the line between the two (Mooij, 2012; Zangari, 2014).

Given the shortcomings within conventional tax systems, various reform proposals have emerged to promote a more neutral tax treatment of debt and equity financing. For instance, the Comprehensive Business Income Tax (CBIT)[7] system eliminates the tax deductibility of interest costs (Mooij, 2012; Radulescu & Stimmelmayr, 2007; Zangari, 2014). Another alternative to the CIT is the Cash-flow taxes (CFT)[8], which offers a simpler tax base defined solely by payments and receipts, with calculations based on the company's net cash flow received from its real business activities (King, 1986; Shome & Schutte, 1993; Wilson, 2002). Building upon the current corporate tax structure, governments can also introduce a notional deduction for the cost of equity finance through an Allowance for Corporate Equity (ACE)[9] system, which complements the existing interest deductibility by providing a comparable tax shield for equity (Célérier et al., 2017; Kayis-Kumar et al., 2022; Mooij, 2012; Schepens, 2016).

After weighing the pros and cons, Mirrlees et al. (2011) put forward several arguments that point to the potential advantages of ACE over CBIT under certain conditions. Furthermore, although King (1986, p. 2) refers to the CFT as "an alternative way to attain the objective of fiscal neutrality without a significant erosion of the tax base", Kayis-Kumar et al. (2022) and Zangari (2014) concluded that an ACE offers many of the benefits of a CFT without the associated implementation difficulties. Accordingly, this study will restrict the analysis to the ACE system.

The ACE regime is a long-standing concept that resurfaced in tax policy discussions since the 1980s, building on theoretical foundations laid by Boadway and Bruce (1984) and Wenger (1983), as referenced in Finke et al. (2014) and Klemm (2007). The idea was further developed through a practical reform proposal put forward in 1991 by the Institute for Fiscal Studies Capital Taxes Group (IFS Capital Taxes Group, 1991), and it has continued to influence tax reform debates to this day. ACE-based reforms have been introduced into the tax systems of several countries, among them Italy, Portugal, Belgium, Brazil, Turkey, and

[7] For an in-depth analysis of the design and implementation of CBIT, refer to Klemm (2021).
[8] See King (1986) and Shome and Schutte (1993) for further details on CFT implementation and their variants.
[9] The concept of ACE is alternatively known as notional interest deductions (Hebous & Ruf, 2017) or risk capital allowances (Burggraeve et al., 2008).

Cyprus (Finke et al., 2014; Hebous & Klemm, 2020; Hebous & Ruf, 2017; Mooij, 2012).

"Under the ACE, a corporation is granted a deduction against the corporate income tax base that is equal to the product between the (adjusted) equity - the *ACE base* - and a given notional rate, the *ACE rate*" (Zangari, 2014), aiming to approximate the cost of equity.

The starting *ACE base* can include the entire book value of equity or only the incremental equity relative to some base year (commonly referred to as "hard" and "soft" ACE systems, respectively). The way this base is adjusted is contingent on country-specific design choices and legal frameworks (Hebous & Klemm, 2020; Hebous & Ruf, 2017; Kayis-Kumar et al., 2022; Mooij, 2012).

Careful attention must be given to the *ACE rate* since the system's neutrality depends on setting the imputed rate of return on equity at an appropriate level (Kayis-Kumar et al., 2022). Therefore, Célérier et al. (2017) mentioned that "the ACE rate must be equal to the rate at which shareholders discount the tax savings from the company's future ACE allowances". Given the certainty of these deductions, the notional return should correspond to the risk-free nominal interest rate; however, this relies on ideal assumptions such as perfect loss offset, and potential deviations in practice justify the inclusion of a risk premium. While, in theory, the ACE rate should be firm-specific to reflect varying risk levels, in practice, most countries adopt a uniform notional rate of return as a more practical approach (Bond & Devereux, 1995; Célérier et al., 2017; International Monetary Fund, 2010; Kayis-Kumar et al., 2022; Mooij, 2012).

Beyond its implementation mechanics, the ACE framework tax system displays several key neutrality properties, as outlined below (Célérier et al., 2017; Klemm, 2007; Mooij, 2012).

The ACE system neutralizes firms' financing choices, at least from a corporate tax perspective (Kayis-Kumar et al., 2022; Keen & King, 2002; Klemm, 2007; Zangari, 2014). Nevertheless, the point raised by Mooij (2012) should also be considered:

> Under the ACE, debt relief still applies to true interest payments, while the equity allowance applies to a notional return. Thus, ACE reduces, but does not eliminate,

tax distortions in corporate finance when actual interest rates differ from the notional return of the ACE. Mooij (2012)[10]

Despite this, empirical evidence consistently points to significant reductions in corporate debt levels following the adoption of ACE regimes, in line with theoretical expectations. For instance, Kock and Gérard (2018) concluded that the introduction of ACE mechanisms in Italy and Portugal led to a decline in financial leverage by approximately 1% to 2%. Similarly, Branzoli and Caiumi (2020) found supporting evidence of a negative relationship in the context of Italy's reform. Princen (2012) reported a leverage reduction of approximately 2% to 7% in the aftermath of the Belgian ACE, with larger firms having exhibited a stronger response than SME. Consistent patterns were also observed under the Austrian ACE system, as documented by Petutschnig and Rünger (2022).

The ACE system is also designed to make the CIT neutral regarding marginal investment decisions by exempting from taxation any project whose notional return equals the cost of capital, thereby leading to a zero effective marginal tax rate. As a result, any marginal investment deemed worthwhile without taxation continues to be so under the ACE regime. Therefore, the ACE reform transforms the CIT into a tax on economic rents, this is profits earned above the normal rate of return[11] (Célérier et al., 2017; Kayis-Kumar et al., 2022; Keen & King, 2002; Klemm, 2007; Mooij, 2012; Zangari, 2014). On this basis, Kayis-Kumar et al. (2022) observe that "an ACE can be expected to lead to increased investment on both the extensive and intensive margins" and note that "the most noteworthy and widely accepted advantage of an ACE is that it stimulates investment."

Empirical studies provide support for this theoretical claim. Among the relevant studies is aus dem Moore (2014), who finds that Belgium's 2006 ACE reform led to a 3% statistically significant increase in fixed asset investment among SME based on a DiD approach, with robustness confirmed through additional tests such as a DDD specification[12]. These results

[10] Mooij (2012) notes that full financing neutrality can be achieved under an alternative system known as the Allowance for Corporate Capital (ACC), which eliminates the interest deduction altogether and instead allows a uniform deduction for a notional risk-free return on total capital, regardless of its source.

[11] It should be noted that this principle does not extend to other tax systems. When taxation applies to all profits rather than solely to economic rents, projects that are only viable before tax may no longer be pursued, ultimately reducing investment levels (Devereux & Freeman, 1991).

[12] The aus dem Moore's (2014) study analyzes the indirect effect of the ACE reform on investment among manufacturing firms by exploiting differences in cash-flow sensitivity across firm sizes. A DiD strategy compares SMEs (more cash-flow constrained) as the treatment group to large firms as the control group, while a DDD specification using matched French manufacturing firms serves as an additional robustness check.

align with Zeli's (2018) analysis of Italy's 2011 ACE reform, which was associated with a rise in investment activity by beneficiary firms. The most pronounced effects were observed in micro and small enterprises, which make up a large share of the Italian economy. The absence of a clear turning point in investment trends and the modest DiD coefficient suggest the severe economic downturn may have limited the observed impact. No anticipatory responses to ACE introduction were found, and effects appeared with a two-year lag post-ACE implementation. While Klemm (2007) found that a Brazilian ACE variant stimulated investment activity, Princen (2012), examining the Belgian case, reported no statistically significant effect of the equity tax shield on the investment ratio, allowing no clear-cut conclusions about its impact. Similarly, Hebous and Ruf (2017) showed that, for German multinationals, the increase in capitalization following ACE adoption was largely driven by passive investments, with no significant effect on active investment.

An additional strength of ACE's design is that it ensures the choice of tax depreciation method has no impact. Specifically, any increase in early years' depreciation for tax purposes reduces reported profit for that period, which, all else being equal, lowers the value of shareholder equity. As a result, the reduction in ACE benefits in later years fully offsets any advantage derived from accelerated depreciation in net present value terms (Célérier et al., 2017; Kayis-Kumar et al., 2022; Keen & King, 2002; Klemm, 2007; Mooij, 2012). "Neutrality of an ACE with respect to investment therefore holds, irrespective of the depreciation allowances in the tax system" (Mooij, 2012).

A similar effect applies to inflation: increases in monetary profits are offset by a higher notional return, leaving the ACE system unaffected by inflation (Klemm, 2007; Mooij & Devereux, 2011).

In addition to the fact that ACE reform "makes some problematic aspects of enterprise accounting practice irrelevant for tax purposes" (Keen & King, 2002), Kayis-Kumar et al. (2022) also note that the ACE tax system is relatively easy to implement, as it builds on the existing system by adding a new form of deduction.

Notwithstanding its merits, the ACE reform is not without drawbacks. Considered by Zangari (2014) as the most important one, the ACE system narrows the corporate tax base, which can lower government tax revenues (Finke et al., 2014; Klemm, 2007; Mooij & Devereux, 2011; Mooij, 2012).

On the one hand, this argument may not be sufficient to dismiss the ACE system, since the potential increase in investment, economic growth, and employment linked to the reform could help reduce its long-term budgetary cost (Kayis-Kumar et al., 2022; Mooij, 2012; Zangari, 2014).

On the other hand, in the absence of firms' behavioral responses or offsetting tax measures, the ACE reform may entail substantial fiscal implications, with empirical estimates indicating average losses of 14% of CIT revenue across countries, with Austria and Canada reaching losses of up to 20% (Kayis-Kumar et al., 2022; Mooij, 2012). Furthermore, Keen and King (2002) find that in Croatia, the ACE introduction led to an initial revenue cost of HrK 1.7 billion[13] (16%), potentially doubling over time.

