

Lending activity and credit supply to firms during the crisis

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ABSTRACT

Banks sometimes respond to deterioration in the quality of their placements by extending loan repayment periods to borrowers in default and hiding the actual quality of placements, hoping that difficulties of borrowers are only temporary. This practice is termed evergreening or zombie lending. Due to a prolonged recession and stagnation coupled with relatively high share of non-performing loans, such practice may be occurring in Europe nowadays. We use data for Croatia, a country that fought recession for several years, to study the existence of zombie lending practice. We analyse credit supply to individual enterprises in Croatia at the beginning and in the midst of the recent crisis and determine to what extent zombie lending is present and how lending behaviour changed during the crisis period. Results of the estimated regressions indicate that there is evidence that some of the loans being prolonged are the result of zombie lending practices. This implies that policymakers should be aware of the possibility of such a relationship between banks and firms, as well as of its impact, and should try to minimise it.

Keywords: zombie lending, credit supply, micro level data

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1 Introduction

Stagnation in aggregate loans to the economy during a recession often hides tumultuous lending activity that unfolds at a micro level and is crucial for successful restructuring of the economy. During recessions, banks usually try to reduce their exposure to enterprises in distress, often by writing off loans, and turning to new and promising projects, thus laying the foundation for economic growth. For example, as documented in Contessi and Francis (2013), US banks, as in previous recessions, strongly reduced the level of existing corporate loans during the 2008 recession. Still, banks sometimes respond to a sharp deterioration in the quality of their placements by extending loan repayment periods to borrowers in default and hiding the actual quality of placements, hoping that difficulties of borrowers are only temporary or because of fear that a bank's position in the market or the management's position vis-à-vis the owners may be threatened. Peek and Rosengren (2005) give evidence of this practice (termed evergreening and later on zombie lending) in Japan. Such responses of banks to unfavourable developments in credit quality can slow down the flow of production resources to propulsive activities, hinder the entry of new entrepreneurs to the market and negatively affect potential growth. It is very difficult to draw the line between a bank's patience with clients in temporary distress and its intention to hide non-performing placements. Examples from practice, such as the case of Japan, clearly show that a several-years long prolongation of bank loans may keep resources in inefficient enterprises and contribute to a long-lasting economic stagnation. This in turn adds pressure on bank stability. Due to a prolonged recession and stagnation coupled with relatively high share of non-performing loans, such practice may as well be occurring in Europe nowadays. Subsequently, we use data for Croatia, a country that experienced prolonged recession, to study the existence of zombie lending practice.

This paper focuses on the link between credit supply and zombie companies using data on bank lending to individual enterprises in Croatia in 2008 and 2012. It aims to establish whether there was any credit misallocation and what bank and company characteristics contribute to such behaviour. There is anecdotal evidence that banks rolled over some potentially problematic loans to firms after the crisis started. By using firm-level data this research will shed more light on the issue of detecting credit misallocation.

The research is organised in seven sections. The section after the introductory section presents survey of the related literature. Stylised facts are presented in the third section. Data and methodology are described in the fourth section. Results of the analysis are discussed in the fifth section, while implication of results and policy discussion is presented in section 6. Finally, the last section concludes the paper.

2 Related literature

In the literature on credit misallocation two terms are widely used: evergreening and zombie lending. Both names refer to the same phenomenon where good money is thrown after bad: loans are rolled over in order to keep borrowers solvent, because otherwise they would most probably default. Banks engage in such a practice because they reap short-term gains, they do not have to declare a loan as non-performing (which is costly) or they do it in order to preserve their relationship with borrowers and/or business partners. In the literature there are three common ways to detect zombies:

- 1) by way of interest rate subsidies, when a borrower pays less than the prime rate (Caballero, Hoshi and Kashyap 2008);

- 2) using company financial indicators (such as profitability, liquidity and leverage) and interacting them with various bank characteristics (Peek and Rosengren 2005); and
- 3) using a productivity measure (Solow residual) and interacting it with various bank characteristics (Albertazzi and Marchetti 2010).

Although often mentioned in policy discussions and in professional publications (e.g. Eichengreen 2015), research on zombie lending is scarce, especially in Europe. However, its importance is great, due to the possible negative effects of zombie lending on economic performance.

Originally, research on credit misallocation was mostly concerned with the case of Japan. One of the most extensive is the widely cited study by Peek and Rosengren (2005). The authors document the practice of zombie lending by Japanese banks following a severe economic crisis and the crash of stock and real estate markets. They use logit equation to model the probability of a bank increasing credit to a firm with the set of bank- and company-specific explanatory variables. Their sample covers the period from 1993 to 1999. The findings corroborate the zombie lending hypothesis: financially weaker firms have a higher probability of a loan increase. The study also finds evidence of balance sheet cosmetics by banks: if their capitalisation is close to the regulatory minimum they are more likely to increase credit to weak firms. However, banks' actual economic health (measured by market perception and the change in their market price) had no significant impact on the probability of the loan increase. Corporate affiliations were also found to be important: banks increased loans more readily to their business group (keiretsu) members and to companies where the bank in question was the principal bank (biggest lender).

To sum up, the study by Peek and Rosengren (2005) finds that banks increased loans to severely impaired firms even when this was not economically viable and the loans were likely to create additional loss for the bank. Incentives for this behaviour came from within banks (to limit the growth of bad loans and because of corporate affiliations) and from outside, from the government, which pressured banks to continue to roll over loans to weak companies to stem a surge in unemployment and firm defaults. The work by Peek and Rosengren (2005) is probably the most comprehensive study that documents the existence of zombie lending in Japan, but it does not explore the effects of this practice on the economy. The authors only hypothesise that this misallocation of credit was an important contributing factor to Japan's decade-long economic stagnation.

