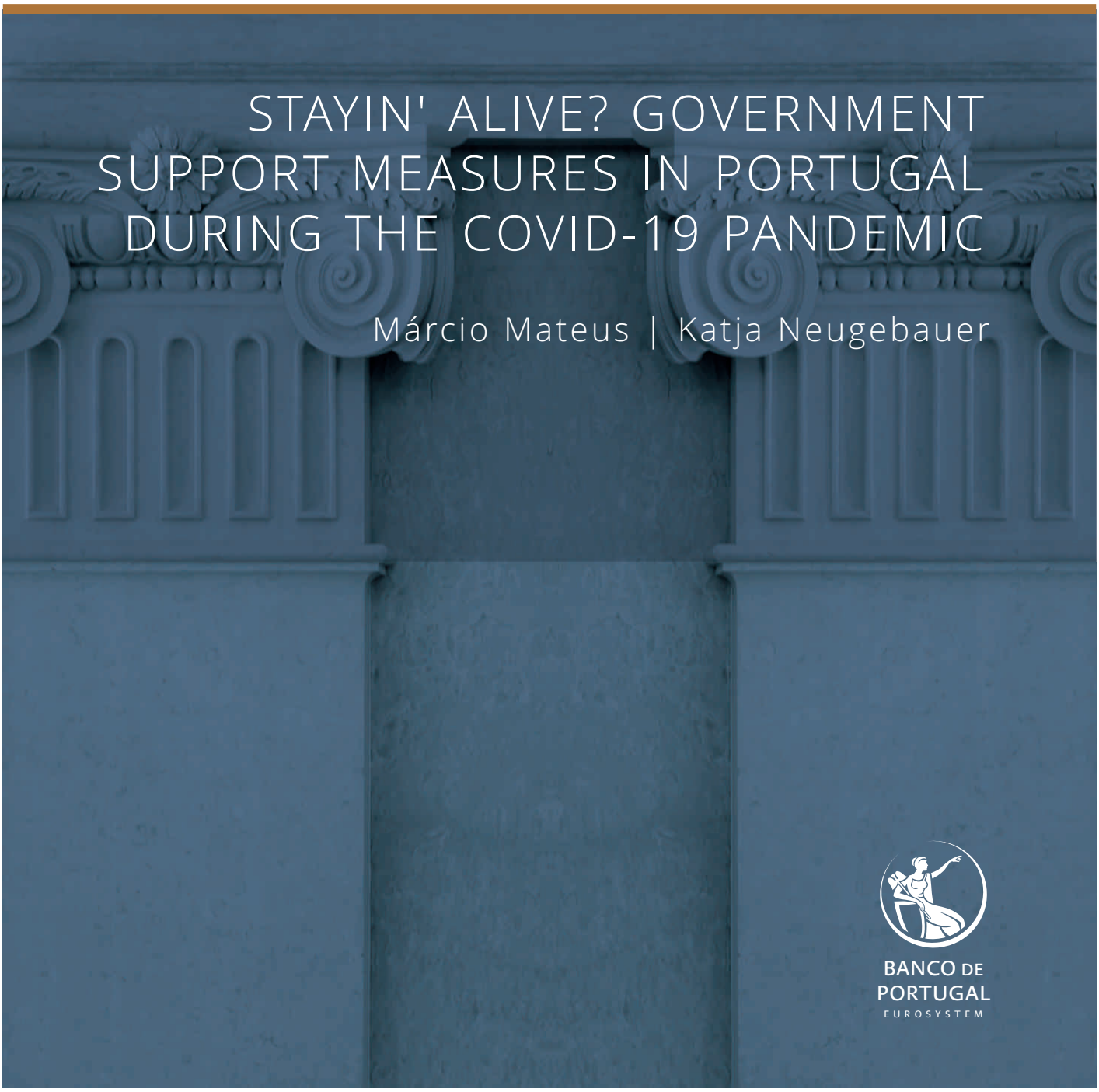
12

WORKING PAPERS 2022

STAYIN' ALIVE? GOVERNMENT SUPPORT MEASURES IN PORTUGAL DURING THE COVID-19 PANDEMIC

Márcio Mateus | Katja Neugebauer



BANCO DE PORTUGAL
EUROSYSTEM

12

WORKING PAPERS 2022

STAYIN' ALIVE? GOVERNMENT SUPPORT MEASURES IN PORTUGAL DURING THE COVID-19 PANDEMIC

Márcio Mateus | Katja Neugebauer

JULY 2022
The analyses, opinions and findings of these papers represent the views of the authors, they are not necessarily those of the Banco de Portugal or the Eurosystem.

Please address correspondence to
Banco de Portugal
Rua do Comércio 148, 1100-150 Lisboa, Portugal
Tel.: +351 213 130 000, email: info@bportugal.pt

BANCO DE PORTUGAL
EUROSYSTEM

Lisboa, 2022 • www.bportugal.pt

Working Papers | Lisboa 2022 • **Banco de Portugal** Rua do Comércio 148 | 1100-150 Lisboa • www.bportugal.pt •
Edition Banco de Portugal • **ISBN (online)** 978-989-678-837-7 • **ISSN (online)** 2182-0422

Stayin' alive? Government support measures in Portugal during the Covid-19 pandemic

Márcio Mateus
Banco de Portugal

Katja Neugebauer
Banco de Portugal

10 August 2022

Abstract
During the Covid-19 crisis, the Portuguese government has provided a plethora of different support measures for firms. These included state-guaranteed loans and a public moratorium for existing loans. This paper examines the access to and uptake of these measures. What were the characteristics of firms being granted state-guaranteed loans? Were they different for firms accessing the moratorium? Did state-guaranteed loans potentially lead to an increase in zombie lending? We try to answer these questions using highly granular bank-, firm- and loan-level data for Portugal. We find that guaranteed loans went mostly to firms operating in the sectors most severely hit by the pandemic and to firms that previously had a credit relation and/or benefitted from a state guarantee. Furthermore, the Portuguese public guarantee scheme seems to mainly have supported lower-credit-risk firms. In addition to that, riskier firms also paid higher interest rates and obtained smaller guaranteed loans than more viable firms. However, in contrast to our results for the state guarantees, we find that riskier firms were more likely to benefit from the public moratorium.

JEL: G30, G38, G21

Keywords: zombie lending, zombie firms, credit misallocation, evergreening, state aid.

Acknowledgements: We thank Ana Cristina Leal, Inês Drumond, Carlos Santos and Tiago Pinheiro for helpful comments and suggestions. We are grateful to Luca Mingarelli, Jonas Wendelborn, Maciej Grodzicki, and Martina Spaggiari for sharing their expertise with us. The views expressed in this article are those of the authors and do not necessarily reflect the views of Banco de Portugal or the Eurosystem. Any errors and mistakes are ours.

E-mail: mfmateus@bportugal.pt; kneugebauer@bportugal.pt

1. Introduction

In 2020, the world was hit by the Covid-19 pandemic. Unlike previous crises, this one hit countries completely unexpectedly and to a rarely seen extent, leading to the adoption of large-scale state-support measures to keep economies afloat. Governments around the globe implemented emergency actions, ranging from social-distancing measures, testing and quarantining policies, to income and liquidity-support measures, to help households and firms. Against this background, many countries relied on the financial system to provide government-backed liquidity to support firms in dealing with the effects of lockdowns, which had led to an abrupt and, in many cases, sustained drying up of income. In the case of Portugal and most other European countries, these liquidity-support measures involved state guarantees for new loans and a debt moratorium for existing ones.

These measures have been essential to support firms in the most acute phase of the crisis, providing liquidity at reduced costs in a context of an abrupt increase in the level of risk. However, the medium- to long-term impact of the measures still remains an open question. Therefore, it is important to evaluate what types of firms have benefitted from these support measures. Did loans with state guarantees only go to firms that were viable before the onset of the pandemic, or did they also lead to an increase in the credit granted to unproductive and high-risk firms? Were there any significant differences between the risk profiles of firms accessing the moratorium and those accessing the public guarantees, since access to the latter was much stricter? We try to answer these questions in this paper using detailed loan-level data from Banco de Portugal's Central Credit Register, matched with both firm and bank balance-sheet data, which allows us to separate credit-supply from credit-demand effects.

Over the last years, public credit-guarantee schemes have gained popularity worldwide as a tool to increase the availability of loans to financially constrained firms, typically SMEs or start-ups. Most of the literature on public credit-guarantee schemes focuses on the existence of asymmetric information between the lender and the borrower, frequently associated with the lack of adequate collateral, as a justification for government interventions in the credit market (Berger and Udell 2006 and Beck *et al.* 2010). The absence of government interventions might otherwise result in the undersupply or rationing of lending (Mankiw 1986, Gale 1990, Gale 1991).

Compared with direct lending by a public institution, loans guaranteed by government-backed institutions but distributed by banks present several advantages. First, a Covid-19 state guarantee is only considered as public debt if and when the guarantee is called, which means that it entails much lower costs as compared to direct lending. This is particularly important for Portugal, one of the countries with the highest levels of public debt in the euro area. Second, since screening and monitoring of borrowers is left to private institutions, the risk of politically-induced lending is being mitigated (Khwaja and Mian 2005).

Furthermore, as state guarantees usually do not cover the full loan amount, banks also bear some credit risk, thus limiting moral-hazard concerns.

Whereas economic theory tells us that capital should go where it yields the highest return and therefore banks should allocate it accordingly, the existence of a public-guarantee scheme creates a new set of incentives. On the one hand, if access conditions to guaranteed loans are very strict, to avoid high costs of the programme for public finances ex-post, only those firms that would obtain bank credit anyway will be benefitting from state guarantees. In this case, the benefit of public guarantees would be restricted to providing credit to firms at lower interest rates, without improving the overall access of firms to credit. On the other hand, if access conditions are too generous, state guarantees might lead to adverse selection, attracting riskier borrowers and thus downgrading the quality of the pool of borrowing firms. Finally, a moral-hazard problem can arise as financial institutions may also have fewer incentives to monitor the borrowers after granting the loan, since the largest part of these loans is guaranteed by the state.

Despite the positive short-term impact of state-guaranteed loans in the context of the Covid-19 pandemic, the medium- to long-term impact can be problematic if it contributes to the survival of unproductive or very risky firms. In fact, the literature suggests that the survival of unproductive firms - often called zombie firms - may hamper the growth of their more productive competitors through congestion effects, as zombie firms retain a certain market share and use scarce productive inputs (Caballero *et al.* 2008, McGowan *et al.* 2018). Zombie lending can also be considered a cause of competitive distortions, with a negative impact on healthy firms (see, e.g., Acharya *et al.* 2019, Acharya *et al.* 2020, Blattner *et al.* forthcoming, Banerjee and Hofmann 2020, McGowan *et al.* 2018, Schmidt *et al.* 2021). Furthermore, it can potentially prevent the "creative destruction" of firms $\grave{a}$ la Schumpeter (1942).

The relationship between credit allocation and productivity is of crucial importance for Portugal, as productivity growth has been subdued since the turn of the millennium, and the aggregate productivity level is relatively low compared to other EU countries. The lower average level of qualification of Portuguese workers and managers and the smaller scale of Portuguese firms, when compared to other EU countries, may certainly explain part of this phenomenon but there is also evidence of inefficient credit allocation between 2008 and 2016 (Azevedo *et al.* 2022).

The effectiveness of state-support measures has gained renewed attention in the wake of the Covid-19 pandemic, and several papers have tried to gauge the impact of the state-support measures that have been put into place. Using an accounting exercise, Schivardi and Romano (2020) find that, without government support, a large number of Italian companies would have become illiquid very early on in the crisis. However, they also show that government support measures in the form of credit guarantees could cover more or less all the liquidity needs of Italian firms. Furthermore, they argue that, during exceptional periods like the Covid-19 pandemic, it might be worthwhile throwing potential zombie firms a

lifeline in order to protect the functioning of production or value chains they might be involved in. During economically stressful times, the loss of a link in the production chain (i.e., the closure of a zombie firm) might lead to missing inputs for other firms in the same value chain, potentially causing a domino effect. Core and De Marco (2021) use Italian loan-level data to test how efficient the private sector has been in allocating public guarantees. They find that larger banks and banks with better information technology played an important role in the efficient allocation of these loans. They also find a positive impact of relationship lending in Italy. A particularly interesting finding of their analysis is that riskier firms had higher take-up rates for state-guaranteed loans. Bighelli *et al.* (2021) use cross-country micro-level data in order to examine the potential consequences of the Covid-19 pandemic on productivity in Croatia, Finland, Slovakia and Slovenia. In doing so, the authors also analyse which firm-level characteristics had an impact on the likelihood of benefitting from government subsidies. They mainly look at wage subsidies that allowed companies to continue paying their employees. They find that the more productive firms in Croatia, Slovakia and Slovenia had a higher likelihood of receiving state aid, although the amount of the subsidies was lower for those firms. In the case of Finland, productivity did not seem to have an impact on the allocation of government subsidies. The authors also find that only a small share of the subsidies went to zombie firms. Altavilla *et al.* (2021) examine whether state-guaranteed loans actually led to an increase in the credit supply to firms, or whether they merely were used as a substitute for non-guaranteed loans. Using credit-register as well as supervisory data for four large euro-area countries (France, Germany, Italy, Spain), they find that there was some substitution taking place but that government guarantees largely contributed to an extension of credit. Furthermore, this new credit went mainly to small and largely creditworthy firms in the sectors most affected by the pandemic. The banks extending these guaranteed loans were predominantly large, liquid and well-capitalised.

