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Tomislav Ridzak

Lending Activity and Credit Supply to Firms During the Crisis - Evidence from the Croatian Micro Level Data

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Lending activity and credit supply to firms during the crisis

Tomislav Ridzak

Evidence from the Croatian micro level data

Abstract

Banks sometimes respond to a sharp deterioration in the quality of placements by extending time limits for loan repayments to borrowers in default and hide the actual quality of placements hoping that difficulties of borrowers are only temporary. This practice is termed evergreening or zombie lending. This research analyses the credit supply to individual enterprises in Croatia during the crisis and finds evidence of evergreening in the crisis period. Credit creation but also contraction decreased in the crisis period indicating that some loans were being prolonged. Results of the estimated regressions indicate that there is evidence that in the crisis periods some of the loans being prolonged are result of evergreening practices.

Keywords: evergreening, zombie lending, credit supply, micro level data

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 mostly try to reduce their exposure to enterprises in distress, often by writing off loans, and turn to new and promising projects, thus laying foundation for the economic growth. For example, as in previous recessions, US banks strongly reduced the level of existing corporate loans during the current crisis as documented in Contessi and Francis (2010). Still, banks sometimes respond to a sharp deterioration in the quality of placements by extending time limits for loan repayments to borrowers in default and hide the actual quality of placements hoping that difficulties of borrowers are only temporary or because of the fear that a bank's position in the market or management's position vis-à-vis owners may be threatened. Peek and Rosengreen (2003) give evidence of this practice (termed evergreening) in Japan. Such responses of banks to unfavourable macroeconomic movements can slow down the movement 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 an intention to hide non-performing placements. Still, examples from practice, such as the Japanese, clearly show that a several-year prolongation of bank loans may keep resources in inefficient enterprises and contribute to a long-lasting economic stagnation, which in turns adds pressure on bank stability.

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 are still the most important financial intermediary in Croatia (Figure A-1 in the Appendix). In addition to that, the size of the banking system has steadily increased over time, reaching 80 per cent of GDP at the end of 2010 (Figure A-2 in the Appendix). These two facts stress out the importance of bank lending for the economy and show how important the bank stability is for performance and the financial stability of the economy.

This research aims to analyse the credit supply to individual enterprises in Croatia during the crisis and to establish whether there was a significant change in bank's behaviour to pre crisis period. There is some anecdotal evidence that the banks rolled over some potentially

problematic loans to firms after the crisis started and by using firm level data this research will shed more light on the issue of detecting credit misallocation.

The research is organised in six sections. After introductory section, that shows motivation for the research, following section presents the survey of the related literature. Measure of credit creation and destruction which gives information how dynamic the credit activity is in Croatia is presented in the third section. Next two sections present the data, methodology and the results of the econometric analysis. Finally, the sixth section concludes.

Literature survey

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

1) by interest rate subsidy where borrower pays less than some prime rate (Caballero et al., 2008)
2) using company financial indicators (such as profitability, liquidity and leverage) and interacting them with various bank characteristics (Peek and Rosengren, 2003)
3) using productivity measure (Solow residual) and interacting it with various bank characteristics (Albetrazzi and Marchetti, 2010)

Originally, the research of credit misallocation was mostly concerned with the case of Japan. One of the most extensive is widely cited study by Peek and Rosenberg (2003). The authors document the practice of credit misallocation by Japanese banks following the severe economic crisis and crash of stock and real estate markets. They use logit equation to model the probability that a bank increases credit to firm and set of bank and company specific explanatory variables (lagged by one year). Their sample covers the period from 1993 to 1999. The findings corroborate the evergeening hypothesis: financially weaker firms have the higher probability of a loan increase. The study also finds evidence of balance sheet cosmetics for the banks: if their capitalization is close to regulatory minimum they are more likely to

increase credit to firms. However, banks actual economic health (measured by market perception, the change of market price of the bank) had no significant impact on the probability of loan increase. Corporate affiliations were also found important, banks increased loans more to their business group (keiretsu) members and to the companies where the bank in question was the main bank (biggest lender).

To sum up, the study by Peek and Rosenberg (2003) finds that the banks increased loans to severely impaired firms even as this was not economically viable and the loans were likely to create additional loss for the bank. Incentives for this behaviour came from with the bank (to limit the growth of bad loans and because of corporate affiliations) and from outside, from government, that put pressure on banks to continue rolling the loans to weak companies to stem surge in unemployment and firm defaults. The work by Peek and Rosenberg (2003) is probably the most complete study that documents the existence of evergreening in Japan, but it does not explore the effects this practice has on the economy. The authors only hypothesise that this misallocation of credit was important contributing factor to the prolonged economic stagnation in Japan that lasted for a decade.

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 their definition zombie firms are a result of a "sham loan restructuring that kept credit flowing to the otherwise insolvent borrowers" (zombies). They find that the congestion created by the zombie firms reduced the profit of healthy firms and discouraged their entry and investment. The authors detect zombie firms by interest rates subsidy. These firms pay too low interest rates (bellow long term average government rate). After documenting the prevalence of zombies in various industries the authors present a theoretical model that makes two predictions. First, presence of zombies distorts competitive process by hindering exit and entry. Second prediction is that this distortion depresses productivity.

Caballero, Hoshi and Kashyap (2008) then seek for empirical corroboration of their model. 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 control variables. The results corroborate the theoretical model and show that industries with high proportion of zombies create fewer jobs and invest less. However,

authors themselves admit that their model is not structural enough to assess whether the benefits from reduced unemployment out weight the costs of lower productivity. Except that, a possible criticism of otherwise outstanding research is that the interest rate might not be the best indicator for zombies. Sometimes, the availability of credit is more important than the cost for the company.

After so called lost decade in Japan the researchers in this area did not have much fertile ground for research as the economic climate was mild around the world, with only minor recessions occurring now and then. However, the financial crisis and strong recession in the late years of the first decade of new millennia exposed all the vulnerabilities of the banking systems in the most advanced economies. The environment where big recession changed the patters of business forever in some areas, leaving firms to cope with new business climate and banks had to obtain additional capital is fertile ground for zombie lending: the firms will be temporarily saved and banks will temporarily need to have less capital. So the question of zombie lending and evergreening is back on the table, but this time in different places.

In this setting Albetrazzi and Marchetti (2010) analyze the effect of financial crisis on credit supply to Italian companies using panel data set with detailed bank and company data in the period from September of 2008 until the March of 2009. In terms of methodology they use fixed effects for firms on a firm-bank panel which enables them to insulate effects of credit supply. They find that low bank liquidity and capitalization negatively affects credit supply. In addition to that they find evidence of evergreening, which is, according to their findings concentrated within smaller less capitalized banks. Albetrazzi and Marchetti (2010) explain this result with loan granting process, which is based on strict credit scoring in the big banks and much more flexible in the smaller banks.

