

“Inspect what you expect to get respect”

Can bank supervisors kill zombie lending?

DIANA BONFIM, GERALDO CERQUEIRO, HANS DEGRYSE and STEVEN ONGENA *

This version: October 2018

Abstract

A bank in poor financial shape may have incentives to continue lending to a “zombie” firm in order to avoid or delay the recognition of credit losses. In spite of growing regulatory pressure, there is evidence that “zombie lending” remains widespread in developed countries. We exploit information on a unique series of special on-site inspections of bank credit portfolios in Portugal to investigate how such inspections affect banks’ future lending decisions. We find that following an inspection a bank becomes 3 to 6 percentage points less likely to refinance a firm with negative equity. Our findings suggest that banks structurally change their lending decisions following inspections.

* Bonfim: *Bank of Portugal* and *Católica-Lisbon School of Business and Economics*; Cerqueiro: *Católica-Lisbon School of Business and Economics*; Degryse: *KU Leuven* and *CEPR*; Ongena: *University of Zurich*, *Swiss Finance Institute*, *KU Leuven*, and *CEPR*. These are our views and do not necessarily reflect those of the *Bank of Portugal* or the *Eurosystem*. We thank Francisca Rebelo for excellent research assistance. Ongena acknowledges financial support from *ERC ADG 2016 - GA 740272 lending*. Degryse acknowledges financial support from FWO. Bonfim and Cerqueiro acknowledge financial support from grants UID/GES/00407/2013 and PTDC/EGE-OGE/30314/2017 of the Portuguese Foundation for Science and Technology-FCT.

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 five years or more, generated a median cumulative output loss of 35% of GDP, and a median peak of non-performing loans of 11% of total loans. An important driver is that banks continue lending to non-viable firms (“zombie firms”) in the hope to recover previously granted loans. Weak banks may further 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 two special on-site inspection programs reflecting a coordinated effort of bank supervisors.

The importance of zombie lending and its implications for the economy has been discussed by policy makers and academics alike. Zombie lending affects the allocation of credit and through its impact on product market competition can have important effects on economic growth (Peek and Rosengren, 2005; Caballero et al., 2008; Schivardi et al., 2017; Adalet McGowan et al, 2017).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. Recent evidence 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., 2016). We

¹ 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.

ask the question whether bank supervisors on-site inspection programs may offer a solution.

In this paper we show that stricter supervision of banks may ex post turn out to be an effective tool in “scaring if not killing” zombie lending. In particular, we exploit on-site bank inspections of the credit portfolios of the largest Portuguese banks to investigate how such inspections affect banks’ future willingness to refinance zombie firms. The main goal of the inspection program was to validate the quality of assets that the banks provide as inputs for their risk assessment. These assessments 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

We combine this quasi-experimental setting with a comprehensive configuration of three matched economy-wide datasets that are maintained by Bank of 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, we further merge the resulting dataset with supervisory bank-level information that covers all banks operating in Portugal.

We provide two sets of results. First, and before showing how the remedy works, we diagnose the problem. We start by documenting that during our sample period (from 2005 to 2015) 22% of the firms that obtain a new loan from an existing lender have negative equity (our preferred indicator of flagging a “zombie firm”). Next, we investigate which bank characteristics affect their propensity to refinance such firms.

² The total combined value of loans inspected was €92 thousand million, or 57% of the eligible credit portfolio. The assessments were carried out by more than 300 experts.

Using regressions with firm-by-year fixed effects (as in Khwaja and Mian, 2008) we find that both (i) low profitability and (ii) a solid and more exclusive lending relationship with the borrower make a bank substantially more likely to refinance such a zombie firm. Finally, we quantify the incidence of zombie lending using our full dataset. We find that a zombie firm that teams up with a weak bank (based on low profitability relative to its peers) is 1.2 percentage points more likely to obtain additional credit than from other banks (and relative to healthy firms). This effect is economically relevant as it represents 6% of the average fraction of borrowers that are refinanced.

Our second set of results is based on two special inspection programs. The first, which took place in the middle of 2012, focused on the construction and real estate sectors. The second took place in the middle of 2013 and focused on all sectors. We analyze the effect of those inspections on a bank's willingness to refinance a zombie firm using triple-difference regressions. The three levels of comparison are: (i) inspected versus non-inspected banks, (ii) zombie versus other firms, and (iii) before versus after the inspection. We find that an inspected bank is between 3 and 6 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). We obtain these estimates after controlling for firm-by-year, bank-by-year, and firm-by-bank fixed effects.

One potential threat to our empirical strategy is that the inspected banks are larger than the non-inspected banks (and thus potentially different in other relevant dimensions). We assuage such 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, one of the on-site inspections focused on two industries only, allowing for a *within bank* comparison. Third, we show that our results become actually stronger if we restrict our sample to the smallest inspected

banks and the largest non-inspected, making the two groups of banks more comparable in terms of size. Finally, we show that our results are not driven by any individual bank.

Our results show that on-site supervision appears to be effective as it affects banks' lending decisions when inspectors are long gone. That is, banks are not changing their lending behavior because supervisors are looking at their past books. Instead, banks seem to learn from the supervisors, or respond to the threat that their future loans might be inspected and thereby internalize the costs associated with future revelatory inspections.

Although direct bank supervision is becoming a crucial pillar of regulatory oversight, empirical evidence on how it affects (future) bank credit decisions is, to the best of our knowledge, scant.³ The study closest to ours is Granja and Leuz (2017), who 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.

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 incidence of zombie lending, while Section 5 investigates the effect of the bank inspections. 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

³ 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.

European Central Bank. The program defined a set of measures and actions to be taken by the Portuguese authorities concerning the financial sector. Bank of Portugal is the national supervisory authority and was entrusted with the responsibility to implement a program of special on-site inspections.⁴

The inspection program was carried out in the eight largest national banking groups, which altogether represented about 80% of the total assets of the banking system. The main goal of this program was to assess the credit portfolios and validate the quality of assets that these banking groups provide as inputs for their risk assessment. These inspections marked a profound change in the way supervision is conducted, with a much more intrusive and granular assessment. We would thus expect that the impacts go beyond the immediate recognition of impairments and spill over into banks' lending decisions and risk management policies.

In our analysis we exploit two of these special on-site inspections, which we describe below.