The above-mentioned results present mixed evidence concerning a future risk of zombiefication, as it seems that economically viable as well as unviable firms have profitted from these state-support measures. Given the strict access requirements to state-guaranteed loans in Portugal during the crisis, it will be interesting to see whether results are more clear-cut in the Portuguese case.

Our analysis starts out by mapping the evolution of zombie firms in Portugal. In a next step, we then analyse whether zombie firms were more likely than non-zombie firms to take out government guaranteed loans. However, the Portuguese government had imposed strict rules on the eligibility for government guarantees, and therefore the uptake by zombie firms should have been largely prevented. Furthermore, firms could also make use of a public moratorium, to which the access conditions were much less strict. Therefore, we add to the existing literature by not only looking at the access of zombie firms to government-guaranteed loans but also their take-up of the public moratorium. Indeed, we expect to find a larger share of zombie and quasi-zombie firms to have made use of the moratorium as

compared to the state guarantees. This might imply risks to financial stability now that the moratorium has ended and firms need to continue paying back their loans.

We find that the number of zombie firms in Portugal has decreased over time. Descriptive results show that while only a small share of zombie and quasi-zombie firms have been granted state-guaranteed loans, their share is substantially higher when it comes to access to the public moratorium. Our regression results confirm these findings. On the one hand, the Portuguese public-guarantee scheme seems to mainly have supported lower-credit-risk firms. On the other hand, we find that riskier firms were more likely to apply for the public moratorium. Furthermore, our results also show that riskier firms paid higher interest rates and obtained smaller guaranteed loans than more viable firms. In addition to that, we find that firms that previously had a credit relation and/or benefitted from a state guarantee were more likely to also benefit this time. Finally, we find that firms in the sectors most affected by the pandemic were more likely to benefit from the state guarantees and the moratorium.

Our paper is structured as follows. Section 2 gives some institutional background on state-support measures in Portugal during the Covid-19 pandemic. Section 3 gives an overview of the data being used, the zombie methodology chosen, and presents some descriptive statistics. Section 4 presents the regression results, and section 5 concludes.

2. Portuguese government-support measures during the Covid-19 pandemic

Access to state-support measures during the Covid-19 pandemic differed across countries. This section gives an overview of the respective public-guarantee scheme and the moratorium in Portugal.

2.1. The Portuguese public guarantee scheme

The Portuguese public guarantee scheme started its operation in 1994, when the first public entity entitled to grant public guarantees (SPGM - Sociedade de Investimentos) was created. Since then, four more public entities, commonly referred to as Sociedades de Garantia Mútua (SGM), have been given the right to grant public guarantees: Agrogarante, Garval, Lisgarante and Norgarante. However, this type of government support only experienced a major boost in Portugal, like in other European countries, in the aftermath of 2007-08 global financial crisis. Between 2007 and 2010, the outstanding amount of guarantees increased from €0.5 to €3.8 billion (Figure 1).

In response to the Covid-19 pandemic, the Portuguese government strengthened the SGM capacity to issue guarantees. Several credit lines were created to support specific sectors of activity, particularly those most affected by the pandemic, or specific regions. Between March 2020 and July 2021, the stock of bank loans to

non-financial corporations (NFC) with a state guarantee attached increased from about €5 billion, around 8% of the stock of bank loans to NFCs, to about €13 billion, about 17% of the stock (Figure 2).

The features of the Covid-19 guaranteed credit lines complied with the European Commission's Temporary Framework for state-aid measures to support the economy during the COVID-19 outbreak.[1] Most of the credit lines have a maximum maturity of six years, although some can reach up to 10 years (some consider a grace period between 1 and 2 years). The maximum amount of the guarantees provided varies according to the credit line. In some cases, a maximum amount per firm is set but usually it is proportional to the number of employees or the firm size. In all credit lines, the maximum amount per beneficiary is capped at one quarter of the sales in 2019 or twice the annual payroll of the beneficiary for 2019, or for the last year available. The guarantee level varies between 70% and 90% of the principal amount due. The spreads of the guaranteed loans are capped at 1%, 1.25% and 1.5% on loans with a maturity below 1 year, between 1 and 3 years, and between 3 and 6 years, respectively. Additionally, firms also incur a guarantee fee that varies between 0.25% and 2%, depending on firm size and loan maturity. Finally, the vast majority of guaranteed lending is associated with genuinely new loans, not a replacement of existing credit facilities with the lender. The eligibility criteria are credit-line specific, and the main factor of differentiation is usually the sector of activity the line was targeted at. Nevertheless, there are many common features between the different credit lines. State guarantees cannot be granted to firms qualified as "undertakings in difficulty"[2] on 31 December 2019, to firms with credit incidents pending within the banking system or the mutual guarantee scheme system, to firms whose tax or social security situation is not in order, or to firms with negative equity on the last approved balance sheet.[3] Firms whose headquarters or management are located in countries, territories or regions with a clearly more favourable tax regime and large firms with more than 3,000 employees, operating in sectors other than the tourism sector[4], were also not eligible. Additionally, the access to some credit lines was also restricted to firms whose turnover dropped below a certain threshold, usually 25% or 40%, via-à-vis pre-Covid levels. Less frequently, firms were also required to maintain all permanent jobs up to 31 December 2020.

1. https://ec.europa.eu/competition-policy/state-aid/coronavirus/temporary-framework_en

2. As defined in Article 2 (18) of the Commission Regulation (EU) No 651/2014 of 17 June 2014.

3. Companies with negative equity on the last approved balance sheet were allowed to access a guaranteed credit line if they presented this situation to be regularised in the interim balance sheet until the date of the respective application.

4. There is only one credit line for which large firms with more than 3,000 employees were eligible, which was Linha Covid – TURISMO (Médias e Grandes Empresas). The tourism sector, as defined by this credit line, includes the following NACE codes: 49392, 55, 56, 77, 79, 82300, 90, 91, 93 and 96040.

2.2. The Portuguese public moratorium

One of the most frequent measures across Europe in response to the pandemic was a loan moratorium for borrowers. Against the initial background of an abrupt decline in firms' turnover and the reduction in households' disposable income within a very short time period, there was a significant risk of the borrowers not being able to fulfill their credit-related obligations. If aligned with European Banking Authority Guidelines (EBA/GL/2020/02), moratoria allowed lenders to not reclassify the loans benefitting from this measure, almost automatically, as forborne. This favourable prudential treatment for loans covered by the moratoria avoided an increase in capital costs and impairments that would have resulted from an almost automatic reclassification.

Given the severity of the risks associated with the Covid-19 pandemic, the Portuguese government – as also observed in other European countries - established a public moratorium regime.[5] Initially in force between 27 March 2020 and 30 September 2020, it was first extended until 31 March 2021[6] and then, in the context of the worsening pandemic, until September 2021.[7] With this latter amendment, firms were entitled to request the application of the public moratorium until 31 March 2021, and up to a maximum of nine months, for loans that did not benefit from this measure before. Only loans granted before the moratorium came into force (i.e., before 27 March 2020) were considered eligible for the moratorium. The large majority of firms joined the moratorium until June 2020 (Figure 3).

The Portuguese moratorium regime introduced a set of measures. First, an extension of credit agreements with principal payment at the end of the contract (bullet loans), under the same terms and for a period equal to the duration of the moratorium. Second, the suspension of the payment of principal, income and interest with maturity scheduled until the end of that period, for the period during which the measure is in effect. Third, the prohibition of revoking credit-line agreements and loans granted for the amounts contracted at the date of entry into force of the Decree-Law (27 March 2020).

Access to the moratorium depended on the cumulative compliance with the following requirements: i) firms are required to have a head-office and economic activity in Portugal; ii) not being part of the financial sector; iii) to have their tax and social security situation in order and; iv) the loan benefitting from the moratorium could not be more than 90 days overdue. Loans granted to finance the acquisition of securities or positions in other financial instruments and credit cards for individual use were also not eligible.

5. Under Decree-Law No 10-J/2020 of 26 March 2020.
6. Under Decree-Law No 26/2020 of 16 June 2020.
7. Under Decree-Law No 107/2020 of 31 December 2020.

3. Data and descriptive statistics

This section presents the different data sources being used in this paper. Furthermore, it describes an innovative way of defining zombie firms, as introduced in Mingarelli *et al.* (forthcoming).

3.1. Data sources

Our analysis builds on two different datasets. The first one, used to analyse the uptake of state-guaranteed loans, includes all new loans to non-financial corporations (henceforth, firms) originated between the beginning of the Covid-19 pandemic (March 2020) and June 2021. The second, used to analyse the uptake of the moratorium, includes all the firms with outstanding loans in March 2020 (beginning of the Covid-19 crisis) together with a dummy identifying if the firm had loans entering under the moratorium until 31 March 2021. We restrict both samples to the maximum extent possible to eligible firms. Thus, firms with overdue credit, firms classified as in "undertakings in difficulty", mainly as a result of negative equity, firms operating in the financial sector (2-digit NACE sectors 64, 65 and 66) and large firms that do not operate in the tourism sector were excluded from the guaranteed-loans sample. Similarly, firms with overdue credit [8], firms operating in the financial sector, and loans for the acquisition of securities or other financial instruments were also excluded from the moratorium sample. Both datasets have been obtained by matching loan-level data with firm- and bank-level data.

Banco de Portugal's Central Credit Register (CCR) data provides loan-level information on all lending relationships between Portuguese credit institutions and Portuguese firms, and includes several loan-specific characteristics of interest, such as loan amount, origination and maturity date, interest rate, purpose and type of contract, borrowing-firm region, type of collateral, and the guarantor. The latter allows us to identify loans that benefitted from a state guarantee and whether the loan is under the credit moratorium.

Firm-level data was obtained mainly from the Central Balance-Sheet Database (CB) of Banco de Portugal, an annual database based on Simplified Corporate Information (IES), which contains detailed annual balance-sheet and income-statement data of virtually all firms in Portugal. This information was complemented by other firm features such as size, sector of economic activity, and firms' default probabilities, available from internal databases at Banco de Portugal. Firms' default probabilities have been obtained from Banco de Portugal's in-house credit assessment system (ICAS) and are based on the methodology presented in Antunes *et al.* (2016).

We classify firms' sectors as either most affected or less affected by the pandemic. We consider those sectors as most affected by the pandemic that

8. For the sake of simplicity all firms with overdue credit were considered non-eligible but, concerning overdue credit, the eligibility was assessed at the loan level.

recorded a reduction in turnover of more than 40% in the 2nd quarter of 2020 (compared with the expectable situation in a scenario without a pandemic, based on the results of the Fast and Exceptional Enterprise Survey - COVID-19 (COVID-IREE)), and all the remaining sectors as less affected.[9]

We obtain detailed bank-level data on all credit institutions operating in Portugal from prudential supervisory reports, in particular Finrep and Corep reports.

Finally, we retrieve monthly region-level information about excess mortality during the Covid-19 pandemic from Statistics Portugal. The different data sources have been matched using common identifiers for firms, financial institutions and regions.

In this paper, we proxy the concept of a new loan as used in the Monetary Financial Institutions (MFIs) statistics, which means that a new loan is recorded when there is a new agreement between a firm and a financial institution, irrespective of the point in time when the loan is withdrawn.[10] We exclude loan agreements classified in the CCR as credits cards, guarantees, standby letters of credit and factoring without recourse.

3.2. Variables

We provide variable definitions in Table 1. The dependent variables in the two firm-level setups are *State guarantee* and *Moratorium*. *State guarantee* is a dummy variable that is equal to one if an eligible firm benefitted from a state guarantee between March 2020 and June 2021. *Moratorium* is a dummy variable that is equal to one if any of a firm's eligible outstanding loans in March 2020 (beginning of the Covid-19 crisis) entered the moratorium until 31 March 2021. As explanatory variables, we include firm size (proxied by a firm's assets), liquidity position (Cash-to-assets ratio), profitability (EBITDA-to-assets ratio), indebtedness (leverage ratio) and level of creditworthiness (measured by a firm's probability of default and level of zombieness). We also include four dummy variables, controlling

9. The following sectors were classified as most affected by the pandemic (NACE codes of the sectors identified in brackets): Manufacture of coke and refined petroleum products (19), Manufacture of computer, electronic and optical products (26), Manufacture of motor vehicles, trailers and semi-trailers (29), Manufacture of furniture (31), Wholesale and retail trade and repair of motor vehicles and motorcycles (45), Other retail sale in non-specialised stores (4719), Retail sale of beverages in specialised stores (4725), Retail sale of information and communication equipment in specialised stores (474), Retail sale of other household equipment in specialised stores (475), Retail sale of cultural and recreation goods in specialised stores (476), Retail sale of other goods in specialised stores (477), Air transport (51), Warehousing and support activities for transportation (52), Accommodation and food service activities (55 and 56), Programming and broadcasting activities (60), Travel agency, tour operator reservation service and related activities (79), Arts, entertainment and recreation (90, 92 and 93) and Activities of membership organisations (94).

