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ON-SITE INSPECTING ZOMBIE LENDING

Abstract

In spite of growing regulatory pressure in most developed economies, “zombie lending” remains a widespread practice by banks. In this paper we exploit a series of large-scale on-site inspections made on the credit portfolios of several Portuguese banks to investigate how these inspections affect banks’ future lending decisions. We find that an inspected bank becomes 20% less likely to refinance zombie firms, immediately spurring their default. However, banks change their lending decisions only in the inspected sectors. Overall, banks seemingly reduce zombie lending because the incentives to hold these loans disappear once they are forced to recognize losses.

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On-site inspecting zombie lending

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On-site inspecting zombie lending

Abstract

In spite of growing regulatory pressure in most developed economies, “zombie lending” remains a widespread practice by banks. In this paper we exploit a series of large-scale on-site inspections made on the credit portfolios of several Portuguese banks to investigate how these inspections affect banks’ future lending decisions. We find that an inspected bank becomes 20% less likely to refinance zombie firms, immediately spurring their default. However, banks change their lending decisions only in the inspected sectors. Overall, banks seemingly reduce zombie lending because the incentives to hold these loans disappear once they are forced to recognize losses.

1. Introduction

Banking crises are associated with prolonged declines in financial intermediation and economic activity. Laeven and Valencia (2018) for example document that more than half of the banking crises in high-income countries lasted at least five years and generated a median cumulative output loss of 35% of GDP. An important driver is that banks continue lending to non-viable firms (“zombie firms”) in the hope to recover previously granted loans. Such behavior is particularly strong in a low interest rate environment, a setting that is expected to be prevalent in the coming years (Banerjee and Hoffman, 2018). Banks may do so in order to avoid or delay the recognition of credit losses. An open question is whether and how the enforcement of regulation remedies the problem of banks’ zombie-lending. In this paper, we aim to answer this question by studying “unconventional supervision” stemming from two special on-site inspection programs that reflect a coordinated effort of bank supervisors.

The importance of zombie lending and its implications for the economy have been discussed by policy makers and academics alike. Zombie lending affects the allocation of credit. Through its impact on product market competition, it can have important effects on productivity and economic growth (Peek and Rosengren, 2005; Caballero et al., 2008; Schivardi et al., 2017; Adalet McGowan et al., 2018).¹ Regulators and supervisors have been struggling to deal with evergreening by banks. Giannetti and Simonov (2013) for example show that bank bailouts with sufficiently large recapitalizations may mitigate evergreening. Tighter regulation could be another approach. However, recent evidence

¹ The Financial Times writes in its February 23, 2018 edition: “On average, across the US, Japan, Australia and western Europe, the proportion of firms that are zombies has risen five-fold since 1987, from 2 to 10 percent”. See <https://www.ft.com/content/40c44992-17c3-11e8-9376-4a6390adb44>. Banerjee and Hofmann (2018) study the importance of publicly listed zombie firms in 14 countries. They show that their presence has ratcheted up since the late 1980s.

documents that in spite of the stricter regulatory environment, this type of pervasive bank behavior became widespread in Europe following the global financial crisis (see for example Acharya et al., 2019). We ask whether bank supervisory on-site inspection programs may offer part of the solution, in case banks adjust their behavior when facing stricter supervisory scrutiny.

We show that stricter supervision of banks ex post turns out to be an effective tool in mitigating zombie lending. The “unconventional supervision” episode we study captures a combined effort of the Troika (i.e., the International Monetary Fund, European Central Bank and European Commission), the banks’ usual supervisor (Banco de Portugal), and hired external auditors. In particular, we exploit actual on-site bank inspections of the credit portfolios of the largest Portuguese banks to investigate how such inspections affect banks’ behavior towards the refinancing of zombie firms. The main goal of the inspection program was to validate the quality of assets that the banks were using as inputs for their regular risk assessments. These validation exercises implied an unprecedented level of intrusion, since the inspectors analyzed a large number of individual credit files of the selected banks and had the freedom to collect additional information from the borrowers themselves.² The timing and the intrusiveness of the inspection program came largely as a surprise to the banking sector.

We combine this quasi-experimental setting with a comprehensive configuration of three matched economy-wide datasets that are maintained by Banco de Portugal. First, we obtain from the Credit Register all loans (above 50 euros) granted to Portuguese firms. Second, we obtain financial information for all Portuguese firms. After merging these two datasets we are able to characterize in detail all firms with bank loans in Portugal. Third,

² The assessments were carried out by more than 300 experts, who spent 153,000 working hours going through individual credit files that amounted to a total of €92 billion.

we further merge the resulting dataset with supervisory bank-level information that covers all banks operating in Portugal.

We study two special inspection programs to investigate to which extent unconventional bank supervision can mitigate zombie lending by banks.³ The first, which took place in the middle of 2012, focused on the construction and real estate sectors (referenced to as the “sectoral inspection”). The second took place in the middle of 2013 and comprised all sectors (referenced to as the “general inspection”). We analyze the effect of those inspections on a bank’s willingness to refinance a zombie firm using triple-difference regressions and saturating the specifications with firm-by-year, bank-by-year, and firm-by-bank fixed effects. Our identification thus comes from comparing the triple difference in lending: (i) to the same firm by an inspected versus a non-inspected bank, (ii) by the same bank to zombie versus non-zombie firms, and (iii) for the same firm-bank pair before versus after the inspections.

We find that an inspected bank is about 4 percentage points less likely to refinance a zombie firm after the inspection (relative to a non-inspected bank, to a non-zombie firm, and to the pre-inspection period). The estimated effect holds across different specifications and for different definitions of a zombie firm, and it is quantitatively similar for the two inspection episodes we analyze. Moreover, it is economically important as it represents 20% of the unconditional probability that a zombie firm is refinanced. We may actually underestimate the disciplining role of supervision if the non-inspected banks also get scared and modify their lending behavior to zombie firms.

³ Zombie lending in Portugal has been documented for example by Azevedo et al. (2018), Blattner et al. (2018), and Gouveia and Osterhold (2018). In Appendix 1 we characterize zombie lending in our sample.

One potential concern about our empirical design is that the inspected banks are larger than the non-inspected banks, and thus potentially different in other relevant dimensions. We note that our empirical methodology relies on a within-bank comparison that already controls for time-varying bank characteristics. However, we assuage any lingering concerns in two ways. First, we show that, prior to the inspections, the inspected and non-inspected banks were refinancing zombie firms at similar rates. That is, pre-trends are parallel across the two groups. Second, we show that our results are similar if we restrict our sample to the smallest inspected banks and the largest non-inspected, making the two groups of banks more balanced in terms of size.

Having established that more intrusive bank supervision helps mitigate zombie lending, next we question why inspected banks are changing their lending behavior. The inspected banks were forced to recognize the lower quality of their credit portfolios (and bear the corresponding capital costs). Consequently, one possibility is that banks reduce zombie lending because the cost of maintaining those loans just went up. A second possibility is that the breadth and intrusiveness of the inspections have a broader disciplining effect on banks. That is, banks may be reducing zombie lending in order to reduce the likelihood and supervisory implications of future inspections.

Our evidence points to the former explanation. To distinguish between the two mechanisms, we focus on the sectoral inspections, which enable us to compare how inspected banks changed their lending behavior in inspected (construction and real estate) and non-inspected sectors. If the inspections had a general disciplining effect, we should see a significant drop in banks' propensity to refinance zombie firms in all sectors. However, we find that banks reduce their propensity to refinance zombie firms only in the inspected sectors. Our results suggest that inspecting banks across all sectors is

therefore necessary to modify banks' behavior across the board. Further, encouraging a prompt recognition of losses decreases incentives for zombie lending.

Finally, we investigate how the inspections affect firm default. A bank that refinances a zombie borrower is preventing this firm from defaulting on its outstanding debt. If the inspections are indeed mitigating such incentives, then the affected firms should become more likely to default after the inspections. This is precisely what we find as within a year after the inspection of their bank, zombies are 1 to 2 percentage points more likely to default.

Although direct bank supervision is a crucial pillar of regulatory oversight, empirical evidence on how it affects (future) bank credit decisions at the loan level is, to the best of our knowledge, scant.⁴ The studies closest to ours are Granja and Leuz (2019) and Haselmann et al. (2019). Granja and Leuz (2019) employ bank-level data to study how the transition under the Dodd-Frank Act of several banks to a different supervisor affects these banks' lending policies and local firm activity. They find that stricter bank supervision leads to an increase in small business loans and higher entry and exit rates.⁵ Other recent work focuses on supra(national) supervision. Haselmann et al. (2019) compare the behavior of different bank supervisors around the adoption of the Single Supervisory Mechanism (SSM) under the European Central Bank. Banks under direct supervision of the SSM report higher risk-weights, higher probability of default and lower

⁴ Agarwal et al. (2014) find that federal regulators are systematically tougher than state regulators, downgrading supervisory ratings almost twice as frequently, and that banks consequently report worse asset quality, higher regulatory capital ratios, and lower return on assets. Delis et al. (2018) find that regulatory interventions in the US promote bank accounting quality, especially during periods of crisis. Gropp et al. (2019b) study banks' incentives to engage in regulatory arbitrage to increase their capital ratios and find that arbitrage is more pronounced in countries where national supervisors have more discretion to engage in regulatory forbearance.

