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THE ROLE OF THE BANKING SECTOR PERFORMANCE IN THE CRISIS OF 2007

Sous la direction de

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Abstract

The bursting of the housing bubble and subsequent collapse of asset prices were at the origin of the large negative shock on the performance of the banking sector during the onset of the 2007 financial crisis. The drying-up of liquidity and freezing of the interbank markets led to the debasement of banks' balance sheets, causing these institutions to choose between issuing equity or reducing lending in order to restore their capital positions. At the same time, both bank lending and business production suffered from the drop in consumer demand caused by the fall in asset prices, negative or weak economic growth, rising unemployment and the loss of consumer confidence.

The second chapter of this thesis focuses on determining how much of the decline in non-financial firms' stock prices was due to liquidity shortages and how much to lower-than-expected consumer demand. Stock returns are examined over nine periods between July 31, 2007 and March 31, 2010. The near-collapse of Bear Stearns and failure of Lehman Brothers are both characterised as liquidity shocks that had a greater impact on financially fragile non-financial firms. The presented findings show that the improvement in demand expectations positively affected the performances of U.S. non-financial firms in the early months of recovery. In later periods, however, neither the amelioration in demand expectations nor the improvement of financial conditions could explain their performances.

In the second half of 2008, after a series of bankruptcies of large financial institutions, the U.S. Treasury poured capital infusions into domestic financial institutions under the Capital Purchase Program (CPP), thus helping to avert a complete collapse of the U.S. banking sector. In carrying out this effort, government regulators had to distinguish between those banks deserving of being bailed out and those that should be allowed to fail. The determinants of the allocation of CPP funds among commercial banks in the U.S. are analysed in Chapter 3. The results of this study show that the CPP favored larger financial institutions whose potential failure represented higher degrees of systemic risk. This allocation of CPP funds was cost-effective from the point of view of taxpayers, as such banks reimbursed the

government for their CPP bailouts sooner than expected. In contrast, smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out and, if they did receive CPP help, took longer to repurchase their shares from the Treasury.

Finally, the effectiveness of the CPP is analysed in Chapter 4 in terms of restoring banks' loan provisions. Again, the relative impacts of liquidity shortages (which negatively affected banks' willingness to lend) and the contraction in aggregate demand for bank loans are examined. The empirical evidence on the effects of capital shortages supports the theory. Banks that have a higher level of capitalisation tend to lend more both during the crisis and in normal times. Moreover, it is found that bailed-out banks displayed higher growth rates of loans during the crisis than in normal times (before 2008) as well as higher rates compared with non-bailed banks during the crisis, with a one percentage point increase in the capital ratio. In addition, bailed-out banks that repurchased their shares from the U.S. Treasury provided more loans during the crisis than those banks that did not.

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Introduction and outline of the thesis

1.1 Credit channel during the crisis

1.1.1 Balance sheet channel

The strength of borrowers' balance sheets and their access to external financing

The 2007 financial crisis was associated, first of all, with a severe financial shock that undermined the performance of the real economy. It started with the bursting of the U.S. housing bubble and deterioration of the financial sector that rather fast spread into the real sectors of economy. The credit channel played an important role in propagation of the financial shock on the sides of both banking and non-financial sectors. It comprises two subchannels that were distinguished by Bernanke and Gertler (1995) and that correspond to the respective transmission channels of the monetary policy: (i) balance sheet channel and (ii) bank lending channel. The former channel and the measures of firms' vulnerabilities to shock propagation through this channel are analysed in this section.

The financial structure of the firm was considered irrelevant for determining its market value by Modigliani and Miller (1958). It implied that the firm's value was unaffected by the way the firm financed its investment projects (through external or its own capital). However, Modigliani-Miller theorem assumed an efficient market in the absence of taxes, bankruptcy and agency costs and asymmetric information that proved to be unrealistic in the real market. The impact of frictions in financial markets on the financial constraints of firms, particularly in crisis, was later well investigated in the corporate finance and investment literature (see Chatelain, 2002).

Myers and Majluf (1984) and Calomiris and Hubbard (1990) proposed the following order of preference for the financing sources available to non-financial firms: the firm's own capital, trade credit, capital market funds and bank credit. It is clear that the access to the latter two sources of financing and the attached conditions depend on the strength of borrowers' balance sheets. Moreover, if its balance sheet carries large shares of debt or illiquid assets, a firm is expected to have trouble attracting external financing and obtaining bank credit because of the low value of its collateral, which can further lead to endogenous credit cycles (Kiyotaki and Moore, 1997; Braun and Larrain, 2005).

One of the best models existing prior to crisis dealing with imperfect capital markets were "financial accelerator" dynamic stochastic general equilibrium models (DSGE), as highlighted in Chatelain and Ralf (2012). These models assumed imperfect capital markets with bankruptcy costs or credit rationing where the debt of the non-financial firm was limited by the future value of its collateral. Hence, in these models firms with weaker balance sheets (i.e. a low level of capitalisation and liquidity) and poor credit performance were less likely to receive a loan.

The balance sheets of non-financial firms were significantly affected during the crisis of 2007. In the period after 2007 the decline in the value of assets eroded borrowers' net worth faster than their gross worth (due to their leverage), which led to a reduction in the value of the collateral and subsequent fall in the amounts able to be borrowed (Brunnermeier, 2009).

As highlighted earlier, monetary policy can also affect the non-financial sectors through the balance sheet channel (Bernanke and Gertler, 1995). In that vein, periods of tighter monetary policy are associated with a decline in the ability of smaller firms to raise funds (see also Kashyap and Stein, 1994; Kishan and Opiela, 1997).

Measures of vulnerability of non-financial firms to financial shocks based on their balance sheet indicators

The existence of balance sheet channel implies that firms that have limited access to financial markets should be more affected by liquidity shocks and changes in monetary conditions. Thus, the impact of distortions in financial markets on real activity depends on whether non-financial firms are vulnerable to financial shocks.

As highlighted in the previous section, in the presence of asymmetric information and transaction costs, there is a gap arising between the relative costs of external and internal sources of financing (Stiglitz and Weiss, 1981; Fazzari *et al.*, 1988; Bernanke and Gertler, 1990; Calomiris and Hubbard, 1990 and Bond and Meghir, 1994). A part of the literature suggests to use cash flow sensitivities of firms as measures of their financial constraints. It is argued that firms that incur higher costs of external financing display higher sensitivities of fixed investments to changes in firm earnings (Fazzari *et al.*, 1988; Carpenter *et al.*, 1995; Himmelberg and Petersen, 1993; Calomiris and Hubbard, 1995).

Based on that approach to explaining firms' financial constraints, Fazzari *et al.* (1988) propose an index of investment cash flow sensitivities and argue that the sensitivity of investment to internal funds increases with the gap between the costs of internal and external financing. Kaplan and Zingales (1997) later provide evidence that investment cash flow sensitivities are unlikely to be useful measures of financial constraints and propose their own KZ index based on the balance sheet characteristics of non-financial firms. However, Hadlock and Pierce (2010) argue that the KZ index is unlikely to be a valid measure of a firm's financial constraints. Other examples of financial constraint indexes include Rajan and Zingales (1998) index of a firm's sensitivity to external financing and Whited and Wu (2006) index, both of which are based on the balance sheet characteristics of firms.

1.1.2 Bank lending channel

Bank lending channel is another mechanism of financial shock transmission to the real economy that focuses on the balance sheet characteristics of lenders (i.e. banks). Banks themselves borrow from financial markets, thus, tighter monetary policy or other external liquidity shocks (such as freezing up of interbank market during the recent crisis) induce banks to search for alternative sources of financing. The capacity of raising funds differs among banks that in turn leads to their heterogeneous responses in terms of altering supply of capital to the real economy. In the literature this question is often referred to as a trade-off between the marginal cost of issuing equity and the marginal cost of cutting back on lending. The results of the study conducted by Kiley and Sim (2010) suggest that the banks respond to a capital shock through a mix of financial disintermediation and recapitalisation.

The literature provides evidence of the influence of bank lending on macroeconomic fluctuations. Halvorsen and Jacobsen (2009) analyse the impact of bank lending on real activity in Norway and the U.K. over the past 21 years. The authors find that a contractive shock to bank lending induces a negative response for the output gap and places downward pressure on consumer prices.

Under the usual assumptions of bank lending literature small, less liquid or less capitalised banks have more problems to offset the shocks and, thus, they are expected to grant fewer loans than banks with better respective balance sheet characteristics (Chatelain *et al.*, 2003). In the recent study Tabak *et al.* (2010) confirm that during periods of easier (tighter) monetary policy, banks increase (decrease) their loan supply and that large, well-capitalised and liquid banks absorb better the effects of monetary policy decisions.

Similarly, Jiménez *et al.* (2010) analyse the extension of lending to new clients (extensive margin) and change in the volumes of loans to old clients (intensive margin) using microeconomic data on loan applications and granted loans in Spain. Such a dataset allows the authors to disentangle loan demand and supply as well as firm and bank balance sheet channels. Their results suggest that during the period analysed both worse economic and tighter monetary conditions reduce loan granting, especially to firms or from banks with lower capital or liquidity ratios. Moreover, firms cannot offset the resulting credit reduction by turning to other banks.

In case of the global shock the performance of both financial intermediaries and borrowers is affected, thus, two channels cause the shock transmission to the real economy. In the recent DSGE model of Hirakata *et al.* (2011) the authors try to compare the consequences of the adverse shock on financial sector with the one that hits borrower's creditworthiness[1] for the real economy. They estimate on the U.S. data that the former one leads to larger recessions than the latter one.

The impact of firms' financial constraints as opposed to demand shock on firms' performance during the crisis is first investigated in Chapter 2. The bank lending channel during the crisis and the influence of the Capital Purchase Program on bank lending is later analysed in Chapter 4.

1.2 Chapter 2. Distinguishing between the effects of demand and financial shocks

The fall in aggregate consumer demand after the crisis in 2007 was no surprise: the higher household leverage before 2007 and the collapsing prices of houses and other assets together with the loss of consumer confidence contributed to the fall in and slow recovery of output, employment and consumption (Mian and Sufi, 2011). Disentangling the relative impacts of financial and demand shocks on real business activity is, however, a more difficult task. Fornari and Stracca (2012) prove that financial shocks have a non-negligible influence on key macroeconomic variables such as output, investment and price level and emphasise that whether the financial shock is mainly an aggregate demand shock or a supply shock remains

[1] Deterioration of the borrower's balance sheets in the article by Hirakata *et al.* (2011) leads to the revision of credit contracts.

unclear.

In the literature that investigates business or lending activity, the effects of changes in aggregate demand are typically proxied by macroeconomic variables such as GDP growth (see Berrospide and Edge, 2010; Calza and Sousa, 2003; Frömmel and Schmidt, 2006; Sorensen *et al.*, 2009). By contrast, other studies use microeconomic data on applications (Jiménez *et al.*, 2010; Holton *et al.*, 2009b) or production orders to account for demand factors.

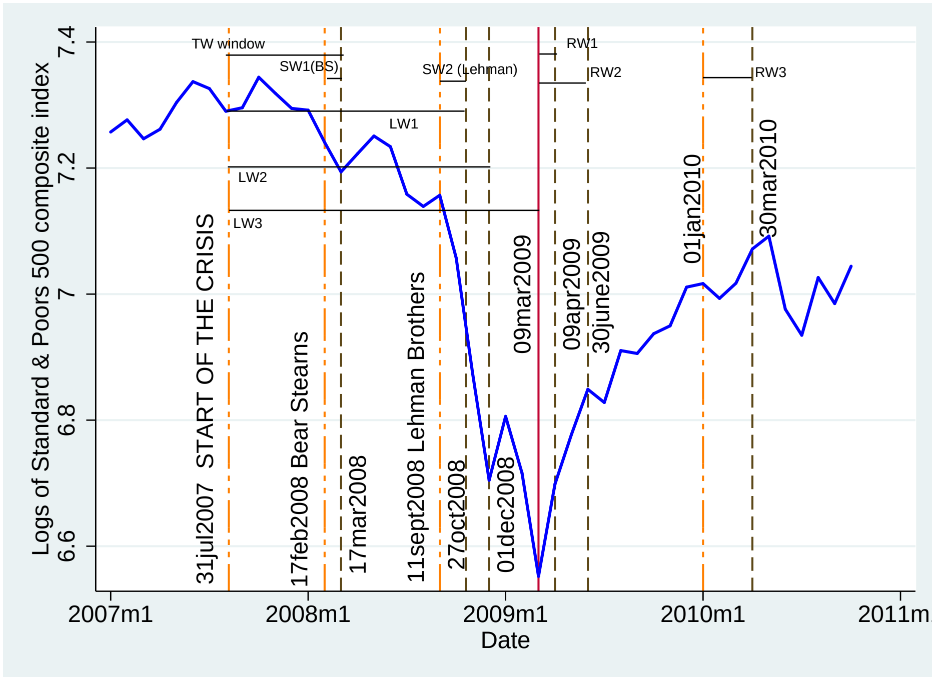
Alternative ways of measuring the heterogeneous reactions of firms to changes in aggregate demand are presented in Tong and Wei (2009a,b) and Claessens *et al.* (2012). These authors suggest several indexes for measuring the demand sensitivity of non-financial firms. One of them is based on the reactions of firms to the 9/11 terrorist attacks (which is presumed to be a demand shock), while another is an estimated index of the elasticity of the net sales of the firm to changes in GDP during the years before the crisis.

Chapter 2 evaluates how the shock on demand expectations and the credit crunch influenced the non-financial firms' performance. The cross-sectional changes in the stock prices of U.S. non-financial firms are investigated over nine large and small periods between July 31, 2007 and March 31, 2010. This chapter uses a methodology similar to that proposed by Tong and Wei (2009a,b), which is based on the CAPM cross-sectional model of stock returns with a standard set of control variables.

Figure 1.2.1 plots the S&P 500 composite index displayed on a logarithmic scale, the slope of the curve measuring the monthly rate of growth during the period from January 1, 2007 to October 1, 2010. The index points out several periods when stock market lost much of its value: on March 17, 2008, on October 27, 2008, on December 01, 2008, and reached its lowest point on March 09, 2009. Based on that, four large and two short periods of slowdown as well as three short periods of recovery were identified for the analysis (recovery starts from March 09, 2009, after the aggregate index reached its bottom).

One of the contributions of this chapter is the inclusion of extended up to March of 2010 time periods and shorter windows of 1-2 months around the particular negative events (the

Figure 1.2.1: S&P 500 composite index displayed on a logarithmic scale from January 1, 2007 to October 1, 2010



near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers) as well as the periods of recovery after the deepest trough in stock market returns in March of 2009.

Empirically, the values prior to the crisis of 2007 are used to construct several indexes that captured heterogeneous reactions of non-financial firms to the collapse in product demand and to credit supply shock. Instead of focusing on the Whited and Wu financial constraint indicator, other balance sheet indicators are taken into account to identify the firm's financial constraint. Besides, as demand sensitivity index proposed by Tong and Wei (2009a and 2009b) has been criticised for its accuracy, alternative ways to compute the demand sensitivity are suggested. Robustness checks include clustering the error terms by sectors, outlier selection and comparing continuous versus discrete time stock market returns.

Both the credit supply shock and the contraction of product demand were shown to have negatively influenced the stock returns of U.S. firms between July 31, 2007 and March 09, 2009 (the period in which the stock returns of firms were negative). However, both factors had positive or non-significant effects during the recovery period starting from spring 2009.

Table 1.1: Change in Stock Prices during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for small windows following the Bear Stearns near-collapse and the bankruptcy of Lehman Brothers

Type of variable	Name	**SW1** Bear Stearns (Feb 17, 2008 - Mar 17, 2008)	**SW1** Bear Stearns(Feb 17, 2008 - Mar 17, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)
Balance sheet char-s					
ALTMAN'S	ZZ	0.015**	0.015**	0.048***	0.025*
Z-ZONE		(3.14)	(3.10)	(3.37)	(2.19)
MOODY'S	Liq			0.058***	
RISKCALC				(3.80)	
BONDSCORE	Vol	-0.016***	-0.015***	-0.065***	-0.026*
		(-4.19)	(-3.12)	(-3.23)	(-2.21)
Demand	$\Delta \ln(q_{i,'01})_s$			-0.055***	
Sensitivity				(-4.30)	
Control	$\Delta \ln(q_{i,t-1})$		-0.011*		-0.041**
variables			(-2.06)		(-3.24)
	$Beta$				-0.178***
					(-18.04)
	Constant	-0.074***	-0.075***	-0.575***	-0.560***
		(-16.84)	(-16.78)	(-44.81)	(-54.19)
	R^2	0.035	0.049	0.108	0.434
	Obs	1031	1030	1019	1019

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

I also found that the demand sensitivity index of Tong and Wei has the greatest explicative power compared with alternative indexes. Firms that were more vulnerable to demand contraction and more financially fragile (i.e. those with smaller Z-scores or classified into a more distressed zone according to the score) before 2007 experienced a larger reduction in the values of their stocks during the crisis.

Further, the near-collapse of Bear Stearns and bankruptcy of Lehman Brothers were characterised by liquidity contractions (financially fragile firms were affected the most) as well as the overall negative tendency of the market and its high volatility (table 1.1). These results confirmed those of Calomiris *et al.* (2010) and Giovane *et al.* (2010), while they also showed that for both events the major consequence was a contraction in credit supply rather than a collapse in product demand.

1.3 Capital Purchase Program (CPP) during the crisis

1.3.1 Capital Purchase Program and its place among other measures

The bursting of the credit and asset price bubbles imposed serious costs to the governments that resulted in higher fiscal deficits and public debt. It also triggered discussions regarding the regulatory responses and their efficacy in stabilising a financial system. It became clear in the wake of the financial crisis that conventional policies did not work properly; besides, even the governments and the central banks of the largest countries had often had different approaches to unconventional policies supporting the functioning of financial markets and real economy.

The views on the government interventions also differ in the academic literature. Some researchers advocate interventions by the central bank that occur exclusively through open market operations as that way the market distortions are minimised (Goodfriend and King., 1999; Kaufman, 1991; Schwartz, 1992). Others, contrarily, support the idea of direct lending and liquidity provisions to avoid the failure of the financial system (Goodhart, 1999; Freixas *et al.*, 2000a,b). In this vein, Diamond and Dybvig (1983); Diamond and Rajan (2001) and Rochet and Vives (2004) all provide evidence of the importance of deposit insurance backed by the government or central bank against bank runs and contagion.

As conventional policy methods were not efficient[2] and the problems of individual financial institutions suggested a systemic threat for the financial sector, governments and central banks around the world were forced to step in and take unprecedented measures to support the industry (thus, play their role of "lenders of last resort", as first described by Thornton (1802) and Bagehot (1873)). The interventions of the U.S. and European governments mostly involved ensuring bank funding through explicit government guarantees and reducing bank leverage through governmental purchases of distressed assets or preferred bank shares (Fender and Gyntelberg, 2008).

However, many critics appeared in the aftermath of these programs that pointed out the limited efficiency of central banks' actions. In that vein, Adrian and Shin (2010) argue that most of the measures undertaken by the central banks during the financial crisis of 2007 were not available to non-depository institutions, which have become an important element of the financial system over the past 30 years. Besides, Buiter and Sibert (2008) argue that in case of Iceland the vulnerability of its banking system was caused by the limited capacity of the Icelandic authorities to act as a lender of last resort. Similarly, Portes (2008) argues that better crisis management by the Icelandic authorities may have avoided economic collapse.

Bank rescue packages and the conditions of participation in the recapitalisation schemes proposed by governments between 2008 and 2009 significantly differed by country. In the United States, bank recapitalisations were finally conducted between October 2008 and December 2009 through the purchases of preferred equity stakes (while the initial plan was to buy banks' "toxic" assets) under the voluntary Capital Purchase Program (CPP hereafter; for more details, see Acharya and Sundaram, 2009; Panetta *et al.*, 2009; King, 2009; Cooley

[2]Since 2008, policy rates in most advanced economies have remained at their effective lower bounds.

and Philippon, 2009; Khatiwada, 2009).

In the U.S., the number of recipients was larger than in any other country[3] because of both the size of the financial sector and the relatively smooth conditions[4]. An argument in favour of the CPP is that it did not end up costing much to taxpayers. Specifically, it spent only 204.9 billion dollars of its 250 billion dollars budget (more than a third of the total Troubled Asset Relief Program). The largest investment was 25 billion dollars and the smallest was 301,000 dollars.

However, the allocation of CPP funds among banks remains at the centre of discussions. Bank fundamentals, their political connectedness and their contributions to systemic risk are often said to be crucial for determining bank bailouts (e.g. Bayazitova and Shivdasani, 2012; Duchin and Sosyura, 2012; Blau *et al.*, 2013).

1.3.2 Endogeneity of the Capital Purchase Program

During the crisis the Federal Reserve and U.S. Treasury had to develop criteria for deciding whether to bail out a given bank or allow it to go under. The goal of the Capital Purchase Program was to provide funds to temporarily illiquid but solvent financial institutions. However, the discussion on the distinction between temporarily illiquid and insolvent financial institutions still continues (Goodhart, 1999; Giannini, 1999; Goodhart and Schoenmaker, 1995). The need of the financial institution in recapitalisation is, first of all, closely related to its probability of default and thus to bank fundamentals and early warning indicators (such as CAMEL[5]). Whalen (1991); Cole and Gunther (1995); González-Hermosillo (1999); Calomiris and Mason (2003); Coffinet *et al.* (2010); Männasoo and Mayes (2005); Arena (2008); Kato *et al.* (2010) all use a bank's balance sheet characteristics and market

[3] A total of 707 banks benefited from the CPP in the U.S., while in the U.K. only three financial institutions participated in the recapitalisation program.

[4] For instance, the dividend to be paid on the preferred shares to the U.S. Treasury was set at 5% annually for the first five years and 9% later on, while the dividend to be paid to the U.K. Treasury was set at 12% for five years and the three-month sterling London Interbank Offered Rate (LIBOR) plus 700 basis points thereafter.

[5] CAMEL stands for Capital Adequacy, Assets, Management Capability, Earnings, Liquidity and Sensitivity to market risk.

signals to predict the failure of financial institutions and conclude that bank fundamentals can predict bank failures after controlling for macroeconomic factors.

Coffinet *et al.* (2010) use option market indicators to predict the time-to-failure of distressed financial firms and find that such indicators perform equally well for predicting financial distress compared with the other time-varying covariates typically included in bank failure models. Further, Männasoo and Mayes (2005) conduct a survival analysis in order to show that bank-specific indicators (such as low capitalisation and high exposure to market risk) play an important role in distress detection and warning in Eastern European transition economies.

An alternative approach to predict bank performance during the financial crisis was proposed by Fahlenbrach *et al.* (2011), who investigate whether banks learned from the Long-Term Capital Management (LTCM) crisis of 1998 and adopted different business models. However, they find no evidence of any such learning process; indeed, they show that those banks that performed badly during the crisis of 1998 also performed poorly during the crisis of 2007.

If banks do not learn from their past performance and they receive funds from the government during a crisis, they tend to expect the same in the future. Hence, if banks expect to be bailed out in a crisis, they will take more risks, which means that providing liquidity to such banks contributes to the creation of moral hazard (Calomiris *et al.*, 2004; Acharya and Yorulmazer, 2008; Diamond and Rajan, 2009; Farhi and Tirole, 2012; Gale and Vives, 2002; Stiglitz, 2012). In this vein, Dam and Koetter (2011) examine whether expectations of bailouts raise moral hazard in terms of excessive risk-taking by German banks and provide evidence of the relatively large impact of moral hazard on banks' risk-taking compared with other bank-specific determinants.

Therefore, on the one hand, regulators were leery of entering into "moral hazard" territory; on the other hand, bank recapitalisations were obviously necessary to support solvent but illiquid banks and thus avert a catastrophic collapse of the entire financial system. The

Federal Reserve thus focused on minimising the propagation of the crisis. In the financial system, there was significant counterparty risk, mostly from the side of large complex financial institutions, which proved to be "too big to fail" in the context of the global financial crisis because of their size, complexity and interconnectedness. In this regard, Bayazitova and Shivdasani (2012) suggest that capital injections under the CPP were provided to banks that displayed higher systemic risk and faced higher financial distress costs, but also had strong asset quality.

Value-at-risk, one of the most popular systemic risk indicators, focuses on the risk of an individual institution in isolation. However, the systemic risk of the institution in isolation is not as important as the contribution of the institution to systemic risk. Although various indicators have been proposed in this regard (Merton and Perold, 1993; Matten, 1996; Urban *et al.*, 1993; Acharya *et al.*, 2010; Adrian and Brunnermeier, 2011), Idier *et al.* (2012) find no evidence that their ex-ante marginal expected shortfall indicator helps predict equity losses better than do balance sheet fundamentals (such as the capital ratio).

Furthermore, Faccio *et al.* (2006); Duchin *et al.* (2010) and Blau *et al.* (2013) all advocate that politically connected firms are more likely to benefit from government bailouts. Indeed, Blau *et al.* (2013) suggest that politically connected firms are more likely not only to be bailed out but also to receive a greater amount and at shorter notice than politically inactive banks.

While the determinants of bank performance, failures and subsequent bailouts are examined in the literature, the bailout repayments often remain unnoticed. However, the fact of bailout repayment and the time that the bank took to reimburse the amount received earlier contain important information regarding bank's health, its capacity to restore its activities and the realised losses for taxpayers.

1.3.3 Chapter 3. Determinants of the allocation of funds and their repayments under the CPP

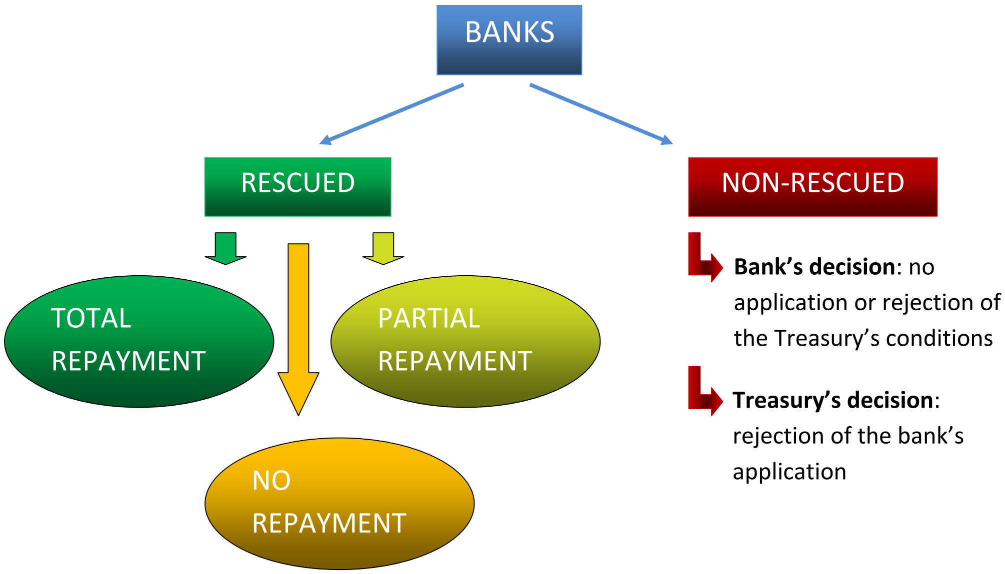
The third chapter of this thesis focuses on the determinants (such as balance sheet characteristics, systemic risk indicators and others described above) of the liquidity provisions and their repayments under the CPP. The allocation of CPP funds is investigated and evaluated by analysing bailout repayments over the four years following the disbursement of CPP funds (2009–2012). In this regard, it is an important source of information on the realised risks of funding allocations. Methodologically, Ordinary Least Squares (OLS), logit, polytomous and duration models are applied to analyse capital injections under the CPP and their reimbursement.

OLS regression is focused on explaining the relative size of the disbursed under the CPP amount; logit regression estimates the probability of the binary outcome (bailout or no bailout); duration analysis examines the time until CPP funds repayment; polytomous regression predicts four possible outcomes: no bailout $y = 0$, bailout and total repayment $y = 1$, bailout and partial repayment $y = 2$, bailout and no repayment $y = 3$ (figure 1.3.1).

Not all banks were automatically eligible for the CPP. First, a bank had to request participation in the CPP by applying to the appropriate Federal banking agency (FBA). Second, the Treasury had to approve the bank's application. Then, the bank had 30 days from the date of that notification to accept the Treasury's terms and conditions and to submit investment agreements and related documentation. This being the case, if a particular bank was not bailed out, two distinct scenarios were possible to explain why (see figure 1.3.1).

First, that bank either did not apply for CPP funds in the first place or did not accept the Treasury's conditions after receiving preliminary approval, perhaps because of the availability of cheaper alternative financing or the absence of the need to recapitalise. Second, such a bank could have been refused CPP funds by the Treasury for two main reasons: (i) it was considered to be insolvent or (ii) its financial situation was deemed superior to those of other applicants (given that the amount to be disbursed under the CPP was limited). Of these,

Figure 1.3.1: Bailout and repayment decision



the first reason seems to be more realistic, as not all CPP funds were disbursed and most banks were suffering from liquidity shortages equally.

The summary of results for polytomous and time-to-repayment regressions are presented in table 1.2 (summarised results from sections 3.4.2 and 3.4.3). The plus sign means a positive influence of the underlined variable on the probability of the outcome $y = i$ in polytomous regressions and an increase in logged survival time (or expected duration until the repayment) in time-to-repayment analysis; the minus sign should be interpreted, vice versa, as a negative impact. The empirical evidence from OLS, logit and polytomous logit suggests that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks. Higher systemic risk indicators such as Marginal Expected Shortfall (MES), size and beta and smaller Z-score (meaning more financially stable bank) are associated with a greater probability of bailout and subsequent total repayment (i.e. lower probability of other outcomes as reported in table 1.2). At the same time, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury than other banks. Thus, saving these banks helped avoid large external costs for the other sectors of the economy in the event of a total collapse of the banking sector, while taxpayers' money was returned in relatively short order. Nevertheless, smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out and, if they did receive CPP help, took longer to repurchase their shares from the Treasury.

There are several interpretations of these results, depending on whether a bank decided not to apply for CPP funds or the Treasury rejected the bank's application. The bank may have decided not to apply for CPP funds if the mortgages and MBSs on its books were of primary loan type. This means that banks preferred to leave high-quality loans on their balance sheets and to securitise and sell off less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. However, if the Treasury decided not to bail out a commercial bank, it may have been due to its specialising in mortgage lending and MBSs rather than commercial lending (probably because they were considered insolvent owing to their predatory lending before the crisis). This allocation of CPP funds was cost-effective from the point of view of taxpayers. Larger firms with smaller shares of mortgages and non-performing loans, higher shares of commercial loans and greater contributions to systemic risk were more likely to be bailed out but also to reimburse CPP funds in full at short notice.

1.4 Capital Purchase Program and its impact on banks and loan supply

1.4.1 CPP funds disbursement and bank's value

The following question is the one regarding the efficacy of public capital injections for banks' performance and loan supply during the crisis. While the bank lending channel sug-

Table 1.2: The influence of the main factors determining the CPP funds disbursement and repayment, U.S. commercial banks, from polytomous logistic regression and survival analysis. Base outcome for polytomous regression: bailout and total repayment

		Polytomous regression			Survival analysis
Variable	Name	No bailout	Bailout and partial repayment	Bailout and no repayment	Time-to-repayment (AFT)
Balance sheet charac-s					
Altman's Z-score	Z	+			–
Cash flow per share	P_2		+		+
Mortgage loans normalised by total loans	AC_1	+		+	+
Commercial and industrial loans normalised by total loans	AC_2	–		–	–
Treasury securuties normalised by total assets	Liq_1	+			
MBS normalised by total assets	Liq_2	+			
Non-performing loans normalised by total loans	AQ	+	+	+	+
Systemic risk variables					
Beta	$Beta_{i,2007}$	–		–	–
Size	$Size_{i,2007}$	–		–	–
MES	$MES_{i,2000-2007}$	–		–	–
	Pseudo R^2	0.156	0.168	0.153	
	Obs	505–519	505–519	505–519	275–279

gests that additional capital leading to the rise in bank's capital ratio is expected to support bank's lending during the crisis, it is unclear what effects rescue packages have had on bank's performance and valuation during the 2007 financial crisis. The effects of announcements regarding comprehensive rescue packages distribution among the U.S. commercial banks on bank risk and valuation were studied by King (2009). The author interprets the reactions of bank stock prices to government interventions as an impact on shareholders, while the movement of credit default swap (CDS) spreads as an impact on creditors. He finds that government support was more beneficial for creditors than it was for shareholders given that the average bank CDS spreads for each country narrowed around the announcement dates in all countries. Further, the stock prices of banks that received a direct liquidity injection underperformed relative to banks that did not receive government capital.

Ng *et al.* (2010) also examine the impact of CPP funds disbursement on the market value of participating bank holding companies. They find that banks that participated in the CPP experienced significantly lower stock returns during the CPP initiation period relative to non-participating banks, whereas market value adjusted upwards after the program's initiation. They also report that rescued banks had stronger fundamentals compared with non-rescued banks both before and during the initiation period. Moreover, Veronesi and Zingales (2010) estimate that while the distribution of CPP funds reduced enterprise value by 2.5% (possibly owing to the inefficient restrictions imposed by the government), it also significantly reduced the probability of bank default, which could diminish bank value by 22%.

1.4.2 Loan supply during the crisis period

Another part of the literature focuses on the analysis of the credit supply during the crisis and the efficacy of subsequent regulatory responses for restoring credit offers to enterprises and individuals. Ivashina and Scharfstein (2010) and Puri *et al.* (2011) show that the U.S. financial crisis induced a contraction in the supply of corporate and retail lending. Popov and Udell (2010) confirm that financial distress in Western European and U.S. parent banks significantly affected business lending to Central and Eastern European firms. They associate this reduction in credit offers with low equity ratios, low Tier-1 capital ratios and losses in financial markets.

Ciccarelli *et al.* (2010) show that during the crisis of 2007 liquidity shocks had a large negative impact on GDP through a reduction in credit supply to firms in the Euro area and tighter lending standards for mortgage loans in the U.S. Ramcharan *et al.* (2013) report that the collapse of the asset-backed securities market during the crisis caused a large contraction in credit supply by credit unions, especially those with lower capital ratios. Similarly, Kapan and Minoiu (2013) analyse the syndicated loan market and show that banks that were more dependent on market funding and had lower liquidity had fewer credit offers than other banks. Adrian and Ashcraft (2012) also confirm that bank lending tends to decline during a crisis, whereas bond financing increases.

The severe consequences of the financial crisis of 2007 have also raised questions about the necessity of tighter bank capital and liquidity regulations as well as the effect of the bank capital channel on credit supply. When capital requirements increase, banks are forced to delever their balance sheets. For instance, Barrell *et al.* (2009) and Kato *et al.* (2010) find that raising capital and liquidity standards would reduce the likelihood of a financial crisis occurring. Francis and Osborne (2009) also use a capital adjustment model to conclude that while tighter financial regulations might contribute to financial stability, these could also have a negative effect on loan supply because of the adjustment to the target capital ratio by banks. Berrospide and Edge (2010), on the contrary, find no significant impact of bank capital on lending for two possible reasons: (i) the reduction in loan demand and increased bank risk played a more important role in slowing the loan growth than bank capital; or (ii) conventional capital ratios cannot properly assess the capital positions of banks.

1.4.3 Chapter 4. Resuming bank lending in the aftermath of the Capital Purchase Program

Brei *et al.* (2011) analyse whether the rescue measures adopted during the crisis helped sustain bank lending. They confirm that banks that have higher levels of capitalisation provide more credit during normal times, while this is only the case during a crisis once the level of capitalisation exceeds a certain threshold. Moreover, Brei and Gadanecz (2012) find no evidence that bailouts contributed to a reduction in risk lending and report that the syndicated loans provided by banks that were later bailed out were riskier than those provided by institutions that were not bailed out.

In its attempt to distinguish between the relative impacts of liquidity shortage and the contraction in aggregate demand on credit growth rates, Chapter 4 of this thesis is close to Chapter 2. This chapter uses the methodology of Brei *et al.* (2011) in order to estimate the impact of bank capital, other balance sheet characteristics and sensitivity to demand shocks on bank lending. This framework allows us to introduce structural changes in parameter estimates for the period of the crisis as well as for normal times for bailed-out and non-bailed banks.

Chapter 4 contributes to the literature on the efficacy of public capital injections during the crisis. It provides a framework in which the sensitivity of the bank's credit offer to financial distortions and its sensitivity to decline in aggregate demand are separated from each other[6]. The relationship between bank balance sheet characteristics, sensitivity to demand shock and bank credit growth is analysed for banks that received CPP funds and those that did not both in normal times and during the crisis. Moreover, the same relationship is then investigated for the subsample of financial firms that received CPP funds in order to distinguish between banks that repurchased their stakes from the U.S. Treasury by July 2012 and those that did not. While Brei *et al.* (2011) only use system GMM approach,

[6]In most of empirical studies, demand factor is proxied by changes in the GDP of the country. It means that they do not take into account heterogeneous reactions of the financial institutions to the changes in aggregate demand (see Berrospide and Edge, 2010 and Brei *et al.*, 2011).

that chapter examines the impact of CPP funds distribution on loan supply using Mundlak (1978), Hausman and Taylor (1981), Instrumental Variables, Arellano and Bond (1991) and system GMM estimators in order to account for various types of endogeneity bias (presented later in section 4.2.2).

Figure 1.4.1 plots median total loan growth rates over time for the banks (i) that did not receive CPP funds; (ii) that received CPP funds and repaid them totally by July 2012; (iii) that received CPP funds but did not repay anything by July 2012. It shows that bailed-out banks that did not redeem their stocks from the Treasury on average supplied more loans than other banks in the period between 2001 and 2008. Banks that did not receive CPP funds on average exhibited the lowest total loans growth rates in the period before 2008. However, the situation changed after 2008. Banks that did not repurchase their shares from the Treasury exhibited the lowest growth rates of loans, while the latter ones started to rise at the banks that did not receive CPP funds and those that repaid their CPP funds.

Figure 1.4.1: Median annual total loans growth rates

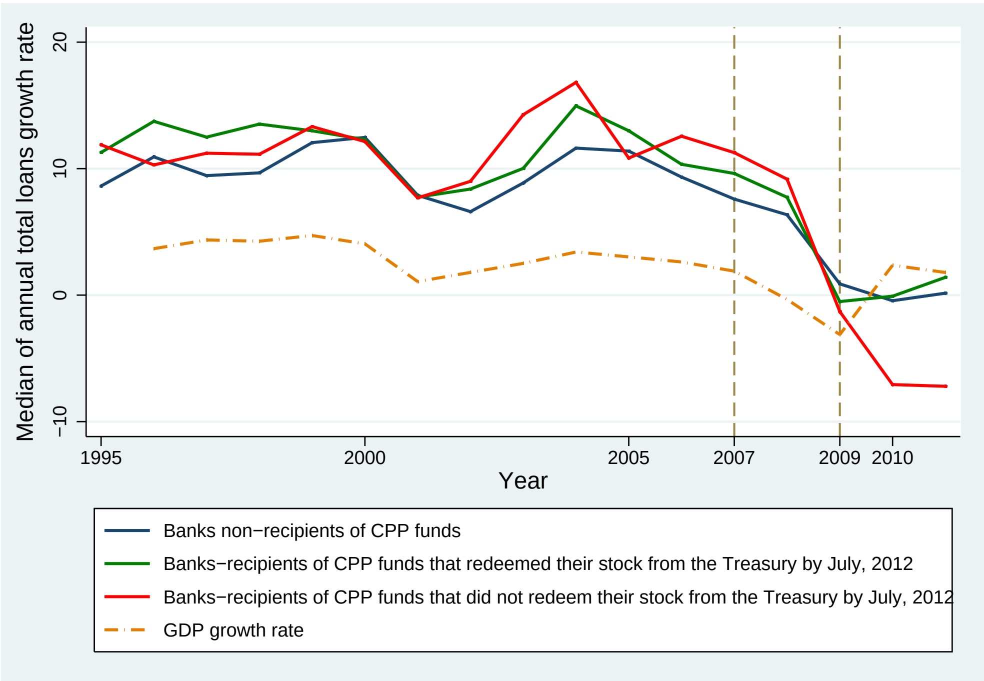


Table 1.3 suggests the same evidence. Mean growth rates are reported in table 1.3 for the banks according to their participation (bailout/no bailout) in and their exit (repayment/no

repayment) from the CPP. Median and standard deviation are reported in brackets, respectively. The table reports similar mean (median) growth rates of total loans for non-bailed banks and banks that repaid CPP funds (2.94% (1.96%) and 3.63% (2.11%), respectively) during the crisis period. However, the growth rate of loans at the banks that did not repay CPP funds is negative: the annual mean growth rate is -0.76%, while the median is -2.43%.

The empirical evidence on the effects of capital shortage these observations (for the summary results see Chapter 4, section 4.4.7, tables 4.22, 4.23 and 4.24). First of all, the results from different estimators suggest that bailed-out banks exhibited higher growth rates of all types of loans than non-bailed banks both in normal times and during the crisis. Moreover, with a one percentage point increase in the capital ratio, bailed-out banks displayed higher growth rates of loans during the crisis than in normal times as well as higher growth rates than those of non-bailed banks during the crisis. This result is in line with that of Francis and Osborne (2009), who use data on U.K. banks and report that better capitalised banks are more willing to supply loans. The same finding is confirmed by Foglia *et al.* (2010), who also find that this effect intensified during the crisis.

Besides, bailed-out banks that repurchased their shares from the U.S. Treasury provided more loans during the crisis than the banks that did not do it. These results provide the evidence, that (i) in general, CPP program was efficient in terms of supporting loan growth during the crisis; (ii) the banks that did not repay CPP funds had experienced severe financial problems and did not translate additional capital into new loans to enterprises and individuals.

It also seems that banks that specialised in commercial and industrial lending and that displayed a higher probability of receiving CPP funds (see Chapter 3 for details) also contributed to a larger extent to the growth rates of loans (mostly commercial and industrial loans, as they specialised in that type of lending).

Hence, banks that had a higher level of capitalisation tended to lend more both during the crisis and in normal times. In tough times, additional capital was not that easily translated

Table 1.3: Summary statistics on growth rates of loans

Bank	1995-2011	No Crisis 1995-2007	Crisis 2008-2011
Growth rates of TL			
All banks	10.81 (8.46;16.18)	13.75 (10.54;15.96)	2.49 (1.41;13.72)
Obs	8061	5958	2103
Bailed-out banks	11.38 (9.14;16.23)	14.81 (11.51;15.73)	2.00 (0.84;13.71)
Obs	3726	2727	999
Non-bailed banks	10.33 (7.87;16.12)	12.85 (9.69;16.11)	2.94 (1.96;13.73)
Obs	4335	3231	1104
Bailed-out banks that REPAID CPP funds	11.70 (9.14;15.51)	14.63 (11.34;15.13)	3.63 (2.11;13.60)
Obs	2360	1732	628
Bailed-out banks that DID NOT REPAY CPP funds	10.81 (9.17;17.40)	15.13 (11.81;16.72)	-0.76 (-2.43;13.47)
Obs	1366	995	371
Growth rate of REML			
All banks	12.08 (8.49;24.45)	15.08 (10.94;24.75)	3.67 (1.74;21.48)
Obs	7935	5849	2086
Bailed out banks	12.37 (8.77;24.49)	15.76 (11.35;24.50)	3.17 (0.53;21.97)
Obs	3686	2693	993
Non-bailed banks	11.84 (8.26;24.42)	14.51 (10.44;24.94)	4.13 (2.36;21.02)
Obs	4249	3156	1093
Bailed-out banks that REPAID CPP funds	12.47 (8.99;24.06)	15.29 (11.26;24.25)	4.76 (2.46;21.75)
Obs	2343	1717	626
Bailed-out banks that DID NOT REPAY CPP funds	12.18 (8.38;25.23)	16.58 (11.58;24.93)	0.47 (-2.35;22.11)
Obs	1343	976	367
Growth rate of CIL			
All banks	11.79 (9.35;30.24)	15.59 (12.30;30.10)	1.40 (0.73;28.77)
Obs	7487	5482	2005
Bailed out banks	11.66 (9.81;27.49)	16.45 (13.20;27.56)	-0.93 (0.09;24.25)
Obs	3554	2575	979
Non-bailed banks	11.90 (8.93;32.58)	14.82 (11.06;32.22)	3.62 (1.41;32.54)
Obs	3933	2907	1026
Bailed-out banks that REPAID CPP funds	12.15 (9.71;25.24)	16.17 (12.77;25.79)	1.29 (1.18;21.26)
Obs	2287	1669	618
Bailed-out banks that DID NOT REPAY CPP funds	10.78 (9.93;31.23)	16.96 (14.29;30.64)	-4.71 (-4.07;28.58)
Obs	1267	906	361

Average annual growth rates (means) are presented in table; median and standard deviation are reported in brackets.
REML stands for Real Estate Mortgage Loans; CIL stands for Commercial and Industrial Loans.

into extended credit offers by banks that did not benefit from the CPP program, as they preferred to keep a substantial part of it for their internal needs.

1.5 Conclusion

The recent financial crisis triggered the development of a whole new strand of the literature. On one hand, it became clear in the wake of the financial crisis that many traditional models did not work properly; on the other hand, the crisis provided new information on the functioning of financial markets and their role in the real economy.

This thesis focuses on several aspects of banking sector performance in the 2007 financial crisis. First of all, the role of the banking sector is analysed via its impact on the real economy. Freezing up of the interbank market and collapse of the asset values led to the debasement of firms' and banks' balance sheets. That adverse financial shock affected differently the firms depending on the degree of their exposure to the credit market, their level of internal capital etc. Chapter 2 investigates the impact of financial shock (i.e. credit crunch) as opposed to the shock on demand expectations on the performances of non-financial firms.

The role of the banking sector during the crisis cannot be fully assessed without taking into account liquidity provisions and other measures that supported the financial sector in 2008–2009. Chapter 3 focuses on the Capital Purchase Program and its fund allocations as well as subsequent fund repayments by the commercial banks. Further, Chapter 4 analyses the bank lending before 2007 and during the crisis. It examines the role of bank fundamentals, CPP funds allocations and their repayment in resuming bank lending in the aftermath of the Capital Purchase Program. Finally, Chapter 5 concludes and provides an overview of related questions for further research.

Chapter 2

Financial versus Demand shocks in stock price returns of U.S. non-financial firms in the crisis of 2007[1]

2.1 Introduction

The financial crisis of 2007–2009 caused global recession that far exceeded the scope of the losses in subprime markets. The banking sector was affected first, when asset prices started to fall, leading to deterioration in financial institutions' balance sheets. Thus, lending standards and margins tightened, causing fire-sales and even more tightening in funding (Acharya *et al.*, 2009; Brunnermeier, 2009). In the same time interbank lending dried up due to the collapse in the banks' confidence in the soundness of other financial institutions (Hagen, 2009). Banks were forced to start hoarding funds even if the creditworthiness of borrowers did not change.

[1] The chapter is based on the published article "Financial versus demand shocks in stock price returns of U.S. non-financial firms in the crisis of 2007," *International Economics*, May 2012, vol.133, pp. 29–49.

This produced a large financial shock on the firms during the crisis, especially on those who relied heavily on external financing (see Duchin *et al.*, 2010 for details). Facing lower demand expectations due to the loss of consumer confidence and the higher costs of external financing, firms had to reduce their production; they suffered decay in their revenues which was anticipated in their stock returns.

To address these issues, investigates the cross-sectional changes in the stock prices of U.S. non-financial firms over nine long and short periods between July 31, 2007 and March 31, 2010. The aim of the chapter is to evaluate the influence of the economic shock on demand expectations and of the credit crunch on these firms. To identify a firm-level cross-section of sensitivities to financial contraction and to the shock on demand expectations, two main groups of measures are used:

1. The sensitivity to liquidity contraction is defined through the Altman's Z-score, Moody's RiskCalc and BondScore model components as well as through the financial constraint index of Whited and Wu (Whited and Wu, 2006). This cross-section is identified separately for each U.S. firm prior to the crisis, in 2006, in order to limit the endogeneity problems.

2. The sensitivity to demand shock is identified in two distinct ways:

   - As an elasticity of firm sales growth to growth in per capita personal income in the state where the company was headquartered in the period between 1990 to 2006;

   - From the response of firms to the terrorist attack of 9/11, which was presumably a demand shock: as firm-level cumulative abnormal returns in the aftermath of the attack and as a median per sector change in log stock returns in the similar period (following Tong and Wei, 2009a and 2009b).

This chapter uses a methodology similar to that of Tong and Wei (2009a,b)), which is based on the CAPM cross-sectional model of stock returns with a standard set of control variables. In this framework the identical model is employed to analyse the stock returns of more than 1000 U.S. non-financial firms over nine different time periods. One of the contributions of this chapter is the inclusion of extended up to March of 2010 time periods and shorter windows of 1–2 months around the particular negative events (the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers) as well as the periods of recovery after the deepest trough in stock market returns in March of 2009.

Empirically, the values prior to the crisis of 2007 are used to construct several indexes that capture heterogenous reactions of non-financial firms to the collapse in product demand and to credit supply shock. Instead of focusing on the Whited and Wu financial constraint indicator, other balance sheet indicators are taken into account to identify the firm financial constraint. Besides, as demand sensitivity index proposed by Tong and Wei (2009a,b) has been criticised for its accuracy, alternative ways to compute the demand sensitivity are suggested. Robustness checks include clustering the error terms by sectors, outlier selection and comparing continuous versus discrete time stock market returns.

Both credit supply shock and contractions in product demand are found to have a negative influence on the stock returns of U.S. firms between July 31, 2007 and March 09, 2009 (i.e. the period in which firms' stock returns were negative). However, both factors had positive or non-significant effects during the recovery period starting from spring 2009. These main conclusions are in line with those of Calomiris *et al.* (2010) who estimated the stock returns of the firms from 44 countries excluding the U.S. in the shorter crisis period (August 2007 through December 2008) and in placebo period prior to crisis (August 2005 through December 2006). Their results also confirm the negative impact of credit supply shock, collapse of global demand (measured through the firm's exposure to decline in global trade) and selling pressures in the equity market on stock returns during the crisis which is not detected for placebo period prior to crisis.

I also find that the demand sensitivity index of Tong and Wei has the greatest explicative power compared with alternative indexes. It is also found to be positively correlated with the elasticity of firm net sales to income, another proxy of sensitivity to shock on demand expectations, which confirms the correct intuition of the index.

Quantitatively Altman's Z-zone indicator is more important than the shock on demand expectations index (computed from the firm reaction to the terrorist attack of 2001) in explaining the stock price performance in almost all the studied periods. Firms that were more vulnerable to demand contraction and more financially fragile (i.e. those with smaller Z-scores or classified into a more distressed zone according to the score) before the crisis experienced a larger reduction in the values of their stocks during it.

Both the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers were characterised by liquidity contractions (financially fragile firms were affected the most) as well as the negative tendency of the whole market and its high volatility. These results confirm those of Calomiris *et al.* (2010) and Giovane *et al.* (2010), while they also show that for both events the major consequence was a contraction in credit supply rather than a collapse in product demand.

Contraction in product demand and credit supply shock had a positive or insignificant influence on the equity prices of U.S. firms observed in the periods following spring of 2009. Here the periods of recovery could be thought of as placebo period from Calomiris *et al.* (2010) as on average there was no decline in equity prices. Financial conditions improved since March of 2009 in a way that more financially distressed firms prior to crisis were performing as well as the other firms. In the first month and quarter of the recovery in stock returns it was improvement in demand expectations that had a positive impact on firm's equity returns. However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009–2010 and the aggregate demand remained week (Feldstein, 2009). It can be also the reason why more profitable firms before the crisis had more problems to recover after the crisis.