The study by Caballero, Hoshi and Kashyap (2008) makes this additional step and analyses the impact that so-called zombie firms have on aggregate activity. By definition, zombie firms are a result of a "sham loan restructuring that kept credit flowing to the otherwise insolvent borrowers". They find that the congestion created by zombie firms reduced the profit of healthy firms and discouraged their entry to the market and investment. The authors detect zombie firms by interest rate subsidies. These firms pay too low interest rates (below the average long-term government rate). Caballero, Hoshi and Kashyap (2008) then seek for the real effects of zombie lending. By using balance sheet data for companies listed on the Tokyo Stock Exchange from 1981 to 2002 they try to explain various activity measures (investment rate, employment growth, productivity) by regressing them to variables that measure the zombie rate in a specific industry, and to control variables. The results show that industries with high proportion of zombies create fewer jobs and invest less.

The interest in the so-called “lost decade” and evergreening in Japan did not diminish with time due to lessons that can be drawn from the Japanese experience. Evergreening was also analysed, among others, in Giannetti and Simonov (2013), Fukuda and Nakamura (2011), Inoue, Uchida and Bremer (2010), Watanabe (2010), Kwon, Narita and Narita (2009), Inoue, Kato and Bremer (2008), Fukuda, Kasuya and Nakajima (2006) and Ahearne and Shinada (2005). All of them corroborate the hypothesis of evergreening in Japan during the prolonged recession and stagnation in the 1990s and give explanations and interpretations of what caused it. Giannetti and Simonov (2013) show that insufficient government capital injections to banks encouraged the evergreening of non-performing loans, while Watanabe (2010), on the other hand, emphasises that regulators' tougher policy toward banks in the second part of the 1990s, connected with Basel I framework, incentivised evergreening practices. Inoue, Kato and Bremer (2008) argue that bad-debt problem was a consequence of the failure of the monitoring function of bank supervisors, while Inoue, Uchida and Bremer (2010) show that there was a bias in banking sector to allow the continuation of unprofitable firms. Fukuda, Kasuya and Nakajima (2006) show that deterioration of the non-performing loans ratio caused an increase in lending to zombie firms.

After the so-called lost decade in Japan, the researchers did not have much room for research in this area as the economic climate around the world was mild, with only minor recessions occurring now and then. However, the financial crisis and strong recession that started in 2008 exposed and created vulnerabilities for banking systems in many economies, especially in Europe. The environment in which strong recession and subsequent stagnation changed the pattern of business, probably forever, leaving firms to cope with the new business climate and banks to obtain additional capital, became fertile ground for zombie lending: the firms will be

temporarily saved and banks will temporarily need to have less capital. So the issue of zombie lending was back on the table, but this time in different places.

In this setting, Albertazzi and Marchetti (2010) analyse the effect of financial crisis on credit supply to Italian companies using a panel data set with detailed bank and company data in the period from September 2008 to March 2009. They find that low bank liquidity and capitalisation negatively affect credit supply. In addition, they find evidence of zombie lending, which is, according to their findings, concentrated within smaller, less capitalised banks. Albertazzi and Marchetti (2010) explain this result with the loan granting process, which is based on strict credit scoring in big banks and is much more relaxed in smaller banks.

Even though recession and slow growth in Europe lasted for several years, apart from the earlier mentioned work of Albertazzi and Marchetti (2010), studies on detecting zombie lending in Europe are, to our knowledge, non-existent. Hence, our study tackling zombie lending is important for increasing the awareness regarding such possible behaviour.

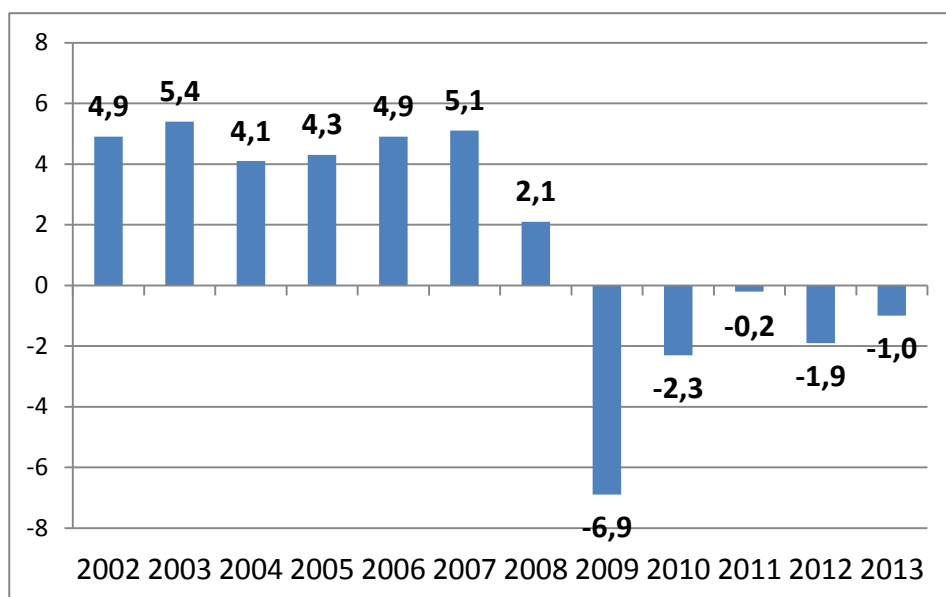
3 Stylised facts

Croatia, like many other European countries, has a bank-centric financial system. Although in recent years other financial intermediaries, primarily pension funds, insurers and leasing companies, have increased their total assets faster than banks, banks remain the most important financial intermediary in Croatia, with a share of 82.6 per cent in 2013. In addition, the size of the banking system has increased over time, reaching almost 80 per cent of GDP at the end of 2013. These two facts stress the importance of bank lending for the economy and

show how important bank stability is for the performance and financial stability of the domestic economy.