10. For more information about the MFIs definition of new credit agreement, see: `https://www.ecb.europa.eu/pub/pdf/other/manualonmfiinterestratestatistics_201701.en.pdf?758381975fe1d761d11d244659fd7ee4`

for: each firm's pre-existing credit relations (Previous credit relation) and state-guarantees (Previous state guarantee), the intensity of the pandemic shock in the firm's sector (Most affected sector), and the firm's gross value added (GVA) prior to the onset of the pandemic (Negative GVA). Finally, we also control for the excess deaths (Excess mortality) in each NUTS II region during the Covid outbreak.

The dependent variables in the two loan-level setups are the annualised agreed interest rate (AAR) and the loan amount. As explanatory variables, we include the firm-level variables presented above, two loan-level variables controlling for loan maturity and for the existence of a guarantee (other than a state-guarantee), and several bank-level variables controlling for bank size (Bank assets), level of regulatory capital (Bank own funds ratio), quality of the loan portfolio (NPL ratio), profitability (ROA) and the share of interbank funding (Interbank funding / Assets).

All firm- and bank-level variables refer to the end of 2019. Since the outbreak of the COVID-19 pandemic in Portugal and in the rest of Europe was in March 2020, we believe they present an accurate picture of the financial situation of Portuguese firms and banks at the time of the onset of the crisis.

3.3. Defining zombie firms

The topic of zombie lending is not new to the literature and has considerably gained momentum during the Covid-19 crisis. However, there is currently still no consensus on how to define a zombie firm. The probably best-known approach has been championed by McGowan *et al.* (2018) and is based on two criteria. First, a company is defined as a zombie if it cannot cover its interest payments with its profits for three consecutive years, i.e., it exhibits an interest coverage ratio (ICR) below one. In addition to that, a potential zombie firm has to be at least ten years old. This takes into account that young firms are often not yet financially stable and can therefore too easily fall into the zombie classification.

Other studies have used different zombie definitions. Banerjee and Hofmann (2018) use the ICR and age setup as a wider definition for (listed) zombie firms. They then add the requirement that zombies should have a comparatively low expected future growth potential and therefore a Tobin's q below the median within their sector in any given year. The disadvantage of this more narrow measure is that it can only be computed for listed companies, which are on average less likely to be zombie firms. In their 2020 paper, Banerjee and Hofmann (2020) define zombie firms as those with an ICR below one for two consecutive years and a Tobin's q below the median within its respective sector. However, they also impose an additional criterion for firms to leave the zombie status: they either have to have an ICR equal to or above one for two consecutive years, or a Tobin's q above the median for two consecutive years, thereby making the zombie definition more symmetrical concerning the entry into and exit out of the zombie status. Bonfim *et al.* (forthcoming) classify a firm as a zombie if it has had negative equity in the previous year. The idea behind this is that these firms are technically insolvent. Other papers (see, e.g., Caballero *et al.* 2008) identify zombie firms

as those receiving subsidised credit, or they combine the ICR criterion with the subsidised credit one (Acharya *et al.* 2020 and Acharya *et al.* 2019). Storz *et al.* (2017) classify a firm as a zombie if it exhibits (i) a ROA < 0, (ii) net investment < 0, and (iii) debt-servicing capacity $< 5\%$ for two consecutive years.

All of these zombie definitions are binary, meaning that a firm is either classified as a zombie or a non-zombie. However, some firms might well be close to the respective cut-off values for the zombie definition but will be classified as non-zombies nonetheless.

Mingarelli *et al.* (forthcoming) address this issue by taking the definitions of McGowan *et al.* (2018), Banerjee and Hofmann (2020), Storz *et al.* (2017), Acharya *et al.* (2020), and Caballero *et al.* (2008) and transforming them into fuzzy ones. The resulting zombie indicators are bounded between 0 and 1 but continuous within this interval.

Figure 4 illustrates the transition from the crisp to the fuzzy zombie definition. The technical details as well as information on the data-cleaning procedure can be found in the Appendix. In this paper, we will be using the fuzzy version of the original (binary) zombie definition by Storz *et al.* (2017).

We use firm-level data to estimate the "level of zombieness" of all Portuguese firms with available information. Data was obtained from the Central Balance-Sheet Database of Banco de Portugal, which contains detailed annual balance-sheet and income-statement data of virtually all firms in Portugal.

3.4. Descriptive statistics

Table 2 presents summary statistics for our different estimation datasets.

3.4.1. State-guarantee sample. About 20% of eligible firms in Portugal obtained a state-guaranteed loan during the pandemic, suggesting a relatively low level of participation of firms in this programme, and 12% had already benefitted from a state guarantee at least once between January 2019 and March 2020. Around one-quarter of eligible firms were active in one of the sectors most affected by the pandemic and roughly half had a banking relationship before the beginning of the pandemic (in line with what is observed for the universe of Portuguese firms, where about half of the firms have no bank credit). Most firms in our sample of eligible companies are relatively small (the median of firms' assets is slightly below €180,000), have a comfortable liquidity position (the median of the cash-to-assets ratio is around 13%), a low leverage ratio (the median of liabilities over assets is about 53%) and a low probability of default (half of the firms in the sample had a probability of default over a one-year horizon below 1.4%). The level of zombieness is relatively low, and about 10% of the firms recorded a negative gross value added in 2019.

Table 3 compares the descriptive statistics of our sample of firms eligible for the state guarantee with those of non-eligible firms. About 133,000 firms, which corresponds to around 27% of the Portuguese firms, were non-eligible for a

state guarantee. The share of firms operating in the sectors most affected by the pandemic is higher for the non-eligible firms (32.6% versus 23.1%), which suggests that a non-negligible part of the firms operating in those sectors were excluded from the guaranteed credit lines. The share of firms with a credit relation or a state guarantee before the beginning of the pandemic was significantly lower for the non-eligible firms (40.8% and 3.9%, versus 51.5% and 12.3%, respectively). Looking at the median, we can observe that eligible firms are significantly larger (€180,000 versus €33,000), have more liquidity (13% versus 6.1%), are more profitable (8.2% versus -3.6%) and markedly less leveraged (53% versus 161%) than non-eligible firms. Moreover, eligible firms are much less likely to enter into default and record a lower level of zombieness (1.4% and 0 versus 7.1% and 0.85, respectively). Finally, the share of firms with a negative GVA is almost three times higher for the non-eligible firms (30.9% versus 10.4%). These results corroborate the increased financial fragility of firms not eligible for the state guarantees.

3.4.2. Moratorium sample. The uptake of the moratorium outperformed the one of the state-guarantee scheme, as about 35% of eligible firms made use of it (Table 2). As with the state-guarantee scheme, around one quarter of eligible firms were in one of the sectors most affected by the pandemic. The share of firms in our moratorium sample that benefitted from a state guarantee before the pandemic was 24%. Firm size, leverage, probability of default and level of zombieness is larger in the moratorium sample, when compared with the state-guarantee sample, whereas the share of liquid assets and the share of firms with a negative GVA is somewhat lower. Overall, the descriptive statistics show an increased riskiness of the moratorium sample.

3.4.3. Zombie firms in Portugal. Figure 5 shows the development in the level of zombieness as well as the share of zombie firms according to the McGowan *et al.* (2018) and Storz *et al.* (2017) definitions. Results for these definitions indicate a decline in the share of Portuguese zombie firms over time. Using the McGowan *et al.* (2018) definition, the share of zombie firms in Portugal in 2019 stood at 6.9%, a decline by 4 p.p. from its peak in 2014. Looking at the binary zombie definition by Storz et al. (2017), results indicate a zombie share of only 4.8% in 2019 (down from 10.4% in 2012). However, by making this definition fuzzy, results get much richer. Figure 5 also plots the share of firms with a zombie score of 0.5 or higher. In 2019, 28.0% of Portuguese firms fell into this range. Breaking this further down shows that 14.1% of Portuguese firms were in the range between $0.9<Z<1$ in 2019, i.e., they were relatively close to being full zombies ($Z=1$). Most firms in this range fail to be classified as full zombies according to the binary zombie definition only because they recorded zero net investment. 9.2% of the firms had a zombie score between 0.5 and 0.9 in 2019. As was the case for the binary definition, the share of zombies using the fuzzy definition has declined steadily since its peak in 2013, where it stood at 36.1%. This decline is also observed when looking at the employment- and asset-weighted shares of full zombie firms, obtained by weighting

the full zombies by their respective shares of employment and assets within the overall population of firms. The share of employment-weighted zombie firms stood at 8.8% in 2013 and declined to 3.1% in 2019, whereas the share of asset-weighted zombies declined from 7.7% in 2013 to 2.9% in 2019. Comparing these weighted shares with the unweighted ones indicates that Portuguese zombie firms are smaller than the average firm, accounting for less employment and total assets.

3.4.4. Zombie firms and their uptake of the Portuguese state-support measures. Between March 2020 and June 2021, 54.8% of the amount of the new loans with state guarantees went to non-zombie firms (firms' level of zombieness was assessed based on the data available up to 2019, i.e., before the pandemic), whereas this share was 52.9% for new loans without state guarantees (Figure 6). Only 0.9% of the amount of new loans with a state guarantee was granted to full zombie firms. The proportion was almost identical for new loans without a state guarantee, about 0.8%. 38.4% of new loans with a state guarantee were obtained by firms with scores below 1 and higher than or equal to 0.5. About half of this amount went to firms with a zombie score of 0.8 or higher but below 1. The fact that loans with state guarantees predominantly went to non-zombie firms or firms with low zombie scores reflects the strict access conditions for these types of loans.

As detailed in section 2.2, access requirements were softer for the moratorium than those for state-guaranteed loans. Nevertheless, only 4.0% of the amount of the loans under the moratorium belongs to full zombie firms. The respective share is 53.1% for firms with zombie scores above (or equal to) 0.5 and below 1 (Figure 7). This indicates that the share of loans under the moratorium that belongs to lower-quality firms is larger than that of higher-quality firms. However, it is noteworthy that also a large share of loans under the moratorium belongs to non-zombie firms (37.3%).

4. Results

In this section we analyse the impact of firm, bank and loan characteristics on the uptake of state-guaranteed loans and the moratorium during the pandemic. The starting point of our analysis is the regression setup used by Core and De Marco (2021), who look at state-support measures in Italy during the Covid-19 pandemic. First, based on firm-level data, we estimate the factors influencing the likelihood of firms getting a guaranteed loan. Second, using loan-level data, we analyse the variables influencing the interest rates and loan amounts of new loans granted during the pandemic. Third, we return to the firm-level data to analyse the factors influencing the moratorium uptake, comparing the risk profile of firms that benefitted from the moratorium with those that benefitted from the state guarantees. All variables presented in the regression tables have been normalised to have a mean of 0 and a standard deviation of 1. Thus, all the coefficients can be compared and read as the effect of a one standard deviation increase. Estimations

are done using Stata's `reghdfe` (Correia 2017), which allows for multi-way fixed effects and clustering.

4.1. State guarantees during the pandemic - firm-level evidence

In this section, we analyse the impact of firm, region and sector characteristics on the uptake of new state guarantees during the pandemic by estimating the following linear probability model:

$$\begin{aligned}\text{State Guarantee}_{f,r,s} = \beta_0 + \beta_1 \text{Most-affected sector}_s + \beta_2 \text{Excess mortality}_r \\ + \beta_3 X_f + FE + \varepsilon_{f,r,s}\end{aligned} \tag{1}$$

where State Guarantee$_{f,r,s}$ is a dummy variable that is equal to one if firm *f*, whose headquarters are located in region *r* and that operates in sector *s* has been granted a loan with a state guarantee, and zero otherwise. The control group consists of firms that were eligible but did not receive any state-guaranteed loan between April 2020 and June 2021. Most-affected sector$_s$ is a dummy variable that takes on the value of one for firms in those sectors that recorded a decrease in turnover of more than 40% in the second quarter of 2020, compared to the expectable situation in a scenario without the pandemic, and zero otherwise. Excess mortality$_r$ is the ratio of the number of human deaths recorded between March 2020 – April 2021 and March 2019 – April 2020 in each region, and vector X_f contains a set of firm-specific controls, as detailed in section 3.2. All firm-level variables refer to the end of 2019. Additionally, we also include three dummy variables that are equal to one if a firm recorded a negative GVA in 2019, accessed a state-guaranteed loan in 2019 or at the beginning of 2020 (before the pandemic) or had a credit relation prior to the onset of the pandemic, respectively, and zero otherwise. Finally, specification 1 also contains region, sector or region-sector fixed effects, thus controlling for unobserved heterogeneity. Standard errors are clustered at the sector level.

The results for the guaranteed-loans uptake are presented in Table 4. The estimates presented in column (1), using only region fixed effects, indicate that operating in one of the sectors that were most affected by the pandemic increases firms' probability of accessing a state-guaranteed loan by 12.9 percentage points, i.e., there is a 65% higher probability compared with the mean take-up rate of 20%. The coefficient of this variable is large in comparison with the other explanatory variables. This is in line with expectations, since most of the state-guaranteed credit lines were specifically targeted at those sectors.