This chapter contributes to the existing literature on the aftermath of the crisis and channels through which the crisis affected the real economy. It is focusing on the U.S.

market that was in the epicentre of the crisis of 2007. The liquidity contraction in the banking sector and transmission of the crisis to the other sectors is the topic widely discussed in the literature. Ivashina and Scharfstein (2010) confirm the decline in new bank loans to large borrowers by 49% during the peak period of the financial crisis relative to prior quarter and by 79% relative to the peak of credit boom (second quarter of 2007). Cornett *et al.* (2011) and Giovane *et al.* (2010) verify the link between drying up of liquidity and decline in credit supply, and find out that financially fragile non-financial firms should have been affected the most.

The effect of financial contraction on real corporate policies is assessed in the paper by Almeida *et al.* (2009). They report that the firms whose long-term debt was largely maturing right after the third quarter of 2007 reduced investment by 2.5% more than otherwise similar firms whose debt was maturing well after crisis. The effects of volatility or, more precisely, innovations in aggregate volatility on expected returns of all the stocks traded on AMEX, NASDAQ and NYSE are analysed in the paper by Ang *et al.* (2004). They report that stocks with high sensitivity to innovations in aggregate volatility and high idiosyncratic volatility have lower average returns. These low average returns to stock cannot be explained by size, book-to-market ratio, momentum, liquidity effects and other characteristics.

The rest of the chapter is structured as follows. Section 2.2 reviews the theoretical background on stock returns' evaluation and presents the estimation methodology adopted in the chapter. Section 2.3 introduces the data, describes different time windows for stock returns and the construction of explanatory variables. Empirical results for cross-section estimations of the determinants of the U.S. non-financial firms stock returns in the large and small windows are presented in 2.4. Section 2.5 concludes.

2.2 Theoretical background and model specification

The profits of the firm have a direct positive impact on return on assets and return on shareholders' equity. These last two measures of the firm's level of profitability are equal to each other in case the firm does not possess any debt. However, return on equity increases with the firm's debt and becomes larger than the return on assets if the latter one exceeds the rate of interest on the debt repayments. On the other side, the net return to the shareholders comprises current dividends and capital appreciation that should be equal to the required by shareholders rate of return according to the following arbitrage condition:

$$\frac{[E_t(q_{i,t+1}) - q_{i,t}] + E_t(d_{i,t+1})}{q_{i,t}} = r_{i,t}. \tag{2.2.1}$$

Here $q_{i,t}$ represents the asset price of the firm i at the end of the period t; $d_{i,t+1}$ - are the expected dividends of the firms paid at period *t+1*; $r_{i,t}$ is the required rate of return by firm's shareholders.

Solving equation 2.2.1 using forward iteration implies that fundamental value of an asset is the present discounted value of expected future earnings:

$$q_{i,t} = E_t\left[\sum_{j=1}^{k}(\frac{1}{1+r_{i,j}})^j d_{i,t+j}\right]. \tag{2.2.2}$$

In this paper the cross-sectional changes in stock returns are examined for U.S. non-financial firms. One of the most prominent asset pricing single factor models is the Capital Asset Pricing Model (CAPM) developed by Sharpe (1985), Lintner (1965), and Mossin (1966). It requires the risk premium on any asset to be equal to the sum of the stock's expected return if the market's excess return is zero, the component of the return due to movements in market index and the firm specific component:

$$\Delta \ln(q_{i,t}) - r_f = \alpha_{i,t} + Beta_i\,[\Delta \ln(q_{M,t}) - r_f] + \epsilon_{i,t}, \tag{2.2.3}$$

where $\Delta \ln(q_{i,t})$ is the change in stock prices (measured through natural logarithms) over several large and small windows; $\Delta \ln(q_{M,t})$ is the change in stock market returns measured through Standard and Poor's 500 (under the hypothesis that the stock market index $q_{M,t}$ represents a correct measure of the macroeconomic risk); r_f represents the risk-free rate of return; $\epsilon_{i,t}$ are the firm specific error terms, non-correlated neither with systematic risk nor with the risk specific to another enterprise.

CAPM was augmented by additional factors. Rosenberg *et al.* (1985) and Chan *et al.* (1991) found the evidence of significance of the ratio of a firm's book value to market value for the cross-section of equity returns (in the United States and Japan, respectively). Fama and French (1993) introduced in their three-factor model both book-to-market values and firm size. Besides, a strong positive relationship was found between common stock returns and earning to price ratio of the NYSE firms in Basu (1983).

Another way of CAPM extension was the idea to introduce time-varying betas conditional on currently available information. Ferson and Harvey (1993) explained stock returns across world stock markets with conditional betas depending on local information variables (dividend yields, short-term interest rates, yield spread of low-risk bonds) and global risk premia depending on global variables. Jagannathan and Wang (1996) also used a conditional beta model and found out that the market risk premium on equities is a function of the corporate bond credit spread. In the present paper financial constraint as well as demand sensitivity characteristics is considered besides the rate of return on the stock market and the individual $Beta_i$ in the following cross-sectional regression:

$$\begin{aligned}\Delta \ln(q_{i,t}) &= \alpha_0 + \beta_1 Beta_{i,2001-2006} + \beta_2 BC_{i,2006} + \beta_3 SDS_{i,1990-2006} + \\ &+ \beta_4 \Delta \ln(q_{i,t-1}) + \beta_5 \frac{Book}{Market}_{i,2006} + \epsilon_s + \epsilon_{i,t}.\end{aligned} \tag{2.2.4}$$

$BC_{i,2006}$ are the balance sheet indicators that define the probability of firm's default: Altman's Z-score, inputs for Moody's RiskCalc and BondScore models.

$SDS_{i,1990-2006}$ are sensitivity to demand shock indexes that include several measures. First one is defined as elasticity of net sales growth to the growth in per capita personal income in the state where the company was headquartered during 1990-2006 period prior to financial crisis (another possibility is to measure sensitivity of firm net sales to GDP growth of the country). The second measure is cumulative abnormal stock price returns in the aftermath of the terrorist attack of 2001 and the third one is $\Delta \ln(q_{i,10sept'01-21sept'01})_s$ - a median per sector (191 sectors in total) of stock price reaction to the same event (following Tong and Wei, 2009a,b).

Besides $Beta_i$ two other control variables are included in the model: $\Delta \ln(q_{i,t-1})$ is the autoregressive component for the period of the same length but prior to the examined window of stock returns; $\frac{Book}{Market}_{i,2006}$ is book-to-market equity ratio of the firm (following Fama and French three-factor model); ϵ_s are the sectoral error terms (errors terms clustered by 191 sectors), $\epsilon_{i,t}$ are individual firm error terms.

2.3 Data and summary statistics

2.3.1 Data sources

The data set is composed of stock prices of 1058 U.S. firms (traded at the New York Stock Exchange) collected from Datastream and firms' balance sheet information from Compustat during 2007-2009. The choice of the country of interest is justified by the fact that the financial crisis originated in the United States (see the Appendix A for the sample selection). The sample used by Tong and Wei (2009b) is larger, it contains 2789 firms. The sample is different due to the merge of data sets from two sources (Datastream and Compustat), differences in the company names and in outlier selection procedures (see details in Appendix A).

2.3.2 Dependent variable: different time windows for stock returns

The key idea of this chapter is to examine changes in firms' stock prices over nine periods: four large windows (where the first one is similar to the window studied in Tong and Wei, 2009b and, thus, will be further referred to as the TW period), two small windows following the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers and three small windows when the recovery in stock indexes has begun in the markets.

In the large windows the start date is set on July 31, 2007 following the collapse on June 20, 2007 of two highly levered Bear Stearns-managed hedge funds that invested in subprime asset-backed securities (see Acharya and Richardson, 2009 for details). This collapse was triggered by the prices in the housing market that have stopped appreciating since 2006. Mortgage refinancing was replaced by rising mortgage defaults in subprime sector which led to the fall in the prices of collateralised debt obligations, fire sales and even faster declining value of assets.

Bear Stearns hedge funds were shuttered the following month. The credit spreads on all kind of investment bonds started to rise, and in the beginning of August, 2007 financial crisis started to be discussed worldwide and completed by the run on BNP Paribas structured investment vehicles on August 09, 2007.

The end of each period is determined through graphical analysis (figure 2.3.1) and identified as a date of the trough in stock prices including the largest market failures as during the near-collapse of Bear Stearns (week of March 10, 2008) and the bankruptcy of Lehman Brothers (September 15, 2008).

Bear Stearns was the fifth-largest investment bank in the U.S. with the most leverage and highly exposed to the subprime mortgage market (Acharya and Richardson, 2009). The fall of Bear Stearns is also called a "rescue" or a "near-collapse" as the bank was finally purchased by JPMorgan Chase with government guarantee of $29 billion of subprime securities. The government has considered a bank to be "too big to fail" and to carry a large systemic risk. Thus, even though the near-collapse of Bear Stearns has had a negative impact on the market, it was considerably less than in the case of Lehman Brothers bankruptcy. The mean stock price decline is 8.5 times smaller than that in the case of Lehman Brothers (-0.07 relative to -0.59, table 2.1). Besides, high values of standard deviations imply some evidence of excessive cross-sectional volatility in the stock returns.

Table 2.1: The summary statistics of changes in stock returns for U.S. non-financial firms

Period	Variable	Name	Obs	Mean	SD	Min	Max
	TW window						
TW	Change in stock prices (July 31, 2007 – March 17, 2008)	$\Delta \ln(q_{i,TW})$	1025	-0.26	0.34	-1.60	0.53
	Autoregressive component TW (December 15, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,TW-1})$	1025	0	1	-2.96	3.56
	Large windows						
LW1	Change in stock prices (July 31, 2007 – October 27, 2008)	$\Delta \ln(q_{i,t1})$	1022	-0.8	0.6	-3.46	0.35
	Autoregressive component 1 (April 28, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,t1-1})$	1022	0	1	-2.6	3.87
LW2	Change in stock prices (July 31, 2007 – December 01, 2008)	$\Delta \ln(q_{i,t1})$	1022	-0.94	0.7	-3.61	0.39
	Autoregressive component 2 (March 28, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,t2-1})$	1022	0	1	-2.6	3.87
LW3	Change in stock prices (July 31, 2007 – March 09, 2009)	$\Delta \ln(q_{i,t3})$	1020	-1.19	0.85	-4.6	0.22
	Autoregressive component 3 (December 31, 2005 – July 31,2007), standardised	$\Delta \ln(q_{i,t3-1})$	1020	0	1	-2.84	3.5
	Small windows						
SW1	Change in stock prices (February 17, 2008 – March 17, 2008) – The **Bear Stearns** near-collapse	$\Delta \ln(q_{i,t4})$	1031	-0.07	0.11	-0.43	0.23

Continued on next page

Table 2.1 – *Continued from previous page*

Period	Variable	Name	Obs	Mean	SD	Min	Max
	Autoregressive component 4 (January 17, 2008 – February 17,2008), standardised	$\Delta\ln(q_{i,t4-1})$	1030	0	1	-4.41	3.61
SW2	Change in stock prices (September 11, 2008 – October 27, 2008) – The **Lehman Brothers** failure	$\Delta\ln(q_{i,t5})$	1019	-0.59	0.32	-1.79	0.043
	Autoregressive component 5 (July 26, 2008 – September 11, 2008), standardised	$\Delta\ln(q_{i,t5-1})$	1019	0	1	-2.49	3.80
	Recovery in stock prices						
RW1	Change in stock prices (March 09, 2009 – April 09, 2009) - the first month of positive growth	$\Delta\ln(q_{i,t6})$	1011	0.34	0.22	-0.29	1.18
	Autoregressive component 6 (February 09, 2009 – March 09, 2009), standardised	$\Delta\ln(q_{i,t6-1})$	1011	0	1	-2.33	3.57
RW2	Change in stock prices (March 09, 2009 – June 30, 2009)- the first quarter of positive growth	$\Delta\ln(q_{i,t7})$	1023	0.44	0.84	-9.48	7.6
	Autoregressive component 7 (November 10, 2008 – March 09, 2009), standardised	$\Delta\ln(q_{i,t7-1})$	1023	0	1	-3.53	3.66
RW3	Change in stock prices (January 01, 2010 – March 31, 2010)	$\Delta\ln(q_{i,t8})$	1025	0.09	0.2	-1.77	1.69
	Autoregressive component 8 (October 01, 2009 – January 01, 2010), standardised	$\Delta\ln(q_{i,t8-1})$	1025	0	1	-3.39	2.78

Lehman Brothers also contained a large systemic risk. The fact that Lehman Brothers did not receive liquidity from the Treasury[2] (at least immediately) could mean that other investment banks were at risk as well. The ”tail” risk has realised, most of financial institutions were heavily exposed to it and without Treasury’s support the whole financial system of the U.S. was in danger. More than 90% of U.S. non-financial firms have experienced a fall in their stock prices in the period between July 31, 2007 and October 27, 2008. At the same period U.S. government had to bail out AIG (American International Group), a well known insurance company heavily exposed to financial sector, and prepare a bail out plan for other financial institutions.

Figure 2.3.1: S&P 500 composite index displayed on a logarithmic scale from January 1, 2007 to October 1, 2010

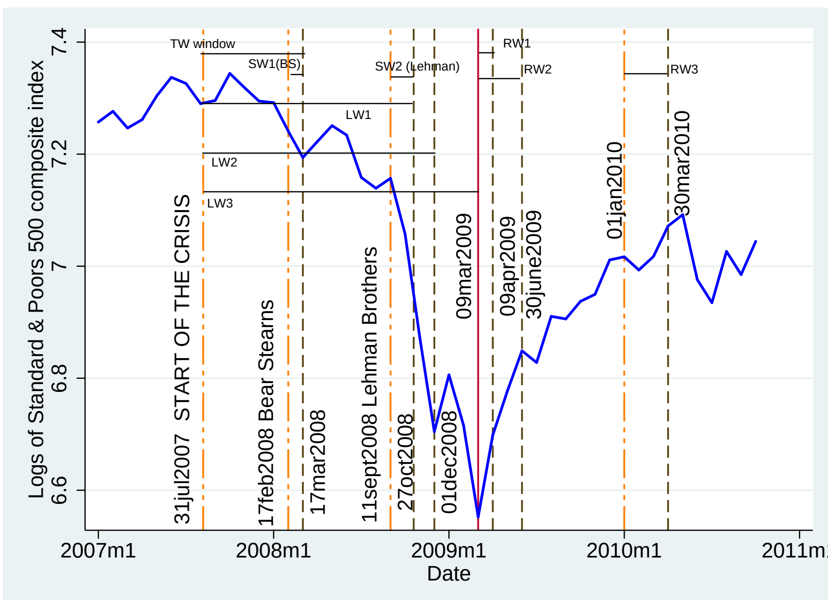


Figure 2.3.1 plots the S&P 500 composite index displayed on a logarithmic scale, the slope of the curve measuring the monthly rate of growth during the period from January 1, 2007 to October 1, 2010. The index points out several periods when stock market lost much of its value: on March 17, 2008, on October 27, 2008, on December 01, 2008, and reached its lowest point on March 09, 2009. The start dates in small windows are taken month or month and a half before the trough dates.

[2]Later the Treasury drastically expanded it role as a lender of last resort (LOLR)

After March 09, 2009 a slow recovery begins, expansionist and non-conventional monetary policies having their effect on the stock market. There is a mean increase in stock returns of 0.34 during the first month (RW1), 0.44 during the first quarter of recovery (RW2) and 0.09 during the first quarter of 2010 (RW3). In the beginning of 2010 firm stock returns stabilise and almost do not rise which is the consequence of the sluggish economic growth.

Large windows

- **TW window** [$\Delta\ln(q_{i,TW})$] July 31, 2007 until March 17, 2008 - after the fall of Bear Stearns - duration of 7,5 months (TW window is of similar length to the one examined by Tong and Wei (2009b)).
- **LW1** [$\Delta\ln(q_{i,t1})$] July 31, 2007 until October 27, 2008 - after the fall of Lehman Brothers - duration of 15 months.
- **LW2** [$\Delta\ln(q_{i,t2})$] July 31, 2007 until December 01, 2008 - end of the ”crisis” year - duration of 17 months.
- **LW3** [$\Delta\ln(q_{i,t3})$] July 31, 2007 until March 09, 2009 - the largest drop in stock price returns during 2007–2010 - duration of 19 months.

Small windows

- **SW1** [$\Delta\ln(q_{i,t4})$] February 17, 2008 until March 17, 2008 - 1 month gap (Bear Stearns fall).
- **SW2** [$\Delta\ln(q_{i,t5})$] September 11, 2008 until October 27, 2008 - 1,5 month gap (Lehman Brothers collapse).

Recovery in stock prices windows

- **RW1** [$\Delta\ln(q_{i,t6})$] March 09, 2009 until April 09, 2009 - 1 month gap (first month of recovery).

- **RW2** [$\Delta \ln(q_{i,t7})$] March 09, 2009 until June 30, 2009 - 3 months gap (first quarter of recovery).

- **RW3** [$\Delta \ln(q_{i,t8})$] January 01, 2010 until March 31, 2010 - 3 months gap (first quarter of 2010).

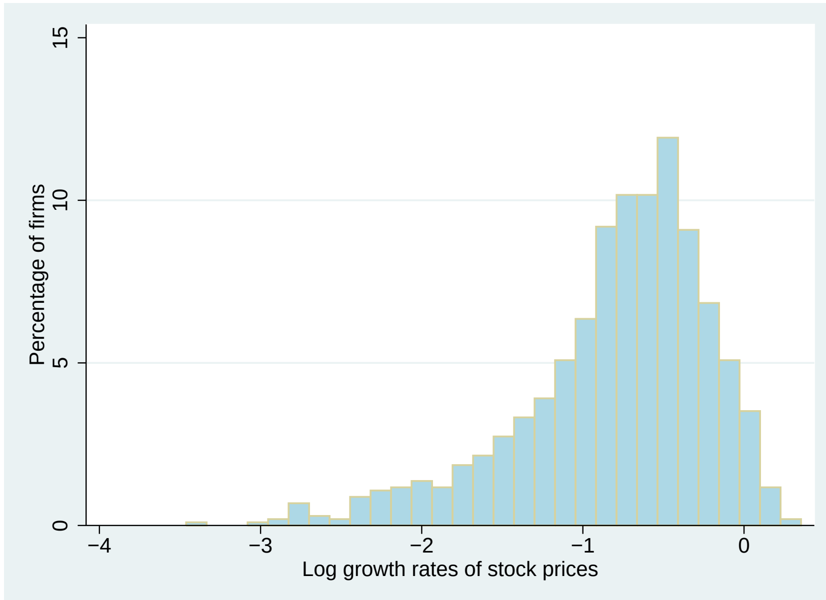
Besides, the autoregressive components are calculated separately for each of the analysed windows in order to capture persistence: they are computed as a difference in stock prices in the period of the same length but prior to the examined period. The value at the end of the period is always deducted from the value at the beginning of the period, the interpretation of the variable is the next one: the higher is the value of the autoregressive component, the larger was the fall in stock returns of the firm during the analysed past period (in case of falling stock prices) or the smaller was the stock price growth (in case of increasing stock prices). That allows to explain a higher value of the component as a worse past performance of the firm stock prices.

2.3.3 Descriptive statistics

Descriptive statistics for changes in stock returns are presented in table 2.1.

Statistics show that the means of the stock return cross-sections are negative in large and small windows before March 09, 2009 (standard deviations are in brackets): in the TW window -0.26 (0.34); in the large windows -0.8 (0.6); -0.94 (0.7); -1.19 (0.85). For the small windows, it emphasizes a negative impact of the Lehman Brothers failure, when the mean stock price decline is 8.5 times larger than that in the case of Bear Stearns (-0.59 (0.32) relative to -0.07 (0.11)). Besides, high values of standard deviations imply some evidence of excessive cross-sectional volatility in the stock returns. Finally, the recovery after the deepest point of the crisis (March 09, 2009)leads to a mean increase in the stock returns of 0.34 (0.22) during the first month (RW1), 0.44 (0.84) during the first quarter of recovery (RW2) and 0.09 (0.2) during the first quarter of 2010 (RW3). Thus, the growth rate of stock

Figure 2.3.2: Distribution of log growth rates of stock prices in the LW1 (July 31, 2007 to Oct 27, 2008) for U.S. non-financial firms



prices is the highest in the first month of recovery (March 09, 2009 until April 09, 2009) while in the next two months it slows down. In the beginning of 2010 firm stock returns stabilise and almost do not rise which is the consequence of the sluggish economic growth.

Figure 2.3.2 shows the distribution of changes in stock returns among U.S. non-financial firms in the period from July 31, 2007 to October 27, 2008. That period is marked with both Bear Stearns and Lehman Brothers failures. As can be seen, more than 90% of U.S. non-financial firms have experienced a fall in their stock prices and it was not only the case for the U.S.

Figure 2.3.3 and figure 2.3.4 demonstrate respectively the distribution of changes in stock prices when measured in terms of the discrete growth rates $\frac{q_{i,t}-q_{i,t-1}}{q_{i,t-1}}$, and when 5% of observations are removed from both sides of the log growth rates distribution. The distribution of the discrete growth rates is closer to the normal than that of the log growth rates. Removing extreme observations from the distribution of the log growth rates makes it less skewed to the left, however, the distribution looks a little 'cut' from the right side.

Figure 2.3.3: Distribution of discrete growth rates of stock prices in the LW1 (July 31, 2007 to Oct 27, 2008) for U.S. non-financial firms

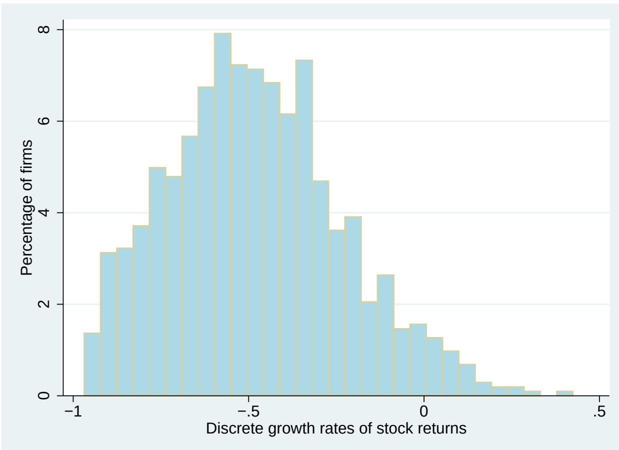
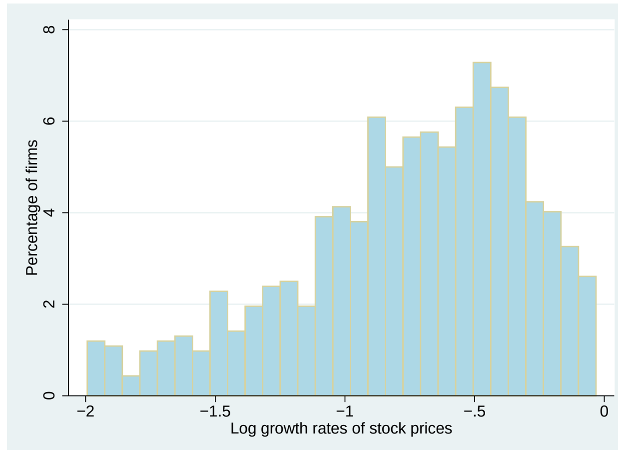


Figure 2.3.4: Distribution of log growth rates of firm stock prices with removed 5th and 95th percentiles in the LW1 (July 31, 2007 to Oct 27, 2008) for U.S. non-financial firms



2.3.4 Balance sheet characteristics

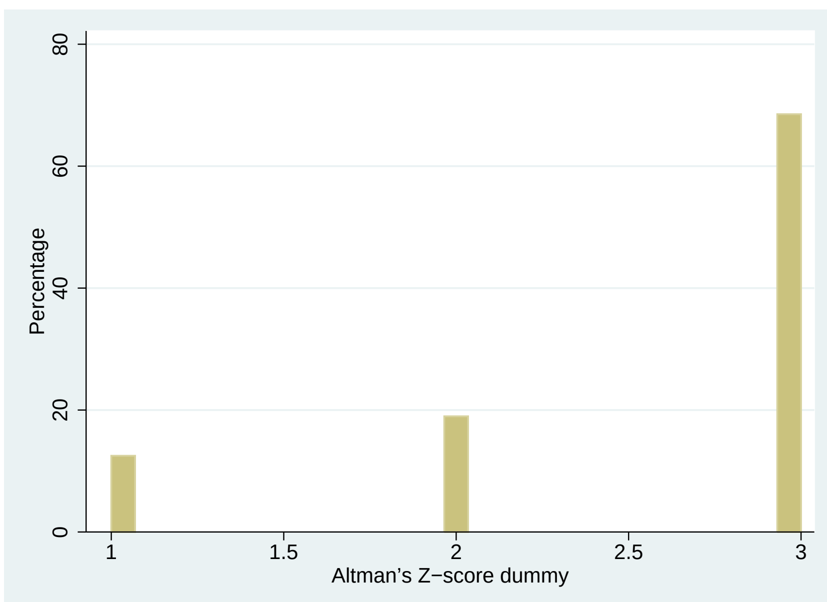
The question of the impact of various frictions in financial markets on financial constraint of the firms is well investigated in the corporate finance and investment literature (Chatelain, 2000). To assess the role of financial constraints in firms' activities, some indexes were proposed: investment cash-flow sensitivities (Fazzari *et al.*, 1988), Kaplan and Zingales (1997) and Rajan and Zingales (1998) indexes of constraints, Whited and Wu index of constraints (Whited and Wu, 2006). Chatelain (2000) shows that such measures of financial constraints may be misspecified, however, he mostly agrees on the choice of the financial constraint determinants by Whited (1992).

Such indexes of financial constraints are also related to 'scoring' indicators measuring the probability of default such as Altman's Z-score (Altman, 1968) as well as the more recent Moody's RiskCalc quantitative default prediction model (Dwyer *et al.*, 2004) that are also based on balance sheet characteristics of the firm. Altman's Z-score (referred to as Z in tables, Altman, 1968) is a well-known weighted indicator of corporate financial fragility that classifies companies from financially distressed to financially stable ones using five financial ratios (see details in Appendix B.1). Besides, an additional Altman's Z-zone (referred to as ZZ in tables) indicator is constructed which it takes values 1, 2 or 3 depending on the "zone of discrimination":

- if $Z - score > 2.99$ – "Safe" Zone and Altman's Z-zone is 3;
- if $1.80 < Z - score < 2.99$ – "Grey" Zone and Altman's Z-zone is 2;
- if $Z - score < 1.80$ –"Distress" Zone and Altman's Z-zone is 1.

The relative distribution of that variable is shown in figure 2.3.5. More than 60% of the firms are found to be "safe" according to the Z-score computed for 2006, around 20% are classified as being in "grey" zone, and around 15% are distressed.

Figure 2.3.5: The percentage distribution of Altman's Z-score dummy calculated for 2006 for U.S. non-financial firms



More recent Moody's KMV RiskCalc V3.1 (Dwyer *et al.*, 2004) is the Moody's rating agency model for predicting probability of the bank default. It comprises financial statement variables and equity market information on the bank's prospects and business risk. Financial ratios are classified in one of the next groups: capital structure, profitability, asset concentration, liquidity and asset quality. The weight of each variable is then calculated using non-parametric techniques and the estimated default frequency is computed for each bank. The list of financial statement variables used in RiskCalc V3.1 U.S. is presented in table 2.2 together with summary description.

As expected default frequency measures as well as the formula for computing them are not available in public access, the input variables of Moody's model are plugged directly in the regressions (taking into account multicollinearity issues with indicators from other models). Some exact ratios that are proposed by Moody's model were not available on Datastream, thus, proxies for these variables and ratios have been used.

Variables from this model that are expected to increase the firm default risk are those that have a negative impact on the firm's performance and enlarge the firm's loses during the crisis.

BondScore Credit Model is another model that calculates credit risks for all U.S. non-financial corporations with total assets in excess of $250 millions and publicly traded equity. The model's output is a one year default probability estimate called Credit Risk Estimate (CRE). BondScore uses Altman-type and Merton-type financial ratios [3] BondScore Model inputs are described in table 2.2.

Table 2.2: Summary of balance sheet characteristics used to identify the financial constraints for U.S. non-financial firms

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Altman's Z-score						
$\frac{CurrentAssets_{2006} - CurrentLiabilities_{2006}}{TotalAssets_{2006}}$	X_1	1025	0.28	0.21	-0.09	0.8
$\frac{RetainedEarnings_{2006}}{TotalAssets_{2006}}$	X_2	1025	0.11	0.7	-2.99	0.93
$\frac{EBIT_{2006}}{TotalAssets_{2006}}$	X_3	1025	0.09	0.09	-0.17	0.30
$\frac{MarketValueofEquity_{2006}}{TotalLiabilities_{2006}}$	X_4	1025	0	0.98	-1.93	1.90

Continued on next page

[3]The model proposed by Merton (1973) estimates probability of default (when the market value of the firm's assets falls below a certain level) through the firm's future assets value which is characterised by its expected value and standard deviation. The greater the value of the firm, and the smaller its volatility, the lower is the probability of default.

Table 2.2 – *Continued from previous page*

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
$\frac{Sales_{2006}}{TotalAssets_{2006}}$	X_5	1025	1.15	0.83	0	7
Z-score	Z	1025	1.19	1.43	-2.10	5.4
Z-zone	ZZ	1025	2.56	0.7	1	3
Z-zone, standardised	ZZ	1025	0	1	-2.21	0.62
Moody's RiskCalc U.S.						
$\frac{LongTermDebt_{2006}}{LTD+NetWorth_{2006}}$, standardised	L_1	1025	0	1	-1.23	3.80
$\frac{RetainedEarnings_{2006}}{CurrentLiabilities_{2006}}$, winsorised at 1%level, standardised	L_2	1025	0	1	-3.47	1.69
$RetOnAssets_{2006}$, winsorised at 1%level, standardised	P_1	1025	0	1	-3.28	2.58
$\Delta RetOnAssets_{'04-'06}$, winsorised at 1%level, standardised	P_2	1025	0	1	-2.71	3.66
$\frac{CashFlow_{2006}}{InterestExpense_{2006}}$, winsorised at 3%level, standardised	DC	1025	0	1	-0.64	3.47
$\frac{CashMarketSec_{2006}}{TotalAssets_{2006}}$, winsorised at 1%level, standardised	Liq	1025	0	1	-0.94	3.00
$\frac{Inventories_{2006}}{Sales_{2006}}$, winsorised at 1%level, standardised	A_1	1025	0	1	-1.22	3.5
$\Delta \frac{AccountRec}{Sales}_{'04-'06}$, winsorised at 1%level, standardised	A_2	1025	0	1	-2.85	3.5
$\frac{CurrentLiabilities_{2006}}{Sales_{2006}}$, winsorised at 1%level, standardised	A_3	1025	0	1	-1.36	3.6
$SalesGrowth_{2006}$, winsorised at 1%level, standardised	G	1025	0	1	-2.6	3.52
$Size_{2006}$, winsorised at 1%level, standardised	S	1025	0	1	-2.45	2.23
BondScore U.S.						
$\frac{EBITDA_{2006}}{Sales_{2006}}$, winsorised at 2%level, standardised	EM	1025	0	1	-3.45	2.62

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Table 2.2 – *Continued from previous page*

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
$\frac{Sales_{2006}}{TotalAssets_{2006}}$, winsorised at 1%level, standardised	AT	1025	0	1	-1.36	3.54
$\frac{Debt_{2006}}{MarketCap+BookValueDebt_{2006}}$, winsorised at 1%level, standardised	L	1025	0	1	-1.09	2.88
$QuickRatio_{2006}$, winsorised at 1%level, standardised	QR	1025	0	1	-0.93	3.63
$Volatility_{2006}$, standardised	Vol	1025	0	1	-1.98	3.37
Whited and Wu index						
WW_{2006}, winsorised at 1%level, standardised	WW	1025	0	1	-2.33	2.5

Whited and Wu index identifies financial constraint for each firm individually depending on the next financial characteristics: ratio of cash flows to assets, dummy that shows if the dividend was paid, ratio of long-term debt to total assets, firm size, firm growth and 3-digit industry growth (see Appendix B.1 for details).

Table 3.2 reports the correlation coefficients between explanatory financial statement variables associated with firm financial constraint. Altman's Z-score includes similar indicators as those used in Moody's RiskCalc model that is confirmed by the correlation coefficients (0.3 between Z-score and retained earnings to current liabilities ratio; -0.41 between Z-score and ratio of current liabilities to sales). In general, Z-score is higher when long-term debt and current liabilities of the firm are lower. BondScore indicators are also correlated with Z-score (negatively with leverage and positively with asset turnover), however, quick ratio and volatility of stock returns seem to carry a different information about the firm than Z-score (correlation is 0.09 and 0.08 respectively).

Higher share of retained earnings, return on assets and liquidity are associated with smaller loses of non-financial firms during the crisis. Higher leverage indicates a greater decline in stock prices of the firms. These conclusions are in line with assumptions from probability of default models.

In most of the windows correlation between firm stock returns and Z-zone index is larger than that between stock returns and Z-score indicator (0.24 and 0.15 respectively in LW3 period, table 2.4). In its absolute value it is similar to the correlation between firms' stock returns and sensitivity to demand shock measured through the reaction of firm stock prices to the terrorist attack of 2001 (it reaches 0.28 in RW1 period).

Everything else being equal, more financially fragile non-financial firms are expected to exhibit greater loses during the crisis. Thus, periods in which such firms are significantly affected can be characterised by scarcity of the sources of external financing. By construction, all the variables are taken at the end of 2006, which helps to avoid the endogeneity problem.

2.3.5 Sensitivity to the shock on demand expectations

Among several shocks that affected the real economy during the crisis of 2007 the collapse of global demand plays an important role [4]. However, the reaction or, in other words, sensitivity to this contraction of product demand varies from one firm to another.

In order to capture the heterogenous reactions of non-financial U.S. firms to demand shocks or, more precisely, shock on demand expectations, several individual firm indexes are constructed (table 2.5).

First measure is the elasticity of firm sales growth to growth in per capita personal income in the state where the company was headquartered in the period between 1990 and 2006. The idea beyond the index is to estimate the impact of an increase in per capita income on net sales of the firm during 16 years prior to crisis (see Appendix B.2 for details). As per capita income directly affects the demand, this coefficient can be interpreted as a sensitivity of the firm to changes in demand expectations. As an alternative, the sensitivity of net sales to changes in GDP is estimated during the same period.

[4] The contraction of credit supply and selling pressure on firm's equity being the other "shock factors" according to Calomiris *et al.* (2010).

Table 2.3: Correlation among explanatory balance sheet and control variables for U.S. non-financial firms

Model	Var	Z	ZZ	L_1	L_2	P_1	P_2	DC	Liq	A_1	A_2	A_3	G	S	EM	AT	L	QR	Vol	WW	AR_{TW}	B	$\frac{B}{M}$
Altman's Z-score	Z	1.00																					
Altman's Z-zone	ZZ	0.61	1.00																				
Moody's	L_1	-0.47	-0.54	1.00																			
RiskCalc	L_2	0.29	0.25	-0.13	1.00																		
	P_1	0.40	0.29	-0.19	0.11	1.00																	
	P_2	-0.01	0.03	-0.02	-0.08	0.35	1.00																
	DC	-0.20	-0.36	0.44	-0.05	-0.06	0.04	1.00															
	Liq	0.47	0.27	-0.32	-0.05	0.24	0.03	-0.19	1.00														
	A_1	0.00	0.12	-0.11	0.03	-0.10	-0.04	-0.14	0.00	1.00													
	A_2	-0.11	-0.04	0.05	-0.08	-0.09	-0.03	-0.11	-0.04	0.00	1.00												
	A_3	-0.18	-0.14	0.07	-0.21	-0.09	-0.04	0.16	0.14	0.05	0.20	1.00											
	G	0.10	0.05	-0.04	-0.03	0.13	0.05	-0.03	0.11	-0.03	-0.32	0.04	1.00										
	S	-0.18	-0.16	0.29	0.06	-0.05	0.00	0.62	-0.08	-0.10	-0.06	0.25	0.04	1.00									
Bond	EM	0.25	0.10	0.00	0.28	0.20	0.02	0.14	0.15	-0.17	-0.01	0.30	0.17	0.16	1.00								
Score	AT	0.03	0.26	-0.10	-0.12	0.16	0.04	-0.14	-0.11	-0.08	-0.05	-0.43	-0.05	-0.16	-0.56	1.00							
	L	-0.50	-0.51	**0.96**	-0.15	-0.20	-0.05	0.41	-0.36	-0.09	0.05	0.15	-0.04	0.29	-0.02	-0.07	1.00						
	QR	0.53	0.16	-0.28	0.16	0.16	0.03	-0.24	0.69	0.00	-0.05	-0.15	0.11	-0.24	0.25	-0.26	-0.33	1.00					
	Vol	0.12	0.03	-0.11	-0.41	0.12	0.09	-0.23	0.36	0.02	0.06	0.05	0.18	-0.38	-0.10	0.12	-0.13	0.25	1.00				
Whited and Wu	WW	0.15	0.11	-0.24	-0.15	0.00	0.02	-0.58	0.16	0.11	0.07	-0.16	0.04	**-0.93**	-0.16	0.09	-0.25	0.28	0.52	1.00			
Control	AR_{TW}	0.00	0.03	0.00	0.07	-0.04	-0.09	0.00	-0.13	0.03	0.00	-0.06	-0.09	0.03	0.05	-0.01	0.01	-0.08	-0.11	-0.07	1.00		
var-s	B	-0.16	-0.14	0.07	-0.09	-0.04	0.03	0.06	-0.05	0.04	0.00	0.07	0.13	0.16	-0.12	-0.08	0.07	-0.09	0.12	-0.10	-0.08	1.00	
	$\frac{B}{M}$	-0.14	-0.09	-0.09	0.03	-0.25	-0.05	-0.11	-0.08	0.13	0.03	-0.11	0.00	-0.20	-0.11	0.06	-0.08	0.00	0.07	0.19	0.13	0.00	1.00

All financial ratios are calculated for 2006. The growth rates are calculated for the period between 2004 and 2006.

AR_{TW} is the autoregressive component from TW period $\Delta \ln(q_{i,TW-1})$; B stands for beta; $\frac{B}{M}$ stands for book-to-market ratio.

Correlation coefficients larger than 0.8 in their absolute values are highlighted in bold.

Table 2.4: Simple correlation with dependent variables over nine periods for U.S. non-financial firms

Group of Var	Var	Large windows				Small windows		Recovery in stock prices windows		
		TW window	LW1	LW2	LW3	SW1	SW2	RW1	RW2	RW3
Altman's Z-score	Z	0.07	0.14	0.15	0.15	0.12	0.15	-0.03	-0.05	-0.08
Altman's Z-zone	ZZ	0.08	0.20	0.21	0.24	0.13	0.17	-0.06	-0.07	-0.16
Moody's RiskCalc	L_1	-0.05	-0.13	-0.12	-0.15	-0.14	-0.09	-0.10	0.06	0.04
	L_2	0.12	0.17	0.18	0.17	0.13	0.14	-0.07	-0.15	-0.12
	P_1	0.15	0.13	0.12	0.20	0.06	0.06	-0.14	-0.08	-0.11
	P_2	0.07	0.04	0.05	0.07	0.11	-0.04	-0.03	-0.01	0.04
	DC	0.02	-0.05	-0.02	-0.02	-0.04	-0.04	0.00	-0.01	-0.04
	Liq	0.05	0.09	0.10	0.15	0.02	0.07	-0.09	-0.11	-0.12
	A_1	-0.06	0.00	-0.01	0.00	0.05	0.00	0.06	-0.02	0.15
	A_2	0.03	-0.01	-0.02	0.00	-0.05	-0.05	0.00	0.06	0.03
	A_3	0.05	-0.02	0.00	0.00	-0.02	-0.08	-0.04	0.00	-0.04
	G	0.02	-0.02	0.00	0.00	-0.03	-0.09	-0.08	-0.09	-0.03
	S	0.06	0.00	0.05	0.08	-0.01	-0.09	0.02	-0.08	-0.08
Bond Score	EM	0.08	0.13	0.13	0.17	0.00	0.08	-0.10	-0.07	-0.22
	AT	-0.04	-0.02	0.01	0.03	0.02	0.05	0.03	0.03	0.06
	L	-0.06	-0.15	-0.13	-0.16	-0.10	-0.10	0.07	0.08	0.04
	QR	0.05	0.12	0.10	0.11	0.10	0.11	-0.14	-0.01	-0.17
	Vol	-0.22	-0.25	-0.28	-0.21	-0.15	-0.16	0.09	0.11	0.03
Whited and Wu	WW	-0.08	-0.03	-0.07	-0.07	-0.03	0.03	-0.07	0.09	0.08
Demand Sensitivity indexes	ϵ_{PCI}	-0.21	-0.15	-0.16	-0.12	-0.11	-0.08	0.11	0.04	-0.08
	ϵ_{GDP}	-0.15	-0.12	-0.14	-0.09	-0.06	-0.06	0.08	0.03	-0.02
	$CAR_{i,'01}$	-0.17	-0.06	-0.04	-0.02	-0.02	-0.04	0.04	0.01	-0.09
	$\Delta \ln(q_{i,'01})_s$	-0.22	-0.24	-0.22	-0.23	-0.07	-0.19	0.28	0.16	0.01
Control variables	$\Delta \ln(q_{i,t-1})$	-0.16	-0.13	-0.19	-0.11	-0.09	-0.24	0.56	0.90	0.18
	$Beta$	-0.15	-0.38	-0.40	-0.51	0.02	-0.56	0.59	0.45	0.17
	$\frac{Book}{Market}$	-0.16	-0.16	-0.19	-0.18	-0.08	-0.04	0.07	0.06	-0.06

All financial ratios are calculated for 2006. The growth rates are calculated for the period between 2004 and 2006.

Correlation coefficients smaller than 0.1 in their absolute values are highlighted in grey.

Table 2.5: Summary of the indexes of sensitivity to demand shock

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Elasticity of firm sales growth to growth in state per capita income during 1990-2006, winsorised at 1% and standardised	ϵ_{PCI}	1025	0	1	-2.21	3.38
Elasticity of firm sales growth to growth in U.S. real GDP in 1990-2006, winsorised at 1% and standardised	ϵ_{GDP}	1025	0	1	-1.86	3.37
Cumulative abnormal stock price returns in the event window of 5 trading days before and after the terrorist attack of 09/11, winsorised at 2% and standardised	$CAR_{i,'01}$	1205	0	1	-1.20	3.48
Mean of change in log stock prices between September 10, 2001-September 21, 2001, computed by sector, winsorised at 1% and standardised	$\Delta \ln(q_{i,'01})_s$	1025	0	1	-3.81	3.58

The second family of measures is based on the idea of Tong and Wei (2009a,b) to interpret the terrorist attack of 09/11 as an event that produced a short-lived shock on demand expectations in the market. As the Report for Congress (Feldstein, 2002) emphasizes, first it was expected that demand would be seriously affected. The GDP of the U.S. contracted in the third quarter of 2001, but then the positive growth resumed in the 4th quarter. That suggests that any effects from the 9/11 on aggregate demand expectations were short-lived. Thus, the terrorist attack is referred to as a large negative shock on demand expectations rather than an effective shock on the real output actually taking place the next year.

The shock of the 9/11 terrorist attack did not spread in financial markets and did not cause the shortage of liquidity: the Federal Reserve took appropriate actions to avert financial panic. Financial assistance and supplementary access to the loans were provided for the businesses. Tong and Wei (2009b) test that hypothesis and find out that the stock market reaction in the aftermath of the attack was not due to the worsened conditions on the financial markets, and thus, it could be interpreted as a fall in demand expectations.

Two measures of the stock price reaction in the aftermath of the terrorist attack are used in the regressions: the cumulative abnormal returns and the change in stock prices in the short period after the attack.

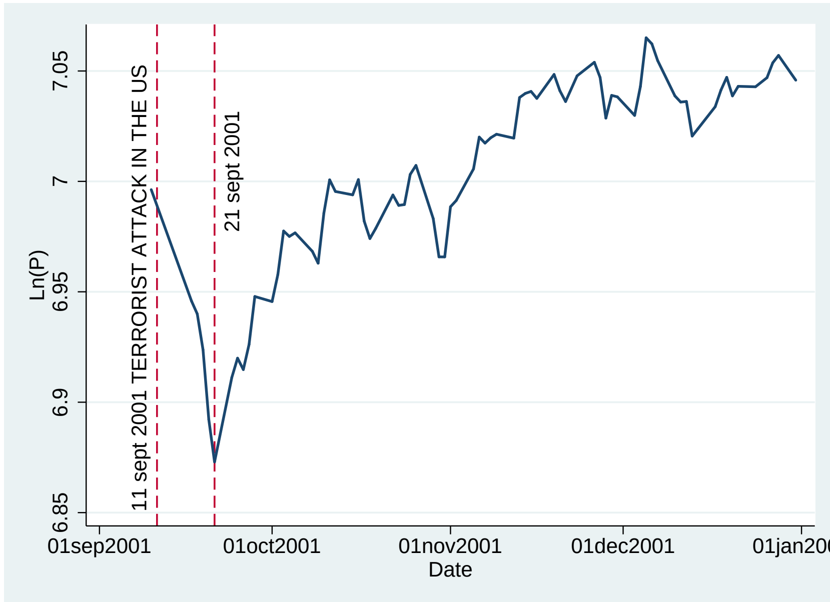
The cumulative abnormal returns are mostly used in the event study methodology to assess the response of some firm/institution to the negative event. The event date in this study is the first trading date after the terrorist attack of 09/11: September, 17th of 2001. The stock exchanges in the U.S. have been closed on September, 11 of 2001 (the day of the attack) and they have remained closed for another three days. The event window includes 5 trading days before and following the attack, thus, a total of 11 days. The estimation window is from 500 trading days to 15 days prior to the event date, which corresponds the year of 2000 and the first half of 2001 (see Appendix B.2 for details).

As an alternative measure, the difference in log stock prices is calculated between September 10, 2001 and September 21, 2001. The median per sector is then taken as a sector-level index of sensitivity to the shock on demand expectations. Originally in the paper of Tong and Wei (2009b) the index is calculated for the period of 18 days, in this chapter the window is reduced to 11 days (see Appendix B.2 for details). According to figure 2.3.6 presented below, the lowest point at the stock markets was reached on September 21, 2001 and since then expectations started to improve again.

Financial shortage may cause demand contraction and vice versa (Bashar, 2011). During liquidity crises banks try to restrict their lending to very short maturities and to increase the interest rates for term loans. Facing worsening financial conditions, firms cut their costs which in a large part include salaries of their workers. Consequently, demand should be deteriorated in the nearest future. However, demand declines in a proportion larger than the fall in the salaries of workers. The reason is that future expectations change rapidly, and the anticipations of future productivity and profits of the enterprises fall significantly.

In the present chapter such an interdependence is avoided by construction: the indexes

Figure 2.3.6: Dow Jones U.S. total stock market index displayed on a logarithmic scale in the period of 9/11 terrorist attack in the United States



of financial constraint and sensitivity to shock on demand expectations are calculated prior to 2007.

While the elasticities of firm sales to personal income and real GDP of the U.S. are highly correlated with each other (with correlation coefficient of 0.62, column 2, table 2.6), they are not so much correlated with other indexes: correlation reaches 34% with cumulative abnormal returns and 17% with stock returns in the aftermath of the terrorist attack of 2001(column 2, table 2.6). That means that elasticity of net sales, firm cumulative abnormal returns following the terrorist attack of 2001 and the reaction of stock prices to the same event can be all included in regressions. Somewhat surprisingly, correlation between the two indexes measured as the reaction of the firm stock returns to the terrorist attack (cumulative abnormal returns CAR and difference in log stock prices $\Delta \ln(q_{i,'01})_s$) is close to zero. Correlation of these indexes with beta shows that CAR is absolutely not correlated with beta (which is logical as it computes the firm abnormal returns), while between beta and Tong and Wei index the correlation coefficient is 0.20. Thus, in a large part index suggested by Tong and Wei takes into account the firm correlation with the market. The correlation coef-

Table 2.6: Correlation between the sensitivity indexes to demand shock and control variables for U.S. non-financial firms

Variable	ϵ_{PCI}	ϵ_{GDP}	CAR	$\Delta\ln(q_{i,'01})_s$	$\Delta\ln(q_{i,TW-1})$	$Beta$	$\frac{Book}{Market}$
ϵ_{PCI}	1.00						
ϵ_{GDP}	0.62	1.00					
CAR	0.34	0.35	1.00				
$\Delta\ln(q_{i,'01})_s$	0.17	0.15	0.02	1.00			
$\Delta\ln(q_{i,TW-1})$	0.03	0.11	0.12	0.05	1.00		
$Beta$	0.10	0.06	0.00	0.20	-0.05	1.00	
$\frac{Book}{Market}$	-0.02	-0.03	-0.07	-0.01	0.08	0.00	1.00

ficients with dependent variables in table 2.4 suggest a larger explicative power of elasticity of firm net sales to per capita income (ϵ_{PCI}) and the reaction of stock prices to the terrorist attack of 2001 ($\Delta\ln(q_{i,'01})_s$).

2.3.6 Control variables

Three factors are added in the regressions as control variables. First of all, it is the correlation with overall market (beta) which is in line with CAPM model (see equation 2.2.3); second, it is the autoregressive component that takes into account the movements of firm stock prices in the past, third, it is the book-to-market ratio of the firm. Fama and French (1995) find out that firms with high book-to-market ratio tend to be persistently distressed (and under-priced by the market) and those with low ratio are associated with sustained profitability. It is expected that weaker firms (with smaller growth in stock prices and higher book-to-market ratio) and the firms more correlated with the market before the crisis perform worse during the crisis than the rest of the market.

It is logical that several financial ratios proposed by different probability of default models are similar to each other. Some variables are then excluded from the final regressions in order to avoid multicollinearity problems which could lead to greater standard errors and larger estimated coefficients. The correlation matrix for all financial indicators is shown in table 3.2.

2.4 Cross-section estimations of the non-financial stock returns determinants

2.4.1 Stock returns in the TW window and other large windows (over 15–19 months of the financial crisis)

The augmented CAPM model is estimated for more than 1000 non-financial U.S. firms over nine periods during the financial crisis of 2007. The results for cross-sectional OLS estimates in large windows (including TW window) are reported in table 2.7.

The third column of that table presents the original results for the baseline regression with control variables from the Tong and Wei paper of 2009. For the other large windows only the estimates from the regressions with control variables are presented (others are available on demand).

All regressions are conducted using stepwise backward selection method. This method begins with initial model and then compares the explanatory power of smaller models by removing insignificant variables. The significance level for removal is 0.05. All explanatory variables are standardised which makes the size of parameters comparable within each column.

The results for TW window are close to those of Tong and Wei. However, in the sample from this chapter Whited and Wu financial constraint index is not performing well. Two other balance sheet characteristics are found significant: returns on assets (P_1) and cash flow volatility (Vol). However, it is still the case that more financially distressed firms or, in other words, more financially constrained ones (with smaller profits and higher cash flow volatility prior to crisis) were the ones that experienced a larger decline in their stock prices than the rest of the market during the time period including the Bear Stearns near-collapse.