However, unlike most other European countries, Croatia experienced a prolonged recession, starting in the second half of 2008 and continuing throughout 2013 (Figure 1). Real GDP fell in 2013 by 12 per cent in comparison to 2008. Recession was triggered by the global financial crisis, but the onset of the new business cycle remained prevented by internal weaknesses as late as in 2013. More stringent financial conditions and deteriorated consumer and business confidence caused personal consumption and investment to decrease at a rapid pace. Moreover, recession in the EU and neighbouring countries, Croatia's most important export markets, caused exports to decline. The Croatian National Bank (2015), the Institute of Economics, Zagreb (2015) and the IMF (2015) projected that the (slow) recovery of Croatia's economy would start in 2015, mostly as a result of demand from major trading partners and some personal consumption recovery.

Figure 1: GDP growth in Croatia from 2002 to 2013



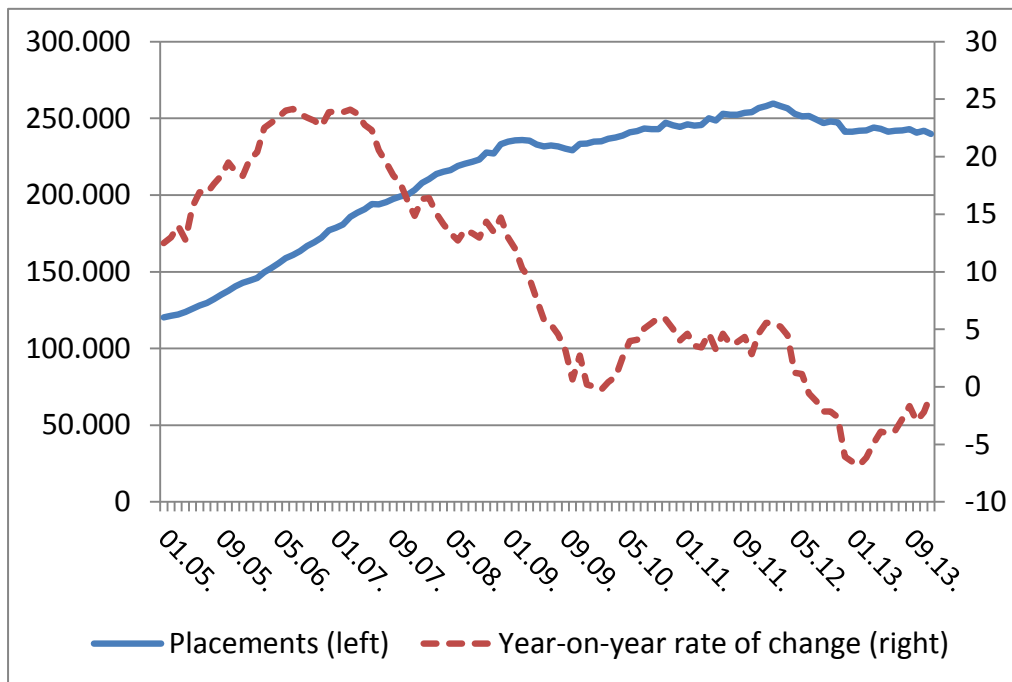
Source: Croatian National Bank.

Weak domestic demand is not reflected in total bank loans during the entire crisis period. The upward trend was present until the beginning of 2012, although with an interruption in 2009, when total bank loans temporarily decreased (Figure 2). Although statistics show a decrease in total loans for 2012 and 2013, this is due to several one-off effects¹ and sale of non-performing loans by banks in Croatia.

All of this indicates that a potential zombie lending problem could be present in Croatia. Given that this kind of behaviour can prolong the desired economic recovery, it is necessary to explore the zombie lending issue and identify whether and to what extent it exists.

¹ Among which the most important is the assumption of the shipyards' debt by the Republic of Croatia (in the process of shipyard privatisation and restructuring).

Figure 2: Credit institution placements (excluding the government)



Source: Croatian National Bank.

4 Overview of methodology and data

A bank can do several things when a debtor encounters financial hardship and starts postponing loan payments. It can cut its losses, collect as much as it can from the debtor and transfer these resources to more productive use by granting the loan to a more able and promising entrepreneur. This is conditional on:

- the bank having enough capital to withstand potential losses (designating a loan as non-performing or bad drives up the costs and diminishes profits as the bank needs to provision for potential losses);
- the legal system allowing for a swift resolution;
- the bank's management concluding that this is advantageous for the bank (small banks that depend on business ties in small communities might be reluctant to be aggressive in this respect);

- the bank's management concluding that this is advantageous for the management (a classic owner - manager problem).

Another option for the bank is to extend the loan of a debtor in financial hardship. Such behaviour can be a result of its patience, which might be advantageous for the bank, but also of the practice of zombie lending. The focus of our investigation is on this second type of behaviour. To do that we explore lending patterns in two sub-samples and try to find evidence of loan misplacement in cases where the supply of loans from the bank went to substandard debtors in an attempt to diminishing potential losses and in the hope that the debtor would recover.

