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Impact of Covid-19 Public Credit Guarantees on Credit Allocation and Firm Performance: Evidence from Portugal

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IMPACT OF COVID-19 PUBLIC CREDIT GUARANTEES ON CREDIT ALLOCATION AND FIRM PEROFMANCE: EVIDENCE FROM PORTUGUAL

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Abstract

The COVID-19 pandemic led to severe disruptions in the global economy, prompting governments to introduce public credit guarantee schemes as a key instrument to sustain lending and support firms facing financial constraints. In Portugal, this mechanism became a central component of the crisis response in order to absorb the financial shock faced by firms. Based on firm-level data from Banco de Portugal, this dissertation analyses whether guaranteed loans were effectively targeted to firms in greater financial need and whether they contributed to expanding access to credit and improving firm performance. Moreover, our study contributes to the empirical literature on credit guarantee schemes from a context of economic stress, particularly in shaping firm-level credit allocation and medium and long-term financial performance. We use a Logit model to explore the determinants of the allocation of guarantees, followed by a Difference-in-Differences approach to assess the impact on financing and key performance indicators. The analysis reveals that guarantees were primarily channelled to firms with stronger financial conditions prior to the crisis, reflecting existing patterns in credit allocation. Although public intervention allowed a substantial expansion of credit, mainly driven by guaranteed loans, there is also evidence of a partial substitution of unsecured lending by guaranteed credit. Firms that received guaranteed credit tend to improve their structural financial position over the long term, rather than merely benefiting from short-term relief. e.

Keywords: Public credit guarantees; Banks; Credit allocation; Risk; Firm financial performance; COVID-19; Portugal

JEL Codes: H81, G01, G21, G38, , L25

Resumo

A pandemia COVID-19 provocou fortes perturbações na economia mundial, levando os governos a implementar programas públicos de garantia de crédito como um instrumento fundamental para sustentar a concessão de empréstimos e, apoiar as empresas que enfrentavam restrições financeiras. Em Portugal, este mecanismo assumiu um papel essencial na resposta à crise, a fim de mitigar o choque financeiro sofrido pelas empresas. Com base em dados fornecidos pelo Banco de Portugal relativos às empresas, esta dissertação analisa se os empréstimos garantidos foram efetivamente concedidos a empresas com maiores necessidades financeiras e se contribuíram para expandir o acesso ao crédito e melhorar o desempenho destas. Este estudo contribui para a literatura sobre as garantias público de crédito em contextos de instabilidade económica analisando, em particular a forma como influenciam a atribuição de crédito e o desempenho financeiro das empresas no médio-longo prazo.

Neste sentido, é utilizado um modelo Logit para explorar os determinantes da atribuição das garantias, seguido de uma abordagem de Diferença-em-Diferenças para avaliar o impacto no financiamento e nos principais indicadores de desempenho. A análise revela que as garantias foram sobretudo canalizadas para empresas com condições financeiras mais sólidas antes da crise, refletindo os habituais padrões na atribuição de crédito. Embora a intervenção pública tenha revelado uma expansão substancial do crédito, sendo esta impulsionada principalmente por empréstimos garantidos, existem também indícios de uma substituição parcial de empréstimos não garantidos por crédito garantido. No longo prazo, as empresas que receberam crédito garantido tendem a melhorar a sua situação financeira estrutural, em vez de se limitarem a beneficiar de apenas um alívio financeiro temporário.

Palavras-chave: Garantias públicas de crédito; Bancos; Alocação de crédito; Risco;; Desempenho financeiro de empresas não financeiras; COVID-19; Portugal

Classificação JEL: H81, G01, G21, G38, , L25

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List of Acronyms

ATT – Average Treatment Effect on the Treated

BPF – Banco Português de Fomento

BPLIM – Banco de Portugal Microdata Research Laboratory

CAE – Classificação de Atividade Económicas

CGS – Credit Guarantee Schemes

CEM – Coarsened Exact Matching

CBHP – Central Balance Sheet Harmonized Panel Data

DiD – Differences-in-Differences

EBITDA – Earnings Before Interest, Taxes, Depreciation, and Amortisation

EIB – European Investment Bank

EU – European Union

GDP – Growth Domestic Product

HCRC – Harmonized Central Credit Register Database

HHI – Herfindahl-Hirschman Index

IMF – International Monetary Fund

OECD – Organisation for Economic Co-operation and Development

ROA – Return on Assets

SBA – Small Business Administration

SME – Small and Medium-sized Enterprises

SPGM – Sistema Português de Garantia Mútua

US – United States

UK – United Kingdom

1. Introduction

In times of systemic economic distress, credit markets tend to contract sharply, exposing structural vulnerabilities in the financial system and severely affecting the financing conditions of firms, particularly small and medium-sized enterprises (SMEs).

As banks reassess risk and become more conservative in their lending strategies, financially constrained firms face increased difficulties in accessing liquidity. To mitigate these dynamics and prevent widespread firm failures, governments often intervene through public support schemes (IMF, 2021). Among the available policy instruments, public credit guarantees have gained prominence as a means to reduce credit risk for lenders while preserving market-based intermediation. These mechanisms have been extensively used during past crises, including the Global Financial Crisis of 2008–2009. (Hanson et al., 2020).

The COVID-19 pandemic marked an unprecedented test for this policy tool. Faced with a sudden and severe economic shock, governments across Europe rapidly activated large-scale guarantee programmes under the EU State Aid Temporary Framework. According to the European Commission (2022), public credit guarantees accounted for approximately 64% of the total COVID-related state aid in the European Union (EU), with a cumulative approved volume exceeding €940 billion. Portugal adopted a similar approach, implementing multiple guarantee programmes between 2020 and 2021 with a focus on SMEs and sectors most affected by the pandemic (European Comission, 2023). The volume of new guaranteed loans reached, in 2021, approximately €9 billion, representing a central pillar of the national policy response and one of the most extensive public credit support programmes implemented in Portugal (Banco de Portugal, 2021).

Despite their widespread use, credit guarantee schemes raise several critical policy questions. A key concern is whether these programmes effectively targeted financially constrained firms, or whether they ended up favouring companies already well positioned to access credit - a phenomenon often referred to as credit misallocation (Altavilla et al., 2023) (Costa, 2021). Another issue is whether guaranteed credit led to a net expansion in lending or simply substituted financing that would have occurred under normal market conditions (Jiménez et al., 2022) (Gropp et al., 2010). These trade-offs are particularly relevant in high-debt economies like Portugal, where inefficient allocation of public resources may increase fiscal risk without delivering proportional economic benefits (Mateus & Neugebauer, 2022).

Additionally, authors such as Silva (2021) and Cascarino et al. (2022) report substantial improvements in credit access, investment, and employment among supported firms, particularly in response to acute liquidity pressures. In contrast, other studies point to more limited gains in productivity and raise concerns about programme design and targeting (Bruhn et al., 2023).

In the Portuguese context, Banco de Portugal (2023) has emphasised the importance of maintaining credit continuity and reducing systemic risk, while the institutional framework evolved rapidly to meet operational and coordination challenges. These insights reinforce the value of country-specific assessments that consider allocation dynamics, firm-bank relationships, and institutional conditions.

As in the studies by Silva (2021), Costa (2021), and Mateus and Neugebauer (2022), this dissertation aims to contribute to the ongoing debate by assessing the allocation and effects of public credit guarantees in Portugal during the COVID-19 crisis. While these previous studies provided important insights into the impact of public support on credit access or firm-level performance, they typically focused on a single outcome and relied on data up to 2017 and early 2021. In contrast, the present analysis jointly examines three critical dimensions: allocation, additionality, and post-treatment firm performance, within a unified empirical framework.

First, we investigate whether the firms that received support were those in greatest financial need, or whether the allocation process favoured firms with stronger financial profiles and more established banking relationships.

Secondly, we examine whether the guaranteed loans translated into an actual expansion of total credit. This analysis is crucial for assessing whether guarantees acted as a complementary tool to private financing or merely replaced credit that would have been granted under normal conditions.

Thirdly, we evaluate whether firms that received guaranteed loans experienced superior performance after the intervention when compared to non-treated firms. This aspect is key to understand whether the policy contributed to medium and long-term economic recovery or merely acted as a short-term stabilisation mechanism.

The methodological approach follows established practices in the empirical literature on credit policy evaluation. The analysis uses a matched panel dataset covering the period 2017–

2023, integrating credit register data from the HCRC and financial data from the CBHP, both provided by Banco de Portugal Microdata Research Laboratory (BPLIM). A Coarsened Exact Matching (CEM) procedure is first applied to improve comparability between treated and non-treated firms based on pre-treatment characteristics. This is followed by a logistic regression model that analyses the firm-level determinants of access to guaranteed credit. Finally, a Difference-in-Differences (DiD) estimation is applied to identify causal effects, controlling for firm-specific characteristics and broader economic conditions.

The empirical results provide three key insights. Consistent with Costa (2021), who identifies signs of misallocation in the Portuguese guarantee programme, the analysis shows that public credit guarantees tended to favour firms with stronger financial conditions prior to the intervention. Firms with a more solid financial structure, lower credit risk, and broader banking networks were significantly more likely to obtain guaranteed credit.

Second, there was a clear expansion in total credit, primarily driven by secured lending. However, as highlighted in the 2023 report by Banco de Portugal, part of this increase appears to have come at the expense of non-guaranteed lending, pointing to partial substitution rather than full additionality, a concern also raised by Mateus and Neugebauer (2022) in the context of high-debt economies.

Moreover, firms that received guaranteed credit displayed a differentiated trajectory: while some short-term financial indicators weakened, longer-term metrics improved moderately. Our results are not in line with the findings of Silva (2021), who finds no significant impact on profitability yet within a shorter time frame. Our findings suggest that guarantees may have enabled firms to restructure their financial strategy and strengthen performance over time, rather than serving solely as a short-term liquidity relief.

The remainder of this dissertation is organised as follows. Chapter 2 reviews the theoretical and empirical literature on public credit guarantees, credit market failures, and firm-bank relationships. Chapter 3 presents the research questions and the hypotheses to be tested. Chapter 4 outlines the methodology, empirical models, sample selection criteria, and variables used. Chapter 5 discusses the main empirical findings. Chapter 6 concludes with a summary of results, policy implications, limitations, and directions for future research.

2. Literature Review

2.1. Public Credit Guarantees: Foundations and Institutional Framework

2.1.1. Concept, Structure, and Typology of Guarantee Schemes

Credit guarantee schemes (CGSs) play a critical role in modern financial systems as policy instruments that mitigate credit market imperfections, especially those affecting small and medium-sized enterprises (SMEs). These schemes are designed to address structural difficulties in accessing finance due to collateral constraints, information asymmetries, or the high-risk perception of SME lending (Crawford et al., 2023). By providing a third-party guarantee, typically backed by public institutions, CGSs intervene by providing partial guarantees on loans, sharing credit risk with lenders and encouraging them to extend credit that would otherwise not be granted (EIB, 2014).

The theoretical justification for CGSs lies in their capacity to reduce adverse selection and credit rationing. According to Honohan (2010), CGSs can reduce the incidence of both adverse selection and moral hazard by sharing risk between the lender and a third-party guarantor. Seminal contributions such as Gale (1990) and Mankiw (1986) further highlight how government interventions can mitigate market failures and disproportionate disruptions in credit allocation, reinforcing the stabilising role of CGSs as both financial and policy tools.

In practice, CGSs vary significantly in their design and implementation. Partial guarantees are the dominant model, covering between 50% and 80% of loan losses, which ensures lenders maintain incentives for proper credit assessment (Beck et al., 2008). Guarantees may be applied to individual loans or portfolios. While portfolio guarantees lower administrative costs, they require strong eligibility rules and monitoring systems to manage risk effectively (EIB, 2014). Institutionally, schemes can be fully public, privately managed, or hybrid.

Beyond enhancing access to finance, CGSs are often used as tools to achieve broader public policy objectives. During the COVID-19 crisis, the Portuguese government implemented €3 billion in guaranteed lines to support SMEs in highly affected sectors such as tourism and manufacturing (European Commission, 2020). These interventions illustrate the counter-cyclical potential of guarantee systems in times of crisis but also reinforce the importance of well-designed schemes with clear mandates, adequate pricing, and strong oversight (Arping

et al., 2010). Still, their long-term effectiveness depends on institutional clarity, sound governance, and performance monitoring to prevent unintended outcomes such as adverse selection or unsustainable public liabilities (Crawford et al., 2023) (Gale, 1990).

2.1.2. How Guarantees Shape Access to Finance for Firms

State-backed credit interventions have reshaped how firms access finance by altering lenders' risk-return profiles and expanding eligibility beyond traditional banking criteria. Rather than simply serving as a backstop for distressed periods, guarantee schemes alter the credit allocation mechanism itself, changing which firms get financed, under what terms, and how banks perceive credit risk in the presence of public backing (Baudino, 2020). These mechanisms play an especially strategic role in reducing the financing gap for enterprises constrained by collateral shortages or limited credit history (Adhikary et al., 2019).

There is strong empirical evidence that loan guarantee schemes increase firms' chances of obtaining credit and improve the terms of borrowing. In the Portuguese context, Farinha & Félix (2015) find that SMEs with weaker financials were more likely to access financing when supported by guarantees, especially in sectors dependent on close bank-firm relationships. Similarly, Adhikary et al. (2019) show that in Indonesia, state guarantees significantly improved access to credit for micro and small firms. Lee (2018) highlights that in the US, Small Business Administration (SBA)-backed guarantees promoted new firm entry, though the long-term benefits for regional economic development depended on the quality and survival of the supported businesses.

The relevance of government-supported lending is even more pronounced during crises. Ivashina & Scharfstein (2010) show that during the 2008 global financial crisis, banks reduced credit sharply, even to firms with existing relationships, underscoring the systemic nature of liquidity contractions. In response, guarantee schemes have emerged as effective counter-cyclical tools. Hackney (2023) demonstrates that US regions with greater exposure to SBA lenders experienced stronger post-crisis recovery in small business lending and local firm growth. During the COVID-19 pandemic, many governments introduced large-scale guarantee frameworks to maintain credit flows and avoid widespread bankruptcies (Baudino, 2020).

Yet not all firms benefit equally from state credit support. Bighelli et al. (2021) find that pandemic-era government guarantees were more likely to reach high-productivity and well-established firms, raising concerns about the potential exclusion of more fragile but viable businesses. Bachas et al. (2021) quantify a strong response of credit volumes to more generous guarantees, but stress the importance of operational efficiency. Santis et al. (2021), add that vulnerable firms, those facing declining revenues and rising debt, were among the primary beneficiaries of fiscal support aimed at addressing urgent liquidity needs.

2.1.3. The Dynamics of Firm-Bank Lending Relationships

The nature of lending relationships between firms and banks is a central element in understanding how credit is allocated, especially under conditions of uncertainty or financial stress. Beyond pricing, these ties involve trust, repeated interactions, and private information that shape future lending (Berger & Udell, 1995). Theoretical models suggest that strong relationships may ease access to credit in crises, but can also generate lock-in effects and strategic behaviour during policy interventions (Bolton et al., 2016)(Acharya et al., 2021).

A pivotal contribution to this literature is the study by Jiménez et al. (2022), who exploited loan-level data from the Spanish credit registry during the COVID-19 crisis to explore how public credit guarantees interacted with existing bank-firm relationships. Notably, the effect was driven by exposure volume rather than relationship duration. This distinction is key: it suggests that banks acted to protect their balance sheets by reinforcing existing exposures. Their methodology also uncovers substitution effects, with guaranteed credit displacing non-guaranteed loans and reducing recognition of loan impairments, particularly for firms classified as riskier.

These dynamics are not limited to crisis periods. Dahiya et al. (2003), focusing on US syndicated loan markets, find that lending banks' valuations decline when borrower firms experience financial distress, especially when strong lending ties exist. Similarly, Carvalho et al. (2015) show that during the global financial crisis, equity losses and investment cuts were concentrated among firms with stronger dependence on distressed banks. In these cases, long-term banking relationships, which are often seen as buffers, became conduits for the transmission of negative shocks. This is echoed by Degryse et al. (2019), who show that firms linked to banks suffering negative credit supply shocks reduced investment and financial debt growth significantly. Their methodological innovation, which captures shocks for both single

and multi-bank firms, underscores that relationships with a single lender can amplify the exposure to credit supply disruptions.