2.1. Sectoral inspection: Construction and real estate sectors

The construction and real estate sectors were particularly hit during the Great Recession and the ensuing European sovereign debt crisis. Since the largest Portuguese banks were considerably exposed to these sectors, the Bank of Portugal carried a special on-site inspection program to assess whether banks' provisioning levels were adequate.⁵

⁴ The inspection program was monitored by a committee that included not only experts from Bank of Portugal, but also from the International Monetary Fund, the European Commission, the European Central Bank, and three additional European central banks: Bank of Spain, National Bank of Belgium, and Bank of France. Two independent external auditing firms were involved in the auditing process: Ernst & Young and PricewaterhouseCoopers.

⁵ For additional details see:

https://www.bportugal.pt/sites/default/files/anexos/documentos-relacionados/combp20121203_en.pdf.

These inspections were carried out between July and November of 2012.⁶ The reference period is June 2012, meaning that only loans granted up to this point were eligible for inspection. 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 eligible amounted to €69 billion, which accounts for around 40% of their corporate lending portfolio. A sample of 2,856 firms (loans) that accounted for a total of €39 billion (or 56% of the eligible portfolio) was audited. The program concluded that the eight banking groups inspected needed to reinforce impairments by €861 million (around 2.2% of the overall amount of exposures assessed). The final report was released on Dec 3, 2012.

2.2. General inspection

The same eight banking groups were subject to another inspection in the second and third quarters 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 in this inspection. Another important difference is that while the previous inspection was conducted by independent auditors, this general inspection was conducted by each banking group's external auditor, under guidelines set out by both Bank of Portugal and an independent auditor.

⁶ There was a first set of inspections carried out between between end-July and end-November. The results were announced on 16th December 2011 and focused more on loans to households.

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 (loans) that accounted for a total of €53 billion (or 57% of the eligible portfolio) were audited. The program 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). The final report was released on Aug 2, 2013.

3. Data and variables

3.1. Datasets

Our analysis uses three comprehensive datasets. First, we have access to all loan exposures of Portuguese firms through the Credit Register maintained by Bank of Portugal. This is one of the most comprehensive credit registers in the world (Miller, 2003), as the reporting threshold is set at a minimum of 50 euros. Reporting is mandatory for all banks and credit institutions. Every month participating institutions report 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. In 2009 the level of detail in the Credit Register was substantially enhanced, starting to include information also on loan maturity and collateral. Participating credit institutions can observe information on their current borrowers, and also on prospective customers, with their previous consent. As such, if a borrower is in default in a given loan, all the other lenders of that firm will be able to observe that. If the firm asks for a new loan and the bank checks its information in the Credit Register, the new bank will also be aware of that. Importantly, once the default episode is cleared, there is no negative information on the Credit Register, i.e., the information shared in a given moment refers only to the current situation of a firm.

The second dataset that we use is the *Informação Empresarial Simplificada* (IES). This dataset has detailed accounting, fiscal and statistical information starting in 2006 on all firms operating in Portugal. It is a joint project of the Ministry of Justice, the Ministry of Finance, Statistics Portugal, and Bank of Portugal. All Portuguese firms are required to file information. We use a version of this dataset managed by Bank of Portugal, in which the information is treated to improve its statistical quality.

By merging these two datasets, we are able to characterize in detail all the firms with bank loans in Portugal, even if they are very small. This extensive coverage is very rarely available in similar datasets and is especially important for our research question, as it allows us to uncover the existence of evergreening for both the smallest and the largest firms. While evergreening for large firms has been documented in the literature (Acharya et al, 2016, Peek and Rosengren, 2005), it is usually harder to obtain evidence on the smallest firms in an economy. However, evergreening might also exist for these firms, though the reasons behind banks' behavior may be quite different. While for large firms banks may evergreen bank loans to avoid massive losses in their balance sheets, for micro firms evergreening may be a result of lower monitoring efforts by bank supervisors for these firms. Furthermore, it requires less coordination among lenders as typically micro firms have fewer creditors. Further, while evergreening for the largest exposures is most likely a decision made at the highest decision-making bodies of a bank, evergreening for the smallest exposures may reflect either local loan officers' discretion or a generalized policy of the bank.

In both cases, bank characteristics are likely to play a role. To explore that, we merge our dataset with supervisory data on banks. Bank of Portugal is the national supervisory authority, what allows us to use detailed accounting and prudential information on the banks operating in Portugal. This allows us to understand if

evergreening is more prevalent for weaker banks. Furthermore, this will be crucial to understand banks' heterogeneous responses to a more intrusive supervisory action.

Our sample period is from 2005 to 2015. In our analysis we use both annual and quarterly frequency.⁷

3.2. Variables

We provide variable definitions in Table 1. Evergreening means that a bank is actively refinancing distressed firms. To capture this behavior, we focus on new loans being granted to existing borrowers. Our dependent variables in our main specifications are thus related to credit growth within bank-firm relationships. We define *New loan* as an indicator of whether the bank increases its exposure relative to an existing borrower, including lines of credit. We focus on existing borrowers because evergreening consists of repeated lending to firms that are essentially insolvent, in which the bank attempts to postpone losses or eventually hope for a possible recovery of the firm. In robustness tests we also compute this variable excluding lines of credit. While including unused committed credit lines allows to capture the entire exposure of the bank to a given borrower, the availability of lines of credit to distressed borrowers is likely limited. *Loan growth* measures the relative increase in a bank's exposure relative to an existing borrower. In order to deal with potential presence of outliers, we truncate this variable at between 0 and 1.

We next turn to the definition of zombie firms. In our main definition a zombie firm has negative equity in the previous year. This means that the firm has accumulated so many losses that liabilities became larger than assets. Technically, this is an insolvent firm. It is thus quite risky for a lender to refinance such highly levered firms. Although

⁷ Our original bank and loan data are at the monthly frequency. Firm balance sheet information is reported only annually.

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: Banks grant loans at soft terms to zombie firms (Caballero et al. (2008) and Acharya et al. (2016)).

We consider two alternative definitions of zombies in our robustness tests. First, we use a more stringent definition of zombie lending in which we require firms to have negative equity for at least 2 years (instead of 1). Second, firms with *Low interest coverage* are those in the first quartile of the distribution of interest coverage, computed as net profits over interest expenses.