Two proxies for demand sensitivity of non-financial firms are significant in TW window: the reaction to the terrorist attack of 2001[5] ($\Delta \ln(q_{i,'01})_s$) and the firm sales growth sensitivity to the changes in personal income prior to 2007 (ϵ_{PCI}). The signs of the coefficients of both variables are coherent with the results of Tong and Wei (2009b) paper and they confirm that more sensitive to demand shock firms were the ones that experienced the largest decline in their stock prices during the crisis.

If firm net sales have been more sensitive to changes in personal income before 2007, the firm lost 6.0% (column 4, table 2.7) more in its stock value during the TW period of the crisis (from July 31, 2007 through March 17, 2008). At the same time, if firm equity returns have been more sensitive to the drop in demand expectations in 2001, the firm lost additional 4.4% (column 4, table 2.7) in its stock prices during the analysed period.

The impact of Tong and Wei index of demand sensitivity remains significant and robust over other large periods LW1, LW2 and LW3. In the window LW1 an increase in ex ante sensitivity to shock on demand expectations (calculated for 2001) by one standard deviation is associated with an extra drop in stock price by 6%. Thus, during the crisis it was not only the liquidity shortage that negatively affected the performance of U.S. non-financial firms but also the collapse in product demand.

Firms that according to their Z-score calculated for 2006 have been considered to be "safer" than the others (and accordingly have had a higher Z-score) performed better during the crisis than those that have been categorised as belonging to "grey" or "distress" zone and have had a lower Z-score (for more details, see section 3.4). An improvement in firm's Z-score in a way that the firm is transferred from the more distressed zone to the safer zone in the large period LW1 from July 31, 2007 until October 27, 2008 (column 5, table 2.7) is associated with an improvement in its stock returns by 8.6%.

These results are similar to those of Calomiris *et al.* (2010) who also find the negative

[5]The index referred to as demand sensitivity index in the paper of Tong and Wei (2009b).

Table 2.7: Change in Stock Prices during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for large windows with control variables

Type of var	Name	**Tong and Wei (2009b)**	**TW window**	**LW1**	**LW2**	**LW3**
		July 31, 2007 - Mar 31, 2008	July 31, 2007 - Mar 17, 2008	July 31, 2007 - Oct 27, 2008	July 31, 2007 - Dec 01, 2008	July 31, 2007 - Mar 09, 2009
Balance sheet char-s						
Altman's Z-zone	ZZ			0.086***	0.084***	0.131***
				(3.37)	(3.34)	(4.38)
Moody's RiskCalc	P_1		0.055***			
			(2.75)			
	Liq			0.060*	0.073*	0.089*
				(2.39)	(2.58)	(2.56)
BondScore	EM					0.102**
						(2.81)
	Vol		-0.053***	-0.141***	-0.190***	-0.169***
			(-3.46)	(-5.58)	(-6.67)	(-4.90)
Whited and Wu	WW	-0.123***				
		(-5.32)				
Demand Sensitivity	ϵ_{PCI}		-0.060***			
			(-3.57)			
	$\Delta \ln(q_{i,'01})_s$	-0.034***	-0.044**	-0.060**	-0.057**	-0.068*
		(-3.87)	(-3.29)	(-2.93)	(-2.66)	(-2.42)
Control variables	$\Delta \ln(q_{i,t-1})$	0.002***	-0.062***	-0.090***	-0.133***	-0.186***
		(6.67)	(-3.80)	(-4.06)	(-5.29)	(-6.25)
	$Beta$	0.030**	-0.029*	-0.200***	-0.284***	-0.379***
		(2.43)	(-2.38)	(-10.08)	(-12.60)	(-13.96)
	$\frac{Book}{Market}$	-0.064***	-0.041*	-0.050*	-0.067**	-0.078*
		(-10.11)	(-2.54)	(-2.38)	(-2.83)	(-2.57)
	Constant	-0.519***	-0.272***	-1.062***	-1.234***	-1.673***
		(-16.75)	(-2.38)	(-11.58)	(-12.06)	(-13.43)
	R^2	0.14	0.165	0.320	0.398	0.435
	Obs	2410	1023	1022	1024	1021

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

influence of the collapse of global demand, the contraction of credit supply and selling pressure on firm's equity on stock returns of the firms during the crisis period. They employ eight different variables that measure the sensitivity of the firms from 44 countries excluding the U.S. to these "shock factors", while also follow Tong and Wei (2009b) and include three factors from Fama–French model (beta, book-to-market ratio and momentum) as control variables.

According to CAPM model the larger is the fall of the stock market index, the larger should be the parameter of beta in the cross-sectional regressions (see equation 2.2.3). It turns out to be the case; the largest fall of the stock market returns on figure 1 corresponds to the largest values of the parameters for long periods (columns 4, 5, 6, 7, table 2.7), (figure 2.3.1).

In line with the results of Calomiris *et al.* (2010), beta exhibits an important negative influence on the stock market returns in the analysed periods: in the large window LW1 from July 31, 2007 until October 27, 2008 its explicative power is two times larger than that of Z-zone indicator or demand sensitivity indexes. As expected, the stock prices of correlated with the market firms fell more during the crisis.

Kothari *et al.* (1995) provide evidence that cross-sectional variation in average returns do reflect substantial compensation for beta risk, while they do not get significant results for book-to-market equity ratio. Calomiris *et al.* (2010) also find book-to-market ratio insignificant in their regression, while in this paper it has a significant negative effect on equity returns.

As expected, higher liquidity (Liq in table 2.7) and EBITDA margin (EM) prior to crisis are associated with a better performance of the firm during the crisis, while higher volatility (Vol) of firm's cash flow before the crisis leads to a larger decline in stock prices during the crisis.

These results confirm the negative impact of financial constraints on the firm performance, especially during the crisis. As a consequence, such financially constrained firms cut more investment, technology, marketing, and employment relative to financially unconstrained firms during the crisis (Campello *et al.*, 2009; Musso and Schiavo, 2008).

R-squared is in between 18% and 43.5% which is considered to be a good fit of the model when explaining stock returns.

2.4.2 Stock returns over 1 to 1.5 months following the Bear Stearns near-collapse and the failure of Lehman Brothers

Now regressions are run on stock returns in small windows around two particular events: the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers.

Firms from "safe" zone experienced a smaller decline in stock prices during these periods. Besides, volatility indicator (Vol in table 2.8) has an important negative impact on the U.S. firm stock prices. Beta ($Beta$ in table 2.8) is quantitatively very important in Lehman Brothers period (SW2) which may be explained by spillover effects of Lehman collapse on the financial markets that confirms "too big to fail" argument. The overall market performance was hit by Lehman Brothers bankruptcy causing larger loses for more correlated with the market companies.

Musso and Schiavo (2008) found that financial constraints might be positively related to productivity growth in the short-term during the crisis due to cuts in costs. However, even if this effect exists, it is not presented in firm's stock returns.

Thus, both events - the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers - are characterised by liquidity contraction (financially fragile firms were affected the most) as well as overall negative tendency of the market and its high volatility. These results confirm arguments of Ivashina and Scharfstein (2010) who show that the new bank loans to large borrowers fell by 47% by the end of the fourth quarter of 2008, representing the willingness or ability to lend during the crisis.

Cornett *et al.* (2011) and Giovane *et al.* (2010) confirm the link between drying up of liquidity and decline in credit supply, which also suggests that financially fragile non-financial

Table 2.8: Change in Stock Prices during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for small windows following the Bear Stearns near-collapse and the bankruptcy of Lehman Brothers

Type of variable	Name	**SW1** Bear Stearns (Feb 17, 2008 - Mar 17, 2008)	**SW1** Bear Stearns(Feb 17, 2008 - Mar 17, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)
Balance sheet char-s					
ALTMAN'S	ZZ	0.015**	0.015**	0.048***	0.025*
Z-ZONE		(3.14)	(3.10)	(3.37)	(2.19)
MOODY'S	Liq			0.058***	
RISKCALC				(3.80)	
BONDSCORE	Vol	-0.016***	-0.015***	-0.065***	-0.026*
		(-4.19)	(-3.12)	(-3.23)	(-2.21)
Demand	$\Delta \ln(q_{i,'01})_s$			-0.055***	
Sensitivity				(-4.30)	
Control	$\Delta \ln(q_{i,t-1})$		-0.011*		-0.041**
variables			(-2.06)		(-3.24)
	$Beta$				-0.178***
					(-18.04)
	Constant	-0.074***	-0.075***	-0.575***	-0.560***
		(-16.84)	(-16.78)	(-44.81)	(-54.19)
	R^2	0.035	0.049	0.108	0.434
	Obs	1031	1030	1019	1019

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

firms should have being affected the most. The effect of supply factors on the growth of lending to firms is the strongest after the bankruptcy of Lehman Brothers as it is also found by Giovane *et al.* (2010) and after the Bear Stearns near-collapse.

2.4.3 Stock returns over 1 to 3 months during the recovery period following March, 2009

In this section three small periods during which the stock market indexes restarted to rise are analysed. Table 2.9 presents the results for regressions with and without controls for these three windows.

In the first RW1 (first month of recovery) and second period RW2 (first quarter of recovery) more sensitive to the shock on demand expectations firms (higher $\Delta\ln(q_{i,'01})_s$) had a better performance than the rest of the market. Its quantitative importance is partly offset by beta but index remains significant after inclusion of control variables. An increase in the sensitivity of the firms to the shock on demand expectations by one standard deviation prior to crisis led to the additional recovery of 2.3% (column 4, table 2.9) in the stock prices of these firms in the RW1 period. That allows to make a conclusion that in the first quarter of recovery there was an improvement in demand expectations in the market that positively affected the performance of U.S. non-financial firms.

However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009-2010 and the aggregate demand remained week (Feldstein, 2009). It can be also the reason why more profitable firms before the crisis had more problems to recover after the crisis.

Beta (*Beta* in table 2.9) coefficients change their signs to the positive ones in all three recovery periods. Due to the overall positive tendency of the market, firms with higher beta (whose stock prices are more correlated with the market) experienced a larger increase in their stock returns.

Firms with higher profits before the crisis did not grow as well as the rest of the market

Table 2.9: Change in Stock Prices during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for small recovery in stock prices windows

Type of var	Name	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010
Balance sheet char-s							
Altman's	ZZ					-0.019**	
Z-zone						(-2.68)	
Moody's	P_1			-0.073*			-0.020*
RiskCalc				(-1.98)			(-2.01)
	A_1					0.019**	0.019**
						(2.97)	(2.97)
	Liq	-0.038***		-0.099***			
		(-3.62)		(-3.45)			
BondScore	EM	-0.052***	-0.031***			-0.040***	-0.026**
		(-4.31)	(-3.45)			(-4.87)	(-3.08)
	Vol			0.084**			
				(2.88)			
Demand	CAR					-0.014*	-0.019**
Sensitivity						(-2.07)	(-3.00)
indexes	$\Delta \ln(q_{i,'01})_s$	0.065***	0.023***	0.084***	0.056***		
		(7.097)	(3.21)	(3.54)	(3.81)		
Control	$\Delta \ln(q_{i,t-1})$		0.058***				0.037***
variables			(6.72)				(4.50)
	$Beta$		0.111***		0.188***		0.024***
			(13.30)		(8.17)		(3.88)
	$\frac{Book}{Market}$				0.034***		-0.028***
					(3.46)		(-3.89)
	Constant	0.347***	0.345***	0.477***	0.435***	0.104***	0.108***
		(36.35)	(47.84)	(17.48)	(35.29)	(16.01)	(14.55)
	R^2	0.131	0.513	0.071	0.182	0.071	0.143
	Obs	1011	1011	1023	1021	1025	1024

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

in RW1 period, as well as in RW3 period (from January 01, 2010 until March 31, 2010). In the RW3 period another demand sensitivity index - cumulative abnormal return at the period of the terrorist attack of 2001 - becomes significant, predicting lower rates of growth in stock prices of firms which have had higher abnormal returns in 2001. It could be related to a slow recovery of demand and production that did not increase as it was expected after all the stimulus measures undertaken in 2008-2009 and to the sluggish economy growth in general.

Firms with higher returns on assets (P_1) exhibit smaller growth in their stock prices during RW3 period which can be related to the size of the firms - bigger firms recover slower than the rest of the market (it can be also the consequence of the sluggish economic growth).

2.4.4 Robustness checks

Alternative regressions with log growth rates and removed 5^{th} and 95^{th} percentiles

Accordingly, an alternative regression is run, where log growth rates of stock prices comprise an interval between 5th and 95th percentiles of the initial sample, leaving aside extreme observations (outliers). Results confirm the significance of key variables for majority of regressions (see table 2.10 for the results for large windows, table 2.11 for the results for small and recovery windows). The analysis of small windows highlights the financial shock features in the period after the Bear Stearns and Lehman Brothers collapses and the improvement in demand expectations in the first month of recovery in the financial markets.

Alternative regressions with discrete growth rates

Besides measuring the stock price changes in continuous growth rates - calculated as difference in logs - it is proposed to verify the results when discrete growth rates are used. For a discussion on using log growth rates versus discrete growth rates see Appendix C. The main results of constructed regressions remain robust; significance of explanatory variables is justified (see table 2.12 for the results for large windows, table 2.13 for the results for small and recovery windows). The same pattern of characteristics is recognised for the Bear Stearns and the Lehman Brothers failures - both have had more impact on financially constrained firms while in the first month of recovery firms more sensitive to the shock on demand expectations recovered the first. Quantitatively the coefficients of the key variables seem to be smaller than in the case of continuous growth rates. That appears due to smaller standard deviations of stock price differences when measured in discrete terms.

2.5 Conclusion

This chapter uses a methodology similar to that of Tong and Wei (2009a,b) which is based on the CAPM cross-sectional model of stock returns with a standard set of control variables. In this framework the identical model is employed to analyse the stock returns of more than 1000 U.S. non-financial firms over nine different time periods. One of the contributions of this chapter is the inclusion of extended up to March of 2010 time periods and shorter windows of 1-2 months around the particular negative events (the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers) as well as the periods of recovery after the deepest trough in stock market returns in March of 2009.

Both credit supply shock and contraction of product demand had negative influence on stock returns of U.S. firms between July 31, 2007 and March 09, 2009 (period in which the stock returns of the firms were negative). However, both factors had positive or insignificant effects during the recovery periods starting from spring of 2009. These main conclusions are in line with those of Calomiris *et al.* (2010) and others.

The performance of Whited and Wu financial constraint index is poor, while other financial distress indicators (Altman's Z-score, liquidity ratio from Moody's RiskCalc model, volatility index from BondScore model) have better explicative power.

Quantitatively Altman's Z-zone indicator is more important than the shock on demand

Table 2.10: Change in Stock Prices (logs, removed 5th and 95th percentiles) during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for large windows

Type of var	Name	**TW** July 31, 2007 - Mar 17, 2008	**LW1** July 31, 2007 - Oct 27, 2008	**LW2** July 31, 2007 - Dec 01, 2008	**LW3** July 31, 2007 - Mar 09, 2009
Balance sheet chars					
Altman's Z-zone	ZZ		0.070**	0.071**	0.102***
			(3.18)	(2.98)	(3.41)
Moody's RiskCalc	P_1	0.050***			
		(2.74)			
	Liq		0.054*		0.102**
			(2.24)		(3.23)
BondScore	EM			0.070*	
				(2.54)	
	Vol	-0.064***	-0.129***	-0.161***	-0.127***
		(-4.41)	(-5.38)	(-6.48)	(-3.38)
Whited and Wu	WW				-0.099**
					(-3.11)
Demand Sensitivity	ϵ_{PCI}	-0.053***			
		(-3.24)			
	$\Delta \ln(q_{i,'01})_s$	-0.035***	-0.059**	-0.055*	-0.076**
		(-2.76)	(-3.08)	(-2.53)	(-2.85)
Control variables	$\Delta \ln(q_{i,t-1})$	-0.061***	-0.070***	-0.090***	-0.142***
		(-4.616)	(-3.34)	(-3.82)	(-5.12)
	$Beta$	-0.032***	-0.189***	-0.289***	-0.420***
		(-2.72)	(-10.02)	(-13.84)	(-16.23)
	$\frac{Book}{Market}$		-0.060**	-0.073***	-0.114***
			(-3.06)	(-3.37)	(-4.10)
	Constant	-0.292***	-0.768***	-0.916***	-1.141***
		(-21.04)	(-38.73)	(-40.46)	(-42.28)
	R^2	0.157	0.319	0.425	0.467
	Obs	977	968	965	958

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

Table 2.11: Change in Stock Prices (logs, removed 5th and 95th percentiles) during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for small windows

Type of var	Name	**SW1** Bear Stearns (Feb 17, 2008 - Mar 17, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010
Balance sheet char-s						
Altman's	ZZ	0.012**	0.026*			-0.018**
Z-zone		(2.69)	(2.40)			(-2.82)
Moody's	P_1					-0.011*
RiskCalc						(-2.02)
	A_1					0.023***
						(3.97)
	Liq	0.012*		-0.015*		
		(2.39)		(-2.00)		
BondScore	EM			-0.021*		-0.028***
				(-2.44)		(-3.73)
	Vol	-0.019***	-0.026*			
		(-3.87)	(-2.35)			
Whited	WW					0.016***
and Wu						(2.67)
Demand	CAR					-0.023*
Sensitivity						(-2.43)
indexes	$\Delta\ln(q_{i,'01})_s$			0.024***		
				(3.51)		
Control	$\Delta\ln(q_{i,t-1})$	-0.009*	-0.031**	0.046***	0.627***	0.026***
variables		(-2.05)	(2.40)	(5.67)	(34.08)	(3.59)
	$Beta$		-0.167***	0.111***	0.030**	0.017**
			(-17.81)	(14.51)	(3.03)	(3.10)
	$\frac{Book}{Market}$				0.033***	-0.026***
					(3.54)	(-4.04)
	Constant	-0.074***	-0.558***	0.338***	0.444***	0.104***
		(-17.86)	(-57.03)	(49.65)	(52.56)	(16.82)
	R^2	0.055	0.433	0.527	0.759	0.146
	Obs	995	979	981	985	988

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

Table 2.12: Change in Stock Prices (discrete growth rates) during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for large windows

Type of var	Name	**TW** July 31, 2007 - Mar 17, 2008	**LW1** July 31, 2007 - Oct 27, 2008	**LW2** July 31, 2007 - Dec 01, 2008	**LW3** July 31, 2007 - Mar 09, 2009
Balance sheet chars					
Altman's Z-zone	ZZ		0.030** (3.07)	0.024** (2.59)	0.026** (2.83)
Moody's RiskCalc	P_1	0.033* (2.11)			
	Liq				0.025* (2.58)
BondScore	EM				
	Vol	-0.036** (-3.00)	-0.051*** (-5.01)	-0.065*** (-6.47)	-0.042*** (-3.64)
Whited and Wu	WW				-0.027** (-2.74)
Demand Sensitivity	ϵ_{PCI}	-0.043** (-3.20)			
	$\Delta \ln(q_{i,'01})_s$	-0.044*** (-4.28)	-0.027** (-3.03)	-0.023* (-2.53)	-0.030*** (-3.62)
Control variables	$\Delta \ln(q_{i,t-1})$	-0.045*** (-4.14)	-0.027** (-2.87)	-0.040*** (-4.23)	-0.034*** (-4.00)
	$Beta$		-0.104*** (-12.29)	-0.139*** (-16.72)	-0.142*** (-17.84)
	$\frac{Book}{Market}$	-0.028* (-2.52)	-0.037*** (-4.18)	-0.043*** (-4.93)	-0.041*** (-4.65)
	Constant	-0.212*** (-18.30)	-0.476*** (-53.05)	-0.520*** (-59.41)	-0.592*** (-71.50)
	R^2	0.145	0.350	0.469	0.507
	Obs	1022	1022	1024	1021

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

Table 2.13: Change in Stock Prices (discrete growth rates) during the Subprime Crisis, U.S. non-financial firms, cross-sectional OLS estimation for small windows

Type of var	Name	**SW1** Bear Stearns (Feb 17, 2008 - Mar 17, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010
Balance sheet char-s						
ALTMAN'S	ZZ	0.014**	0.017*			-0.023**
Z-ZONE		(3.06)	(2.14)			(-2.80)
MOODY'S	P_2	0.008*				
RISKCALC		(2.03)				
	A_1					0.024***
						(3.24)
	A_3		-0.017*			
			(-2.01)			
	Liq		0.026**			
			(3.14)			
BONDSCORE	EM					-0.040***
						(-4.19)
	Vol	-0.014**	-0.027**			
		(-2.95)	(-3.16)			
WHITED	WW					0.027***
AND WU						(3.33)
Demand	CAR					-0.028*
Sensitivity						(-2.25)
indexes	$\Delta \ln(q_{i,'01})_s$			0.031*		
				(2.08)		
Control	$\Delta \ln(q_{i,t-1})$	-0.011*	-0.028***	0.095***	0.711***	0.040***
variables		(-2.44)	(-4.02)	(4.04)	(48.50)	(4.19)
	$Beta$		-0.100***	0.095***		0.028***
			(-19.69)	(5.18)		(3.96)
	$\frac{Book}{Market}$				0.036***	-0.024**
					(3.58)	(-2.93)
	Constant	-0.067***		0.298***	0.443***	0.126***
		(-16.11)		(19.85)	(49.29)	(15.68)
	R^2	0.047	0.458	0.230	0.806	0.145
	Obs	1029	1019	1021	1021	1024

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

expectations index (computed from the firm reaction to the terrorist attack of 2001) in explaining the stock price performance in almost all the studied periods. Firms which were more vulnerable to demand contraction and more financially fragile (with smaller Z-score) prior to the crisis experienced a larger reduction in the values of their stocks during the crisis.

Both events - the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers - are characterised by liquidity contraction (financially fragile firms were affected the most) as well as overall negative tendency of the market and its high volatility. These results confirm those of Calomiris *et al.* (2010) and Giovane *et al.* (2010), while also show that in case of both events the major consequence was the contraction of credit supply and not the collapse of product demand.

Contraction in product demand and credit supply shock had a positive or insignificant influence on the equity prices of U.S. firms observed in the periods following spring of 2009. Here the periods of recovery could be thought of as placebo period from Calomiris *et al.* (2010) as on average there was no decline in equity prices. Financial conditions improved since March of 2009 in a way that more financially distressed firms prior to crisis were performing as well as the other firms. In the first month and quarter of the recovery in stock returns it was improvement in demand expectations that had a positive impact on firm's equity returns. However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009-2010, the aggregate demand remained week.

This chapter contributes to the existing literature on the aftermath of the crisis and channels through which the crisis affected the real economy. It is focusing on the U.S. market that was in the epicenter of the crisis of 2007. The findings of this chapter can be potentially important for policy implications. Most of the negative events include both shocks on demand expectations and financial contraction. However, one of these two shocks may have a heavier negative effect on the market, affecting in a larger way more sensible to that shock firms. Understanding the transmission channels and correctly anticipating which shock will prevail in the market is essential to design appropriate macroeconomic policies.

Appendix A

Sample selection

The data set consists of firms' stock returns and betas from Datastream[1] and balance sheet information of the firms from Compustat[2]. To select the sample, firms are classified by their SIC - Standard Industrial Classification codes. Financial firms (SIC codes between 6000 and 6999) and regulated utilities (SIC codes between 4900 and 4999) are excluded from the sample. The next step consists of deleting any firm observation with missing data or zero stock prices or total assets. The firms that were created after 2001 are eliminated, which is required by construction one type of sensitivity indexes to the shock on demand expectations.

Besides, there were several sectors which were directly affected by the 09/11 terrorist attack: airlines, defence and insurance. At the time of the 9/11, airlines industry was already in troubles due to recession and the terrorist attack severely compounded the industry's financial problem. Even the quickly organised aid package did not save some firms from collapsing. The loss of life and property gave rise to the largest claim in history, estimated for up to 40 billion U.S. dollars - a huge burden for the insurance sector. Hence, firms that belong to these sectors are eliminated from the sample as the fall in their stock prices reflects

[1]Datastream - on-line historical database service provided by Thomson Financial that encompasses a broad range of financial entities and instruments with global geographical coverage.

[2]Compustat - Standard & Poor's database of financial, statistical and market information on active and inactive companies throughout the world.

the direct financial loses of these companies rather than their reaction to the drop in demand expectations:

- SIC 372 Aircraft, Aircraft Engines & Engine Parts, Aircraft Equipment;
- SIC 376 Guided Missiles & Space Vehicles & Parts, Auxiliary Equipment Not Elsewhere Classified;
- SIC 631 Life insurance;
- SIC 632 Accident & Health Insurance & Hospital & Medical Service Plans;
- SIC 633 Fire, Marine & Casualty Insurance;
- SIC 635 Surety Insurance;
- SIC 636 Title Insurance;
- SIC 639 Insurance Carriers, NEC;
- SIC 641 Insurance Agents, Brokers & Service.

After the firms' preliminary selection the sample consists of 1612 U.S. firms.

Other financial ratios (from Moody's RiskCalc U.S. firms model and BondScore model) are also cleaned by deleting extreme observations or winsorizing them at 1-2% level. Most of financial ratios are also standardised.

Appendix B

Construction of the variables

B.1 The balance sheet characteristics associated with firm financial constraint

- Altman's Z-score Altman's Bankruptcy model suggests an index based on the five main financial ratios where weight of each variables defined using discriminant analysis:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5 \tag{B.1.1}$$

where X_1 is the ratio of difference between current assets and current liabilities to total assets; X_2 is the ratio of retained earnings to total assets; X_3 is the ratio of earnings before interest and taxes (EBIT) to total assets; X_4 is the ratio of market value of equity to total liabilities; X_5 is the ratio of sales to total assets.

- Moody's RiskCalc model and BondScore model indicators

While both models use specific techniques to measure the weight of each input ratio, in this article these financial ratios are included directly in the regressions to complete the information on firm financial constraint (together with Altman's Z-score). These are variables related to predictions of firm defaults. All the variables are constructed following their description in the respective model (see summary table 2.2).

Liquidity ratio is a Quick Ratio taken directly from Datastream and is defined as follows: $\frac{CurrentAssets - Inventory}{CurrentLiabilities}$.

Volatility of cash flow is calculated as a standard deviation of $\frac{EBITDA}{Assets}$ over 1996-2006.

- Whited and Wu financial constraint index identifies financial constraint for each firm individually depending on several financial characteristics. The authors of the index exploit an Euler equation approach from a structural model of investment to create their index. They define a firm's financial constraint denoted $FC_{i,2006}$ as the shadow value of external financing that is predicted by six variables:

$$\begin{aligned} FC_{i,2006} \quad = \quad & -0.091 \cdot \frac{CF_{i,2006}}{A_{i,2006}} - 0.062 \cdot Div_{i,2006} + 0.021 \cdot \frac{LTDebt_{i,2006}}{A_{i,2006}} \\ & -0.044 \cdot \ln(A_{i,2006}) + 0.102 \cdot IG_{s,2006} - 0.035 \cdot FG_{i,2006}, \end{aligned}$$

where $FC_{i,2006}$ financial constraint index of Whited and Wu (2007) computed for each U.S. firm; $\frac{CF_{i,2006}}{A_{i,2006}}$ ratio of cash flow to total assets of the firm; $Div_{i,2006}$ dividend dummy that is the indicator which takes the value of 1 if the firm pays cash dividends, 0 otherwise; $\frac{LTDebt_{i,2006}}{A_{i,2006}}$ ratio of long-term debt to total assets of the firm; $\ln(A_{i,2006})$ natural logarithm of total assets of the firm; $IG_{s,2006}$ one year three-digit sector sales growth; $FG_{i,2006}$ one year firm sales growth.

B.2 Sensitivity indexes to demand shock

Several indexes are constructed to measure firms' sensitivities to the shock on demand expectations:

1. Defining sensitivity indexes through elasticity:

    - Elasticity of firm net sales growth to growth in per capita personal income in the state where the company is headquartered in the period between 1990 and 2006:

$$\Delta NS_{i,1990-2006} = \alpha_i + \beta_i \Delta \ln(PCI_{ST,1990-2006}) + \epsilon_{i,1990-2006} \tag{B.2.1}$$

where $\beta_i = \epsilon_{PCI} = \epsilon_{\frac{\Delta NS_{i,1990-2006}}{\Delta PCI_{St,1990-2006}}}$ is the slope or sensitivity of change in net sales to the change in per capita income (PCI) of the state.

- Elasticity of firm net sales growth to U.S. real GDP during 1990-2006:

$$\Delta NS_{i,1990-2006} = \alpha_i + \beta_i \Delta \ln(GDP_{US,1990-2006}) + \epsilon_{i,1990-2006} \tag{B.2.2}$$

where $\beta_i = \epsilon_{GDP} = \epsilon_{\frac{\Delta NS_{i,1990-2006}}{\Delta RGDP_{US,1990-2006}}}$ is the slope or sensitivity of change in net sales to GDP growth.

2. Defining sensitivity through the reaction to the terrorist attack of 09/11:

- Cumulative abnormal returns in the event window of 5 trading days before and after the attack (a total of 11 days). For each firm stock price the daily abnormal return is calculated as a difference between the actual returns and the expected returns estimated from the single-factor market model:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t} \tag{B.2.3}$$

where market index $R_{m,t}$ is S&P 500 stock market index. Cumulative abnormal returns $CAR_{i,Sept04'01-Sept21,'01}$ ($CAR_{i,'01}$ in the tables) for each firm are then calculated as the sum of daily abnormal returns in the event window.

- The difference in log stock prices between September 10, 2001 and September 21, 2001 (following Tong and Wei, 2009a,b). First the percentage change in stock prices (that is the difference in log stock prices) is calculated for the period from September 10, 2001 to September 21, 2001, the day after the terrorist attack of 2001 during which the majority of the firms stocks attain their lowest price:

$$\Delta \ln(q_{i,'01})_s = \Delta \ln(q_{i,10sept'01-21sept'01})_s = \ln(q_{i,10sept'01}) - \ln(q_{i,21sept'01}). \quad \text{(B.2.4)}$$

Then the firms are organised in sectors and the mean of log stock price changes for each three-digit sector is taken as the sector-level sensitivity to the shock on demand expectations $\Delta \ln(q_{i,10sept'01-21sept'01})_s$ ($\Delta \ln(q_{i,'01})_s$ in the tables). The interpretation of the index is the following: the higher is the difference in the log stock prices (or the higher is demand sensitivity index), the more vulnerable is the firm to deterioration in demand expectations.

B.3 Control variables

- Autoregressive component captures persistance of firm's stock returns. It is computed as a difference in stock prices in the period of the same length but prior to the examined window of stock returns.

  The value at the end of the period is always deducted from the value at the beginning of the period, the interpretation of the variable is the next one: the higher is the value of the autoregressive component, the larger was the fall in stock returns of the firm during the analysed past period (in case of falling stock prices) or the smaller was the stock price growth (in case of increasing stock prices). In a similar way autoregressive variable is calculated separately for every period.

- Beta is the quantitative measure of the volatility of a given stock relative to the overall market. The beta factor in Datastream is calculated over a 5-year period using monthly observations on logarithmic scale.

- Book-to-market ratio is the book value of the firm (accounting value) divided by the market value (market capitalisation) of the firm.

Appendix C

Log growth rates versus Discrete growth rates

Log growth rates are well-known and widely used approximations for percentage growth rates, when $g_{i,t} = \Delta \ln(q_{i,t})$:

$$\begin{aligned} q_{i,t} &= (1 + g_{i,t})^t \cdot q_{i,0} \\ \ln(q_{i,t}) &= t \cdot ln(1 + g_{i,t}) + ln(q_{i,0}). \end{aligned} \tag{C.0.1}$$

Thus,

$$\ln(1 + g_{i,t}) = \frac{\ln(q_{i,t}) - \ln(q_{i,0})}{t}, \tag{C.0.2}$$

and

$$g_{i,t} = \frac{\ln(q_{i,t}) - \ln(q_{i,0})}{t} \tag{C.0.3}$$

For any small number where g_i is defined as a firm's i annual growth rate of stock prices q_i in any year t.

However, using such an approximation in the time of large recessions may be misleading. In the case of positive growth rates, when $g_i \succ 0$, log growth rate approximation will have a lower value than the discrete growth rate. This leads to decrease in the value of outliers for positive growth rates in the periods of booms. In the case of negative growth rate, when $g_i \prec 0$, log growth rates have larger absolute values than discrete growth rates and may exceed absolute value of -100%. Thus, log approximation of the growth rate tends to increase the size of outliers during busts. This may induce a more skewed to the left distribution of differences in stock prices when measured by log approximation than when measured by discrete growth rates.

This chapter is focused on the case of recent financial crisis which triggered a long-lasting slowdown of the majority of the enterprises. Hence, there is a large chance that results of presented estimations may change when difference in stock prices is measured in discrete growth rate terms $\left[\Delta \ln(q_{i,t}) = \frac{q_{i,t}-q_{i,t-1}}{q_{i,t-1}}\right]$, or when 5% of observations are removed from both sides of the log growth rates distribution. Alternative regressions are run in order to check for the robustness of the results in both cases.

Chapter 3

Determinants of the allocation of funds under the Capital Purchase Program[1]

3.1 Introduction

The global financial crisis that began in the U.S. in 2007 dealt a severe blow to the American economy as a whole. Financial institutions, corporations, and households all felt the strain, while government interventions across the world imposed heavy burdens on the taxpayers in their societies. These interventions included such measures as loan guarantee schemes for newly issued senior unsecured debt and bank recapitalizations. In the U.S., between October 2008 and December 2009, the U.S. Treasury injected huge amounts of liquidity into 707 banks[2] in 48 states through the purchases of preferred equity stakes under the voluntary Capital Purchase Program (the CPP; for more details, see Acharya and Sundaram, 2009; Cooley and Philippon, 2009; King, 2009; Khatiwada, 2009).

[1]The chapter is based on the published article "Determinants of the allocation of funds under the Capital Purchase Program", *Ekonomi-tek*, January 2013, vol. 2:1, pp. 79–114.

[2]Including more than 450 small and community banks and 22 certified community development financial institutions (CDFIs).

The Federal Reserve and U.S. Treasury had to develop criteria for deciding whether to bail out a given bank or allow it to go under. Many such judgments were made on a case-by-case basis during the height of the crisis, and the debate over the effectiveness of the entire rescue program for the country's commercial banks continues to this day. On the one hand, regulators were leery of entering into "moral hazard" territory (Gale and Vives, 2002; Dam and Koetter, 2011; Stiglitz, 2012); on the other hand, bank recapitalisations were obviously necessary to support solvent but illiquid banks and thus avert a catastrophic collapse of the entire financial system (Fender and Gyntelberg, 2008).

Compared with other types of government support, the purchase of preferred or common shares is often seen as one of the most efficient types of capital infusions (see Wilson and Wu, 2010). Another argument in favour of the CPP is that the program did not end up costing much to taxpayers. Specifically, it spent only $204.9 billion of its $250 billion budget (more than a third of the total Troubled Asset Relief Program). The largest investment was $25 billion and the smallest was $301,000.

By April 30, 2013, the Treasury had recovered more than $222 billion from the CPP through repayments, dividends, interest and other income (from U.S. Department of Treasury website). However, not all bank stakes issued under the CPP at that time were held by the Treasury. In March 2012, the Treasury started to wind down its remaining bank investments through public auctions. This process accelerated during the fall of 2012.

This chapter focuses on the determinants of the liquidity provisions under the CPP. It first defines the factors that contributed to the final bailout allocation and to bailout repayments[3]. Based on that, it is possible to assess the effectiveness of the allocation of CPP funds according to the goals of the program and the realised risks for taxpayers.

The presented analysis rests on four main hypotheses. The first hypothesis is that the distribution of CPP funds and their repayments were geared to the perceived financial fragility of commercial banks just before the crisis. Regulators were expected to provide liquidity to

[3]The bailout repayments under the CPP mean the repurchase of the Treasury's equity stake.

more financially vulnerable banks as well as to those banks exposed to the so-called "tail risk" that materialised after a secular collapse in the housing market.

The second hypothesis is that the CPP was designed to minimize the spreading of the crisis. First, there was the risk of a drying up of credit availability due to the deterioration in the intermediary role of the banking sector. Second, there was significant counterparty risk, mostly from the side of LCFIs (Large Complex Financial Institutions), which proved to be "too big to fail" due to their size, complexity, interconnectedness, and other factors. Several indicators are used in this paper to identify systemically critical institutions: Marginal Expected Shortfall (MES) (Acharya *et al.*, 2010), $\Delta CoVaR$ (Adrian and Brunnermeier, 2011), bank size, and beta.

Another hypothesis underlying this study is that political contributions (including lobbying activities) and a bank's location could have caused a more generous distribution of CPP funds towards specific financial institutions. In this vein, Duchin and Sosyura (2012) find evidence of politically connected firms having priority in being funded.

A bank's excessive risk-taking before the crisis might be one more reason for its participation in the CPP. The higher the degree of risk taken by such an enterprise (indicated by the change in the bank's share value), the larger its losses should be during the crisis and thus the greater its need for CPP funds vis-à-vis other banks (Acharya *et al.*, 2002).

The chapter contributes to the literature on bailouts and on the effectiveness of liquidity provisions. The allocation of CPP funds is investigated and evaluated by analysing bailout repayments over the four years following the disbursement of CPP funds (2009–12). In this regard, it is an important source of information on the realised risks of funding allocations. Methodologically, polytomous and duration models are applied to analyse capital injections under the CPP and their reimbursement.

Not all banks were automatically eligible for the CPP. First, a bank had to request participation in the CPP by applying to the appropriate Federal banking agency (FBA). Second, the Treasury had to approve the bank's application. Then, the bank had 30 days from the date of that notification to accept the Treasury's terms and conditions and to submit investment agreements and related documentation. This being the case, if a particular bank was not bailed out, two distinct scenarios were possible to explain why.

First, that bank either did not apply for CPP funds in the first place or did not accept the Treasury's conditions after receiving preliminary approval, perhaps because of the availability of cheaper alternative financing or the absence of the need to recapitalise. Second, such a bank could have been refused CPP funds by the Treasury for two main reasons: (i) it was considered to be insolvent or (ii) its financial situation was deemed superior to those of other applicants (given that the amount to be disbursed under the CPP was limited). Of these, the first reason seems to be more realistic, as not all CPP funds were disbursed and most banks were suffering from liquidity shortages equally.

According to a report by the Government Accountability Office (2009), the Treasury had received over 1,300 CPP applications from regulators by June 12, 2009, while more than 220 applications had not yet been forwarded to the Treasury by bank regulators[4]. Further, approximately 400 financial institutions that had received preliminary approval had withdrawn their CPP applications by June 12, 2009 because of the uncertainty surrounding future program requirements. However, in this paper, no distinction is made between these two situations, as no data on individual bank applications are freely available. This limitation has been taken into account when interpreting the results.

The results of logit as well as multinomial logit regressions analysis confirm that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks. At the same time, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury than other banks. Thus, saving these banks helped avoid large external costs for the other sectors of the economy in the event of a total collapse of the banking sector, while taxpayers' money was returned in relatively short order. However, such an allocation of CPP funds might have contributed to the creation of moral hazard and

[4]The deadline for applications by small banks was then extended until November 21, 2009.

triggered more future bailouts of large and ”too interconnected” banks. In addition, while financially distressed banks (according to their Z-scores) were more likely to be bailed out (and to receive a larger amount), this was not the case for banks with portfolios overweighted with mortgage-backed securities (MBSs), mortgages, and non-performing loans.

There are several interpretations of these results, depending on whether a bank decided not to apply for CPP funds or the Treasury rejected the bank's application. A bank may have decided not to apply for CPP funds if the mortgages and MBSs on its books were of primary loan type. This means that banks preferred to leave high-quality loans on their balance sheets and to securitise and sell off less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. However, if the Treasury decided not to bail out a commercial bank, it may have been due to its specialising in mortgage lending and MBSs rather than commercial lending.

Banks that specialised in commercial and industrial loans might have been viewed as more viable and temporarily illiquid through no fault of their own (the cause being deterioration of the interbank market), unlike their counterparts that had been wallowing in mortgage lending, which were now insolvent after engaging in predatory lending before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012.

3.2 Estimation methodology

3.2.1 Determinants of CPP funds allocation in 2008–2009: logit and OLS regressions

Allocation of CPP funds among commercial banks in the U.S. is analysed using logistic regression and cross-section OLS. The former one focuses on the probability of the CPP funds disbursement to the particular commercial bank, while the latter one studies the relative size of the distributed CPP funds.

Logit regression allows to estimate the probability of the dependent variable to be equal to 1 (probability that some event occurs). Here BD_i represents a binary variable that takes a value of 1 if a particular bank i received CPP funds in 2008-2009; 0 otherwise.

Cross-sectional bailout probability $Pr(BD_i)$ is modeled in the following way:

$$Pr(BD_i) = \alpha_0 + \beta BC_{i,2007} + \gamma SR_{i,2007} + \chi PL_{i,2006-2008} + \eta RT_{i,2003-2006} + \epsilon_i \qquad (3.2.1)$$

where $BC_{i,2007}$ represent bank balance sheet characteristics for 2007 (indicators from private bank and company default models); $SR_{i,2007}$ are measures of bank systemic risk (and contribution to systemic risk) in 2007; $PL_{i,2007}$ are variables measuring political influence and locational advantages of the bank; $RT_{i,2003-2006}$ include variables associated with bank excessive individual risk-taking during the four years prior to crisis.

The detailed description of the variables and its selection is provided in section 3.3 and in Appendix D.

OLS model includes the same predictive variables while dependent variable is continuous and represents the relative size of disbursed amounts.

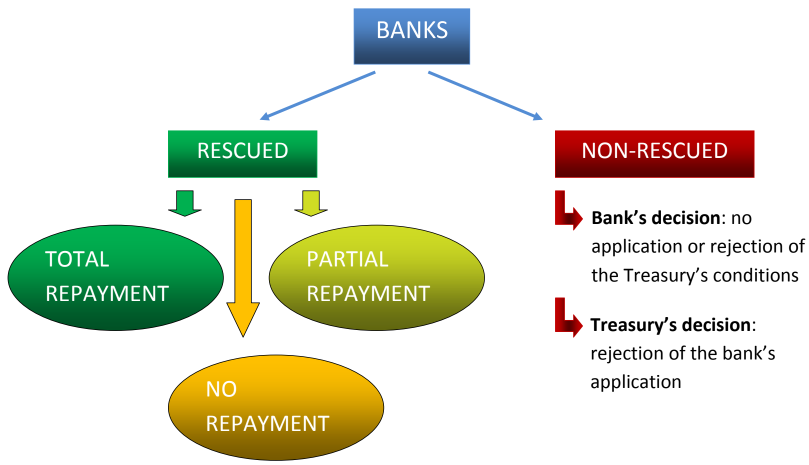
3.2.2 Multinomial (polytomous) logistic regression

Multinomial logistic regression uses the maximum likelihood method to predict a categorical dependent variable that takes on more than two outcomes that have no natural ordering. The discrete dependent variable in that model represents a bank's progress in CPP funds repayment by July 31, 2012.

The set of coefficients for explanatory variables is estimated for each outcome: no bailout, $y = 0$; bailout and total repayment, $y = 1$; bailout and partial repayment, $y = 2$; bailout and no repayment, $y = 3$ (figure 3.2.1).

There are no freely available data on individual bank applications. If a given bank was not bailed out, it might have been refused CPP funds by the Treasury. There are two possible

Figure 3.2.1: Bailout and repayment decision



reasons for such a rejection: (i) the bank was considered insolvent and exhibited a high risk of bailout non-repayment or (ii) its financial situation was considered to be superior to those of other applicants. Alternatively, a non-bailed out bank either did not apply for CPP funds or did not accept the Treasury's conditions after preliminary approval, perhaps because of the availability of cheaper alternative financing or having no need to recapitalise.

The model requires setting the base outcome. The coefficients associated with that base outcome are zero. That is, when the setting outcome is "bailout and total repayment" ($y = 1$), the coefficients for the remaining outcomes measure the change relative to that base group. The probability for each outcome is then measured in the next way ($\beta^{(1)} = 0$):

$$
\begin{aligned}
Pr(y=0) &= \frac{e^{X\beta^{(0)}}}{e^{X\beta^{(0)}} + 1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \\
Pr(y=1) &= \frac{1}{e^{X\beta^{(0)}} + 1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \\
Pr(y=2) &= \frac{e^{X\beta^{(2)}}}{e^{X\beta^{(0)}} + 1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}} \\
Pr(y=3) &= \frac{e^{X\beta^{(3)}}}{e^{X\beta^{(0)}} + 1 + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}
\end{aligned}
\tag{3.2.2}
$$

3.2.3 Duration analysis

Under the CPP, financial institutions received the funds in the period between October 2008 and December 2009, while the date of each bank's exit from the CPP depended on its ability to repurchase the Treasury's stake. The time until the bailout repayment is another measure quantifying the realised risks of funding allocations.

A central component of the analysis in this section is the hazard rate, which is the probability of the CPP refund at time t_i, conditional on not having repaid the bailout before (or having survived to time t_i). Thus, the failure event is the CPP funds repayment that appeared for around 50% of the banks that received the bailout. Other 50% of the banks did not repurchase their shares from the Treasury before the end of the analysed period (31 of July, 2012) and, thus, these observations are right censored.

One of the issues of the duration analysis is to define the shape of the hazard rate. The Semiparametric Cox proportional-hazards model allows us to leave the baseline hazard $h_0(t)$ without particular parametrisation, while the effects of the covariates are parametrised to alter the hazard function in a certain way:

$$h(t|x_j) = h_0(t)exp(x_j\beta_x) \tag{3.2.3}$$

where β_x are regression coefficients and are to be estimated from the data.

The advantage of Cox proportional hazards model is that no assumption is made about the shape of $h_0(t)$ from equation 3.2.3. However, when a correct form of the $h_0(t)$ is chosen, the model could fit the data better and produce better results.

Parametric models can be based, on the one hand, on the proportional-hazards assumption, and, on the other hand, on accelerated-failure-time (AFT) assumption. The first assumption allows the hazard rates monotonically increase or decrease with time.

Increasing hazard rate is in line with the expectations of banks' repayments. The Treasury purchased banks' preferred shares that had to pay 5% annual dividend, while after five years this rate jumped to 9%. Thus, the banks could be motivated to repurchase their shares before the rise of the dividend. At the same time the stabilised conditions on the financial markets allowed banks to switch to the alternative forms of financing. In this sense the "risk" or rate of repayments increases throughout the time, the hazard rate of repayments exhibits a positive duration dependence:

$$\frac{dh(t)}{dt} > 0 \tag{3.2.4}$$

The Kaplan-Meier estimate of the survival function is presented in figure 3.2.2. There is a period in the beginning (of around 100 days) when the function remains constant due to the absence of repayments[5]. For the rest the function is downward sloping and declines at more or less constant rate until 2.4 years (around 900 days) after the bailout. Starting from that point it starts declining at an increasing rate in the period between 2.4 and 2.8 years after the bailout. This period for most of the banks is associated with the third and fourth quarter of 2011. The last half a year (first and second quarter of 2012) the function continues to decline but at a decreasing rate.

Figure 3.2.3 presents smoothed estimates of the hazard function, which has a monotonically increasing shape until around 2.7 years after the bailout and then starts to decline. Together with figure 3.2.2 they suggest that there is an increased rate of repayment in the period between 1.5 and 2.8 years after the CPP funds disbursement, while this repayment hazard rate diminishes after 2.8 years following the bailout.

To capture the monotonically increasing shape of the hazard function, the Weibull distribution is chosen. It is determined by the location parameter and estimated shape parameter p:

$$h(t, x) = \lambda p(\lambda t)^{p-1} \tag{3.2.5}$$

[5]As we know the first refunds by commercial banks took place in March of 2009.

Figure 3.2.2: Kaplan-Meier survival function

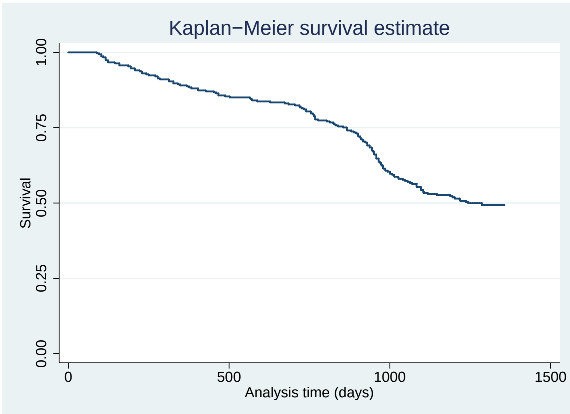
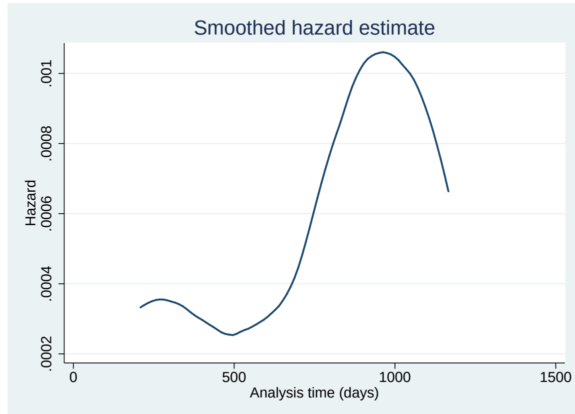


Figure 3.2.3: Estimates of the hazard function



If $\hat{p} > 1$, then the hazard is monotonically increasing with time.

The flattening of the Kaplan-Meier survival estimate and decline of the smoothed hazard estimate (figures 3.2.2 and 3.2.3, respectively) at the end of distribution, however, suggests a possibility of a non-monotonic pattern-of-duration dependence. The log-logistic distribution is chosen from among other AFT models.

$$h(t,x) = \frac{\lambda^{\frac{1}{\gamma}} t^{\left[\left(\frac{1}{\gamma}\right)-1\right]}}{\gamma\left[1+(t)^{\frac{1}{\gamma}}\right]} \tag{3.2.6}$$

As the Weibull model, the log-logistic model has two parameters: location parameter and shape parameter γ. The estimated shape parameter γ is expected to be less than one, when the conditional hazard first rises and then declines.

The choice between the parametric models is made using the Akaike Information Criterion (AIC) and log-likelihood. The AIC scores are compared between the parametric models. The lowest value of AIC is found for the Weibull model of baseline hazard, even though figure 3.2.3 suggests a greater resemblance to log-logistic and log-normal models. Log-logistic distribution of the hazard function is preferred to the log-normal one, according to the AIC criterion; anyway, it is commonly used when fitting data with censoring.

Thus, three duration models are finally fitted: the Cox proportional-hazards model (no specific parametrisation), the Weibull proportional-hazards model (monotonically increasing hazard function), and the log-logistic model (non-monotonic unimodal hazard).

3.3 Data and summary statistics

3.3.1 Data description

To construct the sample of firms, U.S. domestically controlled commercial banks were selected from DataStream. These financial companies operated in the U.S. market in U.S. dollars and were still active in December 2008. After variables needed for estimation were selected, around 650 commercial banks were left in the sample.

The data on bailouts (promised amount, actual disbursed amount, date of entering the program) and bailout reimbursement (amount repaid, date of repayment) were obtained from the Treasury's Office of Financial Stability. The data on political contributions and lobbying expenditures of PACs (Political Action Committees) related to banks came from the website of the U.S. Federal Election Commission.

The data from these three sources were merged. Bailouts under CPP were provided to domestically controlled banks, bank holding companies, savings associations, and savings and loan holding companies. Only actual disbursed amounts were considered as evidence of a bank bailout.