An increase in corporate tax rates may be required to balance the government budget and preserve ACE neutrality. For instance, Finke et al.'s (2014) simulation model estimated that the Germany's ACE introduction would lead to an 18% decline in government tax revenue, which should be compensated by increasing the combined profit tax rate by 6 percentage points. Such adjustments risk amplifying the distortions the ACE is designed to reduce, which is why financing it through higher CIT rates is generally discouraged (Finke et al., 2014; Kayis-Kumar et al., 2022; Klemm, 2007; Mooij & Devereux, 2011; Zangari, 2014).

According to Mooij (2012), confining the *ACE base* to new investment offers a substantial means of curbing the associated revenue loss. An alternative approach would be to limit its scope to the banking sector, where the negative effects of high leverage are considered most severe. Additionally, any revenue shortfall could be balanced through other tax measures.

"Some have used the implementation of an ACE to shift their tax base away from direct taxation towards more indirect taxation, for example, by increasing the rate of Value Added Tax (VAT)" (Kayis-Kumar et al., 2022). Mooij et al. (2018) report that financing the ACE through higher VAT revenue yields a stronger positive impact on investment and GDP than doing so via an increase in the statutory CIT rate. For instance, using a computable general equilibrium model calibrated to the German economy, Radulescu and Stimmelmayr (2007) demonstrate that an ACE reform financed by a 5.1 percentage points VAT increase, reduces the cost of capital, resulting in a 20.5% increase in capital stock and a 9.1% rise in long-run

[13] Approximately €228 million or $216 million, based on exchange rates for 2002.

GDP. Similar outcomes are found by Mooij (2012) for the EU and Switzerland.

A hybrid approach combining ACE and CBIT reforms, as proposed by Mooij and Devereux (2011), helps further mitigate distortions in debt-equity capital structure decisions and yields substantial welfare gains.

Another potential drawback refers to ACE failure to eliminate the arbitrary distinction between equity and debt-financed in international taxation and to effectively counter base erosion and profit shifting, possibly opening new channels for tax avoidance[14] (Kayis-Kumar et al., 2022; Zangari, 2014). By reducing tax rate disparities and limiting negative international spillovers, Mooij and Devereux (2011) conclude that coordinated ACE implementation across EU member states enhances investment and economic welfare, even when offset by higher statutory CIT rates.

A further tax planning strategy that Zangari (2014) mentioned concerns the incremental ACE in particular: firms might artificially restructure their activities by, for example "sales of assets/participations within groups", to benefit from the allowance on "old" equity, even without changing their investment or financing structure. This could weaken its advantage over the standard regime, making anti-avoidance rules necessary.

Notwithstanding the acknowledged limitations of the ACE, and despite the fact that its theoretical foundations have been questioned in models accounting for agency costs and credit constraints (e.g. Keuschnigg & Ribi, 2013; Köthenbürger & Stimmelmayr, 2009), "many tax experts such as Sørensen continue to advocate for the ACE on the strength of its desirable properties" (Kayis-Kumar et al., 2022).

2.2.1. The ACE Reform in Portugal

In 2008, Portugal implemented a tax incentive known as the "Remuneração Convencional do Capital Social" (RCCS)[15], which falls under the category of ACE systems[16]. Over time, significant legislative adjustments have targeted the *ACE rate*: it began at 3% in 2008[17], rose

[14] Further details can be seen in Devereux (2012), Kayis-Kumar et al. (2022) and Zangari (2014).
[15] Which can be translated as Conventional Remuneration of Share Capital.
[16] "Lei n.º 67-A/2007 de 31-12-2007, art. 81.º", 2007.
[17] "Lei n.º 67-A/2007 de 31-12-2007, art. 81.º", 2007.

to 5% in 2014[18], and was further increased to 7% starting in 2017[19]. Before 2017, the tax benefit applied solely to SME, but it was broadened to include all companies thereafter.

From 2017 onwards, companies were subject to an annual deduction cap of €140,000 from their taxable income, corresponding to a 7% rate applied to new capital contributions up to €2,000,000. Eligible contributions for this tax benefit include cash contributions, as well as the conversion of shareholder loans or credits originally granted in cash, whether made at the time of the entity's incorporation or during subsequent capital increases. Furthermore, capital increases financed by profits generated within the same taxable period may also qualify.

The deduction is applied when determining the taxable income for the fiscal year in which the eligible contributions are made, as well as over the following five periods. However, the benefit is conditional on the company not reducing its capital during this period and not determining its taxable income using indirect methods.

It is also important to consider that applying this tax benefit lowers the earnings stripping threshold from 30% to 25%, resulting in tighter restrictions on interest deductions.

Noteworthy research on the Portuguese ACE predominantly explores its impact on corporate financial structures. Queirós (2020) identified a positive relationship between the capitalization levels of SME and the Portuguese ACE. Furthermore, Cruz and Soares (2022), through a survey-based study, found that most firms favor internal over external financing, with 40% of respondents unaware of the existence of the ACE tax incentive. Rocha and Sousa (2025) empirically find a measurable reduction in the financial leverage of large Portuguese companies following the 2017 ACE expansion, consistent with the earlier findings of Kock and Gérard (2018) for SME in 2008.

Beyond its influence on firms' financing decisions, the ACE reform may also impact key performance indicators such as investment levels (Zeli, 2018). Given the importance of this indicator in driving productivity, wages, and economic growth, this study aims to address a significant research gap by examining the effects of the 2017 ACE corporate tax reform on

[18] "Lei n.º 02/2014 de 16-01-2014, art 4.º", 2014.
[19] "Lei n.º 42/2016 de 28-12-2016, art. 224.º", 2016.

the investment decisions of non-SME Portuguese companies. As far as we are aware, this is the first study to explore this topic in the Portuguese context.

The RCCS was replaced in 2023 by the "Incentivo à Capitalização das Empresas (ICE)"[20;21] which, while different in structure, remains an ACE-type system. Apart from this study only using data up to 2019, this shift does not diminish the relevance of examining the former regime, as the primary objective is to deepen the understanding of how taxation influences investment through a quasi-natural experiment.

[20] "Lei n.º 24-D/2022 de 30-12-2022, art. 251.º", 2022.
[21] Which can be translated as Firm Capitalization Incentive.

3. Research Question and Hypothesis

Building upon the research of Djankov et al. (2010), Hassett (1999), Kayis-Kumar et al. (2022) and Vartia (2008), who emphasized that informed policy debate requires credible estimates of the effectiveness of investment tax incentives and underscored the economic relevance of business investment, this study aims to contribute to the existing empirical literature on the effects of CIT system on investment. Specifically, it presents the first causal evaluation of the impact of the 2017 expansion of Portugal's ACE system on the investment behavior of non-SME firms. Therefore, this study's analysis is guided by the following research question:

Research Question 1: Did the introduction of the Portuguese ACE system for large companies lead to an increase in their investment levels?

The literature reviewed by Cummins et al. (1996), Fazzari et al. (1988a, 1988b), Keuschnigg and Ribi (2013) and Vartia (2008) highlights the negative impact of corporate income taxes on capital spending. Given that the ACE reform allows a portion of shareholders' contributions to be deducted from the corporate tax base, studies by aus dem Moore (2014), Klemm (2007) and Zeli (2018) have demonstrated a positive effect of the ACE tax policy on investment. Consequently, according to the literature previously outlined, it is anticipated that the 2017 expansion of the Portuguese ACE will lead to an increase in large firms' investment levels. Therefore, the following research hypothesis is proposed:

Hypothesis 1: The introduction of the Portuguese ACE system for large companies led to an increase in their investment levels.

4. Methodology and Sample

4.1. Methodology

In an ideal empirical setting, evaluating the effect of a government policy would involve comparing the same group's outcomes in the presence and absence of the policy at the same time. However, since this counterfactual scenario is not observable in practice, the DiD methodology is commonly employed as a quasi-experimental approach to approximate it (Baker et al., 2025; Caliendo & Kopeinig, 2008; Roberts & Whited, 2013; Rubin, 1974; Stuart, 2010).

DiD estimates the causal effect of an intervention or event by comparing changes in outcomes before and after the occurrence for a treatment group (which received the intervention) and a comparable control group (which did not receive it) (Baker et al., 2025; Lechner, 2011; Roberts & Whited, 2013; Roth et al., 2023). However, as noted by Princen (2012), the reliable estimation of an intervention's impact through DiD relies on the fulfillment of two key assumptions.

The parallel trends assumption, which is the core assumption of the DiD approach, requires that "in the absence of treatment, the average change in the response variable would have been the same for both the treatment and control groups" (Roberts & Whited, 2013). The second assumption concerns the comparability of the groups, requiring that they display the same characteristics prior to the intervention. Under these identifying assumptions, any post-treatment differences in outcomes between the two groups would be attributed to the intervention itself (Caliendo & Kopeinig, 2008; Princen, 2012).

The DiD methodology has become a popular framework for drawing causal inferences about the effects of specific policy interventions and policy changes (Baker et al., 2025; Lechner, 2011). Notably, Princen (2012) applies this approach to analyze the introduction of ACE reform, setting a precedent for subsequent research using similar quasi-natural experiments, such as aus dem Moore (2014) and Zeli (2018). Building on this established literature, the present study applies the DiD method to assess the impact of the ACE reform on investment levels among large Portuguese companies.