Credit creation and destruction

To get an overview on dynamics of the credit activity in Croatia we use the concept of credit creation and destruction. Whereas the aggregate net flows show credit change in the economy, the gross flows calculated here show the reallocation of credit across borrowers, in our case companies. The creation was calculated as the sum of all increases in total loan amounts to individual clients, while the destruction was calculated as the sum of all decreases in total loan amounts to individual clients, both relative to the balance at the end of the previous

period. More formally, the formulas for creation and destruction are given here. Credit creation for the bank *b* in period *t* is:

$$Creation_{b,t} = \frac{\sum_i \Delta loan_{b,i,t} \; if \; \Delta loan_{b,i,t} > 0}{\sum_i loan_{b,i,t-1}} \quad (1)$$

where subscript *i* designates companies. The destruction for the bank *b* in period *t* is given by

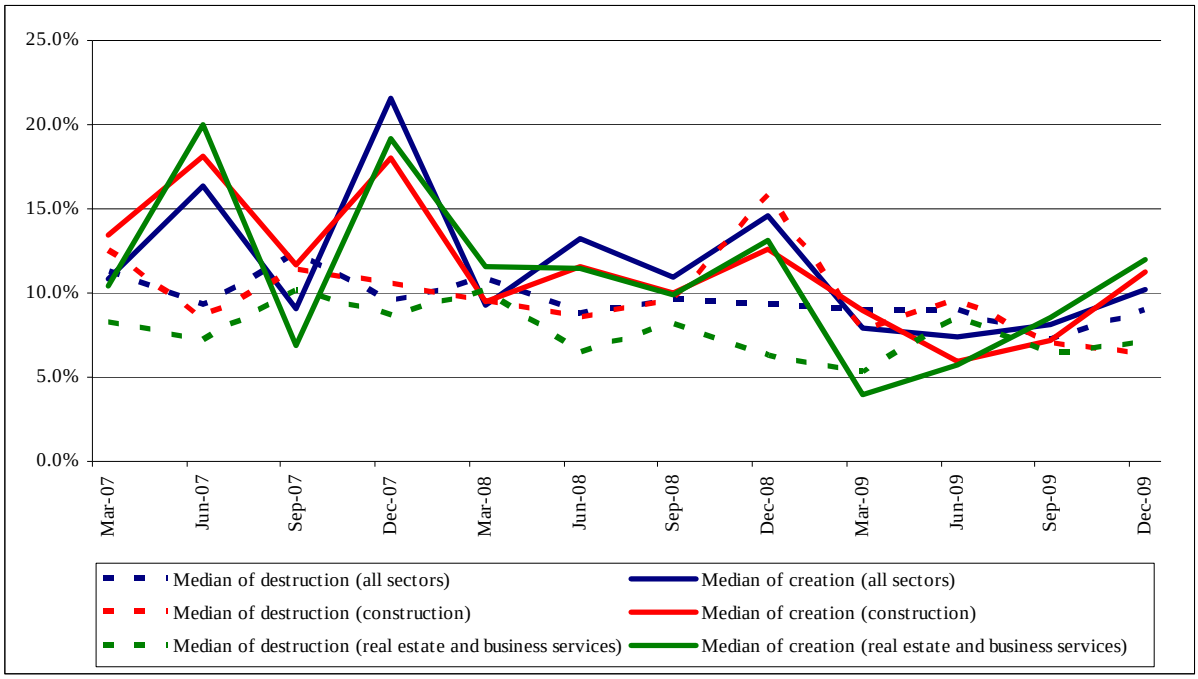
$$Destruction_{b,t} = \frac{\sum_i \Delta loan_{b,i,t} \; if \; \Delta loan_{b,i,t} < 0}{\sum_i loan_{b,i,t-1}} \quad (2)$$

The excess credit growth which measures the reallocation in excess of net credit change is defined as follows:

$$Excess\,credit\,growth_{b,t} = Creation_{b,t} + Destruction_{b,t} - |Creation_{b,t} - Destruction_{b,t}| \quad (3)$$

Figure 1 shows the creation and destruction of loans for a median bank from the first quarter of 2007 to the end of 2009 and Figure 2 shows excess credit growth for a median bank in Croatia. Creation, destruction and excess credit growth are calculated for all companies and for companies operating in construction and real estate and business services. These two sectors were given a lot of attention as the ones where there might be more incentive to continue rolling over the loans as turnover significantly decreased and the stock of unsold homes increased.

Figure 1 Credit creation and destruction for all sectors, construction and real estate and business services (median of all banks)



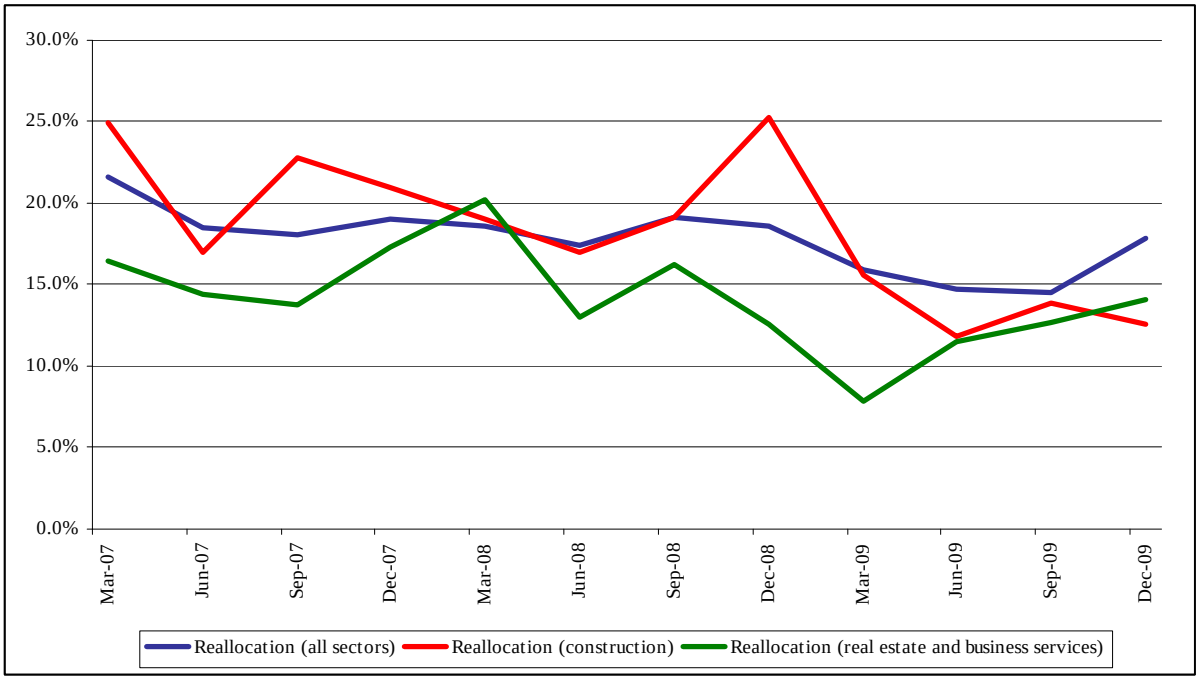
As recession begun, the total credit creation fell (last quarter of 2008) and remained relatively low until the end of the sample with a modest increase in the last quarter of 2009. However, the total credit destruction also fell, indicating that the banks decided to continue to support existing debtors. This is further corroborated in the following table (Table 1) that shows average creation, destruction and excess credit growth for two sub samples: five recession quarters and five most recent pre recession quarters. For loans to all sectors, both creation and destruction were higher in the pre recession sample but destruction decreased much less than creation (1.5 percentage points compared to 3.2 percentage points for creation). Same applies to the two selected sectors: creation fell together with destruction, but destruction in construction was 0.9 per cent lower than the destruction for all sectors taken together.