Banks will have incentives to postpone the recognition of losses especially if they are themselves under financial and regulatory pressure. Such incentives to engage in evergreening are not the same for all banks. A healthy bank is a profit maximizing agent that makes decisions conditional on its risk management policy. However, for weaker banks things may be somewhat blurrier and incentives to take excessive risk may become stronger. Lending for resurrection strategies are sometimes observable in extreme cases. We thus argue that evergreening is essentially about weak banks lending to weak firms. We consider that banks may have more incentives for making riskier lending decisions when they have low profitability (with *Low ROA* identifying banks that are in the bottom quartile of each year's ROA distribution).⁸

We explore the information contained in the Credit Register to compute two relationship measures: the duration of relationship (in months) and an indicator of whether the firm has a main lender (i.e., a bank that concentrates at least 75% of the firm's

⁸ A more standard way to identify weaker banks would be to consider those with lower capital ratios (e.g., Peek and Rosengren (2005) and Albertazzi and Marchetti (2010)). However, given that there were several events during the period that lead to sizeable fluctuations in banks' capital ratios (including private and public capital injections and several changes to capital requirements), we chose to focus on ROA.

loans). Furthermore, we have information on whether the firm is in default with the current lender.

Finally, we employ in some of our analyses some additional firm and bank characteristics. On the firm side the variables are: an indicator of whether the firm is *Micro* (the smallest category, with number of employees below 10 and annual balance sheet total below €2 million); the firm's leverage ratio, the firm's return on assets, profitability (measured by its ROA). On the bank side the variables are: the capital ratio, the ratio of non-performing loans to total credit, and its asset mass (in billion euros).

3.3. Summary statistics

Table 2 presents summary statistics. The unit of analysis is at the firm-bank level. The unconditional probability that a bank refinances an existing borrower is about 20% in a given year. Moreover, a bank's exposure with respect to a given borrower grows on average by 10.8% per year. There is, however, ample variation in the evolution of exposures across relationships, since the standard deviation of exposure growth is twice its mean.

The presence of zombie firms in our sample depends on the definition we use. For example, the fraction of firms with at least one year of negative equity is 22%. This is our preferred definition of zombie firm. The fraction of firms with low interest coverage is almost 36%.

According to our definition of *Weak bank* based on the bottom quartile of the distribution of bank profitability in a given year, about 42% of the loans in our sample are provided by these weak banks. The reason why this figure is higher than 25% is that some of the largest banks (with a higher number of loans outstanding) experience low profitability levels during our sample.

Concerning our relationship characteristics, average relationship duration is 60 months, or 5 years. About 60% of the firms have a main lender (i.e., at least 75% of their loans were granted by one bank). As explained below, we note that in our estimation sample we only use firms that borrow from multiple banks. Almost 8% of the borrowers are in current default with their lender.

The remaining firm characteristics show that firms are on average very small, highly leveraged, and unprofitable.

4. Evidence of zombie lending

4.1. Who gives a hand to zombie firms?

We start by asking in Table 3 which bank and relationship characteristics make a lender more likely to refinance a zombie firm. The dependent variable is a dummy that indicates whether the bank granted a new loan (including a line of credit) to an existing borrower in a given period (year-quarter). We define a zombie firm as one with negative equity in the previous period. 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 additionally require that the zombie firm obtains a new loan from at least one of the current lenders.

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 it represents almost 9% of its sample average. 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. 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. This is an important pattern that we will get back to later on when analyzing bank inspections.

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. 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. In other words, a bank would not want to refinance a firm that borrows mostly from (or is in current default with) another bank, as the firm could channel these proceeds to this other lender to secure additional funding.

4.2. Full sample results

We next quantify the incidence of evergreening practices using our full dataset. We display our baseline results in Table 4. Each observation is a firm-bank pair in a given year-quarter. The period of analysis is 2005Q1-2015Q4. As before, the dependent variable equals one when the lender grants a new loan to an existing borrower, including a new line of credit, and zero otherwise. A zombie firm is one with negative equity in the previous period. The explanatory variable of interest is the interaction of *Weak bank* with *Zombie firm*. We use this interaction to test the premise that a bank is more likely to refinance a firm in poor shape when the bank is also in poor shape. Based on our prior results, we identify weak banks based on their low profitability. To facilitate the

interpretation of regression coefficients, our variable *Weak bank* equals one if the bank's ROA is in the bottom quartile of the current period's distribution, and zero otherwise. We control in all regressions for the firm-bank relationship characteristics (see Table 1). Robust t-statistics that account for potential heteroscedasticity are reported in brackets.

Models (1) to (4) include different sets of fixed effects. Model (1) starts with year-quarter fixed effects. All coefficients shown in this model are thus obtained from cross-sectional differences among firms and among banks in a given year-quarter. The interaction term of *Weak Bank x Zombie Firm* is positive and significant, offering a first glimpse of the practice of evergreening. Model (2) adds firm and bank fixed effects. Although the estimated interaction term remains positive and significant, we note that this specification alters the interpretation of the other coefficients. The first (*Weak bank*) tells us that a bank becomes less likely to refinance healthy borrowers when its profitability plunges into the bottom quartile. The second (*Zombie firm*) tells us that zombie firms are substantially less likely to be refinanced by more profitable banks.

Models (3) and (4) further improve identification by forcing comparison within the same bank and firm-year-quarter (3), and bank-year-quarter and firm-year-quarter (4). In Model (4) we are able to identify only the interaction term, since the other variables are absorbed by the high-dimensional fixed effects. In both Models, the coefficient of *Weak Bank x Zombie Firm* remains positive and statistically significant. Based on Model (4), a zombie firm that teams up with a weak bank is 1.2 percentage points more likely to obtain additional credit than from other banks (and relative to healthy firms). This effect is economically relevant as it represents almost 6% of the average fraction of borrowers that are refinanced in a given year-quarter.

These results hinge upon several assumptions that we put to the test. For brevity, we provide those results in Appendix Table A1. There we show that our results hold when

we: (1) Exclude lines of credit; (2) replace our binary dependent variable *New loan* by its continuous counterpart, *Loan growth*; (3) define a zombie firm when it has negative equity for at least two years (instead of one); and (4) employ low interest coverage as an alternative proxy for zombie firm, as for example in Acharya et al. (2016).