Interestingly, the estimates in column (2) suggest that firms located in regions with a higher excess mortality have a lower probability of accessing a state-guaranteed loan. However, since we are not controlling for other region characteristic in this regression setup, this coefficient may be capturing other unobserved regional effects.

The most important factors influencing the likelihood of firms getting a state guarantee, in all specifications, is having already had a credit relation or a state-guaranteed loan in the past. Column 4, our most saturated specification in terms of fixed effects, indicates that if a firm had any state-guaranteed loan before the beginning of the pandemic (between January 2019 and March 2020), it was 19 percentage points more likely to receive a state-guaranteed loan, compared to a firm without a previous state-guaranteed loan. In the same vein, firms with a credit relation prior to the onset of the pandemic were 17.6 percentage points more likely to receive a state-guaranteed loan vis-à-vis firms without a credit relation. These effects are large and also intuitive, as firms that were already in the credit market and firms that had successfully gone through the application process for a guarantee before would be expected to find it easier to apply for a new loan with a state guarantee during the pandemic.

Looking at the other firm-level variables, the size of the firm has also played an important role in getting a state-guaranteed loan. The respective coefficient enters with a positive sign and is highly statistically significant, indicating that larger firms (that fulfilled the eligibility criteria) were more likely to receive a state-guaranteed loan than smaller firms. Firms with larger cash holdings were less likely to receive a loan with a state guarantee, while more leveraged firms were more likely to have participated in this programme. These results are also in line with economic intuition. On the one hand, firms with more cash at hand are less likely to need further financing. In fact, when we look at the deciles of the cash-to-assets distribution (Table 5), we observe it is not monotonic, i.e., the negative relation between cash-to-assets and state guarantees is only visible for firms with a high level of liquidity (cash-to-assets ratio above the 7th decile). The level of capitalisation and liquidity of Portuguese SMEs has increased significantly since the European sovereign debt crisis, mostly through retained earnings. This trend has continued during the pandemic, thus possibly reducing the need for external funding. On the other hand, most indebted firms are more likely to be liquidity constrained due to the frequent need to refinance and pay back their debt. Indeed, the relation between leverage and the take-up of state guarantees seems to be monotonic, i.e., an increase in the decile of leverage is associated with a higher probability of accessing a state-guaranteed loan. This holds true up until the 8th decile, after which the effect levels out.

Lastly - and most importantly in the context of our analysis - we look at the creditworthiness of the firms receiving state-guaranteed loans using two different indicators: a firm's probability of default and the fuzzy zombie indicator. Table 4 shows that both credit-risk-related coefficients are negative and highly statistically significant, indicating that higher-risk firms, i.e., firms with a higher probability of default and firms with a higher level of zombieness, were less likely to receive a state-guaranteed loan. It should be noted that although both variables are used as proxies for the creditworthiness of a firm, the probability of default and the level of zombieness of a firm are not quite the same. In fact, both variables are only very weakly correlated in our sample.

In the literature, zombie firms are often used as a synonym for unproductive firms. Therefore, as a robustness check, we also employ a dummy variable which takes on a value of one if a firm has a negative GVA and zero otherwise, as an indicator of each firm's level of productivity (column 5). This last indicator turns out to be negative and strongly statistically significant, reinforcing the idea that unproductive firms were less likely to receive a loan with a state guarantee.

Since the Portuguese economy is largely dominated by micro firms, one could wonder whether this group dominates the overall results. Therefore, Table 6 splits the sample into different firm-size classes. While the size of the coefficients in the overall sample are indeed most aligned with the ones in the sample of micro firms, qualitative results do not differ much across the different firm-size classes.

Overall, our results suggest that the Portuguese public-guarantee scheme during the Covid-19 pandemic supported mostly firms operating in the sectors most severely hit by the pandemic and firms that have benefitted from bank lending and from state-guaranteed loans prior to the onset of the pandemic. The Portuguese public guarantee scheme also seems to have supported mostly lower-credit-risk firms, i.e., those with a lower probability of default and lower level of zombieness. This evidence contrasts with the results obtained by Core and De Marco (2021) for Italy, where the riskier firms were more likely to participate in the Italian public guarantee scheme. This difference is probably explained by the stricter access requirements to the Portuguese public-guarantee scheme compared to the Italian one.

4.2. State guarantees during the pandemic - loan-level evidence

In this section, we look at the firm- and bank-level variables influencing the interest rate and loan amount of new loans granted during the pandemic. Using loan-level data, we estimate the following regression:

$$Y_{i,f,r,s,b} = \beta_0 + \beta_1 X_f + \beta_2 \delta_b + FE + \varepsilon_{i,f,r,s,b} \quad (2)$$

where $Y_{i,f,r,s,b}$ is either the interest rate or the amount of loan i granted to firm f, whose headquarter is located in region r and operates in sector s, by bank b. X_f is a vector of firm characteristics and δ_b is a vector of bank characteristics such as size (proxied by bank assets), level of regulatory capital, quality of the loan portfolio, profitability and share of interbank funding. All bank-level variables refer to the end of 2019. In this specification, we include sector, bank or region-sector fixed effects. We present estimates for both, new loans *with* and *without* a state guarantee. Standard errors are clustered at the sector level.

4.2.1. Loan-level evidence for the use of state guarantees during the pandemic - interest rate. The spreads on guaranteed loans were capped at 1%, 1.25% and 1.5% for loans with a maturity below 1 year, between 1 and 3 years, and between 3 and 6 years, respectively. However, spreads and interest rates in those maturity buckets could be lower than that. In fact, Table 2 shows that the average and

median interest rates were 1.4% and 1.5%, respectively, with a standard deviation of 51 basis points, suggesting some cross-sectional variation. During the same period, non-guaranteed loans, which did not have a cap on the spread, recorded average and median interest rates of 3.6% and 2.5%, respectively. The standard deviation for those loans was substantial at 370 basis points.

Even though the state guarantees cover on average 80% of the respective loans, it is not clear ex-ante how banks will price firm-level risk. The existence of a state guarantee creates incentives for the reduction of interest rates and of risk differentiation. However, banks still retain some "skin in the game". This issue is particularly important for Portugal, since there has been some evidence of underpricing in long-term bank loans prior to the Covid-19 pandemic, especially for loans granted to the construction, real-estate, and transportation and storage sectors (Mateus and Pinheiro 2021).

Panel A of Table 7 shows that the interest rates of state-guaranteed loans continue to take firms' creditworthiness into account: firms with a higher PD, a higher leverage ratio and zombie firms were charged higher interest rates, while larger firms and firms with more cash at hand paid lower interest rates on their guaranteed loans. Firm size is the most important firm characteristic influencing the loan interest rate in all specifications. Looking at column 5, we can see that a one standard deviation increase in firms' assets decreases the interest rate by around 210 bps, 15% lower than the mean.[11]

Having already had a previous state-guarantee does not seem to influence a firm's loan interest rate, despite being one of the most important factors influencing the likelihood of getting a loan. The loan maturity also does not seem to have an impact on interest rates of state-guaranteed loans, despite the fact that the maximum spreads allowed by law vary according to the maturity of the loans. Firms that were already in the credit market before the onset of the pandemic seem to pay slightly higher interest rates compared with firms that entered the credit market during this period. This result might be explained by the competition between banks for new firms entering the credit market.

Our data shows that the share of state-guaranteed loans with an additional guarantee (usually a personal guarantee) was surprisingly high (around 37%). The banks' request for a personal guarantee could be explained by the greater ease and speed of execution of this type of guarantees, compared to state guarantees. Results presented in Table 7 (Panel A) show that those loans with another guarantee on top of the state-guarantee are the ones charged with the highest interest rates. In particular, a loan with an additional guarantee, on average, paid 215 bps more, 15% higher than the mean, which seems to suggest an increased level of risk.

Including bank-level variables or bank fixed-effects in the specification reduces the effect of firm-level controls and improves the overall fit of the regression, suggesting that bank heterogeneity is also important in explaining differences in

11. Calculated as -0.208/1.432.

interest rates. The evidence presented in Panel A of Table 7 seems to suggest that large banks are able to process guaranteed loans at lower interest rates. On the other hand, a higher NPL ratio, a higher return on assets and a larger share of interbank funding seem to be associated with a higher interest rate. Banks with easy access to interbank funding, ceteris paribus, are expected to face lower funding costs and thus, to charge lower interest rates on guaranteed loans. However, in a context of abundant market liquidity, the share of interbank funding in the financing structure of Portuguese banks is very low (the median for the banks in the sample is 6.6%) and therefore the opposite effect seems to hold.

Firm size was also the most important firm-level variable for the interest-rate setting of loans *without* a state-guarantee during the period under analysis (Panel B of Table 7). The interest rate determinants are broadly aligned in terms of sign and statistical significance in both panels. However, some interesting differences can be observed. First, the coefficient for the probability of default is now larger, which seems to indicate that risk differentiation is higher in this case. This is in line with expectations, as firms that did not benefit from state-guaranteed loans were more heterogeneous with respect to their risk profile. Furthermore, as mentioned in Section 2.1, the spread of guaranteed loans was capped. However, we cannot rule out completely that the guarantees have led to some form of moral-hazard issues with respect to the pricing of the guaranteed loans. Second, a longer maturity is now statistically significant and associated with lower interest rates. Typically, in Portugal, firm loans with longer maturities have lower annualised interest rates. A longer maturity is usually associated with investment or debt refinancing or with high-quality firms, while short-term loans are more associated with short-term liquidity needs. Banks could be more willing to grant short-term loans, with higher interest rates, to high-risk firms. Notably, Mateus and Pinheiro (2021) show that Portuguese banks earn higher returns on short-term loans than on long-term loans. Third, loans with a guarantee (other than a state guarantee) were charged lower interest rates, which means that collateral, in this setting, seems to have a signalling effect: by posting collateral, lower-risk borrowers can obtain lower interest rates. Finally, bank size does not seem to play a role for interest rates of loans granted without a state guarantee.

4.2.2. Loan-level evidence for the use of state guarantees during the pandemic - loan amount. The maximum guaranteed loan size each firm was able to get was capped at one quarter of its sales in 2019 or twice the annual payroll of the beneficiary for 2019 (or for the last available year). However, we observe that the median loan size (and the other moments of the distribution presented in Table 2) of state-guaranteed loans is significantly larger than that of loans without a state guarantee. The median amount of state-guaranteed loans during the time span analysed was €50,000, while it was only €15,000 for loans without a state guarantee. On the other hand, the standard deviation of the state-guaranteed loan amounts was smaller.

In the previous subsection, we observed that firm and bank heterogeneity were both important to explain the interest rate variation of guaranteed loans. In this subsection, we analyse if the same holds for loan size, testing whether firm or bank characteristics played the most important role. The results reported in Panel A of Table 8 show that larger guaranteed loans were obtained by larger firms, firms with larger cash holdings and more indebted firms. Firm size was by far the most important driver of the loan size. On the other hand, riskier firms, i.e., firms with a higher level of zombieness and firms with a higher probability of default, obtained smaller guaranteed loans during the time span analysed. Results show that also a longer loan maturity is associated with a larger loan size and that the existence of an additional guarantee does not seem to influence the loan amount.

Differently from interest rates, firm characteristics explain a lot more of the variation in loan amounts (R^2=0.66 in column 1 of Panel A of Table 8) than bank characteristics (R^2=0.20 in column 2).

Turning to the amount of loans *without* a state guarantee (Panel B of Table 8), we can see that risky firms also obtain smaller loan amounts and firm size remains the most important firm-level explanatory variable, although the magnitude of the coefficient has decreased significantly. On the other hand, the loan maturity coefficient increased significantly, becoming the second most important variable influencing the amount of loans without a state guarantee. Finally, guaranteed loans (other than a state-guarantee) were associated with larger loan amounts than non-guaranteed loans.

4.3. The public moratorium

Our results so far reveal that riskier firms were less likely to get a state-guaranteed loan during the pandemic, paid higher interest rates, and obtained smaller guaranteed loans. In this section, we turn our analysis to firms accessing the public moratorium. As the access requirements were softer for the moratorium than those for state-guaranteed loans, one might expect that riskier firms were more likely to have benefitted from the moratorium. On the other hand, the easy access to the moratorium may have encouraged all types of firms (riskier and less risky) to get some breathing space in terms of loan repayments during the pandemic. If this last hypothesis holds true, firms' risk level should not be a driver for the access to the moratorium.

In order to analyse the impact of firm characteristics on the uptake of the moratorium during the pandemic, we estimate the following linear probability model:

$$\text{Moratorium}_{f,r,s} = \beta_0 + \beta_1 \text{Most affected sector}_s + \beta_2 X_f + FE + \varepsilon_{f,r,s} \quad (3)$$

where $\text{Moratorium}_{f,r,s}$ is a dummy variable equal to one if firm f in region r and sector s has an outstanding loan in March 2020 (beginning of the Covid-19 crisis in Portugal) that entered under the moratorium until 31 March 2021, and zero

otherwise. As a robustness check, we also consider the share of each firm's bank loans under the moratorium as dependent variable. The control group consists of firms whose loans were eligible for the moratorium but which decided not to make use of it. We include the same firm-level explanatory variables used in the previous specifications. We do not include bank-level variables in this setup, as access to the moratorium was not a choice of the banks but firms could simply opt for it if their loans were eligible.