To strengthen the robustness of the DiD methodology, researchers often combine it with a matching[22] approach that aims to identify, within a large pool of non-treated units, those that closely resemble the treated units in terms of observable pre-intervention characteristics. However, when many covariates are involved, matching directly on all of them can become complex. To address this challenge, Rosenbaum and Rubin (1983) introduced the concept of the propensity score, which condenses the relevant information into a single metric representing the conditional probability of receiving the intervention given the set of observed covariates (Caliendo & Kopeinig, 2008; Fredriksson & Oliveira, 2019; Garrido et al., 2014; Stuart, 2010; Zeli, 2018). Although both logit and probit models can be employed to estimate each firm's propensity score (Fredriksson & Oliveira, 2019; Garrido et al., 2014; Roberts & Whited, 2013), this study adopts a probit specification, following the approach of aus dem Moore (2014), Princen (2012), Schepens (2016) and Zeli (2018).

Once the propensity scores were estimated via a probit model, the widely used nearest-neighbor matching algorithm was employed, in which each treated firm was matched to a single control firm with the closest propensity score. This approach aligns with methodologies adopted in earlier studies (aus dem Moore, 2014; Petutschnig & Rünger, 2022; Princen, 2012; Zeli, 2018).

One issue that could arise with matching methods is the lack of overlap in the propensity score distributions between groups, known as the absence of common support. This problem is often addressed using nearest-neighbor matching with calipers, which restricts matches to pairs whose propensity scores differ by no more than a pre-specified distance. In this study, a caliper was imposed, ensuring that only companies within or close to the region of common support were included in the matched sample (Austin, 2011; Caliendo & Kopeinig, 2008; Rubin & Thomas, 2000; Stuart, 2010).

Another important consideration in the matching process is whether a control firm can be matched to more than one treated firm (Caliendo & Kopeinig, 2008; Stuart, 2010). This study follows the approach adopted by aus dem Moore (2014), Petutschnig and Rünger (2022) and Zeli (2018), in which matching is performed without replacement.

[22] Matching can be broadly defined as being "any method that aims to equate (or "balance") the distribution of covariates in the treated and control groups" (Stuart, 2010).

4.2. Sample

The simple DiD approach's starting point is to define two key elements: two time periods, one before and one after a policy intervention, and two distinct groups, a treatment group that is exposed to the intervention beginning in the second period and a control group that remains unaffected throughout (Baker et al., 2025; Fredriksson & Oliveira, 2019; Roth et al., 2023).

4.2.1. Selection of Treatment and Control Groups

In this study, Spanish firms were selected as the control group for Portuguese firms, following the recommendations of Panier et al. (2013) and Rocha and Sousa (2025) for assessing group similarity.

Spain maintained a traditional tax system during the period of analysis and did not introduce an ACE, ensuring a fiscal environment comparable to Portugal's pre-reform context. Moreover, both countries are geographically close, belong to the same economic space, share the same currency (the Euro), and are members of the European Union. They also exhibit similar economic trends, with comparable GDP and sales growth patterns during the period under study. Furthermore, according to Rocha and Sousa (2025), Spain and Portugal are economically integrated, with roughly 24% of Portuguese exports directed to Spain and about 7% of Spanish exports going to Portugal between 2013 and 2019. This characteristic implies exposure to common industry and aggregate shocks, enhancing comparability between treated and control firms (Panier et al., 2013). In addition, a PSM procedure, as recommended by Caliendo and Kopeinig (2008), Fredriksson and Oliveira (2019), Princen (2012) and Zeli (2018), was applied to minimize any difference in the characteristics between firms in Portugal and Spain and to enhance the credibility of the DiD estimates.

4.2.2. Identification of Pre- and Post-Intervention Periods

The DiD analysis focuses on 2016 as the pre-reform phase and 2017–2019 as the post-reform phase to assess the impact of the 2017 Portuguese ACE[23].

The decision to define 2016 as the baseline year for the DiD analysis is driven by legislative changes that occurred in Portugal and Spain during the preceding years, which could

[23] Following the approach of Schepens (2016), data from 2014 and 2015 were also collected to construct lagged control variables.

otherwise introduce confounding effects. In Portugal, the major 2014 CIT reform notably reduced the nominal tax rate from 25% to 23% in 2014 and subsequently to 21% in 2015 (PWC, 2014). In Spain, besides changes in the corporate income tax rate, a capitalization reserve[24] came into effect in 2015 as part of a broader tax reform (Durán-Cabré & Esteller-Moré, 2015; PWC Worldwide Tax Summaries, 2023).

Data from 2019 onwards are excluded to prevent potential distortions in the results arising from the effects of the COVID-19 pandemic, as in Rocha and Sousa's (2025) methodology.

4.2.3. Data Collection and Cleaning

The empirical analysis relies on a sample constructed using firm-level data compiled from the Bureau van Dijk (BvD) Orbis and Sabi databases. Data for Spanish firms were gathered exclusively from Orbis, while data for Portuguese firms were collected from both Orbis and Sabi to maximize the sample size. For Portuguese companies appearing in both databases, a detailed quality inspection and data revision process was carried out, adapting the aus dem Moore (2014) and Ferrando et al. (2017) methodology. When missing information was identified, entries for the same company were cross-verified between sources and merged to fill gaps and enhance overall data quality. Whenever necessary and feasible, companies' official accounting reports were consulted to validate and supplement the available data, thereby improving the reliability of the final dataset used for empirical analysis.

The data selection and processing began by narrowing the initial sample to companies operating within the corporate sector, following the methodology of aus dem Moore (2014), given that the ACE was a corporate tax reform. Subsequently, consistent with Kock and Gérard (2018), the sample was further refined to include only public and private limited companies, thereby excluding entities such as public authorities and non-profit organizations from the analysis.

Since the unit of analysis in this study is non-SME Portuguese companies, firms were selected based on the classification under Portuguese law[25] including only those employing more than

[24] The capitalization reserve enables companies to reduce 10% of the increase in their equity from their taxable income in a given year. This deduction is contingent upon the allocation of the amount to a non-distributable reserve, which must be kept on the company's balance sheet for at least five years (PWC Worldwide Tax Summaries, 2023).

[25] The category of micro, small, and medium-sized enterprises consists of companies that employ fewer than 250 people and have either a maximum sales volume of 50 million euros or a total annual balance sheet not exceeding 43 million euros ("Decreto-Lei n.º 372/2007 de 06-11-2007, Anexo, art. 2.º", 2007).

250 individuals or generating annual sales exceeding 50 million euros and holding total assets above 43 million euros. To ensure the comparability of the treatment and control groups, which is a fundamental requirement for the validity of the DiD methodology, the same selection criteria were applied to the Spanish firms comprising the control group.

Consistent with Gebauer et al. (2018), Hebous and Ruf (2017), Kestens et al. (2012), Ramos and Pimentel (2023) and Saquido (2003), firms operating in the financial and insurance sectors (NACE Rev.2 codes 6411–6630) were excluded from the sample given their specific financial behavior and regulatory environment. Similarly, companies in the real estate sector (NACE Rev.2 code 6810-6832) and those in the primary sector (NACE Rev.2 codes 0111–0990) were also omitted, following Princen (2012).

To ensure that the investment behavior analyzed reflects decisions made independently at the firm level and not shaped by parent company influence, the firm selection methodology follows a procedure similar to that of Kestens et al. (2012). Therefore, only companies "classified as having no direct majority ownership or firms for which all shareholders or all shareholders with a stake greater than 25% are individuals or employees are considered" (Rocha & Sousa, 2025).

In line with the methodology adopted by Gebauer et al. (2018), Martínez-Carrascal and Ferrando (2008) and Schepens (2016), consolidated financial accounts were preferred whenever available.

Nonetheless, to maintain a high-quality and consistent sample, companies that were lacking information for all relevant variables throughout the six-year period (2014 to 2019) were excluded.

After implementing all the selection criteria, a balanced panel sample used in this study comprises 5,124 observations, covering 854 companies over six years, with 175 from Portugal and 679 from Spain.

Regarding the country-specific macroeconomic data, it was retrieved from the World Development Indicators database of the World Bank.

4.2.4. Definition of the Dependent Variable

To better capture the effect of the ACE reform on corporate investment behaviour, the dependent variable, known as the investment ratio, is defined as capital expenditures (CAPEX) divided by 2014 total assets.

With regard to the numerator, CAPEX is measured following Ferrando et al. (2017), Gebauer et al. (2018), López-Gutiérrez et al. (2015), Pacheco (2017) and Pindado et al. (2011), in line with the long-standing view that total investment encompasses both replacement and expansion expenditures (Jorgenson, 1963). Accordingly, CAPEX is defined as the difference in the value of tangible and intangible assets between two consecutive years plus depreciation and amortization (D&A).

To avoid mechanical distortions in the investment ratio, the denominator is fixed at each firm's total assets in 2014, the first year for which data is available. This methodological choice is grounded in endogeneity concerns since total assets evolve partly because of CAPEX. In the absence of this adjustment, using a time-varying denominator could introduce a feedback effect: firms that invested more in previous years would have a larger asset base, which would lower their investment ratios if their absolute CAPEX levels remained constant. This approach is consistent with Brown et al. (2009), who also fixed the denominator to enable more accurate comparisons of investment ratios across firms and over time.

4.2.5. Definition of the Control Variables

Considered by Memon et al. (2024) as a purification tool, "control variables clarify the relationships between primary variables and eliminate confounding influences". Therefore, following the methodology used by aus dem Moore (2014) and Zeli (2018), who studied the impact of ACE on investment using a similar DiD approach, this study incorporates the Sales Growth Ratio, Cash Flow Ratio, Non-Current Liabilities Ratio, Firm Size, industry dummies and GDP growth rate as control variables. Since Bernerth and Aguinis (2016) state that "the inclusion of control variables, and in particular multiple control variables, is a safer and more statistically conservative approach than not including them", the Operating Return on Equity (ROE) and Liquidity Ratios are also included, in line with Pacheco's (2017) approach.