More broadly, lending relationships affect not only credit availability but also its price, risk profile, and cyclicality. Schwert (2017) finds that better-capitalised banks tend to engage more actively in relationship lending, providing more stable credit lines and being less reactive to firm-specific shocks. This aligns with findings by Acharya et al. (2021), who explore the role of credit lines as liquidity insurance mechanisms. They show that relationship banks are more willing to honour undrawn credit lines during periods of stress, functioning effectively as a backstop to liquidity-constrained firms. However, as Bolton et al. (2016) argue, relationship banks also incur higher operational costs and may exert informational hold-up, particularly during downturns. In practice, banks must balance loyalty to existing clients with the need to preserve capital and manage risk exposure.

Finally, relationship lending interacts with the business cycle in complex and sometimes contradictory ways. As shown by Jiménez et al. (2022) and Degryse et al. (2019), relational structures both facilitate policy transmission and bias support toward existing portfolios, raising questions about equity and efficiency in credit allocation. As a whole, these findings point to a dual role for bank-firm relationships: stabilising in times of stress, but potentially distortive if incentives are misaligned. The challenge lies in ensuring these relational structures promote credit access and resilience, without reinforcing existing inequalities or inefficiencies.

2.2. Credit Market Failures and Economic Reasons for State Intervention

Credit markets are particularly susceptible to inefficiencies that justify targeted public intervention. A central explanation lies in asymmetric information between borrowers and lenders, where firms have more precise knowledge of their own risk profiles than financial institutions. Stiglitz & Weiss (1981) show that adverse selection and moral hazard can lead to credit rationing, as banks may prefer not to raise interest rates, leaving some creditworthy firms excluded from financing.

Institutional factors such as the legal treatment of collateral can also exacerbate credit market distortions. Cerqueiro et al. (2020) demonstrate that creditor priority rules influence the effectiveness of collateral; when enforcement is weak or uncertain, lenders withdraw credit,

particularly from firms with limited bargaining power. These findings underline the importance of collateral protection and legal certainty as foundations for efficient credit markets.

Beyond structural inefficiencies, the cyclical nature of credit allocation can generate amplification effects that are difficult to justify on purely market-based grounds. Cuciniello & Lasio (2020) show that contractions in the supply of new loans often reflect banks' endogenous risk aversion rather than changes in borrower fundamentals, amplifying downturns through feedback loops. Policy instruments that counteract this dynamic, such as credit guarantees or funding-for-lending schemes, can restore intertemporal efficiency.

The case for intervention also emerges from the risk of systemic discontinuities. Mankiw (1986) develops a theoretical framework in which small shifts in interest rates or economic expectations can lead to abrupt collapses in credit flows. These non-linearities suggest that public stabilisation tools may play a role in smoothing financial shocks. Complementing this view, Gale (1991) argues that credit programs can reallocate capital to priority sectors without necessarily expanding overall investment but warns that subsidies can distort incentives if not carefully designed. These concerns are echoed in the European context: Ayadi & Groen (2015) emphasise that guarantee schemes should be judged not only by the amount of support provided but by their contribution to productive allocation and long-term performance, while Schweiger (2011) finds that restructuring aid can artificially sustain low-productivity firms, undermining competitive reallocation and weakening overall efficiency.

Some market failures are more deeply rooted in institutional underdevelopment. Besley (1994) examines rural credit markets and identifies failures linked to poor contract enforcement, limited competition, and the absence of supporting institutions. In these contexts, the challenge is not only to correct pricing failures, but to build the very foundations of financial intermediation. Public initiatives may take the form of credit cooperatives, legal reforms, or mechanisms to reduce monitoring costs, particularly where private actors lack the capacity or incentives to act alone.

2.3. Bank Risk-Taking, Credit Strategies and Firm Selection

Banks operate at the intersection of financial intermediation and risk management, and their strategies for allocating credit reflect a balance between profitability, regulatory constraints, and informational asymmetries. Theoretical models and empirical evidence suggest that

bank-specific characteristics, such as capitalisation, exposure to supervision, and lending technologies, shape how they screen, monitor, and ultimately select firms to finance (Schwert, 2017)(Berger & Udell, 1995). Lending relationships, in turn, generate informational rents and long-term incentives that stabilise credit supply but also shape firm selection, particularly in periods of financial distress (Bolton et al., 2016)(Carvalho et al., 2015).

Risk-taking behaviour is closely tied to monetary policy and the institutional environment in which banks operate. When interest rates are low or regulation is perceived as lenient, banks may adjust their risk appetite, reallocating credit toward higher-yield or riskier segments. Altavilla et al. (2020) show that weaker supervision increases portfolio risk, while Paligorova & Santos (2017) find that accommodative monetary conditions foster riskier lending. Morais et al. (2019) add that foreign banks respond to policy rates and quantitative easing by shifting lending toward riskier borrowers, especially in emerging markets.

Public guarantee schemes implemented during crises add another layer of complexity to banks' credit strategies. These programmes aim to stabilise credit flows by transferring part of the lending risk to the state. However, they also alter banks' incentives, particularly regarding firm selection and credit reallocation. Jiménez et al. (2022) show that in Spain, guarantees expanded SME lending but mainly reinforced existing bank-firm ties, revealing a relational bias. This illustrates how guarantees, while supporting access, may distort monitoring intensity and risk perception.

A central contribution in this area comes from Altavilla et al. (2021, 2023), who examine these dynamics at the European level using AnaCredit, the euro area's harmonised credit registry. The 2021 paper provides initial evidence that public guarantees successfully preserved credit supply during the COVID-19 pandemic. Banks extended guaranteed loans under improved terms, lower spreads and longer maturities, and were more likely to lend to firms that were smaller, riskier, and more severely affected by the crisis. The 2023 paper builds on this foundation, introducing a refined empirical strategy to isolate credit reallocation effects. It shows that banks reduced non-guaranteed lending by more than 30% after initiating guaranteed loans, particularly toward riskier clients, highlighting a strong substitution effect. Moreover, the study documents that banks' use of guarantees was shaped by their own capital strength, with better-capitalised banks offering more generous terms. Taken together, these two studies demonstrate not only the effectiveness of guarantees in

maintaining credit access but also their role in shifting portfolio risk and redistributing credit across firms and sectors. The 2023 paper can thus be read as a methodological and conceptual evolution of the earlier study, integrating firm-level effects with bank portfolio responses.

These behaviours are consistent with findings by Gropp et al. (2010), who exploit a natural experiment in Germany to study the removal of a public guarantee regime. Their natural experiment, through a differences-in-differences design, reveals that, in the absence of guarantees, banks curtailed loan volumes, increased pricing, and adopted more conservative risk profiles. These results underscore the extent to which guarantees shape credit risk preferences and raise questions about long-term incentive distortions.

Furthermore, Wilcox & Yasuda (2019) complement these findings by examining how US banks adjusted their lending strategies as their exposure to government guarantees increased. Initially, guarantees were used to expand the total credit supply. However, as participation grew, banks began substituting guaranteed loans for non-guaranteed ones, especially in riskier segments, thereby limiting the programme's marginal effectiveness.

The strategic reallocation of credit under guarantee schemes also affects how banks manage client portfolios. Mayordomo et al. (2015) and Li et al. (2020) find that active participation allowed banks to increase market share by reinforcing ties with existing clients or acquiring new ones through state-backed credit. This pattern reflects a shift in competition dynamics, where access to public credit support becomes a strategic asset. Minoiu et al. (2024) find spillover effects from such programmes, where credit supply expands even to firms not directly eligible for guarantees, especially when administered through larger, better-capitalised banks. Falagiarda et al. (2020) add that banks may use guarantees defensively, extending credit to reduce exposure to older, riskier loans or reshaping portfolios to benefit from regulatory arbitrage.

These strategies affect firm selection directly. Cerqueiro et al. (2020) emphasise the role of institutional features such as creditor priority, while Greenwald et al. (2023) show that firms with access to credit lines benefited disproportionately during the crisis. Palazzo et al. (2020) warn of adverse effects near programme expiration, when banks may foreclose to preserve recovery value, triggering abrupt credit withdrawals.

The bank's role in firm selection, therefore, is not neutral. It is shaped by policy tools, market structure, and internal constraints, and its outcomes affect both credit availability and economic resilience. As Mayordomo et al. (2015) and Jiménez et al. (2022) suggest, while guarantees can enhance access for constrained firms, they also risk reinforcing relational biases and reallocating credit toward firms already connected. Their effectiveness thus depends on recognising the strategic behaviour of banks and designing interventions that mitigate adverse incentives without compromising credit flow.

2.4. Evaluating the Effects of Public Guarantees on Firms

Public credit guarantee schemes are widely used to improve access to finance for firms facing structural credit constraints. While these programmes aim to mitigate informational asymmetries and collateral shortages, their effects on firm performance, investment, employment, and market dynamics vary across institutional settings and firm characteristics. The existing literature provides robust empirical evidence that guarantees can be effective in expanding credit access and supporting firm growth, though concerns remain regarding targeting efficiency and long-term impact (Silva, 2021)(OECD, 2020).

Several studies confirm that CGSs improve credit availability, especially for small and medium-sized enterprises (SMEs). Mayordomo et al. (2015) show that during the COVID-19 pandemic, Spanish firms receiving guaranteed loans benefited from improved access to finance, but the extent of this benefit was conditioned by their prior bank relationships. The EIB (2014) further highlights that in Central and Eastern Europe, well-designed guarantee schemes helped overcome longstanding credit frictions in SME financing. However, such improvements are not always neutral in their allocation. Moreover, Akcigit et al. (2024) find that guarantees tend to favour already formalised or higher-quality firms, potentially bypassing more constrained but riskier companies.

A key contribution comes from Silva (2021), who evaluates the effects of Portugal's public credit guarantee scheme on SME outcomes using a detailed firm-level dataset. The paper shows that guaranteed firms experienced significant improvements in credit access, employment, total and fixed assets. However, the study finds no evidence of gains in productivity, profitability, or wage growth, suggesting that guarantees long-term effects were

limited. Another important result is that effects were stronger among smaller firms, suggesting that guarantees were effective in alleviating barriers linked to firm size.

How guarantees influence the allocation of credit across different firm types remains a central concern in the evaluation of public guarantee programmes. The literature suggests that, while guarantees improve credit access, their allocation is not always aligned with underlying credit constraints. Zecchini & Ventura (2009) show that guarantees increased the probability of loan approval and allowed Italian SMEs to secure larger loan amounts, even when controlling for risk. Oh et al. (2009), using propensity score matching, find similar results in the Korean context: guarantees improved access to credit and led to higher investment, particularly for smaller firms. However, both studies raise concerns about potential adverse selection when guarantees are too generously allocated without adequate risk assessment.

Unintended effects can also emerge in the allocation of guarantees. Giuliodori et al. (2020) demonstrate that firms receiving guaranteed credit during the crisis in the Netherlands were not necessarily those most affected by the shock, but rather those with stronger pre-existing access to finance. This echoes findings by Banerjee et al. (2015), who, through a set of randomised evaluations across different countries, show that microcredit and guarantee-based interventions may not always reach the most constrained entrepreneurs, especially when selection mechanisms favour formality or prior bank connections.

The effects of guarantees on firm growth and innovation are particularly strong in the case of entrepreneurship-focused schemes. Lelarge et al. (2010), analysing a French programme, find that guarantees increased firm creation and survival rates, especially among young and small firms. The OECD (2020) corroborates these effects across member countries, noting that guarantees remain one of the most effective tools in fostering SME development, particularly where equity funding is scarce. Silva (2021) adds that in the Portuguese context, guarantees significantly increased investment in fixed assets, although the returns on these investments varied by sector and region.

The long-term effects of CGSs are more nuanced. Kuo et al. (2011) argue that while guarantees improve credit access in the short term, schemes without risk-adjusted pricing may distort incentives and lead to excessive dependence on public support. Schweiger (2011), analysing restructuring aid in Slovenia, warns that guarantees can delay necessary firm exits,

reducing allocative efficiency. These concerns are echoed by Lee (2018), who finds that while guaranteed loans supported regional economic growth in the US, they also led to capital misallocation when not accompanied by performance-based monitoring.

The impact of guarantees on employment and resilience during crises is another important dimension. Bruhn et al. (2023), using firm-level panel data across several Latin American countries, show that COVID-era government support preserved employment among supported firms, but the effect was concentrated in larger, more formal enterprises. Giuliodori et al. (2020) similarly report that employment effects were positive but heterogeneously distributed, suggesting the need for targeted design. Hackney (2023), focusing on US regions during the 2007-09 financial crisis, shows that government-guaranteed loans helped firms maintain operations and employment, particularly in areas with higher SBA lender activity. However, firms with higher leverage before the guarantee were more likely to face distress later, raising questions about long-term firm viability and fiscal risk.

The institutional design of credit guarantee schemes plays a central role in shaping their allocation outcomes and equity. In the Portuguese case, the COVID-19 programmes were formally coordinated by Banco Português de Fomento but relied heavily on the operational discretion of commercial banks, which retained substantial autonomy in borrower selection. This structure contributed to significant heterogeneity in take-up across banks and regions, particularly in schemes with partial guarantees. Custódio et al. (2024) document that many eligible firms, especially smaller and less financially sophisticated ones, were either unaware of the programme or unable to meet its procedural demands. In contrast, larger and more formal firms, often with pre-existing banking relationships, responded more swiftly and effectively.

Overall, the effectiveness of CGSs depends not only on whether firms receive support, but also on how well the support aligns with the firm's needs, financial health, and growth potential. As Silva (2021) and Zecchini & Ventura (2009) suggest, well-targeted guarantees can improve credit access, stimulate investment, and generate employment. However, when targeting is weak or incentives are misaligned, guarantees risk reinforcing existing inequalities or delaying necessary restructuring (Giuliodori et al., 2020)(Custódio et al., 2024)(Schweiger,

2011). These considerations underline the critical importance of scheme design, governance, and outreach in maximising both the efficiency and equity of credit guarantee systems.

2.5. Public Support Measures During the COVID-19

2.5.1. The Portuguese Case

Structural and Institutional Context

In the Portuguese context, structural constraints in the allocation of bank credit have long limited the growth potential of small and medium-sized enterprises. Farinha & Félix (2015), using a disequilibrium model on firm-level data between 2010 and 2012, estimate that around 32% of Portuguese SMEs were fully credit-rationed during that period. More broadly, Azevedo et al. (2021) find that in 2013, nearly 44% of total credit was directed to firms in the bottom half of the productivity distribution, reflecting persistent inefficiencies in the allocation of financial resources. These findings underscore the dual challenge facing the Portuguese economy: not only facilitating access to credit, but also to improve the targeting and quality of credit distribution.

Leading up to the COVID-19 crisis, Portugal had begun to recover from the 2008–2009 financial crisis, but systemic vulnerabilities persisted. The *Relatório de Estabilidade Financeira 2019* by Banco de Portugal noted that credit to non-financial corporations (NFCs) was growing modestly at 1.5% annually, and that lending standards remained cautious. While borrowing costs had reached historic lows, access to long-term and stable financing continued to be constrained, especially for SMEs. The corporate sector remained highly indebted, and although non-performing loan (NPL) ratios had declined, particularly in construction and real estate, credit allocation continued to reflect risk aversion and sectoral concentration (Banco de Portugal, 2019).

To mitigate these persistent frictions, the state progressively developed a system of public credit guarantees aimed at reducing lending risk for banks and enhancing SME financing. Initiatives such as PME Investe (launched in response to the global financial crisis) and Capitalizar (introduced in 2016) were implemented through the Sistema Português de Garantia Mútua and intermediated by commercial banks. These programmes provided risk-sharing mechanisms, predefined spreads, and eligibility criteria aligned with the structural needs of the Portuguese business fabric, helping mobilise credit to firms otherwise excluded from formal financial markets (SPGM, 2018) (IAPMEI, 2020).

These efforts culminated in the creation of the Banco Português de Fomento (BPF) — an institutional consolidation of the Instituição Financeira de Desenvolvimento (IFD), PME Investimentos S.A., and the Sociedade de Investimento SPGM S.A., in 2020. The BPF was conceived to scale up and streamline public financial instruments, including credit guarantees, venture capital, and blended finance tools, aligning them with national and EU-level recovery strategies. This transformation strengthened the state's capacity to respond decisively to systemic liquidity shocks and to coordinate large-scale financial interventions (SPGM, 2020).

With the outbreak of COVID-19, this pre-existing infrastructure enabled a rapid and large-scale deployment of credit guarantees. These instruments were no longer merely tools to ease financing constraints but became central pillars of the government's macroeconomic response. Silva (2021) finds that firms benefiting from public guarantees during the pandemic showed stronger growth in credit, employment and assets, though with no statistically significant gains in productivity.