Table 1 Loan creation, destruction and reallocation for two sub samples

	Average from 30/6/2007 to 30/9/2008 (1)	Average from 30/9/2008 to 31/12/2009 (2)	(2) - (1)
Median of destruction (all sectors)	10.18%	8.69%	-1.50%
Median of creation (all sectors)	12.80%	9.64%	-3.17%
Median of destruction (construction)	9.90%	9.29%	-0.61%
Median of creation (construction)	12.16%	9.16%	-3.00%
Median of destruction (real estate and business services)	8.68%	6.73%	-1.95%
Median of creation (real estate and business services)	11.78%	8.66%	-3.11%
Reallocation (all sectors)	18.46%	16.29%	-2.17%
Reallocation (construction)	19.78%	15.83%	-3.95%
Reallocation (real estate and business services)	16.10%	11.77%	-4.34%

Excess credit growth, aggregated measure of credit reallocation between firms exhibits a declining trend since the start of recession and moderate increase in last quarter of 2009. However, reallocation in the construction sector is still subdued.

Figure 2 Excess credit growths for all sectors, construction and real estate and business services (median of all banks)



To sum up, it can be concluded that at the onset of the recession, the creation of new loans decelerated sharply, while the destruction of loans also decreased, which is most probably related to the fact that (potential) non-performing loans were not paid, though it may also be a sign of increased loan rescheduling. In order to explore this phenomenon further, in the next step we explore determinants of credit supply to companies in two sub samples.

Overview of methodology and data

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

- bank having enough capital to withstand potential losses (designating a loan as non-performing or bad drives up the costs to and diminishes profits as bank needs to provision for potential losses)
- that the legal system allows for a swift resolution

- conclusions by the bank management that this is advantageous for the bank (small banks that depend on business ties in a small community might be reluctant to be aggressive in this respect)
- conclusions by the bank management that this is advantageous for the bank management (the classical owner - manager problem)

The focus of this investigation will be to explore lending patters in before and during the crisis and find evidence for loan misplacement, where the supply of loans from the bank went to substandard debtors, with the intention of diminishing the potential losses, hoping the debtor will recover. Such behaviour can be result of bank's patience, which might be advantageous for the bank, but also of the practice of evergreening so in the investigation the focus will be on identifying this second type of behaviour.

The sample comprises data on loans to individual enterprises that banks have to report to the CNB under the Decision on the classification of placements and off-balance sheet liabilities of credit institutions.[1] This sample was further reduced, to enterprises that do business with at least two banks, which enables the monitoring of bank interaction in lending to these enterprises and is crucial for isolating the effects of supply from demand, as it will be shown bellow. Company data was obtained from the Financial Agency database.

Corporate lending from bank *b* to company *i*, which is the dependent variable to be explained, is introduced in a regression as the change in the loans deflated by firm's average assets, while independent variables in the panel of data are financial indicators and other characteristics of banks and enterprises together with their interactions. The fourth quarter of 2008 was taken as the beginning of the crisis period, with data to the end of 2009 being available under a uniform methodology. The pre-crisis period, which serves as a reference for the comparison, has the same duration (five quarters), beginning from the third quarter of 2007.

Change in loans over firms' assets is a good measure of actual importance of each specific loan to each specific firm. One million kuna loan does not have the same importance or impact on the balance sheet for the company that has total assets of 1 million or for the

[1] Official Gazzete 1/2009, 75/2009 and 2/2010.

company that has total assets of 1 billion. Table A-1 in the Appendix show the summary statistics for the dependent variable, (change in loans over average assets ×100) for the two sub samples. Also Table A-2 and Table A-3 (again in the Appendix) show the categorization of dependent variable with respect to number of banks that each firm has credit relations with in crisis and pre-crisis period.

To measure the firm risk we used Z-score. Originally due to Altman (1968) Z-score is a standard financial analysis tool and as such part of credit scoring for corporate clients. Z-score was used as an indicator of an enterprise's financial position; for the crisis period, it was based on end-2008 financial statements, and for the pre-crisis period, it was based on statements for end-2007. Z-score was calculated as a linear combination of five indicators showing profitability, efficiency (capital intensity), funding sources, debt and liquidity. The construction of the Z-score was taken over from Eidelman (1995). Additional explanations on the selection of coefficients may be found in Altman (1968).

Z-score gives financial standing of the company but it doesn't give any indication of its future prospects. For example, a financially weak company might be in possession of a superb technology that produces same or better result with fewer inputs of labour and/or capital. To overcome this problem we calculate the total factor productivity for each company and compare it to the industry average for each industry. This indicator is another way to discern between creditor patience and evergreening.

In order to obtain productivity estimates for each firm we use the total factor productivity which is calculated as a Solow residual. This residual represents the portion of output that is not accounted for by inputs: labour, capital and intermediate goods. Solow residual is obtained from the following equation:

$$tfp_i = ln(y_i) - (\alpha_1 \times ln(l_i) + \alpha_2 \times ln(k_i) + \alpha_3 \times ln(i_i) \qquad (4)$$

where y_i is total sales (representing output), l_i is number of persons employed (representing labour used), k_i is a book value of the company (representing capital used) and i_i are material costs, for the firm *i*. Coefficients α_1, α_2 and α_3 are obtained from the regression of the y_i on l_i,

k_i and $_{,}\ i_i$. For a more detailed overview of calculation methodology see for example Coricelli et al. (2010) and Marchetti and Nucci (2007)[2].

Table A-4 (in the Appendix) shows summary statistics for Z-score and total factor productivity in the crisis and the pre-crisis. Summary statistics for the banking system (liquidity, profitability, capitalization and share of bad in total loans to firms) in the pre crisis and crisis period are in the Table A-5 in the Appendix.