5. What banks do when supervisors are “watching”?

5.1. Evidence from sectoral inspections

We now assess how banks change their lending behavior after supervisors have actively examined their credit portfolios. As explained in Section 2, the program of special on-site inspections applied only to the eight largest banking groups. We therefore use a difference-in-differences methodology that compares banks that were selected for inspection with those that were left out.⁹ Besides being bigger, the selected banks could differ from the non-selected banks in other important dimensions, making a straight comparison between these two groups difficult.

Fortunately, our setting provides a second layer of exogenous variation that we can exploit to overcome this empirical challenge. In particular, the first set of inspections we analyze focused only on the construction and real estate sectors. We can therefore assess for a given bank how its lending behavior to zombie firms as opposed to non-zombie firms changes in the inspected sectors. We can further compare this difference to the same difference in other (non-inspected) sectors. Furthermore, this allows us to perform a within bank comparison.

⁹ The selection was imposed by supervisors and based only on bank size. Of course, one may question why supervisors did not inspect all banks. However, we note that the inspections were very costly in several dimensions, including the coordination effort between all the parties involved. The inspections we discuss in this paper involved 58 employees of the Bank of Portugal and 289 external auditors, who went over individual credit files that altogether amounted to €92 billion.

Our estimation window is as follows. The inspections started in July 2012 and the final results were released in December 2012. We drop from our analysis this inspection period (i.e., 2012Q3 and 2012Q4) and focus on the four “pre-inspection” quarters (2011Q3 to 2012Q2) and the four “post-inspection” quarters (2013Q1-2013Q4).

We present the regression results in Table 5. The estimation sample contains all firms in the construction and real estate sectors with outstanding loans from at least two banks. As before, the dependent variable indicates a refinancing loan and a zombie firm is one with negative equity in the previous period. The explanatory variable of interest is the triple interaction, which assesses 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).

As we move from Model (1) to (4), the regressions are progressively saturated with more fixed effects. Model (1) is a standard three-way fixed effects model that accounts 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) further includes firm-bank fixed effects that forces comparison along a lending relationship.

The estimated coefficient for the triple interaction is negative across all specifications shown and statistically significant, 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-percentage points drop in their refinancing propensity. This result indicates that stricter bank supervision helps mitigate zombie lending.

The estimated coefficients for the remaining interactions are also interesting. The positive estimate in Model (1) for the variable *Zombie* \times *Post* suggest that the non-inspected banks may have picked up some of the zombie borrowers that were cut loose by the inspected banks. The negative estimates in Models (2) and (3) for the variable *Inspected bank* \times *Zombie firm* suggest that inspected banks were ex ante less likely to refinance zombie firms than the non-inspected banks. Finally, the insignificant estimates obtained for *Inspected bank* \times *Post* indicated that inspected did not change their lending behavior vis-à-vis healthy firms in the construction and real estate sectors.

In Table 6 we repeat the same analysis using all firms in the accommodation and food sectors. Since these sectors were not object of inspection, we use them as a placebo test.¹⁰ The estimates we obtain for the variable of interest are always insignificant and economically small, demonstrating that the reduction in zombie lending was indeed driven by the inspections.

5.1.1. 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 in the construction and real estate sectors 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 1 we plot the series of coefficients and corresponding standard errors from estimating regressions analogous to Model (4) of Table 5 (top figure) and Table 6

¹⁰ Recall that the inspections focused not only on loans granted to firms in the construction and real estate sectors, but also in sectors with close links to the construction sector (mainly suppliers). We selected the accommodation and food services sectors because they are also non-tradable sectors and equally downstream.

(bottom figure), in which we replace *Post* by a sequence of time dummies.¹¹ The omitted period is 2012Q2 and the shadowed region indicates the period during which the inspections were taking place.

The timing evidence corroborates a causal interpretation of our results. The top plot shows no evidence of pre-trends, meaning that inspected and non-inspected were changing their exposure to zombie firms roughly at the same rate. After the inspection we see that inspected banks become less likely to refinance zombie firms relative to non-inspected banks. The bottom plot displays only insignificant coefficients both prior to and after the inspection, for our placebo sectors.

5.1.2. *Inspected versus non-inspected banks*

A lingering concern one might have is that the inspected banks are larger – and thus necessarily different – from the non-inspected banks. Although the possible presence of selection bias prevents us from estimating an average treatment effect (ATE), we can use an ad hoc matching procedure to understand the direction of the bias. In particular, we take the four smallest banks that are inspected and compare them to the 4 largest banks that are not inspected. This procedure brings us one step closer towards balancing our treated and control groups in terms of size (and presumably other relevant unobservable characteristics).

In Table 7 we repeat the analysis we did in Table 5 using this smaller sample of banks. Consistent with our previous results, we obtain negative and statistically significant estimates for our triple interaction variable. Importantly, the estimated coefficients are substantially larger, indicating that potential differences between inspected and non-inspected banks cannot explain our previous results.

¹¹ That is, we replace the variable “Inspected bank \times Zombie firm \times Post” by “Inspected bank \times Zombie firm \times 2011Q3”, “Inspected bank \times Zombie firm \times 2011Q4”, etc.

5.2. Evidence from general inspections

We now assess how banks change their lending behavior following a second wave of inspections. Although the set of banks inspected is the same, there are several important differences between this wave of inspections and the previous one. First, this inspection covered corporate loans from all sectors (except mortgages and loans granted to public entities), which is important from an external validity viewpoint. Second, this second inspection was less intrusive in the sense that it was carried out by the banks' habitual auditors (instead of independent auditors appointed by the supervisory team). This feature enables us to see whether the effectiveness of the supervision is affected by the mode it is conducted.

Our estimation window for this general inspection is as follows. The inspection period was during the second and third quarters of 2013, which we omit from the estimation sample. Consistent with our analysis of the first inspection, we take one year before the inspections started and one year after they ended. Therefore, the pre-inspection period is from 2012Q2 to 2013Q1, while the post-inspection period is 2013Q4 to 2014Q3.

We present the regression results in Table 8. All variables and specifications are similar to Table 5. The estimated coefficient for the triple interaction is negative across all specifications shown and statistically significant. Interestingly, the estimated magnitude is strikingly similar to those we obtained in the previous inspection (around 0.03). Thus, inspected banks became 3 percentage points less likely to refinance zombie firms also after this second inspection.