⁵ A few studies have looked at the impact of the intrusiveness of bank supervision on *bank level* outcomes. These studies found that supervision reduces the probability of bank failure and increases bank profitability (Rezende and Wu, 2013; Fuster et al., 2018; Hirtle et al., 2019). Eisenbach et al. (2019) exploit unique data on the working hours of Federal Reserve System bank supervisors to find that supervision exhibits large economies of scale and that increased supervision reduces bank distress.

collateral ratios relative to non-SSM banks lending to the same firm. They further find that this is reflected in SSM banks reducing lending, with negative impacts on firms' real outcomes. Hence, both papers investigate the impact of changes in regulatory and supervisory authorities and technology, while our paper adds to this literature by studying the impact of actual bank supervisory on-site inspections that aim to assess whether banks' provisioning levels were adequate. Ivanov and Wang (2019) study variation in supervisory intensity at the level of syndicated loans. They find that banks reduce loan commitments, increase monitoring and adversely revise their internal risk estimates for borrowers under increased supervisory scrutiny. Our analysis deals with the impact of heterogeneous supervisory scrutiny at bank-firm level on zombie lending.

Other related work considers the impacts of bank stress tests on bank lending behavior. The stress tests often result in additional capital requirements and greater supervisory scrutiny. Cortés et al. (2020) find that the stress tests conducted by the Federal Reserve Board reduced the stress-tested lenders' supply of credit to smaller and riskier businesses. Smaller banks (that are not tested) however do pick up the slack by increasing their share in those regions that were formerly relying more upon stress-tested lenders. Pierret and Steri (2019) also focus on the US stress tests and show that higher capital requirements are not a substitute for supervisory scrutiny when aiming for prudent lending. Our paper deals with coordinated supervision for a subset of banks in specific sectors. This allows to compare bank lending behavior towards inspected and non-inspected sectors.

The remainder of this paper is organized as follows. Section 2 describes the institutional setting. Section 3 details the data and variables. Section 4 investigates the effects of the bank inspections. Section 5 presents a number of robustness tests. Section 6 concludes.

2. Institutional setting

The Portuguese Government signed in May of 2011 a financial assistance program with the International Monetary Fund, the European Commission, and the European Central Bank. At that time, several European countries, including Spain and Ireland, were dealing with extensive crises in their banking sectors. For this reason, the national supervisory authority (Banco de Portugal) was called to implement a program of special on-site inspections to assess the health of the banking sector in Portugal.

The main goal of the inspection program was to assess the credit portfolios and validate the quality of assets that these banking groups were using as inputs for their risk assessment. The inspections were carried out in the eight largest national banking groups, which altogether represented about 80% of the total assets of the banking system. The selection was imposed by supervisors and based only on bank size. It would not be feasible to inspect all banks at once, as intrusive inspection programs are very costly in terms of both the coordination effort between the many parties involved and the human resources used.

The inspection program was monitored by a committee that included experts from Banco de Portugal, but also from the International Monetary Fund, the European Central Bank, the European Commission and three additional European central banks (Banco de España, the National Bank of Belgium, and Banque de France).⁶ The inspections we discuss in this paper involved a total of 58 employees of the Banco de Portugal and 289 external auditors, who spent 153,000 working hours going through individual credit files that amounted to a total of €92 billion (about 43% of the Portuguese GDP in 2019).

These inspections were unconventional in at least three dimensions. The first is the level of granularity, as the auditors had to analyze selected loans one-by-one. Second,

⁶ The actual inspections were carried out by external auditing firms.

banks had to mobilize resources to host the inspecting teams and satisfy their information requests promptly, facilitating the information flow. Third, the inspections were unexpectedly intrusive in the sense that auditors had the freedom not only to analyze the credit books and talk to loan officers, but also to seek additional information directly from borrowers and to perform on-site visits.

There were three inspection waves. The first was carried out between end-July and end-November of 2011 and targeted loans to households. The second and third inspections targeted corporate loans and are the focus of our analysis. We describe these two inspections below.

2.1. Sectoral Inspection

The construction and real estate sectors were particularly hit during the Great Recession and the ensuing European sovereign debt crisis (Azevedo et al., 2018). Since the Portuguese banks were considerably exposed to these sectors, Banco de Portugal carried a special on-site inspection program directed at the construction and real estate sectors. We refer to this inspection as the Sectoral Inspection.⁷

The inspections involved the eight largest banking groups and were carried out between July and November of 2012. The reference period is June 2012, meaning that only loans granted up to this point were eligible for inspection.⁸ The inspections focused not only on loans granted to firms operating in the construction and real estate sectors, but also on firms in sectors with close links to the construction sector (mainly suppliers and the tourism sector). For the eight banking groups as a whole, the total exposure

⁷ For additional details: https://www.bportugal.pt/sites/default/files/anexoscombp20121203_en.pdf.

⁸ The European Banking Authority's Capital Exercise was held in November 2011 and could be a potential confounding event taking place in the pre-event window (e.g., Degryse et al., 2019; Gropp et al., 2019a). As we explain below when describing our empirical methodology, our within-bank comparison of loans to different firms and sectors eases such concerns.

eligible amounted to €69 billion, which accounts for around 40% of their corporate lending portfolio. A sample of 2,856 firms that accounted for a total of €39 billion loans (or 56% of the eligible portfolio) was audited.

The final report was released on December 3, 2012. The report concluded that the eight banking groups inspected needed to reinforce impairments by €861 million (around 2.2% of the overall amount of exposures assessed). Importantly, the inspected banks were not instructed to stop lending to any particular firm; they were simply forced to recognize the lower quality of their credit portfolios and bear the corresponding costs. Therefore, any changes in lending behavior we observe are ultimately the decision of the bank.

2.2. General Inspection

The same eight banking groups were subject to another inspection in the second and third quarter of 2013. The reference period for this second inspection is April 2013, meaning that only loans granted up to this point were eligible for inspection. The purpose of this inspection was again to assess the adequacy of these banks' provisioning levels.

In contrast to the previous inspection that covered particular sectors, all corporate loans (except mortgages and loans granted to public entities) were eligible. To minimize any potential overlap between the two inspections, we drop from the analysis all firms in the construction and real estate sectors, since these sectors were already covered by the previous inspection.

The total exposure covered was €93 billion, including off-balance-sheet exposures such as guarantees conceded and committed credit lines. A sample of 2,206 firms that accounted for a total of €53 billion loans (or 57% of the eligible portfolio) were audited. The final report was released on Aug 2, 2013. The report concluded that the eight banking groups inspected needed to reinforce impairments by €1.1 billion (around 2.1%

of the overall amount of exposures assessed).⁹ As before, the banks were not mandated to target any individual loans or firms.

3. Data and variables

3.1. Data sources

Our analysis uses three comprehensive datasets. First, we obtain from the Central Credit Register nearly all loans granted to non-financial firms in Portugal. This credit register is maintained by Banco de Portugal, which is the regulator and supervisor of the banking system in Portugal. It has nearly full coverage, since the reporting threshold is set at a minimum of 50 euros and reporting is mandatory for all banks and credit institutions. Banks report on a monthly basis detailed data on their loan exposures, including off-balance sheet commitments, such as unused credit lines. For each reported exposure there is information on loan amounts, loan types and loan status. This includes information on whether the loan is performing, overdue, in renegotiation, or written-off.

We collapse the credit register data at the quarterly frequency and match these loan-level data to both firm-level and bank-level data. Firm-level data include detailed balance-sheet and financial statements, as well as location, employment, and age for all firms operating in Portugal. All Portuguese firms are required to file this information on an annual basis. Bank-level data include accounting and prudential information for all banks operating in Portugal. Our final dataset is a panel at the firm-bank-quarter level that covers all loans (above 50 euros) granted in Portugal.

3.2. Sample period

⁹ For additional details: <https://www.bportugal.pt/en/comunicado/credit-portfolio-impairment-review-exercise-confirms-resilience-and-robustness-national>.

Our main sample period is from 2011:Q3 to 2014:Q3. For each of the two inspections analyzed, we build a sample with ten quarters: four quarters before the inspection, the two quarters during which the inspection takes place, and four quarters after the inspection. For the Sectoral Inspection, the corresponding timeline is: 2011:Q3 – 2012:Q2 (pre-inspection), 2012:Q3 – 2012:Q4 (inspection), and 2013:Q1 – 2013:Q4 (post-inspection). For the General Inspection, the timeline is: 2012:Q2 – 2013:Q1 (pre-inspection), 2013:Q2 – 2013:Q3 (inspection), and 2013:Q4 – 2014:Q3.

3.3. Variables

We define our variables in Table 1. *Zombie lending* (or evergreening) consists of repeated lending to firms that are insolvent, through which the bank attempts to postpone losses or eventually hope for a possible recovery of the firm. To capture this behavior, we focus on new loans being granted to existing borrowers. We define *New loan* as an indicator of whether the bank strictly increases its exposure relative to an existing borrower, including lines of credit. This is our main dependent variable.