According to Cantor (1990), Mekonnen et al. (2023), Nguyen and Dong (2013), Saquido (2003) and Whited (1992), higher levels of debt can reduce the resources available for investment and firms' ability to absorb shocks, as a substantial portion of earnings must be allocated to servicing debt obligations. Furthermore, a high debt-equity ratio may heighten concerns over potential bankruptcy, discouraging creditors from extending further financing. At the same time, concerns about ownership dilution may make shareholders reluctant to issue new equity. Together, these dynamics limit the overall availability of financing, significantly constraining the firm's ability to pursue new investments. Conversely, Saquido (2003) and Siedschlag et al. (2014) suggest that a higher level of investment may also be associated with an increase in the debt-to-equity ratio. To capture this effect, the ratio of total non-current liabilities to shareholders' equity is used.

As suggested by the accelerator theory of investment, rising consumer demand generally leads to increased production needs and sales growth, which in turn stimulate investment in capital and machinery (Farooq et al., 2022; Nguyen & Dong, 2013). To capture these demand-driven effects, the Sales Growth Ratio is included as a control variable, calculated as the change in sales divided by shareholders' funds, based on the definition given by aus dem Moore (2014) and Zeli (2018).

Informed by Nguyen and Dong's (2013) argument that "if firms have enough cash inflows, it can be utilized in investment activities", the Cash Flow Ratio is included as a proxy for a firm's internal net worth. The ratio is computed by dividing cash flow by shareholders' funds, where cash flow is pre-defined in the database as the sum of profit for the period and D&A. This method follows the approach outlined by Aivazian et al. (2005), aus dem Moore (2014), Martínez-Carrascal and Ferrando (2008), Mendes et al. (2014), Saquido (2003), and Zeli (2018).

Firm size is also incorporated due to its established significance in influencing investment behavior, as noted in the prior literature review (Fazzari et al.,1988a). Consistent with the methodology used by aus dem Moore (2014), Ferrando et al. (2017), Gebauer et al. (2018), López-Gutiérrez et al. (2015) and Pacheco (2017), firm size is measured as the natural logarithm of total assets.

Pacheco (2017) further argues that more profitable firms are expected to exhibit higher levels of investment, which justifies the inclusion of the Operating ROE Ratio, calculated as

operating income (EBIT- Earnings Before Interest and Taxes) divided by shareholders' equity. The Liquidity Ratio, defined as the ratio of current assets to current liabilities, is also included, as firms may use available liquidity to finance investment (Pacheco, 2017).

There are also other studies, such as Aivazian et al. (2005), López-Gutiérrez et al. (2015), Pindado et al. (2011) and Saquido (2003), that include Tobin's Q, which has the "advantage of capturing the market's valuation of the firm's investment opportunities" (Pacheco, 2017). However, this approach is not deemed appropriate for the present analysis, as the dataset consists predominantly of unlisted Portuguese and Spanish firms.

Industry dummies based on the two-digit level of economic activities in accordance with NACE Rev. 2 are further considered as control variables to account for industry-specific heterogeneity that might confound the treatment effect (aus dem Moore, 2014; Mendes et al., 2014; Petutschnig and Rünger, 2022; Princen, 2012; Zeli, 2018).

Country-specific economic variables are also commonly included as controls in empirical studies on ACE reforms, with GDP growth being a "widely used economic indicator that represents the entire economic activity inside the economy and is adjusted for inflation" (Mekonnen et al., 2023). Periods of economic expansion, marked by rising demand for goods and services, prompt businesses to pursue higher-yield investments to secure greater profits. At the same time, GDP growth strengthens the overall economy, reducing operating costs and improving the ease of doing business, thereby attracting investors' interest (Mekonnen et al., 2023; Tokuoka, 2013). Therefore, this study includes the annual GDP growth rate in line with aus dem Moore (2014), Hebous and Ruf (2017), Mekonnen et al., 2023 and Zeli (2018).

Following previous authors (aus dem Moore, 2014; Gebauer et al., 2018; Martínez-Carrascal & Ferrando, 2008; Pacheco, 2017; Princen, 2012; Zeli, 2018), all control variables expressed as ratios are lagged by one period to reduce potential endogeneity issues. This decision is also economically justified, as firms' investment decisions in a given year are likely to be influenced by their financial conditions in the previous year.

Detailed information on the computation of all variables used in the analysis can be found in Appendix A - Variable Description.

4.2.6. Descriptive Analysis and Identification Strategy

Table 1 presents descriptive statistics for the main variables used in the analysis. Panel A refers to Portugal (treatment group) in the pre-reform year of 2016, while Panel B reports the corresponding statistics for Spain, which serves as the control group during the same period.

Table 1- Descriptive Statistics of Key Variables

This table presents descriptive statistics for the variables included in the model, whose description can be found in Appendix A - Variable Description. Investment Ratio is the ratio of CAPEX divided by 2014 total assets; Liquidity Ratio is ratio between current assets and current liabilities; Non-Current Liabilities Ratio is the ratio of total non-current liabilities over shareholder funds; ROE is the ratio of EBIT over shareholder funds; Sales Growth Ratio is the ratio of change in sales over shareholder funds; Size is the logarithm of total assets; Cash Flow Ratio is the ratio of cash flow over shareholder funds. Panel A and Panel B refer to Portugal and Spain in 2016, respectively. Values are in thousands of euros.

Variable	Obs	Mean	Std. dev.	Min	Median	Max
Panel A - Portuguese companies						
Investment Ratio	175	0.07	0.16	-0.24	0.03	1.38
Liquidity Ratio	175	1.77	1.16	0.15	1.37	6.82
Non-Current Liabilities Ratio	175	0.30	3.77	-43.77	0.38	4.98
ROE	175	0.40	3.05	-1.47	0.15	40.41
Sales Growth Ratio	175	0.84	6.46	-3.30	0.04	83.22
Size	175	10.74	1.95	6.27	10.85	17.60
Cash Flow Ratio	175	0.47	2.97	-1.95	0.20	38.71
GDP Annual Growth	175	2.00	0.00	2.00	2.00	2.00
Panel B - Spanish companies						
Investment Ratio	679	0.06	0.11	-0.81	0.03	1.11
Liquidity Ratio	679	1.99	2.07	0.08	1.47	24.56
Non-Current Liabilities Ratio	679	2.28	38.53	0.00	0.27	1000.29
ROE	679	0.26	2.20	-4.87	0.14	56.91
Sales Growth Ratio	679	0.96	10.86	-12.74	0.12	275.21
Size	679	11.10	1.81	6.77	11.06	18.63
Cash Flow Ratio	679	0.29	2.01	-4.08	0.17	51.97
GDP Annual Growth	679	2.92	0.00	2.92	2.92	2.92

To minimize the influence of abnormal outliers, all ratios are winsorized at the 1st and 99th percentiles. This procedure follows the methodology adopted by Ferrando et al. (2017), Gebauer et al. (2018), Pacheco (2017), Panier et al. (2013) and Petutschnig and Rünger (2022).

Regarding firm-specific characteristics reported in Table 1, Portuguese companies tend to display a more balanced capital structure, with significantly lower leverage (average ratio of 0.30) compared to their Spanish counterparts (2.28). While this suggests a financing model less reliant on non-current liabilities among the treatment firms, the Spanish sample also shows greater variability, as reflected in a larger standard deviation. Furthermore, Portuguese firms outperform Spanish ones in both profitability, with an average ROE 14 percentage points higher (40% vs. 26%), and in the strength of their internal cash flow generation. Nonetheless, the average change in sales relative to shareholders' funds is slightly lower in treatment companies (0.84) compared to those in the control group (0.96).

The pre-existing differences in financial indicators between beneficiary Portuguese firms and non-beneficiary Spanish firms in the year prior to the introduction of the equity tax shield may bias the estimation of the ACE's causal effects. This is due to the difficulty in disentangling whether post-reform investment behavior is driven by the policy itself or by firms' inherent tendency toward such behavior. Accordingly, to enhance comparability between the treatment and control groups and strengthen the validity of the DiD framework, a matching approach is employed in line with best practices in the literature (Austin, 2011; Caliendo & Kopeinig, 2008; Fredriksson & Oliveira, 2019; Princen, 2012; Zeli, 2018).

The matching process between Portuguese and Spanish firms begins with the estimation of propensity scores using a probit model. In this model, the dependent variable is a binary indicator equal to 1 for firms based in Portugal and 0 otherwise. Following the argument put forward by Stuart (2010)[26] and others, the regression in this study includes all relevant firm characteristics that could influence investment decisions, namely: Non-Current Liabilities Ratio, Sales Growth Ratio, Firm Size, ROE and Liquidity Ratio. In line with aus dem Moore (2014), Petutschnig and Rünger (2022), Princen (2012) and Zeli (2018), two-digit NACE Rev. 2 industry dummies are also included to ensure that matched firms operate within the same sector. This estimation was carried out using data from the year 2016, prior to the policy intervention. Therefore, results derived from the probit model estimation can be found in Table 2.

[26] Stuart (2010) emphasizes that "generally poor performance is found of methods that use a relatively small set of predictors of convenience" and highlights the importance of "including variables that may be associated with treatment assignment and/or the outcomes."

Table 2- Probit regression results

This table reports the results from a probit model estimating the propensity of a firm being assigned to the Portuguese treatment group. The dependent variable is a dummy indicator that takes the value of 1 if firms are based in Portugal and 0 for firms in Spain. The independent variables include firm-level characteristics that may affect investment behavior, along with industry dummies based on the two-digit NACE Rev. 2 codes. The analysis is based on cross-sectional data from the year 2016. Statistical significance is indicated by * at the 10% level, ** at the 5% level, and *** at the 1% level. Standard errors are reported in parentheses. The log-likelihood and Pseudo R^2 are also presented.