Importantly, the literature identifies a clear distinction between firms accessing guarantees and those relying on other support measures. Mateus & Neugebauer (2022), using a regression framework on matched firm-bank data, show that guarantees were targeted primarily at solvent, viable firms, while moratoria were more frequently used by those with weaker financial positions. Costa (2021), confirms that guarantees significantly eased credit constraints during the crisis, identifying a positive causal effect on credit volumes by exploiting variation in eligibility rules and implementation timing.

Despite their stabilising role, concerns about long-term credit efficiency remain. Mateus & Pinheiro (2021), through a granular analysis of loan-level pricing and risk-adjusted returns, reveal signs of underpricing in some, which raises red flags over potential misallocation and systemic exposure if credit risk is not properly monitored.

Response During the Pandemic

The outbreak of COVID-19 prompted an unprecedented mobilisation of public financial support, particularly in the form of state-guaranteed credit. Building on the institutional legacy of SPGM and earlier credit programmes, the Portuguese government launched a comprehensive suite of guarantee-backed credit lines to address the sudden collapse in business revenues and preserve the flow of bank lending to the corporate sector. These

instruments were no longer confined to correcting structural credit market failures and became core pillars of the government's macro-financial response to the crisis. The newly established BPF was tasked with centralising the deployment of these instruments, coordinating with commercial banks and mutual guarantee societies to ensure broad and rapid coverage (Banco Português de Fomento, 2020). In April 2020, the EU State Aid Temporary Framework approved an initial €3 billion budget, which was later expanded to €13 billion (European Commission, 2020) (XXII Governo - República Portuguesa, 2020).

The main vehicle for this intervention was the *Linhas de Crédito de Apoio à Atividade Económica - COVID-19*, initially structured into sector-specific facilities (e.g., tourism, events, catering, and industry), later unified into broader schemes accessible to all sectors. These lines allowed Portugal to deploy state-backed guarantees covering up to 90% of loan amounts for micro and small firms and up to 80% for medium-sized and mid-cap companies. Maximum loan amounts ranged from €50,000 to €2 million, with maturities of up to six years and grace periods up to 18 months (XXII Governo - República Portuguesa, 2020).

By October 2021, the total volume of credit with public guarantees amounted to €8.87 billion, of which €7.5 billion had been contracted in 2020 (Banco de Portugal, 2021), and more than €4.1 billion were restructured through maturity or grace period extensions, allowing firms additional liquidity without refinancing pressure. Around 91% of the guaranteed credit was channelled to SMEs, with particularly high uptake in sectors severely affected by lockdowns, such as accommodation, food services and retail.

Firms with access to these facilities benefited from more favourable financing conditions. The average interest rate on guaranteed loans stood around 1.2%, compared to 2.4% for non-guaranteed operations (Banco de Portugal, 2020). Longer maturities and built-in grace periods contributed to easing cash flow pressures, particularly for micro and small enterprises. According to the *Relatório de Estabilidade Financeira 2021* from Banco de Portugal, firms with guaranteed credit showed slightly lower profitability and autonomy compared to those eligible but unsupported. However, they also exhibited lower rates of insolvency and capital impairment, suggesting the guarantees were targeted at firms with short-term liquidity needs rather than structural weaknesses (Banco de Portugal, 2021). Notably, the credit to non-financial corporations grew substantially during the crisis, amount of new loans rising by 4.1% overall, and over 13% for micro and small enterprises. This surge in credit activity

reflects the critical role of public guarantees and complementary measures in preserving firm liquidity during the most acute phase of the crisis. (BPstat, 2021).

The policy design was not limited to financial support, it embedded conditions intended to filter access and ensure targeting precision. The European Commission formally recognised the Portuguese scheme as compliant with EU state aid rules and proportional in design, especially in its attempt to maintain firm solvency while safeguarding public resources (European Commission, 2020). The conditionality attached to guarantees, including requirements related to employment retention, compliance with tax and social security obligations, and pre-pandemic viability, acted both as safeguards and as selection mechanisms that shaped the allocation of credit across firms.

Silva (2021) complements this institutional perspective by showing that supported firms experienced stronger growth in credit, employment and assets during the pandemic, though without measurable improvements in productivity. Costa (2021), using a difference-in-differences approach, identifies a causal effect of the guarantees on easing credit constraints, exploiting variation in eligibility criteria and implementation dates. Mateus & Neugebauer (2022) demonstrate that guarantees were channelled to solvent and viable firms, while riskier companies tended to rely more on moratoria. Both Costa (2021) and Mateus & Neugebaeur (2022) also conduct an analysis of moratoria as a complementary policy tool, highlighting that these measures were primarily accessed by more vulnerable firms and were pivotal in delaying financial distress and smoothing liquidity pressures during the peak of the crisis.

The operational reach of the guarantee schemes was further reflected in credit market sentiment. According to the 2022 edition of the Bank Lending Survey from Banco de Portugal, credit standards tightened across most firm segments during the pandemic, reflecting banks' increased risk aversion. However, the presence of public guarantees played a decisive role in mitigating credit supply constraints, particularly for SMEs facing urgent liquidity needs. Banks reported that the existence of these guarantees allowed them to extend credit under conditions that would otherwise have been considered too risky. This highlights not only the stabilising effect of the schemes, but also their instrumental role in preserving firm-bank relationships under significant financial stress.

Effects on Credit, Employment and Productivity

Public credit guarantees implemented during the COVID-19 period are associated with broadly positive outcomes, particularly in terms of credit access, employment protection, and short-term financial reinforcement at the firm level. Silva (2021) finds that firms benefiting from guarantee-backed loans experienced significant increases in total credit, as well as growth in employment and asset accumulation, relative to non-supported firms. These findings suggest that guarantees were effective in alleviating liquidity pressures and maintaining productive capacity during the crisis. However, the study also reports no statistically significant effect on productivity or profitability, indicating that the support was primarily stabilising rather than transformative.

The positive effect on credit access is further supported by Costa (2021), who shows that state-backed guarantees played a decisive role in mitigating the tightening of lending conditions. Firms with access to guaranteed credit were able to maintain or expand their financing, whereas similar firms without such support experienced a contraction in credit. The impact was especially pronounced among smaller enterprises and in sectors heavily affected by lockdowns, reinforcing the targeted nature of the policy design.

Mateus & Neugebauer (2022) provide additional evidence that the allocation of guarantees was relatively well-targeted, with supported firms displaying stronger ex ante financial indicators than those relying solely on moratoria. This differentiation is crucial to interpreting the outcomes: while guarantees helped sustain viable firms, moratoria were more commonly used by businesses with weaker fundamentals, offering temporary relief without the same stabilising effect on firm-bank relationships.

Supporting these conclusions, data from *Relatório de Estabilidade Financeira 2020* by Banco de Portugal confirm that state-guaranteed credit was concentrated in the most affected sectors, such as accommodation and food services, and disproportionately directed to micro and small enterprises, which accounted for the majority of recipients. In some sectors, public guarantees covered more than 50% of new credit operations at the height of the pandemic response.

In sum, these findings suggest that the guarantee programmes were successful in supporting short-term liquidity and employment preservation across a wide range of firms. Nonetheless, their limited impact on productivity also points to the need for complementary long-term

measures to enhance the efficiency of credit allocation and promote structural competitiveness in the post-crisis recovery.

Post-COVID Evolution of Guaranteed Credit and Financial Stability

Although the active deployment of new public guarantee schemes largely ceased by late 2021, the effects of these instruments continued to shape credit markets well into the post-pandemic period. The maturities and grace periods embedded in the COVID-19 credit lines extended their influence over firm-bank relationships beyond the initial crisis. According to Banco de Portugal (2022), the stock of loans with public guarantees retained relatively long maturities, particularly among the sectors most affected by the pandemic. In 2022, 54% of the outstanding credit to these firms had a residual maturity above four years, a structural shift partly attributable to the six-year design of the COVID-19 guarantee lines. Additionally, firms that accessed guaranteed loans maintained higher liquidity buffers and greater access to medium-term credit relative to their peers.

This persistent footprint was accompanied by growing analytical scrutiny. In 2023, Banco de Portugal conducted a model-based evaluation of the macro-financial effects of the guarantee schemes using a DSGE model. The findings suggest that for every 1% of the stock of credit supported by guarantees, bank default risk fell by 0.48%, credit expanded by 0.32%, and GDP increased marginally by 0.01% (Banco de Portugal, 2023). However, the study also highlighted that only 31% of guaranteed credit was truly additional, while the remaining 69% replaced lending that would have occurred under normal market conditions. This raised concerns about the efficiency of public resource allocation and the extent to which guarantee schemes may have crowded out private credit, particularly in the absence of stricter ex ante evaluation.

By 2024, the financial condition of most firms had improved, with aggregate indicators of profitability, liquidity, and leverage stabilising or surpassing pre-pandemic levels. The share of companies with cash reserves remained above 2019 results, and the average return on assets among firms with guaranteed loans rose to 11.1% from 9.7% (Banco de Portugal, 2024). Nonetheless, sectoral asymmetries persisted: industries such as accommodation, food services and construction, which had been most dependent on emergency support, continued to exhibit higher insolvency rates and slower deleveraging. It is also worth noting

that 96% of loans with guarantees were indexed to variable interest rates, increasing firms' sensitivity to monetary policy tightening, especially in 2023 when interest rates peaked.

Despite this relatively resilient macro picture, questions about long-term credit quality and fiscal risk remain. Some firms may have become reliant on the favourable financing conditions provided during the crisis, while others, particularly smaller or structurally weaker ones, could face refinancing difficulties as grace periods end. Meanwhile, the total number of active firms in Portugal increased by 2.3% in 2023 (BPstat, 2025), suggesting that the guarantee schemes may have played a role in preserving business continuity. However, the extent to which these dynamics reflect sustainable recovery or residual effects of public support remains open to debate. As the focus shifts from emergency liquidity provision to structural competitiveness, the legacy of COVID-era credit guarantees warrants continued monitoring to ensure that distortions do not persist or intensify in the medium term.

Challenges and Risks in Credit Allocation

Despite their stabilising effects, public credit guarantees also raised concerns regarding the quality of credit allocation and the potential for long-term distortions. Mateus & Pinheiro (2021) show that, in several sectors such as construction and real estate, loans were often underpriced relative to their risk profile, even when supported by public guarantees. This underpricing may have encouraged excessive risk-taking or prolonged the survival of firms with limited economic viability. Similarly, Azevedo et al. (2021) find that a substantial share of credit in Portugal continues to be channelled to firms with below-median productivity, highlighting structural inefficiencies that pre-date the pandemic but may have been exacerbated by emergency support mechanisms.

Beyond firm-level concerns, there are broader risks related to the sustainability and efficiency of such public interventions. The scale of guarantee-backed lending raises fiscal questions, particularly if defaults materialise or guarantees are repeatedly extended without clear exit strategies (Banco de Portugal, 2021). Moreover, the heavy concentration of guaranteed credit in a limited number of sectors and among specific financial institutions may increase systemic exposure and reduce market discipline (Banco de Portugal, 2022). These considerations underline the importance of complementing emergency measures with longer-term policies aimed at improving credit allocation, supporting business dynamism, and ensuring that future interventions are both targeted and time-bound.

2.5.2. Comparative International Evidence

While Portugal implemented a comprehensive system of public credit guarantees to stabilise firm financing during COVID-19, similar programmes were launched across many other countries, each shaped by distinct institutional contexts, design features, and implementation challenges. Although programme designs differed, the main objective was to restore credit flows to SMEs, prevent large-scale firm failures, and maintain liquidity in critical sectors of the economy. Lessons from the 2008 financial crisis, when banks sharply curtailed credit even to established borrowers (Ivashina & Scharfstein, 2010), underscored the urgency of timely, state-backed interventions. In Central and Eastern Europe, credit guarantees had already gained relevance prior to the pandemic, which emphasised their potential in markets with underdeveloped collateral frameworks and high credit constraints (EIB, 2014).

Comparing the Portuguese approach with international experiences reveals both common policy elements such as broad eligibility, portfolio-based structures, and subsidised pricing, alongside important divergences in terms of governance models, targeting mechanisms, and long-term trade-offs. During the pandemic, several countries implemented large-scale guarantee programmes with aggressive state backing. In Spain, national guarantee lines were launched to support SME lending through risk-sharing between the state and commercial banks (Corredera-Catalán et al., 2021). In contrast, Italy activated a centralised guarantee system to assist small businesses and self-employed workers (Core & Marco, 2021). Moreover, in Romania, Catana et al. (2020) examined the IMM Invest programme, which combined partial guarantees with interest subsidies to ease credit conditions for SMEs. While each national approach reflected its institutional context, they shared core design features aimed at maintaining liquidity and preserving firm continuity.

The effectiveness of these schemes differed markedly across jurisdictions. In Italy, Cascarino et al. (2022) find that guarantees led to significant credit additionality, then most guaranteed loans would not have occurred otherwise. In the UK, the government implemented two large-scale programmes: CBILS (Coronavirus Business Interruption Loan Scheme), which provided partial guarantees for loans up to £5 million, and BBLS (Bounce Back Loan Scheme), which offered 100% guarantees for smaller loans under simplified procedures. Despite high uptake, these programmes revealed gaps in early implementation and monitoring (Calabrese et al., 2022). In Indonesia, where institutional capacity differs, Adhikary et al. (2019) find that guarantees were successfully directed toward micro

and small firms, supporting their survival and credit access, though productivity gains were more limited.

Additionally, institutional capacity and financial market structure also shaped outcomes. In a pre-pandemic context, Caselli et al. (2019) highlight that in Italy, guaranteed credit contributed to short-term profitability, particularly among smaller firms, but raised concerns about support to less efficient sectors.

At the euro area level, during the COVID-19 emergency, Falagiarda et al. (2020) note that the transmission of guarantees was uneven, depending on bank capitalisation and appetite for risk. Moreover, Bighelli et al. (2021) find that, in some advanced economies, support was skewed toward more productive firms, while in others, guarantees disproportionately reached less efficient businesses, creating risks of misallocation.

The long-term impact of public guarantee schemes is still an open debate. Puri et al. (2011), analysing post-crisis lending in the US, suggest that such interventions may lower banks' incentives to screen borrowers, especially when default risk is absorbed by the state. This dynamic can reinforce credit expansion in the short-term, but raise concerns about future repayment quality and banking discipline.

In addition, sectoral targeting also emerged as a key variable in the effectiveness of public credit guarantee schemes. In Italy, profitability gains from guaranteed loans were concentrated in manufacturing and trade, while firms in lower-productivity service sectors benefited less (Caselli et al., 2019). In Spain, support was disproportionately channeled toward industries with stronger banking ties, such as construction and wholesale trade (Corredera-Catalán et al., 2021). These patterns raise concerns about allocative efficiency, particularly when programme objectives are beyond emergency responses and include structural transformation or innovation. The absence of sector-specific criteria often led to overrepresentation of mature, low-growth firms, which may weaken the long-term impact of public support (Core & Marco, 2021).

The international evidence reviewed above provides useful insights to assess if the Portuguese response has enhanced credit efficiency, prioritised support for productive firms, and minimised the risk of long-term distortions.

3. Research Questions and Hypotheses

As previously discussed in the literature review, the allocation efficiency of public credit guarantees remains an ongoing issue. While some studies suggest that these guarantees primarily support firms facing significant financial constraints (Stiglitz & Weiss, 1981; Jiménez et al., 2022), others argue that they tend to benefit firms already in a stronger position to access credit (Silva, 2021). Furthermore, numerous studies have raised concerns about the true effectiveness of public guarantees in expanding credit supply, questioning whether they primarily replace loans that would have been granted under normal conditions. This study aims to investigate these issues further, focusing on the recent response to COVID-19 pandemic. Below, we outline the research questions and corresponding hypotheses.

Research Question 1: Are public credit guarantees primarily allocated to financially constrained firms, or are they more likely to benefit firms already in a stronger position to access credit?

Hypothesis 1 (*H1*): Public credit guarantees are not equally allocated across firms, depending on their financial characteristics.

Before assessing the impact of market structure on the effects of public credit guarantees, it is important to first evaluate whether these guarantees are systematically targeted at specific types of firms. Therefore, in the context of COVID-19 pandemic, *H1* investigates whether the likelihood of receiving a guarantee was significantly associated with ex-ante financial characteristics such as company size, risk level, financial structure, and prior banking relationships.

The null hypothesis assumes a uniform allocation of guarantees, independent of firms' financial conditions, implying that all firms, regardless of their conditions, had an equal probability of receiving public support.