A zombie firm is essentially an unviable firm. We define *Zombie firm* as one with negative equity in the previous year. The economic rationale behind our definition is that this is a firm that is technically insolvent. It is quite risky for a lender to refinance such highly levered firms. Although one may argue that banks can price in this risk, charging a high loan rate would raise financing costs and thus make these firms even more financially distressed. The available empirical evidence suggests that the opposite actually happens, as banks grant loans at soft terms to zombie firms (Caballero et al., 2008; Acharya et al., 2019). While this is our main definition of a zombie firm, we show that our results hold when we employ multiple alternative definitions.

As mentioned in Section 2, the inspection programs applied only to the eight largest banks in Portugal. The variable *Inspected bank* indicates whether the bank was

subject or not to the inspections. *Default* is an indicator for whether the firm is in default with a current lender.

The four variables discussed above form the backbone of our empirical analysis. We also provide information about some additional variables that, while not directly used in estimation, help understand our data and sample characteristics. First, we compute two relationship measures: the duration of relationship (in years) and an indicator of whether the firm has a main bank (i.e., a bank that concentrates at least 75% of the firm's loans). Second, we collect some firm characteristics: an indicator of whether the firm is small (with number of employees below 50 and annual balance sheet total below €10 million), the number of employees, the firm's leverage ratio, and the firm's profitability (measured by its return on assets).

3.4. Summary statistics

Table 2 presents the summary statistics of the data. Our data offer three sources of variation: across firms, across banks, and across time (year-quarters). The sample period is from 2011:Q3 to 2014:Q3 and comprises the two inspection events. In Appendix Table A2 we provide separate descriptive statistics for the two inspections. As explained below, our estimation sample only uses firms that borrow from multiple banks, since we employ firm-year fixed effects.

The unconditional probability that a bank refinances an existing borrower in a given quarter is 18.4%. The fraction of zombie firms in our sample is almost 15%. More than 62% of the loans in our sample were granted by one of the eight banks that were subject to the inspections. The fraction of firms in default with a current lender is 10.5%. These four variables are the key ingredients of our regressions.

Concerning the other variables, average relationship duration is 6 years and only 15.4% of the firms have a main lender (i.e., at least 75% of their loans were granted by

one bank). The remaining variables show that firms are on average small, highly leveraged, and unprofitable.

3.5. Univariate tests

In Table 3 we present difference-of-means comparisons between zombie and non-zombie firms (Panel A) and between inspected and non-inspected banks (Panel B). Panel A shows that the two types of firms have nearly identical loan refinancing rates at around 18%. We also see that the group of banks that were subject to the inspections has a lower fraction of zombie borrowers, a result that is confirmed in Panel B. Since these statistics are calculated for the entire sample period, which includes the two inspections, this difference may already indicate a reduction in lending by the inspected banks to such borrowers. Relationship characteristics also differ significantly across zombie and non-zombie firms. Most notably, zombie firms are more likely to have a main bank that concentrates at least 75% of the credit to this firm. Finally, zombie firms are substantially smaller and, as expected, they are more leveraged and less profitable than the non-zombie firms.

Panel B compares inspected and non-inspected banks. Recall that the eight largest banking groups were selected for the inspections. The differences we observe between the two types of banks likely reflect differences in bank size. In particular, inspected banks lend to larger borrowers, with whom they maintain longer lending relationships and are more likely to be the main lenders.

3.6. Validating our definition of zombie firm

The zombie firms are observationally riskier than the non-zombie firms. However, this static comparison does not account for potential growth opportunities, which might be especially important for the small firms that represent a large part of our

sample. In addition, banks likely possess more precise information about the quality of their borrowers than we do. While such information is by definition unobservable to us, we can test whether those firms that we label as *zombies* turn out to be worse ex post than their non-zombie peers. We therefore validate our definition of zombie firm by comparing the out-of-sample performance of zombie and non-zombie firms using annual data for the period 2005 to 2010. We perform this comparison prior to the inspections to avoid any possible contamination of the inspections.

We present some suggestive evidence in Figure 1. For each sample year we tag firms either as zombies or non-zombies based on whether they have or not negative equity in the previous year. Think of time zero as the reference year in which we classify firms. Then we compute the average difference between zombies and non-zombies in default rates (top graph), exit rates (middle graph), and employment (bottom graph), for one, two, three, and four years following the reference year.

The figure shows for example that in one year a zombie firm is 15 percentage points more likely to default and 13 percentage points more likely to exit than a non-zombie. The differences in default and exit rates between zombie and non-zombie firms decrease with the horizon (because the worse zombies die quickly), but remain economically relevant. The bottom graph shows a similar pattern for employment, as the zombie firms experience lower employment growth (-10 to -15 employees) than the non-zombie firms.

4. Empirical methodology

We want to measure the causal impact of the inspections on a bank's propensity to refinance a zombie firm. We estimate separate regressions for each of the two inspections using eight quarters of data: the four quarters before the inspection and the four quarters after the inspection. We omit the two quarters during which the inspections

are taking place in order to identify clear before and after changes. We estimate triple differences regressions, which in its most saturated specification is:

$$NewLoan_{fbt} = \alpha_{ft} + \alpha_{bt} + \alpha_{bf} + \beta(Inspected_b \times Zombie_f \times Post_t) + \epsilon_{fbt}, \quad (1)$$

where $NewLoan_{fbt}$ equals one whenever there is strictly positive loan growth from quarter t to $t+1$ within a firm-bank pair, zero otherwise. $Zombie_f$ indicates whether firm f is considered to be zombie or not based on its previous year's financials. $Inspected_b$ indicates whether bank b is subject to inspections or not. The coefficient of interest β measures how the propensity of an inspected bank (relative to a non-inspected bank) to refinance a zombie firm (relative to a non-zombie firm) changes after the inspection (relative to the pre-inspection period). α_{ft} , α_{bt} and α_{bf} capture firm-time, bank-time, and bank-firm fixed effects, respectively. ϵ_{fbt} is the error term.

The two-way fixed effects account for time-varying unobserved heterogeneity both across firms (such as changes in credit demand, as in Khwaja and Mian, 2008) and across banks (such as changes in credit supply), and control for potential biases due to firm-bank matching. Our identification thus comes from comparing the change in lending: (i) for the same firm from an inspected bank relative to a non-inspected bank, (ii) by the same bank to zombie firms relative to non-zombie firms, and (iii) for the same firm-bank pair before and after the inspections.

At the same time, the high number of fixed effects may limit the external validity of our results. In fact, equation (1) uses variation only from firms that borrow from at least two banks, and in which one of them is inspected and the other is not. For this reason, we also present results from less restrictive regression models with one-way effects (firm, bank, and time).

One final point that merits discussion is the comparison between inspected and non-inspected banks. Since the inspected banks are substantially larger than the non-inspected banks, one could argue that they are also likely to differ in other relevant dimensions, such as their lending policies. We note, however, that the regression in equation (1) is performing a within-bank comparison. In order to address any lingering concerns regarding potential differences between inspected and non-inspected banks, we perform two additional tests. First, we test for the plausibility of the parallel trends assumption by investigating the period-by-period adjustment of our dependent variable during the inspection windows.¹⁰ That is, we examine whether before the inspections the inspected and non-inspected banks changed their exposures to zombie (relative to non-zombie) firms at similar rates. Second, we re-estimate equation (1) using only the four smallest banks that are inspected and compare them to the four largest banks that are not inspected. This sample restriction should improve our estimate of the counterfactual, as it helps balance the inspected and non-inspected banks in terms of size (and presumably other relevant unobservable characteristics).

5. Results

5.1. Evidence from the general inspection

We start by showing results for the general inspection, since this was the broadest and most penalizing inspection for banks. On the one hand, this inspection covered corporate loans from all sectors (except mortgages and loans granted to public entities). The fact that it covered all economic sectors is important from an external validity viewpoint (recall that the sectoral inspection focuses only on the construction and real

¹⁰ We do so by replacing $Inspected_b \times Zombie_f \times Post_t$ by a sequence of interactions where the dummy $Post_t$ is replaced by time dummies spanning all periods used in the estimation window.

estate sectors). On the other hand, the general inspection was responsible for the largest increase in bank losses (more than €1 billion).

The estimation window for the general inspection is as follows. The inspection period was during the second and third quarter of 2013. We drop from our analysis these inspection quarters and focus on the four quarters preceding the inspection (2012:Q2 – 2013:Q1) and on the four quarters following the inspection (2013:Q4 – 2014:Q3). We include all sectors except construction and real estate in order to avoid overlap with the sectoral inspection.¹¹

We present the results in Table 4. The estimation sample contains firms with outstanding loans from at least two banks. The coefficient of interest is the triple interaction term, which measures how the propensity of an inspected bank (relative to a non-inspected bank) to refinance a zombie firm (relative to a non-zombie firm) changes after the inspection (relative to the pre-inspection period).