The sample comprises data on loans to individual enterprises that banks also have to report to the supervisor – the Croatian National Bank (CNB). The sample includes data on bank characteristics from the CNB and financial data for enterprises from the Croatian Financial Agency.

Corporate lending from bank b to company i , which is the dependent variable to be explained, is introduced in a panel regression as the relative change in loans, while independent variables are financial indicators and other characteristics of banks and enterprises together with their interactions. The problem we face is that the observed change in loans is the result of supply and demand interaction, so standard OLS cannot distinguish the supply from demand effects or the impact of the bank lending channel vs. the firm borrowing channel on the observed change in loans. Fortunately, Khwaja and Mian (2008) methodology allows us to disentangle supply and demand using fixed effects regression. The key to this methodology is to use unanticipated liquidity shocks to the banking sector that varies across banks in order to trace

out the effects of the bank lending channel. The firm fixed effects then provide an unbiased estimate of the credit demand and the obtained coefficients on the bank-specific variables can be interpreted as drivers of supply. However, as Khwaja and Mian (2008) put it, the downside to this approach is that it restricts analysis to firms with multiple banking relationships, so we could not analyse the total sample by using only this methodology. However, by using the fact that in certain cases there is no bias for ordinary OLS estimates, in some specifications we are able to use the whole sample, including firms with only one bank relationship. More precisely, we can check for possible bias between pooled OLS and FE estimators. As Khwaja and Mian (2008) argue, the OLS coefficient estimates below FE estimates would indicate negative correlation between unobserved demand and liquidity shocks, which implies that the OLS estimates are not biased. This means that in this case we can proceed with OLS regressions, which gives us the opportunity to include all firms from the sample, not only the ones with multiple banking relationships.

To apply the aforementioned methodology we have used two periods when liquidity shocks to the banking sector in Croatia were present. The first period (2008) is at the onset of the recession, when, due to the financial crisis in Europe, the banking model of large international conglomerates that hold 90 per cent of the Croatian market through their subsidiaries came into question and their liquidity in the European money market dried out. This was also visible in the liquidity position of the domestic banking sector (Figure 3) that decreased in 2008 significantly and unexpectedly. After a gradual recovery in 2010, the liquidity of the median bank continued to decrease, albeit it remained close to relatively high levels.

Figure 3: Median of liquidity for Croatian banking sector (liquid assets to total assets)

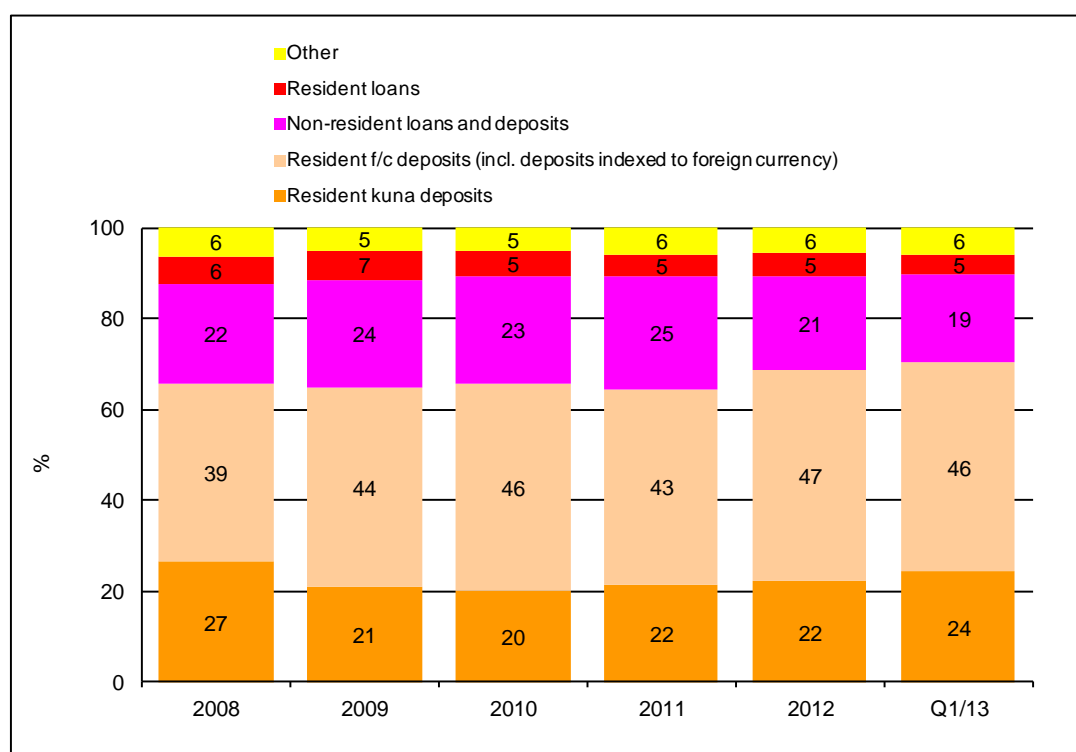


Source: Croatian National Bank.

The second period for the unexpected shock is the year 2012, when Croatian foreign-owned banks experienced relatively strong deleveraging by their foreign owners after several years of stagnating and even increasing of their exposure. This can be seen in a sharp decrease in the share of the non-resident loans and deposits in their total liabilities in 2012 (Figure 4).

Having estimates for two years will enable us to see changes in bank lending and firm borrowing channels at the beginning of the recession, in 2008, and deep into recession (2012), and compare whether there have been any changes in the behaviour.