As before, we wonder to which extent differences between the inspected and non-inspected banks could explain these results. After all, the inspected banks are not only larger, but they have already been inspected before and forced to recognize additional provisions on their past loans. In Table 9 we repeat the analysis of Table 8 using a more

homogenous sample banks, which includes the four smallest inspected banks with the four largest non-inspected. The results are similar to those we obtained with the full sample.

5.3. Additional robustness tests

We perform additional robustness test on our regressions that measure the effect of the inspections on a bank's propensity to refinance zombie firms (in Table 5 and Table 8). One important concern is whether our results are general or driven by a particular bank. To address this concern, we re-estimate a series of regressions as those presented in Model (4) of Tables 5 and 8 dropping one of the inspected banks at the time.

The coefficients we obtain are displayed in Figure 2 (for the first inspection, or Table 5) and Figure 3 (for the second inspection, or Table 8). The first estimate shown is the one obtained with the full sample and shown in the tables. The subsequent eight coefficients (one for each inspected bank) and corresponding 95% confidence intervals enable us to assess the individual influence of each inspected bank on our regression estimates. Both figures show that our previous results cannot be attributed to a particular bank, corroborating our empirical strategy.

In Appendix Tables A2-A5 we show that our results are also not affected when we drop state-owned companies or when we aggregate banks at the holding level.

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 special and 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 3 to 6 percentage points less

likely to refinance a firm with negative equity following an inspection. Our results do not seem driven by differences between inspected and non-inspected banks.

Our results indicate that banks change their lending decisions to internalize the costs of future inspections. In sum, on-site inspections appear to be effective because even when inspectors are gone, “their ghosts remain and scare away zombies.”

References

Acharya, V., T. Eisert, C. Eufinger and C. Hirsch (2016) “Whatever It Takes: The Real Effects of Unconventional Monetary Policy”, Working paper.

Adalet McGowan, M, D Andrews and V Millot (2017). “The walking dead: zombie firms and productivity performance in OECD countries”, *OECD Economics Department Working Papers*, no 1372.

Agarwal, S., Lucca, D., Seru, A., & Trebbi, F. (2014). Inconsistent Regulators: Evidence From Banking. *Quarterly Journal of Economics*, 129(2), 889-938.

Albertazzi, U. and D. J. Marchetti (2010) “Credit Supply, Flight to Quality and Evergreening: An Analysis of Bank-firm Relationships after Lehman”, Banca d’Italia Working Paper 756.

Banerjee, R. and B. Hofmann (2018). “The Rise of Zombie Firms: Causes and Consequences”, *BIS Quarterly Review*, September, 67-78.

Bolton, P., X. Freixas, L. Gambacorta, and P. E. Mistrulli (2016) “Relationship and Transaction Lending in a Crisis,” *Review of Financial Studies*, 29, 2643- 2676.

Caballero, R. J., T. Hoshi, and A. K. Kashyap (2008) “Zombie Lending and Depressed Restructuring in Japan,” *American Economic Review*, 98, 1943–1977.

Giannetti, M., and A. Simonov (2013) “On the Real Effects of Bank Bailouts: Micro Evidence from Japan,” *American Economic Journal: Macroeconomics*, 5, 135–67.

Granja, J., and C. Leuz (2017) The Death of a Regulator: Strict Supervision, Bank Lending and Business Activity,” Working paper.

Storz, M., M. Koetter, R. Setzer, and A. Westphal (2017) “Do We Want These Two to Tango? On Zombie Firms and Stressed Banks in Europe,” Working paper.

Khwaja, A. I., and A. Mian (2008) “Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market,” *American Economic Review*, 98, 1413–1442.

Peek, J., and E. S. Rosengren (2005) “Unnatural Selection: Perverse Incentives and the Allocation of Credit in Japan,” *American Economic Review*, 95, 1144–1166.

Schivardi, F., E. Sette, and G. Tabellini (2017) “Credit Misallocation During the European Financial Crisis,” Working paper.