We estimate four specifications. Model (1) is a standard three-way fixed effects model that controls for time, firm, and bank fixed effects. Model (2) adds firm-time fixed effects that force the model to compare relative lending by inspected and non-inspected banks to the same firm. Model (3) adds bank-time fixed effects that force the model to compare relative lending by the same bank to zombie and non-zombie firms. Model (4) is our Equation (1) which further includes firm-bank fixed effects that forces comparison within a lending relationship. Models (1) to (3) allow to estimate (some of the) double interaction terms. In Model (4) these double interaction terms are completely absorbed by the fixed effects.

¹¹ Including those sectors does not alter our results.

Table 4 shows that the estimated coefficient for the triple interaction is negative and statistically significant across all specifications, indicating that inspected banks became less likely to refinance zombie firms after the inspections. The estimated coefficient is economically relevant as it indicates a 3.7 percentage points drop in their refinancing propensity. This corresponds to 20% of the unconditional likelihood of a zombie firm being refinanced during our sample period (which equals 18%).

The estimated coefficients for the remaining double interaction terms are also interesting. The negative estimates in Models (1) to (3) for the variable *Inspected* \times *Zombie* show that, before the inspections, inspected banks were less likely than the non-inspected banks to refinance zombie firms. This indicates that our empirical setting may actually underestimate the disciplining effect of the inspections. The positive estimates obtained in Models (1) and (2) for *Inspected* \times *Post* suggest that the behavior of the inspected banks towards healthier firms also changes. In particular, the inspections lead to a reallocation of credit from zombie to healthy firms. The insignificant estimate in Model (1) for the variable *Zombie* \times *Post* suggests that the non-inspected banks did not pick their zombie borrowers that were discarded by the inspected banks. The perception of a more intrusive and permanent supervisory action might have changed even the behavior of the banks that were not so closely under the radar of the supervisors.

The next question we ask is which types of firms were primarily affected by the inspections. In Table 5 we present estimates from split regressions based on two firm characteristics: age and size. Columns (1) and (2) compare younger with older firms using a 10-year cutoff. Columns (3) and (4) compare small with large firms. Small firms have less than 50 employees and an annual turnover or balance sheet total below €10 million. The empirical specification is analogous to our baseline Model (4) in Table 4, which controls for firm-year, bank-year, and firm-bank fixed effects.

The first two columns show that inspected banks became less likely to refinance both firms that are younger than 10 years (by 3.3 percentage points) or older than 10 years (by 3.7 percentage points). The difference between the two coefficients is economically small. This finding addresses the important concern that our definition of zombie firm might be picking young firms with high growth opportunities. Regarding size, we obtain for the large firms a much larger estimated effect than for the small firms. However, the former coefficient is estimated more imprecisely, due to the small number of large firms in our sample.

5.2. Identification tests

5.2.1. Parallel trends assumption

One potential concern about our previous results is that before the inspections the inspected banks might be already reducing their exposure to zombie firms more aggressively than the non-inspected banks, which would be a direct violation of the parallel trends assumption. To assess the plausibility of this concern, we investigate the dynamic behavior of our dependent variable over our sample window.

In Figure 2 we plot the series of coefficients and corresponding 95% confidence intervals from estimating regressions analogous to Model (4) of Table 4, in which we replace *Post* by a sequence of time dummies spanning our entire estimation period. The shadowed region indicates the period during which the inspections were taking place.

The timing evidence corroborates a causal interpretation of our results. The plot shows no evidence of pre-trends, meaning that inspected and non-inspected banks were changing their exposure to zombie firms roughly at the same rate before the inspectors arrived. After the inspection we see that inspected banks become less likely to refinance zombie firms relative to non-inspected banks. The speed of adjustment is also interesting. Although the final report was released only in December, the inspected banks started

reducing their exposure to zombie firms right after the inspectors left. This suggests that inspected banks knew that they were overestimating the quality of their credit portfolios, and precautionarily decided to start cleaning their balance sheets in advance to spread such costs over a longer period.

5.2.2. Inspected versus non-inspected banks

The inspected banks are larger – and thus necessarily different – from the non-inspected banks. In order to improve our counterfactual estimate, we select the four smallest banks that are inspected and compare them to the four largest banks that are not inspected. This procedure brings us one step closer towards balancing our inspected and non-inspected banks in terms of size (and presumably other relevant unobservable characteristics).

In Table 6 we repeat the analysis we did in Table 4 using this smaller but more balanced sample of banks. Consistent with our previous results, we obtain negative and statistically significant estimates for our triple interaction variable. The point estimate we obtain for our coefficient of interest in Model (4) is actually larger. It indicates that an inspected bank becomes 4.8 percentage points less likely to refinance a zombie firm after the inspection. This figure is economically relevant, since it equals 26% of the unconditional likelihood of a zombie firm being refinanced during our sample period.

The results in Table 6 show that potential differences between inspected and non-inspected banks cannot explain our previous results. In fact, they indicate that using the full sample of banks may lead to underestimation of the effects of the inspections. This downward bias is consistent with our earlier finding (in Table 4) that inspected banks were less likely than the non-inspected banks to refinance zombie firms beforehand. Table 6 confirms that using the subsample of banks improves our estimate of the counterfactual. In particular, the insignificant estimates we obtain in Models (2) and (3) for the variable

Inspected \times *Zombie* show that the subsample of inspected banks is no longer less likely to refinance zombie firms than the non-inspected banks prior to the inspections.

5.2.3. *Classification of zombie firms*

In our main definition a zombie firm has negative equity. In Table 7 we consider alternative definitions of zombies based on other dimensions of financial distress. We obtain these estimates from our baseline regression model that controls for firm-year, bank-year, and firm-bank fixed effects (Equation (1); Model (4) of Table 4).

Model (1) defines a zombie firm when it has negative equity for at least 2 years. This is a more stringent definition than in our baseline model which defines zombie firms as having negative equity for at least one year. Acharya et al. (2019) identifies low-quality firms as those with low ability to service existing debt. Accordingly, Model (2) employs low interest coverage as proxy for zombie firm. A firm with low interest coverage is in the first quartile of the distribution of interest coverage, computed as net profits over interest expenses. In Model (3) we employ a measure based on default risk. In particular, a zombie is a firm with an estimated probability of default in the top quartile of the previous year's distribution. Our results should not be interpreted as evidence of risk shifting, since we are analyzing a bank's decision to refinance an existing borrower. Caballero et al. (2008) identify zombie firms as low-quality firms who receive subsidized credit. We follow this approach in Model (4) and label a firm as zombie if in a given year: (i) has an estimated probability of default in the top quartile of the previous year's distribution, and (ii) the actual interest expenses paid by the firm are below the interest expenses paid by the most creditworthy firms in our sample. To this end, we use the interest rate paid by the firms with a probability of default in the bottom quartile as benchmark interest rate.

The estimated coefficient for the triple interaction is negative across all specifications shown and statistically significant. In terms of economic magnitude, the point estimates indicate that inspected banks became 1.6 to 3.1 percentage points less likely to refinance zombie firms than non-inspected banks after the inspection.

5.3. Why do inspected banks change their lending behavior?

The results so far show that unconventional supervision through more intrusive bank supervision helps mitigate zombie lending. Our next question is why. We propose two possible mechanisms. The first is that banks are less likely to refinance zombie firms simply because the benefit of doing so was taken away by supervisors. Evergreening arises in the first place because banks want to avoid recognizing losses on their bad borrowers. However, the main outcome of the inspections was precisely to make banks build additional provisions against these loans. As it becomes costly for a bank to keep zombie firms in its portfolio, the bank has less incentives to refinance them. The second mechanism is that the inspections are disciplining banks. That is, banks may be reducing zombie lending in order to reduce the likelihood of future inspections and thus to avoid the costs associated with such inspections.

In an attempt to distinguish between these two mechanisms, we switch our attention to the sectoral inspection. Recall that the sectoral inspection focused on loans granted to firms operating in the construction and real estate sectors. We can thus compare how an inspected bank changed its lending behavior in inspected and non-inspected sectors.

If inspected banks reduce zombie lending because these loans are costlier to keep, we should see no significant change in their propensity to refinance zombie firms in uninspected sectors. In other words, taking a “small bath” through the inspected sectors might mitigate zombie lending in the inspected sectors only. In contrast, if banks worry

about the possibility of future inspections and the actions associated with them, then we should also see a significant drop in their propensity to refinance zombie firms in uninspected sectors. In the latter case, a “big bath” as implemented by the general inspection would not be required as banks would already modify their behavior towards zombie firms in uninspected sectors.¹²

5.3.1. Evidence from sectoral inspections

We investigate how inspected banks change their lending behavior to zombie firms in the inspected and non-inspected sectors. Our empirical model is again Equation (1). The estimation window for this sectoral inspection is as follows. The inspection period was during the third and fourth quarter of 2012, which we omit from the estimation sample. Consistent with our analysis of the general inspection, we take one year before the inspections started and one year after they ended. The resulting estimation period is 2011:Q3 to 2012:Q2 (pre-inspection) and 2013:Q1 to 2013:Q4 (post-inspection).

First, we focus on the inspected sectors. We present the results in Table 8. The estimation sample contains all firms in the construction and real estate sectors with outstanding loans from at least two banks. All variables and specifications are otherwise similar to Table 4. The estimated coefficient for the triple interaction is negative across all specifications shown and statistically significant. Interestingly, the estimated magnitudes are similar to those obtained in the general inspection. According to the point estimate in Model (4), inspected banks became 4.4 percentage points less likely to refinance zombie firms in the construction and real estate sectors after this sectoral inspection.