To obtain the determinants of credit supply to firms the following equation is estimated with the firm fixed effects. The dependent variable is the change of loans from bank *b* to company *i*, deflated by total assets of the company. Explanatory variables in the matrix $\mathbf{x_{b,i}}$ are various characteristic of the bank that is providing the loan: liquidity, profitability, capitalization and ratio of bad loans to total loans to firms. The term u_i is part of the composite error that does not change over banks. In some specifications interactions between the bank and company specific variables are also employed.

$$y_{b,i} = \mathbf{x_{b,i}}\boldsymbol{\beta} + u_i + e_{b,i} \qquad (5)$$

Regression is estimated using fixed effects which eliminate firm unobservable characteristics u_i which are for example risk and credit demand in line with Albetrazzi and Marcheti (2010) proposal. As noted before, the dataset used is a firm × bank and the firm fixed effects will pick-up the unobservable part of the error that does not vary over various banks (u_i). This will include all unobservable firm characteristics and among them demand for credit which would be very challenging to measure otherwise. As a result the obtained coefficients on the bank specific variables can be interpreted as drivers of supply. After basic equation is estimated, various interaction dummies based on the firm and bank characteristics are added to identify potential evergreening practices.

Estimation of equation (5) above is performed by fixed effects transformation or within transformation, which is in explained in detail in Wooldridge, 2001, pages 265-279. In order to avoid estimating a large number of dummy variables, (one for each cross section) which

[2] Marchetti and Nucci (2007) describe and compare several measures of productivity on a sample of Italian companies and show that the differences between various approaches to calculating it are not big.

would drastically reduce number of degrees of freedom, the within transformation first averages equation (5) over banks, so for each firm i average over banks is estimated:

$$\bar{y}_i = \bar{\mathbf{x}}_\mathbf{i}\boldsymbol{\beta} + u_i + \bar{e}_i \qquad (6)$$

Deducting the resulting Equation (6) from Equation (5) we get Equation (7):

$$y_{b,i} - \bar{y}_i = (\mathbf{x}_{\mathbf{b,i}} - \bar{\mathbf{x}}_\mathbf{i})\boldsymbol{\beta} + e_{b,i} - e_i \qquad (7)$$

or

$$\ddot{y}_{b,i} = \ddot{\mathbf{x}}_{\mathbf{b,i}}\boldsymbol{\beta} + \ddot{e}_{b,i} \qquad (8)$$

In the Equtation (8) the fixed effects cancel out and if we estimate this equation, the vector **β**^ is the fixed effects estimator.

In panel data sets residuals might be correlated and OLS standard errors might be biased. The fixed effects remove part of the correlation (u_i) from the composite residuals, (u_i+ $e_{b,i}$ in the Equation (5), the remaining part of the residual, $e_{b,i,}$ can still be correlated which will make ordinary standard errors inappropriate. As Wooldridge (2001) pages 270-275 shows, testing for serial correlation is useless in the case where there are only two banks per firm because by estimating with fixed effects we will get bank demeaned errors ($e¨_{b,i}$ from the Equation 8) and these are by definition negatively correlated even if the original errors ($e_{b,i}$) in the Equation (5) are not. As the significant share of firms in the dataset has only 2 banks per firm (46 per cent in crisis and 44 per cent in per crisis period) this makes testing impossible (Table A-2 and Table A-3 in the Appendix). This is why standard errors, robust to correlation and heteroskedasticity, clustered over firms are used. The estimator is valid in presence of any form of heteroskedasticity and serial correlation (Wooldridge, 2001, pages 275 and 276).[3]

[3] Petersen (2008) shows using panel datasets with simulated data that clustering standard errors by one dimension (in this case firm) while there is significant correlation by the other dimension (in this case banks) can lead to false conclusions. This is why in addition to the standard errors reported in the results tables bellow (clustered by firms) errors clustered by banks were also estimated. This did not change the conclusions of the analysis

Estimation results

First, the focus is on the effect of bank performance and financial strength (which are measured by liquidity, profitability, capitalization and the proportion of non performing loans to enterprises in total loans to enterprises). Specification 1 in Table 2 presents the results for the crisis period. There is evidence of capital related credit contraction: in the crisis period the change in loans over firm's assets was statistically significantly influenced by the banks capitalization. The functional form of the relationship of the capital adequacy ratio and change in loans is non linear, expressed with the quadratic function. This means that, on average, the marginal effect of adding additional capital is positive up to certain point and than starts decreasing. The estimation results presented in Table 2, Specification 1 shows that banks that had the capitalization ratio under 18.78 per cent (first order condition for the maximum value of square function linking the capital adequacy ratio and change in loans over firm's assets) would benefit from the additional capital in the crisis period, while after that number the diminishing returns would kick in. During the crisis, the increase in bank capital from the median of all banks (14.06) for 1 percentage point would increase loan supply to the companies that deal with that bank on average for about 0.87 percent of the firms' assets (0.92×1-2×0.024×1, calculated from Specification 1, Table 2). As shown in Table 3, in the period before crisis, bank capitalization was not significant determinant of loan supply and among other bank characteristics only bank size was important determinant of loan supply, where big banks on average granted 1.7 per cent more loans to average firms' assets.