After outlier cleaning, 597 banks were left in the sample.

3.3.2 Dependent variables

Bailout dependent variables

- *Bailout dummy*

  The variable BD_i is a dummy that takes on two values, 0 and 1 (see table 3.1), that respectively denote the banks that did not receive CPP funds and those that have been bailed out by regulators. Banks that have finally received CPP funds applied for

Capital Purchase Program (CPP), have been approved for funding and then accepted the funds. If on one of the stages of that administrative process the bank refused or was refused to participate in the program, the bailout dummy is equal to 0. Out of 597 banks in the sample approximately 320 banks did not receive a bailout, around 280 banks received the CPP funds.

Table 3.1: Summary of dependent variables and balance sheet characteristics from Altman's and Moody's models for U.S. commercial banks

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Bailout dummy	BD_i	644	0.44	0.5	0	1
Size of the bailout normalised by bank total assets	B_i	644	0.01	0.01	0	0.07
Bailout and repayment categorical variable	R_i	644	0.87	1.16	0	3
Z-score, standardized	Z	597	0	1.00	-2.92	4.27
Moody's RiskCalc U.S. Banks						
Total equity to total assets, winsorized at 2% level, standardized	CS_1	661	0	1	-1.20	3.54
Total deposits to total assets, winsorized at 1% level, standardized	CS_2	642	0	1	-1.67	2.80
Net revenues to total assets, winsorized at 1% level, standardized	P_1	654	0	1	-2.25	3.68
Cash flow per share, winsorized at 2% level, standardized	P_2	640	0	1	-0.84	3.50
Mortgage Real Estate Loans to total loans ratio (in percentage), standardized	AC_1	661	0	1	-3.56	2.02
Consumer and Industrial Loans to total loans ratio (in percentage), winsorized at 2% level, standardized	AC_2	653	0	1	-1.22	3.21
Treasury Securities to total assets ratio (in percentage), winsorized at 2% level, standardized	Liq_1	607	0	1	-0.56	3.59

Continued on next page

Table 3.1 – *Continued from previous page*

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Mortgage-Backed Securities to total assets ratio (in percentage), winsorized at 2% level, standardized	Liq_2	641	0	1	-1.04	3.36
Non-performing loans to total loans ratio (in percentage), winsorized at 2% level, standardized	AQ	661	0	1	-.91	3.69

- *Bailout continuous variable*

  Bailout continuous variable represents actual disbursed CPP funds amount normalised by bank total assets. The maximum relative size of the bailout reaches 7% (see table 3.1). Among the bailed out banks more than 50% obtained capital of the relative size between 2% and 3% of their total assets (see figure 3.3.1 for histogram). The correlation with dependent variables is shown in table 3.2. Correlation coefficients are higher in its absolute values for the bailout dummy but the most correlated explanatory variables remain the same for the relative size of bailout.

CPP funds allocation and repayment

This discrete dependent variable classifies the banks into four groups: banks that did not receive the CPP funds, ($y = 0$); banks that received the CPP funds and reimbursed them totally, ($y = 1$); banks that received the CPP funds and reimbursed them partly, ($y = 2$); and banks that received the CPP funds but did not pay back anything, ($y = 3$).

Slightly more than half of the represented banks did not receive the CPP funds in 2008–09 (Figure 3.3.2). Around 20% of the banks from the sample received the CPP funds and repaid them totally; another 20% of them received the CPP funds but did not pay back anything by July 31, 2012; and a small fraction of the banks (less than 5%) repaid the CPP funds partly (the majority of which repaid at least 50% of the total amount).

Table 3.2: Correlation between dependent variables (dummy and relative size of bailout) and explanatory balance sheet variables for U.S. banks

Model	Var	BD_i	B_i	R_M	Z	CS_1	CS_2	P_1	P_2	AC_1	AC_2	Liq_1	Liq_2	AQ	EM	Lev	Vol
Bail-t dummy	BD_i	1.00															
Bail-t size	B_i	0.90	1.00														
Repay-t	R_M	0.82	0.78	1.00													
Altman's Z-score	Z	-0.20	-0.16	-0.22	1.00												
Moody's	CS_1	-0.15	-0.12	-0.15	**0.66**	1.00											
	CS_2	0.11	0.07	0.06	-0.06	-0.19	1.00										
RiskCalc	P_1	-0.05	0.00	-0.03	0.24	-0.07	-0.08	1.00									
	P_2	0.04	0.01	0.04	0.11	-0.02	-0.03	0.15	1.00								
	AC_1	-0.16	-0.15	-0.05	0.01	0.06	0.10	-0.19	-0.08	1.00							
	AC_2	0.15	0.16	0.06	-0.04	-0.06	-0.12	0.20	0.08	**-0.89**	1.00						
	Liq_1	-0.17	-0.19	-0.14	0.00	0.07	-0.08	-0.15	-0.02	-0.01	-0.03	1.00					
	Liq_2	-0.10	-0.11	-0.15	0.03	0.00	0.26	-0.31	-0.05	-0.01	-0.02	-0.02	1.00				
	AQ	-0.11	-0.12	0.03	-0.24	-0.08	0.04	0.15	0.13	0.07	-0.03	0.03	-0.11	1.00			
Bond	EM	0.05	0.02	-0.05	**0.56**	0.12	0.29	0.02	-0.02	0.03	-0.05	-0.03	0.11	-0.43	1.00		
	Lev	0.15	0.14	0.20	**-0.77**	-0.44	0.14	-0.22	-0.11	0.07	-0.08	0.02	-0.03	0.19	-0.37	1.00	
	Vol	0.02	0.04	0.07	-0.15	-0.12	0.12	0.22	-0.02	0.10	-0.01	-0.11	-0.06	0.18	-0.14	0.02	1.00

The correlation coefficients larger than 0.5 in their absolute values are highlighted in bold.

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Figure 3.3.1: Distribution of actually disbursed bailout amount to bank total assets ratio, winsorized at 1%

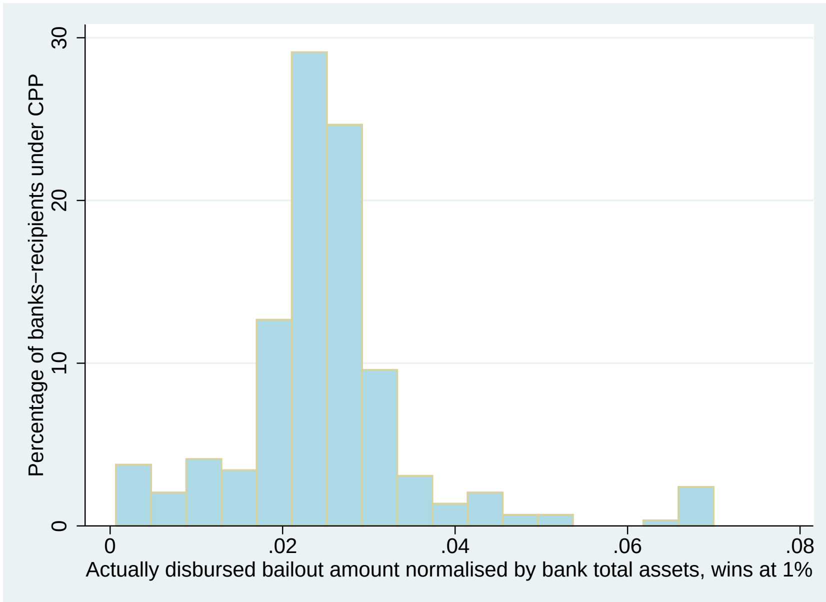
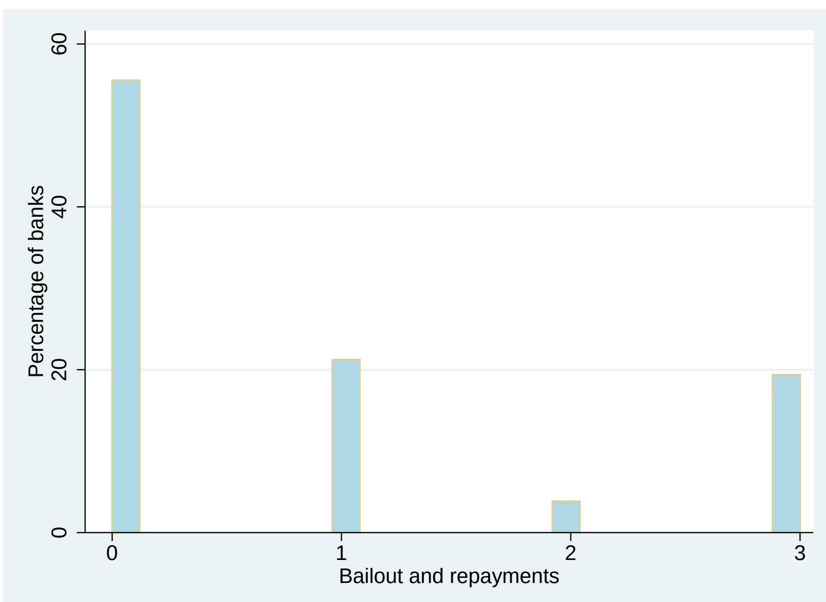


Figure 3.3.2: Distribution of the ordinal variable describing bailout and its repayment by commercial banks by May, 2012



Time-to-repayment

The time at risk or time until the event occurs (here the CPP funds repayment) is analysed in this duration model.

Only bailed out banks were considered for the estimation. Thus, around half of the observations were left in the sample, around 280 banks. The analysed period was limited to between the distribution of the CPP funds in 2008–09 and July 31, 2012. In that period, approximately half of these banks repaid the bailouts.

A bank was said to have repaid the CPP funds if it managed to repurchase the total amount of preferred shares from the Treasury by the end of the analysed period (total refund). Time-to-repayment was counted in days.

The data and the repayment announcements suggested the first repayments would take place in March 2009, around half a year after the start of the CPP program. Starting from that period, the probability of CPP refunds increases with time (see section 3.2.3 for details).

3.3.3 Bank balance-sheet characteristics

Bank balance-sheet characteristics are financial-statement variables that define the "financial health" of a bank, or, in other words, determine the probability of the bank's default. One group of the most popular measures are so-called CAMEL-type variables often used by the regulators for the banks' evaluation. The ratings that are calculated using such variables are confidential, however, the proxies for each category are often used in the empirical literature (Duchin and Sosyura, 2012; Ratnovski and Huang, 2009). Here indicators from the next three models were included: Altman's Z-score, KMV Moody's RiskCalc for U.S. banks, BondScore (Credit Sights) model. Some indicators appeared to be highly correlated with each other and needed to be excluded from the final estimation.

Altman's Z-score

Altman's bankruptcy model proposes a Z-score indicator for each firm, representing the level of distress of that firm. It is the same Z-score that was used in Chapter 2 for non-financial firms. The details regarding calculation of Z-score can be found in Appendix B.1. A higher Z-score is interpreted as an indicator of a "safer" or, in other words, more financially healthy firm, while a lower Z-score indicates a high level of distress for that organization.

It is expected that safer financial firms would show they had suffered less from the capital shortage and had had a smaller probability of receiving the CPP funds. As Altman's Z-score contains parameters like retained earnings, earnings before interest and taxes (EBIT) and other indicators of firm profitability, it is logical that such firms should have performed better than others during the crisis and even if they've participated in the CPP, needed a relatively smaller amount and reimbursed it totally in the first years following the bailout disbursement.

Moody's KMV RiskCalc V3.1 U.S. Banks

More recently, Moody's rating agency came out with its KMV RiskCalc V3.1 model for predicting probability of a bank's default. It comprises financial-statement variables and equity-market information on a bank's prospects and business risk. Financial ratios are classified in one of the next groups: capital structure, profitability, asset concentration, liquidity and asset quality. The weight of each variable is then calculated using non-parametric techniques and the estimated default frequency is computed for each bank.

As expected, default frequency measures as well as the formula for computing them are not available to the public, so the input variables of the Moody's model are plugged directly into the regressions (taking into account the probability of multicollinearity between indicators from different models). Several exact ratios that are proposed by Moody's model were not available on Datastream, thus, proxies for these variables and ratios have been used. Each category is represented by at least one variable; descriptive statistics are provided in table 3.1. The main variables are discussed below.

The following interpretation of the financial statement variables and their hypothetical influence on the bailout probability is done through the notion of the bank's probability of default.

The **Capital Structure group** includes the **ratio of total equity to assets** from the Moody's model (referred to as CS_1 in correlation table and tables with results). The correlation with bailout dummy, relative size of disbursed amount and repayment categorical variable is negative, -0.15, -0.12 and -0.15 respectively (table 3.2). It suggests that the banks with higher capital ratio are associated with a smaller probability of bailout. It can be due to, on one hand, less applications from better capitalised banks for participation in the CPP, on the other hand, due to the Treasury's decision to recapitalise the banks that need it the most, thus, with smaller capital ratios. The capital ratio is highly (positively) correlated with Z-score (correlation coefficient is 0.66, table 3.2) that suggests that Z-score includes most of the information from that variable (for a discussion on multicollinearity issues see section).

The second variable from this category is **total deposits to total assets ratio** (referred to as CS_2 in tables). It is often used in the academic literature to take into account to which extent a bank relies on internal financing. Government is motivated to save the banks which rely on depositary funding (to avoid collapse in aggregate demand and assure political stability in the country), thus, correlation of normalised size of total deposits with bailout dummy and repayment dependent variable is positive even though not very high (0.11, 0.07 and 0.06 respectively, table 3.2).

In the **Profitability group** two variables are included: **net revenues** (including interest income) **normalised by total assets** (P_1 in tables) and **cash flow per share** (P_2 in tables). The former indicator is suggested by Moody's model, the latter one is often used in academic literature to assess the profitability of private companies and have been available on Datastream. Correlation between these two variables is positive (0.15), while none of the two is significantly correlated with bailout dependent variables. According to Moody's Model, higher profitability is associated with lower probability of default and, thus, lower probability of bailout (or need is CPP funds). Negative correlation between the relative size of net income and relative size of Mortgage Backed Securities (MBS hereafter, correlation coefficient is -0.31) suggests that in 2007 commercial banks more exposed to MBS have had lower income than other banks.

Asset Concentration group consists of two variables: **real estate mortgage loans** (AC_1 in tables) and **commercial and industrial loans** (AC_2 in tables), normalised by total loans.

Real Estate Mortgage Loans (AC_1) include commercial and construction mortgages; thus, the relative size could be positively correlated with the size of commercial and industrial loans (AC_2). It appears, though, that these groups of loans are highly but negatively correlated with each other (correlation coefficient is -0.89, table 3.2). It means that if a bank is concentrated in real-estate mortgage lending, it provides fewer loans for commercial and industrial purposes[6]. That can be interpreted as a bank's loan portfolio "specialisation".

Liquidity-related variables (**Liquidity group**) measure the share of liquid assets on the balance sheet of a bank. Moody's RiskCalc v3.1 U.S. Banks model (2006) and Basel II regulation classified mortgage-backed securities (MBS) as safe and liquid holdings. That was indeed the case at the time; MBSs also included government mortgages offered by the Government National Mortgage Association or other U.S. Federal agencies. There exists now a large brunch of literature supporting securitisation as an efficient way to make mortgage loans more available and to lower the interest rates for households. However, the instrument that was developed to transfer the risk to market investors became a source of gambling for the banks.

In the recent crisis, MBSs became highly risky and illiquid assets. That is why the initial indicator proposed in Moody's RiskCalc model that brought together Treasury securities and mortgage-backed securities (as both representing liquid groups of assets) has been replaced by two separate ratios. Higher exposure of the bank to MBSs (Liq_2) is expected to be associated with a worse overall liquidity position of the financial firm in the crisis of 2007, thus, higher probability of bailout. Higher ratio of Treasury securities to total assets (Liq_1), vice versa, is associated with higher liquidity of the commercial bank (due to "flight to

[6]Commercial and industrial loans represent a general amount of loans made to business and industry excluding commercial mortgages and including consumer loans.

security" Treasury securities remained the most liquid during the crisis).

Higher liquidity should reduce the probability of bank's default suggesting a negative correlation with the share of Treasury securities on the balance sheet of the firm. It is indeed the case for the relative size of Treasury securities: the correlation coefficients between the relative size of Treasury securities and bailout dependent variables are negative (-0.17, -0.19 and -0.14 respectively, table 3.2). However, the correlation between normalised mortgage-backed securities (Liq_2) and dependent variables is also negative (-0.10, -0.11 and -0.15 respectively, table 3.2) which leads to the conclusion that government was not focusing on saving banks with higher share of mortgage-related assets (or it was not the primary goal) when taking decisions on providing CPP funds and/or the banks more exposed to MBSs kept on their books securities of better quality ("adverse selection" argument).

Asset Quality group is represented by the **share of non-performing loans in total loans**. Moody's model includes commercial and consumer charge-offs, thus, loans or debts from each category which have been delinquent and subsequently written off. These specific variables were not available on Datastream. These indicators are replaced by the share of non-performing loans in total loans. Non-performing loans can be seen as a lagged indicator that precedes charge-offs (later some loans may recover). The volume of net loan losses is also available on Datastream but it is, as expected, highly correlated with the normalised non-performing loans.

Lower asset quality is expected to increase the probability of default and, consequently, the probability of the bailout. Nevertheless, the correlation coefficient between the bailout dummy and normalised non-performing loans in 2007 is negative (-0.11 and -0.12 with bailout dummy and relative size of disbursed amount, table 3.2) which means that higher level of non-performing loans in 2007 is associated with the smaller probability of the bailout.

BondScore Model

The BondScore Credit Model is another model that calculates credit risks for publicly traded U.S. non-financial corporations with total assets in excess of $250 millions and publicly traded equity.

Three variable from the BondScore Model are analysed (the others are similar to the indicators from Moody's RiskCalc Model): the ratio of earnings before interest, taxes, depreciation and amortization (EBITDA) to a bank's net revenues (EBITDA margin, EM); leverage (Lev); and the volatility of EBITDA (Vol). It is expected that commercial banks with higher margins, lower leverage, and less volatility would exhibit a smaller probability of default and, consequently, would suffer less from liquidity shortages during the crisis. It seems to be the case, even though the indicators are not highly correlated with bailout dependent variables except for leverage. Firms with higher leverage are associated with higher probability of the bailout as well as higher probability of non-repayment of the bailout (the correlation coefficients are 0.15 with bailout dummy, 0.14 with relative size of disbursed amount and 0.20 with categorical repayment variable).

However, the first two BondScore variables cannot be kept in regressions due to the high risk of multicollinearity.

3.3.4 Systemic Risk variables

One of the goals of the CPP was to prevent the crisis spreading from one big institution to another and from the financial sector to the economy at large. Thus, regulators were focused on rescuing those financial institutions they believed were critical to the survival of the entire system.

One of the most frequently used proxies for systemic risk is a firm's size (standardised, $Size_{i,2007}$, table 3.3). It supports the "too big to fail" argument: the lender of last resort cannot deny support to large financial institutions whose closure would significantly affect the rest of the market (Freixas and Parigi, 2008). Thus, larger financial institutions are expected to have a higher probability of receiving CPP funds as well as larger disbursed amounts of the funds. Correlation coefficients are presented in table 3.4. A bank's size is indeed highly and positively correlated with bailout dependent variables (correlation coefficients are 0.24, 0.14 and 0.18 respectively with bailout dummy, relative size of disbursed amount and repayment categorical variable).

The second variable that represents the systemic risk is $Beta_{i,2007}$. It is the correlation between the share value of a financial institution and the overall market. The details on the construction of systemic risk variables are presented in Appendix D. During the crisis period, the stock market in general performed abominably; thus, a company with a higher beta should exhibit a higher probability of default and, accordingly, require government intervention. Correlation coefficients from table 3.4 confirm that hypothesis (0.26, 0.26 and 0.19 with respective bailout dependent variables).

$\Delta CoVaR$ was developed by Adrian and Brunnermeier (2011). $\Delta CoVaR$ represents the difference between the Value-at-Risk of the financial sector – conditional on institution "i" being in distress – and the unconditional Value-at-Risk of the financial sector (see details in Appendix D).

Marginal Expected Shortfall (MES_α) is the expected percentage loss in market value faced by a financial institution when a shock drives the market beyond some threshold (see Appendix D for details).

MES is calculated over three different periods (it could not be done with $\Delta CoVaR$ as there are not enough observations): for the year 2007 ($MES_{i,2007}$), for the period of eight years preceding the crisis (from 2000 to 2007, $MES_{i,2000-2007}$), and for the periods surrounding Bear Stearns and Lehman Brothers collapses (February, March, September and October of 2008, $MES_{i,BSLB}$).

All the measures of systemic risk are calculated in such a way that the higher value of the variable indicates a higher contribution of the commercial bank in question to systemic risk. The correlation coefficients from table 3.4 are positive, confirming that a higher contribution

Table 3.3: Summary of BondScore balance sheet characteristics, systemic risk, political involvement and individual risk-taking related variables

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
BondScore U.S.						
$\frac{EBITDA_{2007}}{Sales_{2007}}$, winsorized at 2%level, standardized	EM	632	0	1	-3.24	1.83
$\frac{Debt_{2007}}{MarketCap+BookValueDebt_{2007}}$, winsorized at 1%level, standardized	Lev	604	0	1	-3.57	2.52
$Volatility_{2007}$, standardized	Vol	502	0	1	-1.88	3.43
Systemic risk						
Size (logarithm of total assets), standardized	$Size_{i,2007}$	661	0	1	-2.84	3.49
Beta, standardized	$Beta_{i,2007}$	621	0	1	-1.76	2.78
Marginal expected shortfall (MES) for 2007, standardized	$MES_{i,2007}$	626	0	1	-2.41	2.95
Marginal expected shortfall (MES) over 8 years between 2000 and 2007, winsorized at 1%level, standardized	$MES_{i,2000-2007}$	632	0	1	-1.87	3.65
Marginal expected shortfall (MES) for the Bear Stearns and Lehman Brothers near-collapse, winsorized at 1%level, standardized	$MES_{i,BSLB}$	608	0	1	-1.81	2.51
Conditional Value-at-Risk, standardized	$\Delta CoVaR_{i,1990-2007}$	628	0	1	-3.13	1.97
Political influence and location						
Political influence dummy	$PD_{2006-2008}$	658	0.03	0.18	0	1
State	$State$	661	25.90	14.39	1	51
Individual risk-taking						
Change in log stock prices during 2003-2006, winsorized at 1% level, standardized	$\ln(q_{i,2003-2006})$	525	0	1	-3.09	2.64

Table 3.4: Correlation between dependent variables (dummy and relative size of bailout) and explanatory systemic risk, political influence, location and individual risk variables for U.S. banks

Type	Var	BD_i	B_i	R_M	$Size$	$Beta$	$MES_{i,2007}$	$MES_{i,2000-2007}$	$MES_{i,BSLB}$	$\Delta CoVaR$	$PD_{2006-2008}$	$State$	$ln(q_{i,2003-2006})$
Depend var-s	BD_i	1.00											
	B_i	0.90	1.00										
	R_M	0.82	0.77	1.00									
Systemic	$Size$	0.24	0.14	0.18	1.00								
Risk	$Beta$	0.26	0.26	0.19	**0.62**	1.00							
	$MES_{i,2007}$	0.12	0.06	-0.02	**0.74**	**0.62**	1.00						
	$MES_{i,2000-2007}$	0.16	0.10	0.00	**0.78**	**0.61**	**0.80**	1.00					
	$MES_{i,BSLB}$	0.15	0.10	0.00	**0.68**	**0.59**	**0.90**	**0.74**	1.00				
	$\Delta CoVaR$	0.05	0.02	0.00	0.25	0.14	0.19	0.20	0.17	1.00			
	$PD_{2006-2008}$	0.12	0.08	0.08	0.39	0.20	0.19	0.24	0.18	0.15	1.00		
	$State$	-0.04	-0.04	-0.03	-0.01	-0.06	0.02	0.02	0.02	0.01	0.01	1.00	
	$ln(q_{i,2003-2006})$	-0.04	-0.02	-0.04	-0.12	-0.09	-0.09	-0.09	-0.08	-0.11	-0.02	-0.03	1.00

The correlation coefficients larger than 0.5 in their absolute values are highlighted in bold.

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

to systemic risk is associated with the higher probability of CPP funds disbursement.

3.3.5 Political Involvement and Location indicators

Wall Street is one of the largest contributors to Federal political campaigns. Monetary contributions to political campaigns and lobbying activities on behalf of the industry are carried out through political action committees (PACs). The data on PAC contributions contain information on official contributions of bank-related PACs. Surprisingly, only 3.3% of financial firms were found to be official contributors between 2006 and 2008.

Lobbying expenditures are another way for the private sector to curry favor with those in power. It is mostly focused on government legislation or specific issues rather than on particular politicians. Lobbying data is taken from Senate's Office of Public Records.

The political-involvement dummy is then constructed, $PD_{2006-2008}$. The dummy takes on a value of one if, in the underlined period, the PAC related to the bank made a political campaign or lobbying contribution, zero otherwise. The correlation of the political-involvement dummy with the bailout variables suggests a positive influence of the former on the latter (0.12, 0.08 and 0.08 with bailout dummy, relative size of disbursed amount and repayment categorical variable).

To control for bank location, the state dummy is then included into regressions.

3.3.6 Bank's excessive risk-taking

The literature describes several attempts to discern from the past performance of financial institutions whether those who had pursued riskier strategies had learned from financial crises to be more careful or continued in the same vein[7].

The representative variable from this group aims to account for individual risk-taking of a bank. It is calculated as the difference in log stock prices of the bank between 2003 and

[7]For instance, through the performance of the banks during the LTCM crisis in 1998, Fahlenbrach *et al.* (2011)

2006, $ln(q_{i,2003-2006})$. Firms that take on more risk and follow more aggressive investment strategies to achieve higher returns are expected to have experienced a major run-up in their stock prices during that period. These should also be the same entities that sustained the most damage during the crisis and that required government intervention to survive. However, the correlation is very low with bailout dependent variables which means that this variable does not contain useful information to predict the bailout probability, bailout size or the repayment of the bailout by the bank.

3.3.7 Multicollinearity problem

It is logical that several financial ratios proposed by different probability of default models are similar to each other. Including all of them could be a reason of high multicollinearity in the regressions that would lead to greater standard errors and larger estimated coefficients. The correlation matrix for all financial indicators is shown in table 3.2.

Altman's Z-score includes information on the relative size of bank's equity, sales and leverage by construction. Consequently, there is a high positive correlation between the capital ratio (CS_1) from Moody's RiskCalc Model and Z-score(0.66, table 3.2), between Z-score and EBITDA margin (ratio of EBITDA and net firm sales, EM) from BondScore model (0.56, table 3.2) and high negative correlation between Z-score and leverage ratio (Lev) from BondScore Model (-0.77, table 3.2). The signs of correlation coefficients are correct: well-capitalised, more profitable and less levered firms are the ones that have a higher Z-score and, thus, are considered to be financially healthier ("safer") than other firms.

Due to the high probability of multicollinearity between these variables, equity size, EBITDA margin and leverage are not included in the regressions.

Systemic risk related variables are also highly correlated with each other (table 3.4). High positive correlation between beta ($Beta$) and firm size ($Size$) means that larger banks are more correlated with the market. Both variables are also positively correlated with Marginal Expected Shortfall (MES) indicators ($MES_{i,2007}$, $MES_{i,2000-2007}$, MES_{BSLB}) and

$\Delta CoVaR_{i,1990-2007}$ which means that larger and more correlated with the market banks are also the most systematically risky ones. Large losses of these firms during the recession periods affect in significant way the rest of the market. This conclusion is in line with findings of Brownlees and Engle (2010) who confirm a positive impact of firm size on MES.

The correlation is positive between the MES measures and $\Delta CoVaR_{i,1990-2007}$ and is about 0.20 (table 3.4), thus, even though these two types of measures of systemic risk are similar to each other, they carry different information and can be both included into regression. However, none of MES indicators can be included into regressions with beta or firm size due to high probability of multicollinearity (correlation coefficients are between 0.60 and 0.70, table 3.4).

3.4 Results

3.4.1 Logit and OLS regressions analysing the bank bailout probability and the relative size of the amount disbursed under the CPP

The results are reported in table 3.5. Columns 3, 5 and 7 present results for logit regressions with binary outcome: bailout or no bailout. Columns 4, 6 and 8 present results for OLS cross-sectional regressions where the dependent variable is the actual disbursed amount normalised by bank's total assets. For each model, the results for three alternative regressions are reported with different measures of systemic risk: beta ($Beta_{i,2007}$), columns 3 and 4; bank size ($Size_{i,2007}$), columns 5 and 6 and Marginal Expected Shortfall over 7 years from 2000 to 2007 ($MES_{i,2000-2007}$), columns 7 and 8.

In order to avoid large tables and concentrate on significant variables, regressions are conducted using stepwise backward selection method with significance level for removal of 0.05. Balance sheet variables, systemic risk and individual excessive risk-taking variables are standardised. It makes the size of parameters (or effects of the explanatory variables) comparable within each column.

The empirical evidence is in favour of the main argument provided in the beginning of this article: more financially distressed firms (illiquid commercial banks) applied for participation in the CPP and exhibited a higher probability to be accepted by the U.S. Treasury. Banks with higher Z-score in 2007 (thus, "safer" or more financially stable banks according to Altman's Z-score) are less likely to be bailed out in 2008- 2009 (see columns 3, 5 and 7, table 3.5) and if bailed out, they receive CPP funds of a smaller size (see columns 4, 6 and 8, table 3.5).

Besides, OLS regression with beta (column 4, table 3.5) suggests that an increase in Z-score by one (variable is standardised, thus its standard deviation is equal to one) is associated with a reduction in the amount distributed under the CPP by 0.3%.

Among Moody's RiskCalc model indicators these are asset concentration, liquidity and asset quality variables that are significant and that remain significant in each regression. The empirical results suggest that the banks specialised in commercial and industrial loans (AC_2 in tables) than in mortgage lending (AC_1 in tables) are more likely to be bailed out (and to receive larger amounts of financial aid) in 2008-2009.

On one hand, the crisis of 2007 was originated in the subprime loan market and one could expect regulators to start saving banks with higher share of mortgage loans. On the other hand, under both Basel I and Basel II the weight of mortgage loans in risk-weighted assets was smaller than that of corporate loans. Thus, banks exposed to commercial loans could be considered by the Treasury more affected during the crisis.

In many cases banks that have originated large amounts of mortgage loans securitised them, repacked and then sold to third-party investors in form of mortgage-backed securities. These assets (including AAA-rated mortgage-backed tranches) became illiquid following the collapse in housing markets. Then one could expect monetary regulators to focus on saving the banks with higher exposure to mortgage-backed securities in order to raise the liquidity

Table 3.5: Determinants of the bank bailout probability and the relative size of the bank bailout under the Troubled Asset Relief Program in 2008-2009, U.S. commercial banks, stepwise cross-sectional estimation

Type of var	Name	**Logit** With *Beta*	**OLS** With *Beta*	**Logit** With *Size*	**OLS** With *Size*	**Logit** With *MES*	**OLS** With *MES*
Balance sheet char-s							
Altman's	Z	-0.712***	-0.003***	-0.910***	-0.003***	-0.691***	-0.003***
Z-score		(-4.288)	(-5.119)	(-5.441)	(-5.543)	(-4.24)	(-6.07)
Moody's	CS_2					0.285*	
RiskCalc						(2.38)	
	P_1	-0.331**				-0.267*	
		(-2.304)				(-1.97)	
	AC_1	-0.372***	-0.002***			-0.422***	-0.002***
		(-3.111)	(-2.957)			(-3.58)	(-3.27)
	AC_2			0.230**	0.002***		
				(2.143)	(2.663)		
	Liq_1	-0.437***	-0.002***	-0.377***	-0.002***	-0.424***	-0.002***
		(-3.385)	(-3.186)	(-3.051)	(-3.425)	(-3.43)	(-3.65)
	Liq_2	-0.509***	-0.002***	-0.498***	-0.002***	-0.581***	-0.002***
		(-3.616)	(-4.211)	(-3.698)	(-4.151)	(-4.04)	(-3.97)
	AQ	-0.345***	-0.002***	-0.378***	-0.002***	-0.292**	-0.0015**
		(-2.934)	(-3.719)	(-3.316)	(-3.402)	(-2.58)	(-2.97)
Systemic Risk	$Beta_{i,2007}$	0.613***	0.003***				
var-s		(5.019)	(6.158)				
	$Size_{i,2007}$			0.749***	0.003***		
				(5.826)	(5.094)		
	$MES_{i,2000-2007}$					0.330**	0.00153**
						(2.69)	(2.71)
Political inv-t	$PD_{2006-2008}$	1.895**					
		(2.214)					
	Constant	-0.213*	0.011***	-0.318***	0.011***	-0.188	0.0109***
		(-1.836)	(20.38)	(-2.78)	(19.93)	(-1.69)	(20.01)
	R^2		0.178		0.148		0.128
	Pseudo-R^2	0.166		0.150		0.126	
	Obs	505	505	514	514	519	519

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

in financial market. Results show that it was not the case: firms with higher exposure to mortgage-backed securities (Liq_2 in tables) were less likely to be bailed out (and if bailed out, received a smaller amount).

Treasury securities remained one of the most liquid and, thus, highly demanded financial assets during the financial crisis. Hence, more liquid banks in terms of higher share of treasury securities (Liq_1 in tables) on their balance sheets should have been financially more stable during the crisis and should not have applied for the financial funds (or applied for a relatively smaller amount). The estimated coefficients from table 3.5 confirm that argument. A part of the loans originated before the financial crisis remained on the banks' balance sheets. It could be argued that banks preferred to leave on their balance sheets mortgage loans and MBSs of higher quality while subprime loans have been mostly securitised and sold to other entities (Acharya *et al.*, 2009). In the literature it is otherwise referred to as an "adverse selection" problem of lenders and could explain why the banks more exposed to mortgage loans and MBSs applied less for participation in the CPP (and received smaller amounts of CPP funds). Somewhat surprisingly, results suggest that banks with higher share of non-performing loans in 2007 (AQ in tables) had a smaller probability to receive CPP funds and if received, the amount distributed under the CPP was smaller. It could be caused by the Treasury's decision. The banks more exposed to non-performing loans could be considered insolvent due to their excessive lending prior to crisis and not temporarily illiquid due to the shortage of liquidity in the financial markets[8].

Systemic risk variables beta ($Beta_{i,2007}$), bank size ($Size_{i,2007}$) and MES ($MES_{i,2000-2007}$) have positive significant coefficients that means that regulators concentrated in offering liquidity to larger, more correlated with the market and riskier institutions. Another measure of systemic risk, $CoVaR_{i,2000-2007}$ is not significant that can be due to not long enough period of estimation and low frequency of used data (no other data is available in free access).

Political involvement variable is significant in only one regression that could be due to

[8] Recall that the CPP was designed for the latter ones.

the poor data availability.

State dummy is not significant at all, as well as bank's individual risk-taking measured by the past performance of the bank's stock prices.

Models fit the data well, R-squared (pseudo R-squared for logit) reaches 17%-18%.

3.4.2 Polytomous logistic model

The multinomial (polytomous) logistic model is used to define the factors that determined the probability of the bank bailouts under CPP and their repayment/non-repayment in the period between 2009 and 2012. The dependent variable indicates if a bank was bailed out or not, and, if it was, how much did it repay to the Treasury by July 2012: the total amount, a part of the disbursed amount, or nothing at all (see figure 3.2.1 and section 3.3.2 for details).

The results for the multinomial regressions are presented in table 3.6. The base outcome is disbursement of the CPP funds to the bank i and total repayment by July 2012.

The coefficients presented in table 3.6 are multinomial log-odds (logits)[9]. They are interpreted as a change in the logit of outcome m ("no bailout", "bailout and partial repayment", "bailout and no repayment") relative to the reference group ("bailout and total repayment") for a unit change in the predictor variable, if the other variables in the model are held constant.

Table 3.6 reports the results for three model specifications with distinct measures of systemic risk: beta ($Beta_{i,2007}$) in column 3; bank size ($Size_{i,2007}$) in column 4, and Marginal Expected Shortfall measured over eight years, from 2000 to 2007 ($MES_{i,2000-2007}$) in column 5.

Balance-sheet characteristics, systemic risk, and individual excessive risk-taking indicators are standardized. The standard deviation of each of these indicators is then equal to one, which makes the size of the parameters comparable within each column.

[9] Another possibility would be to present the coefficients in terms of relative risk ratios.

Table 3.6: Determinants of the bank bailout and its repayment under TARP's Capital Purchase Program between 2008 and 2012, U.S. commercial banks, polytomous logistic regressions. Base outcome: bailout and total repayment

Type of var	Name	Polytomous logit with *Beta*	Polytomous logit with *Size*	Polytomous logit with *MES*
No bailout				
Balance sheet char-s				
ALTMAN'S	Z	**0.489****	**0.681*****	**0.617*****
Z-SCORE		(2.912)	(3.640)	(3.594)
MOODY'S	CS_2	-0.165	0.036	-0.225
RISKCALC		(-1.18)	(0.24)	(-1.67)
	P_1	0.368*	0.272	0.251
		(2.252)	(1.641)	(1.632)
	P_2	-0.035	0.244	-0.014
		(-0.211)	(1.380)	(-0.093)
	AC_1	**0.598*****		**0.572*****
		(4.428)		(4.274)
	AC_2		**-0.451*****	
			(-3.450)	
	Liq_1	**0.321***	**0.334***	**0.343***
		(2.092)	(2.100)	(2.245)
	Liq_2	**0.456****	**0.534****	**0.437****
		(2.840)	(3.144)	(2.748)
	AQ	**0.709*****	**0.813*****	**0.674*****
		(3.911)	(4.062)	(3.736)
BONDSCORE	Vol	0.337*	0.308	0.263
MODEL		(1.987)	(1.853)	(1.597)
Systemic Risk	$Beta_{i,2007}$	**-0.731*****		
var-s		(-5.042)		
	$Size_{i,2007}$		**-1.243*****	
			(-6.765)	
	$MES_{i,2000-2007}$			**-0.625*****
				(-4.577)
	$\Delta CoVaR_{i,1990-2007}$	0.135	0.241	0.178
		(1.040)	(1.78)	(1.385)
Political inv-t	$PD_{2006-2008}$	-0.379	1.091	-0.210
and location		(-0.495)	(1.330)	(-0.306)
	$State$	0.005	0.007	0.009
		(0.607)	(0.86)	(1.05)
Individual	$\Delta ln(q_{i,2003-2006})$	0.118	0.048	0.039
risk-taking		(0.732)	(0.286)	(0.254)
	Constant	1.003***	1.113***	0.967***
		(3.802)	(4.140)	(3.748)
Bailout and	**partial repay-t**			
Balance sheet char-s				
ALTMAN'S	Z	0.134	0.236	0.140
Z-SCORE		(0.385)	(0.619)	(0.381)
MOODY'S	CS_2	-0.013	0.104	0.033
RISKCALC		(-0.041)	(0.334)	(0.114)
	P_1	-0.091	-0.193	-0.147

Continued on next page

Table 3.6 – *Continued from previous page*

Type of var	Name	Polytomous logit with *Beta*	Polytomous logit with *Size*	Polytomous logit with *MES*
		(-0.255)	(-0.541)	(-0.444)
	P_2	**0.595****	**0.756*****	**0.636****
		(2.913)	(3.410)	(3.160)
	AC_1	0.525		0.388
		(1.748)		(1.358)
	AC_2		-0.269	
			(-0.988)	
	Liq_1	-0.194	-0.202	-0.188
		(-0.539)	(-0.555)	(-0.523)
	Liq_2	0.059	0.047	0.033
		(0.173)	(0.128)	(0.101)
	AQ	**0.592***	**0.821****	**0.657***
		(2.006)	(2.640)	(2.288)
BondScore	Vol	0.472	0.573	0.538
Model		(1.445)	(1.869)	(1.753)
Systemic Risk	$Beta_{i,2007}$	0.305		
var-s		(1.017)		
	$Size_{i,2007}$		-0.237	
			(-0.675)	
	$MES_{i,2000-2007}$			-0.028
				(-0.105)
	$\Delta CoVaR_{i,1990-2007}$	-0.081	-0.043	-0.058
		(-0.291)	(-0.155)	(-0.213)
Political inv-t	$PD_{2006-2008}$	1.603	1.815	1.747*
and location		(1.816)	(1.665)	(1.995)
	$State$	-0.021	-0.021	-0.022
		(-1.156)	(-0.179)	(-1.222)
Individual	$\Delta ln(q_{i,2003-2006})$	0.370	0.297	0.283
risk-taking		(1.245)	(1.023)	(1.009)
	Constant	-1.673**	-1.402**	-1.484**
		(-3.109)	(-2.748)	(-2.932)
Bailout and	**no repay-t**			
Balance sheet char-s				
Altman's	Z	-0.254	-0.088	-0.120
Z-score		(-1.207)	(-0.392)	(-0.560)
Moody's	CS_2	-0.157	0.082	-0.106
RiskCalc		(-0.985)	(0.466)	(-0.665)
	P_1	0.047	-0.019	-0.023
		(0.250)	(-0.101)	(-0.117)
	P_2	0.140	0.364	0.168
		(0.832)	(1.920)	(0.990)
	AC_1	**0.415****		**0.364***
		(2.666)		(2.328)
	AC_2		**-0.301***	
			(-2.004)	
	Liq_1	-0.076	-0.044	-0.067
		(-0.393)	(-0.229)	(-0.350)
	Liq_2	-0.347	-0.211	-0.304
		(-1.639)	(-0.984)	(-1.436)
	AQ	**0.543****	**0.695****	**0.571****

Continued on next page

Table 3.6 – *Continued from previous page*

Type of var	Name	Polytomous logit with *Beta*	Polytomous logit with *Size*	Polytomous logit with *MES*
		(2.797)	(3.281)	(2.945)
BondScore	Vol	0.251	0.293	0.303
Model		(1.351)	(1.597)	(1.649)
Systemic Risk	$Beta_{i,2007}$	**-0.338***		
var-s		(-2.075)		
	$Size_{i,2007}$		**-1.040*****	
			(-4.886)	
	$MES_{i,2000-2007}$			**-0.757*****
				(-4.303)
	$\Delta CoVaR_{i,1990-2007}$	-0.014	0.160	0.148
		(-0.102)	(1.024)	(0.963)
Political inv-t	$PD_{2006-2008}$	0.229	1.327	0.258
and location		(0.290)	(1.465)	(0.312)
	$State$	0.004	0.004	0.005
		(0.381)	(0.408)	(0.458)
Individual	$\Delta ln(q_{i,2003-2006})$	0.157	0.099	0.067
risk-taking		(0.878)	(0.551)	(0.369)
	Constant	-0.146	-0.004	-0.173
		(-0.460)	(-0.008)	(-0.555)
	Pseudo R^2	0.156	0.168	0.153
	Obs	505	514	519

Notes: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1% and 5% respectively

The first section in table 3.6 (section ”no bailout” of table 3.6) reveals factors that affect the probability of the bank receiving no bailout (group ”0”), as opposed to the group of banks that received the bailout and repaid it totally (group ”1”). Bear in mind that the ”no bailout” outcome could have been caused by the bank's own decision not to apply for the CPP funds or by the Treasury's rejection of the bank's application.

The empirical evidence suggests that the CPP funds were provided to financially distressed firms. A one-unit increase in a bank's Z-score (Z) is associated with a 0.489 rise in the multinomial log-odds for the ”no bailout” outcome relative to the ”bailout and total repayment” outcome (column 3, section ”no bailout”, table 3.6).

Safer or financially stable banks (with a higher Altman's Z-score in 2007) are less likely to have applied for the CPP funds, as they had easier access to alternative sources of financing. Besides, they were less likely to be approved by the Treasury for participation in the CPP as the stipulated amount was limited ($250 billion, later reduced to $218 billion), and the program was aiming at illiquid financial institutions.

Recall that real-estate mortgage loans (AC_1) and commercial industrial loans (AC_2), normalised by total loans, are negatively correlated (the correlation coefficient is -0.89, table 3.2). This can be assumed to mean that many banks either specialised in mortgage lending or in commercial and industrial lending. When thinking of these specializations in relation to the origin of the financial crisis (the boom-and-bust housing market and, particularly, the excesses in the subprime-mortgage market), one might understandably assume that those banks highly active in mortgage lending were the ones left holding a disproportionate share of illiquid assets and having to apply for the CPP. After all, wasn't the government intent on helping American homeowners by supporting mortgage lending and preventing massive residential defaults?

However, the results show the opposite. Banks well known for their mortgage lending (AC_1) were more likely not to receive the CPP funds, as suggested by the coefficients from Section "no bailout." A one-percentage-point increase in the share of real-estate mortgage loans leads to a 0.598 rise in multinomial log-odds for a "no bailout" outcome relative to a "bailout and total repayment" outcome (column 3, section "no bailout", table 3.6).

In any case, even if the banks that were heavily into that sort of loans had received the bailout, they were more likely not to have repaid it (section "Bailout and no repayment", table 3.6). A one-percentage-point increase in the share of real-estate mortgage loans in total loans leads to a 0.415 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (column 3, section "bailout and no repayment", table 3.6).

An opposite effect is found for the banks that were more exposed to commercial and industrial loans (AC_2): they were more likely to be bailed out and less likely to fail to repay the funds before July 2012. All these findings confirm the results for logit and OLS regressions, with the dependent variables being, respectively, a binary outcome regarding the CPP funds disbursement ("bailout"/"no bailout") and the relative size of the disbursed amount.

If the reason for no bailout was the bank's own decision (no application or the last-stage refusal of the Treasury's conditions), then those specializing in mortgages must have found Treasury's conditions too strict (and looked for alternative financing) or they did not need to be recapitalized. The former explanation does not seem to be very plausible, as CPP conditions were relatively lenient. Most financial institutions participating in the CPP had to pay Treasury a 5% dividend on preferred shares for the first five years and a 9% rate thereafter[10]. In the United Kingdom, the dividend to be paid to the Treasury was set at 12% for the first five years and the three-month London Interbank Offered Rate (LIBOR) plus 700 basis points thereafter[11].

The latter explanation suggests that the banks leaning toward mortgage activity were not willing to apply for the CPP, perhaps because the pre-crisis assets on their books were of a good quality. If so, such banks preferred to leave the high-quality loans on their balance sheets and to securitise and sell off the less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles (for more information on adverse selection practices see Acharya and Richardson, 2009).

In cases where the Treasury decided to bail out a commercial bank, it seems as though the regulators had a bias for petitioners specialising in commercial lending (in order to avoid the drying up of liquidity for businesses). One of the explanations for this could be the relative risk weight of corporate and mortgage loans – if the Treasury was basing its decision on pre-crisis indicators. According to both Basel I and Basel II, the weight of mortgage loans in risk-weighted assets was smaller than that of corporate loans.

Another possibility is that banks that specialised in commercial and industrial loans could have been regarded as more viable and only temporarily illiquid due to the deterioration of

[10]In addition, Treasury received warrants to purchase common shares or other securities from the banks at the time of the CPP investment.

[11]Not mentioning restrictions on executive compensation, dividends, lending commitments, and board appointments.

the interbank market, while those that were predominantly mortgage lenders were seen as insolvent due to their predatory behavior before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012, minimising the risk of non-repayment of CPP investments.

The coefficients for the relative size of non-performing loans (AQ) have to be interpreted in a similar way. The results show that a one-unit rise in the share of non-performing loans in total loans leads to a 0.709 rise in multinomial log-odds for the not-bailed-out banks relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (column 3, section "no bailout", table 3.6).

Thus, the banks more exposed to non-performing loans had a higher probability of not being bailed out, while they also exhibited a higher probability of not repaying the CPP funds. A one-unit larger share of non-performing loans in total loans is associated with a 0.543 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (column 3, section "Bailout and no repayment", table 3.6).

This result correlates with findings of the U.S. Government Accountability Office (GAO) in March 2012. The GAO reported that the institutions remaining in the CPP tended to hold riskier assets than other institutions of similar asset size (Government Accountability Office, 2012).

It is possible that banks that were more exposed to non-performing loans did not apply for CPP funding because they found the program's conditions too onerous. However, it is more probable that it was the Treasury's decision to reject the applications of these banks. A higher share of non-performing loans could be considered an indicator of a bank's insolvency, which would also be associated with greater risks of CPP funds non-repayment.

Banks with stronger positions in Treasury securities (Liq_1) and MBSs (Liq_2) before the crisis are less likely to have been bailed out in 2008–09. The first relationship is justified by the high safety and liquidity of Treasury bills, especially in a time of crisis (the "flight to safety" argument). The banks with the highest level of such liquid assets had a lesser need for external financing and tended not to apply for the CPP. For its part, the Treasury apparently selected temporarily illiquid banks that were holding few Treasury bills.

The second relationship is less clear, as a significant part of MBSs became illiquid during the crisis. Potential explanations are similar to those given for mortgage loans. First, the adverse selection argument suggests that the MBSs kept on the books of the banks were of a prime loan type and thus remained liquid during the crisis. Second, regulators were able to make their decision based on the pre-crisis risk weights of assets (as in regulatory capital ratios). In that case, larger shares of MBSs in banks' portfolio would be an indicator of higher liquidity.

The last possibility is that the Treasury classified the banks having greater amounts of MBSs as less viable than other banks or even insolvent. If so, then such a bank was considered an excessive risk taker that was in trouble due to its own faulty strategy and not due to temporary market factors. In addition, a bank in this category would be seen as being less likely to repurchase its shares from the Treasury (even though it is not confirmed by the coefficients from section "bailout and no repayment", table 3.6).

Analysis of the repayments of the CPP funds from the point of view of the taxpayers reveals that the investment risks were minimised. This is because the CPP funds were provided to the banks with the highest probability of repaying them in the short term: those that were less exposed to MBSs, mortgages, and non-performing loans and those specialising in commercial loans.

However, from the perspective of consumers and borrowers, the program had a potentially counterproductive effect. Since banks with large positions in MBSs, mortgages, and non-performing loans were not helped by the government, which regarded them as less viable than others or more likely to fold, they faced severe liquidity problems. Many mortgage lenders, in particular, couldn't restructure much of their portfolios and were hit by a record number of foreclosures; finding themselves with cash shortfalls, these institutions were forced to raise the interest rates on their mortgages, thus putting the squeeze on even the most creditworthy of homeowners.

All systemic risk variables are significant with negative coefficients when predicting "no bailout" and "bailout and no repayment" outcomes. Larger banks that correlated more with the market ($Beta_{i,2007}$) and with greater contribution to systemic risk ($MES_{i,2000-2007}$) were more likely to apply for CPP assistance (as they experienced greater losses during the crisis) and to be accepted into the CPP by the Treasury. This confirms the assumption that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks in order to restore financial stability and avoid negative spillover effects, as happened when Lehman Brothers imploded.

Moreover, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury compared with other banks. This should not be surprising: it should not be forgotten that the leading banks in the U.S. always had a greater capacity to restore themselves to financial health, given their multiplicity of business lines and ability to attract alternative sources of financing – partly a result of the conventional wisdom that they were too big for the government to allow them to fail.

Nevertheless, the justification for the CPP remains: saving these banks helped head off damage to other sectors of the economy, and, in any case, the taxpayers got their money back relatively quickly.

3.4.3 Time-to-repayment analysis

Another way to look at the factors that brought about the CPP funds repayments is to analyze the time it took for a bank to exit the program. The choice of parametrisations for that analysis is described in 3.2.3. Each continuous variable that enters the model is checked for correlation with a dependent variable. In addition, the models with single continuous predictors are considered as well as the results of the Chi-squared tests in order to choose predictors for the final model.