¹² The on-site inspections were costly for banks in several dimensions. First, they were unexpectedly intrusive in the sense that auditors had the freedom not only to analyze the credit books, but also talk to borrowers, possibly eroding reputational capital of the banks. Second, banks had to mobilize resources to host the inspecting teams and satisfy their requests. Third, the ex post costs imposed by supervisors in terms of loan provisioning were not only high but also concentrated in a short time frame.

The spillovers of the sectoral inspections to other banks and firms are now different from those seen in the general inspection. On the one hand, the positive estimate in Model (1) for the variable $Zombie \times Post$ suggests that the non-inspected banks may have picked up some of the zombie borrowers that were cut loose by the inspected banks. On the other hand, the insignificant estimates obtained in Models (1) and (2) for $Inspected \times Post$ suggest that inspected banks did not change their lending behavior vis-à-vis healthy firms in the construction and real estate sectors.

Second, we repeat the analysis using the uninspected sectors. We select two sectors with limited direct links to the construction and real estate sectors. The accommodation and food services sectors are appropriate candidates since they have similar characteristics to the real estate and accommodation sectors in terms of being non-tradeable sectors, equally downstream, and with similar loading to the economy (see Figure 3). Since these sectors were not object of inspection, we use them to perform a within-bank comparison that allows to discriminate between the two possible mechanisms at play (forced recognition of losses versus disciplining effects). The results reported in Table 9 show that the estimates for the variable of interest are always insignificant and economically small. This demonstrates that the reduction in zombie lending was indeed driven by the inspections, and the “small bath” inspection does not induce banks to modify their lending towards zombie firms in unrelated sectors in a different way than other non-inspected banks do.

In Figure 4 we investigate the period-by-period behavior of our coefficients of interest over our sample window for the inspected (top) and non-inspected (bottom) sectors. The timing evidence corroborates a causal interpretation of our results. The top plot shows that inspected and non-inspected banks were changing their exposure to zombie firms in the construction and real estate sectors roughly at the same rate before

the inspectors arrived. The bottom plot displays only insignificant coefficients both prior to and after the inspection, for the uninspected sectors. These results suggest that the prevailing mechanism explaining the contraction of zombie lending after the inspections comes from the forced recognition of losses, as banks do not change their behavior in sectors that were not under the radar of the supervisors.

5.4. Bank inspections and firm default

A bank that “evergreens” loans to its zombie borrowers is essentially preventing these firms from defaulting on their outstanding debt. If the inspections are indeed reducing banks’ incentives to evergreen outstanding loans, then the affected firms should become more likely to default after the inspections.

This is precisely what we test in Table 10. The dependent variable is an indicator of whether the firm defaults on that particular lender. In Models (1) and (2) we focus on the general inspections, while in Models (3) and (4) we focus on the sectoral inspections. We follow the same methodology and use the same estimation samples as in Table 4 (for the general inspection) and Table 8 (for the sectoral inspection).

For each inspection we present estimates from two specifications. In the first specification (Models (1) and (3)), we estimate an average effect across all firms while controlling for bank and firm-year fixed effects. We use this specification to test whether firms became more likely to default on an inspected bank (relative to the non-inspected banks) after the inspections. The estimated coefficients are positive and statistically significant for both inspections, confirming that firms are on average more likely to default on banks that were inspected.

In the second specification (Models (2) and (4)), we further differentiate between zombie and non-zombie firms. This enables us to also control for bank-time and firm-bank fixed effects. The coefficient of interest is the same triple interaction term that we

analyzed in all our previous estimation tables. We obtain positive and statistically significant estimates for both inspections, showing that there is an incremental increase in the likelihood of default for a zombie firm relative to a non-zombie. That is, within a year after the inspections a zombie firm is more likely to default, by 1 to 2 percentage points, on a lender that is inspected. This is consistent with our prior evidence that inspected banks become less likely to refinance these zombie firms after the inspections.

6. Conclusion

There is evidence that “zombie lending” remains a widespread practice by banks in developed countries and that in spite of growing regulatory pressure. In this paper we exploit a series of large-scale intrusive on-site inspections made on the credit portfolios of several Portuguese banks to investigate how these inspections affect banks’ future lending decisions.

We find that following this unconventional supervision an inspected bank becomes 20% less likely to refinance a zombie firm. This finding holds for two different inspection episodes, for different definitions of a zombie firm, and is not driven by differences between inspected and non-inspected banks. Our estimates may actually underestimate the disciplining role of supervision if the non-inspected banks also get scared and change their lending behavior. Consistent with the view that banks evergreen loans to prevent their zombie borrowers from defaulting, we also find that zombie firms become relatively more likely to default on an inspected lender after the inspections.

Finally, we question why banks are changing their lending behavior. If the inspections have a disciplining effect on banks, then we should see a significant drop in their propensity to refinance zombie firms in all sectors. However, we find that banks change their lending decisions only in the inspected sectors, and not in uninspected sectors. Therefore, banks seem to reduce zombie lending because these loans are costlier

to maintain. Inspecting banks across a wide array of sectors seems therefore necessary to modify banks' behavior across the board. However, these inspections are costly and cannot be repeated permanently. The mechanisms at play are thus crucial to advise policymakers. Given that our results show that the mechanism driving the change in banks' evergreening behavior works through forcing banks to recognize losses rather than through a more general disciplining effect, policies that promote an encompassing and prompt recognition of losses, as those adopted by the SSM, can effectively mitigate zombie lending in the aftermath of a crisis.

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Figure 1 – Average default and exit rates of zombies and non-zombies

The sample contains annual data from 2005 to 2010. The figures plot the point estimates (with 95% confidence intervals) of the difference in (i) average default rate, (ii) exit rate, and (iii) employment, between zombie firms and non-zombie firms, for different horizons (from one to four years).

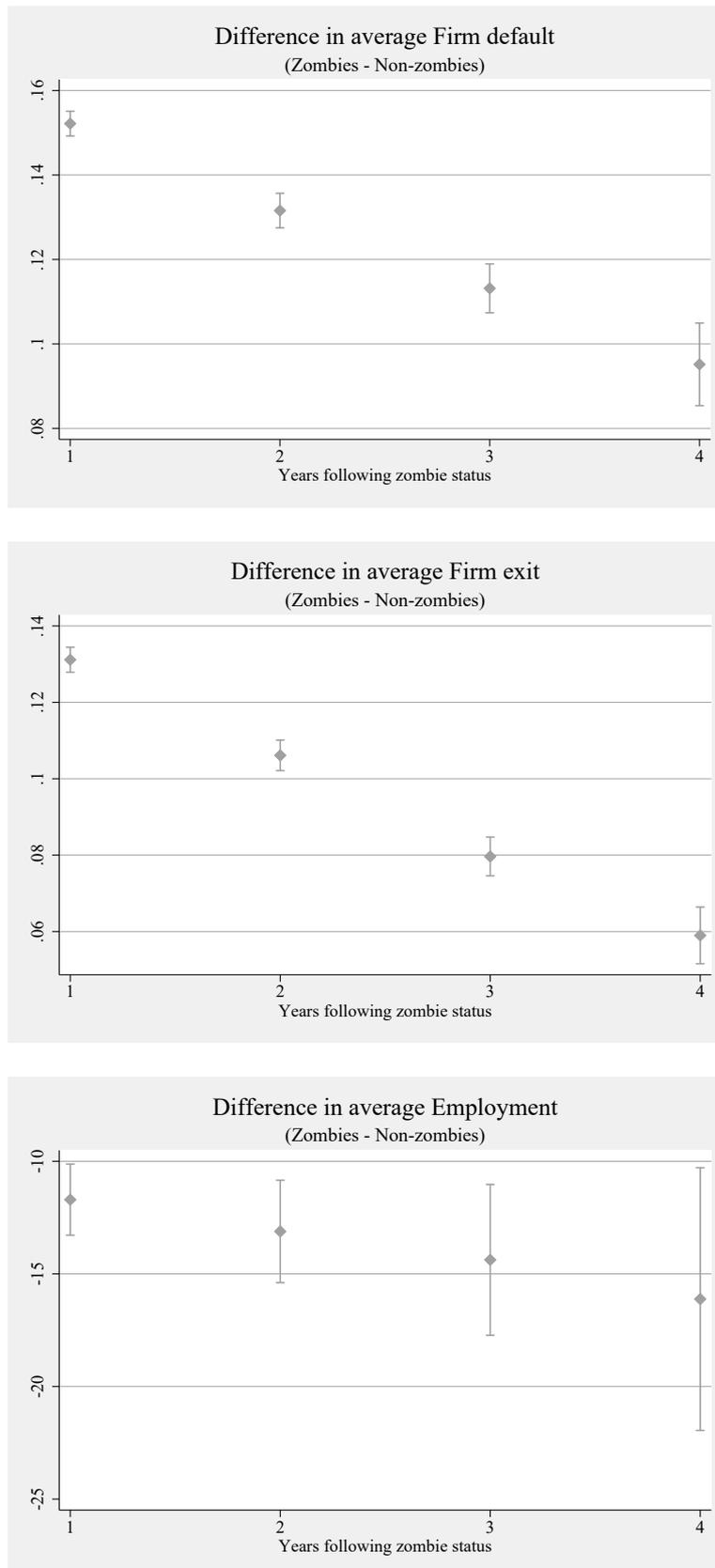


Figure 2 – Zombie lending around the general inspection

The figure uses quarterly data for the period 2012:Q2 to 2014:Q3. The shadowed region corresponds to the two inspection quarters (2013:Q2 and 2013:Q3) that are not included in the sample. The graph plots period-by-period coefficients and 95% confidence intervals that we obtain by replacing in equation (1) the variable Post in the triple interaction by a sequence of period dummies spanning all periods used in the estimation window.