Figure 4: Structure of banking system liabilities



Source: Croatian National Bank.

Companies with relatively low financial standing that receive additional loans are an indication of a bank's zombie lending behaviour. Z-score² and coverage of short-term debt by net operating income are used to measure firms' financial standing and their risk. We construct a dummy variable to designate such risky companies. These are the ones that have Z-score below the sample's 25th percentile and low coverage of short-term debt by net operating income (below the 25th percentile). Interacting risky company dummy with banks that have subpar capital adequacy ratio³ indicates potential lender – debtor pairs involved in the zombie lending practice. This zombie interaction dummy based on the firm and bank characteristics is then added in the regressions. A positive, statistically significant coefficient on this variable signals zombie lending behaviour. The reason why we use interaction

² Originally due to Altman (1968) Z-score is a standard financial analysis tool and as such part of the credit scoring for corporate clients. Z-score is calculated as a linear combination of five indicators showing profitability, efficiency (capital intensity), funding sources, debt and liquidity. The weightings for the sub-components are taken over from Eidelman (1995).

³ These are banks with the below-median capital adequacy ratio.

variables is because when we estimate regressions with fixed effects, it is not possible to include Z-score and other company related variables directly. However, by interacting company characteristics that do not change across banks and bank characteristics that change for at least some banks, fine details of company–bank link can be explored. A firm's characteristics are included directly only when we estimate regressions with OLS.

In order to test for robustness, we construct zombie variable in additional two ways by interacting banks with low capitalisation and firms with low Z-score and in the second instance interacting banks with low capitalisation and firms with low coverage of short-term debt by net operating income. In addition, we use a dummy for the principal bank, which aims to test whether the relationship with the principal bank is different from the relationship with other banks. The principal bank is defined as the one that has the biggest exposure among all banks that have exposures to a certain client.

To sum up, to obtain the determinants of credit supply to firms we estimated the following equation with the firm fixed effects:

$$y_i = \alpha + \beta_1 x_{b,i} + \beta_2 z_i + \beta_3 c_i + \beta_4 d_i + \beta_5 e_i + \beta_6 f_i + \beta_7 g_i + \beta_8 h_i + \beta_9 i_i + \beta_{10} j_i + \beta_{11} k_i + \beta_{12} l_i + \beta_{13} m_i + \beta_{14} n_i + \beta_{15} o_i + \beta_{16} p_i + \beta_{17} q_i + \beta_{18} r_i + \beta_{19} s_i + \beta_{20} t_i + \beta_{21} u_i + \beta_{22} v_i + \beta_{23} w_i + \beta_{24} x_i + \beta_{25} y_i + \beta_{26} z_i + \beta_{27} \epsilon_{b,i} \tag{1}$$

The dependent variable is the relative change of loans from bank *b* to company *i*. Explanatory variables in the matrix $x_{b,i}$ are various characteristic of the bank that is providing the loan: leverage, profitability, capitalisation and ratio of non-performing loans to total loans, as well as the interaction terms explained earlier. The term u_i is part of the composite error that does not change across banks, while $e_{b,i}$ is a random error term. In OLS specifications company characteristics are added.

In the panel data sets residuals might be correlated and OLS standard errors might be biased. Even though the fixed effects remove part of the correlation (u_i) from the composite residuals ($u_i + e_{b,i}$ in the Equation (1)), the remaining part of the residual $e_{b,i}$, can still be correlated, which makes the ordinary standard errors inappropriate. As Wooldridge (2001) argues, testing for serial correlation is useless in cases where there are only two bank relationships per firm because by estimating with fixed effects we will get bank demeaned errors and these are by definition negatively correlated, even if the original errors ($e_{b,i}$) in Equation (1) are not. As a significant share of firms in the data set has only two bank relationships per firm (more than 50 per cent) this makes testing impossible. This is why standard errors, robust to correlation and heteroscedasticity, are used instead of ordinary standard errors. The estimator is valid in presence of any form of heteroscedasticity and serial correlation (Wooldridge, 2001).

5 Results

In this chapter we formally test whether there is evidence of zombie lending, a practice where weak firms, that would most probably default without loans from the banks, have higher probability to be granted a loan, because of specific links between the company and the bank or because this is financially attractive for the bank. Finding a significant positive coefficient value on the zombie variable that indicates lender – debtor pairs, where lender is poorly capitalised and debtor is a subpar company, is considered evidence of zombie lending behaviour.

To test this, we estimate series of regressions aimed at determining banks' supply of credit to firms in two periods: at the very beginning of the economic and financial crisis (Table 1) and

several years into the recession (Table 2). The first period is interesting, as it gives us the opportunity to study bank behaviour regarding zombie lending at the beginning of recession, when banks were still highly capitalised and foreign owners did not initiate deleveraging. The second period (2012) is well into the recession, when deleveraging towards foreign owners was relatively strong.

In addition, the situation where there are several lenders and one borrower opens the door for strategic interaction. If one bank decides to engage in zombie lending and supports a subpar debtor, other banks might use that fact and start decreasing exposures at the expense of the supporting bank. That is why we test for zombie lending behaviour in a sample where firms have relationships with two or more banks (Tables 1 and 2, specifications 1-4) and in the full sample, displaying all bank – firm links (Tables 1 and 2, specifications 6-8).