Table 2 Estimation results, crisis period

Eq Name:	SPEC_1	SPEC_2	SPEC_3	SPEC_4	SPEC_5	SPEC_6
Dep. Var:	**Change in loans from bank to firm over average assets in crisis period**					
Bank liquidity	-26.4102 [31.7571]	-25.3830 [31.8339]	-23.9533 [31.6223]	-19.3638 [30.8905]	1.0706 [30.0718]	-25.5374 [31.9093]
Bank liquidity squared	61.2468 [63.1158]	60.3104 [63.3040]	56.6344 [62.7370]	43.3457 [60.1398]	7.1571 [58.1989]	59.5294 [63.4185]
Bank profitability	0.2050 [18.9062]	-1.3326 [18.8509]	1.0736 [19.3602]	4.4639 [21.3135]	11.0896 [18.5377]	0.4704 [18.8369]
Capital adequacy ratio	0.9182 [0.3970]**	0.9559 [0.3925]**	0.8605 [0.4113]**	0.6029 [0.4237]		0.9495 [0.3964]**
Capital adequacy ratio squared	-0.0244 [0.0098]**	-0.0252 [0.0097]***	-0.0234 [0.0101]**	-0.0167 [0.0105]		-0.0252 [0.0098]***
Share of bad loans to firms	-0.4058 [0.1200]***	-0.3951 [0.1227]***	-0.4058 [0.1196]***	-0.4000 [0.1277]***	-0.4141 [0.1165]***	-0.3888 [0.1247]***
Share of bad loans to firms squared	0.0173 [0.0039]***	0.0170 [0.0039]***	0.0174 [0.0039]***	0.0174 [0.0041]***	0.0179 [0.0038]***	0.0167 [0.0040]***
Biggest creditor dummy	-7.3796 [0.4831]***	-7.3960 [0.4807]***	-7.5826 [0.5389]***	-7.2192 [0.5280]***	-7.2273 [0.5247]***	-7.3756 [0.4848]***
Constant	-0.9673 [6.0353]	-1.6811 [5.9855]	-0.5291 [6.0717]	0.9614 [6.0831]	3.7821 [3.9670]	-1.3326 [6.0401]
Big bank dummy	-0.0272 [0.5827]	1.2348 [0.8017]	-0.0169 [0.5773]	0.0250 [0.5972]	0.2225 [0.5843]	0.8821 [0.5254]
Big bank dummy × Z_SCORE_R		-2.5766 [0.8894]***				
(Capital adequacy ratio <= median) × Z_SCORE_R			-0.6169 [0.9448]			
(Capital adequacy ratio <= median) × Z_SCORE_R × Bigest creditor dummy			0.7319 [0.7218]			
(Capital adequcy ratio <= median) × Z_SCORE_R × TFP_LOW				-0.5622 [0.8402]	0.1204 [0.8211]	
(Capital adequacy ratio <= median) × Z_SCORE_R × TFP_LOW × Biggest creditor dummy				1.9187 [0.9164]*	1.9059 [0.9242]**	
Capital adequcy ratio <= median					-1.2454 [0.6373]*	
Big bank dummy × Small company dummy						-1.8853 [0.8448]**
Observations:	*7243*	*7243*	*7243*	*6787*	*6787*	*7243*
R-squared:	*0.5896*	*0.5904*	*0.5896*	*0.5718*	*0.5720*	*0.5900*

Note: Observations are for the firm-bank pair. Estimated equations include fixed effects for firms, robust standard errors clustered at individual firms are reported in brackets * significant at 10%, ** significant at 5% *** significant at 1%

Second variable that was detected as significant determinant of credit supply in the crisis period was the share of non-performing to total loans to firms. This ratio basically measures what will happen with capitalization in the future. The rise in the non-performing loans will increase the costs the banks' have in the future and through earnings influence capitalization. Again, this was estimated as non linear quadratic relationship. The marginal effect of the increase in non-performing loans ratio is negative up till the 11.70 per cent share of non-performing in total loans to households (calculated from Specification 1, Table 2). The rise in

share of non-performing to total loans from the median 7.87 for 1 percentage point would on average, in the crisis period, diminish the credit supply to the firms that deal with that bank for about 0.37 per cent of firms' assets. It seems that, during the crisis period, the banks were worried about the non-performing loans and that has caused contraction in the credit supply. In the pre-crisis period the share of non performing loans in total loans to firms (same as other bank specific variables, liquidity and profitability) was not significant determinant of credit supply as can be seen from the equations estimated on the pre-crisis period (Table 3).

Table 3 Estimation results, pre crisis period

Eq Name:	**SPEC_1**	**SPEC_2**	**SPEC_3**	**SPEC_4**	**SPEC_5**	**SPEC_6**
Dep. Var:	**Change in loans from bank to firm over average assets in per-crisis period**					
Bank liquidity	104.1939 [82.4874]	108.8580 [81.8500]	95.1181 [81.0565]	88.3893 [78.9655]	94.8885 [81.0434]	103.8888 [82.3326]
Bank liquidity squared	-181.4185 [156.4012]	-190.0323 [155.2089]	-165.1316 [154.3770]	-151.6821 [148.8131]	-162.9241 [152.7946]	-180.9216 [155.8059]
Bank profitability	46.3212 [66.6655]	42.7323 [65.4683]	39.2864 [67.1828]	11.6649 [64.8036]	9.4435 [68.1747]	48.3753 [66.1969]
Capital adequacy ratio	-0.1964 [0.2084]	-0.1831 [0.2065]	-0.3613 [0.2161]	-0.0856 [0.2220]		-0.2054 [0.2103]
Capital adequacy ratio squared	0.0046 [0.0047]	0.0045 [0.0047]	0.0075 [0.0050]	0.0009 [0.0052]		0.0049 [0.0048]
Share of bad loans to firms	-0.0070 [0.0735]	0.0005 [0.0718]	-0.0171 [0.0682]	-0.0147 [0.0736]	-0.0016 [0.0772]	-0.0094 [0.0738]
Share of bad loans to firms squared	-0.0049 [0.0024]**	-0.0052 [0.0024]**	-0.0045 [0.0024]*	-0.0046 [0.0026]*	-0.0051 [0.0028]*	-0.0049 [0.0024]**
Biggest creditor dummy	-7.7380 [0.5112]***	-7.7525 [0.5122]***	-7.5027 [0.6114]***	-7.2516 [0.5096]***	-7.2511 [0.5081]***	-7.7264 [0.5140]***
Constant	-7.9655 [11.1577]	-8.8840 [11.0538]	-4.5974 [11.0456]	-6.4620 [10.6897]	-8.7390 [10.7351]	-7.8697 [11.1698]
Big bank dummy	1.6579 [0.5109]***	3.1567 [0.5373]***	1.6473 [0.5132]***	1.6028 [0.5606]***	1.6576 [0.5208]***	1.2192 [0.6156]**
Big bank dummy × Z_SCORE_R		-2.9654 [0.7233]***				
(Capital adequacy ratio <= median) × Z_SCORE_R			-0.9999 [0.8485]			
(Capital adequacy ratio <= median) × Z_SCORE_R × Biggest creditor dummy			-0.7696 [0.7946]			
(Capital adequcy ratio <= median) × Z_SCORE_R × TFP_LOW				-0.7413 [1.0086]	-0.6962 [0.9317]	
(Capital adequacy ratio <= median) × Z_SCORE_R × TFP_LOW × Biggest creditor dummy				-0.5120 [0.7926]	-0.5257 [0.7969]	
Capital adequcy ratio <= median					0.3510 [0.5485]	
Big bank dummy × Small company dummy						0.8378 [0.5987]
Observations:	*9341*	*9341*	*9341*	*8734*	*8734*	*9341*
R-squared:	*0.4347*	*0.4359*	*0.4351*	*0.4337*	*0.4337*	*0.4348*

Note: Observations are for the firm-bank pair. Estimated equations include fixed effects for firms, robust standard errors clustered at individual firms are reported in brackets * significant at 10%, ** significant at 5% *** significant at 1%

The statistical significance of the capital adequacy ratio and share of bad loans to total loans to firms in crisis period is quite robust across all specifications as can be seen from the Table 2. The same applies for insignificance of these bank characteristics in the period before the crisis (Table 3).