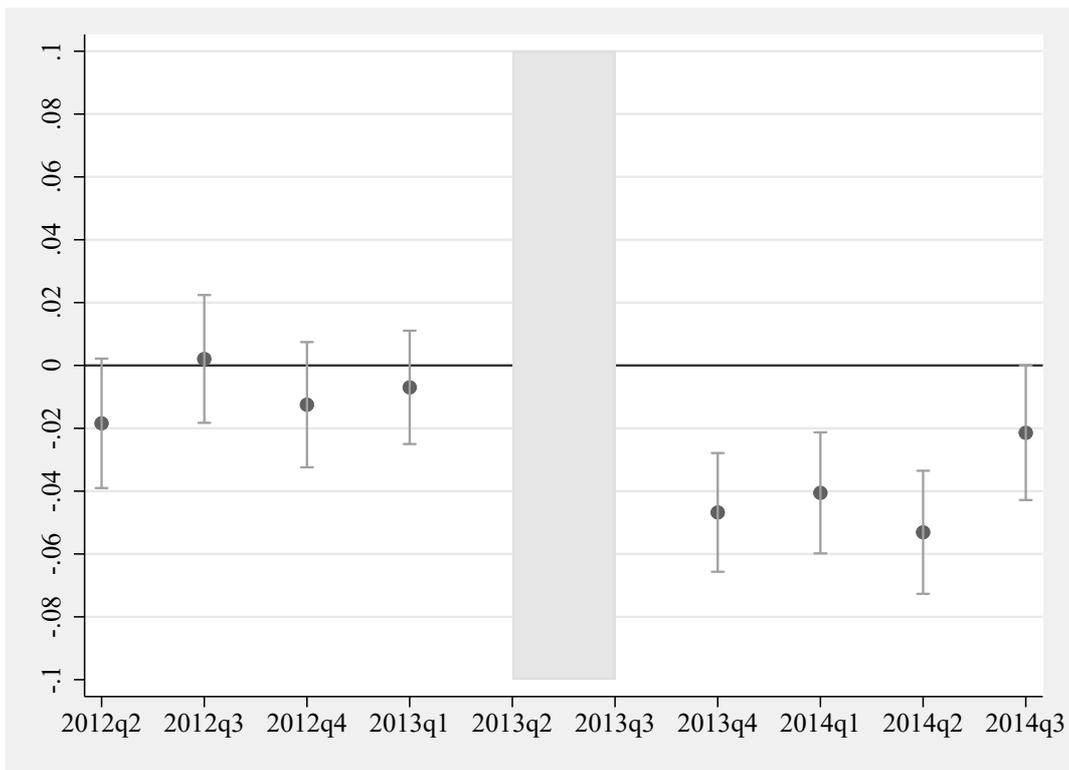


Figure 3 – Average revenue in the inspected and non-inspected sectors

The figure plots average revenue in the two following sectors: Construction and real estate (inspected sector) and for Accommodation and food services (non-inspected sector). Annual data are from the Portuguese Statistics Office.

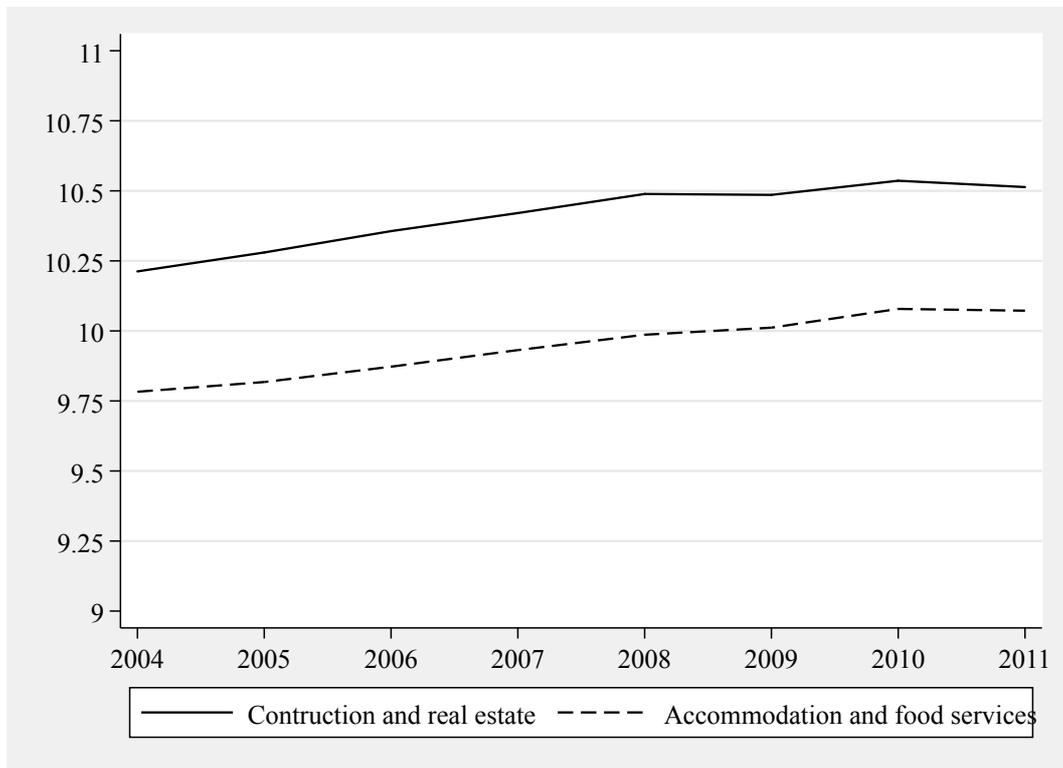


Figure 4 – Zombie lending around the Sectoral Inspection

The figure uses quarterly data for the period 2011:Q3 to 2013:Q4. The shadowed region corresponds to the omitted period (2012:Q2) and to the two inspection quarters (2012:Q3 and 2012:Q4) that are not included in the sample. Each graph plots period-by-period coefficients that we obtain by replacing in equation (1) the variable $Post_t$ in the triple interaction by a sequence of period dummies spanning all periods used in the estimation window. The top graph includes firms from the Construction and Real Estate sector, and the bottom graph includes firms from the Accommodation and Food Services sector.