Results for three types of regressions (with Cox PH, Weibull, and log-logistic parametrisations) are presented in table 3.7. Similar to the results from the previous section, model specifications include different systemic risk measures: beta ($Beta_{i,2007}$) and Marginal Expected Shortfall ($MES_{i,2000-2007}$).

The coefficients for proportional-hazard models (Cox PH and Weibull PH, columns 3, 4, 5 and 6, table 3.7) have to be interpreted differently than those for accelerated failure time models (log-logistic AFT, columns 7 and 8, same table). The coefficients from the first pair of models indicate how covariates affect the hazard rate. Positive coefficients increase the hazard rate and, therefore, reduce the expected duration. The positive coefficients from AFT models indicate how covariates influence the logged survival time and, hence, increase the expected duration.

For the models with Weibull parametrization, the logarithm of the shape parameter p is 0.483 and 0.510 (for the regressions with beta and MES as systemic risk indicators, respectively), which means that the value of the parameter is larger than one, and the hazard is monotonically increasing with time. These results fit the observations made from Figure 3.2.3. The more time that passes following disbursement of the CPP funds, the more banks repurchase their stakes from the Treasury.

Moreover, the logarithm of the shape parameter γ estimated for log-logistic regressions is negative (-0.654 and -0.710, respectively); thus, the value of the parameter is less than one, and the conditional hazard function first rises and then starts to fall. The more banks exit the CPP program, the fewer banks are left in the sample, and those remaining in the CPP experience difficulties with repaying CPP funds.

As the lowest value of AIC criteria is found for the Weibull model (columns 5 and 6, table 3.7), the more detailed interpretation of results is given for that model.

The rate of repayment (i.e. hazard rate) increases by 21.2% for the specification with beta ($Beta_{i,2007}$) and by 14.3% for the specification with MES ($MES_{i,2000-2007}$) with a unit increase in Altman's Z-score. Thus, more financially stable banks repurchase their preferred shares

Table 3.7: Time-to-repayment analysis, U.S. commercial banks, proportional hazards (PH) and accelerated failure time (AFT) models

Type of var	Name	**Cox PH**	**Cox PH**	**Weibull PH**	**Weibull PH**	**Log-logistic AFT**	**Log-logistic AFT**
		With *Beta*	With *MES*	With *Beta*	With *MES*	With *Beta*	With *MES*
Balance sheet char-s							
Altman's	Z	0.199**	0.128	0.212***	0.143*	-0.143**	-0.103
Z-score		(2.562)	(1.569)	(2.693)	(1.775)	(-2.294)	(-1.610)
Moody's	P_2	-0.108**	-0.113***	-0.107**	-0.114***	0.073**	0.085***
RiskCalc		(-2.468)	(-2.625)	(-2.468)	(-2.653)	(2.260)	(2.708)
	AC_1	-0.315***	-0.301***	-0.303***	-0.289***	0.206***	0.177***
		(-3.488)	(-3.209)	(-3.415)	(-3.171)	(2.862)	(2.659)
	AQ	-0.366***	-0.418***	-0.381***	-0.434***	0.250***	0.264***
		(-2.919)	(-3.131)	(-2.986)	(-3.196)	(2.910)	(3.062)
Systemic Risk	$Beta_{i,2007}$	0.221**		0.213**		-0.134**	
var-s		(2.364)		(2.275)		(-2.018)	
	$MES_{i,2000-2007}$		0.395***		0.392***		-0.291***
			(4.639)		(4.611)		(-4.384)
	Constant			-11.796***	-12.108***	7.040***	7.010***
				(-12.849)	(-12.979)	(74.831)	(73.900)
	$Ln(p)$			0.483***	0.510***		
				(5.976)	(6.372)		
	$Ln(gamma)$					-0.654***	-0.701***
						(-7.690)	(-8.339)
	AIC	1406.630	1406.519	546.147	536.265	549.771	537.188
	Obs	275	279	275	279	275	279

Notes: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1% and 5% respectively faster. These results are in line with the findings of the U.S. Government Accountability Office (Government Accountability Office, 2012). They report that the institutions remaining in the CPP by March 2012 were financially weaker than the ones that had exited the program.

Both the relative size of non-performing loans (AQ) and mortgage loans (AC_1) negatively affect the repayment hazard: a one unit increase in the former one is associated with a drop in rate of repayment by 38.1% (43.4% for the regression with MES); one unit increase in the latter one is associated with a 30.3% decline in the repayment hazard rate (28.9%).

Higher systemic risk values, vice versa, have a positive influence on repayment hazard: with one unit increase in beta, the rate of repayment increases by 21.3%. In case of a rise in MES the repayment hazard rises by 39.2%.

These results are in line with those presented in the previous section. More systemically risky banks managed to repurchase their preferred shares faster than the rest, while those with larger shares of non-performing and mortgage loans experienced more difficulties with repayments.

These findings can be thought of as the realized risks of the CPP investments. As was reported in the previous section, the banks exposed to non-performing and mortgage loans were less likely to be bailed out, while larger banks with a greater potential for contributing to systemic risk were more likely to receive the CPP funds. In terms of probability of repayment and time until repayment, the allocation decision is seen as having been correct, as it allowed regulators to select those banks that would be able to repurchase their shares from the Treasury in the shortest time.

Interestingly, higher cash flow per share (P_2) becomes significantly negative when explaining the repayment hazard rate. There can be several explanations of why the banks with higher cash flow repurchased their shares later. One of them is that these banks had higher cash flows due to their exposure to risky assets such as subprime loans. Thus, during the crisis, such bailed-out banks had greater difficulty repaying the CPP funds.

Another possibility is that the banks with higher cash flow per share did not wish to repurchase their shares from the Treasury too fast (this predictor also has a positive impact on the probability of partial repayment, section "bailout and partial repayment", table 3.6)), as it was a comfortable and relatively cheap source of external funding compared to market financing costs.

3.5 Conclusion

Conventional wisdom today holds that the Capital Purchase Program of the U.S. government was an unalloyed success. However, looking back, we perceive a number of flaws in the methodology of the program and their effects. The allocation of CPP funds is investigated and evaluated by analysing bailout repayments over the four years following the disbursement of CPP funds (2009-2012).

The empirical evidence from polytomous and duration models suggests that CPP funds were provided to systemically critical and financially distressed institutions. Nevertheless, commercial banks with higher share of real estate mortgage loans, MBSs and non-performing loans were less likely to be bailed out.

Not all banks were eligible for the CPP. A bank had to apply for the CPP, get an approval from the Treasury and finally accept the Treasury's conditions by providing required documentation. If the reason of no bailout was the bank's own decision, two explanations are possible: the banks exposed to MBSs, mortgage and non-performing loans did not need to be recapitalised or they found Treasury's conditions too strict (and looked for alternative financing).

A bank may have decided not to apply for CPP funds if the mortgages and MBSs on its books were of primary loan type ("adverse selection" argument). However, if the Treasury decided not to bail out a commercial bank, it seems as though regulators focused on saving those banks that specialised in commercial lending rather than those that specialised in mortgage lending and MBSs.

One of the explanations could be the relative risk weight of MBSs, corporate and mortgage loans in case the Treasury based its decision on pre-crisis indicators. According to both Basel I and Basel II the weight of mortgage loans and MBSs in risk-weighted assets was smaller than that of corporate loans.

Moreover, banks that specialised in commercial and industrial loans could have been considered to be more viable and temporarily illiquid due to the deteriorations in the interbank market, while banks that specialised in mortgage lending could have been seen as insolvent due to their predatory lending before the crisis.

This allocation of CPP funds was effective from the point of view of taxpayers. Larger firms with smaller shares of mortgages and non-performing loans, higher shares of commercial loans and greater contributions to systemic risk were more likely to be bailed out but also to reimburse CPP funds in full at short notice.

Most importantly, the overall positive impression of the efficacy of the CPP does not confirm the soundness of the "too big to fail" principle. In fact, such a philosophical driver of the allocation of CPP funds might have contributed to the creation of moral hazard and triggered more future bailouts of mammoth and "too interconnected" banks. Thus, more reforms should be introduced (expanding the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, see Acharya and Richardson (2009) for discussion) in order to limit the propensity of the financial sector to put the entire system at risk and to benefit from its "too big to fail" position.

From the point of view of consumers and borrowers, the program had a potentially ineffective side. Commercial banks exposed to mortgage-backed securities, mortgages and non-performing loans did not get enough financing from the government during the crisis. That could become a reason of a low number of loan restructurings and welfare loses for the homeowners.

More accuracy in the assessment of the effectiveness of the CPP funds could be achieved if the Treasury reported individual information on the status of CPP applications for each stage of the selection procedure. Distinguishing between financial institutions that did not apply for CPP funds, were rejected by the Treasury, or did not accept the Treasury's conditions would clarify the conclusions.

Appendix D

Systemic Risk indicators

Bank size ($Size_{i,2007}$) is the logarithm of total assets of the bank.

Beta ($Beta_{i,2007}$) is obtained from DataStream and represents the measure of the asset's risk with respect to the market (correlation with the market) over the past 5 years. Thus, $Beta_{i,2007}$ is calculated for the period from 2002 to 2007.

$\Delta CoVaR_p$ measures the marginal contribution of a separate financial firm to the risk of the whole financial sector (Adrian and Brunnermeier, 2011). It is calculated as a difference between Value-at-Risk of the financial sector conditional on institution i being in distress ($VaR_p^{FS|"i" distress}$) and the unconditional Value-at-Risk of financial sector (VaR_p^{FS}):

$$\Delta CoVaR_p^i = VaR_p^{FS|"i" distress} - VaR_p^{FS} \tag{D.0.1}$$

Institution i is said to be in distress when it exhibits the lowest growth rates of its market-valued total assets. VaR_p^{FS} are mean growth rates of financial sector at the p^{th} percentile (5^{th} percentile here) of its distribution unconditionally on other institutions. The growth rate of market-valued total assets (X_t^i) is calculated in the following way:

$$X_t^i = \frac{ME_t^i \cdot LEV_t^i - ME_{t-1}^i \cdot LEV_{t-1}^i}{ME_{t-1}^i \cdot LEV_{t-1}^i} = \frac{A_t^i - A_{t-1}^i}{A_{t-1}^i} \tag{D.0.2}$$

Knowing that

$$A_t^i = ME_t^i \cdot LEV_t^i = BA_t^i \cdot (\frac{ME_t^i}{BE_t^i}) \tag{D.0.3}$$

where ME_t^i is the market value of a bank i's total equity, LEV_t^i is the ratio of total assets to book equity, A_t^i are market-valued total assets, BA_t^i are book-valued total assets, $\frac{ME_t^i}{BE_t^i}$ is market-to-book ratio of institution *"i"*.

Following Adrian and Brunnermeier (2011) the growth rate of the financial sector is calculated as a weighted average of market-valued returns of all financial institutions in the sample:

$$X_t^{FS} = \sum_i (X_t^i \cdot w_{t-1}^i) \tag{D.0.4}$$

where w_{t-1}^i is the weight of financial institution i in banking sector at period *t-1*. The (unconditional) Value-at-Risk of the financial sector is then defined as bottom 5% growth rates of financial sector between July of 1990 and July of 2008 (quarterly data from Compustat). The Value-at-Risk of the financial system conditional on institution i being in distress is calculated as mean growth rates of financial sector in the periods when institution i was found to be in distress. The difference between two measures is $\Delta CoVaR_p^i$.

Marginal Expected Shortfall (MES_α) is expected percentage loss in market value faced by institution i given that a shock drives the market beyond the threshold C (market drop by more than a certain threshold). Expected shortfall is the average of financial market returns on days when the portfolio's loss exceeds its VaR limit. Financial market return R is a weighted sum of each bank's return r_i:

$$R = \sum_i w_i \cdot r_i \tag{D.0.5}$$

where w_i is the weight of bank i in the banking system. Expected shortfall of the financial sector can be then represented as a weighted sum of individual banks' expected shortfalls:

$$ES_\alpha = -\sum_i w_i E[r_i|R \leq -VaR_\alpha] \tag{D.0.6}$$

The Marginal Expected Shortfall of the bank i can be expressed as the derivative of expected shortfall of the banking sector with respect to the bank's weight w_i:

$$\frac{\partial ES_\alpha}{\partial w_i} = -E[r_i|R \leq -VaR_\alpha] = MES^i_\alpha \tag{D.0.7}$$

The threshold is defined at 5th percentile of market returns. Marginal Expected Shortfall of the bank i ($MES^i_{5\%}$) is computed in the following way:

$$MES^i_{5\%} = \frac{1}{N} \sum_{t:R-in-its-5\%-tail} r^i_t \tag{D.0.8}$$

where $\frac{1}{N} \sum_{t:R-in-its-5\%-tail} r^i_t$ are average returns of financial firm i when the banking sector returns are in their 5% tale (measured on a daily basis using S&P 500 index). $MES^i_{5\%}$ is calculated for 2007, over 8 years between 2000 and 2007 and for the periods surrounding Bear Stearns and Lehman Brothers collapses (February, March, September and October of 2008).

Chapter 4

Resuming bank lending in the aftermath of the Capital Purchase Program

4.1 Introduction

The well-functioning banking sector is often said to play a crucial role in cultivating business activity. Indeed, financial distress as well as the lack of confidence that undermined banking activity during the crisis of 2007 immediately affected the real economy. Governments had to undertake conventional and ad hoc measures offering liquidity in the form of bailout packages. The main program that provided liquidity to U.S. commercial banks was the Capital Purchase Program (CPP). The goal of these interventions was to stabilise the financial system by providing capital to viable financial institutions (see details in Chapter 3). However, there is still no clear evidence of the efficacy of public (as opposed to market-based) capital injections for sustaining bank loan growth.

Empirical studies show that loan provisions to the private sector tend to slow down during banking crises (Kaminsky and Reinhart, 1999; Eichengreen and Rose, 1998; Demirgüç-Kunt *et al.*, 2006). There can be several reasons for that. On one hand, the literature focuses on the vulnerability of banks' balance sheets and their sensitivity to liquidity shortage. That transmission channel of credit supply to the real economy is investigated in Black and Rosen (2009); Hirakata *et al.* (2009); De Haas and van Horen (2010); Berrospide and Edge (2010); Brei *et al.* (2011). It is confirmed that the bank's balance sheets position greatly affects the bank's credit offer to enterprises and individuals.

On the other hand, credit growth can decelerate not only due to the financial conditions of the bank and its willingness to lend, but also due to the deterioration in demand for bank products and services. The same adverse exogenous shocks that triggered the problems with bank's liquidity can induce the decline in the aggregate demand (Dell'Ariccia *et al.*, 2008). The overall decline in economic activity negatively affects the willingness of the individuals and firms to borrow, both for consumption and investments. Besides, as highlighted in Dell'Ariccia *et al.* (2008), the credit cycle effect à la Kiyotaki and Moore (Kiyotaki and Moore, 1997) can occur during the crisis. In that case, even creditworthy borrowers see the value of their collaterised assets (as well as their balance sheets) to deteriorate, which leads to a decline in the credit offer, even by healthy banks.

Thus, there is a link with the literature focusing on disentangling the relative impacts of demand and financial shocks (Tong and Wei, 2009b; Claessens *et al.*, 2012). These authors suggest several indexes for measuring the sensitivity of the nonfinancial firms to demand shocks that could be also applied to the financial sector.

In its attempt to distinguish between these two effects on credit growth rates, this chapter is closely related to the second chapter of the thesis. This chapter uses the methodology of Brei *et al.* (2011) in order to estimate the impact of bank capital, other bank balance sheet characteristics, and sensitivity to demand shocks on bank lending. That framework allows for the introduction of structural changes in parameter estimates for the period of the crisis and for normal times, as well as for bailed-out and non-bailed banks. While Brei *et al.* (2011) focus on the data regarding 108 large international banks, in this chapter the focus is on the

U.S. commercial banks and the role of the CPP in resuming bank lending.

This chapter contributes to the literature on the efficacy of public capital injections during the crisis. It provides the framework in which the sensitivity of the bank's credit offer to financial distortions and its sensitivity to decline in aggregate demand are separated from each other[1]. The relationship between bank balance sheet characteristics, sensitivity to the demand shock, and bank credit growth is analysed for the banks that received CPP funds and the banks that did not participate in the CPP in normal times and during the crisis. Moreover, the same relationship is also investigated for the subsample of the financial firms that received the CPP funds in order to distinguish between the banks that repurchased their stake from the U.S. Treasury and the banks that did not repurchase their stake by July of 2012.

The great deal of this chapter is focused on pre-testing the models and selecting the adequate instruments for the estimators with instrumental variables. I start with fixed effects estimator that, however, does not allow us to obtain the parameter estimates for the time-invariant variables (such as bailout or repayment dummy). Besides, as the model is dynamic, the fixed effects estimator is inefficient and might lead to inconsistent estimates. The Mundlak-Krishnakumar model (Mundlak, 1978; Krishnakumar, 2006) is then conducted and, on one hand, provides the estimates for time-invariant variables and, on the other hand, following Chatelain and Ralf (2010), is used as a pre-test estimator that helps to select instrumental variables for further estimations. The Hausman-Taylor estimator (Hausman and Taylor, 1981) enables the separation between exogenous and endogenous time-variant and time-invariant variables. With regard to the endogenous nature of the bailout dummy[2], it is expected to obtain consistent and efficient estimates using that method.

The logit regression from Chapter 3 is then used as a first-stage in the Two Stage Least Squares (2SLS) model based on instrumental variables (IV). The bailout dummy is instru-

[1] In most of empirical studies, demand factor is proxied by changes in the GDP of the country. It means that they do not take into account heterogenous reactions of the financial institutions to the changes in aggregate demand (see Berrospide and Edge, 2010; Brei *et al.*, 2011).

[2] See discussion in Chapter 3

mented using the proxy for systemic risk (beta) and the share of mortgage-backed securities in a bank's total assets. The fitted values of bailout dummy are then plugged into the second stage regression. The final models are Arellano-Bond first-difference (Arellano and Bond, 1991) and Blundell-Bond estimators (Blundell and Bond, 1998) that use Generalised Method of Moments-style (GMM) instruments and are often referred to as one of the most efficient estimators when working with large number of observations and small-time dimension datasets and when fitting the dynamic model.

The empirical evidence on the effects of capital shortage supports the theory. Banks with a higher level of capitalisation tend to lend more both during the crisis and in normal times. This result is in line with that of Francis and Osborne (2009), who use data on U.K. banks and report that better-capitalised banks are more willing to supply loans. The same is confirmed by Foglia *et al.* (2010), who also find that this effect is intensified during the crisis.

Moreover, during the crisis, bailed-out banks exhibited higher growth rate of loans than in normal times (before 2008) and higher than that of non-bailed banks during the crisis, with a one percentage point increase in capital ratio. This means that liquidity provisions to the banks during the recent crisis supported bank lending. Besides, these results extend those from Chapter 3 suggesting that bailed-out banks were also the ones that could contribute to a larger extent to the rise in credit offer. It also seems that the banks that were characterised as specialised in commercial and industrial lending and that exhibited higher probability of receiving CPP funds (see Chapter 3 for details) were also the ones that contributed to a larger extent to the growth rates of loans (thus, mostly commercial and industrial loans, as they were specialised in that type of lending).

The same results also show that during the crisis, more capital is required for the non-bailed banks to sustain the growth of credit supply on a pre-crisis level. In tough times, additional capital is not that easily translated into extended credit offers by the banks that did not benefit from the CPP program, as they prefer to keep a substantial part of it for their internal needs.

It seems that the banks that repaid CPP funds by July of 2012 were the ones that received enough additional capital to support their operations during the crisis and to continue providing credits to enterprises and individuals. In their case, the recapitalisation scheme worked efficiently, providing them the possibility to repurchase their stake from the Treasury and to translate additional capital into more lending.

It is also in line with the results of Brei *et al.* (2011), who argue that the banks-recipients of CPP funds start to translate additional capital into greater lending during the crisis once their capitalisation exceeds a critical threshold. That critical threshold should also account for the commitment to reimburse the CPP funds. The bank that is not capable of repurchasing its stake from the Treasury cannot be expected to expand the credit offer to enterprises and individuals. It is more probable that such a bank will adjust its assets portfolio to meet the capital requirements by cutting the number of newly issued loans.

The rise in aggregate demand contributes to the increase in bank lending in good times. However, during the crisis, the situation changes, especially for different types of loans. For instance, since 2007, the demand factor has had no impact on the growth rates of real estate mortgage loans for non-bailed banks. With the collapse in housing markets and generally unstable economic situation, consumers were less willing to take new mortgages.

4.2 Model and estimation methodology

4.2.1 Model

In this empirical model, bank lending between 1995 and 2011 is explained by two core factors: banks' financial constraint (or, in other words, the level of capitalisation) and their sensitivity to the shocks on aggregate demand. However, the period between 1995 and 2011 includes intensive growth (2001-2006), recession (2007-2009), as well as the period of sluggish economic growth following the recession (after 2009). Besides, substantial liquidity injections into the banking sector under the CPP took place during the recession in 2008-2009.

Such particular conditions during the analysed period cannot be ignored. They represent significant structural changes that may have affected the relationship between bank-specific factors and bank lending.

Thus, the parameter estimates are allowed to change for two states of economy: crisis and normal times. Besides, the parameters shift for the banks-beneficiaries of the CPP funds relative to the banks that did not receive the funds. Moreover, the subsample of the banks-recipients of CPP funds is analysed in order to check for differences in the same relationship among the banks that repurchased their stock from the U.S. Treasury in short notice (before July 2012) and the ones that did not.

The differential behaviour between the periods of time and banks is introduced in the model via dummies and their interactions with individual financial bank characteristics and sensitivities to changes in aggregate demand.

The first full specification of the dynamic panel regression following Brei *et al.* (2011) and Gambacorta and Marques-Ibanez (2011) is the following:

$$\begin{aligned} \Delta Ln(L_{it}) = \phi_0 + \phi_1 C_t + \eta \Delta Ln(L_{i,t-1}) + \chi_1 Z_{t-1} + \left[\chi + \chi^* C_t\right] B_i \\ + \left[\delta + \delta^* C_t + (\omega + \omega^* C_t) B_i\right] BSC_{i,t-1} + \alpha_i + \epsilon_{it} \end{aligned} \tag{4.2.1}$$

where

- $\Delta Ln(L_{it})$ is the growth rate of lending at the bank i during the year t ;
- $BSC_{i,t-1}$ are lagged bank-specific characteristics associated with financial and demand constraints of commercial bank i;
- Z_{t-1} are lagged macroeconomic controls (real GDP growth, change in Federal Funds interest rate);

- C_t is the dummy that distinguishes between the crisis period and normal times;
- B_i indicates the banks that received the CPP funds relative to those that did not;
- α_i represents random bank effects; and
- ϵ_{it} are observation-specific errors.

This model is estimated using fixed effects, Mundlak-Krushnakumar, Hausman-Taylor, Instrumental Variables (IV), Arellano-Bond first difference, and Blundell-Bond system GMM estimators. Each of these estimators transforms Equation 4.2.1 in a particular way in order to obtain efficient and consistent estimators. Clearly the estimators that are based only on within-transformation of the variables do not allow for the estimation of time-invariant variables, such as the bailout dummy. Hence, when using fixed effects and Arellano-Bond first difference estimators, the bailout dummy as well as the interactions between bank-specific variables and the bailout dummy are omitted from model 4.2.1, described above.

Another group of regressions is run on a subsample of 252 banks-recipients of CPP funds. The cofficients similar to those from the previous regression are marked herein with a subscript b. Here the differential relationship is allowed for the banks that redeemed their stake from the Treasury and those that did not:

$$\begin{aligned}\Delta Ln(L_{it}) = \phi_{b0} + \phi_{b1}C_t + \eta_b \Delta Ln(L_{i,t-1}) + \chi_b Z_{t-1} + \left[\chi_b + \chi_b^* C_t\right] R_i \\ + \left[\gamma + \gamma^* C_t + (\kappa + \kappa^* C_t) R_i\right] BSC_{i,t-1} + \alpha_{bi} + \epsilon_{bit}\end{aligned} \tag{4.2.2}$$

where R_i specifies the banks that reimbursed the CPP funds before July 2012 and the banks that did not pay anything (in the subsample of banks-recipients of CPP funds).

The same estimators as for model 4.2.1 are used to estimate model 4.2.2. R_i is the time-invariant repayment dummy, and thus, it is also omitted when using fixed effects and the Arellano-Bond first difference estimator.

Individual bank-specific characteristics $BSC_{i,t-1}$ include balance sheet indicators that account for supply factors that influence a bank's decision regarding the offer of the loans. The bank's financial constraint is mainly associated with its level of capitalisation. During the crisis, for instance, a bank's capital ratio is expected to worsen due to the bank's losses in subprime mortgage-related assets (it can also be any other adverse capital shock or even change in banking regulation). If the bank does not have enough capital buffer and cannot raise equity[3], it is expected that the bank will tend to adjust its capital ratio by cutting the number of newly issued loans.

In the literature, this question is often referred to as a trade-off between the marginal costs of issuing equity and the marginal cost of cutting back on lending. The results of the study conducted by Kiley and Sim (2010) suggest that the banks respond to a capital shock through a mix of financial disintermediation and recapitalisation. Besides, instead of just including macroeconomic controls on the country level (as was done, for instance, in Brei *et al.*, 2011), the individual levels of sensitivity to changes in U.S. real GDP are computed. They account for heterogeneous reactions of commercial banks to expansion or contraction of the aggregate demand. These bank-specific sensitivities to changes in GDP are introduced as proxies for the impact of demand factors on the bank's lending activity.

The basic idea of parameter estimates for interactions between crisis, bailout, and repayment dummies with sensitivity to GDP growth and balance sheet characteristics is similar. The estimation of the models described above results in the set of coefficients for any bank-specific factor (both balance sheet characteristic or sensitivity to demand shock), presented in table 4.1.

These various coefficients allow us to explore the impact of supply and demand factors on loan growth and to see how it changes (i) in the period of crisis compared to normal times; (ii) between the banks that received CPP funds and the banks that did not participate in the CPP; and (iii) between the banks that repurchased their stake from the Treasury by July

[3]That is the case, for instance, when the bank is not approved for the CPP funding.

Table 4.1: Resulting set of coefficients for the bank-specific characteristic BSC_1 and its interactions with dummies from models 4.2.1 and 4.2.2

Banks/Periods	No Crisis	Crisis
All banks		
No Bailout	δ_1	$\delta_1 + \delta_1^*$
Bailout	$\delta_1 + \omega_1$	$\delta_1 + \delta_1^* + \omega_1 + \omega_1^*$
No Repayment	γ_1	$\gamma_1 + \gamma_1^*$
Repayment	$\gamma_1 + \kappa_1$	$\gamma_1 + \gamma_1^* + \kappa_1 + \kappa_1^*$

2012 and the banks that did not. As indicated in the second chapter, the fact of the bank bailout means that the bank applied for CPP funds, was approved by the U.S. Treasury and accepted the final conditions by providing required documentation. Conversely, there are two possible reasons that the bank did not to receive the bailout: either the bank did not apply for CPP funds (because it had access to alternative sources of financing or did not require recapitalisation during the crisis), or the bank's application for participation in the CPP was rejected by the Treasury (for more discussion on that topic, see Chapter 3).

The coefficient δ_1 shows the short-term impact of the change in variable BSC_1 on bank lending at non-bailed banks in normal times ($B_i = 0$; $C_t = 0$). The long-term effect is given by $\frac{\delta_1}{1-\eta}$ for model 4.2.1 or by $\frac{\delta_1}{1-\eta_b}$ for model 4.2.2. When the coefficient δ_1^* is significant, it means that the relationship between the underlined variable BSC_1 and bank lending is significantly different in crisis time compared to normal times for non-bailed banks. The full impact is then calculated as $\delta + \delta^*$. Other coefficients are interpreted in a similar way.

In tables with results individual coefficients δ, δ^*, ω, and ω^* for model 4.2.1 and γ, γ^*, κ, and κ^* for model 4.2.2 are reported with stars identifying their level of significance, while the coefficients measuring the full impact ($\delta + \delta^*$, $\delta + \omega$ etc.) can be found in square brackets.

4.2.2 Endogeneity bias

Dynamic panel models 4.2.1 and 4.2.2 presented in section 4.2.1 allow for, on one hand, empirical modeling of dynamic effect through the lagged dependent variable (past behaviour affecting current one); on the other hand, individual-specific dynamics. When estimating these models, however, several econometric issues related to endogeneity bias may arise. They are described below followed by the proposed solution in form of the alternative estimator.

- Correlation between the lagged dependent variable $L_{i,t-1}$ and individual random effect ϵ_{it}. Nickell (1981) reports that standard methods of estimation such as within estimator and Ordinary Least Squares (OLS) can lead to seriously biased coefficients in dynamic models (often referred to as "fixed effects Nickell's bias"). This issue is particularly important in case of panel datasets with large number of individuals and small number of time periods. It is said that within autoregressive parameter bias is larger when the number of time periods T is small (less than 10), negligible when T is larger than or equal to 30. In the full sample of banks examined in this chapter the average number of available time periods is 10.1, while the maximum number of periods is 16 (annual data between 1995 and 2011), suggesting that the coefficients obtained via within estimator (presented in the following section) can be biased. The models that deal with autoregressive bias and that are designed for short time dimension and large entity dimension datasets are those based on Generalised Methods of Moments Estimator (GMM).

- Endogeneity of time-invariant variables B_i and R_i due to their correlation with individual-level random effect. This issue can be treated using the Hausman-Taylor estimator (Hausman and Taylor, 1981). That estimator assumes that some of the explanatory variables are correlated with the individual-level random effects, but that none of the explanatory variables are correlated with the idiosyncratic error. Endogenous bias of time-invariant variables is corrected using internal instruments, more details are presented in section 4.2.5. In that sense Hausman-Taylor estimator improves over Fixed Effects (because it allows to estimate the parameters for time-invariant variables) and over Mundlak-Krishnakumar estimator (that does not deal with the endogeneity of time-invariant variables).

- Endogeneity of time-varying indicators (such as bank-specific variables). That bias may arise due to correlation with individual random effects. Within transformation or first-differencing both permit to avoid that problem and obtain consistent parameter estimates.

- The presence of reverse causality. Loans growth rates are assumed to be endogenous; however, causality may run in both directions: bank-specific characteristics influence the growth rates of loans while the growth rates of loans affect bank-specific characteristics (for instance, capital ratio). Besides, the bailout dummy is endogenous as it is the consequence, on one hand, of the particular bank's decision (as the bank chooses to apply or not for the Capital Purchase Program and later accepts or not the final conditions attached by the Treasury), on the other hand, of the Treasury's decision (acceptance or refusal of the bank's application for CPP funds, more on that see in Chapter 3). In that case, the method of Instrumental Variables is efficient as it provides unbiased coefficients for endogenous regressors through the two-step estimation procedure (see section 4.2.6).

- Dealing with endogeneity bias using the instruments that are too many and weak. That is the issue that often arises when applying Arellano-Bond (Arellano and Bover, 1995) and system GMM (Blundell and Bond, 1998) estimators (see section 4.2.9). The proper instruments have to satisfy the conditions of validity (exogeneity) and relevancy that is not always the case. GMM estimators are supposed to deal with most of the endogeneity issues presented above, however, the consistency of the parameters obtained for time-invariant variables is not investigated so far.

4.2.3 Fixed effects estimator

Several techniques are used to measure the influence of bank-specific characteristics (BSC_{it}) on changes in bank lending to enterprises and individuals. First, dynamic panel regression 4.2.1 is estimated using the fixed effects (FE) estimator. This approach is based on the within groups estimator[4], which explores the impact of variables that vary over time within each group (bank).

The between estimator was not efficient with regard to the purpose of the analysis, in which over-time changes are important sources of information. The random effects (RE) approach, i.e., using Generalized Least Squares (GLS), requires common effects to be uncorrelated with regressors, which is unlikely. Besides, FE is preferred to RE according to the results of the Hausman test. The null hypothesis of no correlation between individual errors and regressors is rejected, and thus, the fixed effects model is chosen.

However, fixed effects estimator assumes that all regressors have non-zero within variance (i.e. variation over time for a given individual), thus, time-invariant variables such as the bailout dummy B_i and bailout repayment dummy R_i cannot be included in the regressions[5]. Lagged dependent variable is not included in the baseline regressions either due to its correlation with individual random effect ("fixed effects Nickell's bias" described in the previous section). Thus, the full specification of model 4.2.1 can only be analysed via a different econometric approach. The baseline model with fixed effects includes only main variables and their interactions with crisis dummy.

Besides entity-fixed effects, time-fixed effects are allowed for to account for unexpected variations across time periods. The test rejects the null that year coefficients are equal to zero; thus, *t-1* year dummies are included into regressions. Alternative regressions include GDP growth to control for per-year change in macroeconomic conditions. The changes in monetary policy rate (Federal Funds) ultimately could not be included in the regressions

[4] Or "least squares dummy variable estimator" (LSDV).

[5] Note that if included, time-invariant regressors cancel out following within transformation of the variables.

due to the high probability of multicollinearity.

Another way to measure the relationships from model 4.2.1 is to first difference both left-hand and right-hand side of the equation. Thus, instead of bank-specific characteristics $BSC_{i,t-1}$ in levels their first differences $\Delta BSC_{i,t-1}$ are employed in model 4.2.1.

A test for heteroscedasticity rejects the null hypothesis of constant variance; thus, the heteroscedastic effects are controlled for in each regression. No serial correlation is detected in the regressions.

Fixed Effects estimator: full specification

Besides analysing separately behaviour of bailed-out banks relative to non-bailed banks and banks that reimbursed CPP funds to the U.S. Treasury and those that did not pay anything according to the two separate models 4.2.1 and 4.2.2, specification from this section includes all categories of banks. Within estimator is applied to this regression, thus, making it impossible to estimate the impact of time-invariant variables such as bailout and repayment dummies (B_i and R_i respectively). However, the coefficients for their interactions with crisis dummy can be estimated[6]:

$$\begin{aligned}\Delta Ln(L_{it}) = \phi_0 + \phi_1 C_t + \chi_1 Z_{t-1} + \chi_B^* C_t \cdot B_i + \chi_R^* C_t \cdot R_i \\ + \left[\delta + \delta^* C_t + (\gamma + \gamma^* C_t) B_i + (\kappa + \kappa^* C_t) R_i\right] BSC_{i,t-1} + \alpha_i + \epsilon_{it} \qquad (4.2.3)\end{aligned}$$

where

- $\Delta Ln(L_{it})$ is the growth rate of lending of bank i during year t ;
- $BSC_{i,t-1}$ are lagged bank-specific characteristics associated with the financial and demand constraints of commercial bank i;

[6]The coefficients for interaction terms $B_i \cdot C_t$ and $R_i \cdot C_t$ show how the effect of bailout/repayment of CPP funds on the growth rates of lending changes across periods of crisis and normal times

- Z_{t-1} are lagged macroeconomic controls (real GDP growth, change in Federal Funds interest rate);
- C_t is the dummy that distinguishes between the crisis period and normal times;
- B_i indicates the banks that received CPP funds relative to those that did not;
- R_i specifies the banks that reimbursed CPP funds before July 2012 and the banks that did not pay anything (in the subsample of banks-recipients of CPP funds)
- α_i represents random bank effects; and
- ϵ_{it} are observation-specific errors.

The rest of coefficients have to be interpreted in the same way as it was shown in table 4.1. According to model 4.2.3 banks are divided into six categories: (i) banks that did not participate in the CPP ($B_i = 0$; $R_i = 0$; $C_t = 0$ in normal times/ $B_i = 0$; $R_i = 0$; $C_t = 1$ during the crisis); (ii) banks that received CPP funds and did not pay anything by July 2012 ($B_i = 1$; $R_i = 0$; $C_t = 0$ in normal times/ $B_i = 1$; $R_i = 0$; $C_t = 1$ during the crisis); and (iii) banks that received CPP funds and repaid them totally by July 2012 ($B_i = 1$; $R_i = 1$; $C_t = 0$ in normal times/ $B_i = 1$; $R_i = 1$; $C_t = 1$ during the crisis).

Lagged dependent variable is excluded from the regression in order to avoid endogeneity bias. The full specifications including autoregressive component are later estimated using different methods such as Arellano-Bond and system GMM estimators that allow to instrument lagged variable as well as other endogenous variables and to obtain consistent parameters.

Fixed Effects estimator: bank subsamples

Another way to check the robustness of the results and to separate the impact of balance sheet characteristics on the loan growth rates at different banks is to perform that analysis by each group of banks. Thus, fixed effects regressions are conducted separately for non-bailed banks, for the bailed-out banks that reimbursed CPP funds and for the bailed-out banks that did not reimburse CPP funds. The coefficients for each group of banks are allowed to change between normal times and crisis period. Autoregressive components are not included due to the high probability of endogeneity bias.

4.2.4 Mundlak-Krishnakumar estimator

As explained in the previous section, fixed effects estimator only uses information on within variance of covariates, ignoring the between variance. Hence, it does not allow the estimation of time-invariant variables (Baltagi, 2001; Hsiao, 2003; Wooldridge, 2002). One of the estimators that allows to gauge the effects of time-invariant variable is Mundlak estimator (Mundlak, 1978), later extended by Krishnakumar (2006). This estimator not only helps to estimate the impact of time-invariant variables but also, when used as a pre-test estimator, to decide which time-varying variables are endogenous and which are not(Chatelain and Ralf, 2010). This information will be then useful in Hausman-Taylor, IV and GMM estimators that require distinguishing between exogenous and endogenous variables and selecting appropriate instruments.

The basic methodology of Mundlak-Krushnakumar estimator is presented below. The model 4.2.1 contains both time-series cross-section data and time-invariant variables and can be rewritten in the following simplified form:

$$y_{it} = \beta x_{it-1} + \gamma b_i + \alpha_i + \epsilon_{it} \tag{4.2.4}$$

where y_{it} is dependent variable; x_{it-1} are lagged time and individual varying explanatory variables; b_i are time-invariant explanatory variables (or dummies); α_i are individual random effects, and β and γ are coefficients to be estimated for time-varying and time-invariant variables, respectively. The error term ϵ_{it} is assumed to be uncorrelated with x_{it-1}, b_i and α_i. As there is no theoretical evidence yet on the adequacy of Mundlak model with autoregressive variables, lagged dependent variable y_{it-1} is removed from the model.

The difficulty of estimation of that model is the potential correlation of individual effects α_i with x_{it-1} and especially with time-invariant variables b_i. Mundlak (1978) proposes to use an auxiliary regression to account for such a relationship:

$$\alpha_i = \pi x_{i\circ} + \phi b_i + \alpha_i^M \tag{4.2.5}$$

where x_{i0} is average over time for each individual of time-varying variables, π and ϕ are coefficients to be estimated for these averages and time-invariant variables, respectively.

Combining auxiliary regression with initial regression yields the following equation:

$$y_{it} = \beta x_{it-1} + (\gamma + \phi) b_i + \pi x_{i\circ} + \alpha_i^M + \epsilon_{it} \tag{4.2.6}$$

Applying Generalised Least Squares (GLS) model to estimate the last equation, Mundlak (1978) showed that

$$\widehat{\beta_{GLS}} = \widehat{\beta_W} \tag{4.2.7}$$

$$\widehat{\pi_{GLS}} = \widehat{\beta_B} - \widehat{\beta_W} \tag{4.2.8}$$

$$\widehat{\gamma_{GLS}} = \widehat{\gamma_B} \tag{4.2.9}$$

where $\widehat{\beta_B}$ and $\widehat{\gamma_B}$ are between estimators, while $\widehat{\beta_W}$ is a within estimator[7].

For each time-varying variable $x_{i\circ}$ Mundlak-Krishnakumar regression tests the null hypothesis $\widehat{\beta_B} - \widehat{\beta_W} = 0$ (Equation 4.2.8). Thus, the smaller and the closer to zero is the estimated parameter $\widehat{\pi_{GLS}}$, the more exogenous variable $x_{i\circ}$ is. Later these exogenous x_{i0} variables can be used as instruments in Hausman and Taylor (Hausman and Taylor, 1981) and other estimators (Chatelain and Ralf, 2010).

[7]Mundlak also proved them to be best linear unbiased estimators (BLUE).

4.2.5 Hausman-Taylor estimator

The choice between fixed or random effects approach is determined by the assumption about correlation between explanatory variables and random individual effects as described in section 4.2.3. Baltagi (2001) and Baltagi *et al.* (2003) define that choice as the one between "all" or "nothing"[8].

Hausman and Taylor (1981) proposed a model that contained advantages of both estimators. On one hand, some explanatory variables are allowed to be correlated with individual effects, on the other hand, it captures the effects of time-invariant variables. Hausman and Taylor (1981) suggest to split both x_{it-1} and z_i from simplified model 4.2.4 into two sets of variables (x_{1it-1} and x_{2it-1}, b_{1i} and b_{2i} respectively):

$$y_{it} = \beta_1 x'_{1it-1}\beta_2 + x'_{2it-1}\beta_2 + b'_{1i}\gamma_1 + b'_{2i}\gamma_2 + \alpha_i + \epsilon_{it} \tag{4.2.10}$$

where x_{1it-1} are time- and individual-varying uncorrelated with α_i variables; x_{2it-1} are time- and individual-varying correlated with α_i variables; b_{1i} are time-invariant uncorrelated with α_i variables; b_{2i} are time-invariant correlated with α_i variables, and α_i are bank random effects.

As there is no theoretical evidence yet on the adequacy of the Hausman-Taylor estimator with autoregressive variables, lagged dependent variable y_{it-1} is removed from the model. Hausman and Taylor propose then to use instrumental variables approach when exogenous variables, x_{1it-1} and b_{1i}, serve as their own instruments; time-varying endogenous variables are instrumented by their deviation from individual means, $x_{2it-1} - \bar{x_{2i\circ}}$, and time-invariant endogenous variables, b_{2i}, are instrumented by the individual average of x_{1it-1}, $\bar{x_{1i\circ}}$.

The following steps of estimation are considered in the Hausman-Taylor model:

- first, the model is within transformed in order to obtain consistent but inefficient estimators of β_{1w} and β_{2w} from model 4.2.10;

[8]"All" in case of effects model that assumes that all explanatory variables are correlated with random individual effects. "Nothing" in case of random effects model with an opposite assumption.

- b_{1i} and b_{2i} are regressed on group means of residuals from the previous regression using x_{1it-1} and b_{1i} as instruments;

- the variance of the random effect as well as the weights for Feasible Generalised Least Squares (FGLS) are obtained from the previous regression. Random effects GLS transformation in performed on each of the variables;

- weighted instrumental variables estimators are used to obtain coefficients of interest by instrumental variables regression.

If there are as many time-varying exogenous variables x_{1it-1} as there are individual time-invariant endogenous regressors b_{2i} (in other words, the model is identified), then Hausman-Taylor estimator is more efficient than fixed effects. In case the model is under-identified (there are less exogenous regressors x_{1it-1} than endogenous b_{2i}) then Hausman-Taylor model is identical to fixed effects.

As Mudlak model at the same time requires an exogenous time-invariant variable, the indicator of the bank's headquarters state, b_{1i}, is included in the model.

4.2.6 Instrumental variables estimator

Hausman-Taylor Estimator analysed in the previous section uses the method of instrumental variables assuming that some explanatory variables are correlated with individual random effects (α_i in Equation 4.2.10). It also assumes that none of the explanatory variable are correlated with individual error term (ϵ_{it}). Instrumental variables (IV) estimator, in contrast, allows some explanatory variables to be correlated with that individual error term and at the same time to obtain consistent parameter estimates.

Panel data model with random individual effects is estimated using a two-stage least-squares (2SLS) IV approach that allows to obtain consistent parameter estimates for the instrumented bailout dummy (as the dummy is inclined be correlated with idiosyncratic error ϵ_{it}). The first stage is then similar to the logit regressions from Chapter 3 and provides fitted values of the bailout dummy (which is the probability of bank's bailout):

$$b_i = \beta_{st1} x_{it-1} + \lambda_1 Beta_i + \lambda_2 \frac{MBS}{TA}_{it-1} + \alpha_{st1i} + \epsilon_{st1it} \tag{4.2.11}$$

where $Beta_i$ and $\frac{MBS}{TA}_{it}$ are instruments for the bailout dummy. $Beta_i$ is beta or correlation between the bank's stock and the market that was used in Chapter 3 (it is beta computed for the 5 year period between 2002 and 2007); $\frac{MBS}{TA}_{it-1}$ is the lagged share of mortgage-backed securities in bank's total assets. The rest of the explanatory variables are the same as in model 4.2.1.

The second stage of 2SLS regression is similar to regression 4.2.1 and its simplified version 4.2.4, where the bailout dummy is substituted with its fitted values obtained from the first stage regression 4.2.11:

$$y_{it} = \beta_{st2} x_{it-1} + \gamma \hat{b_i} + \alpha_{st2i} + \epsilon_{st2it} \tag{4.2.12}$$

Regressions run on both stages of 2SLS are not dynamic, the autoregressive dependent variable $y_{i,t-1}$ is removed from them. The dynamic nature can give rise to autocorrelaton in the second stage regression. Anderson and Hsiao (1982) were first ones to propose the use of the IV estimator after first-differencing, that was later further developed by Arellano and Bond (1991). That exercise is performed later in section 4.2.7. Results for the model specification that includes lagged value of growth rates of loans in both first stage and second stage equations (but with higher probability that resulting coefficients are biased as lagged dependent variable is treated as exogenous) are presented in Appendix L.

As reported in Chapter 3, systemic risk variables are good predictors of the bank bailout. Banks with higher contributions to systemic risk were found to be more likely to be bailed out and if bailed out to receive a larger amount of CPP funds. As systemic risk variables are highly correlated with each other, it is not possible to include several of them in the same regression due to the high probability of multicollinearity. However, in case endogenous bailout dummy is instrumented with a single variable the model is exactly identified. It means there are as many moment conditions as there are parameters to be estimated. However, it is better to have more instruments than strictly needed because obtained estimates can be more precise and tests for the validity of the overidentifying restrictions can be constructed.

Thus, another instrument is included into regressions which is the share of mortgage-backed securities in total assets of the bank. As it was also shown in Chapter 3 the lagged value of relative size of MBS for 2007, $\frac{MBS}{TA}_{i2007}$, was explaining well the distribution of CPP funds in 2008 and 2009. Furthermore, $\frac{MBS}{TA}_{it-1}$ is not significantly correlated with growth rates of lending as it was shown in correlation table 4.4. Hence, that instrument is expected to satisfy both conditions of validity (exogeneity) and relevancy explained in more details in section 4.2.9.

4.2.7 Arellano-Bond: difference GMM estimator

The full specification of model 4.2.1 contains a large number of variables among which most of the regressors are endogenous or predetermined. Besides, the dynamic nature of the model, the size and the properties of the sample might become a reason of several econometric issues such as:

- Inclusion in the equation of lagged values may give a rise to autocorrelation;
- Bank fixed effects (that are time-invariant) can be highly correlated with explanatory variables. The error term contains, on one hand, unobserved country-specific effects, on the other hand, observation-specific errors;
- Small frequency of the data triggers an identification problem for a panel with few observable time periods and many groups (see Mileva, 2007 for more details).

The Arellano-Bond GMM estimator is, first of all, designed for situations when regressors are not strictly exogenous[9] and for panels with large number of groups N and small number of time periods T. Secondly, difference GMM helps to solve the problem of fixed effects and autocorrelation[10] (see Roodman, 2006 for more details).

The main condition for applying Arellano-Bond GMM estimator is that first-differenced instruments should not be correlated with unobserved bank effects. For some variables in model 4.2.4, the assumption $E\left[\epsilon|x\right] = 0$ is too strong. Thus, another set of instrumental variables z_{it} that are orthogonal to the error term can be used to estimate β from population mean conditions.

β becomes an efficient and consistent estimator if the correlation between explanatory variables x_{it} and instrumental variables z_{it} is sufficiently strong and $E\left[\epsilon|z\right] = 0$.

First-difference transformation is applied to model 4.2.4 due to which individual fixed effects α_i, as well as time-invariant dummies b_i, are removed from the equation:

$$\Delta y_{it} = \eta \Delta y_{i,t-1} + \beta \Delta x_{it-1} + \epsilon_{it} \tag{4.2.13}$$

Several approaches to the dynamic panel model estimation in first-differences were proposed in the literature. It was first Balestra and Nerlove (1966) who proposed to use regressors x_{it} or their first differences as instruments for model 4.2.13. However, the valid instruments could only be obtained under the assumption of exogeneity of x_{it}, thus, only their past values up to *t-2* could be used as instruments. That assumption has limited the number of orthogonality conditions and the efficiency of resulting estimators.

Later Anderson and Hsiao (1982) suggested to add the second lag of the dependent variable and/or its first-difference to the initial set of instruments generated by x_{it}. However, the low efficiency of such estimators still remained. Besides, the "weak instruments" problem, the low number of instruments (which is a particular problem for the panels with limited

[9] Thus, possibly correlated with past or current errors.
[10] Autocorrelation within individuals but not across them

time dimension) and no explicit control over serial correlation made the performance of these estimators poor.

Arellano and Bond (1991) proposed to solve the problem of small number of orthogonality conditions by including the rest of the lags of level variables into the model. Both lagged dependent variables and lagged x_{it} are found to be valid instruments. Moreover, the authors propose to account for serial correlation of the disturbances in model 4.2.13 and suggest the variant of the estimator robust to heteroscedasticity (Harris *et al.*, 2008).

However, difference GMM has the same disadvantage as the fixed effects approach. When using difference transformation, in the same way as when using within transformation, the time-invariant regressors are eliminated. Therefore, it is impossible to estimate full specifications of models 4.2.1 and 4.2.2 with this approach as no parameters for bailout and repayment dummies can be obtained.

4.2.8 Two-step system GMM estimator

In this chapter the system GMM is preferred to difference GMM as it allows to include time-invariant regressors into the model as well as to account for heteroscedasticity of model errors.

System GMM is the augmented version of the difference GMM estimator. Initially it was developed to improve the difference GMM estimators as lagged levels were often poor instruments for first-differenced variables[11]. Arellano and Bover (1995) and Blundell and Bond (1998) modified the difference GMM estimator by adding the original level equation to the system. The instruments for the variables in levels are their own lagged first-differences. The larger number of instruments allows to increase the efficiency of the estimator.

Two-step system GMM provides an algorithm for computing the *feasible efficient two-step GMM estimator*, where residuals from the first step are used to form the optimal weighting matrix. The efficient GMM estimator is then estimated using that matrix. Therefore the two-

[11]Especially if the variables are close to a random walk

step GMM estimates are robust to the presence of heterescedasticity and serial correlation.

The cost of the increased efficiency of system GMM estimator is a set of additional restrictions on initial conditions. Basically it requires first-differences to be uncorrelated with unobserved group effects. Another disadvantage of applying the system GMM estimator is an important rise in the instrument count. In case the lag range is not restricted and the instrument matrix is not collapsed, each instrumenting variable generates one column for each time period and each lag available in that time period. As highlighted in Roodman (2006), the number of instruments is then quadratic in T.

Often referred to as "too many instruments" problem, it can lead to, first of all, overfitting of endogenous variables which could bias coefficient estimates toward those from non-instrumenting estimators. Second, high instrument count could become the reason of imprecise estimates of the GMM optimal weighting matrix and, consequently, downward biased standard errors (see Roodman, 2008 for more details).