Research Question 2: Do public credit guarantees result in additional credit provision, rather than mainly substituting loans that firms would have received under normal conditions?

Hypothesis 2 (*H2*): A substantial share of guaranteed loans substitute credit that firms would have otherwise received in the absence of public guarantees.

It is essential to assess whether public credit guarantees genuinely led to an increase in financing or merely replaced loans that would have been granted under normal conditions. In this case, it is expected that a substantial share of the guaranteed loans would replace non-guaranteed loans that firms could have otherwise contracted with banks with no public support. The null hypothesis is that the credit granted under public guarantees results in additional financing rather than replacing pre-existing loans.

To test this, the analysis compares firms that received guaranteed credit from 2020 onwards with those that did not, focusing on the difference between guaranteed credit and non-guaranteed credit. It will also consider factors such as company size, banking relationships, and capital structure as control variables, since these may influence whether loans are being replaced or whether credit is truly expanding.

Research Question 3: To what extent do public credit guarantees contribute to improvements in firm performance, beyond providing short-term financial relief?

Hypothesis 3 (*H3*): Public credit guarantees allow firms to stabilise short-term financial conditions but have limited or no effect on profitability and medium-long-term performance indicators.

The effectiveness of public credit guarantees in stabilising short-term financial conditions is a key consideration. Concerning *H3*, it is expected that public credit guarantees help firms stabilise their finances in the short term but did not result in significant long-term improvements in profitability, investment, or employment. The null hypothesis is that public guarantees do not lead to significant long-term effects on firm performance.

To evaluate this, the analysis includes variables related to investment, employment, operational profitability, and net profitability. We use other control variables, including the firm's financial structure, previous financial performance, and industry sector. This approach will help to assess whether the guarantees have a genuine impact on firm performance or if their effect is mainly short-lived.

4. Methodology, Empirical Strategy, Sample and Data

This chapter outlines the empirical foundations of our study and is organised into four main sections. The first presents the econometric framework we use to identify and quantify the effects of public credit guarantees on firm outcomes. The second details the empirical implementation of the hypotheses formulated in the previous chapter. The third describes the sample construction process, including the integration of the underlying databases and the criteria used to ensure data consistency. Finally, the fourth section is dedicated to data sources and variable definitions, and includes a descriptive analysis of the sample and some preliminary statistical tests to get support of the empirical strategy that follows.

4.1. Methodology

Estimating the impact of public credit guarantees requires a methodological approach capable of addressing non-random selection into treatment. Firms that received guaranteed credit during the COVID-19 period are likely to differ systematically from those that did not, making simple comparisons potentially misleading. To address this concern, the empirical strategy combines two complementary components: (i) Coarsened Exact Matching (CEM) to improve comparability between treated and control firms based on pre-treatment characteristics; (ii) a separate logit model to analyse the characteristics associated with the likelihood of receiving guaranteed credit; and (iii) a Difference-in-Differences framework to estimate possible causal effects of the guarantees on firm outcomes.

Although the use of Coarsened Exact Matching helps improve the comparability between treated and control firms, it relies on the definition of coarsening cut-offs, which may affect the balance achieved across covariates. The definition of coarsening bins requires a balance, since broader intervals may smooth over some firm-level differences, whereas overly fine partitions can reduce the effective sample size available for comparison. Furthermore, CEM only ensures balance on observed characteristics, meaning that unobservable factors can still influence both treatment and firm outcomes (Iacus et al., 2012). These limitations also apply to the logit model used in point (ii) to estimate the likelihood of receiving guaranteed credit, which captures associations conditional on observable firm characteristics. If relevant variables influencing both selection into treatment and firm fundamentals are omitted, the model estimates may suffer from omitted variable bias.

Additionally, the Difference-in-Differences approach is widely applied in empirical research, but it hinges on the parallel trends assumption that treated and control firms would have followed similar paths in the absence of treatment (Bertrand et al., 2004). This assumption is not directly testable and may be violated if unobserved shocks affect the groups differently over time (Degryse et al., 2019). To mitigate these risks, the empirical strategy includes pre-treatment matching based on observable characteristics (via CEM) and uses robust standard errors clustered at the firm level in the panel regression. This matching approach is widely used to reduce selection bias due to observable heterogeneity. Our approach follows closely papers that addressed similar issues, such as Costa (2021) and Akcigit et al. (2024).

The CEM procedure begins by defining bins (coarsening) for observable pre-treatment characteristics such as firm size, leverage, profitability, and prior credit relationships. Firms are then exactly matched within these coarsened groups (*strata*), ensuring that treated and control units are directly comparable across the selected dimensions. The full CEM procedure, including the specification of coarsening variables, strata definitions, and a summary comparison with univariate balance tests before and after matching is detailed in *Appendix A*.

Once matched, firms are observed over time using a DiD specification to compare changes in outcomes between treated and control groups, before and after the introduction of the guarantee schemes. The aim is to isolate the Average Treatment Effect on the Treated (ATT), capturing how guaranteed credit influenced variables such as employment, investment or credit growth. This method leverages the COVID-19 pandemic as an exogenous policy shock, following a similar strategy adopted by Jiménez et al. (2022).

The treatment group is defined as firms that benefited from at least one guaranteed loan during the pandemic, while the control group consists of matched firms that did not receive such support. To ensure the credibility of the identification, pre-treatment balance tests are conducted to assess whether statistically significant differences remain across covariates after matching, a diagnostic step commonly applied in studies such as Mateus & Neugebauer (2022).

While the DiD model is used to evaluate the causal effects of the guarantees (in *H2* and *H3*), the first hypothesis (*H1*) is tested separately using a logit model estimated on the full sample.

This allows for a direct analysis of whether financial strength influenced the likelihood of receiving support, independently of any matching procedure.

Together, these two components provide a robust empirical framework: the logit model identifies the financial determinants of access to public guarantees, while the DiD approach evaluates their causal effects on firm-level outcomes.

4.2. Empirical Model and Implementation

Building on the empirical framework outlined in *Section 4.1* and the research hypotheses presented in *Section 3*, this section describes the econometric implementation used to analyse the allocation and effects of public credit guarantees. Each hypothesis is tested using a tailored model specification adapted to its underlying question.

The subsections that follow describe the model structure, the variables used, the interpretation of the main coefficients, and how each hypothesis is translated into an econometric specification. Moreover, a detailed description of all variables used in this analysis is provided in *Appendix B*.

4.2.1. The Role of Financial Strength in the Allocation of Credit Guarantees

The first hypothesis (*H1*) investigates whether public credit guarantees during the COVID-19 period were more likely to be allocated to firms already in a stronger financial position, rather than to those facing financial constraints. This question is addressed by modelling the likelihood of receiving a guaranteed loan as a function of firms' observable financial and structural characteristics measured in the last pre-treatment year.

To operationalise this, a logistic regression is estimated over the full sample of firms, where the dependent variable is a binary treatment indicator equal to *1* if the firm received at least one public credit guarantee between 2020 and 2023, and *0* otherwise.

The estimation model to test *H1* is specified as:

$$\Pr(\text{Treated}_i=1) = \frac{1}{1+e^{-\left(\alpha+\sum_{j=1}^{k}\beta_j X_{ji}\right)}} \qquad \textbf{(4.2.1.)}$$

In this specification, X_{ji} represent the firm-level financial characteristics measured in 2019, including firm size (total assets), profitability (*ROA*), leverage (capital ratio), and credit risk (volume of overdue credit). It also includes the Herfindahl-Hirschman Index (HHI), which

reflects how concentrated bank relationships are within each firm[1]. Standard errors are clustered at the firm level to account for intra-firm correlation.

Each coefficient β_j reflects the marginal contribution of the corresponding financial variable to the log-odds of receiving a public guarantee during the treatment period. A positive and statistically significant coefficient $(\beta_j > 0)$ suggests that financially stronger firms were more likely to access guaranteed credit, which is consistent with the hypothesis that the allocation process favoured more resilient firms, possibly due to their greater creditworthiness or lower default risk. This interpretation would align with findings in Silva (2021) and Jiménez et al. (2022), where firms with stronger credit profiles or more established banking relationships were more likely to benefit from credit support schemes.

In contrast, a negative and statistically significant coefficient $(\beta_j < 0)$ would indicate that firms with weaker financial positions, which means smaller size, lower profitability, or higher leverage, had higher odds of receiving support. This would support the view that the policy effectively reached liquidity-constrained firms, prioritising those most in need.

If the coefficient is not statistically different from zero, results are not conclusive.

This specification provides a direct and transparent test of the targeting mechanism underlying the public credit guarantee schemes. It allows for an empirical evaluation of whether financially stronger firms had systematically greater access to guaranteed loans during the COVID-19 period.

4.2.2. The Impact of Public Guarantees on Credit Expansion

In this section, *H2* explores whether public credit guarantees led to an effective expansion of total credit or merely substituted loans that firms would have received under normal conditions. While public guarantees are designed to alleviate credit constraints and stimulate lending, concerns persist that banks may have used these instruments to refinance or replace existing debt without increasing overall credit availability. This substitution effect, as highlighted by Altavilla et al. (2023), can result in a reallocation of risk to the Public sector

[1] The Herfindahl-Hirschman Index (HHI) is used to measure the concentration of a firm's credit relationships across banks. For each individual firm, the HHI is defined as the sum of squared credit shares held by each of its banks, ranging from 0 (fully diversified across several banks) to 1 (credit concentrated in a single bank). In this context, a higher HHI indicates greater dependence of that firm on one or a few banks, while lower values reflect broader diversification of its banking relationships.

rather than a net increase in firm financing. On the other hand, Cascarino et al. (2022) find that guaranteed loans were largely additional in the Italian case, underscoring the importance of context-specific evidence.

To assess this question, a Difference-in-Differences (DiD) model is estimated to compare changes in credit levels between treated firms (those receiving at least one guaranteed loan from 2020 onwards) and matched control firms that did not benefit from such guarantees.

The empirical model is as follows:

$$Y_{it} = \alpha + \delta\,(\text{Treated}_i \times \text{Post}_t) + \theta'\,(\text{Treated}_i \cdot \text{Post}_t \cdot Z_{ji,t}) + \beta'\,X_{ji,t} + \mu_i + \lambda_t + \varepsilon_{it} \qquad \textbf{(4.2.2.)}$$

In this equation, Y_{it} represents the total amount of credit held by firm i in year t, constructed as the maximum of monthly outstanding credit positions throughout the year, capturing the highest level of credit effectively utilised over the period.

In this specification, Post_t is a time dummy equal to 1 for all years from 2020 onwards, i.e., the period following the implementation of public credit guarantee programmes in response to the COVID-19 pandemic, and 0 otherwise.

To deepen the analysis, this dependent variable is also decomposed into two components: the volume of guaranteed credit and non-guaranteed credit. This allows for testing whether an observed increase in total credit is genuinely driven by additional lending or results from substitution between instruments. In addition, non-current liabilities are included as a complementary outcome to investigate the potential effects of public guarantees on firms' long-term financing structures.

Specifically, the evolution of each credit component is analysed across treated and control groups. If total credit remains constant, but guaranteed credit increases while non-guaranteed credit declines would suggest a substitution effect. Conversely, a simultaneous increase in both components would support the view that public guarantees expanded overall credit availability.

The coefficient δ measures the Average Treatment Effect on the Treated. A positive and statistically significant δ implies that firms receiving guaranteed loans experienced a net credit expansion relative to non-treated peers. This result would provide evidence in favour of the effectiveness of the guarantee schemes in boosting credit supply. Conversely, a negative coefficient (i.e. $\delta < 0$) would point to the prevalence of substitution, in line with

the concerns raised in the recent literature and institutional evaluations such as Banco de Portugal (2023).

Furthermore, interaction terms between the treatment indicator and selected firm-level characteristics are introduced. These interactions allow the model to capture heterogeneous treatment effects, reflecting the possibility that the impact of public guarantees is not uniform across all firms but rather depends on their underlying financial structure. By incorporating such terms (Z_{it}), illustrated in *Table 1*, the specification provides a more nuanced assessment of how guarantees operate in practice, identifying whether certain types of firms benefit disproportionately or respond differently to the availability of guaranteed credit.

The model also includes a comprehensive set of firm-level control variables $X_{ji,t}$, which are listed in below:

Table 1. Firm-level Variables for Hypothesis 2

Interactions Terms (Z_{it})	**Control Variables ($X_{ji,t}$)**
Debt to Assets Ratio	Log(Total Assets)
ROA	Log(Regular Credit: Short Residual Maturity)
	Log(Number of Bank Relationships)

Notes: The control variables are expressed in natural logarithms to reduce skewness in in their distributions and to mitigate the influence of extreme values. Author's elaboration.

Finally, firm and year fixed effects (μ_i and λ_t) are included to capture unobserved heterogeneity and common shocks. Robust standard errors are clustered at the firm level, following the same approach adopted in Section 4.2.1, to correct for potential autocorrelation and heteroskedasticity in the panel structure of the data.

4.2.3. The Influence of Loan Guarantees Schemes on Firm Performance

This section tests the third hypothesis (*H3*), which investigates whether public credit guarantees lead to meaningful improvements in firm performance, or whether their effects are limited to short-term financial relief. While the primary aim of these schemes was to preserve firm liquidity during the COVID-19 crisis, there is considerable debate over whether they also contributed to long-term firm recovery.

Several studies highlight this ambiguity. Silva (2021) finds that although guaranteed firms expanded credit and preserved employment, their productivity and profitability remained largely unaffected. Similarly, Banerjee et al. (2015) and Akcigit et al. (2024) note that the effectiveness of guarantees often depends on firm structure, with benefits skewed toward temporary stabilisation rather than durable performance gains. On the other hand, Lelarge et al. (2010) and Hackney (2023) document more positive effects, such as increased firm creation and regional growth, but stress that these results are conditional on firm quality and survival. Given this mixed evidence, it is crucial to test whether, in the Portuguese case, public guarantees contributed to genuine improvements in firm-level outcomes or merely preserved the status quo.

To assess this hypothesis, a Difference-in-Differences (DiD) model is estimated, comparing treated firms, those that received at least one guaranteed loan between 2020 and 2023, with matched control firms that did not. The treatment period begins in 2020, following the implementation of the guarantee schemes. The objective is to observe how the performance of treated firms evolved relative to control firms across the pre- and post-treatment periods.

The empirical specification is as follows:

$$Y_{it} = \alpha + \delta\,(\text{Treated}_i \times \text{Post}_t) + \beta' X_{ji,t} + \gamma' F_{ji,t} + \varepsilon_{it} \qquad \textbf{(4.2.3.)}$$

The dummy variable Post_t follows the same definition as in equation 4.2.2., indicating the post-treatment period (2020 onwards).

In this specification, Y_{it} refers to the performance outcome of firm *i* in year *t*, encompassing both financial and operational dimensions. The list of dependent variables includes both short-term financial health and longer-term economic performance. These variables are summarised in *Table 2*. By analysing a broad range of outcomes, the model aims to capture both transitory and persistent effects of the guaranteed schemes.

The coefficient δ measures the differential post-treatment change in firm performance attributable to receiving public guarantees. A positive and statistically significant value (i.e., $\delta > 0$) implies that guaranteed firms exhibited stronger improvements relative to the control group, suggesting that the guarantees acted not only as a stabilisation mechanism but also as a driver of post-crisis firm recovery. Such evidence would align with the findings of Hackney (2023), who documents long-run gains in firms benefiting from similar programmes.

Conversely, a negative δ would indicate that firms receiving support failed to improve their outcomes relative to the counterfactual scenario. This would support the hypothesis that guarantees primarily helped preserve liquidity or prevent insolvency, without triggering significant changes in operational performance. In this context, guaranteed credit may have replaced non-guaranteed loans that firms would have otherwise secured under normal market conditions, thus contributing little to a net improvement in credit conditions or business fundamentals. This interpretation is consistent with the findings of Akcigit et al. (2024) and Banco de Portugal (2023), which suggest that a substantial share of guaranteed loans lacked additionality and may have only delayed financial distress.

To reduce bias from omitted variables, the model includes a vector of control variables $X_{ji,t}$, which are presented in this table:

Table 2. Firm-level Variables for Hypothesis 3

Dependent Variables (Y_{it})		**Control Variables ($X_{ji,t}$)**
Long-Term	**Short-Term**	
Log(Non-current Assets)	Current Ratio	EBITDA Margin
Log(Turnover)	Cash Ratio	Log(Total Liabilites)
ROA	Trade Payables/Total Assets	Log(Number of Employees)

Notes: The control variables are expressed in natural logarithms to reduce skewness in in their distributions and to mitigate the influence of extreme values. Author's elaboration.