First, we focus on the effect of bank performance and financial strength, which are measured by leverage, profitability, capitalisation and the proportion of non-performing loans, on the supply of loans. A healthy banking system means that banks are able to provide adequate amounts of loans regardless of the phase the business cycle is in. Hence, we expect that capitalisation will be an important determinant of bank lending, since poorly capitalised banks tend to restrict lending. Further, we expect that the ratio of non-performing loans might become important deep in the crisis period and that banks are expected to constrain the supply of credit when faced with materialised credit risk. Similarly, we also expect the liquidity of a bank, as measured by loan to deposit ratio, to become important as banks start to deleverage during the crisis.

Estimation results mostly corroborate our hypotheses. Among bank-specific variables at the

onset of recession in 2008, in addition to banks' active interest rate, capital adequacy ratio (CAR) stands out as a statistically significant determinant of credit supply (Table 1 specification 1). However, as might be expected, the link between the capital adequacy ratio and willingness to lend is not linear, but rather has an inflexion that is defined by the quadratic function in specification 1. Increasing capital over a certain amount (in this case 19.47 per cent), which is higher than the basic legal requirement of 12 per cent, might indicate that the bank has a lot of risky loans as a part of its business strategy and holds additional capital to cover these risks. On the other hand, lower capital adequacy that is below the market norm (median) might indicate that a bank struggles to meet industry standard and as a result restricts lending and/or uses zombie lending to hide the actual quality of loans in its loan book. This implies that banking system supervisors can use information on a bank's capitalisation as an early warning signal of a potential zombie lending problem.

In specification 2, banking system median is used as industry standard for capitalisation (16.42 per cent). We can conclude from specifications 1 and 2 that banks that are capitalised below industry standard (here defined as median) tend to restrict lending and that banks with higher capitalisation tend to lend more (up to the aforementioned threshold).

The same estimation strategy and the same set of equations were used for the year 2012, but the results are somewhat different (Table 2), as expected for the banking system of an economy that has been experiencing several years of recession. Among bank-specific variables only the non-performing loans ratio (which was not statistically significant in the 2008 specification) has a significant negative influence on bank lending. This ratio basically measures what will happen with capitalisation in the future. The rise of non-performing loans will increase the costs that banks will have in the future and influence capitalisation through

earnings. Other bank-specific variables are not statistically significant, probably indicating that, except for the non-performing loans ratio, constraints for lending are on the demand side and not the supply side.

After determining that the effect of bank capitalisation and non-performing loans on credit supply in 2008 and 2012 was significant, we turn our attention towards finding evidence of zombie lending. Except for finding possible evidence of zombie lending, we expect to find that banks' behaviour towards relationship lending practices might have changed over time. Faced with increased risk and long economic crisis, banks might be less willing to treat companies differently just because of a prior relationship with them.

Indeed, as it can be observed from the beginning of the recession (Table 1), the principal bank dummy is significant in all specifications indicating the existence of relationship lending. Even though relationship lending by itself can have a positive impact on economic growth and employment (e. g. Memmel et al., 2008), it might, at the same time, provide fertile ground for zombie lending, especially in the downturn phase of the business cycle.

Table 1: Estimation results for 2008

Specification:	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7	Spec 8
Dep. Var:	Change in loans from bank to firm							
C	-0.601143 (0.1698)**	-0.293573 (0.1159)*	-0.362009 (0.1132)**	0.101096 (0.1273)	-0.581735 (0.1612)**	-0.307499 (0.0880)**	-0.381733 (0.0643)**	-0.39016 (0.0648)**
Principal bank	0.087192 (0.0098)**	0.074303 (0.0101)**	0.087299 (0.0098)**	0.078334 (0.0102)**	0.074526 (0.0123)**	0.025072 (0.0088)**	0.036654 (0.0110)**	0.03966 (0.0111)**
Bank loan to deposit ratio	0.000626 (0.0006)	-0.000062 (0.0006)	0.00036 (0.0006)	-0.000111 (0.0006)	0.001246 (0.0005)*	0.001035 (0.0003)**	0.000918 (0.0003)**	0.000943 (0.0003)**
Bank profitability (ROA)	0.011144 (0.0072)	0.011787 (0.0077)	0.015466 (0.0071)*	0.011525 (0.0079)	0.015409 (0.0066)*	0.01357 (0.0040)**	0.009903 (0.0041)*	0.010405 (0.0041)*
Share of nonperforming loans to firms	0.00218 (0.0014)	0.001839 (0.0014)	0.001479 (0.0014)	0.00159 (0.0015)	0.000648 (0.0013)	0.000901 (0.0007)	0.000155 (0.0008)	0.000233 (0.0008)
Bank's active interest rate	0.040654 (0.0126)**	0.024335 (0.0120)*	0.036379 (0.0118)**	0.028453 (0.0124)*	0.038833 (0.0121)**	0.019192 (0.0065)**	0.019815 (0.0065)**	0.020668 (0.0065)**
Bank's passive interest rate	0.00704 (0.0155)	0.02411 (0.0148)	0.014026 (0.0146)	0.019079 (0.0151)	0.002399 (0.0157)	0.014361 (0.0083)	0.017139 (0.0081)*	0.015945 (0.0082)
Bank's capital adequacy ratio (CAR)	0.02134 (0.0090)*				0.017807 (0.0091)	0.000517 (0.0049)		
Bank's capital adequacy ratio squared	-0.000548 (0.0002)*				-0.000474 (0.0002)*	-0.000043 (0.0001)		
(Firm with low net operating income / ST debt) * (CAR < median)		0.436063 (0.0330)**					0.296762 (0.0156)**	
CAR < median		-0.04866 (0.0156)**	-0.029628 (0.0169)	-0.032262 (0.0159)*			-0.029316 (0.0090)**	-0.0205 (0.0090)*
(Z score < 25th perc.) * (CAR < median)			0.013645 (0.0286)					
(Z score < 25th perc.) * (Low net operating income / ST debt) * (CAR < median) (ZOMBIE variable)				-0.398481 (0.0470)**				0.279369 (0.0202)**
Number of banks							0.017646 (0.0034)**	0.0191 (0.0035)**
Z score							0.010642 (0.0033)**	0.009967 (0.0033)**
Small company dummy							-0.019351 (0.0095)*	-0.02024 (0.0096)*
Estimation:	FE	FE	FE	FE	OLS	OLS	OLS	OLS
Observations:	3244	2970	3244	2970	3244	9367	7891	7891

Note: * significant at 5%-level, ** significant at 1%-level. White standard errors are in brackets.