The results obtained need not necessarily be interpreted as evidence of rationing of corporate loans since enterprises could "move" between banks. Therefore, it is possible that clients substituted loans from well capitalised and more liquid banks for loans from poorer banks, so that this phenomenon needs to be analysed in more detail before arriving at a more complete conclusion. To do this new regression is estimated. For each firm the change in loans from highly capitalized banks (with capital adequacy ratio equal or above the median was regressed to a change in loans from low capitalized banks (whose capital adequacy ratio was bellow the median). The results presented in Table 4 indicate that substitution from low capitalized to high capitalized banks was very limited. On average only about 8 per cent of the decrease of loans from low capitalized banks was substituted by increase from high capitalized banks in the crisis period. However, this result, although low (Albetrazzi and Marchetti (2010) get 30 per cent substitution rate for Italy), is still higher than in the pre crisis period where on average only about 5 per cent of the loans were substituted between low and high capitalized banks (Table 4 pre crisis specifications). The result is robust to inclusion of size, riskiness and ownership controls.

Table 4 Estimation results for substitution from low to highly capitalized banks

	Crisis period		Pre crisis	
Eq Name:	Crisis 1	Crisis 2	Pre crisis 1	Pre crisis 2
Dep. Var:	Change in loans from highly capitalized banks over average			
Change in loans from low capitalized banks over average assets	-0.077046	-0.076157	-0.052059	-0.045282
	(.0.0452)*	(.0.045)*	(.0.0292)*	(.0.0295)*
C	0.027195	0.020929	0.22118	0.120914
	(.0.0316)	(.0.0114)	(.0.1174)	(0.0158)***
Size dummies	Yes	No	Yes	No
Ownership dummies	Yes	No	Yes	No
Credit risk dummies	Yes	No	Yes	No
Observations:	1516	1516	1469	1469
R-squared:	0.0116	0.006	0.0421	0.0036

Note: Robust standard errors (heteroskedasticity and autocorreation) are in the parenthesis * significant at 10%, ** significant at 5% *** significant at 1%

Finally two dummies are added: biggest creditor dummy and the bank size dummy. Biggest creditor dummy checks if the bank in the firm-bank pair is the biggest creditor of the company. Normally, because some firms change banks (refinance the loan in another bank) or because in normal circumstances the loan is gradually repaid to the bank (in the absence of loan roll-over) it is expected that the dummy has negative sign, which is the case both in the crisis and pre-crisis period. The big bank dummy that is equal to one if the bank is big is also added. All banks with bellow 1 per cent market share are small, the banks with 1 to 5 per cent of market share are medium sized and the banks with above 5 per cent share are considered big. Results indicate that the big banks granted significantly more loans than the small and medium sized banks in the period before crisis but not in the crisis period.

To sum up, the results show that the credit flows to firms in the sample depended on the status of bank (in the crisis period the capitalization and the share of non-performing to total loans to

firms were found to be significant determinants of loan supply) with whom the firms interacted as substitution was very limited within the sample.

After determining that there was a significant effect of bank capitalization and share of non performing loans on credit supply in the crisis period we turn our attention towards finding evidence of evergreening, a practice where weak firms have the higher probability to be granted the loan, because of the specific links between company and bank or because this is financially attractive for the bank in the short term (the bank does not have to reserve for the bad loan). So, the focus of the rest of the investigation will be to check whether there is any difference in credit supply with respect to various firm characteristics and their interaction with bank characteristics. As a first step we construct a dummy variable to designate risky companies. Those are the one that have the Z-score bellow sample median.

Specification 2 in Table 2 gives the results of company fixed effects regression where risky companies are singled out with Z_SCORE_R dummy which equals 1 for all the companies with Z-score bellow sample median. The Table 4 shows the breakdown of the dependent variable (change in loans over average firms' assets ×100) with respect to this variable. It is not possible (and also unnecessary) to include this variable directly in to regression equation because of the fixed effects. As explained in the estimation section, the fixed effects estimators are obtained by the within transformation, where in the first step the regression is run on the average values of variables for each company and later deducted from pooled estimated to obtain fixed effect estimators. If there are variables that do not change over banks (like in this case Z_SCORE_R), for a specific firm the averaging step will produce two constants in the regression, the fixed effect and another one due to variable that is constant over banks. This produces a perfect colinearity between these two variables in the regression. But, by interacting company characteristics that do not change over banks and bank characteristics that change over at least some banks, fine details of company-bank link can be explored.

Table 4 Categorization of the dependent variable* with respect to the Z_SCORE_R

Z_SCORE_R	Crisis period			Pre-crisis period		
	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.
0	-0.37	15.67	3962	2.29	24.09	4949
1	-0.18	17.45	3760	2.01	18.68	4946
All	**-0.28**	**16.56**	**7722**	**2.15**	**21.55**	**9895**

* change in loans over average firms' assets*100

In this first step the proxy for company riskiness is interacted with the bank size. The bank size is determined by market share as explained above. There are 6 big banks among the sample of 33 banks in this research, accounting for 69.9 per cent of observations in crisis and 62.2 per cent before the crisis. All these banks are foreign owned and through their mother banks, which are big international banks, probably have more access to additional capital and can import more advanced operating procedures. It is interesting to see whether these banks that have wider selection of clients and can invest more in to their risk assessment systems behave differently than other (small and medium banks) which operate under different conditions, being owned by domestic investors or smaller international banking groups. Results presented in Table 2 indicate that these banks are different that the rest of the banking system with respect to their treatment of risky companies. To be more precise, on average these banks granted less loans to risky companies and more loans to less risky companies than small and medium banks did. By doing this, the big banks actually increased the quality of their portfolios. This finding is not related to crisis period only, as they have been doing this in the period before crisis also. Pre crisis estimates are presented in Table 3, Specification 2. The only difference is that in the per-crisis period big banks on average granted significantly more loans than small and medium sized. The size dummy is statistically and economically significant, showing that the firms that were with big banks on average got 3.2 per cent more loans to average firms' assets.

Next, in the second step, we proceed to check for evergreening / zombie lending. As explained, zombies are companies that would most probably default without loans from the banks. Banks engage in such practice because they reap short term gains: they do not have to declare loan bad and create reservations that impact profits and capitalization. Empirically, we check for this by interacting several dummies: low capitalization dummy (banks that were

capitalized less or equal to the median), dummy that checks if the bank is the biggest creditor and company characteristics.

Comparing estimation results of Specification 3 in the Table 2 (crisis) and in the Table 3(pre-crisis period) we can observe that there was no significantly different behaviour of banks that were capitalized less or equal to the median regarding risky companies during or before crisis period. The interaction between the dummy that checks if the bank in question is the biggest creditor and risk and capitalization dummy aims to test if there is any difference in loan supply to risky firms where the bank in question is the biggest creditor at the beginning of the period. Results show that in both periods there is no different behaviour of low capitalized banks with respect to risky companies and risky companies where the bank is the biggest creditor before or during the crisis.