Figure 1 – Dynamic effect of sectoral inspection on zombie lending

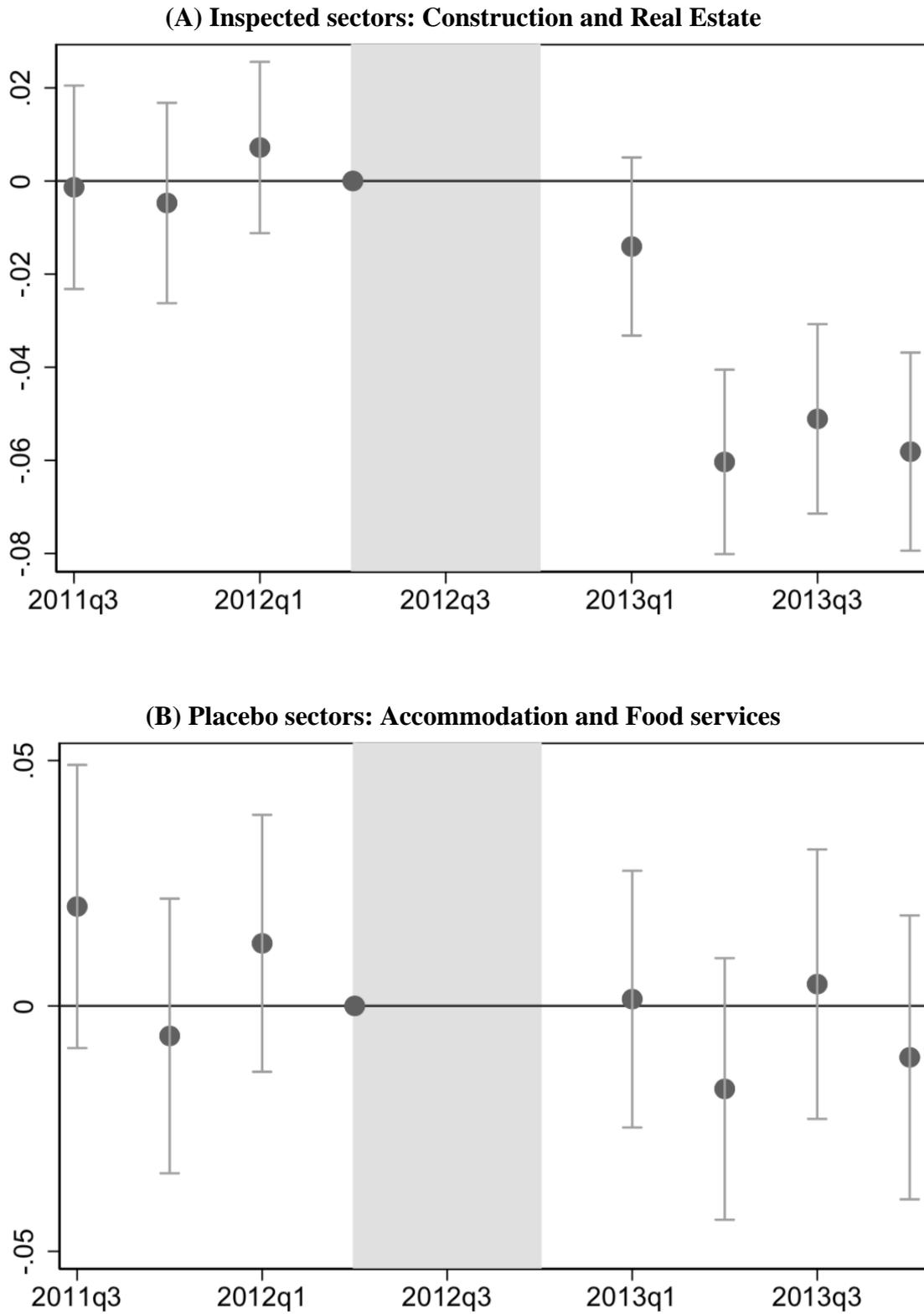


Figure 2 – Stability of regression coefficients (Table 5)

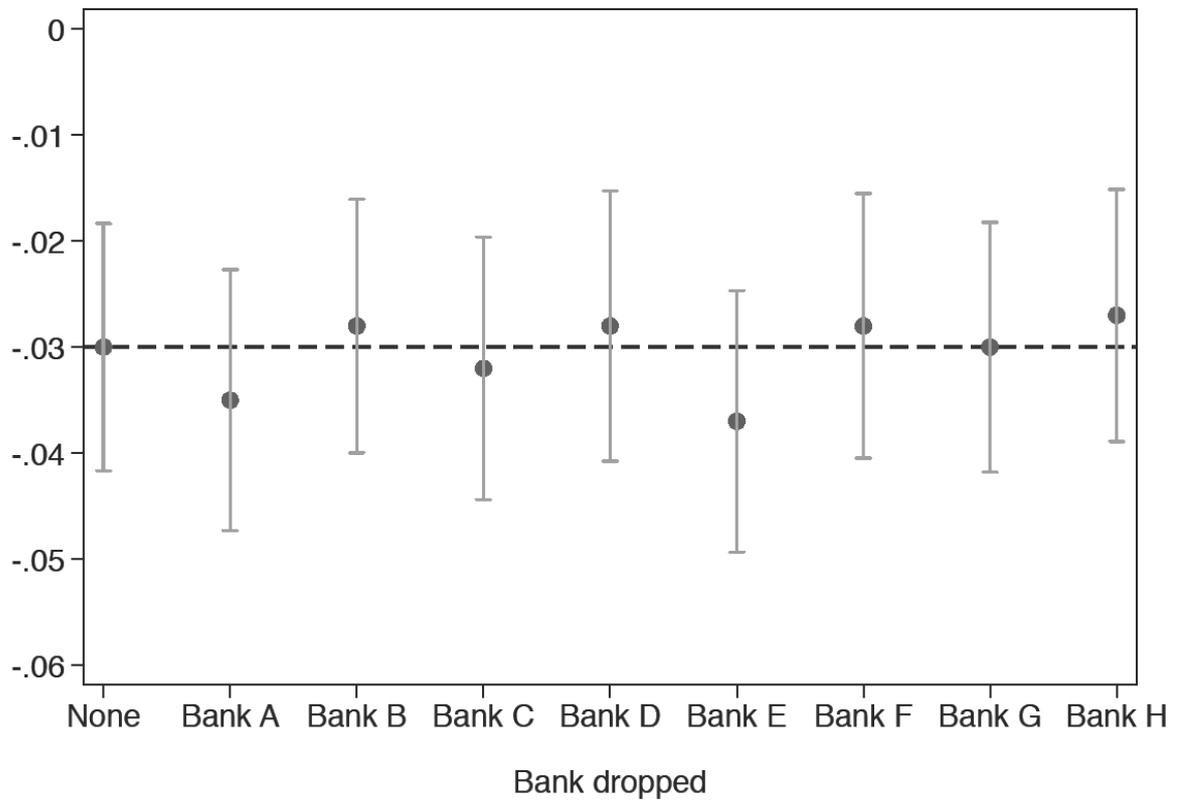


Figure 3 – Stability of regression coefficients (Table 8)