Dependent Variable	**Portugal (1)**
Liquidity Ratio	-0.0367
	(0.0490)
Non-Current Liabilities Ratio	-0.0014
	(0.0550)
ROE	0.1972
	(0.2883)
Sales Growth Ratio	-0.0616
	(0.0424)
Size	-0.1898***
	(0.0472)
Industry controls	Yes
N	791
Log likelihood	-343.8134
Pseudo R^2	0.1725

The only firm characteristic that significantly affects the likelihood of a firm being based in Portugal is its size (Table 2).

To construct a comparable control group, each Portuguese firm was matched to a similar Spanish firm applying a basic one-to-one nearest neighbor matching algorithm based on estimated propensity scores. The matching was conducted without replacement and with a caliper, ensuring that each Spanish firm was used only once and that poor-quality matches were excluded. As a result, unmatched observations were excluded from the analysis, yielding a final sample of 156 Portuguese firms and 156 Spanish firms. This matching procedure was implemented using the psmatch2 command in Stata, based on the Leuven and Sianesi (2003) approach.

Since "the most important step in using matching methods is to diagnose the quality of the resulting matched samples" (Stuart, 2010), this study began by following the authors' recommended preliminary step: examining the distribution of propensity scores in both the original and matched groups. The kernel density plots (Figures 1 and 2) reveal that, while

there are substantial differences in the distributions of the treatment and control groups prior to the matching, they closely overlap afterward across the full range of propensity score values.

Figure 1 - Kernel Density of Propensity Scores Before Matching

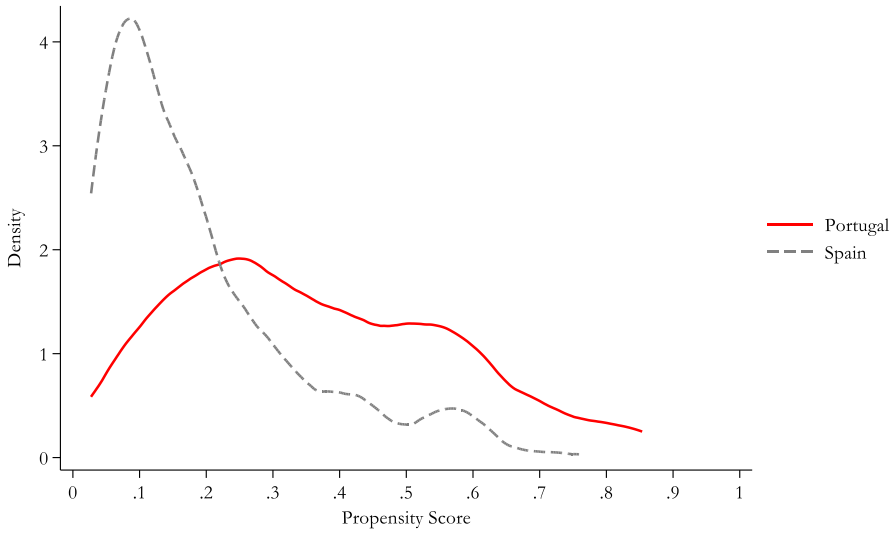
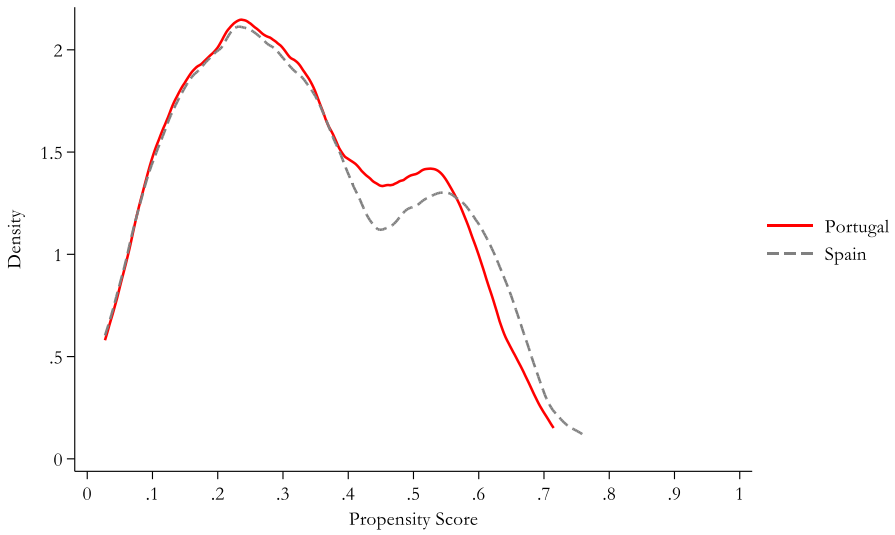


Figure 2 - Kernel Density of Propensity Scores After Matching



Further insights into the quality of the matching procedure can be found in Table 3. The PSM resulted in a balanced means of all variables across the treatment and control groups. Except for firm size, all covariates exhibit post-matching standardized differences of means below 10%, which is lower than the commonly suggested maximum thresholds of 10% to 25% for acceptable covariate balance (Stuart, 2010; Stuart et al., 2013).

Additionally, three out of five covariates show overall bias reductions exceeding 48% and the t-test confirms no statistically significant differences between the groups, further validating the improved balance in line with standard guidelines (Caliendo & Kopeinig, 2008; Garrido et al., 2014; Zeli, 2018).

Table 3 - Covariate Bias Reduction Estimates Post-PSM

This table shows the reduction in covariate bias after applying PSM using 2016 data. U indicates the unmatched sample, while M is the matched sample. Bias is defined by Rosenbaum and Rubin (1985) as the difference in sample means between the treated and control groups, divided by the square root of the average of their sample variances. The t column accounts for the t-test assessing whether the difference in means between the two groups is statistically significant.

Variable	Unmatched / Matched	Mean		%bias	%reduct |bias|	*t* test	
		Treated	Control			t	p>|t|
Liquidity Ratio	U	1.771	1.839	-5.4		-0.60	0.546
	M	1.796	1.794	0.2	97.0	0.02	0.988
Non-Current Liabilities Ratio	U	0.741	0.660	7.5		0.84	0.403
	M	0.729	0.588	13.1	-73.4	1.24	0.214
ROE	U	0.196	0.186	4.4		0.51	0.608
	M	0.200	0.198	1.2	73.4	0.10	0.918
Sales Growth Ratio	U	0.398	0.476	-5.2		-0.60	0.547
	M	0.398	0.358	2.7	48.6	0.26	0.797
Size	U	10.717	10.946	-12.6		-1.52	0.130
	M	10.794	10.642	8.4	33.3	0.73	0.466

At the overall sample level, as highlighted by Caliendo and Kopeinig (2008), the quality of the matching procedure is also reflected in the decline in mean and median standardized bias, which dropped from 7.0% to 5.1% and from 5.4% to 2.7%, respectively (Table 4).

Table 4 - Overall Bias Reduction in the Covariates Post-PSM

This table shows the reduction in overall bias in the covariates after applying PSM using 2016 data. These statistics include the mean and median bias.

Sample	Mean Bias	Median Bias
Unmatched	7.0	5.4
Matched	5.1	2.7

The effectiveness of the matching procedure is further reinforced by the analysis of Figures 3 and 4, providing evidence that Portuguese and Spanish companies followed similar trends

in both average and median investment ratios before the implementation of the 2017 ACE reform, thereby supporting the validity of the DiD's parallel trends assumption. From 2017 to 2018, Portuguese firms exhibited a marked surge in investment activity, which offset the decline observed in 2019, while the control group's ratios increased gradually throughout the period.

Figure 3 - Evolution of the Investment Ratio (Mean)

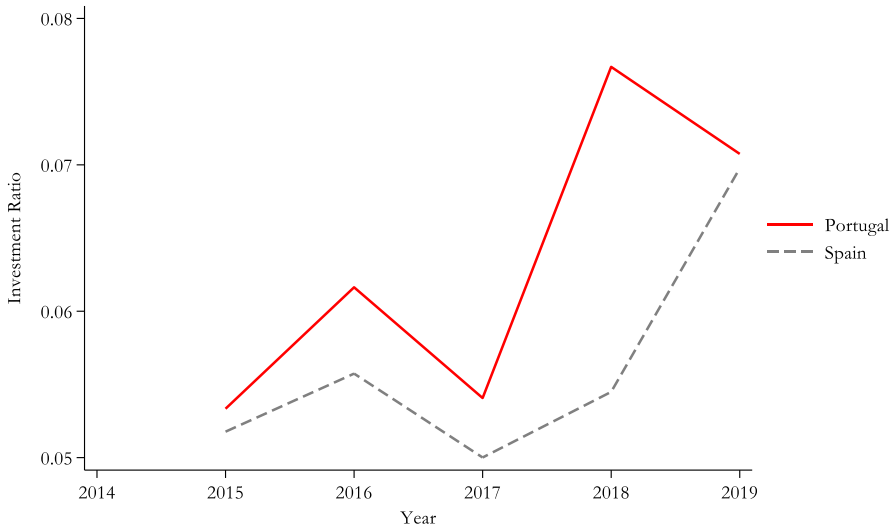
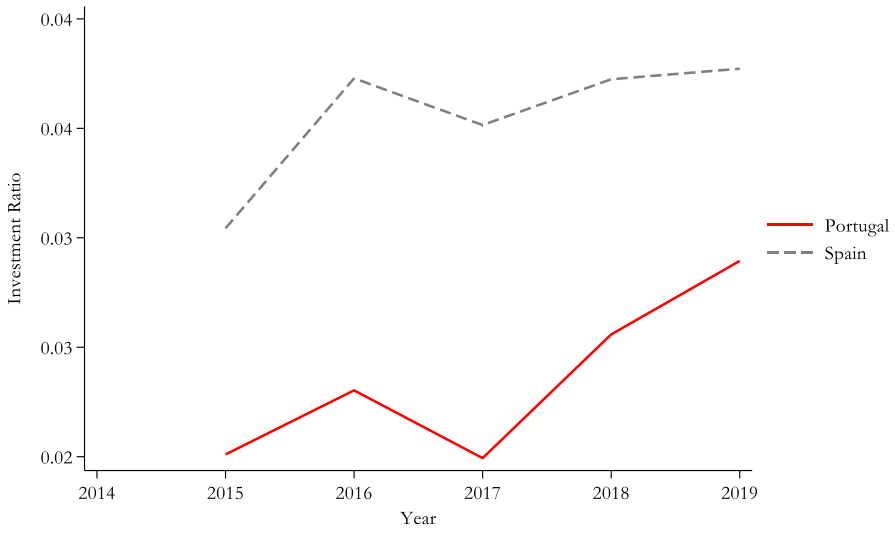


Figure 4 - Evolution of the Investment Ratio (Median)



In summary, the matching process proved effective in constructing a control group with characteristics that mirror those of the treatment group prior to the intervention. This

provides a solid foundation for applying the DiD method, with the assurance that its core assumptions are met.