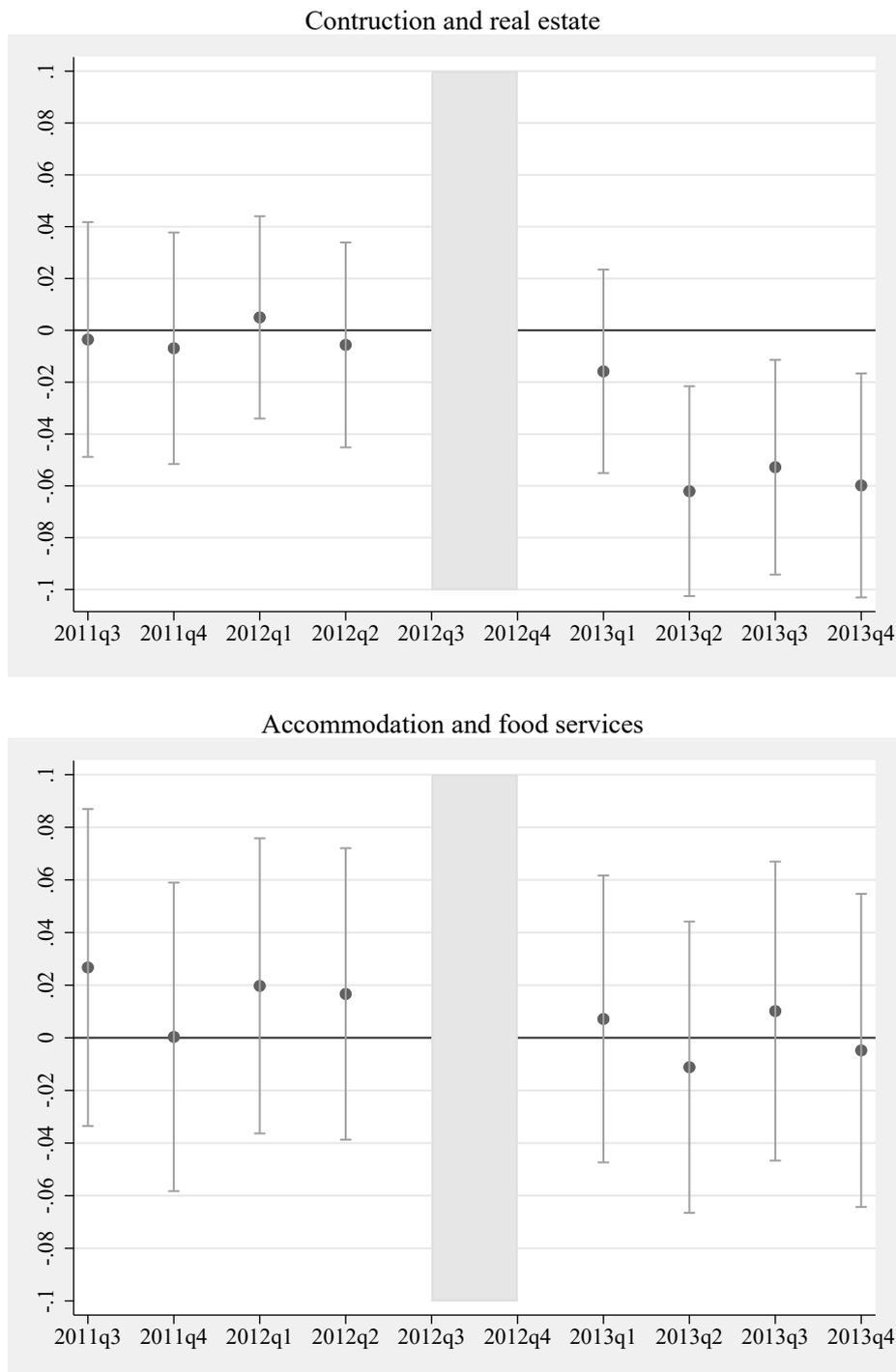


Table 1 – Description of variables

The table defines the main variables used in the paper.

Variable	Definition
<i>Main variables</i>	
New loan	= 1 if the firm obtains a new loan same lender; = 0 otherwise.
Zombie firm	= 1 if the firm had negative equity in t-1; = 0 otherwise.
Inspected bank	= 1 if bank is subject to the mandatory onsite inspections
Default	= 1 if the firm is in default with the bank; = 0 otherwise
<i>Other variables</i>	
Duration	Duration of relationship (in years).
Main bank	= 1 if bank has at least 75% of total loans
Small firm	= 1 if the firm employs < 10 persons and has annual turnover or assets < EUR 2 million; = 0 otherwise.
Employment	Number of employees
Leverage	= Debt / Assets.
Profitability	= Net income / Assets.

Table 2 – Descriptive statistics

The statistics are based on quarterly data for the period 2011:Q3 to 2014:Q3 and cover the two bank inspections. In the Sectoral Inspection (2011:Q3 to 2014:Q1) we include only the Construction and Real Estate sector. In the General Inspection (2012:Q2 to 2014:Q3) we include all sectors except Construction and Real Estate. The number of observations is 2,525,984.

Variable	Mean	Std Dev	P25	Median	P75
<i>Main variables</i>					
New loan	0.184	0.387	0	0	0
Zombie firm	0.146	0.353	0	0	0
Inspected bank	0.622	0.485	0	1	1
Default	0.105	0.306	0	0	0
<i>Other variables</i>					
Duration	5.99	4.56	2.17	4.83	9.33
Main bank	0.154	0.361	0	0	0
Small firm	0.905	0.293	1	1	1
Employment	27	209	3	6	16
Leverage	71.4	32.2	49.6	69.5	87.2
Profitability	-2.36	11	-3.57	0.399	2.65

Table 3 – Univariate tests

The statistics are based on quarterly data for the period 2011:Q3 to 2014:Q3 and cover the two bank inspections. In the Sectoral Inspection (2011:Q3 to 2014:Q1) we include only the Construction and Real Estate sector. In the General Inspection (2012:Q2 to 2014:Q3) we include all sectors except Construction and Real Estate. The number of observations is 2,149,917. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

PANEL A – Firms: Zombies versus non-zombies

Variable	Zombies	Non-zombies	Difference
<i>Main variables</i>			
New loan	0.179	0.181	0.002***
Zombie firm	1	0	-1
Inspected bank	0.601	0.645	0.044***
Default	0.295	0.079	-0.216***
<i>Other variables</i>			
Duration	6.03	6.77	0.735***
Main bank	0.212	0.148	-0.064***
Small firm	0.964	0.893	-0.072***
Employment	13.3	29.6	16.30***
Leverage	117	63.8	-53.20***
Profitability	-10.1	-1.07	9.03***

PANEL B – Banks: Inspected versus non-inspected

Variable	Inspected	Non-inspected	Difference
<i>Main variables</i>			
New loan	0.221	0.122	-0.099***
Zombie firm	0.138	0.161	0.023***
Inspected bank	1	0	-1
Default	0.1	0.112	0.011***
<i>Other variables</i>			
Duration	6.96	4.51	-2.45***
Main bank	0.164	0.136	-0.028***
Small firm	0.896	0.92	0.024***
Employment	29.7	22.6	-7.12***
Leverage	70.7	72.6	1.94***
Profitability	-2.28	-2.49	-0.21***

Table 4 – General Inspection and zombie lending

The regressions use quarterly data for the period 2012:Q2 to 2014:Q3 excluding the two inspection quarters (2013:Q2 and 2013:Q3). The sample includes firms from all sectors except Construction and Real Estate. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sectors analyzed: All sectors except Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected × Zombie × Post	-0.034*** [-7.896]	-0.025*** [-4.516]	-0.028*** [-4.979]	-0.037*** [-6.525]
Inspected × Zombie	-0.005* [-1.902]	-0.017*** [-4.627]	-0.017*** [-4.402]	
Inspected × Post	0.027*** [15.583]	0.030*** [14.068]		
Zombie × Post	-0.001 [-0.322]			
Year-quarter FE	Yes	-	-	-
Firm FE	Yes	-	-	-
Firm×Year-quarter FE	-	Yes	Yes	Yes
Bank FE	Yes	Yes	-	-
Bank×Year-quarter FE	-	-	Yes	Yes
Firm×Bank FE	-	-	-	Yes
Number of observations	985,055	985,055	985,055	985,055
R-squared	0.183	0.423	0.425	0.584

Table 5 – Exploring firm heterogeneity

The regressions use quarterly data for the period 2012:Q2 to 2014:Q3 excluding the two inspection quarters (2013:Q2 and 2013:Q3). The sample includes firms from all sectors except Construction and Real Estate. *Young* firms are 10 years or less of age, while *Mature* firms have more than 10 years. *Small (Large)* firms have less (more) than 50 employees and an annual turnover or balance sheet total below (above) €10 million. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sectors analyzed: All sectors except Construction and Real Estate

Dependent variable	New loan from existing lender			
	Firm type: Young	Mature	Small	Large
	(1)	(2)	(3)	(4)
Inspected × Zombie × Post	-0.033*** [-3.723]	-0.037*** [-4.686]	-0.038*** [-6.558]	-0.106* [-1.727]
Year-quarter FE	-	-	-	-
Firm FE	-	-	-	-
Firm×Year-quarter FE	Yes	Yes	Yes	Yes
Bank FE	-	-	-	-
Bank×Year-quarter FE	Yes	Yes	Yes	Yes
Firm×Bank FE	Yes	Yes	Yes	Yes
Number of observations	296,361	667,073	860,791	16,436
R-squared	0.634	0.570	0.599	0.497

Table 6 – Using a subsample of banks: smallest inspected and largest uninspected banks

The regressions use quarterly data for the period 2012:Q2 to 2014:Q3 excluding the two inspection quarters (2013:Q2 and 2013:Q3). The sample includes firms from all sectors except Construction and Real Estate. The sample is also restricted to the four smallest inspected banks and the four largest non-inspected banks. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sectors analyzed: All sectors except Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected × Zombie × Post	-0.030*** [-4.045]	-0.029** [-2.067]	-0.032** [-2.225]	-0.048*** [-3.398]
Inspected × Zombie	0.014** [2.462]	-0.000 [-0.039]	-0.000 [-0.005]	
Inspected × Post	0.031*** [10.550]	0.031*** [5.531]		
Zombie × Post	0.002 [0.408]			
Year-quarter FE	Yes	-	-	-
Firm FE	Yes	-	-	-
Firm×Year-quarter FE	-	Yes	Yes	Yes
Bank FE	Yes	Yes	-	-
Bank×Year-quarter FE	-	-	Yes	Yes
Firm×Bank FE	-	-	-	Yes
Number of observations	323,913	323,913	323,913	323,913
R-squared	0.308	0.519	0.521	0.672

Table 7 –Alternative definitions of zombie firm

The regressions use quarterly data for the period 2012:Q2 to 2014:Q3 excluding the two inspection quarters (2013:Q2 and 2013:Q3). The sample includes firms from all sectors except Construction and Real Estate. A firm with low interest coverage is in the first quartile of the distribution of interest coverage, computed as net profits over interest expenses. A firm with a high probability of default is in the top quartile of the previous year's distribution of default probabilities, estimated using Banco de Portugal's internal credit risk model. A firm has subsidized credit if in a given year: (i) has an estimated probability of default in the top quartile of the previous year's distribution, and (ii) the actual interest expenses paid by the firm are below the interest expenses paid by the most creditworthy firms in the sample (defined as those with probability of default in the bottom quartile). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sectors analyzed: All sectors except Construction and Real Estate