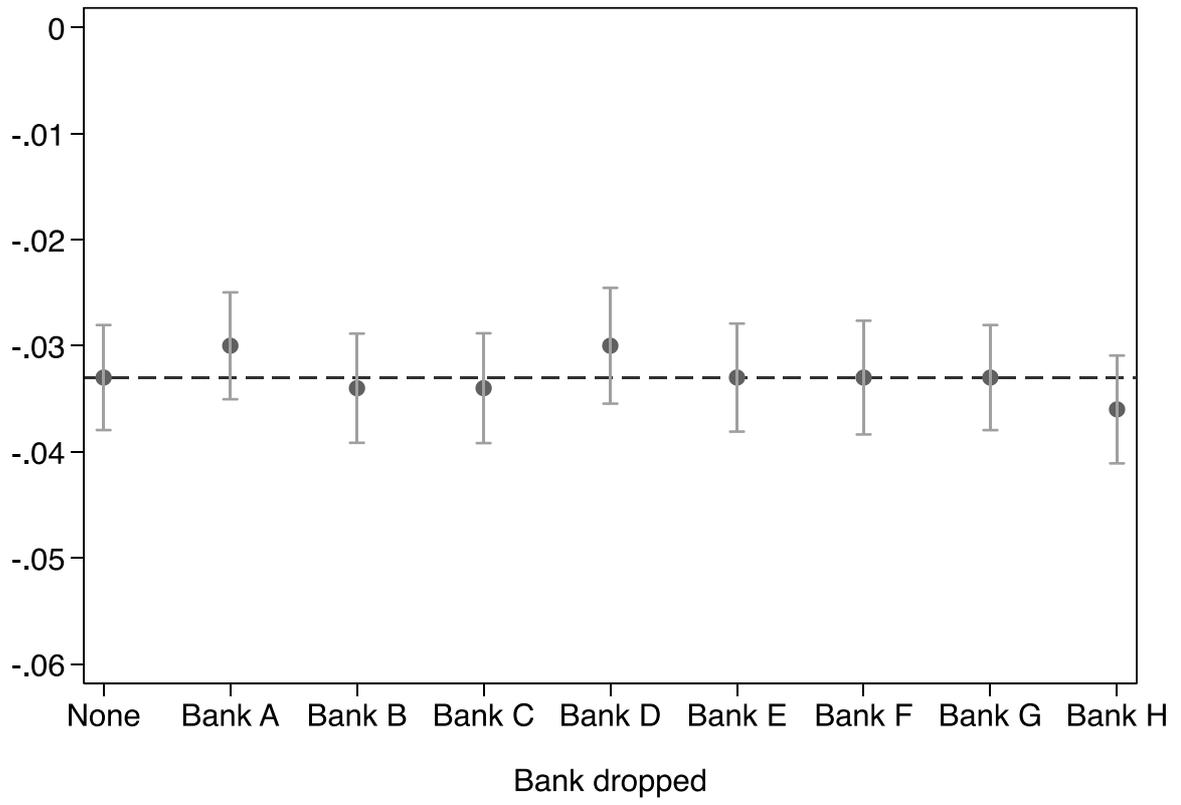


Table 1 – Description of variables

Variable	Definition
<i>Dependent variables</i>	
New loan	= 1 if the firm obtains additional credit from the same lender; = 0 otherwise.
Loan growth	Increase in firm credit from a given lender. Variable truncated between 0 and 1.
<i>Zombie firm</i>	
Negative equity	= 1 if the firm had negative equity in t-1; = 0 otherwise.
Low interest coverage	= 1 if the firm had a ratio of net profits to interest expenses in the bottom quartile in t-1; = 0 if the firm had a ratio of net profits to interest expenses in the top quartile in t-1.
<i>Weak bank</i>	
Low ROA	= 1 if the bank's ROA is in the bottom quartile in the current period; = 0 otherwise.
<i>Relationship characteristics</i>	
Duration of relationship	Duration of relationship (in months).
Main bank	= 1 if bank has at least 75% of total loans
On default with current bank	= 1 if the firm is in default with current lender; = 0 otherwise.
<i>Other firm characteristics</i>	
Micro firm	= 1 if the firm employs < 10 persons and has annual turnover or assets < EUR 2 million; = 0 otherwise.
Financial leverage	= Debt / Assets.
ROA	= Net income / Assets.

Variable	Definition
<i>Other bank characteristics</i>	
Bank ROA	= Net income / Assets
Capital ratio	Capital ratio.
Credit overdue	= NPLs / Credit.
Bank size	Bank assets (in billion euros).

Table 2 – Descriptive statistics

Data are at the loan-level for the period 2005-2015. See Table 1 for variable definitions.

Variable	Mean	Standard Deviation	Min	Median	Max
<i>Dependent variables</i>					
New loan	0.208	0.348	0	0	1
Loan growth	0.108	0.243	0	0	1
<i>Zombie firm</i>					
Negative equity	0.223	0.416	0	0	1
Low interest coverage	0.358	0.475	0	0	1
<i>Weak bank</i>					
Low ROA	0.423	0.422	0	0.333	1
<i>Relationship characteristics</i>					
Duration of relationship (months)	60.300	43.500	0	52	226
Main bank	0.606	0.435	0	1	1
On default with current bank	0.077	0.240	0	0	1
<i>Other firm characteristics</i>					
Micro firm	0.817	0.385	0	1	1
Financial leverage	0.762	0.653	0.025	0.662	3.360
Firm ROA	-0.067	0.269	-1.150	0.004	0.294

Variable	Mean	Standard Deviation	Min	Median	Max
<i>Other bank characteristics</i>					
Bank ROA	0.071	0.839	-2.700	0.232	3.010
Capital ratio	0.123	0.033	0.032	0.120	0.286
Credit overdue	0.055	0.042	0.006	0.044	0.274
Bank size	9.600	1.740	4.780	10.100	11.500

Table 3 – Who refinances zombie firms?

Data are at the loan-level for the period 2005-2015. See Table 1 for variable definitions.

Dependent variable: New loan from existing lender	
<i>Bank characteristics</i>	
Bank ROA	-0.006*** [-7.195]
Credit overdue	-0.001*** [-36.933]
Log(Bank Assets)	0.032*** [76.465]
<i>Relationship characteristics</i>	
Duration of relationship	0.001*** [7.111]
Main bank	0.126*** [56.435]
In default with current bank	0.187*** [71.930]
<hr/>	
Firm-year-quarter FE	Yes
Number of observations	427,587
R-squared	0.419

Table 4 – Evidence of zombie lending

Data are at the loan-level for the period 2005-2015. See Table 1 for variable definitions.