The bias and the standard errors can be lowered by using the Windmeijer correction (Windmeijer, 2005) for the two-step efficient GMM. The solution for the former problem requires keeping the number of instrument lags low. The choice of instruments and their lags is described in the next section following the strategies in the literature on the performance of the IV and GMM estimators (Chatelain and Teurlai, 2001; Donald *et al.*, 2009; Mehrhoff, 2009). Additional tests on relevancy and validity of the instruments are presented in section 4.2.9.

4.2.9 Choice of instruments for system GMM

Limiting the number of moment conditions

If the number of instruments is too large, GMM estimator becomes inconsistent. In case the number of instruments is not constrained, each instrumenting variable generates one column for each time period and lag available in that time period (Roodman, 2006). In this section 23 variables are treated as endogenous or predetermined for full specifications of models 4.2.1 and 4.2.2:

- six main variables (lagged dependent variable and 5 bank specific characteristics (BSC_{it}));
- interaction of five BSC_{it} with crisis dummy;
- interaction of five BSC_{it} with bailout (or repayment) dummy;
- interaction of five BSC_{it} with both crisis and bailout (or repayment) dummies;
- bailout (or repayment) dummy and its interaction with crisis dummy (two in total).

The equation is said to be exactly identified when there are at least as many instruments generated as included endogenous variables. On the other hand, the optimal weighting matrix of the GMM estimator has a rank of N (number of banks) at most. This matrix becomes singular and the two-step estimator cannot be computed when the number of instruments exceeds N (Soto, 2009). As the sample contains information on almost 550 financial institutions, the number of generated instruments in system GMM should not exceed 550.

In case the count of moment conditions is not reduced, the standard instrument set provides $\frac{T(T-1)}{2} = 105$ moment conditions for a single lagged dependent variable, $\frac{(T-2)(T-1)}{2} = 91$ moment conditions for each endogenous variable and $T - 1 = 14$ moment conditions for each exogenous variable (Mirestean and Charalambos, 2009).

To reduce the instrument count two main techniques are used:

- **Limiting the lag length** is based on the selection of the lags to be included in the instrument set. Baum *et al.* (2002) advises to constrain the lags between the second and the fifth. In that case the number of moment conditions will be equal to the number of instrumented variables (exogenous, endogenous or predetermined) multiplied by the number of lags used.
- **Collapsing the instrument set** also allows to make the instrument linear in T. The columns of the original instrument matrix are "collapsed" reflecting the fact that

orthogonality condition has to be valid for each lag but not any more for each time period.

Some additional transformations can be applied on the instrument set. For instance Mehrhoff (2009) proposes to apply the Principal Component Analysis (PCA) to the instrument set. The transformation matrix becomes then stochastic rather than deterministic. After performing Monte-Carlo simulations the author finds that factorised instruments produce the lowest bias and standard errors, while recommends to collapse the matrix prior to factorisation.

Selection of the optimal instruments

It is not only the instrument count that influences the choice of the instruments for GMM estimations but also the "quality" of these instruments. There exists two criterias for proper instrumental variables in linear IV and GMM regressions. The "good" instruments have to be:

- correlated with endogenous regressors;
- orthogonal to the error process (or, in other words, exogenous);

In the literature the first condition is often referred to as the "relevancy" of instruments, while the second one referred to as the "validity" of instruments. Instruments are said to be weak and the system to be weakly identified, if the instruments are weakly correlated with endogenous regressors (Stock *et al.*, 2002; Bun and Windmeijer, 2010).

There are several methods to deal with the problem of instrument relevance. In this article the correlation coefficients between the set of instruments and endogenous variables are first analysed for each equation. Thus, the correlation tables that report the correlation coefficients between lagged variables in levels (dependent and explanatory variables until the fourth lag) and differenced variables $Y_{it} - Y_{it-1}$, $Y_{it-1} - Y_{it-2}$, $X_{it-1} - X_{it-2}$ are constructed for the first-difference equation. Accordingly such tables are constructed for the variables from the equation in levels but reporting the correlation between lagged first-differences and variables in levels Y_{it}, Y_{it-1} and X_{it-1} (see Appendix E).

The deeper lags of level variables (for the first difference equation) and those of first differences (for the level equation) have a larger probability of being weaker instruments, i.e. being weekly correlated with endogenous regressors[12]. However, the first lags of instruments might be highly correlated with the dependent variable Y_{it} and its first difference $Y_{it} - Y_{it-1}$ which may cast a doubt on the orthogonality between instruments and errors. As mentioned above, the deeper lags might be preferred to the lower ones because they provide a higher probability of instrument independence from unobserved error process. Thus, when selecting the instruments, the trade-off between the level of weakness of the instruments and their exogeneity is taken into account.

Besides, the corresponding moment conditions can be tested if the system of equations is overidentified[13]. It can be done via Hansen statistic in the presence of heteroscedasticity or via Sargan statistic under the assumption of conditional homoscedasticity. Heteroscedasticity is detected in these regressions, so it is the Hansen statistic that is reported in the resulting tables. The null hypothesis of the test implies that the instruments satisfy the orthogonality conditions required for their employment (Baum *et al.*, 2002), and that all together they are valid instruments.

In order to additionally check the orthogonality of some instruments or subset of instruments, the Difference-in-Sargan/Hansen statistic (or C-statistic) is analysed. That statistic basically measures the difference in Sargan/Hansen statistics computed, on one hand, for the regression with the full set of instruments, on the other hand, for the regression with a particular (tested) set of instruments removed from the full one. The null hypothesis is that of the valid subset of instruments.

[12]That is why the lags deeper than the fourth lag are not analysed.

[13]Overidentification here means that there is a surfeit of instruments.

The two-step robust regressions that normally produce asymptotically more efficient estimators are conducted[14]. It makes the estimators consistent in the presence of any pattern of heteroscedasticity or autocorrelation.

Testing for underidentification and weak instruments

Empirical tests of overdientifying restrictions are often criticized for having a low power. Besides, as highlighted by Bazzi and Clemens (2013), multiple instruments do not allow the detect the possibility of the most valid instruments to be the weakest and the strongest to be the the least valid.

Besides, the first stage regressions where endogenous variables are regressed on the full set of instruments are examined. The Bound *et al.* (1995) F-statistics and "partial" R^2 as well as the Shea's partial R^2 (which is is more relevant as there is more than one endogenous regressor in the model) are analysed for several instrument subsets in order to choose sufficiently relevant endogenous regressors.

The Bound *et al.* (1995) F-statistic allows us to measure the significance of a particular instrument by excluding this instrument from the regression. It is the "squared partial correlation" between the excluded instrument or a subset of instruments and endogenous regressor that is in question, $\frac{RSS_{I1}-RSS_I}{TSS}$, where RSS_{I1} is the residual sum of squares in the regression instrumented with I_1, RSS_I is the residual sum of squares in the regression with the full set of instruments (see Baum *et al.*, 2002 for more details).

However, it is not an efficient measure of the fit of regressions, if there are multiple endogenous regressors in the model. The intercollerations among the regressors need to be taken into account. The Shea's partial R^2 is a more consistent measure of the regression's fit in that case.

Thus, additional tests for identification and weak instruments are applied in the paper following Bazzi and Clemens (2013); Stock and Yogo (2002). The strength of identifica-

[14] A finite-sample Windmeijer correction to the two-step covariance matrix is applied to correct otherwise downward biased standard errors.

tion is tested via the test of the rank of a matrix based on the Kleibergen-Paap (2006) *rk* statistic. The test allows to check whether the equation is identified, i.e., that the excluded instruments are correlated with the endogenous regressors. The null hypothesis of the test is that the equation is underidentified, meaning when partialling out exogenous covariates and other cross-correlations with endogenous variables and instruments, the weakest correlation between an instrument and one of the endogenous variables does not contribute enough variation to add a rank of the instrument matrix (Bazzi and Clemens, 2013). A rejection of the null indicates that the matrix is full column rank and, thus, that the model is identified. The p-values for the Kleibergen-Paap *rk* statistic under the assumption of heteroscedasticity are presented in tables.

Another group of statistics includes Cragg-Donald Wald and Kleibergen-Paap Wald statistics and allows to test for weak identification. In case of weak identification the correlation between endogenous regressors and excluded instruments is small. However, Cragg-Donald Wald statistic is only valid under the assumption of identically and independently distributed errors (i.i.d.). Thus, it is mostly the second one Kleibergen-Paap Wald F-statistic that is reported.

Following Stock and Yogo (2002), the definition of weak instruments in terms of the relative bias is adopted. A group of instruments is weak if the bias of the IV estimator, relative to the bias of ordinary least squares (OLS), exceeds a certain threshold (5%, 10% or 30% are reported). Relevant critical values for Kleibergen-Paap Wald F-statistic (thus, for the case with robust standard errors) have not been tabulated. However, it is advised in the literature (for instance, by Baum *et al.*, 2007) to apply though with caution the Stock and Yogo critical values initially tabulated for Cragg-Donald statistic. Stock and Yogo critical values are not tabulated for cases with more than three endogenous variables. As in the regressions from this chapter there are mostly more than three endogenous variables entering the regressions, the critical values are reported for the case of three endogenous variables, an ultimate available number of instrumental variables and 5%, 10% and 30% maximal bias of the IV estimator relative to OLS. Another way is to follow the original Staiger and Stock (1997) rule-of-thumb that states that the F-statistic should exceed 10. Under the null hypotheses the instruments are weak, and in order to reject the null hypothesis the calculated Kleibergen-Paap Wald F-statistic should exceed the critical value.

4.3 Construction of the variables

4.3.1 Data description

To construct the sample of firms, U.S. domestically controlled commercial banks were selected in DataStream. These financial firms operated on the U.S. market in U.S. dollars and were still active in December of 2009. After selecting the variables needed for estimation for the period between 1995 and 2011, around 600 commercial banks were left in the sample.

The data on bailouts (promised amount, actual disbursed amount, the date of entering the program) and bailout reimbursement (amount repaid, date of repayment) is obtained from the Treasury's Office of Financial Stability.

The data from these two sources is merged. Bailouts under CPP were provided to domestically controlled banks, bank holding companies, savings associations, and savings and loans holding companies. Only actual disbursed amount is considered as a fact of the bank bailout.

After outlier cleaning 550 banks were left in the sample.

4.3.2 Dependent variables

- **Total loans (TL) growth rate** $\Delta Ln(TL)_{it}$

  The lending activity of the banks is measured through, first of all, the growth rate (change in logarithms) of total loans (futher referred to as TL) to enterprises and individuals. The data on volumes of loans was obtained from DataStream. Table

4.2 presents descriptive statistics for total loans growth rates during the crisis and normal times. The annual means are reported in that table together with medians and standard deviations that are shown in brackets, respectively. Total loans growth (as well as REML and CIL growth rates) is winsorised at 1% level to remove the effect of outliers.

Table 4.2 demonstrates the drop in average growth rates of lending between normal times and the crisis of 2007. Across all banks from the sample average growth rate of total loans dropped from 13.75% (10.54%)[15] in the pre-crisis period (from 1995 to 2007) to 2.49% (1.41%) during the crisis (after 2007).

At first sight the fact of disbursement of CPP funds does not affect the growth rates much. Nevertheless, it looks like the bailed-out banks exhibited higher average loan growth rates before the crisis (14.81% (11.51%) relatively to 12.85% (9.69%), column 3, table 4.2) while smaller loan growth rates starting from 2008 relatively to the loan growth rates of non-bailed banks (2.00% (0.84%) relatively to 2.94% (1.96%), column 4, table 4.2).

Figures 4.3.1, 4.3.2 and 4.3.3 plot median TL, REML and CIL loan growth rates over time, respectively, for the banks (i) that did not receive CPP funds; (ii) that received CPP funds and repaid them totally by July 2012; (iii) that received CPP funds but did not repay anything by July 2012.

They show that bailed-out banks that did not redeem their stocks from the Treasury on average supplied more loans than other banks in the period between 2001 and 2008. Banks that did not receive CPP funds on average exhibited the lowest total loans growth rates in the period before 2008. However, the situation changed after 2008. Bank that did not repurchase their shares from the Treasury exhibited the lowest growth rates of loans, while loan growth rates started to rise at the banks that did not receive CPP funds and those that repaid their CPP funds.

[15]Median is reported in brackets.

Table 4.2: Summary statistics on growth rates of loans

Bank	1995-2011	No Crisis 1995-2007	Crisis 2008-2011
Growth rates of TL			
All banks	10.81 (8.46;16.18)	13.75 (10.54;15.96)	2.49 (1.41;13.72)
Obs	8061	5958	2103
Bailed-out banks	11.38 (9.14;16.23)	14.81 (11.51;15.73)	2.00 (0.84;13.71)
Obs	3726	2727	999
Non-bailed banks	10.33 (7.87;16.12)	12.85 (9.69;16.11)	2.94 (1.96;13.73)
Obs	4335	3231	1104
Bailed-out banks that REPAID CPP funds	11.70 (9.14;15.51)	14.63 (11.34;15.13)	3.63 (2.11;13.60)
Obs	2360	1732	628
Bailed-out banks that DID NOT REPAY CPP funds	10.81 (9.17;17.40)	15.13 (11.81;16.72)	-0.76 (-2.43;13.47)
Obs	1366	995	371
Growth rate of REML			
All banks	12.08 (8.49;24.45)	15.08 (10.94;24.75)	3.67 (1.74;21.48)
Obs	7935	5849	2086
Bailed out banks	12.37 (8.77;24.49)	15.76 (11.35;24.50)	3.17 (0.53;21.97)
Obs	3686	2693	993
Non-bailed banks	11.84 (8.26;24.42)	14.51 (10.44;24.94)	4.13 (2.36;21.02)
Obs	4249	3156	1093
Bailed-out banks that REPAID CPP funds	12.47 (8.99;24.06)	15.29 (11.26;24.25)	4.76 (2.46;21.75)
Obs	2343	1717	626
Bailed-out banks that DID NOT REPAY CPP funds	12.18 (8.38;25.23)	16.58 (11.58;24.93)	0.47 (-2.35;22.11)
Obs	1343	976	367
Growth rate of CIL			
All banks	11.79 (9.35;30.24)	15.59 (12.30;30.10)	1.40 (0.73;28.77)
Obs	7487	5482	2005
Bailed out banks	11.66 (9.81;27.49)	16.45 (13.20;27.56)	-0.93 (0.09;24.25)
Obs	3554	2575	979
Non-bailed banks	11.90 (8.93;32.58)	14.82 (11.06;32.22)	3.62 (1.41;32.54)
Obs	3933	2907	1026
Bailed-out banks that REPAID CPP funds	12.15 (9.71;25.24)	16.17 (12.77;25.79)	1.29 (1.18;21.26)
Obs	2287	1669	618
Bailed-out banks that DID NOT REPAY CPP funds	10.78 (9.93;31.23)	16.96 (14.29;30.64)	-4.71 (-4.07;28.58)
Obs	1267	906	361

Average annual growth rates (means) are presented in table; median and standard deviation are reported in brackets.
REML stands for Real Estate Mortgage Loans; CIL stands for Commercial and Industrial Loans.

Figure 4.3.1: Median annual total loans growth rates

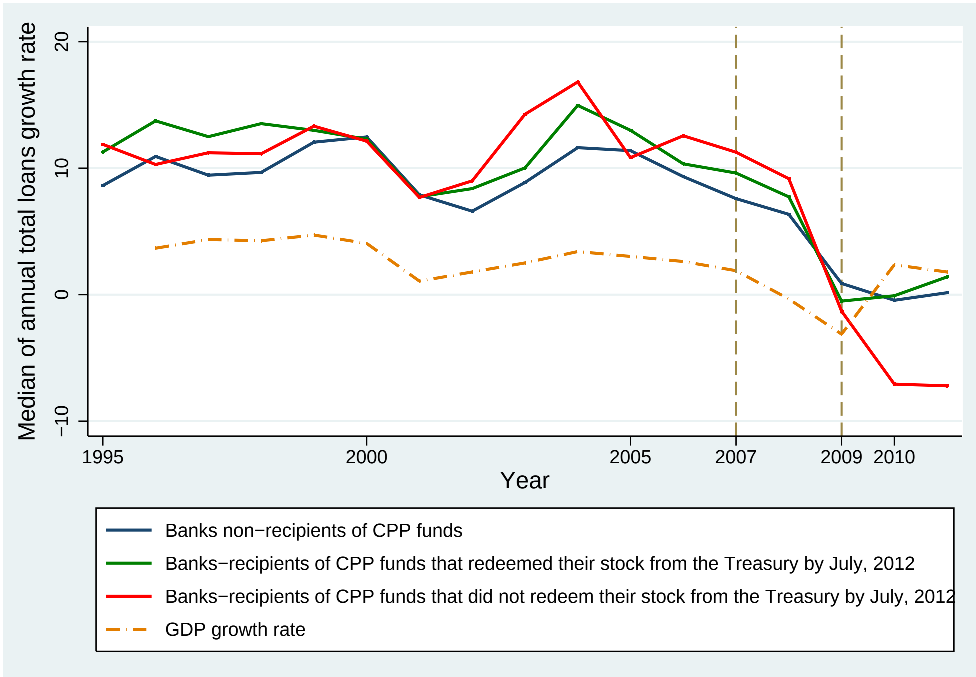
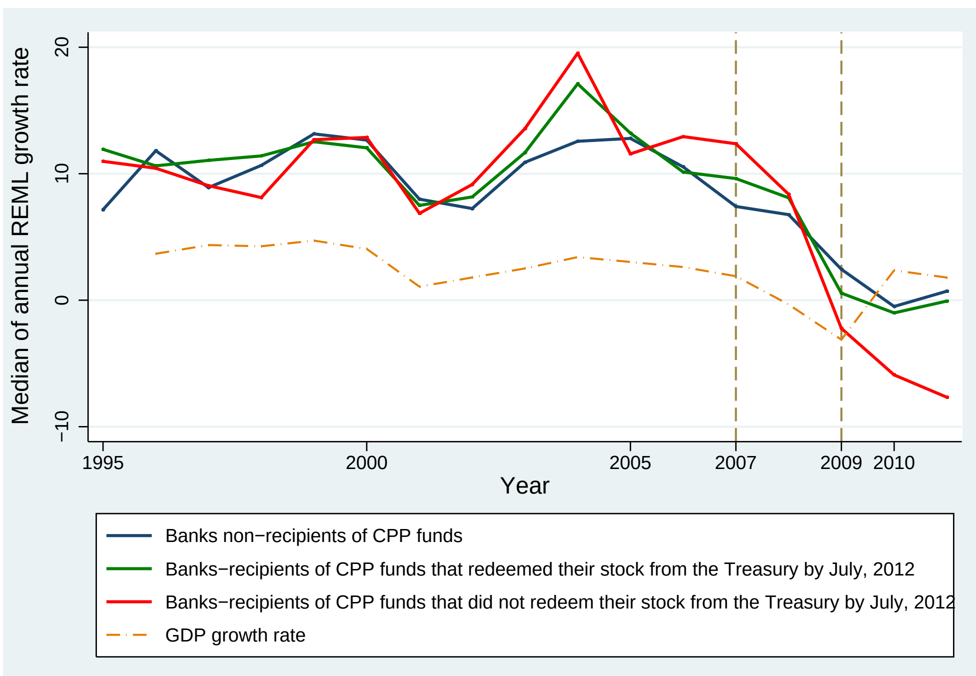
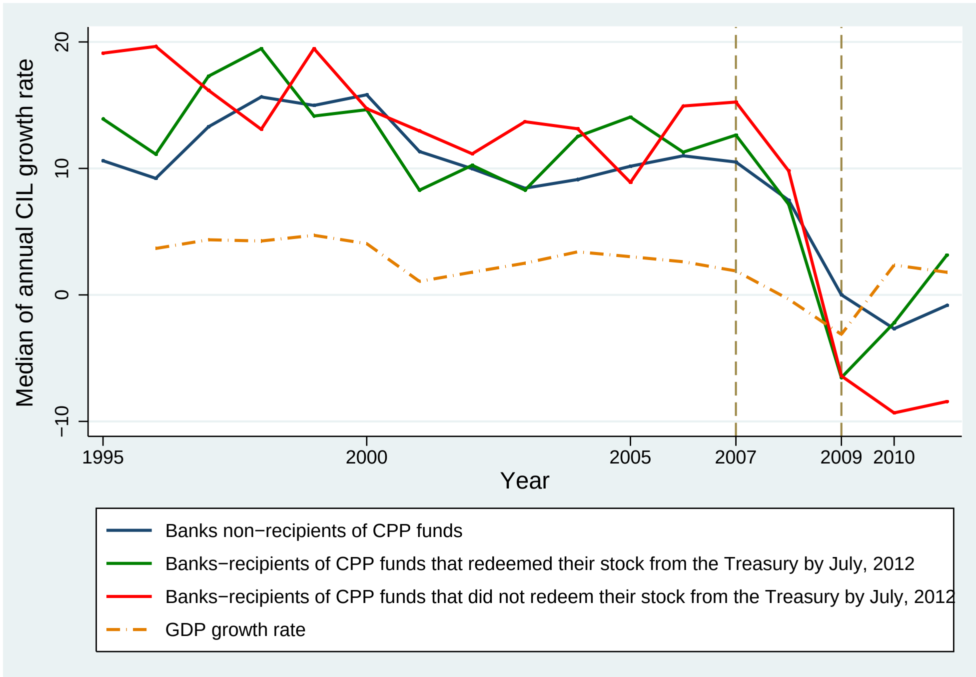


Figure 4.3.2: Median annual REML growth rates



This observation might be interpreted on a way that the banks with the highest loan growth rates before the crisis were the ones applying for the CPP funds, not repaying

Figure 4.3.3: Median annual CIL growth rates



them and notably cutting lending during the crisis. At the same time, the banks that repurchased their stakes from the Treasury managed to restore their acitivities and to increase loan supply after 2009 (after 2010 in case of mortgage loans, table 4.3.2). Thus, it looks like the lending pattern differs significantly during the crisis between non-bailed banks and banks that received the CPP funds and repaid them totally, and banks that did not repurchase their shares from the Treasury by July 2012.

The same trend is detected when analysing the summary statistics in table 4.2. The banks that did not repurchase their stakes from the U.S Treasury exhibited an average negative loan growth during the crisis period, while those that repaid the CPP funds had a positive but relatively small loan growth (-0.76% (-2.43%) compared to 3.63% (2.11%), same table).

This may be due to the fact that the banks which did not repay the CPP funds experienced larger financial problems than other banks and did not succeed in restoring their lending activity partly because they might have been constrained by the need of the future CPP funds repayment.

Overall this statistics confirms that, first of all, the lending pattern changes in a significant way for the banks that participated in the CPP program and that did not, especially when distinguishing between the pre-crisis and crisis periods.

- **Real Estate Mortgage Loans (REML) growth rate** $\Delta Ln(REML)_{it}$

REML represent the loans made to finance construction or to purchase real estate. It includes residential, construction, commercial and other types of mortgages. The same tendencies as for the total loans growth rates can be found in the detailed statistics for the REML growth in table 4.2. Non-bailed banks are found to have higher average growth rates of REML during the crisis (4.12% relatively to 3.17%, table 4.2), which is the opposite in the pre-crisis period.

In crisis period the average growth rate of total loans at the banks that repaid the CPP funds is more than three times smaller than in the pre-crisis period (4.76% relatively to 15.29%, same table), while it is more than thirty five times smaller for the banks that did not repay the CPP funds (0.47% relatively to 16.58%).

- **Commercial and Industrial Loans (CIL) growth rate** $\Delta Ln(CIL)_{it}$

Commercial and Industrial Loans (further referred to as CIL) are the loans made to business and industry and include consumer, installment, financial and institutional loans. This is the group of loans that experienced the largest reduction in its growth rates during the crisis comparing to TL and REML. The CIL growth rate at bailed-out banks becomes negative. It dropped from 16.45% to -0.92% (columns 3 and 4, table 4.2) between the pre-crisis and crisis period. Non-bailed banks on average offered a smaller amount of credit in the pre-crisis period but substantially larger amount of CIL after 2007 (the CIL growth rate is 14.82% and 3.62%, respectively).

This large decline in commercial and industrial lending among the bailed-out banks was due to the very low lending activity of the banks that did not repay the CPP funds.

The average CIL growth rate for them equals -4.71% in the crisis period comparing to 1.29% growth rate at the bailed-out banks that repaid CPP funds. Thus, the banks that did not provide refund to the U.S. Treasury were the banks that cut their lending the most during the crisis, especially in commercial and industrial loans (figure 4.3.3).

4.3.3 Individual bank-specific characteristics

Balance sheet characteristics

Bank balance sheet characteristics are financial statement variables that are often used to evaluate the financial situation or status of the banks. These are the variables that are often used in the literature on bank lending channel, determinants of bank's financial fragility and probability of default models such as Moody's RiskCalc v3.1 U.S. Banks model (Dwyer *et al.*, 2006). Several main indicators included in the regressions capture the level of capitalisation of the banks, their size, liquidity and overall financial health.

All individual bank-specific characteristics are demeaned. That means that the annual averages across all banks are subtracted from each bank-specific characteristics $BSC_{it} - \overline{B}SC_t$. That is done following Brei *et al.* (2011) in order the parameter estimates of Models 4.2.1 and 4.2.2 to be interpreted as the impact on the average bank. The correlation coefficients between the within-transformed dependent variables $Y_{it} - \overline{Y_i}$ and within-transformed main lagged regressors $(BSC_{it} - \overline{B}SC_i)$ as well as their interactions with dummies are presented in tables 4.4-4.6.

- **Altman's Z-score**

  As in Chapters 2 and 3, Z-score indicator that represents the level of distress of each firm is calculated herein. Five financial ratios are used to calculate that score (see details in Appendix B.1). Higher Z-score is interpreted as an indicator of a "safer" or, in other words, more financially healthy firm, while lower Z-score indicates high level of distress of the firm (see summary statistics in table 4.3).

Table 4.3: Summary statistics

Variable	**Name**	**Obs**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
			Growth rate of loans			
Total loans growth, winsorised at 1%	$\Delta ln(TL)$	8061	10.81	16.18	-23.24	81.14
REML growth, winsorised at 1%	$\Delta ln(REML)$	7935	12.08	24.45	-57.08	127.25
CIL growth, winsorised at 1%	$\Delta ln(CIL)$	7487	11.79	40.24	-133.17	182.61
			Balance sheet characteristics			
Altman's Z-score	Z_{it}	7079	0.30	0.13	-1.74	3.13
Capital ratio, winsorised at 1%	$\frac{TE}{TA}_{it}$	8567	10.25	4.28	3.05	31.80
MBS to total assets	$\frac{MBS}{TA}_{it}$	8225	9.38	9.82	0	74.25
TSM to total assets	$\frac{TSM}{TA}_{it}$	7504	6.78	7.26	0	58.61
Size	$Size_{it}$	8556	13.51	1.67	3.00	21.54
			Individual demand sensitivity			
Sensitivity to ΔGDP per state	$Sens_{it}$	11492	10.44	22.33	-29.33	110.16
			Macroeconomic conditions			
GDP growth	ΔGDP_t	10816	2.38	1.92	-3.12	4.71
Change in the Federal Funds rate	ΔINT_t	10816	-0.34	1.70	-4.58	2.00
			Other control variables			
Crisis dummy	C_t	12223	0.23	0.42	0	1
Bailout dummy	B_i	11492	0.41	0.49	0	1
Repayment dummy	R_i	4726	0.61	0.49	0	1
Bailout and crisis dummy interaction	$B_i * C_t$	11492	0.10	0.29	0	1
Repayment and crisis dummy interaction	$R_i * C_t$	4726	0.14	0.35	0	1

Z-score includes information on bank's liabilities, earnings etc. That is one of the key determinants of the bank's financial stability and, thus, the credit offer by the bank. It allows to determine whether safer and more financially healthy banks supported the supply of credit in the presence of the crisis. The safer banks might exhibit a lower loan growth in normal times as they grant few risky and subprime loans. However, in the crisis period such banks might have an easier access to external financing as they possess a better collateral[16] and exhibit a greater probability to satisfy the capital requirements.

- **Capital ratio**

  The level of capitalisation of each bank is measured through the equity to total assets ratio. This ratio is the most broad measure of bank capital. It is preferred to total capital and tier one-based capital ratios due to the data availability (there is less information on risk-weighted assets than on total assets).

  Besides, adequacy ratios are the targeted capital ratios due to the bank capital requirements. Thus, banks tend to adjust their level of exposure to risky assets which in large part is based on altering the composition of the bank's loan portfolio. In that case the probability of endogeneity between the capital ratio and dependent variable is rising, making it more difficult to obtain the unbiased parameter estimates.

  The equity-to-assets ratio is winsorised at 1% level. After winsorization procedure the average capital ratio is around 10.25% (table 4.3). It is expected that better capitalised banks provide more loans during hard times (crisis period). Indeed, the correlation between the growth rates of total loans and captial ratio is postive (0.13, table 4.4). Moreover, more capitalised banks, in case they were bailed out, are expected to exhibit higher loan growth rates than non-bailed banks.

- **Size**

[16] That argument is in line with the logics of Kiyotaki and Moore (1997) model where they highlight the role of collateral for the access to credit market.

Table 4.4: Correlation coefficients for within-transformed dependent and main explanatory variables with no interactions

Var	Δln $(TL)_{it}$	Δln $(REML)_{it}$	Δln $(CIL)_{it}$	Δln $(TL)_{it-1}$	Δln $(REML)_{it-1}$	Δln $(CIL)_{it-1}$	Z_{it-1}	$\frac{TE}{TA}_{it-1}$	$Size_{it-1}$	$\frac{MBS}{TA}_{it-1}$	$\frac{TSM}{TA}_{it-1}$	$Sens_{it-1}$	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}	$Beta$
$\Delta ln(TL)_{it}$	1.00																			
Δln $(REML)_{it}$	0.67	1.00																		
Δln $(CIL)_{it}$	0.35	-0.10	1.00																	
Δln $(TL)_{it-1}$	0.44	0.31	0.13	1.00																
Δln $(REML)_{it-1}$	0.30	0.14	0.13	0.68	1.00															
Δln $(CIL)_{it-1}$	0.19	0.17	-0.01	0.36	-0.08	1.00														
Z_{it-1}	0.28	0.20	0.13	0.16	0.11	0.09	1.00													
$\frac{TE}{TA}_{it-1}$	0.13	0.08	0.09	0.02	0.02	0.06	0.48	1.00												
$Size_{it-1}$	-0.30	-0.20	-0.15	-0.14	-0.08	-0.10	-0.23	-0.13	1.00											
$\frac{MBS}{TA}_{it-1}$	-0.03	-0.03	-0.00	-0.14	-0.08	-0.05	-0.10	-0.01	0.14	1.00										
$\frac{TSM}{TA}_{it-1}$	0.13	0.09	0.06	0.09	0.05	0.05	0.10	-0.00	-0.26	-0.24	1.00									
$Sens_{it-1}$	0.26	0.15	0.14	0.22	0.15	0.12	0.21	0.17	-0.29	-0.06	0.05	1.00								
C_t	-0.23	-0.14	-0.12	-0.11	-0.07	-0.07	-0.13	-0.04	0.42	-0.03	-0.15	-0.38	1.00							
B_i	0.05	0.01	0.03	0.04	0.02	-0.00	-0.01	0.01	0.06	-0.16	-0.04	-0.08	0.00	1.00						
B_iC_t	-0.13	-0.07	-0.08	-0.05	-0.03	-0.06	-0.13	-0.02	0.34	-0.05	-0.12	-0.25	0.64	0.44	1.00					
R_i	0.06	0.02	0.05	0.03	0.00	0.01	-0.02	0.04	0.05	0.02	-0.05	0.02	-0.03	**0.70**	0.27	1.00				
R_iC_t	-0.09	-0.05	-0.05	-0.05	-0.03	-0.04	-0.10	0.03	0.28	-0.03	-0.11	-0.17	0.48	0.33	**0.76**	0.48	1.00			
GDP_{t-1}	0.32	0.20	0.16	0.25	0.15	0.14	0.31	0.10	-0.41	-0.11	0.17	0.38	-0.62	-0.01	-0.41	0.02	-0.32	1.00		
FF_{t-1}	0.23	0.14	0.11	0.20	0.11	0.12	0.28	0.06	-0.15	-0.11	0.08	0.50	-0.38	-0.01	-0.26	-0.00	-0.20	**0.84**	1.00	
$Beta_{i,2002-2}$	0.00	0.00	0.01	-0.01	-0.01	-0.01	0.00	0.07	0.41	-0.05	-0.10	0.09	-0.05	0.32	0.10	0.37	0.16	0.05	0.04	1.00

This table reports the correlation coefficients for within-transformed variables.

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Bank size is measured as a logarithm of the bank's total assets. On one hand, larger banks tend to be more resilient to shocks as they own a more diversified portfolio of assets. Besides, larger banks might be less sensitive to the changes in credit demand and withdrawal of deposits as they are considered "too big to fail". By the same token larger banks receive more support in terms of recapitalisation funds (see Chapter 3). On the other hand, the losses of larger banks might be more significant than those of smaller banks during the crisis due to their greater exposure to the market of derivatives.

- **Mortgage-Backed Securities (MBS)**

There are two proxies for the level of liquidity that are considered in this model. Both are included in the liquidity indicator proposed by the Moody's RiskCalc v3.1 U.S. Banks model (Dwyer *et al.*, 2006). However, here it is suggested to distinguish between mortgage-backed securities and treasury and municipal securities due to their different positions during the recent crisis.

Moody's RiskCalc v3.1 U.S. Banks model (Dwyer *et al.*, 2006) and Basel II regulation classified mortgage-backed securities (MBS) as safe and liquid holdings. That was indeed the case at the time, MBSs also included government mortgages provided by Government National Mortgage Association or other U.S. Federal agencies. In normal times MBS were highly liquid assets that were widely traded, while with accelerating speed of subprime defaults and consequential foreclosures significant part of them became highly risky or even "toxic".

Mortgage-backed securities in levels are normalised by total assets and are expected to positively affect loan growth rates before 2008 but negatively during the crisis. After 2008 MBS are expected to become a financial burden on the balance sheet of the banks that might lead to the scarce credit offer by such banks.

The correlation tables 4.4, 4.5 and 4.6, however, suggest only a weak correlation between the share of MBS in total assets and loan growth rates (-0.03, table 4.4). Thus, when choosing between MBS and the share of Treasury securities in the bank portfolio, the latter one is selected for the inclusion in final regressions.

- **Treasury and Municipal Securities (TSM)** include the loans made to federal, state and/or municipal government. As they represent the government debt issued by the U.S. Treasury, that type of securities remained the most liquid and secure during the crisis. The "flight to security" that occurred due to the turbulence at the financial markets only strengthened the position of government-issued debt. Thus, the banks with larger amounts of Treasury and municipal securities in their asset portfolios had stronger and more liquid positions during the crisis, that could be translated into the more intensive lending activity. The correlation coefficients from tables 4.4, 4.5 and 4.6 between dependent variables and the shares of Treasury securities confirm that argument. Correlation with growth rates of total loans reaches 0.13 in normal times, 0.15 in crisis period and 0.11 for the bailed-out banks (tables 4.4, 4.5 and 4.6 respectively).

Sensitivity to demand shock on bank products

Most of the literature on bank lending including Brei *et al.* (2011); Berrospide and Edge (2010) focuses on the financial determinants of the bank credit supply. Demand factors are mostly captured via inclusion of the GDP growth rate, inflation and interest rates and other aggregate macroeconomic characteristics. In this article one of the core determinants of the credit supply are heterogeneous reactions of financial institutions to the shock on aggregate demand. These individual bank sensitivities allow to gauge the impact of decline in demand for credits on the bank loan growth.

First the cross-sectional demand sensitivities are constructed following Claessens *et al.* (2012). Each bank's net income growth is regressed on the change in real GDP of the state where the bank is headquartered (in the period between 1990 and 2006):

Table 4.5: Correlation coefficients for within-transformed dependent and main explanatory variables interacted with crisis dummy

Var	$\Delta ln (TL)_{it}$	$\Delta ln (REML)_{it}$	$\Delta ln (CIL)_{it}$	$Z_{it-1} * C$	$\frac{TE}{TA}_{it-1} * C$	$Size_{it-1} * C$	$\frac{MBS}{TA}_{it-1} * C$	$\frac{TSM}{TA}_{it-1} * C$	$Sens_{it-1} * C$	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}
$\Delta ln (TL)_{it}$	1.00															
$\Delta ln (REML)_{it}$	0.68	1.00														
$\Delta ln (CIL)_{it}$	0.37	-0.07	1.00													
$Z_{it-1} * C$	0.25	0.18	0.11	1.00												
$\frac{TE}{TA}_{it-1} * C$	0.13	0.08	0.09	0.49	1.00											
$Size_{it-1} * C$	-0.28	-0.20	-0.14	-0.29	-0.07	1.00										
$\frac{MBS}{TA}_{it-1} * C$	-0.04	-0.05	-0.00	-0.12	0.02	0.13	1.00									
$\frac{TSM}{TA}_{it-1} * C$	0.15	0.10	0.07	0.17	-0.07	-0.38	-0.23	1.00								
$Sens_{it-1} * C$	0.21	0.12	0.12	0.21	0.23	-0.38	-0.04	0.09	1.00							
C_t	-0.23	-0.14	-0.12	-0.09	-0.07	0.46	0.00	-0.28	-0.37	1.00						
B_i	0.04	0.01	0.02	-0.06	0.03	0.09	-0.01	-0.04	-0.01	0.01	1.00					
B_iC_t	-0.13	-0.07	-0.09	-0.12	-0.02	0.37	-0.03	-0.21	-0.25	0.64	0.44	1.00				
R_i	0.05	0.02	0.03	-0.02	0.10	0.06	-0.01	-0.04	0.02	-0.02	**0.70**	0.27	1.00			
R_iC_t	-0.09	-0.05	-0.06	-0.09	0.05	0.31	-0.03	-0.18	-0.16	0.49	0.33	**0.76**	0.48	1.00		
GDP_{t-1}	0.31	0.20	0.16	0.30	0.10	-0.52	-0.10	0.29	0.49	-0.62	-0.01	-0.41	0.01	-0.32	1.00	
FF_{t-1}	0.22	0.13	0.11	0.29	0.09	-0.39	-0.10	0.21	0.46	-0.38	-0.01	-0.26	-0.00	-0.20	**0.84**	1.00

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Table 4.6: Correlation coefficients for within-transformed dependent and main explanatory variables interacted with bailout dummy

Var	$\Delta ln (TL)_{it}$	$\Delta ln (REML)_{it}$	$\Delta ln (CIL)_{it}$	$Z_{it-1} * B$	$\frac{TE}{TA}_{it-1} * B$	$Size_{it-1} * B$	$\frac{MBS}{TA}_{it-1} * B$	$\frac{TSM}{TA}_{it-1} * B$	$Sens_{it-1} * B$	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}
$\Delta ln (TL)_{it}$	1.00															
$\Delta ln (REML)_{it}$	0.68	1.00														
$\Delta ln (CIL)_{it}$	0.37	-0.07	1.00													
$Z_{it-1} * B$	0.22	0.16	0.10	1.00												
$\frac{TE}{TA}_{it-1} * B$	0.10	0.06	0.08	0.46	1.00											
$Size_{it-1} * B$	-0.24	-0.16	-0.11	-0.24	-0.07	1.00										
$\frac{MBS}{TA}_{it-1} * B$	-0.02	-0.02	0.00	-0.14	-0.02	0.13	1.00									
$\frac{TSM}{TA}_{it-1} * B$	0.11	0.07	0.04	0.15	0.05	-0.38	-0.22	1.00								
$Sens_{it-1} * B$	0.19	0.10	0.11	0.23	0.12	-0.32	-0.04	0.10	1.00							
C_t	-0.23	-0.14	-0.12	-0.13	-0.03	0.30	-0.06	-0.12	-0.28	1.00						
B_i	0.04	0.00	0.02	0.05	-0.02	0.32	0.01	-0.24	-0.11	0.00	1.00					
B_iC_t	-0.13	-0.07	-0.09	-0.15	-0.05	0.52	-0.07	-0.25	-0.40	0.64	0.44	1.00				
R_i	0.05	0.02	0.03	0.02	0.03	0.25	0.02	-0.20	-0.05	-0.02	**0.70**	0.27	1.00			
R_iC_t	-0.09	-0.05	-0.06	-0.11	0.03	0.42	-0.05	-0.22	-0.28	0.49	0.33	**0.76**	0.48	1.00		
GDP_{t-1}	0.31	0.20	0.16	0.26	0.04	-0.30	-0.07	0.13	0.44	-0.62	-0.01	-0.41	0.01	-0.32	1.00	
FF_{t-1}	0.22	0.13	0.11	0.22	0.00	-0.12	-0.08	0.05	0.38	-0.38	-0.01	-0.26	-0.00	-0.20	**0.84**	1.00

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

$$\Delta NI_{i,1990-2006} = \alpha_i + \beta_i \Delta \ln(RGDP_{ST,1990-2006}) + \epsilon_{i,1990-2006} \qquad (4.3.1)$$

where $\beta_i = \epsilon_{GDP} = \epsilon_{\frac{\Delta NI_{i,1990-2006}}{\Delta RGDP_{ST,1990-2006}}}$ is the slope or sensitivity of change in bank's net income to real GDP growth in the state where the bank is headquartered. The alternative measure of this index contains the data on personal income instead of real GDP.

The idea beyond the first step is to estimate the impact of an increase in real GDP on bank revenues during 16 years prior to crisis. Secondly, the cross-sectional sensitivity is converted into individual bank sensitivity by multiplying the β_i[17] estimated from Equation 4.3.1 by annual real GDP growth of the state where the bank is headquartered $\Delta \ln(GDP_{ST,t})$.

The correlation coefficients from table 4.4 confirm that sensitivity to demand shock is highly and positively correlated with growth rates of TL, REML and CIL (the coefficients are 0.26, 0.15 and 0.14, respectively, table 4.4).

4.3.4 Dummies and macroeconomic variables

- **Dummies**
  - *Crisis dummy* is the dummy that takes on a value of 1 in the period from 2008 until 2011. It is longer than the conventional view on the crisis mostly suggests (between 2008-2009). Nevertheless, here the period is extended in order to capture the post-crisis period with sluggish economic growth during which the banks were supposed to recover and to support the credit offer to enterprises and individuals. Each bank-specific variable is interacted with the crisis dummy and both bailout and crisis dummy (or repayment and crisis dummy for Model 4.2.2). The dummy itself and its interactions with other dummies are also included in the regressions.
  - *Bailout dummy* is the dummy that takes on two values, 0 and 1 (see table 4.2) to distinguish between the banks that did not receive CPP funds and those that

[17] β_i basically represents the change in net income of the bank when GDP rises by one unit.

did. Banks that have finally received CPP funds applied for Capital Purchase Program (CPP), have been approved for funding and then accepted the funds. Out of around 600 banks in the sample approximately 318 banks did not receive the CPP funds, while around 278 banks did.

- *Repayment dummy* is the binary variable that is equal to 1 if the bailed-out bank had repurchased its stake from the U.S. Treasury by July 2012; 0 otherwise. Regressions with repayment dummy and interactions of the bank-specific variables with that dummy are only run on the limited sample of bailed-out banks. 169 banks out of 278 banks (more than 60%) which received the CPP funds have reimbursed it by July 2012.

- **Macroeconomic variables**

  - *Real annual GDP growth* accounts for time-fixed effects in the sample. The lending activity of the banks is expected to expand in the years with higher rates of production growth reflecting increasing population wealth and improvement of the state of economy in general.
  - *Change in 3-months London Interbank Overnight Rate (LIBOR)* reflects the tendencies and changes in macroeconomic policies that are spilled over to the interbank markets. It is a principal component of the bank lending channel literature that discusses the short-term effects of monetary policies on the changes in bank lending. Banks borrowing from the central bank or from the interbank markets, in case of abundant capital and low interest rates, tend to lower the interest rates on credits that in turn leads to higher investments and more intensive bank lending activity. The effect is the opposite in case of a rise of the interest rates.

However, these two macroeconomic variables cannot be included simultaneously in the regressions due to the high correlation between them (it reaches 0.84, table 4.4). That correlation arises due to the countercyclical nature of monetary policy: the central bank tends to increase the interest rates in the periods of intensive growth and to lower the interest rates during the recession. Hence, most of the regressions are conducted including only GDP growth.

4.4 Results

4.4.1 Fixed Effects Model

Baseline Fixed Effects Model

Estimation results for the baseline robust regressions are reported in table 4.7. All individual bank characteristics are demeaned following Brei *et al.* (2011). Each bank-specific regressor enters regression in the form $BSC_{it} - \overline{BSC_t}$ such that $\overline{BSC_t} = \frac{\sum_{i=1}^{N} BSC_{it}}{N}$. Thus, resulting parameter estimates of the bank-specific characteristics BSC_{it} can be interpreted as the impact on the average bank.

Moreover, all resulting coefficients for bank-specific characteristics are multiplied by the standard deviations of the respective variables. Thus, the parameter estimates show the change in growth rate of loans when that respective variable increases by one unit (standard deviation is equal to one). It makes it easier to interpret the coefficients and to recognise the relative effects of the variables within the same regression.

Fixed effects methodology does not allow to include time-invariant regressors into the model as it was emphasised in section 4.2.3. Thus, bailout and repayment dummies as well as interactions of the bank-specific characteristics with these dummies are excluded from the baseline regression. The impact of the dummies is basically comprised in fixed effects. Consequently, in the baseline regressions the parameter shift is only allowed between normal times and crisis period.

As noted in section 4.2.2, within estimator in dynamic models can lead to biased coefficients ("fixed effects Nickell's bias") due to correlation between lagged dependent variable and individual random effects. Thus, autoregressive component (lagged growth rate of loans) is removed from the baseline regression. Results for regressions including lagged dependent variables are presented in Appendix G.

Table 4.7 reports the coefficients δ and δ^* from Equation 4.2.1 as well as the the resulting coefficients for the crisis period $\delta + \delta^*$ (in square brackets). Thus, δ coefficients have to be interpreted as the impact of bank-specific characteristics on the growth rate of loans for all the banks in the sample in normal times, while $\delta + \delta^*$ coefficients gauge the same effect but during the crisis period (2008–2011).

The first pair of columns (columns 3 and 4, table 4.7) provides results for the regressions with the growth rate of total loans as the dependent variable (ΔTL_{it}), the second pair reports the coefficients when the growth rate of real estate mortgage loans ($\Delta REML_{it}$) is the dependent variable, while the third pair of columns presents the parameter estimates for the regressions with the growth rates of commercial and industrial loans (ΔCIL_{it}) as the dependent variable.

As expected, the crisis has a negative impact on bank lending activity: the growth rates collapse for the average bank by around 7.5% for total loans when the real GDP growth is controlled for.

Most of the bank-specific characteristics are significant in predicting the loan growth rate both in normal times and during the crisis. In general as expected, safer (with higher Altman's Z-score) and better capitalised (with greater equity ratio) banks with larger share of Treasury securities in the asset portfolio exhibit higher growth rates of loans.

Bank's safety indicator (Z-score) includes information on bank capitalisation[18], however, larger weights are attributed to income and earnings related indicators. For the average bank a one point increase in Z-score leads to an increase in total bank lending by around 3.1-3.4%[19] during the crisis.

[18]One of the indicators used to construct Z-score is the share of liabilities financed by equity.

[19]Recall that all bank-specific variables are demeaned by their annual averages and that the reported coefficients are adjusted for their standard deviations. Thus, a one point increase in average bank's Z-score raises the growth rate of total loans by (-0.11%+3.50%)*1= 3.39% during the crisis.

Table 4.7: Fixed effects robust estimator - Baseline regression results

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: all banks, normal times (δ)							
Altman's	Z_{it-1}	-0.11	-0.14	-0.10	-0.06	1.41	1.27
Z-score		(-0.20)	(-0.26)	(-0.13)	(-0.08)	(0.95)	(0.85)
Capital ratio	$\frac{TE}{TA}_{it-1}$	3.22***	3.18***	3.14***	3.14***	7.78***	7.91***
		(6.28)	(6.03)	(3.94)	(3.74)	(5.28)	(5.10)
TSM to	$\frac{TSM}{TA}_{it-1}$	0.84***	0.98***	0.77	0.84*	-0.28	-0.14
total assets		(2.63)	(2.97)	(1.52)	(1.70)	(-0.33)	(-0.14)
Size	$Size_{it-1}$	-22.11***	-22.15***	-24.03***	-23.19***	-20.42***	-21.22***
		(-15.13)	(-15.68)	(-11.34)	(-10.93)	(-6.39)	(-6.48)
Sensitivity	$Sens_{it-1}$	5.16***	4.73***	4.08***	3.65***	5.80***	5.37***
to ΔGDP		(8.05)	(8.08)	(3.24)	(3.10)	(3.03)	(2.91)
Individual bank characteristics: δ^*, $\delta + \delta^*$ in square brackets							
Altman's	$Z_{it-1} * C_t$	3.50*** [**3.39**]	3.23*** [**3.10**]	5.71*** [**5.61**]	5.44*** [**5.38**]	-1.27 [**0.14**]	-1.53 [**-0.27**]
Z-score		(4.65)	(4.37)	(5.12)	(5.02)	(-0.63)	(-0.75)
Capital ratio	$\frac{TE}{TA}_{it-1} * C_t$	1.07 [**4.30**]	1.89* [**5.07**]	-0.52 [**2.62**]	0.26 [**3.39**]	6.19** [**13.96**]	7.18** [**15.08**]
		(1.00)	(1.75)	(-0.34)	(0.17)	(2.08)	(2.44)
TSM to	$\frac{TSM}{TA}_{it-1} * C_t$	0.56 [**1.40**]	0.56 [**1.54**]	-0.84 [**-0.07**]	-0.84 [**0.00**]	2.87 [**2.59**]	2.66 [**2.52**]
total assets		(1.04)	(0.93)	(-0.95)	(-0.96)	(1.48)	(1.37)
Size	$Size_{it-1} * C_t$	-0.98** [**-23.09**]	-1.43*** [**-23.58**]	-2.39*** [**-26.43**]	-2.88*** [**-26.07**]	0.26 [**-20.16**]	-0.23 [**-21.45**]
		(-2.17)	(-3.15)	(-3.54)	(-4.24)	(0.21)	(-0.19)
Sensitivity	$Sens_{it-1} * C_t$	-4.73*** [**0.43**]	-3.87*** [**0.86**]	-4.94*** [**-0.86**]	-3.87*** [**-0.21**]	-3.22 [**2.58**]	-2.58 [**2.79**]
to ΔGDP		(-5.18)	(-4.10)	(-3.18)	(-2.71)	(-1.25)	(-0.97)
Macroeconomic conditions and dummies							
GDP growth	ΔGDP_{t-1}		1.28***		1.09***		1.89***
			(12.66)		(5.31)		(5.06)
Crisis	C_t	-11.83***	-7.47***	-10.67***	-8.24***	-16.15***	-7.66***
		(-9.05)	(-13.89)	(-5.42)	(-10.26)	(-4.37)	(-5.05)
	Constant	15.06***	12.63***	14.32***	14.61***	18.57***	12.65***
		(14.18)	(31.47)	(8.76)	(20.39)	(7.19)	(9.43)
	R-sq	0.35	0.32	0.15	0.13	0.08	0.07
	Obs	5637	5495	5619	5478	5344	5218

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

The effect of Z-score is particularly amplified in the regressions explaining the growth of REML in the crisis period. A one point increase in Z-score of the bank raises the growth rate of REML by almost 6% during the crisis (columns 5 and 6, table 4.7). However, Z-score does not exhibit a significant explanatory power in case of CIL. In these regressions it is the level of capitalisation that plays the most important role. A one percentage increase in equity to assets ratio leads to around 8% (columns 7 and 8, table 4.7) rise in growth rate of CIL for the average commercial bank in the period before 2008. This effect is magnified in the crisis period when 1% higher capital ratio leads to around 14-15% rise in the growth rate of CIL for the average bank.