Specifications 2 to 4 in Table 1 for the period at the beginning of the crisis corroborate the hypothesis of existence of zombie lending practices in part, but the results are still inconclusive. Using indicator variable for companies with low coverage of short-term debt by net operating income (specification 2), we can see that there is some evidence of an increase

in loan supply to such debtors, when the bank in question is less capitalised than the system median. However, specification 3 shows that there is no evidence that less capitalised banks tend to extend loans to debtors with poor financial standing (with relatively low Z-score). In reality, in contrast to zombie lending hypothesis we observe that subpar debtors are being avoided even by weaker banks, as shown by the zombie interaction variable in specification 4.

In specification 5 we have used the same set of explanatory variables as in specification 1, but this time without company fixed effects that control for loan demand, in line with Khwaja and Mian (2008) approach. This gives us the opportunity to include all firms in the sample, not only the ones with multiple banking relationships. This is done in specifications 6 to 8. We are now able to add firm controls to these specifications, such as Z-score, indicator for small company and the number of banks the company has relations with, as fixed effects for companies are not employed.

Unlike in the case of multiple bank-firm relationship sub-sample only, here we do find evidence of zombie lending. The coefficient for zombie interaction dummy that detects companies with low financial standing that do business with low capitalised banks is positive, indicating that banks are increasing their exposure to such companies (specification 8 in Table 1).

Such different behaviour of banks in the sample, which includes companies that have only one bank relationship, indicates that banks are willing to engage in zombie lending when they are the only creditor. As explained, this is to be expected, because presence of several creditors opens the playing field for strategic games – if bank A starts increasing loans to a bad company, this will give a chance to bank B to decrease its exposure and bank A will be

left with an increasing portion of what is likely a bad debt. As this is not the case in situations where there is only one creditor, banks are more willing to engage in such practice.

In 2012, like in 2008, we do not find strong conclusive evidence of zombie lending in the subsample with two and more banks per company. However, like in 2008, there is strong evidence of zombie lending for the full sample that includes companies having a relationship with only one bank (zombie interaction dummy in Table 2, specification 8, is statistically significant).

Further, in the sample with all bank-firm relationships, unlike in 2008, in 2012 the coefficient with indicator variable for the principle bank is negative (or insignificant in some specifications), indicating that the banks, on average, have abandoned relationship lending practices, with the notable exception of supporting zombie companies in cases where they are the only creditor.

Table 2: Estimation results for 2012

Specification:	Spec 1	Spec 2	Spec 3	Spec 4	Spec 5	Spec 6	Spec 7	Spec 8
Dep. Var:	Change in loans from bank to firm							
C	-0.08757 (0.1581)	0.076279 (0.0833)	0.081844 (0.0806)	0.376688 (0.0993)**	-0.0625 (0.1293)	-0.01748 (0.0741)	0.004868 (0.0439)	0.008054 (0.0442)
Principal bank	-0.00992 (0.0085)	-0.00059 (0.009)	-0.01001 (0.0085)	-0.00041 (0.009)	-0.01822 (0.0105)	-0.01258 (0.008)	-0.02184 (0.0099)*	-0.02325 (0.0099)*
Bank loan to deposit ratio	-0.00038 (0.0004)	-0.00061 (0.0004)	-0.00034 (0.0004)	-0.00048 (0.0005)	0.000176 (0.0004)	-7E-06 (0.0002)	-0.00033 (0.0002)	-0.00032 (0.0002)
Bank profitability (ROA)	-0.02886 (0.0149)	-0.01423 (0.0171)	-0.01979 (0.0162)	-0.0211 (0.0171)	-0.0128 (0.0134)	-0.01236 (0.008)	-0.01329 (0.0084)	-0.01473 (0.0085)
Share of nonperforming loans to firms	-0.00323 (0.0014)*	-0.00352 (0.0015)*	-0.00371 (0.0014)**	-0.00382 (0.0015)**	-0.00204 (0.0012)	-0.00214 (0.0007)**	-0.00124 (0.0007)	-0.00117 (0.0008)
Bank's active interest rate	-0.00102 (0.001)	-7.5E-05 (0.0012)	-0.00072 (0.0011)	-0.00016 (0.0012)	-0.00058 (0.001)	-0.00048 (0.0006)	-0.00059 (0.0006)	-0.00073 (0.0006)
Bank's passive interest rate	0.008716 (0.0118)	0.001903 (0.0124)	0.007228 (0.012)	0.003683 (0.0125)	0.009299 (0.0114)	0.008412 (0.0069)	-0.00351 (0.0072)	-0.00321 (0.0073)
Bank's capital adequacy ratio (CAR)	0.018662 (0.0136)				0.007379 (0.0116)	0.003515 (0.0068)		
Bank's capital adequacy ratio squared	-0.00049 (0.0003)				-0.0002 (0.0003)	-0.00008 (0.0002)		
(Firm with low net operating income / ST debt) * (CAR < median)		0.251844 (0.0290)**					0.252466 (0.0166)**	
CAR < median		-0.02814 (0.0192)	0.01564 (0.0198)	-0.00948 (0.0189)			-0.03425 (0.0111)**	-0.02024 (0.0112)
(Z score < 25th perc.) * (CAR < median)			-0.00374 (0.0261)					
(Z score < 25th perc.) * (Low net operating income / ST debt) * (CAR < median) (ZOMBIE variable)				-0.30906 (0.0575)**				0.204514 (0.0165)**
Number of banks							0.00866 (0.0027)**	0.00823 (0.0027)**
Z score							0.003883 (0.0027)	0.003391 (0.0028)
Small company dummy							-0.01106 (0.0096)	-0.01336 (0.0097)
Estimation:	FE	FE	FE	FE	OLS	OLS	OLS	OLS
Observations:	3244	2970	3244	2970	3244	9367	7891	7891