Table 5 Categorization of the dependent variable* with respect to the Z_SCORE_R×TFP_LOW

Z_SCORE_R ×TFP_LOW	Crisis period			Pre-crisis period		
	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.
0.00	-0.27	15.07	5026	2.20	19.04	6340
1.00	-0.30	15.54	1935	2.33	16.47	2626
All	**-0.28**	**15.20**	**6961**	**2.24**	**18.33**	**8966**

* change in loans over average firms' assets*100

To continue our zombie quest in the third step the financial standings of the company is interacted with its productivity (Specification 4, Table 2 for crisis and Table 3 for per-crisis period). As noted before, Z-score gives financial standing of the company but it doesn't give any indication of its future prospects. So in this third step, total factor productivity that was calculated for each firm is used. The dummy variable TFP_LOW is 1 for all the companies that are less productive than the industry average. The interaction term between TPP_LOW × Z_SCORE_R singles out financially challenged companies that have low productivity. The Table 5 shows the breakdown of the dependent variable (change in loans over average firms' assets ×100) with respect to product of these two dummies. Increasing loans to such companies where the bank in question is the biggest creditor (biggest bank dummy) is considered to be evidence of evergreening, because these companies are both risky and less productive than the average company in their sector. Again, this product of dummies is

interacted with the bank capitalization dummy (all banks that have capitalization ratio less or equal to median) because it is expected (as explained in the discussion above) that banks with low capitalization will be less eager to acknowldge bad loans. Results show that in the crisis period low capitalized banks did grant more loans to financially challenged companies but only where they were the biggest creditors, corroborating the evergeening hypothesis. The result is both statistically and economically significant, showing that firms in this bank-firm pair on average got 1.9 per cent more loans to average firms' assets. Note that in this specification the capital adequacy ratio and its square are not statistically significant anymore. The probable reason is multicollinearity (4 terms regarding capital adequacy ratio are included). However, when only one dummy for low capitalized banks is included (in addition to interaction dummies) as in the Specification 5 the capital adequacy ratio is again statistically significant.

Final step is to see what happens with small firms. These firms are usually designated riskiest and subsequently most probable to default as many studies show. For example Falkenstein et al. (2000) presenting Moody's default probability model show how size of the company as measured by assets and sales are negatively related to probability of default. In addition they stress out that the small companies are typically less diversified and have less management experience / depth. The small company dummy is coded according to definition from the Law on Accounting that defines small companies according to asset value, sales and number of people employed. Small firms are, by that definition those which fulfil two of following three criteria: employ less than 50 people, have less than 4.4 million euro in assets and less that 8.8 million euro in sales. Results presented in Table 2 (Specification 6) show that the big banks moved away from small companies in the crisis period, that is, they granted less loans to them than small banks. On average big banks granted 1.9 per cent less loans (to average companies' assets) than small banks. This was not the case before the crisis (Table 3, Specification 6).

Summarily from estimation results show that big banks had a practice of cutting their exposure towards riskier firms before the crisis and that in the crisis period (as defined here) they continued this trend. Same applies to financially challenged companies with low productivity: big banks tended to diversify away from these companies. Except the fact that bank capitalization affected credit supply in the crisis period the most important difference is the treatment of small companies. It seems that on average small companies were avoided by big banks during the crisis, which was not the case before the crisis.

More importantly, if we combine pre crisis and crisis periods the results show an interesting trend that gives us important information about the functioning of the banking market in Croatia. It seems that in both periods that were under investigation here small banks were getting inferior clients, those that were financially challenged and less productive than other companies in their sector. As this was happening in the pre crisis and crisis period, we cannot claim this is only result of the crisis. For quite some time big banks had the opportunity to transfer know how and experience in the credit scoring from their mother bank and now probably have adequate credit scoring systems. Except that, because of the fact that they are big these banks have access to many firms and are able to pick the cherries, the best companies.

Most important result of the estimated regressions is about everegreenig. The results clearly show that in the crisis period the banks that were capitalized less or equal to the median increased their exposure to the sub par debtors, which are riskier and less productive than median firm, but only in the case where they were the biggest creditors. This is exactly what the theory implies and what other empirical investigations found in the case of Japan and Italy. The banks decided to support sub-par debtors because the combination of exposure towards these firms (the banks in question are the biggest creditors) and relatively low bank capitalization make them vulnerable to probable defaults of theses firms in case the credit line was severed.

Conclusion

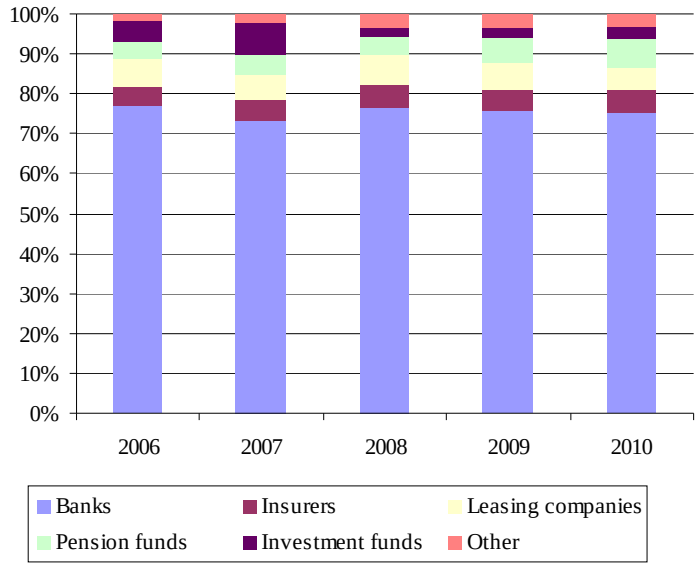
Credit creation but also contraction decreased in the crisis period indicating that some loans were being prolonged. Results of the estimated regressions indicate that there is evidence that some of the loans being prolonged are result of evergreening practices. Specifically, findings show that the banks that are capitalized equal or bellow the median were increasing their exposure towards sub par borrowers and those were defined as risky companies (with Z-Score bellow median) having poor productivity (total factor productivity bellow average for the sector) during the crisis period. In the pre-crisis period this was not the case.

Except that regressions estimated in the second part of the research showed that bank capitalization was significant factor for credit supply in crisis period. Estimated regressions also pointed out the problem the small banks have. Obviously the competition from the big banks forced them to deal with clients that are, on average financially less stable that the companies that end up with big banks. The results also insulated the type of the firm that was most hit by the crisis in terms of access to loans. Those are small firms, which were avoided by the big banks in the crisis and are because of that oriented towards small and medium sized banks.

Finally, results also indicate that the firm – bank relationship is strong: the firms are not substituting loans from low to high capitalized banks. In the period of crisis when capitalization become important determinant of loan supply this has put companies whose major bank was less capitalized at a disadvantaged position.