Building on this foundation, the investment ratio for company i at time t can be analyzed using an Ordinary Least Squares (OLS) regression, specified as the following econometric model for the DiD estimation:

$$I_{i,t} = \alpha + \beta_1 * Portugal_i + \beta_2 * Time_t + \beta_3 * Portugal_i * Time_t + \beta_4 * X_{i,t} + \beta_5 * Z_{i,t} + \varepsilon_{i,t}$$

The model includes a treatment-country dummy variable called Portugal, which takes the value 1 if the firm is in Portugal (the country where the tax reform occurred) and 0 if the firm is in the non-experimental country, which is Spain in this study. Meanwhile, the variable Time is a dummy that equals 1 for the years when the treatment is in force (2017 to 2019), and 0 for the year before the tax reform (2016). The interaction term between Portugal and Time has the coefficient β3, which is the coefficient of interest in the DiD analysis. It captures the variation in the investment behavior of Portuguese companies (in relation to the Spain control firms) in the years following the ACE introduction (relative to the years before). The model also includes a set of firm-level control variables, denoted by the vector X, which includes industry dummies and firm-specific covariates likely to influence companies' investment, such as the Sales Growth Ratio, Non-Current Liabilities Ratio, Liquidity Ratio, Cash Flow Ratio, ROE (all lagged by one year) and Firm Size. Alongside this, the model controls broader macroeconomic conditions using a country-level control variable, the GDP Annual Growth, captured in vector Z. Finally, the error term $\varepsilon_{i,t}$ accounts for all other unobserved factors that may influence a firm's investment behavior.

5. Results and Discussion

5.1. Differences-in-Differences Results

Using a DiD approach following the matching of treatment and control groups, Table 5 presents results from several regression specifications derived from the study's baseline model. The estimated coefficients and their robust standard errors were reported, with the latter clustered at the firm level. In these regressions, particular attention is given to the coefficient on the interaction term (PortugalxTime), as it captures the causal effect of the Portuguese equity tax shield on investment behavior among non-SME Portuguese firms.

Regression (2) reports a simplified DiD regression, including only a limited set of explanatory variables: the DiD estimator (Portugal × Time), along with country and post-treatment time dummies. In this specification, the interaction term's coefficient is positive but not statistically significant. Given the insights of Memon et al. (2024) and Schiozer et al. (2021), who argue that including relevant control variables may enhance regressions' fit and therefore improve the precision of coefficient estimates, the DiD model is subsequently re-estimated with the inclusion of firm-specific and macroeconomic control variables.

In the adjusted specification in regression (3), the coefficient β_3 associated with the DiD estimator becomes statistically significant at the 1% level, suggesting that control variables help reveal the treatment effect. This coefficient signals that the implementation of the Portuguese ACE system led, on average, to an increase of approximately 4.08 percentage points in firms' investment ratio, *ceteris paribus*. Since the Portugal and Time coefficients are not statistically significant, their estimated values cannot be meaningfully interpreted. In this specification, the Cash Flow Ratio is excluded, as "the cash-flow sensitivity of business investment should only apply to small and medium-sized firms" (aus dem Moore, 2014), whereas the current analysis focuses solely on non-SME. Based on the Adjusted R^2 statistic, the included variables explain 17.68% of the variation in the investment ratio.

Table 5 - Differences-in-Differences Regression Results

This table reports the results from DiD regressions estimated via OLS, with the investment ratio as the dependent variable. The variable of interest is Portugal×Time, an interaction term combining a treatment-country dummy (Portugal) and a post-treatment period dummy (Time). The Portugal variable equals 1 for firms based in Portugal and 0 otherwise, while Time equals 1 for the post-reform period (2017–2019) and 0 for pre-reform years. Portugal×Time2017 is a dummy equal to 1 for Portuguese firms in the year 2017, and 0 otherwise. The same applies to Portugal×Time2018 and Portugal×Time2019, with respective years. Time2017 is a dummy variable equal to 1 for all observations in 2017. Similarly, Time2018 and Time2019 refer to the years 2018 and 2019, respectively. The OLS regressions are run using the firm-level control variables and industry dummies, as previously described. The sample period is 2016-2019. Standard errors, reported in parentheses, are robust to firm-level clustering. Statistical significance is indicated by * at the 10% level, ** at the 5% level, and *** at the 1% level. The adjusted R^2 and Mean Variance Inflation Factor (VIF) are also presented.

Dependent Variable	**Invest. Ratio (2)**	**Invest. Ratio (3)**	**Invest. Ratio (4)**	**Invest. Ratio (5)**
PortugalxTime	0.0032	0.0408***	0.0410***	
	(0.0097)	(0.0149)	(0.0153)	
PortugalxTime2017				-0.0012
				(0.0113)
PortugalxTime2018				0.0205*
				(0.0120)
PortugalxTime2019				-0.0012
				(0.0129)
Portugal	0.0035	-0.0201	-0.0215	-0.0002
	(0.0117)	(0.0139)	(0.0131)	(0.0110)
Time	0.0023	-0.0097	-0.0131*	
	(0.0061)	(0.0069)	(0.0071)	
Time2017				-0.0087
				(0.0074)
Time2018				-0.0048
				(0.0070)
Time2019				0.0091
				(0.0095)
Liquidity $Ratio_{t-1}$		-0.0081***	-0.0055**	-0.0054**
		(0.0030)	(0.0027)	(0.0027)
Non-Current Liabilities		-0.0046	-0.0157***	-0.0157***
$Ratio_{t-1}$		(0.0037)	(0.0045)	(0.0045)
ROE_{t-1}		0.0169	-0.1624***	-0.1631***
		(0.0226)	(0.0362)	(0.0362)
Sales Growth $Ratio_{t-1}$		0.0013	0.0025	0.0025
		(0.0016)	(0.0016)	(0.0016)
Size		0.0009	0.0027	0.0027
		(0.0039)	(0.0035)	(0.0035)
Cash Flow $Ratio_{t-1}$			0.2439***	0.2448***
			(0.0424)	(0.0424)
GDP Annual Growth		-0.0246***	-0.0234***	(omitted)
		(0.0081)	(0.0082)	
Industry controls	Yes	Yes	Yes	Yes
N	1,248	1,248	1,248	1,248
Mean VIF	1.48	1.76	1.83	1.72
Adjusted R2	0.1667	0.1768	0.2778	0.2782

Since Pacheco (2017) argues that capital market imperfections may lead even larger firms to rely more heavily on internal cash flows as a source of financing, in regression (4) the Cash Flow Ratio is included among the covariates. The coefficient on the variable of interest (PortugalxTime) remains highly significant at the 1% level and retains a positive sign. Furthermore, the statistical significance of the coefficient on the Time variable, which equals one for observations in the post-reform period, suggests that time plays an important role in explaining a company's investment ratio (Princen, 2012). In light of these findings and the notable increase in the Adjusted R^2 by over 10%, this model specification is retained for the subsequent analysis.

By replacing the general post-treatment interaction term (PortugalxTime) with year-specific interaction terms (PortugalxTime2017, PortugalxTime2018 and PortugalxTime2019), following a similar approach to the one used by Stokke (2015) and Zeli (2018), the regression (5) captures the dynamic effects of the ACE reform. The results suggest that the 2017 ACE reform did not lead to an immediate impact on investment expenditures. Rather, a statistically significant increase emerged with a one-year lag, implying that Portuguese firms required time to adjust to the new policy environment.

It is also important to note that the Variance Inflation Factor (VIF) statistic across all regression specifications is below 2, remaining well within the maximum commonly accepted thresholds of 5 and 10 cited in the literature (Kutner et al., 2005; Shrestha, 2020). This provides strong evidence that multicollinearity is not a concern in the estimated models.

In conclusion, the statistical regression results reported in Table 5 provide strong support for the hypothesis formulated in this study. The ACE system stands out as a successful example of how equity-based tax policy can promote corporate investment, as evidenced by the response of large Portuguese firms. This impact is particularly strong in the year immediately following the ACE reform. Nevertheless, it is important to conduct comprehensive robustness checks that assess the consistency of the findings under alternative matching specifications and model construction.

5.2. Robustness Checks

5.2.1. Alternative Matching Specifications

Table 6 presents the results of the robustness checks, with all regressions estimated using the baseline model specification presented in regression (4).

Table 6 - Robustness Results for Alternative Matching Specifications

This table reports the results from DiD regressions estimated via OLS, with the investment ratio as the dependent variable. All regressions rely on the baseline model specification presented in regression (4), though several adjustments were made. Regressions (6) through (9) report the results using between one and five matched control firms per Portuguese firm, respectively. In regression (10) the baseline regression is estimated without applying the caliper option in the psmatch2 command in STATA. Regression (11) reports results from a specification that excludes the ROE and Liquidity Ratio variables from the probit regression model used to construct the propensity scores. The sample period is 2016-2019. Standard errors, reported in parentheses, are robust to firm-level clustering. Statistical significance is indicated by * at the 10% level, ** at the 5% level, and *** at the 1% level. The adjusted R^2 and Mean VIF are also presented.