Lastly, firm, year, sector and legal form fixed effects ($F_{ji,t}$) are included to control for unobserved heterogeneity and aggregate dynamics. As in the previous sections, standard errors are clustered at the firm level to ensure robust inference under potential serial correlation.

4.3. Sample

The empirical analysis relies on a comprehensive panel dataset resulting from the integration of two main sources: the Harmonized Central Credit Register Database (HCRC) and the Central Balance Sheet Harmonized Panel Data (CBHP), both compiled by Banco de Portugal. The datasets were merged at the firm-year level, using the unique firm identifier (*tina*) and the corresponding reference year. The resulting sample covers the period from 2017 to 2023. Both sources follow the documentation and variable structures provided in

the official manuals released in June 2024 (for HCRC) and in June 2025 (for CBHP) by BPLIM.

The final sample includes only active Portuguese firms with valid financial and credit information for at least one year. The following criteria were applied:

1) The sample comprises small, medium-sized, and large firms. Microenterprises were excluded.[2] This restriction ensures that the analysis focuses on economically relevant companies with more complete and consistent information, and aligns with the eligibility scope of most public guarantee schemes.
2) Only non-financial firms were retained, based on sector classifications defined in the CAE-Rev.3 from the Instituto Nacional de Estatística (INE).[3] This restriction reflects the design of the Portuguese guarantee programs, which primarily targeted firms in the real economy.
3) Only firms with a valid and active legal registration were included, excluding informal or dissolved entities whose data may not represent actual economic behaviour.
4) Firms with no active credit relationships — i.e., zero bank exposure over the entire sample period — were excluded. This ensures that the sample captures firms with at least one meaningful interaction with the credit system.
5) Firms were required to have non-missing values in key financial and credit variables, including total amount of credit, secured regular credit, total assets, and equity. This guarantees the availability of essential information for all selected observations.
6) Duplicate records were identified and removed based on firm-year combinations to prevent distortions in descriptive statistics and estimation.
7) Firms with very large outliers or inconsistent reporting across sources were excluded to enhance the dataset's empirical robustness.

[2] According to the criteria established in Article 2.º of Decree Law No. 372/2007, published in Diário da República Portuguesa, microenterprises are defined as firms with fewer than 10 employees and either annual turnover or balance sheet (a statement of company's assets and liabilities) below exceeding €2 million. This definition is consistent with that of the EU Legislation (Recommendation 2003/361/EC) and was used to exclude microenterprises from the analysis. (European Comission, 2003)

[3] Firms were excluded if their primary activity was classified under financial or service sectors, specifically CAE Rev.3 sections 64 (Atividades de serviços financeiros, exepto seguros e fundos de pensões), 65 (Seguros, resseguros e fundos de pensões, excepto segurança social obrigatória), 66 (Actividades auxiliares de serviços financeiros e dos seguros), 68 (Atividades Imobiliárias), 77 (Atividades de aluguer), 78 (Atividades de emprego), and 82 (Actividades de serviços administrativos e de apoio prestados às empresas). (Instituto Nacional de Estatística, 2007)

Following data cleaning, only a selected subset of variables was retained from each database. From the CBHP, we extracted balance sheet variables (e.g., Total Assets, Equity, Liabilities), income statement components (e.g., Turnover, EBITDA), employment levels, and a set of financial ratios. From the HCRC, we used variables measuring credit volumes, overdue and written-off credit, and several indicators characterising firm-bank lending relationships, such as the number and concentration of banking partners.

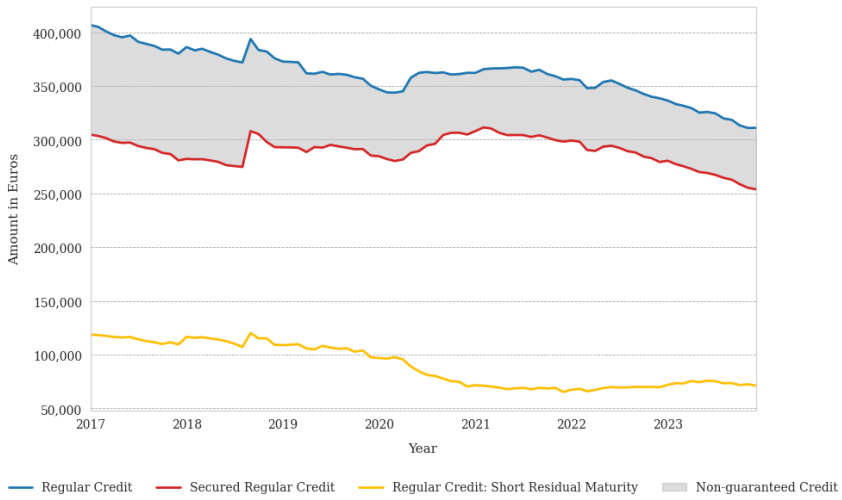
The resulting sample comprises 275,051 unique firms and 1,326,602 firm-year observations, covering a wide range of industries and credit relationships. This dataset provides a robust empirical foundation to evaluate the allocation and impact of public credit guarantees during the COVID-19 crisis. However, for the empirical analysis, only 106,896 firms and 624,742 firm-year observations are retained after the matching procedure, in order to improve comparability between treated and control groups and to strengthen the methodology.[4]

4.4. Data

4.4.1. Exploratory Data Analysis

Below we present an exploratory analysis of our full sample to understand the firms' evolution in the covered period, highlighting the reaction to the pandemic. *Figure 1* shows the evolution of average credit indicators per firm around 2017 and 2023.

Figure 1. Average Monthly Credit Evolution per Firm



Notes: Author's elaboration.

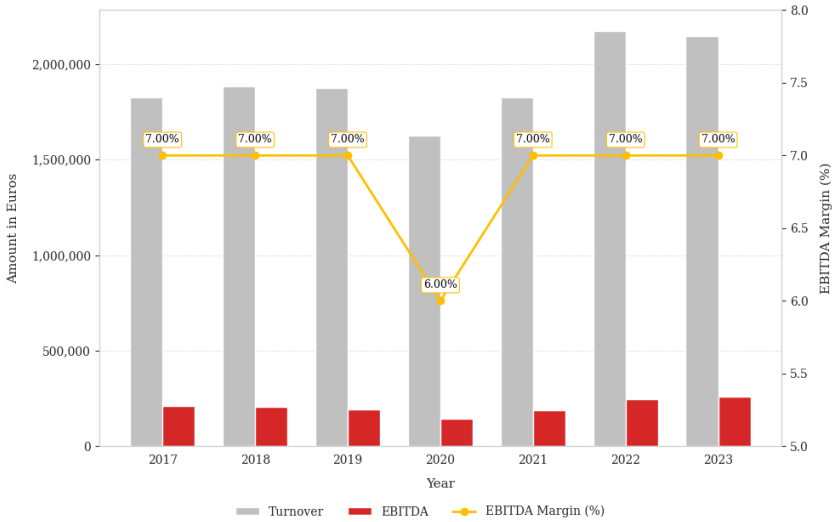
[4] For comparison, it is worth noting that Costa (2021), Silva (2021), and Mateus & Neugebauer (2022) also rely on firm-level microdata from BPLIM. Costa (2021) combines CRC, CBHP, and COVID-IREE survey data for a sample of 6,857 firms. Silva (2021) focuses on the 2014–2017 period using CRC and CBHP data, with 453 treated firms. Finally, Mateus and Neugebauer (2022) analyse a substantially larger dataset, covering around 253,000 firms in the state-guaranteed credit sample and 140,000 in the moratorium sample.

The dynamics of credit supply exhibit a clear break at the period of COVID-19. Prior to 2020, both regular credit and its secured component trends gently downward, consistent with gradual deleveraging in normal times. With the introduction of the guarantee schemes, the secured component rises by approximately 8% in 2020–2021, suggesting a shift in firm reliance from unsecured to state-backed credit instruments.

This compositional shift reflects the widespread adoption of credit moratoria, which allowed firms to suspend payments on existing loans. According to Banco de Portugal (2021), by September 2020, over €48.1 billion in loans were under moratorium, covering 54,000 firms and accounting for 33.2% of all outstanding credit to non-financial corporations (BPStat, 2021). These figures suggest that a substantial portion of firms in the dataset may have benefited from this temporary relief, which is reflected in the stabilisation and even slight recovery of secured credit levels during 2020-2021, despite the underlying economic uncertainty. The drop in short-residual-maturity credit between 2019 and 2021 reflects a combination of factors: on one hand, many short-term loans were placed under moratorium, freezing repayment obligations; on the other, the longer maturities and grace periods embedded in the guarantee schemes reduced the volume of newly issued short-term debt, temporarily reshaping firm-level liability structures.

From 2022 onwards, both regular and secured credit decline, and the gap re-opens modestly, indicating gradual normalisation. Over the same window, credit with short residual maturity stabilised at a lower level, following a cumulative drop by around 30%.

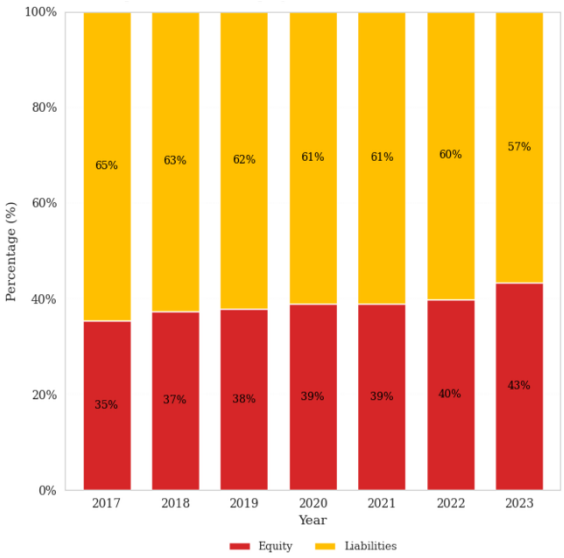
Figure 2. Firms' Operating Performance (2017-2023)



Notes: Author's elaboration.

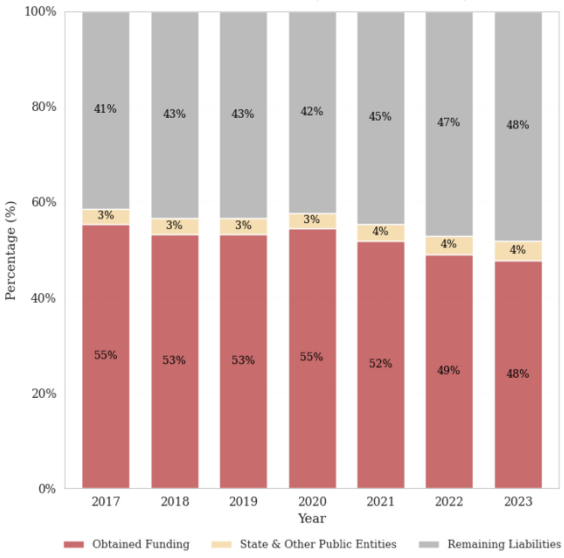
Figure 2 documents the contraction and subsequent recovery of Portuguese firms during the pandemic period. Up to 2019, indicators are broadly stable, with average turnover around €1.75 million, positive average EBITDA, and an EBITDA margin close to 7%. In 2020, all three measures declined as activity contracts. An initial rebound is visible in 2021, amid the rollout of support measures, and continues through 2022, when the amount of revenues and EBITDA slightly exceed pre-pandemic benchmarks while the EBITDA margin re-stabilises near 7%. In 2023, there is a modest decrease relative to 2022, yet operating levels remain comparable to, and marginally above, those observed before the pandemic.

Figure 3. Capital Structure - Equity vs Liabilities (% of Total Assets)



Notes: The indicator *Equity* represents the Total Equity. *Liabilities* correspond to the Total Liabilities. Author's elaboration.

Figure 4. Liabilities Breakdown (% of Total Liabilities)



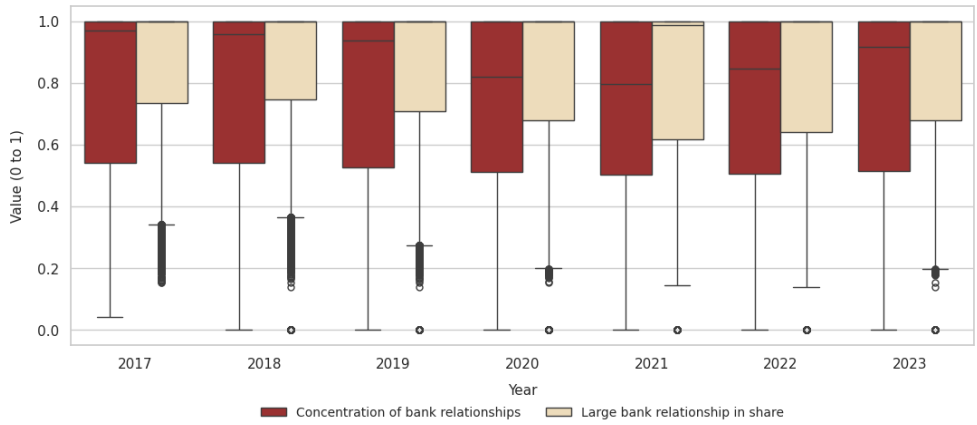
Notes: The indicator *Obtained Funding* represents the sum of Non-current and Current *Liabilities* – Obtained Funding. *State and Other Public Entities* corresponds to the Current Liabilities – State & Other Public Entities. *Remaining Liabilities* are the sum of the other remaining liabilities. Author's elaboration.

As illustrated in *Figure 3*, firms display gradual deleveraging over 2017-2023. The liabilities' share of total assets declines by -8pp, with a slightly increasing trajectory, while equity rises accordingly from approximately 35% to 43%. This slow, steady pattern is characteristic of balance-sheet repair after a large shock: leverage is reduced over multiple years through retained earnings, market conditions, and the natural roll-over of debt maturities.

Additionally, in the Liabilities breakdown (Figure 4), *Obtained Funding* falls 7pp, especially from 2021 onwards, and the *State and other public entities* remain small throughout, which means the rise of *Remaining Liabilities* is explained by the decrease in the *Obtained Funding* indicator.

Taken together with the results of *Figure 1*, these regularities are consistent with an extension of maturities during the pandemic period and a subsequent normalisation of the funding mix, with a more moderate reliance on short-term bank funding and a slightly greater role for other operational liabilities.

Figure 5. Firm-Bank Relationships



Notes: Author's elaboration.

The concentration of bank relationships is calculated through the HHI Index which summarises how a firm's total bank credit is distributed across all its lenders. It increases as credit becomes concentrated in fewer banks and declines when exposures are spread more evenly; values lie between 0 (high diversification) and 1 (all credit with a single bank). The largest-lender share records the proportion of a firm's total bank credit provided by its main lender.

As can be seen in *Figure 5*, firm–bank relationships are highly concentrated: both the HHI of credit shares across banks and the largest-lender share display elevated medians and wide dispersion, indicating that many firms rely on one or a few lenders. Around 2020 there is a modest temporary loosening in the largest-lender share, followed by partial reconsolidation, consistent with firms activating additional relationships to access guarantee lines and then rationalising them afterwards.

Moreover, the prevalence of high concentration suggests that access conditions during the pandemic were likely mediated by existing relationships, whereas the short-lived dip is compatible with the activation of additional banking lines during the emergency and subsequent rationalisation. The persistence of outliers across years underscores heterogeneity in relationship structures even as the centre of the distributions moves only modestly over time.

4.4.2. Testing for Similarity Between Treated and Non-Treated Firms

To assess the comparability between treated and non-treated firms after the CEM procedure, *Table 3* presents the descriptive statistics for both groups across a range of financial, operational and credit-related variables at the end of 2019.