Note: * significant at 5%-level, ** significant at 1%-level. White standard errors are in brackets.

6 Implication of results and policy discussion

Finding the presence of zombie lending in the economy calls for caution. Since increasing productivity, employment and investment at firm level are important contributors to overall economic activity, supporting zombie companies, even on a small scale, might have a negative effect on the society as a whole. In that context, Belullo, Broz and Ridzak (2017) argue that zombie lending might create a productivity drag for the whole economy which might in the next step feed into lower growth rates of the economy. When investigating zombie lending behaviour Cabalero, Hoshi and Kashyap (2008) found a negative link between zombie lending and productivity, but also between zombie lending and investment and employment. This implies that policymakers should be aware of the possibility of such a relationship between banks and firms, as well as of its impact, and should try to minimise it.

This research gives several options for tackling zombie lending practice. Firstly, competitive and deep credit markets serve as a good hedge against zombie lending. Results show that firms that have multiple bank relationships did not contribute to zombie lending behaviour, while zombie lending is linked to firms that have a relationship with only one bank. Policymakers can and should influence competitiveness of credit markets. This includes increasing competition in the banking market but also developing non-bank financial intermediaries.

Secondly, results show that poorly capitalised banks tend to engage more in zombie lending. Hence, solid capitalisation built before the crisis is a good way to curb zombie lending practices. Current regulatory framework based on Basel III (Basel Committee on Banking Supervision, 2011) generally requires more capital for banks so the average capitalisation at

the EU-level increased in the course of a few years. It seems that policymakers have designed reforms that should stifle zombie lending. However, full and adequate implementation of various capital buffers and capital charges by regulators is crucial for the complete success of this process.

Thirdly, inadequate capitalisation is closely linked to the issue of non-performing loans and this research shows that non-performing loans negatively contribute to credit supply. This is why swift resolution of non-performing loans is important for a better functioning of the credit market. However, disposal of non-performing loans often requires write-offs that go against earnings or capital, depending on the level of earnings, which is another reason why adequate capitalisation is crucial for efficient functioning of the banking system.

Finally, as results show that small firms have difficulties in obtaining new loans compared to other firms (specifications 7 and 8 in Table 1) and those are, as sample data shows, firms that are often linked to only one bank, policymakers should worry about the ability of small firms to access bank credit by various credit promotion schemes within the framework of which, if necessary, part of the risk is taken over by the government.

7 Conclusion

In this article we investigated zombie lending practices, in which banks support financially weak firms because of their self-interest, by using a rich bank–firm database. Analysis shows that there is evidence of such behaviour but mostly when the bank providing credit has lower capitalisation and when only one bank is acting as a creditor for the affected firm. Results also show that better firms (as measured by higher Z-score) tended to get more loans, indicating

that banks know how to distinguish between good and bad debtors. This corroborated our zombie lending hypothesis which implies that banks grant loans to bad firms only when this is in their interest.

Among other factors impacting credit growth to firms, bank capitalisation level and the ratio of bank's non-performing loans are also important. We also found evidence of relationship lending practices that declined in the course of the crisis.

Taken together, the result that zombie lending was present in cases where the bank in question was the sole provider of credit and the result that relationship lending practices declined as the crisis went on indicates that there was no Japanese-style loan prolongation for companies linked to banks. We conjecture that competition among banks in Croatia was greater and their connections with the business sector motivated by profit. Also, despite prolonged recession, Croatian banks were in better financial position than Japanese, which ultimately caused zombie lending on a larger scale, like in Japan, to be avoided.

Our research shows that solid bank capitalisation is key to avoiding zombie lending, but also a necessary condition for resolution of bad loans and subsequently one of the preconditions for loan growth to enterprises. As a result, policymakers concerned about the ability of the banking system to supply credit to promising projects in the economy should aim to keep bank capitalisation levels adequate. Although the process of raising capital requirements and cleaning the balance sheet is painful for a bank and its shareholders in the short run, a well-capitalised bank that has dealt with the issue of non-performing loans supplies more loans to the real economy and thus performs its social function better. It seems that policymakers around the world have learned that from the recent crisis, given that the new regulation based

on Basel III aims for, on average, higher capital requirements.

In addition, not only the timely detection and prevention of zombie lending practices is important in order to be sure in the quality of the supervised banks' assets, but it is also important because of the detrimental effects of such practice on the overall economy as resources are not put to their most productive use. Hence, policymakers should act as a corrective mechanism in order to prevent such practices from becoming pervasive.

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