	2 Match (6)	**3 Match (7)**	**4 Match (8)**	**5 Match (9)**	**Without caliper (10)**	**Change Probit (11)**
PortugalxTime	0.0298*	0.0297*	0.0325**	0.0291*	0.0367**	0.0284*
	(0.0167)	(0.0153)	(0.0151)	(0.0150)	(0.0144)	(0.0164)
Portugal	-0.0087	-0.0092	-0.0136	-0.0139	-0.0161	-0.0234*
	(0.0144)	(0.0132)	(0.0128)	(0.0130)	(0.0127)	(0.0132)
Time	-0.0077	-0.0070	-0.0075	-0.0065	-0.0137**	-0.0076
	(0.0080)	(0.0078)	(0.0077)	(0.0081)	(0.0069)	(0.0085)
Liquidity $Ratio_{t-1}$	-0.0043	-0.0053*	-0.0056**	-0.0059**	-0.0042*	-0.0041
	(0.0030)	(0.0030)	(0.0027)	(0.0028)	(0.0025)	(0.0044)
Non-Current Liabilities $Ratio_{t-1}$	-0.0147***	-0.0123***	-0.0133***	-0.0139***	-0.0157***	-0.0130***
	(0.0040)	(0.0037)	(0.0036)	(0.0034)	(0.0039)	(0.0043)
ROE_{t-1}	-0.1279***	-0.1203***	-0.1251***	-0.1240***	-0.1503***	-0.0820**
	(0.0410)	(0.0393)	(0.0368)	(0.0363)	(0.0368)	(0.0395)
Sales Growth $Ratio_{t-1}$	0.0006	0.0011	0.0014	0.0018	0.0010	-0.0009
	(0.0020)	(0.0018)	(0.0017)	(0.0018)	(0.0017)	(0.0019)
Size	0.0044	0.0033	0.0031	0.0029	0.0049	0.0010
	(0.0032)	(0.0030)	(0.0030)	(0.0030)	(0.0032)	(0.0032)
Cash Flow $Ratio_{t-1}$	0.1885***	0.1867***	0.1949***	0.2007***	0.2227***	0.1833***
	(0.0458)	(0.0443)	(0.0417)	(0.0413)	(0.0423)	(0.0476)
GDP Annual Growth	-0.0223**	-0.0222***	-0.0246***	-0.0220***	-0.0225***	-0.0140
	(0.0098)	(0.0083)	(0.0082)	(0.0076)	(0.0078)	(0.0086)
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes
N	1,456	1,672	1,800	1,904	1,384	1,240
Mean VIF	1.87	1.88	1.84	1.85	1.85	1.87
Adjusted R2	0.2308	0.2244	0.2243	0.2210	0.2417	0.2002

Given the substantial number of control firms in the dataset, sometimes it was feasible to get several high-quality matches for each treated firm (Rubin & Thomas, 2000; Smith, 1997). Accordingly, matching procedures were conducted using two to five Spanish firms per Portuguese firm (regressions (6) to (9), respectively).

While increasing the number of matches can help reduce variance, it may also introduce additional bias, since the "2nd, 3rd and 4th closest matches are, by definition, further away from the treated individual than is the 1st closest match" (Stuart, 2010). Matching with replacement was employed to address this issue, allowing a control firm to be matched to more than one treated firm if sufficiently similar (Stuart, 2010). Consistent with established methodological standards (Dehejia & Wahba, 1999; Stuart, 2010), frequency weights were applied, assigning control observations weights proportional to how frequently they were selected as matches. Therefore, in all specifications, the estimated coefficient β_3 remains positive and statistically significant, suggesting that adopting a favorable tax treatment for equity increases the average investment ratio of large Portuguese companies by approximately 3 percentage points. This consistency supports the robustness of the results with respect to the number of matches used.

An additional robustness test was conducted by estimating the baseline regression without applying the caliper in regression (10), meaning that no restriction was placed on the maximum allowable difference between the propensity scores of the treated and control units when pairing them. Although this approach allows for the possibility of poor matches as noted by Caliendo and Kopeinig (2008) and Stuart (2010), the estimated Portugal×Time coefficient remains significant, both statistically (at the 5% level) and economically (0.0367).

Even when the matching procedure is modified by excluding the ROE and Liquidity Ratio explanatory variables from the Probit regression used to construct the propensity scores, the main conclusions remain robust (regression (11)). However, the estimated effect of the interaction term coefficient is slightly reduced to 2.84%, with its statistical significance falling to the 10% level. The coefficient on the Portugal dummy also shows significance at the 10% level, indicating that, even in the absence of the ACE tax reform, country-specific factors may influence firms' investment ratios (Princen, 2012).

5.2.2. Time Period Adjustment and Dynamic Effects

Although the Portuguese ACE reform was introduced in 2017 for large firms, the financial benefits from the deduction were only realized when firms filed their 2018 tax returns. Therefore, consistent with regression (5), the effects on investment are expected to be more pronounced from 2018 onward, reflecting a one-year delay in the ACE reform's impact. Accordingly, a robustness check was conducted by redefining the pre-reform period as 2016 and 2017, and the post-reform period as 2018 and 2019. The variables PortugalxTime and Time were adjusted to reflect this change, and the regression results are presented in Table 7.

The OLS estimates in regression (12) indicate an average increase of 1.83 percentage points in the investment ratio of Portuguese firms in the post-reform period, with the effect being statistically significant at the 10% level.

To further capture the dynamic effects of the ACE reform, an extended DiD model was estimated, interacting the treatment group with separate year dummies for 2018 and 2019. The results presented in regression (13) are consistent with the expected outcome: the coefficient on the interaction term Portugal×Time2018 is positive and statistically significant at the 1% level, providing strong evidence of an increase in investment by Portuguese firms in 2018 relative to Spanish firms. No statistically significant effect is observed for 2019, possibly because firms concentrated their investment adjustments in the previous year.

Table 7 - Robustness Check Results Using Revised Time Period

This table reports the results from DiD regressions estimated via OLS, with the investment ratio as the dependent variable. The main variable of interest is Portugal×TimeAdj, an interaction term equal to 1 if the firm is based in Portugal and the observation falls in either 2018 or 2019, and 0 otherwise. The Portugal variable is a dummy indicator equal to 1 for firms based in Portugal and 0 for Spain, while TimeAdj equals 1 for observations from the years 2018 and 2019, and 0 for 2016 and 2017. Additionally, Portugal×Time2018 is a dummy variable equal to 1 for Portuguese firms in 2018, and 0 otherwise; the same logic applies to Portugal×Time2019 for the year 2019. The variables Time2018 and Time2019 are year dummies equal to 1 for all observations in 2018 and 2019, respectively. The OLS regressions are run using the firm-level control variables and industry dummies, as previously described. The sample period is 2016-2019. Standard errors, reported in parentheses, are robust to firm-level clustering. Statistical significance is indicated by * at the 10% level, ** at the 5% level, and *** at the 1% level. The adjusted R^2 and Mean VIF are also presented.

Dependent Variable	**Invest. Ratio (12)**	**Invest. Ratio (13)**
PortugalxTimeAdj	0.0183*	
	(0.0094)	
PortugalxTime2018		0.0270***
		(0.0097)
PortugalxTime2019		0.0070
		(0.0129)
Portugal	-0.0029	-0.0026
	(0.0078)	(0.0077)
TimeAdj	0.0000	
	(0.0071)	
Time2018		-0.0043
		(0.0064)
Time2019		0.0064
		(0.0107)
Liquidity $Ratio_{t-1}$	-0.0053**	-0.0054**
	(0.0027)	(0.0027)
Non-Current Liabilities $Ratio_{t-1}$	-0.0157***	-0.0157***
	(0.0045)	(0.0045)
ROE_{t-1}	-0.1628***	-0.1629***
	(0.0362)	(0.0362)
Sales Growth $Ratio_{t-1}$	0.0027	0.0026
	(0.0016)	(0.0016)
Size	0.0027	0.0027
	(0.0035)	(0.0035)
Cash Flow $Ratio_{t-1}$	0.2444***	0.2444***
	(0.0423)	(0.0424)
GDPAnnualGrowth	-0.0088	-0.0074
	(0.0063)	(0.0066)
Industry controls	Yes	Yes
N	1,248	1,248
Mean VIF	1.59	1.65
Adjusted R2	0.2784	0.2784

5.2.3. Analysis of Small and Medium-sized Enterprises

Since the notional rate of the ACE changed throughout the years for SME, including an increase from 5% to 7% starting in 2017, the analysis was extended to assess the potential implications of these changes on corporate investment behavior[27] (Table 8). To ensure methodological consistency and to enhance the reliability of the findings, a PSM approach was first applied, using 1:1 nearest-neighbor matching without replacement. This was followed by a DiD estimation to isolate the impact of the policy change.

Table 8 - Robustness Check Results Using a Different Sample of Companies

This table reports the results from DiD regressions estimated via OLS, with the investment ratio as the dependent variable. In regression (14), the analysis is restricted to SME and in regression (15) the sample is expanded to include both SME and large firms. The regression is estimated using the set of variables previously specified in the previously regression (4). The sample period is 2016-2019. Standard errors, reported in parentheses, are robust to firm-level clustering. Statistical significance is indicated by * at the 10% level, ** at the 5% level, and *** at the 1% level. The adjusted R2 and Mean VIF are also presented.