Demand factor is also significant both in normal times and during the crisis. In the period between 1995 and 2007 higher sensitivity of net income to changes in real GDP leads to higher growth rates in total loans of the average bank. However, in the period between 2008 and 2011 this effect almost disappears or the relation even becomes negative, especially for REML. If the bank is 1% more sensitive to the aggregate demand shock, the growth rates of REML are at least 0.2-0.9% lower for the average bank during the crisis. That can be explained by the fact that more sensitive to changes in real GDP banks suffer larger losses than other banks during bad times due to the drop in consumer demand for banking products.

As in Brei *et al.* (2011), there are negative and significant coefficients for the bank size which suggests that mostly smaller banks were contributing to the increase in loan supply and this effect is amplified in the crisis period.

Results for regressions including lagged growth of loans are presented in Appendix G and lead to similar conclusions. Significance of the majority of variables and their impact on the loan growth rates remain the same or close to those obtained from baseline regressions without autoregressive component.

In general the model fits the data well. It performs better in case of regressions with growth rates of total loans bringing R-squared to 32-35%.

Robustness check for Fixed Effects model

In this subsection the results for the fixed effects regressions with bank-specific characteristics in first differences are presented. That allows to check the results obtained in the previous section for robustness, if all right-hand side variables from equation 4.2.1 are first-differenced.

As in the previous subsection the differences of bank-specific variables $\Delta BSC_{i,t-1}$ are demeaned with respect to their annual averages across all banks in sample. Final coefficients are multiplied by the standard deviation of the first differences that allows to interpret them as a change in the growth rate of loans when $\Delta BSC_{i,t-1}$ rises by one.

First-differenced models are conducted without autoregressive component following the same reasoning as in the case of Nickell's bias. Lagged dependent variable is correlated with lagged random effects that can lead to the correlation between their first-differences and downward biased coefficients.

Results are presented in table 4.8. Generally, when estimating regressions with first-differenced explanatory variables, they become less significant and R-squared decreases. In case of regressions for growth rates of total loans the R-squared decreases from 32-35% to 18-22%.

Interestingly, the signs of the coefficients for the first differences of capital ratios change to negative during normal times. They are significantly negative for the first two regressions explaining the growth rates of total loans. Larger rise in capital ratio is associated with smaller growth rates of total loans in normal times. However, during the crisis the effect of the increase in capital ratio remains positive and leads to a rise in growth rates of total loans and consumer and industrial loans (the coefficients are, however, insignificant for the growth rates of real estate mortgage loans). Thus, while the positive impact of additional capital is not confirmed for normal times, it is found to be positively significant for supporting the credit growth during the crisis.

The coefficients of bank size also have opposite signs relative to those obtained in the

Table 4.8: Fixed effects robust estimator - regression in first differences

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
		Individual bank characteristics: all banks, normal times (δ)					
Altman's	ΔZ_{it-1}	0.46	0.44	0.34	0.31	0.67	0.66
Z-score		(1.55)	(1.49)	(0.66)	(0.66)	(0.70)	(0.67)
Capital ratio	$\Delta \frac{TE}{TA}_{it-1}$	-0.87*	-1.00**	-0.95	-1.03	-0.79	-0.98
		(-1.92)	(-2.21)	(-1.40)	(-1.54)	(-0.55)	(-0.68)
TSM to	$\Delta \frac{TSM}{TA}_{it-1}$	0.00	-0.04	-0.32	-0.35	0.46	0.46
total assets		(-0.05)	(-0.15)	(-1.03)	(-1.08)	(0.65)	(0.64)
Size	$\Delta Size_{it-1}$	3.52***	3.30***	4.10***	3.90***	1.48	1.27
		(5.09)	(4.80)	(4.07)	(3.91)	(0.95)	(0.83)
Sensitivity	$\Delta Sens_{it-1}$	0.36	0.12	-0.24	-0.48	1.55	1.31
to ΔGDP		(0.63)	(0.29)	(-0.18)	(-0.35)	(0.92)	(0.84)
		Individual bank characteristics: δ^*, $\delta + \delta^*$ **in square brackets**					
Altman's	$\Delta Z_{it-1} * C_t$	1.98*** [**2.44**]	2.02*** [**2.46**]	3.66*** [**3.99**]	3.74*** [**4.05**]	-2.37 [**-1.70**]	-2.34 [**-1.68**]
Z-score		(2.96)	(2.87)	(3.24)	(3.31)	(-1.00)	(-0.97)
Capital ratio	$\Delta \frac{TE}{TA}_{it-1} * C_t$	2.96** [**2.09**]	2.99** [**1.98**]	2.11 [**1.16**]	2.09 [**1.06**]	7.50** [**6.71**]	7.53** [**6.55**]
		(2.50)	(2.47)	(1.26)	(1.24)	(2.11)	(2.12)
TSM to	$\Delta \frac{TSM}{TA}_{it-1} * C_t$	0.14 [**0.14**]	0.27 [**0.23**]	-0.04 [**-0.36**]	0.08 [**-0.27**]	0.64 [**1.10**]	0.79 [**1.25**]
total assets		(0.38)	(0.48)	(-0.48)	(-0.37)	(0.11)	(0.08)
Size	$\Delta Size_{it-1} * C_t$	-1.41 [**2.11**]	-1.33 [**1.96**]	-0.92 [**3.18**]	-0.93 [**2.96**]	3.04 [**4.52**]	2.83 [**4.10**]
		(-1.09)	(-1.02)	(-0.48)	(-0.48)	(0.92)	(0.85)
Sensitivity	$\Delta Sens_{it-1} * C_t$	-0.24 [**0.12**]	0.12 [**0.24**]	0.00 [**-0.24**]	0.36 [**-0.12**]	-1.19 [**0.36**]	-0.96 [**0.36**]
to ΔGDP		(-0.31)	(0.18)	(0.02)	(0.31)	(-0.59)	(-0.51)
		Macroeconomic conditions and dummies					
GDP growth	ΔGDP_{t-1}		1.34***		1.10***		1.90***
			(12.21)		(5.35)		(4.98)
Crisis	C_t	-16.45***	-7.68***	-16.89***	-8.72***	-15.77***	-8.04***
		(-11.45)	(-12.80)	(-7.86)	(-9.69)	(-3.96)	(-5.40)
	Constant	15.78***	8.46***	15.97***	10.54***	16.59***	7.47***
		(12.96)	(22.35)	(8.67)	(15.97)	(5.35)	(6.31)
	R-sq	0.22	0.18	0.09	0.08	0.04	0.03
	Obs	5059	4959	5043	4923	4790	4663

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

previous subsection. The banks whose total assets grow the most are associated with higher growth rates of total and mortgage loans both in normal times and – to a smaller extent – during the crisis. Thus, while larger banks tend to exhibit smaller growth rates of loans, the banks that experience the largest growth of their assets tend to lend more both in normal times and during the crisis.

The impact of crisis dummy variable, C_t, as well as that of real GDP growth, ΔGDP_t, on the loan growth rates remain the same. In benign periods of economic growth loans increase at a higher pace, while during the crisis the growth rates of loans drop by at least 8.5% (column 4, table 4.8), when controlled for GDP growth.

Fixed Effects estimator: full specification

Same within estimator is applied in this section to estimate model 4.2.3 that combines interaction of the main balance sheet variables with bailout, repayment and crisis dummies. In that way the impact of the main variables on loan growth rates for six categories of U.S. banks is analysed: banks that did not receive CPP funds (in normal times/during the crisis); banks that received CPP funds and repaid them totally by July 2012 (in normal times/during the crisis) and banks that received CPP funds but did not repay them (in normal times during the crisis). The full impact of some balance sheet characteristic BSC_1 on the growth rates of loans for each bank category in the analysed period is then computed and is shown in the following table in square brackets.

Results are presented in table4.9. Lagged dependent variable is excluded from the regression to avoid endogeneity bias. Bailout dummy as well as repayment dummy are not included in the regressions either as their impacts cannot be estimated in fixed effects estimator framework.

Table 4.9: Fixed Effects estimator - The effects of CPP funds disbursement and repayment on bank lending activity in normal times and during the crisis

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-0.68	-0.73	-1.45	-1.32	1.89	1.80
	(-0.91)	(-1.08)	(-1.37)	(-1.38)	(1.16)	(1.05)
$\frac{TE}{TA}_{it-1}$	3.44***	4.00***	4.00***	4.73***	7.73***	8.55***
	(5.15)	(5.83)	(4.03)	(4.62)	(3.73)	(4.02)
$\frac{TSM}{TA}_{it-1}$	0.28	0.56	-0.14	0.14	0.84	1.40
	(0.67)	(1.24)	(-0.22)	(0.17)	(0.73)	(1.07)
$Size_{it-1}$	-22.18***	21.45***	-24.93***	-23.71***	-20.55***	-20.35***
	(-9.72)	(-10.44)	(-7.67)	(-8.11)	(-4.09)	(-3.69)
$Sens_{it-1}$	4.08***	4.08***	2.79	2.79	6.02**	6.02**
	(4.43)	(4.66)	(1.51)	(1.56)	(2.08)	(2.06)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta+\delta^*$ in square brackets)						
$Z_{it-1} * C_t$	4.91***[**4.23**]	3.80***[**3.07**]	7.23***[**5.78**]	5.94***[**4.62**]	-0.26 [**1.63**]	-1.03 [**0.77**]
	(4.54)	(3.43)	(4.56)	(3.71)	(-0.07)	(-0.29)
$\frac{TE}{TA}_{it-1} * C_t$	-0.09[**3.35**]	1.12 [**5.11**]	-2.06 [**1.93**]	-0.73 [**4.00**]	7.35 [**15.08**]	8.29* [**16.84**]
	(-0.07)	(0.74)	(-1.10)	(-0.38)	(1.64)	(1.89)
$\frac{TSM}{TA}_{it-1} * C_t$	1.47* [**1.75**]	0.84 [**1.40**]	1.05 [**0.91**]	0.35 [**0.49**]	1.96 [**2.80**]	1.05 [**2.45**]
	(1.72)	(0.96)	(0.83)	(0.29)	(0.71)	(0.39)
$Size_{it-1} * C_t$	-1.68*[**-23.86**]	-0.98 [**-22.42**]	-2.69**[**-27.62**]	-2.05 [**-25.76**]	1.14 [**-19.41**]	1.71 [**-18.64**]
	(-1.78)	(-1.00)	(-2.07)	(-1.54)	(0.40)	(0.61)
$Sens_{it-1} * C_t$	-3.44***[**0.64**]	-2.79**[**1.29**]	-4.08 [**-1.29**]	-3.22 [**-0.43**]	-1.93 [**4.08**]	-1.29 [**4.73**]
	(-2.60)	(-2.20)	(-1.60)	(-1.44)	(-0.45)	(-0.32)
Individual bank characteristics: bailed-out banks that did not repay CPP funds, normal times (γ, $\delta+\gamma$ in square brackets)						
$Z_{it-1} * B_i$	0.23 [**-0.45**]	0.39 [**-0.34**]	1.05 [**-0.40**]	0.82 [**-0.50**]	-2.71 [**-0.81**]	-3.34 [**-1.53**]
	(0.16)	(0.26)	(0.51)	(0.39)	(-0.55)	(-0.72)
$\frac{TE}{TA}_{it-1} * B_i$	-0.43 [**3.01**]	-1.76 [**2.23**]	-0.60 [**3.39**]	-1.85 [**2.88**]	5.41 [**13.15**]	5.59 [**14.14**]
	(-0.31)	(-1.25)	(-0.30)	(-0.77)	(1.23)	(1.11)
$\frac{TSM}{TA}_{it-1} * B_i$	-0.63 [**-0.35**]	-1.19 [**-0.63**]	0.56 [**0.42**]	-0.14 [**0.00**]	-4.00 [**-3.15**]	-4.56 [**-3.15**]
	(-0.70)	(-1.32)	(0.37)	(-0.08)	(-1.29)	(-1.46)
$Size_{it-1} * B_i$	-3.21 [**-25.39**]	-3.88 [**-25.32**]	-3.04 [**-27.97**]	-2.93 [**-26.64**]	6.48 [**-14.07**]	7.03 [**-13.32**]
	(-0.84)	(-1.02)	(-0.54)	(-0.51)	(0.76)	(0.76)
$Sens_{it-1} * B_i$	0.86 [**4.94**]	0.86 [**4.94**]	2.79 [**5.59**]	2.79 [**5.59**]	-6.66 [**-0.64**]	-6.88 [**-0.86**]
	(0.60)	(0.55)	(1.18)	(1.12)	(-1.36)	(-1.42)
Individual bank characteristics: bailed-out banks that did not repay CPP funds, crisis (γ^*, $\delta+\delta^*+\gamma+\gamma^*$ in square brackets)						
$Z_{it-1} * B_i * C_t$	-0.68 [**3.78**]	1.09 [**4.55**]	0.14 [**6.96**]	2.60 [**8.04**]	-3.31 [**-4.38**]	-2.48 [**-5.05**]
	(-0.33)	(0.50)	(0.04)	(0.80)	(-0.57)	(-0.44)
$\frac{TE}{TA}_{it-1}$	1.20 [**4.12**]	2.15 [**5.50**]	1.59 [**2.92**]	1.98 [**4.12**]	-1.63 [**18.86**]	-0.56 [**21.87**]

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Table 4.9 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$*B_i*C_t$	(0.47)	(0.85)	(0.41)	(0.52)	(-0.18)	(-0.06)
$\frac{TSM}{TA}_{it-1}$	-0.77 [**0.35**]	1.12 [**1.33**]	-1.89 [**-0.42**]	-0.14 [**0.21**]	3.79 [**2.59**]	5.96 [**3.86**]
$*B_i*C_t$	(-0.49)	(0.58)	(-0.66)	(-0.04)	(0.57)	(0.85)
$Size_{it-1}$	0.20 [**-26.87**]	-0.10 [**-26.40**]	-2.12 [**-32.78**]	-2.36 [**-31.05**]	3.14 [**-9.79**]	2.54 [**-9.07**]
$*B_i*C_t$	(0.15)	(-0.08)	(-1.12)	(-1.22)	(0.62)	(0.48)
$Sens_{it-1}$	-1.72 [**-0.21**]	-2.58 [**-0.43**]	0.21 [**1.72**]	-0.43 [**1.93**]	-1.50 [**-4.08**]	-2.15 [**-4.30**]
$*B_i*C_t$	(-1.01)	(-1.36)	(0.07)	(-0.18)	(-0.25)	(-0.33)
Individual bank characteristics: bailed-out banks that repaid CPP funds, normal times (κ, $\delta+\gamma+\kappa$ **in square brackets**)						
$Z_{it-1}*R_i$	2.65 [**2.20**]	2.30 [**1.96**]	5.01* [**4.61**]	4.82* [**4.33**]	4.59 [**3.77**]	5.21 [**3.68**]
	(1.43)	(1.17)	(1.81)	(1.68)	(0.91)	(1.11)
$\frac{TE}{TA}_{it-1}*R_i$	-1.68 [**1.33**]	-1.59 [**0.64**]	-5.28** [**-1.89**]	-5.50* [**-2.62**]	-8.77** [**4.38**]	-10.96** [**3.18**]
	(-1.00)	(-0.91)	(-2.00)	(-1.89)	(-1.98)	(-2.18)
$\frac{TSM}{TA}_{it-1}*R_i$	2.45** [**2.10**]	3.08*** [**2.45**]	1.96 [**2.38**]	2.59* [**2.59**]	2.66 [**-0.49**]	2.59 [**-0.56**]
	(2.39)	(2.98)	(1.30)	(1.66)	(0.82)	(0.79)
$Size_{it-1}*R_i$	4.79 [**-20.60**]	3.83 [**-21.49**]	6.51 [**-21.46**]	5.39 [**-21.25**]	-5.59 [**-19.65**]	-8.70 [**-22.02**]
	(1.26)	(0.96)	(1.15)	(0.87)	(-0.68)	(-1.00)
$Sens_{it-1}*R_i$	2.58 [**7.52**]	2.15 [**7.09**]	-0.64 [**4.94**]	-1.07 [**4.51**]	12.25**[**11.61**]	11.61**[**10.75**]
	(1.59)	(1.32)	(-0.22)	(-0.41)	(2.56)	(2.49)
Individual bank characteristics: bailed-out banks that repaid CPP funds, crisis (κ^*, $\delta+\delta^*+\gamma+\gamma^*+\kappa+\kappa^*$ **in square brackets**)						
Z_{it-1}	-3.89* [**2.55**]	-4.33* [**2.52**]	-6.29* [**5.68**]	-7.22** [**5.65**]	-0.22 [**-0.02**]	-0.03 [**0.14**]
$*R_i*C_t$	(-1.72)	(-1.83)	(-1.79)	(-2.05)	(-0.04)	(-0.00)
$\frac{TE}{TA}_{it-1}$	1.72 [**4.17**]	0.52 [**4.43**]	3.74 [**1.37**]	2.75 [**1.37**]	0.47 [**10.57**]	0.30 [**11.21**]
$*R_i*C_t$	(0.57)	(0.17)	(0.79)	(0.59)	(0.05)	(0.03)
$\frac{TSM}{TA}_{it-1}$	-1.40 [**1.40**]	-2.80 [**1.61**]	-2.38 [**-0.84**]	-3.36 [**-0.56**]	-4.42 [**0.84**]	-5.89 [**0.56**]
$*R_i*C_t$	(-0.88)	(-1.37)	(-0.81)	(-1.12)	(-0.65)	(-0.83)
$Size_{it-1}$	0.60 [**-21.48**]	-1.01 [**-23.58**]	2.65 [**-23.61**]	1.17 [**-24.49**]	-5.08 [**-20.45**]	-6.09 [**-23.86**]
$*R_i*C_t$	(0.54)	(-0.96)	(1.57)	(0.70)	(-1.15)	(-1.29)
$Sens_{it-1}$	-1.50 [**0.86**]	1.07 [**2.79**]	-5.59 [**-4.51**]	-2.79 [**-1.93**]	-1.50 [**6.66**]	0.43 [**7.74**]
$*R_i*C_t$	(-0.67)	(0.47)	(-1.47)	(-0.81)	(-0.22)	(0.05)
Macroeconomic conditions						
C_t	-12.91***	-7.81***	-12.73***	-9.47***	-12.86***	-6.23***
	(-8.90)	(-10.08)	(-6.20)	(-8.95)	(-3.11)	(-2.79)
B_i*C_t	0.26	0.27	1.69	1.70	-1.74	-1.40
	(0.21)	(0.20)	(0.89)	(0.86)	(-0.41)	(-0.33)
R_i*C_t	1.69	1.44	2.18	1.80	0.08	-0.38
	(1.32)	(1.05)	(1.09)	(0.87)	(0.02)	(-0.09)
ΔGDP_{t-1}		1.25***		1.00***		1.90***
		(12.07)		(4.74)		(5.10)
Constant	14.88***	12.47***	13.84***	14.15***	18.70***	12.61***

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Table 4.9 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(12.94)	(21.67)	(7.68)	(14.57)	(7.09)	(8.39)
R-sq	0.36	0.33	0.15	0.14	0.08	0.07
Obs	5637	5495	5619	5478	5344	5218

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

As shown in 4.9 the crisis dummy has a large negative effect on the growth rates of loans. When controlled for the GDP growth the growth rates of total loans are almost 8% (column 3, table 4.9) smaller during the crisis period relative to normal times. The coefficients for interactions of bailout and repayment dummies with crisis dummy are positive but insignificant while the full impact cannnot be computed due to the absence of the estimated parameters for time-invariant dummies B_i and R_i.

The parameters obtained for non-bailed banks in normal times are similar to those from table 4.7. The capital ratio has a significant positive impact on the growth rates of loans, an increase in capital ratio by one percentage point leads to a 3.4-4% (columns 2 and 3, section "non-bailed banks, normal times", table 4.9) rise in growth rates of total loans at non-bailed banks in normal times. Besides, smaller banks with higher sensitivity to changes in consumer's demand also experience higher growth rates of loans.

During the crisis it is financial stability that place an important role for explaining the loans growth at non-bailed banks: those with a higher Z-score extend lending at a greater pace in difficult times. The drop in consumer's demand also seem to contribute to slowing down of credit initiation. An increase in sensitivity to consumer's demand at average non-bailed bank by one unit leads to a 0.6-1.3% (columns 2 and 3, section "non-bailed banks, crisis", table 4.9) higher growth rates of total loans during the crisis relative to a 4% (columns 2 and 3, section "non-bailed banks, normal times", table 4.9) rise in total lending during benign times.

The interactions between main variables and dummies for the bailed-out banks that did not repay CPP funds are mostly insignificant when estimated with fixed effects, it can be also related to a small number of banks in that group and low efficiency of within estimator in the presence of endogeneity of explanatory variables.

For the group of banks that repurchased their stakes from the U.S. Treasury several factors seem to be significant in predicting the growth rates of loans. More financially stable banks seem to increase supply of mortgage loans at a higher pace in normal times than other banks. However, in normal times with an additional unit of capital the banks from that group tend to lend less than other banks. The growth rates of mortgage loans are in fact negatively related to the increase in capitalisation ratio of the average bank from that group.

During the crisis, however, the banks from that group become more sensitive to the changes in their capitalisation level and translate additional capital into higher growth rates of loans. With one additional unit of capital during the crisis time the average bank that repaid CPP funds extends the growth rates of its total loans by 4.2-4.4% (columns 2 and 3, table 4.9).

The R-squared shows that the model fits the data relatively well, it reaches 33-36% for the regressions with total loans.

Fixed Effects estimator: bank subsamples

In this section a similar to the previous sections analysis is conducted for the subsamples of banks. The impact of the main balance sheet characteristics is distinguished between normal and crisis periods. Results of the regressions for the first subsample of non-bailed banks are presented in table 4.10.

The average bank from the subsample of non-bailed banks seem to be sensitive to the additional capital during normal times. A rise of the capital ratio by one percentage point is associated with a 3.8-4.6% (columns 3 and 4, table 4.10) increase in growth rates of total loans, with a 4.4-5.3% (columns 5 and 6, table 4.10) increase in growth rates of mortgages

Table 4.10: Fixed effects robust estimator - Subsample of non-bailed banks

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: all banks, normal times (δ)							
Altman's	Z_{it-1}	-0.50	-0.77	-1.19	-1.37	2.40	1.92
Z-score		(-0.63)	(-1.06)	(-1.06)	(-1.32)	(1.36)	(1.01)
Capital ratio	$\frac{TE}{TA}_{it-1}$	3.83***	4.57***	4.37***	5.26***	8.55***	9.87***
		(4.97)	(5.79)	(3.82)	(4.53)	(3.66)	(4.05)
TSM to	$\frac{TSM}{TA}_{it-1}$	0.44	0.59	0.00	0.15	0.96	1.48
total assets		(0.90)	(1.24)	(-0.02)	(0.15)	(0.79)	(1.09)
Size	$Size_{it-1}$	-18.11***	-17.77***	-19.97***	-19.35***	-18.90***	-17.41***
		(-9.19)	(-10.33)	(-7.19)	(-7.81)	(-4.33)	(-3.73)
Sensitivity	$Sens_{it-1}$	0.98***	0.93***	0.69	0.64	1.42**	1.38**
to ΔGDP		(4.60)	(4.63)	(1.63)	(1.57)	(2.15)	(2.07)
Individual bank characteristics: δ^*, $\delta + \delta^*$ **in square brackets**							
Altman's	$Z_{it-1} * C_t$	5.07*** [**4.57**]	4.27*** [**3.50**]	7.60*** [**6.41**]	6.92*** [**5.55**]	-1.17 [**1.23**]	-1.54 [**0.38**]
Z-score		(4.18)	(3.52)	(4.25)	(3.93)	(-0.30)	(-0.40)
Capital ratio	$\frac{TE}{TA}_{it-1} * C_t$	0.00 [**3.83**]	1.18 [**5.75**]	-2.16 [**2.21**]	-1.08 [**4.18**]	8.94* [**17.49**]	9.82* [**19.70**]
		(0.00)	(0.69)	(-1.01)	(-0.51)	(1.74)	(1.96)
TSM to	$\frac{TSM}{TA}_{it-1} * C_t$	1.48 [**1.92**]	0.89 [**1.48**]	0.96 [**0.96**]	0.44 [**0.59**]	1.92 [**2.88**]	1.04 [**2.52**]
total assets		(1.63)	(0.97)	(0.71)	(0.32)	(0.65)	(0.36)
Size	$Size_{it-1} * C_t$	-1.20 [**-19.31**]	-0.83 [**-18.60**]	-1.92* [**-21.89**]	-1.79 [**-21.14**]	1.11 [**-17.79**]	1.48 [**-15.93**]
		(-1.50)	(-1.03)	(-1.79)	(-1.64)	(0.46)	(0.63)
Sensitivity	$Sens_{it-1} * C_t$	-0.84*** [**0.15**]	-0.64** [**0.29**]	-0.88 [**-0.20**]	-0.74 [**-0.10**]	-0.54 [**0.88**]	-0.34 [**1.03**]
to ΔGDP		(-2.70)	(-2.17)	(-1.62)	(-1.40)	(-0.59)	(-0.35)
Macroeconomic conditions and dummies							
GDP growth	ΔGDP_{t-1}		1.43***		1.65***		1.29**
			(9.91)		(5.09)		(2.18)
Crisis	C_t	-14.47***	-7.36***	-15.63***	-7.83***	-9.69	-7.74***
		(-8.95)	(-9.07)	(-5.65)	(-6.66)	(-1.53)	(-3.19)
	Constant	8.48***	5.85***	9.28***	6.83***	8.01*	7.10***
		(6.42)	(11.94)	(5.11)	(7.13)	(1.73)	(4.04)
	R-sq	0.35	0.32	0.15	0.14	0.07	0.07
	Obs	2851	2784	2842	2775	2665	2607

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

loans or with a 8.5-9.9% (columns 7 and 8, table 4.10) increase in growth rates of commercial and industrial loans. During the crisis that effect seems to mostly remain the same for total loans while dropping for mortgage loans and rising for commercial and industrial loans. It means that during the crisis additional capital was easier translated in supply of commercial and industrial loans than in that of mortgage loans at the average non-bailed bank.

Financially stable non-bailed banks tends to lend more during the crisis than in normal times, while larger banks lend less both in normal times and during the crisis. Higher consumer's demand leads to higher growth rates of loans in normal times, while this effect disappears during the crisis. In general across non-bailed banks the growth rates of total loans drop by at least 7.4% (column 4, table 4.10) after 2007 when controlling for GDP growth.

The second analysed subsample of banks comprises bailed-out banks that repurchased their stakes from the Treasury by July 2012. Results are presented in table 4.11. The growth rates of total loans at the average bank from that group dropped during the crisis by at least 6.4% (column 4, table 4.11) after controlling for GDP growth.

On average the growth rates of loans are not responding significantly to the rise in capitalisation ratio in normal times, while they become more sensitive in tough times. One percentage point increase in capital ratio leads to a rise in the growth rates of total loans by 2.8-3.1% (columns 3 and 4, table 4.11), to a 1% (columns 5 and 6, table 4.11) rise in growth rates of mortgage loans or to a 7.3-7.9% (columns 7 and 8, table 4.11) rise in growth rates of commercial and industrial loans during the crisis. The impact of size on the growth rates of all types of loans is the same as in case of non-bailed banks: larger banks extend their credit lines less than smaller ones during normal times and particularly during the crisis.

The effect of the changes in consumer's demand is the same as in case of non-bailed banks: higher demand in benign times leads to higher growth rates of loans while the collapse of consumer's demand during the crisis leads to a drop in loan growth rates.

The model is fitting well both the subsample of non-bailed banks and that of bailed-out

Table 4.11: Fixed effects robust estimator - Subsample of bailed-out banks that repaid CPP funds

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
		Individual bank characteristics: all banks, normal times (δ)					
Altman's	Z_{it-1}	1.86	1.72	3.79*	3.79*	3.36**	3.25*
Z-score		(1.48)	(1.35)	(1.96)	(1.95)	(1.99)	(1.85)
Capital ratio	$\frac{TE}{TA}_{it-1}$	0.96	0.45	-1.29	-2.01	3.00**	2.34
		(1.13)	(0.51)	(-0.95)	(-1.45)	(2.08)	(1.63)
TSM to	$\frac{TSM}{TA}_{it-1}$	2.02***	2.36***	2.22***	2.49***	-0.27	-0.54
total assets		(3.52)	(3.72)	(2.68)	(2.82)	(-0.19)	(-0.36)
Size	$Size_{it-1}$	-23.68***	-24.55***	-26.14***	-24.97***	-20.77***	-24.46***
		(-8.90)	(-9.08)	(-6.48)	(-6.02)	(-4.03)	(-4.71)
Sensitivity	$Sens_{it-1}$	5.13***	4.83***	3.17*	2.87*	8.29***	7.69***
to ΔGDP		(5.82)	(6.12)	(1.85)	(1.79)	(4.39)	(4.11)
		Individual bank characteristics: δ^*, $\delta + \delta^*$ in square brackets					
Altman's	$Z_{it-1} * C_t$	0.31 [**2.16**]	0.50 [**2.22**]	1.13 [**4.91**]	1.19 [**4.99**]	-3.53 [**-0.17**]	-3.14 [**0.10**]
Z-score		(0.24)	(0.39)	(0.58)	(0.64)	(-1.57)	(-1.31)
Capital ratio	$\frac{TE}{TA}_{it-1} * C_t$	1.83 [**2.79**]	2.64* [**3.09**]	2.22 [**0.93**]	2.94 [**0.93**]	4.32 [**7.32**]	5.52* [**7.86**]
		(1.18)	(1.82)	(0.97)	(1.30)	(1.50)	(1.94)
TSM to	$\frac{TSM}{TA}_{it-1} * C_t$	-0.67 [**1.35**]	-0.81 [**1.55**]	-3.23** [**-1.01**]	-3.10** [**-0.61**]	1.48 [**1.21**]	1.28 [**0.74**]
total assets		(-0.75)	(-0.85)	(-2.34)	(-2.27)	(0.53)	(0.45)
Size	$Size_{it-1} * C_t$	-0.96 [**-24.64**]	-2.42*** [**-26.97**]	-2.46** [**-28.60**]	-4.03*** [**-29.01**]	-0.85 [**-21.63**]	-1.85 [**-26.31**]
		(-1.28)	(-3.30)	(-2.09)	(-3.70)	(-0.51)	(-1.14)
Sensitivity	$Sens_{it-1} * C_t$	-4.22*** [**0.90**]	-3.02*** [**1.81**]	-6.18** [**-3.02**]	-4.67** [**-1.81**]	-2.56 [**5.73**]	-2.26 [**5.43**]
to ΔGDP		(-3.39)	(-2.64)	(-2.55)	(-2.17)	(-0.68)	(-0.56)
		Macroeconomic conditions and dummies					
GDP growth	ΔGDP_{t-1}		1.14***		0.28		2.39***
			(6.50)		(0.80)		(4.49)
Crisis	C_t	1.26	-6.38***	5.59*	-7.79***	-5.77	-6.79***
		(0.52)	(-6.52)	(1.72)	(-5.30)	(-1.20)	(-3.22)
	Constant	23.63***	24.12***	20.91***	26.78***	24.81***	23.05***
		(12.39)	(15.54)	(7.39)	(10.63)	(7.30)	(6.86)
	R-sq	0.31	0.29	0.11	0.10	0.09	0.08
	Obs	1824	1769	1821	1766	1772	1721

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

banks that repaid CPP funds, the R-squared in both cases is higher than 30%.

The last subsample of banks analysed includes bailed-out banks that did not repay CPP funds. Results of fixed effects regressions for this group of banks are presented in table 4.12. The drop in growth rates of total loans for the average banks is around 8.3% (column 4, table 4.12) after controlling for GDP growth.

The banks from this group seem to be rather sensitive to changes in the level of capitalisation in normal times. One percentage rise in capital ratio leads to a 2-2.8% (columns 3 and 4, table 4.12) higher growth rates of total loans, to a 2.4-3.3% (columns 5 and 6, table 4.12) rise in growth rates of mortgage loans or to a 11.9-12.7% (columns 7 and 8, table 4.12) higher growth rates of commercial and industrial loans. During the crisis that sensitivity does not seem to change significantly relative to normal times.

Financial health of the bank plays an important role in defining the growth rates of mortgage and total loans during the crisis. An in crease in Z-score by one unit at the average banks that did not repay CPP funds is associated with a 2.4-4.18% (columns 3 and 4, table 4.12) higher growth rates of total loans after 2007. Larger banks from this group lend less than smaller banks both before 2007 and after 2007. The drop in consumer's demand negatively affects the growth rates of total and mortgage loans during the crisis and becomes one of the reasons of falling growth rates of total loans.

R-squared for these groups of banks reaches 41-48% when explaining the growth rates of total loans, thus the model fits the data on that subsample of banks well.

4.4.2 Mundlak-Krishnakumar Estimator

In this section Models 4.2.1 and 4.2.2 are estimated using Mundlak-Krishnakumar estimator. It allows, first of all, to obtain the estimators for time-invariant variables (such as bailout dummy and repayment dummy) and, second, to distinguish between endogenous and exogenous variables through the estimated parameters $\widehat{\beta_B} - \widehat{\beta_W}$ (see Equation 4.2.8).

Results for two groups of regressions 4.2.1 and 4.2.2 with robust standard errors are

Table 4.12: Fixed effects robust estimator - Subsample of bailed-out banks that did not repay CPP funds

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
		Individual bank characteristics: all banks, normal times (δ)					
Altman's	Z_{it-1}	-0.12	-0.28	-0.23	-0.42	-0.73	-1.31
Z-score		(-0.11)	(-0.25)	(-0.15)	(-0.26)	(-0.18)	(-0.36)
Capital ratio	$\frac{TE}{TA}_{it-1}$	2.85***	1.94*	3.31**	2.44	11.87***	12.75***
		(2.66)	(1.77)	(2.05)	(1.28)	(3.28)	(3.13)
TSM to	$\frac{TSM}{TA}_{it-1}$	-0.18	-0.53	0.41	0.00	-2.41	-2.65
total assets		(-0.28)	(-0.79)	(0.36)	(0.01)	(-0.96)	(-1.10)
Size	$Size_{it-1}$	-26.93***	-24.74***	-29.32***	-26.14***	-11.46	-12.20
		(-8.93)	(-7.95)	(-6.55)	(-5.45)	(-1.47)	(-1.64)
Sensitivity	$Sens_{it-1}$	4.51***	4.51***	5.33***	5.33***	-0.61	-0.82
to ΔGDP		(4.35)	(4.35)	(3.61)	(3.32)	(-0.18)	(-0.21)
		Individual bank characteristics: δ^*, $\delta + \delta^*$ in square brackets					
Altman's	$Z_{it-1} * C_t$	2.44* [**2.33**]	4.18** [**3.89**]	4.99** [**4.77**]	7.30***[**6.87**]	-3.05 [**-3.78**]	-3.06 [**-4.38**]
Z-score		(1.67)	(2.59)	(2.06)	(3.00)	(-0.73)	(-0.81)
Capital ratio	$\frac{TE}{TA}_{it-1} * C_t$	0.80 [**3.65**]	3.08 [**5.02**]	-0.57 [**2.74**]	1.41 [**3.84**]	3.16 [**15.03**]	6.39 [**19.14**]
		(0.36)	(1.63)	(-0.17)	(0.49)	(0.43)	(0.90)
TSM to	$\frac{TSM}{TA}_{it-1} * C_t$	0.00 [**-0.18**]	1.82 [**1.29**]	-1.12 [**-0.71**]	0.47 [**0.47**]	3.59 [**1.18**]	5.59 [**2.94**]
total assets		(-0.01)	(1.16)	(-0.50)	(0.20)	(0.73)	(1.03)
Size	$Size_{it-1} * C_t$	-1.83* [**-28.75**]	-1.02 [**-25.76**]	-5.09*** [**-34.41**]	-4.24*** [**-30.37**]	3.70 [**-7.76**]	4.08 [**-8.13**]
		(-1.74)	(-1.26)	(-3.52)	(-3.12)	(0.96)	(0.94)
Sensitivity	$Sens_{it-1} * C_t$	-4.92*** [**-0.41**]	-4.92*** [**-0.41**]	-3.48** [**1.84**]	-3.48* [**1.84**]	-3.48 [**-4.10**]	-3.48 [**-4.30**]
to ΔGDP		(-4.80)	(-3.95)	(-2.21)	(-1.96)	(-0.83)	(-0.78)
		Macroeconomic conditions and dummies					
GDP growth	ΔGDP_{t-1}		0.94***		0.54		2.65***
			(3.50)		(1.30)		(3.05)
Crisis	C_t	2.54	-8.31***	3.96	-8.95***	-9.28	-5.75
		(0.67)	(-6.63)	(0.85)	(-4.69)	(-1.15)	(-1.41)
	Constant	8.25**	10.18***	7.50*	12.53***	24.20***	8.32***
		(2.36)	(11.99)	(1.83)	(9.43)	(3.34)	(2.84)
	R-sq	0.48	0.41	0.30	0.24	0.11	0.09
	Obs	962	942	956	937	907	890

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

reported in tables 4.13 and 4.14 respectively. Recall that the first group of regressions is run on the full sample of banks and distinguishes between bailed-out and non-bailed banks in normal and crisis times. The second group of regressions is run on the subsample of bailed-out banks separating the banks that repaid CPP funds and from those that did not pay anything by July, 2012, both in crisis and normal times.

Variables for which the estimated parameter $\widehat{\beta_B} - \widehat{\beta_W}$ (thus, coefficient for respective means of the variables) is small and t-statistic is close to zero (here parameters with t-statistic smaller than one are chosen) are highlighted in gray in tables 4.13 and 4.14 and used then as instrumental variables in Hausman and Taylor (1981) model.

In general the coefficients for main variables as well as for interactions of main variables with crisis dummy reported in both tables 4.13 and 4.14 are less significant than those obtained in fixed effect regression in the previous section. However, the signs of the coefficients remain similar.

Table 4.13: Mundlak-Krishnakumar Estimator - The effects of CPP funds disbursement and crisis on bank lending activity (without autoregressive component)

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-0.94	-0.93	-1.82*	-1.62	1.34	1.34
	(-1.20)	(-1.28)	(-1.65)	(-1.60)	(0.80)	(0.76)
$\frac{TE}{TA}_{it-1}$	3.65***	4.17***	4.51***	5.11***	7.09***	7.82***
	(5.55)	(6.15)	(4.72)	(5.18)	(3.55)	(3.86)
$\frac{TSM}{TA}_{it-1}$	0.28	0.56	0.14	0.35	0.98	1.40
	(0.59)	(1.18)	(0.19)	(0.55)	(0.87)	(1.13)
$Size_{it-1}$	-19.38***	-18.53***	-19.52***	-18.38***	-18.07***	-18.14***
	(8.63)	(8.62)	(5.92)	(5.76)	(3.74)	(3.49)
$Sens_{it-1}$	4.08***	4.08***	3.87**	3.65**	5.37**	5.16**
	(4.63)	(4.87)	(2.33)	(2.36)	(2.07)	(1.98)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta + \delta^*$ in square brackets)						
$Z_{it-1} * C_t$	4.72*** [**3.78**]	3.74*** [**2.81**]	6.32*** [**4.51**]	5.41*** [**3.78**]	-0.39 [**0.95**]	-0.99 [**0.36**]
	(3.75)	(3.02)	(3.31)	(2.93)	(-0.11)	(-0.28)
$\frac{TE}{TA}_{it-1} * C_t$	-0.21 [**3.44**]	0.82 [**4.98**]	-1.80 [**2.71**]	-0.86[**4.25**]	7.39* [**14.48**]	8.08* [**15.90**]
	(-0.13)	(0.54)	(-0.85)	(-0.41)	(1.67)	(1.86)
$\frac{TSM}{TA}_{it-1} * C_t$	1.54* [**1.82**]	0.91 [**1.47**]	0.91 [**1.05**]	0.28 [**0.63**]	2.10 [**3.08**]	1.40 [**2.80**]
	(1.89)	(1.11)	(0.78)	(0.24)	(0.82)	(0.54)

Continued on next page

Table 4.13 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$Size_{it-1} * C_t$	-1.61* [**-20.99**]	-0.94 [**-19.47**]	-3.53***[**-23.06**]	-2.91**[**-21.30**]	1.45 [**-16.63**]	1.95 [**-16.19**]
	(-1.70)	(-0.97)	(-2.67)	(-2.17)	(0.54)	(0.73)
$Sens_{it-1} * C_t$	-3.01**[**1.07**]	-2.36* [**1.72**]	-4.08* [**-0.21**]	-3.44 [**0.21**]	1.72 [**7.09**]	2.15 [**7.31**]
	(-2.19)	(-1.74)	(-1.86)	(-1.63)	(0.38)	(0.49)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta + \omega$ **in square brackets**)						
$Z_{it-1} * B_i$	1.56 [**0.62**]	0.50 [**0.58**]	3.32** [**1.51**]	3.18* [**1.56**]	0.16 [**1.50**]	-0.07 [**1.27**]
	(1.29)	(1.25)	(1.97)	(1.89)	(0.06)	(-0.02)
$\frac{TE}{TA}_{it-1} * B_i$	-1.03 [**2.62**]	-2.36** [**1.80**]	-3.22** [**1.29**]	-4.73***[**0.39**]	0.43*[**7.52**]	-0.99 [**6.83**]
	(-1.01)	(-2.22)	(-1.98)	(-2.72)	(0.15)	(-0.33)
$\frac{TSM}{TA}_{it-1} * B_i$	1.12* [**1.40**]	0.91 [**1.47**]	1.68* [**1.82**]	1.47 [**1.82**]	-2.52 [**-1.54**]	-3.01 [**-1.61**]
	(1.66)	(1.37)	(1.78)	(1.50)	(-1.41)	(-1.61)
$Size_{it-1} * B_i$	-1.94 [**-21.31**]	-3.21 [**-21.74**]	-2.69 [**-22.21**]	-3.08 [**-21.46**]	1.43 [**-16.64**]	0.70 [**-17.44**]
	(-0.75)	(-1.22)	(-0.70)	(-0.79)	(0.25)	(0.11)
$Sens_{it-1} * B_i$	1.72 [**5.80**]	1.50 [**5.59**]	1.29 [**5.16**]	1.29 [**4.94**]	-0.43 [**4.94**]	-0.64 [**4.51**]
	(1.33)	(1.20)	(0.56)	(0.57)	(-0.12)	(-0.17)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta + \delta^* + \omega + \omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-2.12 [**3.22**]	-0.78 [**3.53**]	-1.71 [**6.12**]	-0.42 [**6.54**]	-1.56 [**-0.44**]	-0.83 [**-0.55**]
	(-1.27)	(-0.46)	(-0.68)	(-0.17)	(-0.37)	(-0.20)
$\frac{TE}{TA}_{it-1}$	2.36 [**4.77**]	2.62* [**5.24**]	3.65 [**3.14**]	3.74 [**3.27**]	-4.00 [**10.91**]	-3.09 [**11.82**]
$*B_i * C_t$	(1.08)	(1.20)	(1.16)	(1.21)	(-0.69)	(-0.54)
$\frac{TSM}{TA}_{it-1}$	-1.75 [**1.19**]	-0.70 [**1.68**]	-3.43** [**-0.70**]	-2.31 [**-0.21**]	1.40 [**1.96**]	2.52 [**2.31**]
$B_i * C_t$	(-1.57)	(-0.69)	(-1.90)	(-1.23)	(0.11)	(0.43)
$Size_{it-1}$	-0.12 [**-22.64**]	-1.29 [**-23.99**]	0.02 [**-25.01**]	-1.19 [**-25.75**]	-1.40 [**-16.74**]	-3.12 [**-19.19**]
$*B_i * C_t$	(0.49)	(-0.81)	(0.24)	(-0.54)	(-0.25)	(-0.68)
$Sens_{it-1}$	-2.58 [**0.21**]	-2.58 [**0.64**]	-1.29 [**-0.21**]	-1.50 [**0.00**]	-6.02 [**0.64**]	-6.45 [**0.21**]
$*B_i * C_t$	(-1.46)	(-1.38)	(-0.49)	(-0.58)	(-1.14)	(-1.16)
Macroeconomic conditions						
C_t	-11.24***	-7.77***	-13.08***	-9.03***	-8.57***	-6.31***
	(-11.03)	(-10.17)	(-7.99)	(-8.54)	(-2.70)	(-3.05)
B_i	1.07	1.21*	-0.26	-0.12	2.85**	2.59*
	(1.57)	(1.73)	(-0.30)	(-0.14)	(2.07)	(1.81)
$B_i * C_t$	1.45	1.05	3.26**	2.78**	-2.74	-2.61
	(1.57)	(1.10)	(2.48)	(2.09)	(-1.08)	(-1.02)
ΔGDP_{t-1}		1.23***		1.05***		1.83***
		(12.14)		(5.08)		(4.99)
Means						
Mean Z_{it-1}	-48.79***	-43.71***	-50.90***	-48.53***	-69.21***	-65.96**
	(-4.31)	(-3.36)	(-4.11)	(-3.67)	(-2.86)	(-2.55)
Mean $\frac{TE}{TA}_{it-1}$	-0.06	-0.22	-0.17	-0.33	0.16	-0.02
	(-0.19)	(-0.66)	(-0.49)	(-0.92)	(0.25)	(-0.04)
Mean $Size_{it-1}$	12.13***	11.49***	11.37***	10.68***	11.59***	11.51***
	(8.63)	(8.62)	(5.92)	(5.76)	(3.74)	(3.49)

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Table 4.13 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$\frac{TSM}{TA}_{it-1}$	-0.14	-0.17	-0.07	-0.10	-0.48**	-0.54**
	(-1.19)	(-1.42)	(-0.45)	(-0.69)	(-2.33)	(-2.57)
Mean	-0.08	-0.07	0.05	0.06	-0.28*	-0.27*
$Sens_{it-1}$	(-1.29)	(-1.08)	(0.57)	(0.71)	(-1.92)	(-1.80)
Mean $Z_{it-1} * C_t$	7.87	4.35	9.58	7.80	35.12	31.06
	(0.45)	(0.24)	(0.46)	(0.38)	(1.04)	(0.89)
Mean	2.52***	2.18**	2.52**	2.11*	-0.38	-0.60
$\frac{TE}{TA}_{it-1} * C_t$	(2.73)	(2.35)	(2.28)	(1.92)	(-0.18)	(-0.28)
Mean	2.56	3.25	6.34	6.15	3.74	4.53
$Size_{it-1} * C_t$	(0.94)	(1.19)	(1.62)	(1.58)	(0.61)	(0.73)
Mean	-0.77	-0.63	-0.44	-0.23	-1.44	-1.26
$\frac{TSM}{TA}_{it-1} * C_t$	(-1.63)	(-1.34)	(-0.74)	(-0.38)	(-1.55)	(-1.34)
Mean	1.38	1.27	-1.41	-1.51	1.91	1.82
$Sens_{it-1} * C_t$	(1.27)	(1.15)	(-1.13)	(-1.19)	(0.75)	(0.67)
Mean	7.73	2.93	-0.62	-4.51	46.67	49.33
$Z_{it-1} * B_i$	(0.48)	(0.17)	(-0.03)	(-0.23)	(1.45)	(1.46)
Mean	0.45	0.82	0.98*	1.39**	-0.24	0.01
$\frac{TE}{TA}_{it-1} * B_i$	(0.91)	(1.63)	(1.69)	(2.31)	(-0.27)	(0.01)
Mean	-0.03	0.95	0.53	1.03	-3.72	-3.08
$Size_{it-1} * B_i$	(-0.02)	(0.50)	(0.20)	(0.39)	(-1.01)	(-0.77)
Mean	0.18	0.18	0.07	0.09	0.57*	0.63**
$\frac{TSM}{TA}_{it-1} * B_i$	(1.15)	(1.09)	(0.35)	(0.45)	(1.81)	(1.97)
Mean	0.02	0.02	-0.08	-0.09	0.15	0.16
$Sens_{it-1} * B_i$	(0.32)	(0.23)	(-0.69)	(-0.80)	(0.88)	(0.90)
Mean	26.44	30.05	-0.01	4.24	31.52	33.56
$Z_{it-1} * B_i * C_t$	(0.80)	(0.91)	(-0.00)	(0.10)	(0.64)	(0.67)
Mean	-3.81**	-4.09***	-3.58**	-3.74**	-1.57	-1.89
$\frac{TE}{TA}_{it-1} * B_i * C_t$	(-2.54)	(-2.78)	(-2.02)	(-2.14)	(-0.54)	(-0.64)
Mean	3.88	3.89	6.35	6.05	8.00	7.64
$Size_{it-1} * B_i * C_t$	(0.90)	(0.88)	(1.06)	(1.01)	(1.00)	(0.93)
Mean	-1.88**	-2.03**	-1.66*	-1.98**	-0.68	-0.94
$\frac{TSM}{TA}_{it-1} * B_i * C_t$	(-2.26)	(-2.46)	(-1.70)	(-1.99)	(-0.50)	(-0.68)
Mean	-0.17	-0.09	2.91	2.97	0.10	0.28
$Sens_{it-1} * B_i * C_t$	(-0.11)	(-0.06)	(1.52)	(1.49)	(0.04)	(0.09)
Constant	11.03***	9.87***	13.33***	12.08***	11.07***	9.14***
	(16.29)	(15.73)	(12.86)	(13.62)	(5.99)	(6.24)
Overall R^2	0.35	0.32	0.18	0.15	0.11	0.10
Obs	5637	5495	5619	5478	5344	5218

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

In normal times higher capitalisation of the bank is associated with higher growth rates of lending both for non-bailed and bailed-out banks. A one percentage point increase in the bank capital ratio leads to a 3.6-4.2% increase (columns 2 and 3, section "non-bailed banks, normal times", table 4.13) in total lending for non-bailed banks and to a 1.8-2.6% rise (columns 2 and 3, section "bailed-out banks, normal times", table 4.13) in total lending for bailed-out banks.

During the crisis more capitalised bailed-out banks tend to increase lending to a slightly larger extent than non-bailed banks. A one percentage point increase in bank capital is associated with a 4.8-5.2% faster total loans growth (columns 2 and 3, section "bailed-out banks, crisis", table 4.13) for the average bailed-out bank during the crisis comparing to that of 3.4-5.0% (columns 2 and 3, section "non-bailed banks, crisis", table 4.13) for the average non-bailed bank.

The same pattern is recognised for the growth rates of mortgage and commercial and industrial lending. During the crisis non-bailed banks tend to increase mortgage lending by 2.7-4.2% (columns 4 and 5, section "non-bailed banks, crisis", table 4.13) with one percentage point rise in bank capital ratio relative to a 4.5-5.1% rise (columns 4 and 5, section "non-bailed banks, normal times", table 4.13) in normal times. During the crisis bailed-out banks increase mortgage lending by 3.1-3.3% (columns 4 and 5, section "bailed-out banks, crisis", table 4.13) with one percentage point rise in bank's level of capitalisation comparing to a 0.4-1.3% rise (columns 4 and 5, section "bailed-out banks, normal times", table 4.13) in normal times.