Table 3. Descriptive Statistics Between Treat and Control Groups

	Treatment Group			**Control Group**		
	Median	**Mean**	**Std. Dev.**	**Median**	**Mean**	**Std. Dev.**
Balance Sheet						
Total Assets	144	1,030	30,655	95	1,189	13,871
Non-current Assets	28	543	28,621	9	543	10,423
Equity	43	442	17,193	25	566	7,287
Liabilities	84	589	14,359	59	623	8,787
Non-current Liabilities	23	283	10,337	2	209	4,999
Current Liabilities	43	306	4,695	35	415	5,232
Income Statement						
Turnover	164	742	5,621	104	1,100	18,649
Total Expenses	164	744	5,712	106	1,096	18,721
EBITDA	12	87	2,197	6	105	1,380
Financial Indicators						
Current Ratio	1.97	4.53	8.75	1.97	5.56	10.79
Capital Ratio	0.34	0.12	1.77	0.36	−0.67	4.84
Debt to Assets Ratio	0.66	0.88	1.77	0.64	1.67	4.84
Cash Ratio	0.35	1.57	4.64	0.45	2.47	6.66
ROA	0.08	0.05	0.77	0.06	−0.21	2.03
EBITDA Margin	0.07	0.04	1.74	0.05	−0.13	2.74
Trade Payables/Total Assets	0.07	0.16	0.32	0.05	0.23	0.90
Credit Outstanding						
Regular Credit	22	186	2,459	0.68	46	1,940
Secured Regular Credit	20	160	1,897	0.00	24	868
Regular Credit: Short Residual Maturity	2	56	775	0.44	25	1,229
Overdue Credit	0.00	5	221	0.00	9	378
Non-guaranteed Credit	0.46	40	1,161	196.00	25	1,440
Bank Relationships						

Number of bank relationships	1.00	1.68	1.19	1.00	1.19	0.62
Large bank relationship in share	1.00	0.92	0.16	1.00	0.96	0.14
Concentration of bank relationships	1.00	0.85	0.22	1.00	0.93	0.18
Employment						
Number of employees	3.00	7.48	36.47	2.00	7.72	91.77
Number of Firms		71,868			35,028	

Notes: This table reports pre-treatment values (reference year: 2019) for both treated and control groups, using the matched sample resulting from the Coarsened Exact Matching (CEM) procedure. All monetary values (Balance Sheet, Income Statement and Credit Outstanding) are represented in thousand euros. For comparison, a version of this table based on the unmatched sample (before matching) is provided in *Annex 1*. Author's elaboration.

A general overview of the *Table 3* suggests that treated firms exhibit different characteristics compared to their matched counterparts.

In terms of firm size and operating scale, control firms are on average slightly larger, with total assets of approximately €1.19 million compared to €1.03 million for treated firms. The same pattern holds for equity (€566,000 vs €442,000), turnover (€1.10 million vs €742,000), and total expenses(€1.10 million vs €744,000). These figures suggest that, on average, control firms are larger and operate with higher volumes of activity, though the treated group also includes sizable firms with substantial operations.

Looking at financial performance and structure, treated firms display stronger profitability and healthier capitalisation. Despite similar levels of short-term liquidity (average current ratios of 4.53 for treated and 5.56 for control firms), the capital ratio is notably better for treated firms (0.12 vs -0.67), implying that control firms include more undercapitalised or financially distressed entities. Profitability indicators such as ROA (0.05 vs -0.12) and EBITDA margin (0.04 vs -0.13) are marginally higher on average for treated firms, reinforcing the notion that firms with stronger fundamentals may have been more likely to access guaranteed credit.

Differences in credit outstanding are particularly sharp. Treated firms show higher average values across all credit categories. For instance, regular credit averages €186,000 in the treated group, compared to just €46,000 among control firms. The gap is equally significant in secured regular credit (€160,000 vs €24,000), short-residual maturity credit(€56,000 vs €25,000), and non-guaranteed credit (€40,000 vs €25,000). These differences are partially

explained by the construction of the treatment variable, but also reflect broader disparities in pre-treatment financing patterns.

Regarding banking relationships, treated firms tend to have a more diversified financing base. On average, they maintain relationships with more banks (1.68 vs 1.19), have a lower concentration of credit across lenders (HHI of 0.85 vs 0.93), and are less dependent on a single dominant lender (0.92 vs 0.96). This suggests a slightly more diversified financing base, which may have facilitated access to state-backed credit during the pandemic. In contrast, control firms are more likely to rely on a single or dominant banking partner, which may have limited their eligibility or access.

Finally, when it comes to employment, the two groups exhibit similar average firm sizes, with treated firms employing 7.48 workers on average and control firms 7.72.

5. Results and Discussion

5.1. Financial Determinants of Guarantee Allocation: Evidence of Selection Bias

This hypothesis tests whether public guarantees were disproportionately allocated to firms with stronger financial characteristics prior to the COVID-19 pandemic. If guarantee schemes followed conventional lending logic, the selection process would likely favour larger, more profitable, better-capitalised firms with lower credit risk and broader banking relationships.

Table 4. Logit Model: Determinants of Receiving Public Credit Guarantees

	Coef.	**Std. Err.**
Constant	2.0718***	0.0842
Log(Total Assets)	0.0534***	0.0052
ROA	0.1025***	0.0185
Capital Ratio	0.0653***	0.0059
Log(Overdue Credit)	-0.0523***	0.0031
Concentration of bank relationships	-2.1500***	0.0491
Pseudo R-squared	0.0434	
N	106,896	

Notes: The dependent variable is represented by the treatment dummy. Regressors correspond to firm-level characteristics measured in 2019. Continuous variables are expressed in natural logarithms to reduce skewness and facilitate interpretation. Standard errors are clustered at the firm level . ** p<0.1, ** p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

Table 4 presents the estimated parameters of the logistic regression (equation 4.2.1) that evaluates the determinants of Receiving Public Credit Guarantees (testing *H1*). The first key determinant is firm size, a widely used proxy for economic resilience and collateral availability. The estimated coefficient is 0.0534, which is positive and statistically significant, indicating that larger firms were more likely to receive guaranteed loans. Lenders may have viewed larger firms as more resilient or better able to offer collateral, especially in a period of heightened uncertainty. These findings are consistent with Gropp et al. (2010), who document similar size-related selection effects in German credit markets, and with Mateus & Neugebauer (2022) for the Portuguese case.

Secondly, the regressor Return on Assets (ROA) measures how efficiently a firm transforms its assets into net income, a core indicator of operational and financial performance. The coefficient of 0.1025 signals a strongly positive association between profitability and the likelihood of receiving guaranteed credit. This reinforces the idea that banks continued to apply standard risk-return principles, preferring firms that had positive financial performance pre-pandemic. This result echoes the findings of Crawford et al. (2023), that found profitability was a key driver of access to public support across Europe.

The estimated coefficient for capital ratio (measured as total equity over total assets) suggests a positive and statistically significant coefficient relation between solvency and access to guaranteees. This aligns with a precautionary risk-based management by banks, even when loans have a strong state backing. Rather than taking on highly leveraged firms, which might still pose repayment risks despite guarantees, banks appear to have favoured those with healthier balance sheets. These results are consistent with Jiménez et al. (2022) and Altavilla et al. (2023), who find that pre-existing credit standards were not relaxed, but rather reinforced under public guarantee frameworks.

Turning to the results of overdue credit, this regressor represents the volume of unpaid debt obligations, functioning as a proxy for credit history and repayment discipline. The coefficient is negative and statistically significant (-0.0523), indicating that firms with higher levels of overdue credit were substantially less likely to receive guaranteed loans. This reinforces the idea of Altavilla et al. (2021) that past delinquencies remained a strong deterrent for lenders, even under partial risk transfer, as well as the point of Silva (2021), who observes that firms with poor credit records were frequently excluded from Portuguese support schemes.

Finally, the Herfindahl-Hirschman Index (HHI) of bank concentration displays a significant negative coefficient of -2.15, indicating that firms dependent on a single banking partner had a much lower probability of receiving guaranteed credit. In contrast, firms with more diversified financial connections, possibly benefiting from better screening, reputation signals or multiple negotiation channels, were more likely to be treated. This effect reinforces the view presented by Silva (2021), who highlights the importance of institutional connectivity and relational capital in accessing public support.

To validate these findings, robustness tests are presented in *Appendix C*, showing that results remain consistent across empirical model specifications and sub-samples. In particular, the treatment variable was redefined using higher thresholds for guaranteed credit (above the 25th, 50th, and 75th percentiles). Moreover, these confirm that the observed patterns are not due to chance or omitted variable bias.

In conclusion, the allocation of public credit guarantees during the COVID-19 pandemic systematically favoured firms with stronger ex-ante fundamentals and broader financial access rather than financially constrained firms.

5.2. Credit Expansion or Substitution? Evaluating the Additionality of Guarantee Schemes

Table 5 presents the estimated parameters of the Difference-in-Differences empirical model (equation 4.2.2.) on the matched sample of firms, to evaluate whether the allocation of public credit guarantees during the COVID-19 crisis resulted in a net expansion of firm-level credit or merely replaced credit that firms would have otherwise received under normal lending conditions.

Table 5. Credit Response to Public Credit Guarantees: DiD Estimates

	Credit Metrics			
	Regular Credit	**Regular Secured Credit**	**Non-guaranteed Credit**	**Non-Current Liabilities**
Treat × Post	1.3137***	1.7878***	-0.3743	0.4821***
(Treat × Post) × Debt to Assets Ratio	-0.0425***	-0.0547***	-0.0150	-0.0689***
(Treat × Post) × ROA	0.0180	0.0231	0.0379	-0.0683
Log(Total Assets)	0.6194***	0.8214***	0.2834***	0.6477***
Log(Regular Credit: Short Maturity)	-0.0045	-0.0273***	0.0607***	-0.0621***
Log(Number of Bank Relationships)	1.7232***	2.6454***	0.4673	1.2424***
Firm FE	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes
N	517,846	517,846	517,846	517,846
R-squared	0.883	0.323	0.584	0.743

Notes: Columns (1), (2), (3) and (4) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. Author's elaboration.

Column (1) shows a statistically significant ATT of 1.3171 for total regular credit, indicating that treated firms increased their credit levels by approximately 131% more than comparable non-treated firms. This substantial expansion suggests that guarantee schemes in Portugal were effective in sustaining firm-level credit, consistent with the broader rise in lending volumes reported by Banco de Portugal (2021) during the peak of the pandemic. This is in line with Altavilla et al. (2023), that document that in the euro area, around two-thirds of guaranteed credit replaced non-guaranteed loans, particularly among riskier borrowers; and Jiménez et al. (2022) that find that in Spain, banks reinforced existing exposures through guaranteed loans, often reallocating risk rather than expanding total credit.

Focusing specifically on secured credit, Altavilla et al. (2023) show that public guarantees led to a pronounced increase in collateralised lending across European countries. The results corroborate this pattern, with an ATT of 178.78 percentage points for regular secured credit (column (2)), confirming that most of the expansion observed was indeed driven by the guaranteed component. Costa (2021) highlights the role of these secured instruments in improving access to long-term finance for Portuguese SMEs, while Silva (2021) observes a shift in bank-firm relationships toward risk-sharing under the guarantee framework. These observations are in line with the estimation results, which point to a strong reliance on guaranteed credit as the dominant channel of liquidity provision.

However, for the dynamics of non-guaranteed credit seem results are inconclusive: we get an insignificant coefficient in column (3). Jiménez et al. (2022) report a reduction in non-guaranteed lending following the rollout of guarantee programmes, especially for firms with pre-existing banking ties. Similarly, Santis et al. (2021) note that the substitution of credit types was a common response across EU members. Indeed, Banco de Portugal (2023) estimates that only 31% of the guaranteed credit was truly additional, with the remaining 69% likely replacing loans that would have occurred under standard conditions. In any case,

the increase in total credit is largely accounted for by its guaranteed component, while non-guaranteed lending did not increase meaningfully.[5]

The analysis of long-term financing under public guarantees is further reinforced in column (4). Costa (2021) stresses that one of the most distinctive features of the Portuguese guarantee schemes was the extended maturity of the credit lines, offering up to six years and grace periods of 12 to 18 months. The ATT of 48.21 percentage points for *non-current liabilities* suggests that guaranteed credit significantly altered the maturity structure of corporate debt. This is consistent with the evidence from Banco de Portugal (2022), which reports that more than half of the outstanding credit with guarantees in 2022 had maturities exceeding four years. The findings thus highlight that the guarantee schemes not only affected the volume but also the composition and maturity of firm financing.

With regard to differences in the effectiveness of the guarantees across firms are also evident. the interaction terms between *(Treat × Post × Debt-to-Assets Ratio)* are negative and statistically significant in columns (1), (2), and (4), indicating that more leveraged firms benefited less from the guarantees. This agrees with Akcigit et al. (2024), that argue that even with public backing, banks tend to favour financially stronger firms, maintaining conservative lending standards.

We also find a strong correlation between the number of banking relationships and access to guaranteed credit. The estimated parameter of the *log(Number of Bank Relationships)* shows a positive and significant effect across all columns, supporting the view that diversified banking connections facilitated access to state-backed lending during the crisis in line with Silva (2021) results.

Further support for the interpretation of longer-term restructuring comes from the negative and significant coefficient of the control variable *log(Regular Credit: Short Maturity)* in column (4). This decline in short-term credit is consistent with the shift in liability composition documented in Section 4.4.1 and reflects the embedded design of the guarantee lines. Banco de Portugal (2021) explicitly notes that firms benefited from more favourable financing

[5] The decline in non-guaranteed credit observed in Column (3) of *Table 5* may partly reflect the widespread adoption of public and private moratoria, which suspended loan repayments without triggering forbearance classification. Under European Banking Authority Guidelines (2020), such moratoria did not require loans to be reclassified, potentially distorting the measurement of new lending. Therefore, the observed substitution effect should be interpreted with caution, as it may partly capture regulatory and accounting practices rather than a pure crowding-out mechanism

conditions and longer maturities, contributing to liquidity stabilisation during the most acute phases of the pandemic.

In *Appendix* D, we show results for some robustness tests that confirm the findings here, including alternative treatment definitions based on secured credit above the 25th, 50th, and 75th percentiles, as well as the exclusion of outliers (5th and 95th percentiles).

In sum, the results suggest public credit guarantees during the COVID-19 crisis resulted in a net expansion of total credit, particularly through secured and long-term components, but did not seem to lead to a proportionate increase in non-guaranteed lending. The empirical evidence is therefore consistent with a scenario of credit expansion that could reflect partial substitution, in that banks seem to have reallocated risk within existing banking relationships, especially for firms with stronger fundamentals. Although the precise extent of net additionality cannot be precisely quantified.

5.3. Do Public Guarantees Programmes Improve Firm Performance?

Table 6 presents the results the estimation of the Difference-in-Differences (DiD) model (equation 4.2.3), comparing the changes in performance outcomes between treated and control firms before and after the implementation of the public guarantee schemes.

Table 6. Long vs Short Term Firm Performance Indicators: DiD Estimates

	Long-term Variables			**Short-term Variables**		
	Non-current Assets	**Turnover**	**ROA**	**Current Ratio**	**Cash Ratio**	**Trade Payables/ Total Assets**
Treat × Post	0.1267***	0.0503***	0.0327***	-0.2431***	-0.2224***	-0.0175***
EBITDA Margin	0.0093***	0.0048	0.0056	0.0490***	0.0244***	-0.0028***
Log(Total Liabilities)	0.3360***	0.1058***	0.0389***	-0.5205**	-0.2739**	0.0130***
Log(Number of Employees)	0.4182***	0.3443***	-0.0299***	-0.3108***	-0.1534***	-0.0202***
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Status FE	Yes	Yes	Yes	Yes	Yes	Yes
N	517,846	517,846	517,846	517,846	517,846	517,846
R-squared	0.020	0.055	0.001	0.002	0.002	0.000

Notes: Columns (1) and (2) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. The results for the robustness tests follow the same approach as described in Sectioon 5.2. and are presented in *Appendix E*. Author's elaboration.

The results presented in columns (1) to (3) of *Table 6* suggest that, in the Portuguese case, medium-long-term outcomes improved significantly among treated firms. Most of the related literature has associated public guarantees with short-term stabilisation. Silva (2021) finds that Portuguese firms benefiting from public guarantees showed improvements in liquidity and credit access, but no meaningful gains in productivity or profitability. Akcigit et al. (2024) similarly argue that guarantees often help firms survive temporarily without generating sustained performance gains.

Column (1) shows a positive and statistically significant ATT of 12.67 percentage points for non-current assets, indicating an increase in investment capacity relative to the control group. This could reveal that guaranteed loans were used not only for survival but also to support fixed capital formation. Column (2) reveals an ATT of 0.053 for turnover, suggesting a modest but measurable expansion in firm revenues.

These findings resonate with those of Hackney (2023), that reports that government-backed credit contributed to long-term growth in firms' operational capacity and employment levels, particularly when firms had pre-existing access to lending infrastructure. Column (3) further shows a statistically significant ATT of 3.27pp for *ROA*, indicating an improvement in profitability metrics. This contrasts with previous studies such as Jiménez et al. (2022) and Silva (2021), which found little to no effect on profitability, and suggests that, under certain conditions, guarantees may yield longer-term economic benefits beyond short-term liquidity relief.