	SME (14)	**Full Sample (15)**
PortugalxTime	0.0057**	0.0062***
	(0.0024)	(0.0024)
Portugal	0.0223***	0.0214***
	(0.0019)	(0.0019)
Time	0.0086***	0.0088***
	(0.0011)	(0.0011)
Liquidity $Ratio_{t-1}$	-0.0010***	-0.0010***
	(0.0001)	(0.0001)
Non-Current Liabilities $Ratio_{t-1}$	-0.0052***	-0.0053***
	(0.0003)	(0.0003)
ROE_{t-1}	-0.0221***	-0.0232***
	(0.0034)	(0.0034)
Sales Growth $Ratio_{t-1}$	0.0111***	0.0107***
	(0.0004)	(0.0004)
Size	0.0094***	0.0090***
	(0.0005)	(0.0004)
Cash Flow $Ratio_{t-1}$	0.1011***	0.1030***
	(0.0035)	(0.0036)
GDP Annual Growth	-0.0070***	-0.0066***
	(0.0012)	(0.0012)
Industry controls	Yes	Yes
N	261,500	262,206
Mean VIF	1.73	1.72
Adjusted R2	0.0722	0.0726

[27] The SME sample was obtained from Orbis, following the same selection criteria outlined in Section 4.2.3.

In regression (14), the sample is restricted to SME to isolate the effect of more generous ACE deductions on their investment decisions. The coefficient of the DiD estimator is statistically significant at the 5% level and indicates that the increased ACE rate led, on average, to an increase of 0.57 percentage points in SME's investment ratio, *ceteris paribus*.

When the sample is expanded to include both SMEs and large firms in regression (15), allowing for a broader assessment of the policy changes in Portugal, the results remain qualitatively similar. Notably, the introduction of the ACE reform for large firms in 2017, together with the increase in the notional ACE rate for SMEs that same year, appear to have jointly contributed to the observed increase in investment. This is reflected in the stronger statistical significance of the DiD estimator at the 1% level. Moreover, with a broader sample of over 32,000 Portuguese and Spanish firms, all remaining variables become statistically significant at the 1% level, suggesting more robust effects.

6. Conclusion

The pervasive debt-equity taxation bias may pose challenges for governments, not only by fostering unsustainable capital structures and amplifying economic vulnerabilities, but also by discouraging productivity-enhancing investments. This is particularly concerning, as such investment forms the cornerstone of firm competitiveness and sustainable profitability, which are essential for maximizing shareholder value and promoting broad-based economic growth. These considerations give rise to a fundamental question: can the corporate tax system evolve to counteract debt bias while fostering a more investment-friendly economic environment?

In pursuit of an answer, this study analyzes an exogenous change in the Portuguese corporate tax system, focusing on the 2017 expansion of the ACE regime to include non-SME firms. This reform allowed companies to deduct a notional return on equity from their taxable income, in addition to interest on debt, thereby narrowing the gap in the tax treatment of these two forms of financing. As such, this quasi-experimental study employs a DiD methodology, comparing the evolution of investment levels in Portuguese firms (treatment group) before and after the introduction of the ACE system with those of Spanish firms (control group). The choice of Spanish firms is motivated by their structural and economic similarity to Portuguese counterparts, as well as the absence of a comparable ACE regime in Spain. A PSM procedure was further undertaken to enhance the quality of the comparison and reinforce the robustness of the DiD estimates.

The study's evidence demonstrates that the Portuguese ACE system raised firms' investment ratios by about 3 to 4 percentage points on average, ceteris paribus. Comparable results were reported in the studies of aus dem Moore (2014), Klemm (2007) and Zeli (2018), which investigated the Belgian, Brazilian and Italian contexts, respectively. Accordingly, the research findings contribute to the literature on the effects of corporate income taxes on capital spending while supporting the negative relationship found in theories of investment. Furthermore, the year-specific models reveal a statistically significant increase in investment with a one-year lag, suggesting that Portuguese firms needed time to adjust to the new ACE policy environment.

In this regard, the findings contribute to enrich the policy discourse by providing nuanced insights that can inform more effective tax policy design and, ultimately, long-term economic growth.

Notwithstanding the contributions made, critically reflecting on the inherent limitations of this study is important. Chief among them is the constrained temporal scope, comprising a single pre-reform year (2016) and three post-reform years (2017–2019), which hampers the capacity to capture the longer-term effects of the ACE system and heightens susceptibility to short-term volatility potentially distorting the findings.

The selection of 2016 as the baseline year was a deliberate effort to circumvent potential confounding effects stemming from major corporate income tax changes enacted in Portugal during 2014 and 2015, as well as the introduction of a capitalization reserve in Spain in 2015 as part of a broader fiscal overhaul. However, the implicit assumption that these adjustments had only an immediate impact and did not affect firm behavior in subsequent years represents a further limitation of the analysis.

The small sample of Portuguese firms should also be acknowledged as a potential constraint.

While these limitations are important to recognize, they do not preclude opportunities for further research to deepen understanding of the topic.

One potential avenue involves investigating the impact of the ACE system within the banking sector, given its typically high levels of leverage. Exploring this segment could provide valuable insights into how firms operating under stricter regulatory and capital requirements respond to tax incentives for equity financing.

Moreover, given that equity tax-deductions tend to narrow the corporate tax base, their impact on government tax revenues and the economy warrants further investigation in the Portuguese context.

A further extension might consider assessing the effects of the transition from the previous ACE regime (RCCS) to the current one (ICE) system on Portuguese firms' investment behavior, which could yield important evidence on the comparative effectiveness of different capital allowance frameworks.

Lastly, the robustness of the analysis could be enhanced by exploring alternative control groups and implementing additional matching techniques beyond the nearest neighbor propensity score matching, thereby testing the sensitivity of the results to different comparison strategies and improving the credibility of the estimated effects.

7. References

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Appendix

Appendix A - Variable Description

Table 9 - Description of the Original Variables Extracted from the Databases

Variable Acronym	Variable Name	Description	Source
Intangible Assets	Intangible Fixed Assets	Book value of all intangible assets such as formation expenses, research expenses, goodwill, development expenses and all other expenses with a long-term effect (th EUR)	Bureau Van Dijk
Tangible Assets	Tangible Fixed Assets	Book value of all tangible assets such as buildings, machinery, etc (th EUR)	Bureau Van Dijk
Other Fixed Assets	Other Fixed Assets	Book value of all other fixed assets such as long-term investments, shares and participations, pension funds etc. (th EUR)	Bureau Van Dijk
Current Assets	Current Assets	Book value of total current assets (th EUR)	Bureau Van Dijk
Total Assets	Total Assets	Book value of total assets (th EUR)	Bureau Van Dijk
Shareholders Funds	Shareholders Funds	Book value of total equity (th EUR)	Bureau Van Dijk
Non-Current Liabilities	Non-Current Liabilities	Book value of long-term liabilities (th EUR)	Bureau Van Dijk
Current Liabilities	Current Liabilities	Book value of current liabilities (th EUR)	Bureau Van Dijk
Sales	Sales	Book value of net sales (th EUR)	Bureau Van Dijk
D&A	Depreciation	Book value of total depreciation and amortization of assets (th EUR)	Bureau Van Dijk
EBIT	Operating Profit/Loss [=EBIT]	Book value of EBIT (th EUR)	Bureau Van Dijk
Net income	Profit/Loss for the Period [=Net income]	Book value of net income for the year before deduction of minority interests (th EUR)	Bureau Van Dijk
Cash Flow	Cash Flow	Book value of the profit for the period plus depreciation (th EUR)	Bureau Van Dijk
GDP growth	GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency	World Bank

Table 10 - Description of the Regression Variables

Variable Acronym	Variable Name	Description
PortugalxTime	Portugal ACE Interaction Dummy	Dummy variable that takes the value of 1 if the company is Portuguese and the Portuguese ACE is in force (2017 to 2019)
PortugalxTime2017	Portugal ACE 2017 Dummy	Dummy variable that takes the value of 1 if the company is Portuguese and the observation year is 2017
PortugalxTime2018	Portugal ACE 2018 Dummy	Dummy variable that takes the value of 1 if the company is Portuguese and the observation year is 2018
PortugalxTime2019	Portugal ACE 2019 Dummy	Dummy variable that takes the value of 1 if the company is Portuguese and the observation year is 2019
PortugalxTimeAdj	Portugal Post-2017 ACE Dummy	Dummy variable that takes the value of 1 if the company is Portuguese and the observation year is either 2018 or 2019
Portugal	Portugal Dummy	Dummy variable that takes the value of 1 if the company is Portuguese
Time	ACE Period Dummy	Dummy variable that takes the value of 1 for the years when the Portuguese ACE is in force (2017 to 2019)
Time2017	Year 2017 Dummy	Dummy variable that takes the value 1 for observations in the year 2017
Time2018	Year 2018 Dummy	Dummy variable that takes the value 1 for observations in the year 2018
Time2019	Year 2019 Dummy	Dummy variable that takes the value 1 for observations in the year 2019
TimeAdj	Post-2017 Period Dummy	Dummy variable that takes the value 1 for observations in the years 2018 and 2019
Investment Ratio	Investment Ratio	Ratio of investment to total assets was calculated by taking the difference in the value of total tangible and intangible assets between two consecutive years (plus depreciations and amortizations) and dividing the result by the total assets reported in the balance sheet for 2014
Liquidity Ratio	Liquidity Ratio	Ratio of current assets to current liabilities
Non-Current Liabilities Ratio	Non-Current Liabilities to Equity Ratio	Ratio of total non-current liabilities over shareholder funds
ROE	Operating Return on Equity	Ratio of EBIT over shareholder funds
Sales Growth Ratio	Sales Growth Ratio	Ratio of the change in sales over shareholder funds
Size	Firm Size	Natural logarithm of total assets
GDP Annual Growth	GDP Growth (Annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency
Cash Flow Ratio	Cash Flow Ratio	Ratio of cash flow over shareholder funds
Industry dummies	Industry Code (NACE Rev. 2)	Two-digit level of economic activities in accordance with NACE Rev. 2