Dependent variable: Zombie measure:	New loan from existing lender			
	2 years of negative equity (1)	Low interest coverage (2)	High probability of default (3)	Subsidized credit (4)
Inspected × Zombie × Post	-0.028*** [-3.634]	-0.016*** [-3.793]	-0.031*** [-7.218]	-0.018*** [-2.834]
Year-quarter FE	-	-	-	-
Firm FE	-	-	-	-
Firm×Year-quarter FE	Yes	Yes	Yes	Yes
Bank FE	-	-	-	-
Bank×Year-quarter FE	Yes	Yes	Yes	Yes
Firm×Bank FE	Yes	Yes	Yes	Yes
Number of observations	759,498	985,055	985,055	985,055
R-squared	0.594	0.574	0.582	0.581

Table 8 – Sectoral Inspection and zombie lending in the inspected sectors

The regressions use quarterly data for the period 2011:Q3 to 2013:Q4 excluding the two inspection quarters (2012:Q3 and 2012:Q4). The sample includes only firms from the Construction and Real Estate sector. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sector analyzed: Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected × Zombie × Post	-0.051*** [-5.636]	-0.028** [-2.342]	-0.030** [-2.504]	-0.044*** [-3.351]
Inspected × Zombie	0.006 [1.092]	-0.023*** [-2.714]	-0.021*** [-2.576]	
Inspected × Post	0.001 [0.250]	-0.002 [-0.403]		
Zombie × Post	0.027*** [3.910]			
Year-quarter FE	Yes	-	-	-
Firm FE	Yes	-	-	-
Firm×Year-quarter FE	-	Yes	Yes	Yes
Bank FE	Yes	Yes	-	-
Bank×Year-quarter FE	-	-	Yes	Yes
Firm×Bank FE	-	-	-	Yes
Number of observations	220,315	220,315	220,315	220,315
R-squared	0.203	0.437	0.444	0.622

Table 9 – Sectoral Inspection and zombie lending in non-inspected sectors

The regressions use quarterly data for the period 2011:Q3 to 2013:Q4 excluding the two inspection quarters (2012:Q3 and 2012:Q4). The sample includes only firms from the Accommodation and Food Services sector. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Sector analyzed: Accommodation and food services

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected × Zombie × Post	0.001 [0.054]	-0.005 [-0.321]	-0.007 [-0.438]	-0.008 [-0.462]
Inspected × Zombie	-0.011 [-1.500]	-0.011 [-1.006]	-0.012 [-1.045]	
Inspected × Post	0.001 [0.143]	0.012 [1.351]		
Zombie × Post	-0.002 [-0.218]			
Year-quarter FE	Yes	-	-	-
Firm FE	Yes	-	-	-
Firm×Year-quarter FE	-	Yes	Yes	Yes
Bank FE	Yes	Yes	-	-
Bank×Year-quarter FE	-	-	Yes	Yes
Firm×Bank FE	-	-	-	Yes
Number of observations	70,524	70,524	70,524	70,524
R-squared	0.197	0.453	0.464	0.647

Table 10 – Bank inspections and firm default

The regressions in columns (1) and (2) use quarterly data for the period 2012:Q2 to 2014:Q3 excluding the two inspection quarters (2013:Q2 and 2013:Q3), and the estimation sample includes firms from all sectors except Construction and Real Estate. The regressions in columns (3) and (4) use quarterly data for the period 2011:Q3 to 2013:Q4 excluding the two inspection quarters (2012:Q3 and 2012:Q4), and the estimation sample includes only firms from the Construction and Real Estate sector. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: Inspection:	Firm defaults on current lender			
	General		Sectoral	
	(1)	(2)	(3)	(4)
Inspected × Post	0.002** [2.396]		0.009*** [3.181]	
Inspected × Zombie × Post		0.009*** [3.619]		0.016** [2.059]
Year-quarter FE	-	-	-	-
Firm FE	-	-	-	-
Firm×Year-quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	-	Yes	-
Bank×Year-quarter FE	-	Yes	-	Yes
Firm×Bank FE	-	Yes	-	Yes
Number of observations	985,055	985,055	220,315	220,315
R-squared	0.680	0.864	0.690	0.860

APPENDIX

Appendix I – Who provides a hand to zombie firms?

In this Appendix, we investigate which bank and relationship characteristics make a lender more likely to refinance a zombie firm. We use quarterly data for the period 2005-2015 and define a zombie firm as one with negative equity in the previous period. Our estimation sample contains only zombie firms according to this criterium. We additionally require that the zombie firm obtains a new loan from at least one of the current lenders. We estimate the following regression:

$$NewLoan_{fbt} = \beta(BankChar_{bt}) + \gamma(Relat_{fbt}) + \alpha_{ft} + \epsilon_{fbt}.$$

The dependent variable is a dummy that indicates whether the bank granted a new loan (including a line of credit) to an existing zombie borrower in a given period (year-quarter). In this analysis we restrict our attention to the sample of zombie firms that have loans outstanding from at least two lenders. This allows us to control for firm*year fixed effects and thus to explore cross-sectional differences across lenders to the same zombie firm in a given year. We have two sets of explanatory variables. The first term captures bank characteristics (profitability, credit overdue, size), while the second term capture firm-bank relationship characteristics (duration of the relationship, credit concentration, whether the firm is in default with the current bank).

We present the results in Appendix Table A2. The results show that the lender with weaker profitability is the one more likely to step in and refinance a zombie borrower. The estimated coefficient for the variable *Bank ROA* is economically relevant, since a one standard deviation decrease in this variable increases the predicted probability of refinancing a zombie firm by almost 1 percentage point, which accounts for 5.5% of the average fraction of zombie firms that are refinanced. This finding corroborates previous evidence on evergreening

practices and supports the notion that banks have incentives to evergreen loans to zombie borrowers especially if they are themselves under financial pressure (Storz et al., 2017). A high fraction of non-performing loans reduces the willingness to refinance zombie firms, but the estimated effect is economically small. We also find that larger banks are more likely to refinance zombie firms.

Relationships characteristics also play an important role in explaining which bank is more likely to refinance a zombie borrower. In particular, a bank is more likely to refinance when it has a longer relationship with the firm and when it concentrates a high fraction of the firm's borrowing. This shows the tenuous link between the bright side of relationship lending and the dark side of evergreening (e.g., Beck et al., 2018; Bolton et al., 2016). A bank is also more likely to refinance a zombie firm when it defaulted on its past obligations. Taken together, these results are not surprising because under these conditions the bank is able to better internalize the potential benefits of refinancing a zombie firm.

Table A1 – Who gives a hand to zombie firms?

Data are at the loan-level for the period 2005-2015. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:	New loan from existing lender
<i>Bank characteristics</i>	
Bank ROA	-0.010*** [-11.711]
Credit overdue	-0.004*** [-19.543]
Log(Bank Assets)	0.030*** [62.485]
<i>Relationship characteristics</i>	
Duration of relationship	< 0.001*** [8.571]
Main bank	0.128*** [57.440]
In default with current bank	0.188*** [72.419]
<hr/>	
Firm-year-quarter FE	Yes
Number of observations	427,587
R-squared	0.417

Table A2 – Separate descriptive statistics for the two inspections

In Panel A the sample period is from 2011:Q3 to 2014:Q1 and it includes only the Construction and Real Estate sector. In Panel B the sample period is from 2012:Q2 to 2014:Q3 and it includes all sectors except Construction and Real Estate.

PANEL A – Sectoral Inspection (N = 260,492)

Variable	Mean	Std Dev	P25	Median	P75
<i>Main variables</i>					
New loan	0.191	0.393	0	0	0
Zombie firm	0.152	0.359	0	0	0
Inspected bank	0.624	0.484	0	1	1
Default	0.175	0.38	0	0	0
<i>Other variables</i>					
Duration	5.98	4.27	2.42	5.08	9
Main bank	0.166	0.372	0	0	0
Small firm	0.927	0.261	1	1	1
Employment	22.8	166	2	5	13
Leverage	72.8	32.1	50.8	71.5	89.8
Profitability	-3.12	10.6	-4.25	.0589	1.54

PANEL B – General Inspection (N = 1,247,492)

Variable	Mean	Std Dev	P25	Median	P75
<i>Main variables</i>					
New loan	0.187	0.39	0	0	0
Zombie firm	0.145	0.352	0	0	0
Inspected bank	0.631	0.483	0	1	1
Default	0.0924	0.29	0	0	0
<i>Other variables</i>					
Duration	6.15	4.7	2.25	4.92	9.67
Main bank	0.152	0.359	0	0	0
Small firm	0.899	0.301	1	1	1
Employment	27.9	216	3	6	17
Leverage	70.8	32.3	49	68.8	86.3
Profitability	-2.05	11	-3.1	.512	2.99