In contrast, the results for short-term financial indicators suggest a deterioration rather than improvement. Column (4) shows that the *current ratio* declined by 24.31 percentage points, a result that is statistically significant and economically relevant. Column (5) reveals a similarly

ATT of -0.2224 for the cash ratio. These declines suggest that treated firms, while accessing long-term guaranteed financing, simultaneously reduced their short-term liquidity buffers. This pattern diverges from Santis et al. (2021), which expected guarantees to mitigate liquidity risk, and aligns more closely with Banco de Portugal (2023), which notes that a significant portion of guaranteed loans may have lacked true additionality and may have merely delayed financial distress for some firms. In this context, the weakening of short-term indicators may reflect either a strategic liability reallocation or concealed fragilities among treated firms.

Column (6) reinforces this interpretation. The ATT for Trade Payables/Total Assets is -1.75 percentage points, indicating a slight reduction in firms' reliance on supplier credit. This may reflect the substitution of informal financing with formal, guaranteed bank lending. Crawford et al. (2023) also find that public guarantees can lead to the displacement of short-term, relationship-based credit by more structured financial instruments. Together, the results across short-term indicators point to a reorganisation of firms' liability structure, rather than an enhancement of liquidity positions.

These findings challenge the expectations embedded in Hypothesis 3. While the hypothesis anticipated positive effects on short-term financial conditions and no impact on long-term performance, the results suggest the opposite: treated firms showed weaker short-term liquidity metrics but recorded moderate and statistically significant improvements in investment, revenues, and profitability when compared to the control group. This pattern is consistent with the idea that guarantees enabled firms to adopt a more strategic financial structure, prioritising longer-term sustainability over short-term buffers.

Overall, the evidence rejects Hypothesis 3. The effects of public credit guarantees appear to extend beyond short-term liquidity stabilisation, with treated firms recording moderate improvements in medium to long-term performance indicators.

6. Conclusions

This dissertation investigates the impact of the public guarantees on credit allocation and firm performance in response to the COVID-19 crisis. The analysis relies on detailed microdata from Banco de Portugal, constructed by merging firm-level credit register information from HCRC with financial and accounting data from the CBHP. The empirical approach combined Coarsened Exact Matching, Logit estimation, and Difference-in-Differences analysis.

We test whether guarantees were selectively allocated to firms with better fundamentals; whether public guarantees led to an expansion or substitution of total credit;and the effects on short-term and medium-long-term firm performance.

We find strong evidence that the allocation of guarantees favoured firms with stronger financial profiles prior to the intervention. Similar to the findings of Costa (2021) Mateus & Neugebauer (2022), firms with stronger balance sheets and recent financial performance, lower credit risk, and broader banking relationships were significantly more likely to obtain guaranteed credit. This reflects, on the one hand, the conservative lending behaviour of banks, even in times of crisis, as highlighted by Altavilla et al. (2023) and others, and on the other, the conditionalities embedded in the design of the guarantee schemes. Overall, results suggest that guarantee schemes, while publicly backed, were still conditioned by the pre-existing architecture of the credit market.

The analysis of credit volumes reveals that guaranteed loans contributed to a substantial increase in total credit. However, non-guaranteed lending did not exhibit a statistically significant increase, consistent with the possibility of partial substitution rather than full credit additionality. Indeed, this behaviour reflects the simultaneous effect of public moratoria and the design of the guarantee programmes. This pattern is in line with the concerns raised by the Banco de Portugal (2023) and others , that public guarantees were primarily intended to preserve credit flows by reallocating risk, rather than to stimulate entirely new lending. The Portuguese case examined here illustrates this objective clearly: the schemes were conceived as emergency tools to mitigate systemic disruption and preserving financial stability during the crisis.

As for our third research question, we find moderate gains in medium and long-term financial perfomance coupled with limited improvements in short-term liquidity indicators. Treated

firms increased investment, turnover and profitability, potentially using guaranteed credit to support strategic adjustments. Prior studies, such as Silva (2021) and Jiménez et al. (2022 had found that guarantees mostly alleviate short-term constraints but measured the effects after a shorter span period.

Robustness tests confirm the consistency of the findings. Yet our analysis has certain limitations that must be acknowledged. First, the large scale of the dataset improves external validity and allows for comprehensive observation, but may also reduce the precision of some estimates, particularly where firm behaviour is highly heterogeneous. Second, the lack of bank-level and credit exposure data prevents a more detailed understanding of institutional strategies and lender-specific allocation patterns. Lastly, the results regarding firm performance should be interpreted with caution, as the relatively low *R-squared* values indicate that a significant share of the variation in performance remains unexplained.

For future research, it may be relevant to extend the analysis along several dimensions. Exploring long-term outcomes such as firm survival, innovation, or productivity would help clarify whether guarantees supported sustained recovery. Comparative studies across countries with different institutional frameworks and different guarantee design schemes could also enrich the understanding of programme effectiveness.

Overall, this dissertation contributes to the empirical literature on public credit guarantees by providing detailed evidence from a context of exceptional economic stress. The findings help to understand how these programmes operated in Portugal, showing both their potential to reallocate credit and their limitations in reaching the most financially vulnerable firms. Although the impact varied across different dimensions, the results show that public guarantees had a real effect on credit volumes and a positive impact on the financial paths of the supported firms.

7. Appendices

7.1. Appendix A – CEM Matching Procedure

Coarsened Exact Matching (CEM) is a non-parametric pre-processing method that aims to reduce selection bias in observational data by improving the balance between treated and control groups across observable characteristics. It does so by temporarily coarsening covariates into intervals (bins) and retaining only those observations that can be exactly matched across treatment status within the same stratum. This approach limits model dependence and avoids extrapolation beyond regions of common support, making it particularly suitable for policy evaluations in high-dimensional firm-level data. (Iacus et al., 2012).

We implement CEM using data from the year 2019, which serves as the pre-treatment baseline prior to the introduction of the public guarantee programmes in 2020.

The matching procedure is based on a set of continuous and categorical variables that reflect key financial dimensions: firm size, equity position, liquidity, credit risk, and the structure of bank relationships. These include the logarithm of total assets, the logarithm of overdue credit, ROA, Capital Ratio, as well as the Herfindahl-Hirschman Index to capture bank concentration. Moreover, sector classification (CAE Rev.3) and legal form are matched exactly as categorical variables.

Continuous variables are coarsened into four bins based on empirical quartiles from the treated group (q=4), ensuring a distributionally fair comparison. The matching retains only those strata that include at least one treated and one control firm. Observations from unmatched strata are excluded from the analysis.

The quality of the match is evaluated using Standardised Mean Differences (SMD), which measure the magnitude of the difference in means between treated and control firms for each covariate, scaled by the pooled standard deviation. *Table A1* below presents the SMD absolute values before and after matching of the main variables of the sample. A successful matching procedure is expected to substantially reduce SMD, indicating improved covariate balance.

Table A1. Standard Mean Differences (SMD): Before vs After Matching

	|SMD|	
	Pre-Matching	**Post-Matching**
Regular Credit	0.3065	0.0790
Secured Regular Credit	0.5320	0.1100
Total Assets	0.0052	0.0120
Liabilities	0.0078	0.0060
Current Ratio	0.1659	0.1270
ROA	0.1511	0.1020
Mean	0.1696	0.073

Notes: Author's Elaboration

As shown in *Table A1*, the CEM procedure significantly improves balance across all matching variables. The mean |SMD| drops substantially from 0.1696 to 0.073. This indicates that the treated and control groups are substantially more comparable along observable characteristics after matching, reducing the risk of biased estimation in subsequent causal analysis.

To complement the balance diagnostics, *Table A2* presents the number of firms coverage before and after matching, and the sample size.

Table A2. CEM Summary

	Pre-Matching	**Post-Matching**
Treated Firms	185,340 (67.4%)	71,868 (67.2%)
Control Firms	89,711 (32.6%)	35,028 (32.8%)
Total Firms	275,051	106,896
N	1,326,602	624,742

Notes: *N* corresponds to the number of observations. Author's elaboration

7.2. Appendix B – List of Variables (Definitions, Sources, and Construction)

Table A3. List and Description of Variables

Variables Code	Variables Name	Description
CBHP – Balance Sheet		
B001	Total Assets	Total assets held by the firm at year-end
B004	Non-current Assets	Fixed tangible assets and intangible assets; Financial investment; Remaining non-current assets
B049	Cash and Bank Deposits	Current Assets – Cash and bank deposits
B061	Equity	Paid-up capital; Other equity instruments; Reserves and retained earnings; Other items of equity; Net Income; Interim dividends
B080	Total Liabilities	Total Liabilities (Current and Non-current liabilities)
B081	Non-current Liabilities	Obtained funding; Post-employment benefits; Remaining non-current liabilities
B085	Non-current Liabilities – Obtained Funding	Long-term debt and loans obtained
B089	Current Liabilities	Total current liabilities
B094	Current Liabilities – States and other entities	Debt owed to the state and public entities
B096	Current Liabilities – Obtained Funding	Short-term debt and loans obtained
CBHP – Income Statement		
D001	Turnover	Operating revenues generated by the firm
D062	Total Expenses	Total operating and financial expenses
D084	EBITDA	Earnings before interest, taxes, depreciation, and amortization

CBHP – Employment

E001	Number of Employees	Number of paid and unpaid employees

CBHP – Financial Indicators

R001	Current Ratio	Current Assets over Current Liabilities
R003	Capital Ratio	Equity over Total Assets
R036	ROA	Return on Assets (Net Income/Total Assets)
R040	EBITDA Margin	EBITDA over Turnover
R157	Trade Payables/Total Assets	Account Payables over Total Assets
debt_to_assets	Debt to Assets Ratio	Total Liabilities over Total Assets
cash_ratio	Cash Ratio	Cash and bank deposits over Current Liabilities

HCRC – Credit Metrics

valor_reg	Regular Credit	Total amount of credit in good standing
valor_reg_secured	Secured Regular Credit	Total amount of credit with at least one type of collateral
valor_reg_str	Regular Credit: Short Maturity	Total amount of credit with a residual maturity of equal or less than one year
valor_vencido	Overdue Credit	Amount of credit that is past due
non_guaranteed_credit	Non-guaranteed Credit	Credit without any formal guarantees (Regular Credit – Secured Regular Credit)

HCRC – Bank Relationships

nb_relacao	Number of bank relationships	Number of distinct financial institutions per firm
max_relacao	Large bank relationship in share	Maximum share of credit held by a single institution
hhi_relacao	Concentration of bank relationships	Herfindahl–Hirschman Index of credit concentration

CBHP/HCRC – Identifiers

tina	Firm Identifier	Unique firm identifier

sitempresa	Firm Status	Firm situation at the end of the fiscal period
cae3	Firm Main Sector Activity	Portuguese classification of Economic activities (CAE3 Rev. 3)
natjur	Legal Form	Legal nature of the company

Notes: Author's Elaboration.

Construction of Variables

Alongside the raw indicators directly drawn from CBHP and HCRC, three variables are constructed to capture firms' credit composition, leverage, and liquidity.

Non-guaranteed credit: defined as the difference between total credit and regular secured credit, measuring the portion of bank financing not backed by public guarantees:

$$\text{Non-guaranteed Credit} = \text{Regular Credit} - \text{Secured Regular Credit}$$

Debt-to-Assets Ratio: a standard measure of financial leverage, capturing the proportion of total debt in relation to the firm's asset base:

$$\text{Debt-to-Assets Ratio} = \frac{\text{Total Liabilities}}{\text{Total Assets}}$$

Cash Ratio: a liquidity indicator that assesses the ability to meet short-term obligations using the most liquid resources:

$$\text{Cash Ratio} = \frac{\text{Cash and Bank Deposits}}{\text{Current Liabilites}}$$

7.3. Appendix C – Robustness Tests (*H1*)

Table A4. Robustness Tests for Hypothesis 1

	Q25		Q50		Q75	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
Constant	3.2468***	0.0951	0.2802***	0.0804	-6.7983***	0.0914
Log(Total Assets)	0.0572***	0.0049	0.2334***	0.0049	0.6777***	0.0069
ROA	0.0394***	0.0088	0.0299***	0.0095	-0.0043	0.0124
Capital Ratio	0.0211***	0.0032	0.0081**	0.0032	-0.0437***	0.0034
Log(Overdue Credit)	0.0319***	0.0033	0.0314***	0.0031	0.0659***	0.0035
Concentration of bank relationships	-3.6899***	0.0684	-3.4169***	0.0507	-3.0908***	0.0389
Pseudo R-squared	0.0744		0.0744		0.2462	
N	107,542		109,004		110,532	

Notes: The dependent variable is represented by the treatment dummy. Regressors correspond to firm-level characteristics measured in 2019. Continuous variables are expressed in natural logarithms to reduce skewness and facilitate interpretation. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. Author's elaboration.

To assess the robustness of the results obtained for Hypothesis 1, a sensitivity analysis was performed by redefining the treatment variable across different quantiles of the distribution. In the baseline specification, treatment was defined as a binary indicator equal to 1 if the firm received guaranteed credit between 2020 and 2023, regardless of the amount. In this robustness test, the dummy variable was redefined to equal 1 only if the amount of guaranteed credit received was above the 25th (column Q25), 50th (column Q50), and 75th (column Q75) percentiles, respectively. This approach tests whether the main findings hold when considering firms that received larger-than-average volumes of support, thus focusing on more intensely treated firms. This methodology helps to verify whether results are sensitive to the specification of key variables.

As shown in *Table A4*, the results remain largely consistent with the baseline estimates. Across all three quantiles, firm-level characteristics such as size (log of total assets), profitability (ROA), and the presence of overdue credit continue to be positively and significantly associated with the probability of receiving guaranteed credit. The capital ratio is also significant and positive for lower quantiles (Q25 and Q50), but turns negative at Q75, suggesting that more highly capitalised firms may have been relatively less likely to receive very large guarantee volumes. Most notably, the coefficient on the concentration of bank

relationships remains negative and highly significant across all specifications, reinforcing the baseline conclusion that firms with less concentrated banking networks were more likely to access public guarantees.

Overall, this robustness test confirms that the original findings are not driven by how the treatment was defined. Whether using a binary indicator or focusing on firms receiving higher volumes of guaranteed credit, the allocation of public guarantees appears to have systematically favoured firms with stronger financial profiles and more diversified banking connections.

7.4. Appendix D – Robustness Tests (*H2*)

In this section, several robustness tests are conducted to assess the sensitivity of the empirical results obtained for Hypothesis 2. The objective is to confirm whether the findings related to credit expansion versus substitution remain valid under alternative treatment definitions or sample restrictions. In particular, the treatment dummy is redefined, as in *Appendix C*, using percentile thresholds of guaranteed credit volume (Q25, Q50, and Q75), and a separate test applies winsorization techniques to mitigate the influence of extreme values in the outcome variables.

Table A5. Robustness Tests for Hypothesis 2 (Q25)

	Credit Metrics			**Non-Current Liabilities**
	Regular Credit	**Regular Secured Credit**	**Non-guaranteed Credit**	
Treat × Post	2.7555***	4.5491***	-0.3293	1.0583***
(Treat × Post) × Debt to Assets Ratio	-0.0490***	-0.0762***	-0.0121	-0.0770***
(Treat × Post) × ROA	0.0090	0.0416	0.0198	-0.0173
Log(Total Assets)	0.5856***	0.7440***	0.3011***	0.6465***
Log(Regular Credit: Short Maturity)	-0.0071	-0.0413***	0.0678***	-0.0643***
Log(Number of Bank Relationships)	1.2409***	1.8176***	0.5320	1.0967***

Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	445,678	445,678	445,678	445,678
R-squared	0.900	0.458	0.604	0.748

Notes: (1) Log(Regular Credit); (2) Log(Regular Secured Credit); (3) Log(Non-guaranteed Credit). The variables that are expressed in natural logarithms has the purpose to reduce skewness and facilitate interpretation. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. Author's elaboration.

Table A5 presents the first robustness test, where the treatment variable is redefined to include only firms whose guaranteed credit volume exceeds the 25th percentile (Q25) onwards 2020. This approach isolates the effect of guarantees among firms receiving more substantial support, thereby allowing for a cleaner identification of the impact of larger interventions.