Results for the moratorium uptake are presented in Table 9. The estimates presented in column (1) indicate that being in one of the most affected sectors increases firms' probability of accessing the moratorium, compared to firms operating in less affected sectors, by 11 percentage points, i.e., there is a 32% higher probability compared with the mean take-up rate of 35%. Interestingly, firms that benefitted from a state-guaranteed loan prior to Covid-19 pandemic were not only more likely to access the Covid-related state guarantees, as seen earlier, but they were also more likely to make use of the public moratorium.

Looking at the firm-level variables, we observe that larger firms were more likely to make use of the public moratorium, while firms with more cash at hand were less likely to do so. Finally, when we look at the risk of the firms with loans under the moratorium, we observe a significant difference relative to firms applying for state-guaranteed loans. Results in Table 9 show that both quality-related coefficients are now positive, indicating that higher-risk firms, i.e., firms with a higher probability of default and firms with a higher level of zombieness, were more likely to apply for the moratorium. These results show that the moratorium has benefitted relatively riskier firms, in contrast with what was observed for state guarantees. The statistical significance and magnitude of the coefficients remain by and large unchanged when we consider the share of each firm's bank loans under the moratorium as our dependent variable instead of the simple moratorium dummy variable (Table 10).

5. Conclusion

Credit guarantees and credit moratoria were widely used worldwide to support businesses affected by the Covid-19 pandemic. While these measures have been key to stabilising the economy in the short-run, supporting struggling firms in a context of high levels of uncertainty and a sharp deterioration of economic agents' confidence, the medium- to long-term impact of these measures remains an open question. Based on the Portuguese experience, we assess the risk profile of firms accessing the state guarantees and the moratorium.

Our paper has three main findings.

First, we find that guaranteed loans went mostly to firms operating in the sectors most severely hit by the pandemic and to firms that had a credit relation and/or benefitted from a state guarantee before the onset of the Covid-19 pandemic.

Second, the Portuguese public guarantee scheme seems to have mainly supported lower-credit-risk firms, i.e., those with a lower probability of default and

a lower level of zombieness. Our results contrast with the results obtained for Italy by Core and De Marco (2021), where riskier firms were more likely to participate in the Italian public guarantee scheme. Additionally, in the case of Portugal, riskier firms paid higher interest rates and obtained smaller guaranteed loans than more viable firms.

Third, in contrast to the state guarantees, our results show that riskier firms were more likely to apply for the public moratorium.

Overall, our results suggest that state-guaranteed loans were mostly granted to firms that had a lower level of risk before the onset of the Covid-19 pandemic. In this sense, the strict access requirements to the Portuguese public guarantee scheme seem to have mitigated a significant increase in riskier lending, while supporting those sectors most affected by the pandemic. On the other hand, our results also show that riskier firms have benefitted relatively more from the moratorium.

Going forward, the increase in the level of zombiefication of Portuguese firms will not only depend on their pre-Covid risk level but also on their ability to recover from this shock now that the pandemic has subsided. Ultimately, an increase in the level of zombiefication of the Portuguese economy would have an impact on the banking sector as well, as these firms might default on their loans, thereby leading to an increase in the level of non-performing loans in the Portuguese banking sector. More research on that will be needed in the future.

References

Acharya, Viral V., Matteo Crosignani, Tim Eisert, and Christian Eufinger (2020). "Zombie Credit and (Dis-)Inflation: Evidence from Europe." NBER Working Papers 27158, National Bureau of Economic Research, Inc, URL https://ideas.repec.org/p/nbr/nberwo/27158.html.

Acharya, Viral V, Tim Eisert, Christian Eufinger, and Christian Hirsch (2019). "Whatever It Takes: The Real Effects of Unconventional Monetary Policy." *Review of Financial Studies*, 32(9), 3366–3411.

Altavilla, Carlo, Andrew Ellul, Marco Pagano, Andrea Polo, and Thomas Vlassopoulos (2021). "Loan Guarantees, Bank Lending and Credit Risk Reallocation." CSEF Working Papers 629, Centre for Studies in Economics and Finance (CSEF), University of Naples, Italy, URL https://ideas.repec.org/p/sef/csefwp/629.html.

Antunes, António R., Pedro Prego, and Homero Gonçalves (2016). "Firm default probabilities revisited." *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*.

Azevedo, Nuno, Márcio Mateus, and Álvaro Pina (2022). "Bank credit allocation and productivity: stylised facts for Portugal." *Studies in Economics and Finance*, 39(4), 644–674.

Banerjee, Ryan Niladri and Boris Hofmann (2018). "The rise of zombie firms: causes and consequences." *BIS Quarterly Review*.

Banerjee, Ryan Niladri and Boris Hofmann (2020). "Corporate zombies: Anatomy and life cycle." BIS Working Papers 882, Bank for International Settlements, URL https://ideas.repec.org/p/bis/biswps/882.html.

Beck, Thorsten, Leora F. Klapper, and Juan Carlos Mendoza (2010). "The typology of partial credit guarantee funds around the world." *Journal of Financial Stability*, 6(1), 10–25.

Berger, Allen N. and Gregory F. Udell (2006). "A more complete conceptual framework for SME finance." *Journal of Banking & Finance*, 30(11), 2945–2966.

Bighelli, Tommaso, Tibor Lalinsky, and CompNet Data Providers (2021). "COVID-19 government support and productivity: Micro-based cross-country evidence." *CompNet Policy Brief*, (14).

Blattner, Laura, Luísa Farinha, and Francisco Rebelo (forthcoming). "When Losses Turn Into Loans: The Cost of Weak Banks." *American Economic Review*.

Bonfim, Diana, Geraldo Cerqueiro, Hans Degryse, and Steven Ongena (forthcoming). "On-site inspecting zombie lending." *Management Science*.

Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap (2008). "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review*, 98(5), 1943–1977.

Core, Fabrizio and Filippo De Marco (2021). "Public Guarantees for Small Businesses in Italy during Covid-19." CEPR Discussion Papers 15799, C.E.P.R. Discussion Papers.

Correia, Sergio (2017). "Linear Models with High-Dimensional Fixed Effects: An Efficient and Feasible Estimator." Tech. rep. Working Paper.

Gale, William (1990). "Federal lending and the market for credit." *Journal of Public Economics*, 42(2), 177–193.

Gale, William G. (1991). "Economic Effects of Federal Credit Programs." *The American Economic Review*, 81, 133–152.

Khwaja, Asim Ijaz and Atif Mian (2005). "Do Lenders Favor Politically Connected Firms? Rent Provision in an Emerging Financial Market." *The Quarterly Journal of Economics*, 120(4), 1371–1411.

Mankiw, N. Gregory (1986). "The Allocation of Credit and Financial Collapse." *The Quarterly Journal of Economics*, 101(3), 455–470.

Mateus, Márcio and Tiago Pinheiro (2021). "Bank pricing of corporate loans." *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*.

McGowan, Müge Adalet, Dan Andrews, and Valentine Millot (2018). "The walking dead? Zombie firms and productivity performance in OECD countries." *Economic Policy*, 33(96), 685–736.

Mingarelli, Luca, Beatrice Ravanetti, Tamarah Shakir, and Jonas Wendelborn (forthcoming). "On the identification of zombie firms: methodological perspectives." Working Paper ?, European Central Bank.

Schivardi, Fabiano and Guido Romano (2020). "A simple method to estimate firms liquidity needs during the COVID-19 crisis with an application to Italy." *Covid Economics*, 35, 51–69.

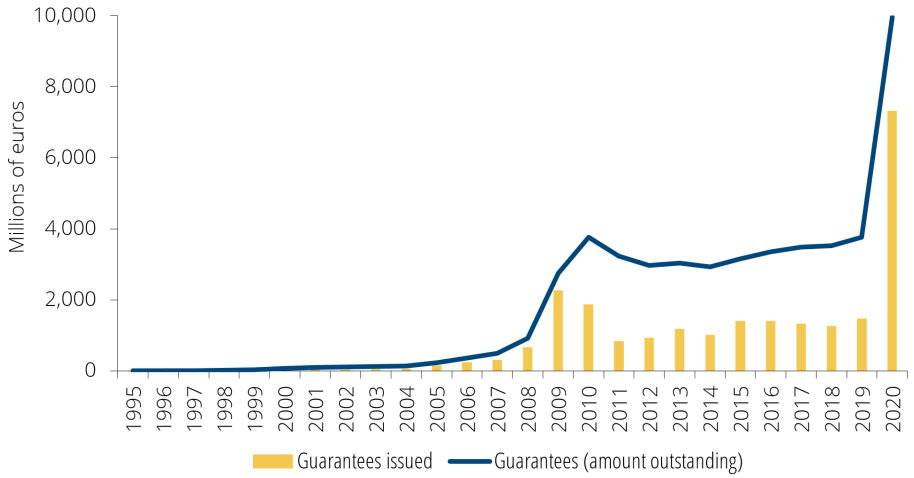
Schmidt, Christian, Yannik Schneider, Sascha Steffen, and Daniel Streitz (2021). "Capital Misallocation and Innovation." *SSRN Working Paper*.

Schumpeter, Joseph A. (1942). *Capitalism, socialism, and democracy*. Harper & Brothers, New York.

Storz, Manuela, Michael Koetter, Ralph Setzer, and Andreas Westphal (2017). "Do we want these two to tango? On zombie firms and stressed banks in Europe." ECB Working Paper 2104.

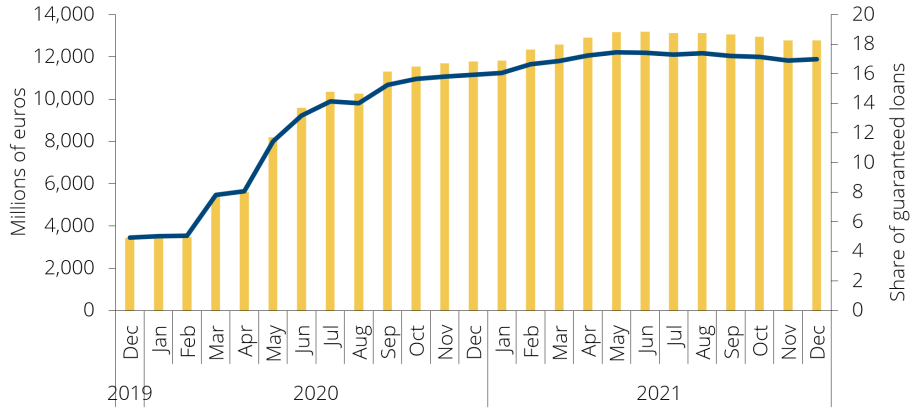
Figures and Tables

Figure 1: Annual amount of guarantees issued and end-of-year amounts outstanding



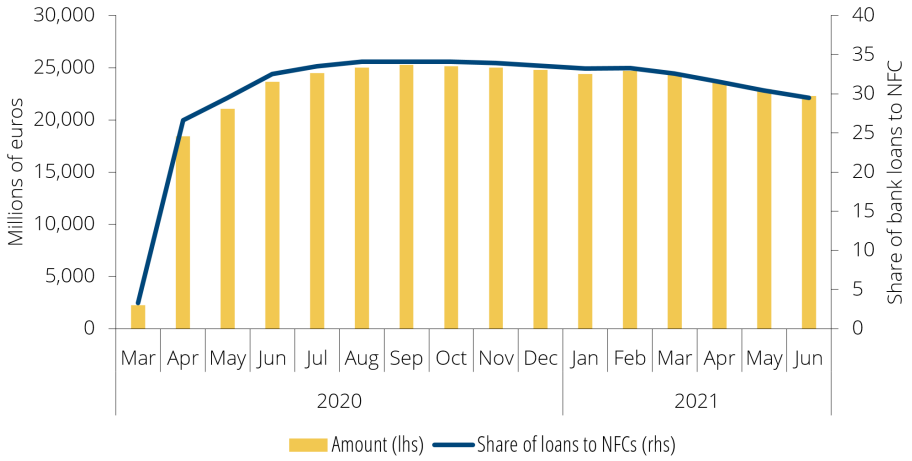
Source: Annual income statements of SPGM - Sociedade de Investimento and Banco Português de Fomento.

Figure 2: Stocks and shares of bank loans to NFCs with a state guarantee



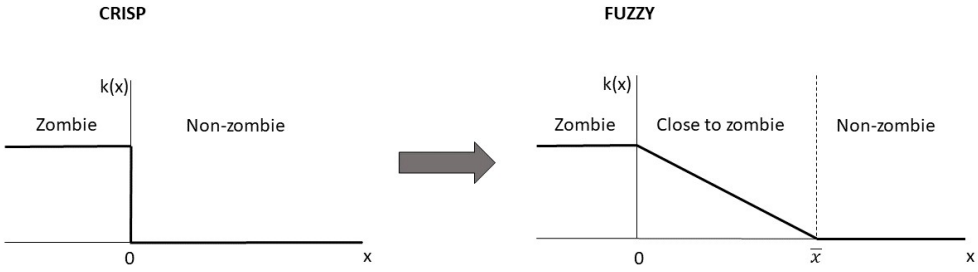
Source: Banco de Portugal's Central Credit Register.