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Weak bank × Zombie firm	0.013*** [8.649]	0.010*** [6.268]	0.007*** [3.573]	0.012*** [6.739]
Weak bank	0.007*** [10.934]	-0.009*** [-11.045]	-0.006*** [-6.451]	
Zombie firm	-0.061*** [-63.140]	-0.040*** [-26.778]		
Year-quarter FE	Yes	Yes	-	-
Firm FE	-	Yes	-	-
Firm×Year-quarter FE	-	-	Yes	Yes
Bank FE	-	Yes	Yes	-
Bank×Year-quarter FE	-	-	-	Yes
Number of observations	1,878,586	1,878,586	1,878,586	1,878,586
R-squared	0.015	0.182	0.420	0.427

Table 5 – Zombie lending when supervisors are watching (Sectoral inspection)

Inspected Sectors: Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.046*** [-5.498]	-0.027** [-2.444]	-0.030*** [-2.725]	-0.030** [-2.574]
Inspected bank × Zombie firm	0.001 [0.204]	-0.025*** [-3.367]	-0.023*** [-3.140]	
Inspected bank × Post	-0.006 [-1.619]	-0.006 [-1.420]		
Zombie firm × Post	0.031*** [5.130]			
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	259,226	259,226	259,226	259,226
R-squared	0.198	0.445	0.455	0.608

Table 6 – Placebo test using some of the non-inspected sectors (Sectoral inspection)

Placebo sectors: Accommodation and Food Services

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.001 [-0.101]	0.002 [0.163]	-0.005 [-0.330]	-0.017 [-1.027]
Inspected bank × Zombie firm	-0.008 [-1.145]	-0.012 [-1.225]	-0.012 [-1.200]	
Inspected bank × Post	-0.011* [-1.673]	-0.005 [-0.576]		
Zombie firm × Post	-0.008 [-1.006]			
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	85,331	85,331	85,331	85,331
R-squared	0.19	0.457	0.473	0.634

Table 7 –Ad hoc matching inspected and non-inspected banks (Sectoral inspection)

Inspected Sectors: Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.064*** [-3.868]	-0.076** [-2.252]	-0.080** [-2.352]	-0.063* [-1.864]
Inspected bank × Zombie firm	0.042*** [3.226]	0.042* [1.672]	0.046* [1.811]	
Inspected bank × Post	0.006 [0.952]	-0.024* [-1.864]		
Zombie firm × Post	0.034*** [3.676]			
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	71,477	71,477	71,477	71,477
R-squared	0.332	0.541	0.544	0.688

Table 8 –Zombie lending when supervisors are watching (General inspection)

Inspected sectors: All

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.036*** [-9.961]	-0.024*** [-5.109]	-0.026*** [-5.539]	-0.033*** [-6.664]
Inspected bank × Zombie firm	-0.004 [-1.641]	-0.018*** [-5.919]	-0.018*** [-5.693]	
Inspected bank × Post	0.023*** [15.716]	0.026*** [14.244]		
Zombie firm × Post	-0.003 [-1.108]			
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	1,442,560	1,442,560	1,442,560	1,442,560
R-squared	0.178	0.428	0.431	0.578

Table 9 –Ad hoc matching inspected and non-inspected banks (General inspection)

Inspected sectors: All

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.025*** [-3.705]	-0.027** [-2.095]	-0.029** [-2.242]	-0.039*** [-2.937]
Inspected bank × Zombie firm	0.014*** [2.811]	-0.000 [-0.003]	0.000 [0.008]	
Inspected bank × Post	0.032*** [11.890]	0.032*** [6.189]		
Zombie firm × Post	-0.000 [-0.078]	-0.000 [-0.078]		
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	396,451	396,451	396,451	396,451
R-squared	0.291	0.518	0.52	0.662

APPENDIX TABLES

Table A1 – Robustness tests on Table 4

Dependent variable:	New loan	Loan growth	New loan	New loan
Lines of credit included:	No	Yes	Yes	Yes
Zombie firm:	Negative equity (1 year)	Negative equity (1 year)	Negative equity (2 years)	Low interest coverage (1 year)
	(1)	(2)	(3)	(4)
Weak bank × Zombie firm	0.013*** [7.126]	0.002** [2.317]	0.012*** [4.830]	0.017*** [10.744]
Firm×Year-quarter FE	Yes	Yes	Yes	Yes
Bank×Year-quarter FE	Yes	Yes	Yes	Yes
Number of observations	1,878,586	1,878,586	1,312,656	1,714,303
R-squared	0.439	0.408	0.439	0.424

Table A2 – Additional robustness tests on Table 5: Drop state-owned companies

Inspected Sectors: Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.045*** [-5.469]	-0.027** [-2.445]	-0.030*** [-2.724]	-0.030** [-2.573]
Inspected bank × Zombie firm	0.001 [0.196]	-0.025*** [-3.363]	-0.023*** [-3.141]	
Inspected bank × Post	-0.006* [-1.658]	-0.006 [-1.431]		
Zombie firm × Post	0.032*** [5.140]			
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	259,054	259,054	259,054	259,054
R-squared	0.198	0.446	0.455	0.608

Table A3 – Additional robustness tests on Table 5: Consolidated banks

Inspected Sectors: Construction and Real Estate

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.052*** [-5.853]	-0.027** [-2.202]	-0.029** [-2.403]	-0.023* [-1.816]
Inspected bank × Zombie firm	0.009* [1.688]	-0.022*** [-2.653]	-0.020** [-2.488]	
Inspected bank × Post	-0.005 [-1.349]	-0.005 [-1.009]		
Zombie firm × Post	0.038*** [5.327]			
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	259,226	259,226	259,226	259,226
R-squared	0.198	0.445	0.454	0.608

Table A4 – Additional robustness tests on Table 8: Drop state-owned companies

Inspected Sectors: All

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.036*** [-9.989]	-0.024*** [-5.168]	-0.026*** [-5.588]	-0.032*** [-6.594]
Inspected bank × Zombie firm	-0.004* [-1.669]	-0.018*** [-5.932]	-0.018*** [-5.712]	
Inspected bank × Post	0.023*** [15.753]	0.026*** [14.276]		
Zombie firm × Post	-0.003 [-1.082]			
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	1,439,791	1,439,791	1,439,791	1,439,791
R-squared	0.178	0.428	0.431	0.578

Table A5 – Additional robustness tests on Table 8: Consolidated banks

Inspected Sectors: All

Dependent variable:	New loan from existing lender			
	(1)	(2)	(3)	(4)
Inspected bank × Zombie firm × Post	-0.031*** [-7.915]	-0.016*** [-2.981]	-0.017*** [-3.307]	-0.031*** [-5.658]
Inspected bank × Zombie firm	0 [-0.169]	-0.018*** [-5.377]	-0.018*** [-5.295]	
Inspected bank × Post	0.019*** [12.230]	0.021*** [10.507]		
Zombie firm × Post	-0.004 [-1.137]			
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	1,442,560	1,442,560	1,442,560	1,442,560
R-squared	0.177	0.428	0.431	0.578