The results remain broadly consistent with the main analysis. The coefficient on *Treat* × *Post* in columns (1) and (2), corresponding to total regular credit and secured credit, respectively, remains positive and statistically significant, and even increases in magnitude. In contrast, non-guaranteed credit in column (3) shows no significant variation, supporting the interpretation of partial substitution. Column (4) shows a significant increase in non-current liabilities, suggesting a shift in the financial structure of treated firms towards longer-term commitments.

Table A6 presents the second robustness test for Hypothesis 2, where the treatment group is redefined to include only firms with guaranteed credit volumes above the median (quantile 50%).

Table A6. Robustness Tests for Hypothesis 2 (Q50)

	Credit Metrics			
	Regular Credit	**Regular Secured Credit**	**Non-guaranteed Credit**	**Non-Current Liabilities**
Treat × Post	2.3409***	3.5157***	-0.1023	1.5598***
(Treat × Post) × Debt to Assets Ratio	-0.0704***	-0.1159***	-0.0068	-0.1197***

(Treat × Post) × ROA	0.0411	0.0918	0.0410	0.0313
Log(Total Assets)	0.5009***	0.6297***	0.2995***	0.5711***
Log(Regular Credit: Short Maturity)	0.0112	-0.0115*	0.0657***	-0.0570***
Log(Number of Bank Relationships)	1.2434***	1.9387***	0.4723	0.8873***
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	461,424	461,424	461,424	461,424
R-squared	0.901	0.643	0.599	0.762

Notes: Columns (1), (2), (3) and (4) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . **p<0.1, **p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

The findings remain consistent with those of the baseline and the Q25 specification. The coefficients on *Treat* × *Post* in columns (1) and (2) are still strongly significant and slightly lower than those observed for Q25, but continue to confirm a clear expansionary effect on regular and secured credit. Column (3) again shows no significant effect on non-guaranteed credit, providing further evidence of partial substitution. The coefficient in column (4), related to non-current liabilities, is the highest observed so far, suggesting that guarantees may have contributed to a more pronounced restructuring of debt maturity profiles among firms above the median treatment level.

These results indicate that the expansion of secured credit persists across different levels of treatment intensity, while the substitution pattern remains unchanged.

Table A7. Robustness Tests for Hypothesis 2 (Q75)

	Credit Metrics			
	Regular Credit	**Regular Secured Credit**	**Non-guaranteed Credit**	**Non-Current Liabilities**
Treat × Post	1.6619***	2.2598***	-0.0079	1.3804***
(Treat × Post) × Debt to Assets Raio	-0.1106***	-0.1850***	-0.0425**	-0.2162***

(Treat × Post) × ROA	0.1690*	0.3579**	0.1062	0.2350
Log(Total Assets)	0.5239***	0.6848***	0.2939***	0.5654***
Log(Regular Credit: Short Maturity)	0.0086	-0.0154***	0.0658***	-0.0586***
Log(Number of Bank Relationships)	1.5711***	2.4947***	0.4445	1.0376***
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	470,228	470,228	478,228	470,228
R-squared	0.893	0.572	0.597	0.758

Notes: Columns (1), (2), (3) and (4) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. Author's elaboration.

Table A7 reports the robustness test for Hypothesis 2 using the 75th percentile (Q75) as the threshold for treatment. This specification focuses on the subset of firms that received the highest levels of guaranteed credit, allowing for the identification of effects among the most intensely supported firms.

As expected, the results confirm the expansionary effect of guarantees on regular and secured credit (columns 1 and 2), although the magnitudes of the coefficients are slightly lower than in the Q50 specification. However, a notable difference appears in column (3), where the coefficient for non-guaranteed credit becomes significantly negative for the first time. This suggests a clearer signal of credit substitution at higher treatment intensities, possibly indicating that larger guaranteed loans were more likely to displace other lending instruments.

The coefficient on non-current liabilities (column 4) remains positive and significant, in line with previous results, reinforcing the idea that firms leveraged guarantees to restructure their financial obligations. These findings point to an increasingly visible substitution effect as guaranteed amounts increase, while the overall expansion in secured credit remains robust.

Finally, *Table A8* presents the last robustness test for Hypothesis 2, which relies on a winsorized sample excluding extreme outliers, specifically observations outside the 5th and 95th percentiles of key financial variables. This approach aims to improve the reliability of

the estimates by mitigating the influence of extreme values that may distort the regression coefficients

Table A8. Robustness Tests for Hypothesis 2 (Winsorization of Extreme Outliers)

	Credit Metrics			**Non-Current Liabilities**
	Regular Credit	**Regular Secured Credit**	**Non-guaranteed Credit**	
Treat × Post	1.2295***	1.6795***	-0.3827	0.4346***
(Treat × Post) × Debt to Assets Ratio	-0.0421***	-0.0544***	-0.0144*	-0.0642***
(Treat × Post) × ROA	0.0114	0.0133	0.0339	-0.0738
Log(Total Assets)	0.6497***	0.8579***	0.2946***	0.6749***
Log(Regular Credit: Short Maturity)	0.0012	-0.0255***	0.0683***	-0.0610***
Log(Number of Bank Relationships)	1.7953***	2.7954***	0.5065	1.3116***
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	465,736	465,736	465,736	465,736
R-squared	0.874	0.237	0.602	0.736

Notes: Columns (1), (2), (3) and (4) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . *$p<0.1$, **$p < 0.05$, ***$p < 0.01$. *N* corresponds to the number of observations. Author's elaboration.

The results in this model are remarkably similar to the baseline specifications. The coefficients for *Treat* × *Post* in columns (1) and (2) are still statistically significant and positive, confirming the expansionary effect of guaranteed loans on regular and secured credit. Column (3), corresponding to non-guaranteed credit, continues to show a negative but insignificant effect, reinforcing the previous interpretation of partial substitution. The coefficient in column (4), linked to non-current liabilities, is still positive and significant, albeit slightly lower in magnitude compared to Q75, suggesting that the effect persists even after excluding the most extreme firms.

In sum, the robustness tests for Hypothesis 2 provide solid confirmation of the baseline results. Across different sample definitions, the core interpretation remains intact: public guarantees led to a significant expansion in secured credit, while non-guaranteed credit often stagnated or declined, indicating partial substitution. While the magnitude of coefficients fluctuates slightly, particularly among firms in higher quantiles, the direction and statistical significance remain consistent. Notably, the winsorized model excluding extreme outliers produced results most closely aligned with the baseline, reinforcing the credibility and internal consistency of the empirical strategy.

7.5. Appendix E – Robustness Tests (*H3*)

This section explores the robustness of the results obtained for Hypothesis 3, which assessed the effect of public credit guarantees on both short-term and long-term firm performance indicators. The same methodology adopted for robustness in Hypothesis 2 is applied here.

The first robustness test is based on a recalibrated treatment dummy that equals 1 only for firms that registered guaranteed credit above the 25th percentile of the distribution between 2020 and 2023.

Table A9. Robustness Tests – 25th percentile (*H3*)

	Long-term Variables			**Short-term Variables**		
	Non-current Assets	**Turnover**	**ROA**	**Current Ratio**	**Cash Ratio**	**Trade Payables/ Total Assets**
Treat × Post	0.2300***	0.0441***	0.0188**	-0.2605**	-0.2088***	-0.0144***
EBITDA Margin	0.0112***	0.0062	0.0087*	0.0602***	0.0252***	-0.0031***
Log(Total Liabilities)	0.3386***	0.1106***	0.0308***	-0.6078**	-0.3079***	0.0133***
Log(Number of Employees)	0.4107***	0.3604***	-0.0326**	-0.3651***	-0.1783***	-0.0199***
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes

Legal Status FE	Yes	Yes	Yes	Yes	Yes	Yes
N	445,678	445,678	445,678	445,678	445,678	445,678
R-squared	0.022	0.062	0.001	0.002	0.002	0.000

Notes: Columns (1) and (2) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . ** p<0.1, ** p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

Table A9 shows that, from a long-term perspective, the coefficients for Non-current Assets (0.2300), Turnover (0.0441), and ROA (0.0188) all remain positive and statistically significant, albeit slightly larger than in the baseline. This suggests that the positive performance effects of credit guarantees are particularly pronounced for firms above the lower end of the treatment distribution.

For short-term indicators, the results continue to indicate a deterioration in liquidity. The coefficients for Current Ratio (−0.2605), Cash Ratio (−0.2088), and Trade Payables / Total Assets (−0.0144) are all negative and significant, confirming the downward pressure on short-term buffers found in the main specification.

Table A10. Robustness Tests – 50th percentile (*H3*)

	Long-term Variables			**Short-term Variables**		
	Non-current Assets	**Turnover**	**ROA**	**Current Ratio**	**Cash Ratio**	**Trade Payables/ Total Assets**
Treat × Post	0.4781***	0.0422***	0.0184**	-0.1431*	-0.1358**	-0.0250***
EBITDA Margin	0.0108***	0.0062	0.0087*	0.0602***	0.0252***	-0.0031***
Log(Total Liabilities)	0.3124***	0.1096***	0.0303***	-0.6107**	-0.3084***	0.0145***
Log(Number of Employees)	0.3943***	0.3600***	-0.0329**	-0.3682***	-0.1797***	-0.0192***
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Status FE	Yes	Yes	Yes	Yes	Yes	Yes
N	461,424	461,424	461,424	461,424	461,424	461,424

R-squared	0.029	0.062	0.001	0.003	0.003	0.001

Notes: Columns (1) and (2) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . ** p<0.1, ** p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

Redefining the treatment dummy to capture firms with guaranteed credit volumes above the median, confirms and slightly reinforces the patterns observed in both the main specification and the lower quantile (Q25) analysis. On the long-term side, the coefficients for Non-current Assets (0.4781), Turnover (0.0422), and ROA (0.0184) remain positive and statistically significant. The magnitude of the coefficient on Non-current Assets is notably higher than in the Q25 model, suggesting that firms with more substantial guaranteed credit may have been better positioned to sustain long-term investments and performance recovery.

For short-term variables, the results continue to point toward weaker liquidity positions post-treatment. Current Ratio (−0.1431), Cash Ratio (−0.1358), and Trade Payables / Total Assets (−0.0250) are all significantly negative. However, the absolute magnitude of these effects is slightly lower than in Q25, possibly indicating a modest attenuation of short-term pressure for firms that received larger credit volumes.

Table A11 reports the robustness tests for Hypothesis 3 using the 75th percentile (Q75) as the threshold for treatment.

Table A11. Robustness Tests – 75th percentile (*H3*)

	Long-term Variables			**Short-term Variables**		
	Non-current Assets	**Turnover**	**ROA**	**Current Ratio**	**Cash Ratio**	**Trade Payables/ Total Assets**
Treat × Post	0.4315***	0.0434***	0.0129	0.0382	-0.0442	-0.0274***
EBITDA Margin	0.0110***	0.0062	0.0087*	0.0600***	0.0251***	-0.0031***
Log(Total Liabilities)	0.3167***	0.1096***	0.0308***	-0.6255**	-0.3160***	0.0147***
Log(Number of Employees)	0.3901***	0.3592***	-0.0328**	-0.3787***	-0.1840***	-0.0186***
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Status FE	Yes	Yes	Yes	Yes	Yes	Yes
N	470,228	470,228	470,228	470,228	470,228	470,228
R-squared	0.027	0.062	0.001	0.003	0.003	0.001

Notes: Columns (1) and (2) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . ** p<0.1, ** p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

The long-term effects largely remain stable across specifications, with Non-current Assets (0.4315) and Turnover (0.0434) continuing to display positive and statistically significant effects. The coefficient for ROA, however, loses significance, suggesting that profitability responses might not be as robust for the most intensively treated firms.

Meanwhile, the deterioration in short-term liquidity persists: both the Cash Ratio (−0.0442) and Trade Payables / Total Assets (−0.0274) remain negative and significant, reinforcing previous findings. The Current Ratio, while now positive, is not significant.

To further ensure that the results are not driven by outliers, *Table A12* presents the robustness tests after winsorizing the main variables at the 5th and 95th percentiles. This approach limits the influence of extreme values while preserving the overall structure of the dataset, making it a commonly used method in empirical finance and accounting research.

Table A12. Robustness Tests – Winsorization of Extreme Outliers (*H3*)

	Long-term Variables			**Short-term Variables**		
	Non-current Assets	**Turnover**	**ROA**	**Current Ratio**	**Cash Ratio**	**Trade Payables/ Total Assets**
Treat × Post	0.1267***	0.0503***	0.0327***	-0.2431***	-0.2224***	-0.0175***
EBITDA Margin	0.0093***	0.0048	0.0056	0.0490***	0.0244***	-0.0028***
Log(Total Liabilities)	0.3360***	0.1058***	0.0389***	-0.5205**	-0.2739**	0.0130***
Log(Number of Employees)	0.4182***	0.3443***	-0.0299***	-0.3108***	-0.1534***	-0.0202***
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Legal Status FE	Yes	Yes	Yes	Yes	Yes	Yes
N	465,736	465,736	465,736	465,736	465,736	465,736
R-squared	0.020	0.055	0.001	0.002	0.002	0.000

Notes: Columns (1) and (2) are measured in natural logarithms to reduce skewness. Standard errors are clustered at the firm level . ** p<0.1, ** p < 0.05, *** p < 0.01*. *N* corresponds to the number of observations. Author's elaboration.

The long-term performance indicators remain largely in line with the baseline, particularly for Non-current Assets (0.1267), Turnover (0.0503), and ROA (0.0327), all of which remain positive and significant. These results confirm that the effect of public guarantees on long-run firm outcomes is not overly dependent on extreme observations. For the short-term variables, the pattern of liquidity deterioration persists. The coefficients for the Current Ratio (−0.2431), Cash Ratio (−0.2224), and Trade Payables / Total Assets (−0.0175) all remain negative and statistically significant, mirroring the baseline direction and magnitude.

In sum, the robustness test for Hypothesis 3 consistently confirm the main findings. Across all specifications, the results remain stable in both sign and significance. The positive impact of guarantees on long-term firm performance persists, particularly for investment-related indicators, while the negative effects on short-term liquidity measures also prove robust. The overall consistency of the results reinforces the credibility of the baseline DiD estimation and strengthens the validity of the empirical conclusions drawn from *H3*.

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8.1. Datasets References

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9. Annexes

9.1. Annex 1 – Summary Statistics of Full Sample Before Matching

Table A13. Descriptive Statistics Between Treat and Control Groups (Before Matching)

	Treatment Group			Control Group		
	Median	**Mean**	**Std. Dev.**	**Median**	**Mean**	**Std. Dev.**
Balance Sheet						
Total Assets	232	2,399	76,505	108	2,098	27,781
Non-current Assets	51	1,359	62,828	10	1,064	22,239
Equity	74	880	29,715	31	888	13,689
Liabilities	139	1,519	51,615	64	1,210	20,768
Non-current Liabilities	39	721	31,676	2	488	15,682
Current Liabilities	69	798	21,019	39	722	9,727
Income Statement						
Turnover	250	1,854	34,092	113	1,934	30,629
Total Expenses	253	1,896	36,674	116	1,931	30,249
EBITDA	20	189	5,912	7	211	4,564
Financial Indicators						
Current Ratio	1.86	3.95	7.61	1.97	5.49	10.66
Capital Ratio	0.34	0.22	1.34	0.38	−0.59	4.84
Debt to Assets Ratio	0.66	0.80	2.32	0.62	1.91	12.04
Cash Ratio	0.29	1.25	3.95	0.44	2.41	6.58
ROA	0.09	0.07	0.64	0.06	−0.22	2.70
EBITDA Margin	0.08	0.08	1.60	0.05	−0.11	2.82
Trade Payables/Total Assets	0.09	0.16	0.39	0.06	0.23	1.04
Credit Outstanding						
Regular Credit	42	417	4,435	0.73	66	2,185
Secured Regular Credit	39	340	3,166	0.00	27	854
Regular Credit: Short Residual Maturity	5	139	1,356	0.47	30	1,185
Overdue Credit	0.00	10	676	0.00	8	354
Non-guaranteed Credit	0.50	106	1,975	0.21	41	1,795
Bank Relationships						
Number of bank relationships	2.00	2.34	1.74	1.00	1.21	0.66
Large bank relationship in share	0.96	0.83	0.21	1.00	0.96	0.15
Concentration of bank relationships	0.76	0.73	0.27	1.00	0.93	0.19
Employment						
Number of employees	4.00	14.06	135.58	2.00	10.65	105.39
Number of Firms		141,117			40,793	

Notes: This table reports pre-treatment values (reference year: 2019) for both treated and control groups. All monetary values (Balance Sheet, Income Statement and Credit Outstanding) are represented in thousand euros. Author's elaboration.

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