Figure 3: Amounts and shares of NFC loans under the public moratorium



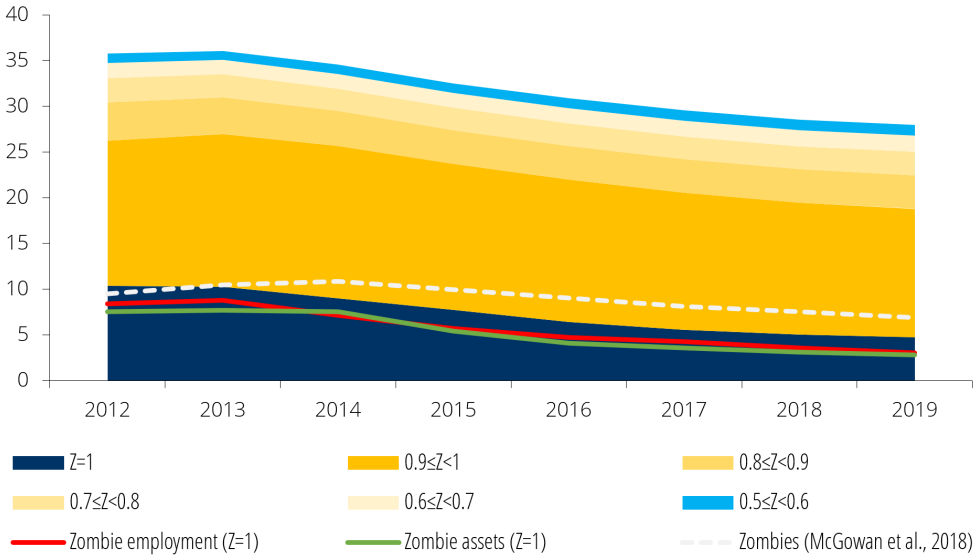
Source: Banco de Portugal's Central Credit Register.

Figure 4: From crisp to fuzzy zombies



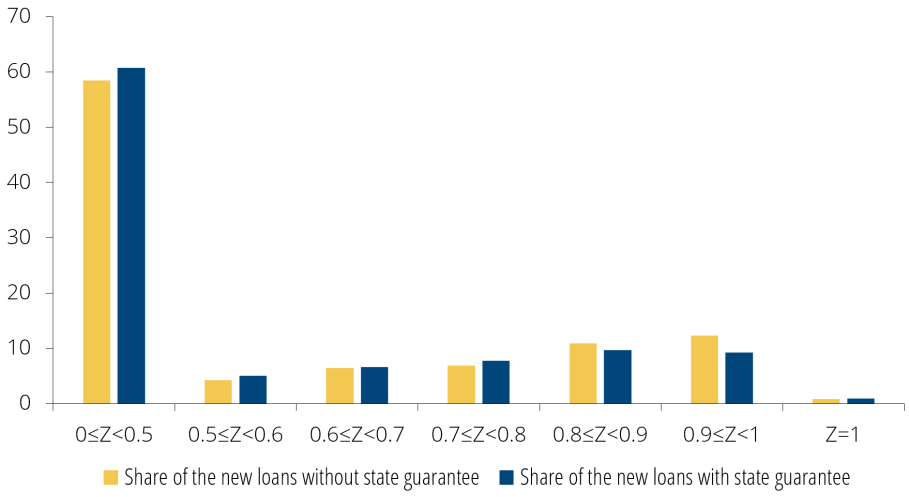
Source: Adapted from Mingarelli *et al.* (forthcoming).
See the Appendix for a full description of the calculation of the zombie indicator.

Figure 5: Share of zombie and quasi-zombie firms in Portugal | in %



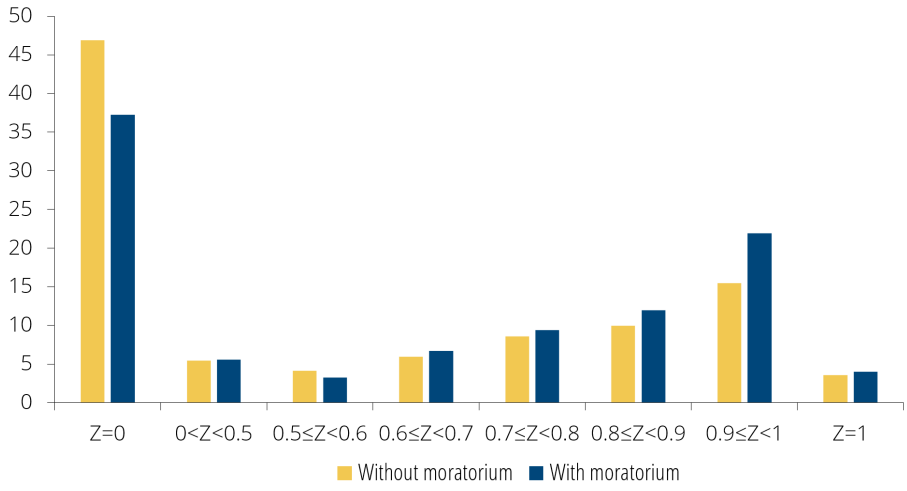
Source: Central Balance-Sheet Database and authors' calculations.

Figure 6: Share of new loans granted to zombie and quasi-zombie firms



Source: Central Balance-Sheet Database, Central Credit Register and authors' calculations.

Figure 7: Share of loans under the moratorium allocated to zombie and quasi-zombie firms



Source: Central Balance-Sheet Database, Central Credit Register and authors' calculations.

Table 1. Definition of variables

This table presents the definition of all variables used in this paper.

Variable	Definition	Source
Firm level data		
State-guarantee	= 1 if an eligible firm benefitted from a state guarantee between March 2020 and June 2021; =0 otherwise	Central Credit Register (BdP)
Moratorium	= 1 if any of a firm's outstanding loans in March 2020 (beginning of the Covid-19 crisis) entered the moratorium until 31 March 2021 (the last month loans could enter the moratorium regime); =0 otherwise	Central Credit Register (BdP)
Most affected sector	= 1 if a firm operates in one of the sectors that recorded a decrease in turnover of more than 40% in the second quarter of 2020, compared to the expectable situation in a scenario without the pandemic; =0 otherwise	Fast and Exceptional Enterprise Survey (Statistics Portugal)
Previous credit relation	= 1 if a firm had a credit relation prior to the onset of the pandemic; =0 otherwise	Central Credit Register (BdP)
Previous state guarantee	= 1 if a firm accessed a state-guaranteed loan in 2019 or at the beginning of 2020 (before the pandemic); =0 otherwise	Central Credit Register (BdP)
Assets	total assets of a firm (in millions of euros)	Central Balance-Sheet Database (BdP)
Cash / Assets	ratio of currency and deposits to total assets	Central Balance-Sheet Database (BdP)
EBITDA / Assets	ratio of EBITDA-to-total assets	Central Balance-Sheet Database (BdP)
Leverage	ratio of total liabilities to total assets	Central Balance-Sheet Database (BdP)
Probability of default	a firm's default probability at a one-year horizon (in percentage)	BdP's in-house credit assessment system
Zombie	fuzzy zombie indicator, calculated as described in the Appendix	Central Balance-Sheet Database and authors' calculations
Negative GVA	= 1 if a firm recorded a negative gross value added in 2019; =0 otherwise. Gross value added is defined as: Sales + Operating subsidies + Stock variation + Own work capitalised + Supplementary income - Third party supplies and services - Costs of goods sold and materials consumed - indirect taxes.	Central Balance-Sheet Database (BdP)
Loan level data		
Loan amount	loan amount (in euros)	Central Credit Register (BdP)
Loan interest rate	loan annualised agreed rate (in percentage)	Central Credit Register (BdP)
Loan maturity	loan maturity (in years)	Central Credit Register (BdP)
Guarantee (other than state)	= 1 if a loan has a guarantee other than a state-guarantee; =0 otherwise	Central Credit Register (BdP)
Region level data		
Excess mortality	ratio of the number of deaths between March 2020 and April 2021 and between March 2019 and April 2020 in each region (NUTS II level)	Statistics Portugal
Bank-level data		
Bank assets	total assets of a bank (in millions of euros)	FINREP (BdP)
Bank own funds ratio	ratio of own funds to risk-weighted assets (in percentage)	COREP (BdP)
Bank NPL ratio	ratio of total gross non-performing loans to total gross loans (in percentage)	FINREP (BdP)
Bank ROA	ratio of net income to average assets (in percentage)	FINREP (BdP)
Interbank funding / Assets	ratio of interbank funding to total assets (in percentage)	FINREP (BdP)

Table 2. Descriptive statistics

This table presents summary statistics for the different samples used for estimation in this paper. The upper half of the table presents the state-guarantee sample. It contains data at the firm level, the loan level as well as regional and bank-level data. Descriptive statistics for the moratorium sample are presented in the lower half of the table.

State-guarantee sample	N	Mean	Std.Dev.	5th pct.	Median	95th pct.
Firm level data						
State-guarantee (dummy)	253,251	0.200	0.400	0.000	0.000	1.000
Most affected sector (dummy)	253,251	0.235	0.424	0.000	0.000	1.000
Previous credit relation (dummy)	253,251	0.513	0.500	0.000	1.000	1.000
Previous state guarantee (dummy)	253,251	0.124	0.330	0.000	0.000	1.000
Assets (€ millions)	253,251	1.247	12.500	0.015	0.177	3.715
Cash / Assets	253,251	0.237	0.261	0.001	0.133	0.824
EBITDA / Assets	253,251	0.106	0.765	-0.123	0.082	0.487
Probability of default (%)	253,251	2.554	3.354	0.237	1.386	9.000
Zombie	253,251	0.256	0.399	0.000	0.000	1.000
Negative GVA (dummy)	253,251	0.103	0.304	0.000	0.000	1.000
Loan level data						
Loan amount (€) - with state-guarantee	61,560	132,532	307,101	10,000	50,000	500,000
Loan amount (€) - without state-guarantee	231,235	61,386	476,707	1,189	15,000	191,482
Loan interest rate (%) - with state-guarantee	61,558	1.432	0.509	0.671	1.500	2.250
Loan interest rate (%) - without state-guarantee	230,465	3.583	3.714	0.000	2.500	10.471
Loan maturity (years) - with state-guarantee	61,560	5.379	1.111	3.833	6.000	6.000
Loan maturity (years) - without state-guarantee	231,235	1.580	2.559	0.083	0.333	6.000
Guarantee (other than state) - with state-guarantee	61,560	0.368	0.482	0.000	0.000	1.000
Guarantee (other than state) - without state-guarantee	231,235	0.576	0.494	0.000	1.000	1.000
Region level data						
Excess mortality	7	1.121	0.066	1.045	1.135	1.222
Bank-level data						
Bank assets (€ millions)	34	10,688	22,503	33	787	81,651
Bank own funds ratio (%)	34	31.083	27.663	13.033	19.275	95.808
Bank NPL ratio (%)	34	7.405	10.640	0.134	4.940	25.404
Bank ROA (%)	34	0.131	2.303	-5.804	0.551	2.791
Interbank funding / Assets (%)	34	26.60	35.88	0.00	6.61	95.18

Moratorium sample	N	Mean	Std.Dev.	5th pct.	Median	95th pct.
Firm level data						
Moratorium (dummy)	138,921	0.349	0.477	0.000	0.000	1.000
Most affected sector (dummy)	138,921	0.263	0.440	0.000	0.000	1.000
Previous state guarantee (dummy)	138,921	0.238	0.426	0.000	0.000	1.000
Assets (€ millions)	138,921	2.321	71.178	0.023	0.245	5.142
Cash / Assets	138,921	0.159	0.191	0.002	0.085	0.580
EBITDA / Assets	138,921	-0.038	9.603	-0.222	0.080	0.380
Probability of default (%)	138,921	3.085	4.183	0.181	1.641	10.875
Zombie	138,921	0.290	0.406	0.000	0.000	1.000
Negative GVA (dummy)	138,921	0.066	0.247	0.000	0.000	1.000

Table 3. Descriptive statistics: eligible vs. non-eligible firms for state-guarantees

This table presents summary statistics of firm-level explanatory variables for eligible and non-eligible firms with respect to access to the state guarantees.