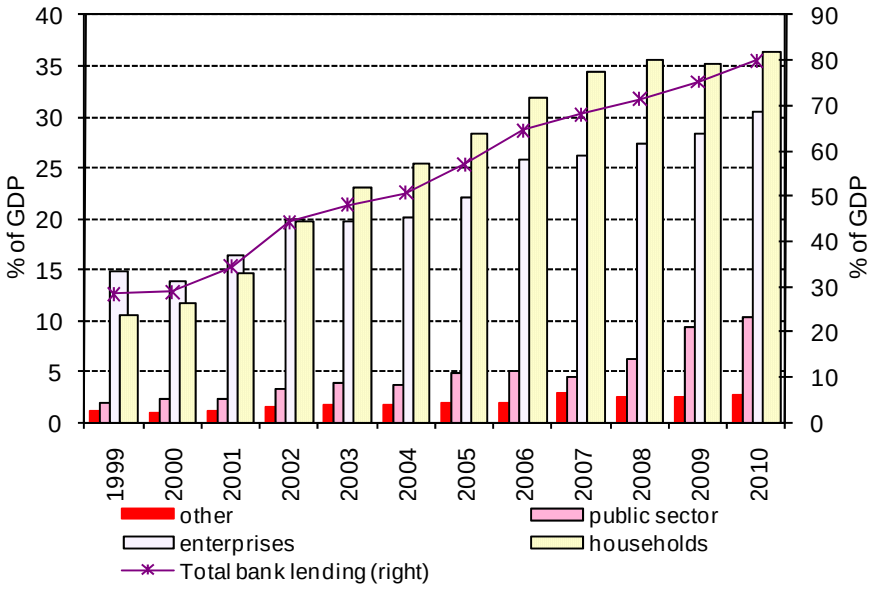
Appendix

Figure A-1 Relative importance of financial intermediaries in Croatia



Source: CNB, HANFA, CBS

Figure A-2 Importance of bank lending, net value of bank loans end of period



Source: CNB, CBS

Table A-1 Descriptive statistics for the dependent variable in the crisis period (30.9.2008 to 31.12.2009 and in pre crisis period (30.6.2007 to 30.9.2008)

	Change of loans over average assets × 100	
	crisis period	pre-crisis period
Mean	-0.276	2.164
Median	-0.106	0.000
Maximum	147.189	310.558
Minimum	-233.707	-913.894
Std. Dev.	16.558	21.557
Skewness	-0.079	-7.980
Kurtosis	27.248	401.487
Jarque-Bera	189187.600	65752604.000
Probability	0.000	0.000
Sum	-2131.599	21470.840
Sum Sq. Dev.	2116750	4610391
Observations	7722	9922

Table A-2 Change in loans to firms over average assets categorized by number of banks per firm (crisis period)

Change in loans to firms over average assets categorized by number of banks per firm (CRISIS period)			
Number of banks	Mean	Std. Dev.	Number of firms/observations
2	-0.44	20.98	3524
3	0.18	14.52	1652
4	-0.50	11.62	884
5	-0.38	10.91	490
6	-0.30	6.03	331
7	-0.80	8.84	208
8	0.26	5.79	149
9	0.85	4.74	94
10	0.35	4.16	119
11	-0.07	2.88	89
12	-0.54	2.48	54
13	-1.21	2.40	18
14	-0.88	2.22	30
15	-1.01	1.24	12
16	-0.99	4.33	51
21	0.14	0.60	17
All	**-0.28**	**16.56**	**7722**

Table A-3 Change in loans to firms over average assets categorized by number of banks per firm (pre-crisis period)

Change in loans to firms over average assets categorized by number of banks per firm (PRE-CRISIS period)			
Number of banks	Mean	Std. Dev.	Number of firms/observations
2	2.85	29.81	4370
3	2.26	14.13	2139
4	1.56	10.92	1136
5	1.54	10.62	640
6	0.74	9.19	420
7	1.04	5.92	266
8	1.76	9.14	224
9	-0.11	10.71	135
10	0.88	4.82	150
11	0.67	2.97	121
12	1.03	3.55	84
13	0.56	5.46	39
14	0.45	1.63	56
15	0.16	0.46	15
16	0.78	3.78	80
21	0.30	1.42	21
26	0.77	2.79	26
All	**2.16**	**21.56**	**9922**

Table A-4 Descriptive statistics for Z-score and total factor productivity in the crisis period (30.9.2008 to 31.12.2009 and in pre crisis period (30.6.2007 to 30.9.2008)

	Crisis		Pre-crisis	
	Z_SCORE	TFP	Z_SCORE	TFP
Mean	1.521	0.000	1.661	0.000
Median	1.356	-0.031	1.464	-0.034
Maximum	16.043	3.071	21.590	2.874
Minimum	-4.728	-7.281	-3.327	-2.293
Std. Dev.	1.242	0.261	1.356	0.259
Skewness	1.958	-1.750	2.964	3.598
Kurtosis	16.624	106.804	29.322	35.072
Jarque-Bera	69179.62	3312673	300148.3	404508.1
Probability	0	0	0	0
Sum	12570.18	-1.36E-10	16437.23	2.39E-10
Sum Sq. Dev.	12739	501.3126	18203.38	602.1126
Observations	8263	7370	9895	8986

Table A-5 Descriptive statistics for bank specific variables in the crisis period (30.9.2008 to 31.12.2009 and in pre crisis period (30.6.2007 to 30.9.2008)

	Crisis				Pre-crisis			
	Liquidity	Profitability	Capital adequacy ratio	Share of bad loans to firms	Liquidity	Profitability	Capital adequacy ratio	Share of bad loans to firms
Mean	0.281	0.001	17.152	10.700	0.280	0.004	17.486	10.830
Median	0.277	0.007	14.060	7.871	0.272	0.005	15.730	7.708
Maximum	0.445	0.029	40.700	35.902	0.442	0.025	44.880	36.188
Minimum	0.154	-0.131	7.450	0.943	0.180	-0.029	10.420	0.336
Std. Dev.	0.068	0.026	8.119	8.683	0.057	0.008	7.681	8.773
Skewness	0.420	-4.038	1.534	1.125	0.814	-1.668	1.800	0.895
Kurtosis	2.982	20.693	4.533	3.658	3.841	9.684	6.320	3.329
Jarque-Bera	0.969	520.075	16.179	7.559	4.619	76.733	32.975	4.554
Probability	0.616	0.000	0.000	0.023	0.099	0.000	0.000	0.103
Sum	9.2655	0.017513	566.02	353.1029	9.24668	0.129699	577.05	357.3964
Sum Sq. Dev.	0.14813	0.021872	2109.304	2412.538	0.10443	0.002281	1887.773	2462.825
Observations	33	33	33	33	33	33	33	33

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