	Mean		5th pct.		Median		95th pct.	
	Eligible	Non-eligible	Eligible	Non-eligible	Eligible	Non-eligible	Eligible	Non-eligible
Most affected sector (dummy)	0.231	0.326	0.000	0.000	0.000	0.000	1.000	1.000
Previous credit relation (dummy)	0.515	0.408	0.000	0.000	1.000	0.000	1.000	1.000
Previous state guarantee (dummy)	0.123	0.039	0.000	0.000	0.000	0.000	1.000	0.000
Assets (€ millions)	1.249	2.048	0.015	0.001	0.177	0.033	3.714	1.385
Cash / Assets	0.237	0.190	0.001	0.000	0.133	0.061	0.824	0.892
EBITDA / Assets	0.106	-10.685	-0.123	-5.348	0.082	-0.036	0.487	0.340
Leverage	0.513	268.010	0.037	0.564	0.527	1.611	0.955	27.339
Probability of default (%)	2.555	9.734	0.237	1.020	1.386	7.094	9.001	27.599
Zombie	0.256	0.537	0.000	0.000	0.000	0.846	1.000	1.000
Negative GVA (dummy)	0.104	0.309	0.000	0.000	0.000	0.000	1.000	1.000

Table 4. State-guaranteed loans (firm-level data)

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable is a dummy that is equal to one for eligible firms that received a government-guaranteed loan during the Covid-19 pandemic, and zero for eligible firms that did not. Variables have been normalised to have a mean of zero and a standard deviation of one. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Dependent variable	**State-guarantee dummy**				
	(1)	(2)	(3)	(4)	(5)
Most affected sector	0.129***				
Previous credit relation	0.198***	0.174***	0.177***	0.176***	0.172***
Previous state guarantee	0.206***	0.189***	0.192***	0.190***	0.189***
Assets	0.070***	0.103***	0.098***	0.098***	0.094***
Cash/assets	-0.033***	-0.048***	-0.048***	-0.047***	-0.046***
EBITDA/assets	0.006	0.004	0.005	0.005	0.002
Leverage	0.109***	0.109***	0.109***	0.107***	0.099***
Probability of default	-0.040***	-0.047***	-0.047***	-0.047***	-0.040***
Zombie	-0.036***	-0.027***	-0.027***	-0.026***	
Excess mortality		-0.053***			
Negative GVA					-0.054***
Fixed effects					
Region	YES	NO	YES	NO	NO
Sector	NO	YES	YES	NO	NO
Region-Sector	NO	NO	NO	YES	YES
Number of observation	252,887	252,887	252,887	252,887	252,887
Adjusted R2	0.202	0.228	0.239	0.248	0.250

Table 5. State-guaranteed loans (firm-level data) - deciles

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable is a dummy that is equal to one for eligible firms that received a government-guaranteed loan during the Covid-19 pandemic, and zero for eligible firms that did not. Variables have been normalised to have a mean of zero and a standard deviation of one. The first column of this table corresponds to the fourth column of Table 4, our baseline specification. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Dependent variable	**State-guarantee dummy**		
	(1)	(2)	(3)
Previous credit relation	0.176***	0.174***	0.174***
Previous state guarantee	0.190***	0.188***	0.188***
Assets	0.098***	0.099***	0.098***
Cash/assets	-0.047***		-0.045***
Cash/assets - 2nd decile		0.037***	
Cash/assets - 3rd decile		0.041***	
Cash/assets - 4th decile		0.036***	
Cash/assets - 5th decile		0.025***	
Cash/assets - 6th decile		0.016***	
Cash/assets - 7th decile		0.004	
Cash/assets - 8th decile		-0.002	
Cash/assets - 9th decile		-0.012**	
Cash/assets - 10th decile		-0.010***	
EBITDA/assets	0.005	0.005	-0.003*
Leverage	0.107***	0.105***	
Leverage - 2nd decile			0.008**
Leverage - 3rd decile			0.020***
Leverage - 4th decile			0.034***
Leverage - 5th decile			0.046***
Leverage - 6th decile			0.064***
Leverage - 7th decile			0.078***
Leverage - 8th decile			0.086***
Leverage - 9th decile			0.082***
Leverage - 10th decile			0.085***
Probability of default	-0.047***	-0.044***	-0.045***
Zombie	-0.026***	-0.026***	-0.028***
Fixed effects			
Region	NO	NO	NO
Sector	NO	NO	NO
Region-Sector	YES	YES	YES
Number of observation	252,887	252,887	252,887
Adjusted R2	0.248	0.250	0.247

Table 6. State-guaranteed loans (firm-level data) - firm size classes

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable is a dummy that is equal to one for eligible firms that received a government-guaranteed loan during the Covid-19 pandemic, and zero for eligible firms that did not. Size categories are defined according to the Commission Recommendation 2003/361/EC of 6 May 2003. Micro firms: number of employees < 10, turnover and/or annual balance-sheet total ≤ 2 million euros. Small firms: number of employees < 50, turnover and/or annual balance-sheet total not ≤ 10 million euros. Medium-sized firms: number of employees < 250, turnover ≤ 50 million euros and/or annual balance-sheet total ≤ 43 million euros. Large corporations: remaining cases. Variables have been normalised to have a mean of zero and a standard deviation of one. The first column of this table corresponds to the fourth column of Table 4, our baseline specification. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Dependent variable	**State-guarantee dummy**				
	All firms	Micro	Small	Medium	Large
Previous credit relation	0.176***	0.187***	0.139***	0.121***	0.086***
Previous state guarantee	0.190***	0.157***	0.194***	0.256***	0.054
Assets	0.098***	0.042***	0.056***	-0.003	-0.073***
Cash/assets	-0.047***	-0.046***	-0.091***	-0.075***	-0.019***
EBITDA/assets	0.005	0.006	0.010*	-0.026	-0.005***
Leverage	0.107***	0.100***	0.134***	0.066***	0.034***
Probability of default	-0.047***	-0.032***	-0.034***	-0.038*	-0.031***
Zombie	-0.026***	-0.039***	0.010	0.022	-0.010**
Fixed effects					
Region	NO	NO	NO	NO	NO
Sector	NO	NO	NO	NO	NO
Region-Sector	YES	YES	YES	YES	YES
Number of observation	252,887	211,701	32,519	4,607	436
Adjusted R2	0.248	0.188	0.242	0.335	0.88

Table 7. State-guaranteed loans (loan-level data) - Interest rate

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable in Panel A is the interest rate of loans with a state guarantee. Panel B presents the results for loans without a state guarantee. Variables have been normalised to have a mean of zero and a standard deviation of one. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Panel A						
Dependent variable	**Interest rate (AAR) of loans with a state guarantee**					
	(1)	(2)	(3)	(4)	(5)	(6)
Previous credit relation	0.060***	0.015**	0.050***	0.046***	0.042***	0.042***
Previous state guarantee	-0.014	-0.053***	-0.004	-0.012*	0.005	0.006
Assets	-0.244***		-0.216***	-0.214***	-0.208***	-0.205***
Cash/assets	-0.063***		-0.055***	-0.035***	-0.034***	-0.037***
EBITDA/assets	0.020		0.010	0.020***	0.019***	0.017***
Leverage	0.018		0.006	0.015**	0.013*	0.013*
Probability of default	0.049		0.044*	0.055***	0.053***	0.057***
Zombie	0.025**		0.026***	0.024***	0.021***	
Loan maturity (years)	-0.013	0.026	0.008	0.011	0.008	0.008
Guarantee (other than state)	0.261***	0.204***	0.202***	0.203***	0.215***	0.215***
Bank assets		-0.170***	-0.157***	-0.146***		
Bank own funds ratio		-0.020	-0.005	0.006		
Bank NPL ratio		0.230***	0.223***	0.258***		
Bank ROA		0.356***	0.323***	0.354***		
Interbank funding / Assets		0.279***	0.280***	0.309***		
Negative GVA						-0.005
Fixed effects						
Region	YES	YES	YES	NO	NO	NO
Region-Sector	NO	NO	NO	YES	YES	YES
Bank	NO	NO	NO	NO	YES	YES
Number of observation	61,569	61,569	61,569	61,569	61,569	61,569
Adjusted R2	0.128	0.190	0.230	0.279	0.302	0.301

Panel B						
Dependent variable	**Interest rate (AAR) of loans without a state guarantee**					
	(7)	(8)	(9)	(10)	(11)	(12)
Previous credit relation	0.047***	-0.019*	0.043***	0.041***	0.039***	0.038***
Previous state guarantee	-0.006	-0.035*	0.008	0.009	0.004	0.005
Assets	-0.347***		-0.350***	-0.306***	-0.294***	-0.291***
Cash/assets	-0.044***		-0.041***	-0.043***	-0.040***	-0.041***
EBITDA/assets	0.016		0.006	0.016*	0.019*	0.016*
Leverage	0.014		0.001	0.011	0.015	0.015
Probability of default	0.111***		0.100***	0.094***	0.090***	0.092***
Zombie	0.024		0.016	0.010	0.013	
Loan maturity (years)	-0.212***	-0.189***	-0.205***	-0.205***	-0.213***	-0.214***
Guarantee (other than state)	-0.045**	-0.003	-0.075***	-0.084***	-0.093***	-0.093***
Bank assets		0.026	0.010	0.018		
Bank own funds ratio		-0.004	0.017	0.001		
Bank NPL ratio		0.326***	0.279***	0.266***		
Bank ROA		0.252***	0.187***	0.179***		
Interbank funding / Assets		0.055	0.095***	0.106***		
Negative GVA						-0.007
Fixed effects						
Region	YES	YES	YES	NO	NO	NO
Sector	NO	NO	NO	NO	NO	NO
Region-Sector	NO	NO	NO	YES	YES	YES
Bank	NO	NO	NO	NO	YES	YES
Number of observation	230,544	230,544	230,544	230,544	230,544	230,544
Adjusted R2	0.167	0.091	0.200	0.305	0.332	0.332

Table 8. State-guaranteed loans (loan-level data) - Loan amount

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable in Panel A is the loan amount of loans with a state guarantee. Panel B presents the results for loans without a state guarantee. Variables have been normalised to have a mean of zero and a standard deviation of one. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Panel A						
Dependent variable	**Loan amount of the loans with a state guarantee**					
	(1)	(2)	(3)	(4)	(5)	(6)
Previous credit relation	-0.024***	0.139***	-0.023***	-0.028***	-0.029***	-0.029***
Previous state guarantee	-0.011	0.178***	-0.007	-0.003	0.001	-0.002
Assets	0.777***		0.769***	0.760***	0.760***	0.754***
Cash/assets	0.063***		0.061***	0.044***	0.044***	0.049***
EBITDA/assets	0.025**		0.026**	0.025**	0.026**	0.027***
Leverage	0.073***		0.074***	0.073***	0.073***	0.072***
Probability of default	-0.078***		-0.078***	-0.071***	-0.072***	-0.076***
Zombie	-0.037***		-0.038***	-0.037***	-0.038***	
Loan maturity (years)	0.142***	0.073***	0.137***	0.118***	0.119***	0.119***
Guarantee (other than state)	-0.004	-0.006	-0.002	0.004	0.010*	0.010
Bank assets		0.082***	0.032***	0.036***		
Bank own funds ratio		0.063***	0.012*	0.008*		
Bank NPL ratio		0.002	-0.000	-0.002		
Bank ROA		-0.146***	-0.052**	-0.039***		
Interbank funding / Assets		-0.015*	-0.026*	-0.018*		
Negative GVA						-0.010*
Fixed effects						
Region	YES	YES	YES	NO	NO	NO
Sector	NO	NO	NO	NO	NO	NO
Region-Sector	NO	NO	NO	YES	YES	YES
Bank	NO	NO	NO	NO	YES	YES
Number of observation	61,571	61,571	61,571	61,571	61,571	61,571
Adjusted R2	0.657	0.196	0.66	0.699	0.7	0.699

Panel B						
Dependent variable	**Loan amount of the loans without a state guarantee**					
	(7)	(8)	(9)	(10)	(11)	(12)
Previous credit relation	-0.054***	0.021*	-0.054***	-0.036***	-0.036***	-0.035***
Previous state guarantee	-0.018	0.021	-0.024	-0.038**	-0.028*	-0.028*
Assets	0.349***		0.353***	0.414***	0.406***	0.401***
Cash/assets	-0.008		-0.007	0.016*	0.016**	0.019**
EBITDA/assets	0.066***		0.070***	0.036***	0.035***	0.043***
Leverage	0.106***		0.110***	0.051***	0.050***	0.053***
Probability of default	-0.060***		-0.057***	-0.042***	-0.045***	-0.052***
Zombie	-0.037		-0.039*	-0.027**	-0.030***	
Loan maturity (years)	0.330***	0.307***	0.333***	0.295***	0.306***	0.306***
Guarantee (other than state)	0.311***	0.260***	0.316***	0.235***	0.243***	0.242***
Bank assets		-0.033	-0.013	0.011		
Bank own funds ratio		0.085***	0.064***	0.050***		
Bank NPL ratio		-0.073**	-0.038*	0.005		
Bank ROA		-0.107***	-0.054*	-0.006		
Interbank funding / Assets		-0.030	-0.075***	-0.032		
Negative GVA						0.028***
Fixed effects						
Region	YES	YES	YES	NO	NO	NO
Sector	NO	NO	NO	NO	NO	NO
Region-Sector	NO	NO	NO	YES	YES	YES
Bank	NO	NO	NO	NO	YES	YES
Number of observation	231,279	231,279	231,279	231,279	231,279	231,279
Adjusted R2	0.33	0.23	0.34	0.51	0.52	0.52

Table 9. Moratorium (firm-level data) - dummy

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable is a dummy that is equal to one for eligible firms that went under the moratorium during the Covid-19 pandemic, and zero for eligible firms that did not. Variables have been normalised to have a mean of zero and a standard deviation of one. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Dependent variable	**Moratorium dummy**			
	(1)	(2)	(3)	(4)
Most affected sector	0.106***			
Previous state guarantee	0.188***	0.186***	0.186***	0.186***
Assets	0.067***	0.104***	0.106***	0.108***
Cash/assets	-0.111***	-0.112***	-0.111***	-0.116***
EBITDA/assets	0.005**	0.005**	0.006***	0.005**
Leverage	0.002	0.005**	0.005**	0.005**
Probability of default	0.052***	0.047***	0.046***	0.064***
Zombie	0.032***	0.036***	0.036***	
Negative GVA				-0.027***
Fixed effects				
Region	YES	YES	NO	NO
Sector	NO	YES	NO	NO
Region-Sector	NO	NO	YES	YES
Number of observation	138,997	138,997	138,997	138,997
Adjusted R2	0.081	0.141	0.146	0.146

Table 10. Moratorium (firm-level data) - share

This regression table presents estimation results obtained by using a Linear Probability Model. The dependent variable is the share of the loan amount of eligible firms that went under the moratorium during the Covid-19 pandemic. Variables have been normalised to have a mean of zero and a standard deviation of one. Standard errors are clustered at the sector level. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Dependent variable	**Moratorium dummy**			
	(1)	(2)	(3)	(4)
Most affected sector	0.112***			
Previous state guarantee	0.138***	0.141***	0.142***	0.142***
Assets	0.025	0.062***	0.064***	0.065***
Cash/assets	-0.100***	-0.100***	-0.099***	-0.103***
EBITDA/assets	0.006***	0.006**	0.007***	0.006***
Leverage	0.001	0.003	0.003	0.004
Probability of default	0.052***	0.047***	0.046***	0.058***
Zombie	0.022**	0.027***	0.028***	
Negative GVA				-0.016**
Fixed effects				
Region	YES	YES	NO	NO
Sector	NO	YES	NO	NO
Region-Sector	NO	NO	YES	YES
Number of observation	138,997	138,997	138,997	138,997
Adjusted R2	0.057	0.126	0.13	0.13

Appendix

Calculating the quasi-zombie indicator (based on Mingarelli et al. *(forthcoming))*

The fuzzy zombie definition can be formalised as follows. Let $V_y^{(i)}$ be a vector such that

$$V_y^{(i)} = (ROA_y^{(i)}, NIR_y^{(i)}, DSC_y^{(i)} - 5\%),$$

with
$ROA_y^{(i)}$ = return on assets of firm i in year y,
$NIR_y^{(i)}$ = net investment ratio of firm i in year y,
$DSC_y^{(i)}$ = debt service capacity of firm i in year y.

In the binary setup by Storz *et al.* (2017), firm i is defined as a zombie if its $ROA < 0$, $NIR < 0$, and $DSC < 5\%$ for $Y = 2$ consecutive years. This can be written as a simple geometric mean:

$$Z_{i,y} = \left(\prod_{w=0}^{Y-1} \prod_{x_y \in V_y^{(i)}} \mathbb{1}_{x_{y-w} < 0} \right)^{\frac{1}{Y|V|}}.$$

For the fuzzy version of the zombie, we define a kernel $k(x)$ as

$$k(x) = \mathbb{1}_{x<0} + \frac{\bar{x} - x}{\bar{x}} \mathbb{1}_{0 \leq x < \bar{x}},$$

where $\bar{x} \equiv median(x)$. The geometric mean thus becomes

$$Z^*_{i,y} = \left(\prod_{w=0}^{Y-1} \prod_{x_y \in V_y^{(i)}} k(x_{y-w}) \right)^{\frac{1}{Y|V|}}.$$

We adapt the Storz et. al. (2017) zombie definition in order to arrive at a continuous (fuzzy) definition, following the same reasoning of Mingarelli *et al.* (forthcoming).

As in Storz et. al. (2017), we exclude certain (structurally different) sectors: primary sector (NACE 01-09), financial sector (NACE 64-66), public administration (NACE 84), activities of households (NACE 97-98), extraterritorial organisations (NACE 99). Firms with negative total assets, negative liabilities or negative stock of capital[12] were also excluded. Contrary to Storz et. al. (2017), we keep listed and large firms in the sample.

12. Calculated as the book value of each firm's tangible and intangible assets.

Inactive firms were also dropped from our sample. A firm is considered inactive if: a) their assets and liabilities do not change in two consecutive years, b) firms' EBITDA is equal to zero, and c) the firm is inactive in their last year in the sample.

Finally, we interpolate values for a single missing year in between two years for which data exists (simple average) for assets, liabilities, EBITDA, stock of capital, cash holdings, equity and net income.

When one of the indicators that are required to classify a firm as zombie is missing but one of the other indicators is available and fails the zombie threshold, we classify the firm as a non-zombie. If a firm is not a zombie in year t-1, we assume it is also not a zombie in year t (by definition) if it has no data available.

When estimating the fuzzy zombie, the median of each variable (net investment, ROA and DSC) is being estimated based only on positive values ($\overline{x} \equiv median(x)^{+}$). This assumption differs from Mingarelli *et al.* (forthcoming), who also consider the zeros to estimate the median. Our option is explained by the large number of firms in Portugal with zero net investment that would make the median of investment equal to 0 (if the zero was included in the calculation). The zeros were also excluded from the calculation of the median of other variables in order to be aligned with the treatment of investment.

Working Papers

2020

1|20 On-site inspecting zombie lending
Diana Bonfim | Geraldo Cerqueiro | Hans Degryse | Steven Ongena

2|20 Labor earnings dynamics in a developing economy with a large informal sector
Diego B. P. Gomes | Felipe S. Iachan | Cezar Santos

3|20 Endogenous growth and monetary policy: how do interest-rate feedback rules shape nominal and real transitional dynamics?
Pedro Mazeda Gil | Gustavo Iglésias

4|20 Types of International Traders and the Network of Capital Participations
João Amador | Sónia Cabral | Birgitte Ringstad

5|20 Forecasting tourism with targeted predictors in a data-rich environment
Nuno Lourenço | Carlos Melo Gouveia | António Rua

6|20 The expected time to cross a threshold and its determinants: A simple and flexible framework
Gabriel Zsurkis | João Nicolau | Paulo M. M. Rodrigues

7|20 A non-hierarchical dynamic factor model for three-way data
Francisco Dias | Maximiano Pinheiro | António Rua

8|20 Measuring wage inequality under right censoring
João Nicolau | Pedro Raposo | Paulo M. M. Rodrigues

9|20 Intergenerational wealth inequality: the role of demographics
António Antunes | Valerio Ercolani

10|20 Banks' complexity and risk: agency problems and diversification benefits
Diana Bonfim | Sónia Felix

11|20 The importance of deposit insurance credibility
Diana Bonfim | João A. C. Santos

12|20 Dream jobs
Giordano Mion | Luca David Opromolla | Gianmarco I.P. Ottaviano

13|20 The DEI: tracking economic activity daily during the lockdown
Nuno Lourenço | António Rua

14|20 An economic model of the Covid-19 pandemic with young and old agents: Behavior, testing and policies
Luiz Brotherhood | Philipp Kircher | Cezar Santos | Michèle Tertilt

15|20 Slums and Pandemics
Luiz Brotherhood | Tiago Cavalcanti | Daniel Da Mata | Cezar Santos

16|20 Assessing the Scoreboard of the EU Macroeconomic Imbalances Procedure: (Machine) Learning from Decisions
Tiago Alves | João Amador | Francisco Gonçalves

17|20 Climate Change Mitigation Policies: Aggregate and Distributional Effects
Tiago Cavalcanti | Zeina Hasna | Cezar Santos

18|20 Heterogeneous response of consumers to income shocks throughout a financial assistance program
Nuno Alves | Fátima Cardoso | Manuel Coutinho Pereira

19|20 To change or not to change: the impact of the law on mortgage origination
Ana Isabel Sá

2021

1|21 Optimal Social Insurance: Insights from a Continuous-Time Stochastic Setup
João Amador | Pedro G. Rodrigues

2|21 Multivariate Fractional Integration Tests allowing for Conditional Heteroskedasticity withan Application to Return Volatility and Trading
Marina Balboa | Paulo M. M. Rodrigues Antonio Rubia | A. M. Robert Taylor

3|21 The Role of Macroprudential Policy in Times of Trouble
Jagjit S. Chadha | Germana Corrado | Luisa Corrado | Ivan De Lorenzo Buratta

4|21 Extensions to IVX Methodsnof Inference for Return Predictability
Matei Demetrescu | Iliyan Georgiev | Paulo M. M. Rodrigues | A.M. Robert Taylor

5|21 Spectral decomposition of the information about latent variables in dynamic macroeconomic models
Nikolay Iskrev

6|21 Institutional Arrangements and Inflation Bias: A Dynamic Heterogeneous Panel Approach
Vasco Gabriel | Ioannis Lazopoulos | Diana Lima

7|21 Assessment of the effectiveness of the macroprudential measures implemented in the context of the Covid-19 pandemic
Lucas Avezum | Vítor Oliveiral | Diogo Serra

8|21 Risk shocks, due loans, and policy options: When less is more!
Paulo Júlio | José R. Maria | Sílvia Santos

9|21 Sovereign-Bank Diabolic Loop: The Government Procurement Channel!
Diana Bonfim | Miguel A. Ferreira | Francisco Queiró | Sujiao Zhao

10|21 Assessing the effectiveness of the Portuguese borrower-based measure in the Covid-19 context
Katja Neugebauer | Vítor Oliveira | Ângelo Ramos

11|21 Scrapping, Renewable Technology Adoption, and Growth
Bernardino Adão | Borghan Narajabad | Ted Temzelides

12|21 The Persistence of Wages
Anabela Carneiro | Pedro Portugal | Pedro Raposo | Paulo M.M. Rodrigues

13|21 Serial Entrepreneurs, the Macroeconomy and top income inequality
Sónia Félix | Sudipto Karmakar | Petr Sedláček

14|21 COVID-19, Lockdowns and International Trade: Evidence from Firm-Level Data
João Amador | Carlos Melo Gouveia | Ana Catarina Pimenta

15|21 The sensitivity of SME's investment and employment to the cost of debt financing
Diana Bonfim | Cláudia Custódio | Clara Raposo

16|21 The impact of a macroprudential borrower based measure on households' leverage and housing choices
Daniel Abreu | Sónia Félix | Vítor Oliveira | Fátima Silva

17|21 Permanent and temporary monetary policy shocks and the dynamics of exchange rates
Alexandre Carvalho | João Valle e Azevedo | Pedro Pires Ribeiro

18|21 On the Cleansing Effect of Recessions and Government Policy: Evidence from Covid-19
Nicholas Kozeniauskas | Pedro Moreira | Cezar Santos

19|21 Trade, Misallocation, and Capital Market Integration
Laszlo Tetenyi

20|21 Not All Shocks Are Created Equal: Assessing Heterogeneity in the Bank Lending Channel
Laura Blattner | Luísa Farinha | Gil Nogueira

21|21 Coworker Networks and the Labor Market Outcomes of Displaced Workers: Evidence from Portugal
Jose Garcia-Louzao | Marta Silva

22|21 Markups and Financial Shocks
Philipp Meinen | Ana Cristina Soares

2022

1|22 Business cycle clocks: Time to get circular
Nuno Lourenço | António Rua

2|22 The Augmented Bank Balance-Sheet Channel of Monetary Policy
Christian Bittner | Diana Bonfim | Florian Heider | Farzad Saidi | Glenn Schepens | Carla Soares

3|22 Optimal cooperative taxation in the global economy
V. V. Chari | Juan Pablo Nicolini | Pedro Teles

4|22 How Bad Can Financial Crises Be? A GDP Tail Risk Assessment for Portugal
Ivan De Lorenzo Buratta | Marina Feliciano | Duarte Maia

5|22 Comparing estimated structural models of different complexities: What do we learn?
Paulo Júlio | José R. Maria

6|22 Survival of the fittest: Tourism Exposure and Firm Survival
Filipe B. Caires | Hugo Reis | Paulo M. M. Rodrigues

7|22 Mind the Build-up: Quantifying Tail Risks for Credit Growth in Portugal
Ivan de Lorenzo Buratta | Marina Feliciano | Duarte Maia

8|22 Forgetting Approaches to Improve Forecasting
Robert Hill | Paulo M. M. Rodrigues

9|22 Determinants of Cost of Equity for listed euro area banks
Gabriel Zsurkis

10|22 Real effects of imperfect bank-firm matching
Luísa Farinha | Sotirios Kokas | Enrico Sette | Serafeim Tsoukas

11|22 The solvency and funding cost nexus – the role of market stigma for buffer usability
Helena Carvalho | Lucas Avezum | Fátima Silva

12|22 Stayin' alive? Government support measures in Portugal during the Covid-19 pandemic
Márcio Mateus | Katja Neugebauer