Results also suggest that in the period before 2007 bailed-out banks are reluctant to translate additional capital into new mortgage loans preferring instead to support commercial and industrial lending. Recall that in the previous chapter it was found that the growth rates of real estate mortgage loans are highly and negatively correlated to the growth rates of commercial and industrial loans. This fact was interpreted as a "specialisation" of the bank according to the dominant loan types in the bank's portfolio. That interpretation suggests that during the crisis the banks specialised in commercial and industrial lending with an additional unit of capital tend to offer more loans than the banks specialised in mortgage lending. Moreover, it also shows that obtained results are in line with those from Chapter 3. In the latter one it was reported that banks that specialised in commercial and industrial loans were more likely to be bailed out, while at the same time they tended to exhibit a higher probability of repurchasing their shares from the Treasury than other banks. In that sense it is not surprising that these banks were more likely to expand the lines of commercial and industrial loans.

Demand factor has a positive impact on growth rates of loans in normal times, while it almost totally disappears for the bailed-out banks during the crisis. A one point increase in sensitivity to demand shock leads to a 4.1% (columns 2 and 3, section "non-bailed banks, normal times", table 4.13) faster total loans growth for non-bailed banks in normal times relatively to a 1.1-1.7% rise (columns 2 and 3, section "non-bailed banks, crisis", table 4.13) during the crisis. The same increase in demand sensitivity for bailed-out banks is associated with a 5.6-5.8% rise (columns 2 and 3, section "bailed-out banks, normal times", table 4.13) in total lending in normal times, while only with a 0.2-0.6% increase in growth rates of total loans during the crisis (columns 2 and 3, section "bailed-out banks, crisis", table 4.13).

This result means that while more capitalised bailed-out banks exhibited higher growth rates of loans, demand for loans at bailed-out banks declined more that that at non-bailed banks. The explanation may be related to the unwillingness of the borrowers to take loans at bailed-out banks. It can be due to the expectations of CPP funds repayments and uncertainty concerning the bank's future. It seems that the fact of the bank's bailout (especially for smaller banks) was considered by the borrowers a bad sign regarding the bank's financial situation, and they preferred to get their credits at other banks.

Similar to the results of fixed effects regression, size of the bank has a negative impact on credit offer. Larger banks provide less loans in normal times and this effect is amplified during the crisis.

When analysing separately the banks that repaid CPP funds and the banks that did not repay anything by July 2012, it looks like well capitalised banks that did not repay CPP funds lend more than the banks that repaid CPP funds, both in normal times and during the crisis. Banks that did not repurchase their stakes from the U.S. Treasury by July 2012 increase their lending by 2.1-2.6% (columns 2 and 3, section "bank that did not repay CPP funds, normal times", table 4.14) in normal times and by 4.8-6.1% (columns 2 and 3, section "bank that did not repay CPP funds, crisis", table 4.14) during the crisis with one percentage point increase in capital ratio. Banks that repaid CPP funds with one percentage point increase in capitalisation raise their total lending by 0.9-1.4% (columns 2 and 3, section "bank that repaid CPP funds, normal times", table 4.14) in normal times compared to 2.4-3% (columns 2 and 3, section "bank that repaid CPP funds, crisis", table 4.14) during the crisis. The same trend is found for mortgage and commercial loans growth rates.

Drop in consumer's demand has a negative impact on growth rates of loans, especially during the crisis. For the average bank that repaid CPP funds a one point increase in sensitivity to demand shock leads to a 0.2-0.4% (columns 2 and 3, section "bank that repaid CPP funds, crisis", table 4.14) lower growth rate of total lending during the crisis and to a 3.9-4.5% (columns 4 and 5, section "bank that repaid CPP funds, crisis", table 4.14) lower growth rates of mortgage lending. For the banks that did not repurchase their stakes from the Treasury the impact of demand factor is also smaller comparing to normal times but it stays overall positive (except for the growth rates of commercial and industrial loans). A one percentage point increase in the sensitivity to demand shock leads to a 3.9% (columns 2 and 3, section "bank that did not repay CPP funds, normal times", table 4.14) rise of total loans growth at the average bank that did not repay CPP funds in normal times and to a 0.2-0.4% (columns 2 and 3, section "bank that did not repay CPP funds, crisis", table 4.14) rise during the crisis.

This evidence suggests that the banks that repaid CPP funds suffered from a drop in consumer's demand during the crisis more than the banks that did not repay CPP funds. Thus, the fact of the bailout repayment did not contribute to the higher aggregate demand for the bank's products and services.

As highlighted in section 4.2.4, the lagged value of dependent variable was not included in the baseline regressions. The theory on Mundlak-Krishnakumar estimator does not yet provide the proof of its adequacy in the presence of autoregressive variables. The results for supplementary regressions including autoregressive component are presented in Appendices H and I. It can be noted that the signs of the coefficients remain the same while their size and significance change for some variables (such as capital ratio, see tables H and I.1).

Table 4.14: Mundlak-Krishnakumar Estimator - The effects of CPP funds repayment and crisis on bank lending activity. Subsample of bailed-out banks. Regressions without autoregressive variables.

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: banks that did not repay CPP funds, normal times (γ)						
Z_{it-1}	0.05	-0.16	0.99	0.90	-1.73	-2.51
	(0.05)	(-0.16)	(0.66)	(0.56)	(-0.48)	(-0.75)
$\frac{TE}{TA}_{it-1}$	2.62***	2.06**	2.36*	1.59	10.96***	11.82***
	(3.31)	(2.52)	(1.89)	(1.11)	(3.84)	(3.61)
$\frac{TSM}{TA}_{it-1}$	-0.32	-0.58	0.52	0.13	-2.90	-2.90
	(-0.41)	(-0.78)	(0.44)	(0.10)	(-1.17)	(-1.14)
$Size_{it-1}$	-27.65***	-25.25***	-30.65***	-25.83***	-10.97	-11.19
	(-8.46)	(-7.38)	(-6.17)	(-4.81)	(-1.43)	(-1.40)
$Sens_{it-1}$	3.87***	3.87***	4.94***	5.16***	-0.43	-0.64
	(3.51)	(3.41)	(2.93)	(2.89)	(-0.13)	(-0.20)
Individual bank characteristics: banks that did not repay CPP funds, crisis (γ^*, $\gamma+\gamma^*$ in square brackets)						
$Z_{it-1} * C_t$	2.27** [**2.32**]	3.03*** [**2.87**]	3.59* [**4.57**]	4.66** [**5.56**]	-2.26 [**-3.99**]	-2.44 [**-4.95**]
	(2.18)	(2.58)	(1.89)	(2.36)	(-0.83)	(-0.91)
$\frac{TE}{TA}_{it-1} * C_t$	2.22** [**4.85**]	4.02***[**6.08**]	2.29 [**4.65**]	3.82** [**5.41**]	3.45 [**14.41**]	5.68 [**17.50**]
	(1.96)	(3.72)	(1.20)	(2.03)	(0.94)	(1.53)
$\frac{TSM}{TA}_{it-1} * C_t$	0.79 [**0.92**]	1.68 [**1.72**]	-0.27 [**-0.06**]	0.55 [**0.52**]	4.95 [**1.16**]	6.04* [**2.23**]
	(0.70)	(1.45)	(-0.13)	(0.26)	(1.44)	(1.74)
$Size_{it-1} * C_t$	-2.68**[**-30.34**]	-3.89***[**-29.13**]	-5.38***[**-36.03**]	-6.43***[**-32.25**]	0.88 [**-10.09**]	-0.68 [**-11.87**]
	(-2.41)	(-3.14)	(-3.61)	(-4.15)	(0.33)	(-0.26)
$Sens_{it-1} * C_t$	-3.65***[**0.21**]	-3.44** [**0.43**]	-2.79 [**2.15**]	-2.79 [**2.36**]	-3.44 [**-3.87**]	-3.22 [**-3.87**]

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Table 4.14 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(-2.64)	(-2.04)	(-1.56)	(-1.35)	(-0.91)	(-0.85)
Individual bank characteristics: banks that repaid CPP funds, normal times (κ, $\gamma + \kappa$ **in square brackets**)						
$Z_{it-1} * R_i$	0.88 [**0.93**]	0.99 [**0.83**]	0.12 [**1.10**]	0.13 [**1.03**]	5.68 [**3.95**]	6.38* [**3.87**]
	(0.61)	(0.65)	(0.05)	(0.06)	(1.46)	(1.69)
$\frac{TE}{TA}_{it-1} * R_i$	-1.26 [**1.36**]	-1.16 [**0.90**]	-2.26 [**0.10**]	-1.96 [**-0.37**]	-8.86***[**2.09**]	-10.22***[**1.59**]
	(-1.04)	(-0.90)	(-1.17)	(-0.92)	(-2.68)	(-2.78)
$\frac{TSM}{TA}_{it-1} * R_i$	2.26** [**1.94**]	2.77*** [**2.19**]	1.74 [**2.26**]	2.39* [**2.52**]	2.65 [**-0.26**]	2.19 [**-0.71**]
	(2.43)	(2.90)	(1.21)	(1.65)	(0.93)	(0.77)
$Size_{it-1} * R_i$	5.53 [**-22.12**]	3.08 [**-22.16**]	7.68 [**-22.96**]	5.06 [**-20.77**]	-5.73 [**-16.70**]	-8.94 [**-20.13**]
	(1.42)	(0.74)	(1.33)	(0.79)	(-0.66)	(-0.97)
$Sens_{it-1} * R_i$	3.87**[**7.74**]	3.44** [**7.31**]	-0.21 [**4.73**]	-0.43 [**4.73**]	12.68***[**12.25**]	12.04***[**11.39**]
	(2.50)	(2.38)	(-0.07)	(-0.18)	(3.18)	(3.09)
Individual bank characteristics: banks that repaid CPP funds, crisis (κ^*, $\gamma + \gamma^* + \kappa + \kappa^*$ **in square brackets**)						
$Z_{it-1} * R_i * C_t$	-0.57 [**2.63**]	-1.11 [**2.75**]	0.45 [**5.14**]	-0.42 [**5.47**]	-1.14 [**0.55**]	-0.84 [**0.59**]
	(-0.39)	(-0.71)	(0.19)	(-0.17)	(-0.35)	(-0.26)
$\frac{TE}{TA}_{it-1}$	-0.60 [**2.99**]	-2.52**[**2.39**]	-1.20 [**1.20**]	-3.09 [**0.37**]	1.13 [**6.67**]	-0.60 [**6.67**]
$*R_i * C_t$	(-0.46)	(-1.96)	(-0.60)	(-1.56)	(0.32)	(-0.17)
$\frac{TSM}{TA}_{it-1}$	-1.87* [**1.48**]	-2.52**[**0.52**]	-3.35**[**-0.26**]	-3.81**[**-1.03**]	-2.39 [**-0.71**]	-3.16 [**-2.58**]
$R * C_t$	(-1.88)	(-2.21)	(-2.12)	(-2.26)	(-0.78)	(-0.98)
$Size_{it-1}$	2.04 [**-22.76**]	2.54* [**-23.51**]	2.25 [**-26.10**]	2.57 [**-24.62**]	-0.02 [**-15.84**]	0.99 [**-19.82**]
$*R_i * C_t$	(1.46)	(1.74)	(1.08)	(1.22)	(-0.01)	(0.42)
$Sens_{it-1}$	-4.51*** [**-0.43**]	-4.08** [**-0.21**]	-6.45***[**-4.51**]	-5.80**[**-3.87**]	-2.36 [**6.45**]	-1.50 [**6.66**]
$*R_i * C_t$	(-2.77)	(-2.31)	(-2.66)	(-2.38)	(-0.81)	(-0.52)
Macroeconomic conditions						
C_t	-13.18***	-7.72***	-15.78***	-8.76***	-7.98**	-6.76***
	(-8.87)	(-9.83)	(-7.12)	(-7.16)	(-2.12)	(-3.39)
R_i	3.45***	2.81***	3.02**	2.01	2.27	3.02
	(3.59)	(3.04)	(2.19)	(1.54)	(1.11)	(1.56)
$R_i * C_t$	-2.12*	0.27	-2.04	1.47	-0.40	-1.10
	(-1.77)	(0.37)	(-1.07)	(1.05)	(-0.13)	(-0.56)
ΔGDP_{t-1}		1.02***		0.35		2.41***
		(6.26)		(1.20)		(4.88)
Means						
Mean	-53.29***	-48.49***	-63.16***	-60.62**	8.85	26.44
Z_{it-1}	(-3.11)	(-2.69)	(-2.78)	(-2.54)	(0.21)	(0.61)
Mean	1.32**	1.44***	1.51**	1.71**	-0.57	-0.94
$\frac{TE}{TA}_{it-1}$	(2.42)	(2.59)	(2.00)	(2.20)	(-0.51)	(-0.76)
Mean	14.50***	13.41***	15.70***	13.56***	4.90	4.79
$Size_{it-1}$	(7.27)	(6.45)	(5.38)	(4.41)	(1.12)	(1.04)
Mean	0.47**	0.49**	0.52	0.55*	-0.17	-0.23
$\frac{TSM}{TA}_{it-1}$	(2.24)	(2.41)	(1.56)	(1.66)	(-0.37)	(-0.47)
Mean	0.02	0.01	0.00	-0.03	0.12	0.16

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Table 4.14 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$Sens_{it-1}$	(0.39)	(0.18)	(0.04)	(-0.31)	(0.83)	(1.07)
Mean	78.66**	65.85*	59.95	46.68	57.37	44.62
$Z_{it-1} * C_t$	(2.42)	(1.96)	(1.31)	(1.00)	(0.89)	(0.66)
Mean	-6.96***	-7.70***	-7.12***	-7.87***	-6.91**	-8.04**
$\frac{TE}{TA}_{it-1} * C_t$	(-3.99)	(-4.32)	(-3.03)	(-3.32)	(-2.00)	(-2.19)
Mean	10.24**	9.70**	17.38***	15.07**	9.64	11.02
$Size_{it-1} * C_t$	(2.21)	(2.05)	(2.73)	(2.31)	(1.00)	(1.08)
Mean	-4.16***	-4.30***	-4.85***	-4.96***	0.58	0.10
$\frac{TSM}{TA}_{it-1} * C_t$	(-3.84)	(-3.81)	(-3.55)	(-3.46)	(0.31)	(0.05)
Mean	0.79	0.82	0.88	1.01	0.80	0.37
$Sens_{it-1} * C_t$	(0.64)	(0.65)	(0.47)	(0.52)	(0.45)	(0.18)
Mean	28.51	22.82	29.37	25.08	-55.16	-70.05
$Z_{it-1} * R_i$	(1.28)	(0.98)	(0.96)	(0.78)	(-1.18)	(-1.47)
Mean	-1.81**	-1.72**	-1.34	-1.33	0.95	1.28
$\frac{TE}{TA}_{it-1} * R_i$	(-2.36)	(-2.19)	(-1.33)	(-1.30)	(0.66)	(0.84)
Mean	-5.39**	-4.46	-7.32**	-6.54*	0.68	3.11
$Size_{it-1} * R_i$	(-2.02)	(-1.58)	(-1.99)	(-1.68)	(0.13)	(0.56)
Mean	-0.67***	-0.73***	-0.82**	-0.89**	0.32	0.38
$\frac{TSM}{TA}_{it-1} * R_i$	(-2.78)	(-3.07)	(-2.24)	(-2.40)	(0.59)	(0.69)
Mean	-0.17	-0.15	-0.05	-0.00	-0.64**	-0.66**
$Sens_{it-1} * R_i$	(-1.25)	(-1.05)	(-0.23)	(-0.01)	(-2.57)	(-2.48)
Mean	-32.30	-16.39	-39.69	-21.60	46.26	58.89
$Z_{it-1} * R_i * C_t$	(-0.84)	(-0.41)	(-0.77)	(-0.41)	(0.73)	(0.90)
Mean	6.94***	7.36***	7.10***	7.59***	5.52	6.40*
$\frac{TE}{TA}_{it-1} * R_i * C_t$	(4.25)	(4.45)	(3.23)	(3.45)	(1.64)	(1.89)
Mean	1.79	3.47	3.07	5.81	4.20	1.90
$Size_{it-1} * R_i * C_t$	(0.33)	(0.64)	(0.43)	(0.81)	(0.43)	(0.18)
Mean	1.82*	1.97*	3.40***	3.44***	-2.85*	-2.40
$\frac{TSM}{TA}_{it-1} * R_i * C_t$	(1.81)	(1.89)	(2.77)	(2.69)	(-1.70)	(-1.34)
Mean	1.32	1.31	1.34	1.00	1.71	2.20
$Sens_{it-1} * R_i * C_t$	(0.80)	(0.77)	(0.44)	(0.32)	(0.62)	(0.73)
Constant	12.88***	10.05***	14.83***	12.65***	12.15***	7.94***
	(11.41)	(10.67)	(9.08)	(9.95)	(4.17)	(3.90)
Overall R^2	0.36	0.32	0.18	0.16	0.11	0.10
Observations	2786	2711	2777	2703	2679	2611

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

4.4.3 Hausman-Taylor Estimator

Hausman-Taylor model also allows to estimate parameters for time-invariant variables, but in contrast to Mundlak-Krishnakumar model it uses instrumental variables approach. Here exogenous time-varying variables x_{1it-1} from Equation 4.2.10 are those highlighted in gray in tables 4.13 and 4.14 that report results for Mundlak-Krishnakumar regressions.

The coefficients for the means of variables reported in tables 4.13 and 4.14 are for instance highly significant for past realisations of loan growth. Thus, these variables are considered endogenous and are instrumented as it is described in the section 2.3.

There are two time-invariant variables entering the model: the bailout dummy (or repayment dummy in second group of regressions following Model 4.2.2) and an indicator of the state where the bank is headquartered. The former one is considered endogenous as the decision on bailout was taken by the bank (the bank's decision to apply or not to apply for CPP funds) together with the U.S. Treasury (Treasury's approval or rejection of CPP application) based on some number of bank characteristics and other criterias. The latter one is an exogenous variable indicating the location of the bank.

Results for Hausman-Taylor models are presented in tables 4.15 for the full set of banks distinguishing between bailed-out and non-bailed banks and 4.16 for the subsample of bailed-out banks distinguishing between the banks that repurchased their stock from the U.S. Treasury and those that did not.

Table 4.15: Hausman-Taylor Estimator - The effects of CPP funds disbursement and crisis on bank lending activity (without autoregressive component)

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-0.69	-0.71	-1.47	-1.31	1.42	1.44
	(-1.38)	(-1.40)	(-1.60)	(-1.40)	(0.81)	(0.81)
$\frac{TE}{TA}_{it-1}$	3.44***	4.00***	3.95***	4.64***	7.73***	8.46***
	(7.17)	(8.02)	(4.44)	(5.06)	(4.77)	(5.10)
$\frac{TSM}{TA}_{it-1}$	0.35	0.63	-0.07	0.21	0.77	1.33
	(0.83)	(1.49)	(-0.06)	(0.30)	(0.63)	(1.01)

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Table 4.15 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$Size_{it-1}$	-22.00***	-21.40***	-24.38***	-23.55***	-12.47***	-13.82***
	(-16.09)	(-14.79)	(-9.78)	(-8.98)	(-3.27)	(-3.39)
$Sens_{it-1}$	4.08***	3.87***	2.79**	2.79**	5.16***	4.94**
	(5.97)	(5.81)	(2.27)	(2.19)	(2.62)	(2.54)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta+\delta^*$ **in square brackets**)						
$Z_{it-1} * C_t$	5.00***[**4.31**]	3.86***[**3.15**]	7.41***[**5.94**]	6.11***[**4.80**]	1.31 [**2.72**]	0.54 [**1.98**]
	(6.13)	(4.68)	(4.95)	(4.07)	(0.50)	(0.20)
$\frac{TE}{TA}_{it-1} * C_t$	-0.17 [**3.27**]	1.03**[**5.03**]	-2.23 [**1.72**]	-0.90 [**3.74**]	5.50* [**13.23**]	6.36**[**14.82**]
	(-0.18)	(1.13)	(-1.34)	(-0.54)	(1.84)	(2.10)
$\frac{TSM}{TA}_{it-1} * C_t$	1.47** [**1.82**]	0.84 [**1.47**]	1.05 [**0.98**]	0.42 [**0.63**]	2.31 [**3.08**]	1.40 [**2.73**]
	(2.01)	(1.13)	(0.80)	(0.31)	(0.97)	(0.58)
$Size_{it-1} * C_t$	-1.69**[**-23.69**]	-0.96 [**-22.36**]	-2.65* [**-27.03**]	-2.00 [**-25.55**]	1.82 [**-10.65**]	2.44 [**-11.38**]
	(-2.14)	(-1.20)	(-1.84)	(-1.37)	(0.70)	(0.93)
$Sens_{it-1} * C_t$	-3.44***[**0.64**]	-2.79**[**1.07**]	-4.08**[**-1.29**]	-3.22 [**-0.43**]	-0.64 [**4.51**]	0.00 [**4.94**]
	(-3.20)	(-2.51)	(-2.00)	(-1.58)	(-0.19)	(-0.03)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta+\omega$ **in square brackets**)						
$Z_{it-1} * B_i$	1.48* [**0.80**]	1.46* [**0.75**]	3.34** [**1.88**]	3.13** [**1.83**]	0.13 [**1.54**]	0.05 [**1.49**]
	(1.81)	(1.73)	(2.23)	(2.04)	(0.05)	(0.02)
$\frac{TE}{TA}_{it-1} * B_i$	-0.82 [**2.62**]	-2.23***[**1.76**]	-2.71* [**1.25**]	-4.38***[**0.26**]	0.82 [**8.55**]	-0.86 [**7.61**]
	(-1.04)	(-2.77)	(-1.92)	(-2.96)	(0.32)	(-0.32)
$\frac{TSM}{TA}_{it-1} * B_i$	0.98* [**1.33**]	0.84* [**1.47**]	1.68 [**1.61**]	1.47 [**1.68**]	-2.45 [**-1.68**]	-3.08 [**-1.75**]
	(1.69)	(1.42)	(1.58)	(1.36)	(-1.32)	(-1.60)
$Size_{it-1} * B_i$	1.04 [**-20.96**]	-0.16[**-21.56**]	3.84 [**-20.53**]	3.57 [**-19.98**]	3.31 [**-9.17**]	3.16 [**-10.67**]
	(0.59)	(-0.08)	(1.22)	(1.06)	(0.74)	(0.66)
$Sens_{it-1} * B_i$	-0.19**[**3.89**]	0.45* [**4.32**]	-0.06 [**2.73**]	1.31 [**4.11**]	1.01 [**6.17**]	1.68 [**6.62**]
	(2.27)	(1.88)	(1.39)	(1.23)	(-0.03)	(-0.12)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta+\delta^*+\omega+\omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-2.71** [**3.08**]	-1.20 [**3.41**]	-3.14 [**6.14**]	-1.34 [**6.60**]	-3.22 [**-0.38**]	-2.43 [**-0.40**]
	(-2.33)	(-1.02)	(-1.47)	(-0.62)	(-0.86)	(-0.64)
$\frac{TE}{TA}_{it-1}$	2.49* [**4.94**]	2.62* [**5.41**]	4.21 [**3.22**]	4.08 [**3.44**]	-2.66 [**11.39**]	-1.63 [**12.33**]
$*B_i * C_t$	(1.75)	(1.83)	(1.63)	(1.57)	(-0.58)	(-0.35)
$\frac{TSM}{TA}_{it-1}$	-1.54 [**1.26**]	-0.49 [**1.82**]	-3.36* [**-0.70**]	-2.24 [**-0.14**]	1.75 [**2.38**]	3.01 [**2.66**]
$*B_i * C_t$	(-1.40)	(-0.43)	(-1.68)	(-1.10)	(0.48)	(0.84)
$Size_{it-1}$	-0.85 [**-21.80**]	-0.68 [**-23.20**]	0.07 [**-23.12**]	-1.35 [**-23.33**]	-0.72 [**-8.06**]	-2.13 [**-10.36**]
$*B_i * C_t$	(0.90)	(-0.72)	(0.04)	(-0.78)	(-0.23)	(-0.68)
$Sens_{it-1}$	-2.58 [**-2.13**]	-2.58 [**-1.05**]	-1.72 [**-3.07**]	-1.72 [**-0.84**]	-4.08 [**1.44**]	-4.30 [**2.32**]
$*B_i * C_t$	(-1.59)	(-1.52)	(-0.60)	(-0.59)	(-0.79)	(-0.82)
Macroeconomic conditions						
C_t	-13.03***	-7.78***	-12.99***	-9.39***	-15.47***	-6.48***
	(-11.20)	(-12.63)	(-6.11)	(-8.38)	(-4.01)	(-3.22)
B_i	55.64***	63.87***	57.21***	63.74***	33.37***	41.49***
	(4.16)	(4.37)	(3.87)	(4.14)	(3.01)	(3.27)

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Table 4.15 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$B_i * C_t$	1.15	0.70	2.67*	2.15	-2.85	-2.97
	(1.52)	(0.91)	(1.93)	(1.54)	(-1.16)	(-1.19)
State	0.15	0.13	0.16	0.13	0.11	0.12
	(0.65)	(0.57)	(0.65)	(0.55)	(0.61)	(0.61)
ΔGDP_{t-1}		1.27***		1.07***		2.00***
		(12.13)		(5.65)		(5.86)
Constant	-17.27**	-23.06**	-19.05*	-21.31**	-0.97	-13.53*
	(-1.98)	(-2.55)	(-1.95)	(-2.24)	(-0.12)	(-1.65)
Sargan-Hansen test (p-value)	0.41	0.10	0.53	0.18	0.41	0.12
Obs	5512	5382	5482	5353	5185	5067

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

Results reported in both tables confirm those discussed in the previous section. Instrumented endogenous bailout dummy has significant positive coefficients that support the evidence that an average bailed-out banks tend to lend more than non-bailed banks. During the crisis these coefficients slightly rise for total and real estate mortgage loans and decrease for commercial and industrial loans. However, these additional changes in coefficients between normal and crisis periods are relatively insignificant.

Higher level of bank capitalisation has a positive impact on growth rates of lending. As in the previous section, well-capitalised bailed-out banks tend to offer slightly more loans during the crisis than non-bailed banks. During the crisis a one percentage point rise in capital ratio leads to a 3.3-5% (columns 2 and 3, section "non-bailed banks, crisis", table 4.15) rise in total lending at non-bailed banks and to a 5-5.4% (columns 2 and 3, section "bailed-out banks, crisis", table 4.15) at bailed-out banks.

The size effect also remains significant as in the results from the previous section, larger banks tend to provide less loans than smaller banks and that relationship remains the same during the crisis period. Larger shares of liquid securities such as Treasury bills in the banks' portfolios is on average associated with higher loan growth but that relationship is not very significant.

Demand factor now equally affects the loan offer both at bailed-out banks and non-bailed banks. While increase in demand for bank loans drives growth rates in normal times, negative demand shock oppositely affects the banks' loan offer during the crisis. One point rise in sensitivity to demand shock leads to 0.4-1.3% (columns 4 and 5, section "non-bailed banks, crisis", table 4.15) smaller growth rates of mortgage loans during the crisis at non-bailed banks and to almost no reaction of growth rates of mortgage lending at bailed-out banks during the crisis.

The results are also similar to those from Mundlak regressions for the second group of regressions. The coefficient for repayment dummy is significantly positive, which means that an average bank that repurchased its shares from the Treasury by July 2012 tend to less more than the bank that did not repurchase its stake. That effect declines during the crisis, but not significantly. These results are in line with the statistics presented earlier in table 4.2.

Table 4.16: Hausman-Taylor Estimator - The effects of CPP funds repayment and crisis on bank lending activity. Subsample of bailed-out banks. Regressions without autoregressive components

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: banks that did not repay CPP funds, normal times (γ)						
Z_{it-1}	0.06	-0.10	0.32	0.30	-2.20	-2.89
	(0.07)	(-0.11)	(0.21)	(0.20)	(-0.91)	(-1.15)
$\frac{TE}{TA}_{it-1}$	2.52***	1.93**	2.59*	1.96	11.45***	12.08***
	(3.47)	(2.37)	(1.96)	(1.34)	(5.24)	(4.98)
$\frac{TSM}{TA}_{it-1}$	-0.19	-0.45	0.39	0.13	-3.10*	-3.23*
	(-0.29)	(-0.58)	(0.29)	(0.10)	(-1.44)	(-1.44)
$Size_{it-1}$	-29.50***	-28.70***	-31.42***	-30.65***	-1.64	-2.30
	(-11.60)	(-10.62)	(-7.01)	(-6.40)	(-0.36)	(-0.44)
$Sens_{it-1}$	4.51***	4.51***	5.59***	5.37***	-1.29	-0.86
	(4.82)	(4.53)	(3.24)	(3.03)	(-0.48)	(-0.34)
Individual bank characteristics: banks that did not repay CPP funds, crisis (γ^*, $\gamma + \gamma^*$ in square brackets)						
$Z_{it-1} * C_t$	2.05**[**2.11**]	2.76***[**2.66**]	3.92**[**4.24**]	4.90***[**5.20**]	-1.52 [**-3.72**]	-1.79 [**-4.68**]

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Table 4.16 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(2.00)	(2.61)	(2.13)	(2.59)	(-0.50)	(-0.58)
$\frac{TE}{TA}_{it-1} * C_t$	2.2* [**4.75**]	4.22***[**6.14**]	2.16 [**4.75**]	3.98* [**5.94**]	1.73 [**13.18**]	4.25 [**16.33**]
	(1.91)	(3.58)	(1.04)	(1.90)	(0.50)	(1.25)
$\frac{TSM}{TA}_{it-1} * C_t$	0.14 [**-0.05**]	0.27 [**-0.18**]	-0.04 [**0.35**]	0.08 [**0.21**]	0.64 [**-2.46**]	0.79 [**-2.44**]
	(0.87)	(1.63)	(-0.14)	(0.27)	(1.31)	(1.60)
$Size_{it-1} * C_t$	-2.50***[**-32.00**]	-3.80***[**-32.49**]	-5.04***[**-36.45**]	-6.24***[**-36.89**]	1.11 [**-0.53**]	-0.53 [**-2.83**]
	(-3.10)	(-4.63)	(-3.47)	(-4.26)	(0.46)	(-0.22)
$Sens_{it-1} * C_t$	-3.87***[**0.64**]	-3.65**[**0.86**]	-2.79 [**2.79**]	-2.15 [**3.22**]	-3.22 [**-4.51**]	-3.22 [**-4.08**]
	(-2.91)	(-2.53)	(-1.10)	(-0.83)	(-0.80)	(-0.81)
Individual bank characteristics: banks that repaid CPP funds, normal times (κ, $\gamma + \kappa$ **in square brackets**)						
$Z_{it-1} * R_i$	1.74 [**1.80**]	1.86 [**1.77**]	3.12 [**3.44**]	3.11 [**3.41**]	6.21* [**4.01**]	6.88**[**3.99**]
	(1.51)	(1.54)	(1.50)	(1.43)	(1.84)	(1.97)
$\frac{TE}{TA}_{it-1} * R_i$	-1.56 [**0.96**]	-1.46 [**0.46**]	-3.85**[**-1.26**]	-3.78* [**-1.83**]	-8.57***[**2.89**]	-10.03***[**2.06**]
	(-1.59)	(-1.36)	(-2.16)	(-1.96)	(-2.90)	(-3.15)
$\frac{TSM}{TA}_{it-1} * R_i$	1.94**[**1.74**]	2.52***[**2.06**]	1.48 [**1.87**]	2.06 [**2.19**]	2.32 [**-0.77**]	2.13 [**-1.10**]
	(2.24)	(2.69)	(0.94)	(1.23)	(0.92)	(0.81)
$Size_{it-1} * R_i$	9.35***[**-20.15**]	5.20 [**-23.49**]	-14.71***[**-16.70**]	8.94 [**-21.70**]	-4.22 [**-5.86**]	-5.95 [**-8.25**]
	(3.15)	(1.60)	(2.90)	(1.58)	(-0.80)	(-0.99)
$Sens_{it-1} * R_i$	3.44***[**7.95**]	3.01**[**7.52**]	0.21 [**5.80**]	-0.43 [**4.94**]	12.90***[**11.61**]	11.82***[**10.96**]
	(2.65)	(2.16)	(0.12)	(-0.14)	(3.24)	(2.92)
Individual bank characteristics: banks that repaid CPP funds, crisis (κ^*, $\gamma + \gamma^* + \kappa + \kappa^*$ **in square brackets**)						
$Z_{it-1} * R_i * C_t$	-1.15 [**2.70**]	-1.77 [**2.76**]	-1.80 [**5.57**]	-2.66 [**5.65**]	-1.53 [**0.96**]	-1.17 [**1.03**]
	(-0.90)	(-1.33)	(-0.77)	(-1.11)	(-0.40)	(-0.30)
$\frac{TE}{TA}_{it-1}$	-0.50 [**2.69**]	-2.52* [**2.16**]	-0.56 [**0.33**]	-2.52 [**-0.37**]	1.83 [**6.44**]	-0.03 [**6.27**]
$* R_i * C_t$	(-0.39)	(-1.91)	(-0.24)	(-1.06)	(0.46)	(-0.01)
$\frac{TSM}{TA}_{it-1}$	-1.68 [**0.20**]	-2.39**[**-0.05**]	-3.10 [**-1.27**]	-3.68* [**-1.40**]	-1.68 [**-1.81**]	-2.45 [**-2.76**]
$* R_i * C_t$	(-1.44)	(-1.99)	(-1.47)	(-1.71)	(-0.48)	(-0.69)
$Size_{it-1}$	2.54***[**-20.12**]	3.08***[**-24.20**]	3.29**[**-18.45**]	3.63**[**-24.31**]	0.77 [**-3.98**]	1.66 [**-7.12**]
$* R_i * C_t$	(2.87)	(3.39)	(2.05)	(2.23)	(0.29)	(0.62)
$Sens_{it-1}$	-5.37***[**-1.29**]	-4.51***[**-0.64**]	-9.89***[**-6.88**]	-8.81***[**-6.02**]	-1.50 [**6.88**]	-0.86 [**6.88**]
$* R_i * C_t$	(-3.25)	(-2.65)	(-3.27)	(-2.83)	(-0.29)	(-0.17)
Macroeconomic conditions						
C_t	-12.51***	-8.32***	-12.57***	-9.87***	-20.29***	-7.47***
	(-9.08)	(-11.31)	(-5.12)	(-7.52)	(-4.19)	(-3.47)
$R_i * C_t$	-2.41**	-0.01	-2.20	0.99	-1.26	-1.71
	(-2.22)	(-0.01)	(-1.13)	(0.70)	(-0.39)	(-0.73)
State	0.11	0.16	0.12	0.18	0.01	0.03
	(0.50)	(0.49)	(0.51)	(0.58)	(0.05)	(0.15)
R_i	36.01***	95.04***	27.73**	84.93***	8.51	12.12
	(3.33)	(3.82)	(2.44)	(3.24)	(0.93)	(1.01)
ΔGDP_{t-1}		1.01***		0.37		2.56***
		(6.19)		(1.26)		(5.32)

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Table 4.16 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Constant	-9.10	-47.08***	-6.60	-39.61**	20.27**	2.78
	(-0.98)	(-2.63)	(-0.66)	(-2.14)	(2.29)	(0.28)
Sargan-Hansen test (p-value)	0.21	0.36	0.20	0.28	0.46	0.16
Obs	2786	2711	2777	2703	2679	2611

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

During the crisis a one point increase in the capital ratio is associated with 4.7-6.1% (columns 2 and 3, section "banks that did not repay CPP funds, crisis", table 4.16) higher growth rates of total loans at the banks that did not repay CPP funds compared to a 2.2-2.7% rise (columns 2 and 3, section "banks that repaid CPP funds, crisis", table 4.16) in total lending at the banks that repaid CPP funds. The difference is even larger for the growth rates of mortgage loans. During the crisis the bank that did not repay CPP funds raises mortgage loans offer by 4.7-6% (columns 4 and 5, section "banks that did not repay CPP funds", table 4.16) with one additional unit of capital while the bank that repaid CPP funds exhibits almost no changes in mortgage loans offer.

Tables 4.15 and 4.16 also report the p-values for Sargan-Hansen test of overidentifying restrictions. The p-values greater than 0.05 provide evidence that the null hypothesis of the validity of full set of instruments in Hausman-Taylor regressions cannot be rejected.

Similarly to the previous section, the results for the same regressions but with autoregressive components are reported in Appendices J and K. Results of these regressions seem to be more robust than in case of Mundlak-Krishnakumar model. The coefficients remain close to those obtained in the baseline regressions in terms of their signs and significance.

4.4.4 Instrumental variables

Two-stage Least Squares estimator (2SLS) is also based on instrumental variables (IV) approach, that assists in addressing endogeneity of the bailout dummy and in providing consistent parameters of the corresponding parameters. Wooldridge (2002) described it as the most efficient IV estimator. In the first stage all instruments are used simultaneously in order to obtain the fitted values of the bailout dummy.

The 2SLS model is overidentified as two instruments are available from logit regressions run in Chapter 3: beta as a proxy for the bank's systemic risk and the share of mortgage-backed securities in total assets. In Chapter 3 both instruments were found to be good predictors for the bailout dummy and the relative size of bailout. The correlation coefficients from table 4.4 also suggest that these instruments are correlated with endogenous bailout dummy: the correlation between the bailout dummy and beta reaches 0.32, while between the bailout dummy and withing-transformed $\frac{MBS}{TA}_{it-1}$ it attains -0.16 (table 4.4). Hence, it is expected the both instruments are relevant or informative. Besides, none of the two instruments is highly correlated with loan growth rates, what is in line with the assumption regarding their exogeneity or validity.

Results of the second stage regression of 2SLS with random effects are presented in table 4.17. The fitted values of the bailout dummy from the first regression can be interpreted as the probabilities of bailout. As explained in section 4.2.6, dynamic panel data model requires instrumenting of the lagged dependent variable. That exercise is later performed in section 4.4.5, while hereby autoregressive component is omitted, bailout dummy is treated as endogenous and other explanatory variables are considered exogenous.

The coefficients of probability of bailout are significantly positive. It means that the banks exhibiting the highest probability of bailout expand credit lines to a larger extent than non-bailed banks in normal times. This result is similar to that from Hausman-Taylor regression. Nevertheless, during the crisis the growth rates of loans at bailed-out banks significantly decline relative to the normal times (that is shown by negative coefficients for the interaction between crisis and bailout dummies $B_i * C_t$, table 4.17).

Table 4.17: IV 2SLS - The effects of CPP funds disbursement and crisis on bank lending activity. Instrumented bailout dummy

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-1.59***	-1.27***	-3.97***	-3.59***	-0.98	-0.57
	(-2.79)	(-2.15)	(-4.53)	(-3.96)	(-0.62)	(-0.35)
$\frac{TE}{TA}_{it-1}$	4.51***	4.90***	4.47***	4.86***	6.53***	6.79***
	(8.30)	(8.45)	(5.61)	(5.81)	(4.48)	(4.49)
$\frac{TSM}{TA}_{it-1}$	-0.21	0.28	-0.56	-0.42	-0.98	-0.28
	(-0.43)	(0.50)	(-0.95)	(-0.59)	(-0.82)	(-0.25)
$Size_{it-1}$	-5.67***	-7.36***	-2.02**	-2.62**	-0.33	-0.42
	(-6.50)	(-7.08)	(-2.22)	(-2.51)	(-0.18)	(-0.23)
$Sens_{it-1}$	4.73***	4.51***	4.51***	4.30***	3.44**	3.44**
	(7.04)	(6.21)	(5.06)	(4.56)	(2.18)	(2.10)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta + \delta^*$ in square brackets)						
$Z_{it-1} * C_t$	6.03*** [**4.44**]	4.89*** [**3.62**]	9.01*** [**5.04**]	8.12*** [**4.53**]	3.14 [**2.16**]	2.43 [**1.86**]
	(6.37)	(5.03)	(5.87)	(5.25)	(1.20)	(0.91)
$\frac{TE}{TA}_{it-1} * C_t$	-1.20 [**3.31**]	-0.13 [**4.77**]	-4.00**[**0.47**]	-3.39**[**1.47**]	5.97** [**12.50**]	6.57** [**13.36**]
	(-1.16)	(-0.13)	(-2.41)	(-2.03)	(2.05)	(2.20)
$\frac{TSM}{TA}_{it-1} * C_t$	1.68** [**1.47**]	0.91 [**1.19**]	1.26 [**0.70**]	0.56 [**0.14**]	1.75 [**0.77**]	0.84 [**0.56**]
	(1.99)	(1.04)	(0.91)	(0.40)	(0.73)	(0.35)
$Size_{it-1} * C_t$	-0.42 [**-6.09**]	0.03 [**-7.33**]	-1.91 [**-3.93**]	-1.58[**-4.20**]	2.33 [**2.00**]	2.59 [**2.17**]
	(-0.43)	(0.04)	(-1.13)	(-0.93)	(0.82)	(0.90)
$Sens_{it-1} * C_t$	-4.73***[**0.00**]	-3.01** [**1.50**]	-5.59** [**-1.08**]	-3.65 [**0.65**]	-1.29 [**2.15**]	-0.21 [**3.23**]
	(-3.20)	(-2.04)	(-2.25)	(-1.53)	(-0.30)	(-0.05)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta + \omega$ in square brackets)						
$Z_{it-1} * B_i$	2.02** [**0.43**]	1.92** [**0.65**]	2.90** [**-1.07**]	3.11** [**-0.48**]	2.08 [**1.10**]	1.93 [**1.36**]
	(2.23)	(2.01)	(2.12)	(2.16)	(0.87)	(0.77)
$\frac{TE}{TA}_{it-1} * B_i$	-0.95 [**3.56**]	-2.28** [**2.62**]	-0.26 [**4.21**]	-1.76 [**3.10**]	2.11 [**8.64**]	1.20 [**7.99**]
	(-1.14)	(-2.48)	(-0.18)	(-1.26)	(0.90)	(0.49)
$\frac{TSM}{TA}_{it-1} * B_i$	1.26** [**1.05**]	0.84 [**1.12**]	1.47* [**0.91**]	1.19 [**0.77**]	-0.91 [**-1.89**]	-1.68 [**-1.96**]
	(1.96)	(1.26)	(1.70)	(1.25)	(-0.56)	(-1.02)
$Size_{it-1} * B_i$	-0.29 [**-5.96**]	-0.31 [**-7.67**]	-1.30 [**-3.32**]	-1.04 [**-3.66**]	-2.69 [**-3.02**]	-2.87 [**-3.29**]
	(-0.27)	(-0.24)	(-1.08)	(-0.78)	(-1.23)	(-1.20)
$Sens_{it-1} * B_i$	2.36**[**7.09**]	2.36** [**6.87**]	2.79** [**7.30**]	2.58* [**6.88**]	0.00 [**3.44**]	-0.21 [**3.23**]
	(2.45)	(2.13)	(2.03)	(1.79)	(-0.01)	(-0.08)

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Table 4.17 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta+\delta^*+\omega+\omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-2.50* [**3.96**]	-1.32 [**4.22**]	-2.43 [**5.51**]	-1.58 [**6.06**]	-3.05 [**1.19**]	-2.78 [**1.01**]
	(-1.89)	(-0.97)	(-1.13)	(-0.73)	(-0.84)	(-0.75)
$\frac{TE}{TA}_{it-1}$	0.00 [**2.36**]	0.52 [**3.01**]	0.69 [**0.90**]	1.55 [**1.26**]	-6.19 [**8.42**]	-5.07 [**9.49**]
$*B_i * C_t$	(0.01)	(0.32)	(0.25)	(0.58)	(-1.36)	(-1.09)
$\frac{TSM}{TA}_{it-1}$	-1.68 [**1.05**]	-0.35 [**1.68**]	-4.21** [**-2.04**]	-2.80 [**-1.47**]	2.31 [**2.17**]	3.72 [**2.60**]
$B_i * C_t$	(-1.34)	(-0.27)	(-2.05)	(-1.37)	(0.67)	(1.06)
$Size_{it-1}$	1.30 [**-5.08**]	-0.08 [**-7.72**]	1.63 [**-3.60**]	0.29 [**-4.95**]	0.67 [**-0.02**]	-0.36 [**-1.06**]
$*B_i * C_t$	(1.07)	(-0.06)	(0.79)	(0.14)	(0.19)	(-0.10)
$Sens_{it-1}$	-3.01 [**-0.65**]	-3.87* [**-0.01**]	-2.79 [**-1.08**]	-3.87 [**-0.64**]	-1.93 [**0.22**]	-3.01 [**0.01**]
$*B_i * C_t$	(-1.45)	(-1.86)	(-0.85)	(-1.14)	(-0.35)	(-0.53)
Macroeconomic conditions						
C_t	-6.67***	-3.32***	-6.10***	-2.21	-2.44	-0.61
	(-5.57)	(-3.70)	(-2.64)	(-1.19)	(-0.65)	(-0.19)
$\hat{B}_i$	26.95***	34.36***	18.68***	20.37***	17.09**	20.35**
	(7.06)	(7.45)	(4.38)	(4.29)	(2.18)	(2.38)
$B_i * C_t$	-7.65***	-7.53***	-11.68***	-10.52***	-12.74**	-13.66***
	(-5.54)	(-5.89)	(-3.55)	(-3.46)	(-2.44)	(-2.71)
ΔGDP_{t-1}		1.45***		1.38***		2.07***
		(11.33)		(6.37)		(5.66)
Constant	-2.69	-7.78***	3.13	0.52	1.96	-1.73
	(-1.33)	(-3.21)	(1.34)	(0.20)	(0.46)	(-0.37)
Sargan-Hansen test (p-value)	0.22	0.60	0.76	0.73	0.10	0.20
Kleibergen-Paap LM test (p-value)	0.01	0.00	0.00	0.00	0.01	0.00
Obs	4560	4449	4551	4441	4354	4254

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

Higher capitalisation of both bailed-out and non-bailed banks is associated with higher growth rates of loans. A one percentage point increase in bank capital ratio leads to a 4.5-4.9% (columns 2 and 3, section "non-bailed banks, normal times", table 4.17) rise in growth rates of loans for the average non-bailed bank in normal times and to a 3.3-4.8% (columns 2 and 3, section "non-bailed banks, crisis", table 4.17) rise during the crisis. For the bailed-out banks the same rise in capital ratio is associated with a 2.6-3.6% (columns 2 and 3, section "bailed-out banks, normal times", table 4.17) increase in growth rates of total lending in normal times and with a 2.4-3.0% (columns 2 and 3, section "bailed-out banks, crisis", table 4.17) increase during the crisis. Thus, during the crisis both bailed-out and non-bailed banks tend to expand credit offer with one additional unit of capital.

When analysing the effects of additional capital separately on the growth rates of mortgage loans and those of commercial and industrial loans, it can be noticed that during the crisis both bailed-out and non-bailed banks prefered to extend commercial and industrial loans rather than mortgage loans. With one percentage point increase in capital ratio the growth rates of mortgage loans increase by 4.5-4.9% (columns 4 and 5, section "non-bailed banks, normal times", table 4.17) in normal times while only by 0.5-1.5% (columns 4 and 5, section "non-bailed banks, crisis", table 4.17) during the crisis at non-bailed banks. The impact of additional capital on the growth rates of commercial and industrial loans during the crisis is, vice versa, larger than in normal times. The growth rates of commercial and industrial loans at non-bailed banks increase by 6.5-6.8% (columns 6 and 7, section "non-bailed banks, normal times", table 4.17) in normal times with an additional unit of capital, while by 12.5-13.4% (columns 6 and 7, section "non-bailed banks, crisis", table 4.17) during the crisis.

Higher sensitivity of the bank to demand shock in normal times is associated with higher growth rates of loans (both for bailed-out and non-bailed banks), while this effect disappears or even becomes negative during the crisis. This result is also in line with the results from previous sections. It suggests that the decline in the aggregate demand contributed to the drop in growth rates of bank lending in 2008–2011.

Size becomes less significant than in the regressions conducted in previous sections. Nevertheless, results suggest that larger banks (both bailed-out and non-bailed) exhibit smaller growth rates of loans during the crisis.

As mentioned in section 4.2.6, the lagged dependent variable was excluded from 2SLS model in order to avoid the endogeneity bias. The results for the same 2SLS but with lagged values of growth rates of loans are presented in table L.1 (Appendix L). The main conclusions remain the same when interpreting results for these regressions.

The p-values for Sargan-Hansen test of overidentifying restrictions are all larger than 0.05, what suggests that overall the instruments used in the IV 2SLS regressions are valid. Besides, Kleibergen-Paap LM test statistics reject the null hypothesis of underidentification of structural equation (or of the failure of rank condition, see details in section 4.2.9).

4.4.5 Difference GMM estimator

In this section model 4.2.1 is estimated with difference GMM estimator proposed by Arellano and Bond (1991). Similarly to the fixed effects estimator, difference estimator can only include times-varying parameters. Time-invariant variables are cancelled out when the regression is first differenced.

Thus, the estimated model contains only main bank-specific variables and their interactions with crisis dummy. Results are presented similarly to those for fixed effects regressions. It means that regressions are run on the growth rates of TL, REML and CIL; furthermore, some specifications include time-specific dummies while the others include macroeconomic controls.

The lags for the instrumented variables are chosen following the procedure described in the section 4.2.9. The lags up to fourth lag are analysed in order to choose the best lag for each endogenous variable that satisfies both exogeneity and relevancy conditions. For instance, the second lag of dependent variable is a strong instrument, however, it could be the least valid one. In that case the deeper lags of dependent variable are sometimes preferred to the second lag as there is more chance of such an instrument to be exogenous. The list of selected lags is available in Appendix F. In order to limit the number of endogenous variables (and, accordingly, instrumental variables) that double under system GMM estimator due to the presence of both difference and level equations, the share of treasury securities in bank's portfolio is removed from the regressions. That explicative variable was the least efficient one in explaining the growth rates of loans in previous regressions.

The parameter estimates corrected for heteroscedasticity are reported for each of these difference GMM regressions in table 4.18. As in the previous sections, the final coefficients for each bank-specific characteristic are multiplied by the standard deviation of the respective variable so that the resulting coefficients report the change in loan growth rates when underlying variable increases by one unit.

Arellano-Bond test for autocorrelation presents strong evidence against the null hypothesis of zero autocorrelation in the first-differenced errors of order 1 (AR(1)) in all the regressions. This result is expected as first-differenced errors are serially correlated by construction. The same test cannot reject the hypothesis of no second-order serial correlation (AR(2)), what implies that selected lags of the variables used as instruments are not endogenous.

The statistics for Hansen test of overidentifying restrictions ("Hansen test" in table 4.18) are analysed instead of those for Sargan test as the former ones are robust to heteroscedasticity. The output indicates that the instruments are overall valid.

Table 4.18: First-difference robust GMM estimator - Baseline regression results

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values						
$\Delta ln(TL_{it-1})$	0.09**	0.16***				
	(2.22)	(7.07)				
$\Delta ln(REML_{it-1})$			-0.10	0.07		
			(-1.53)	(1.37)		
$\Delta ln(CIL_{it-1})$					-0.13**	-0.11*
					(-2.02)	(-1.84)
Individual bank characteristics: all banks, normal times (δ)						
Z_{it-1}	-0.30	-0.01	-2.53	-1.51	-1.84	-0.14
	(-0.34)	(-0.01)	(-1.46)	(-0.99)	(-0.46)	(-0.04)

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Table 4.18 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$\frac{TE}{TA}_{it-1}$	3.14**	5.16***	2.36	4.48**	12.98***	10.40**
	(2.34)	(3.92)	(1.12)	(2.14)	(3.01)	(2.54)
$\frac{TSM}{TA}_{it-1}$	-3.57	-0.49	0.70	1.05	-1.82	-0.70
	(-1.55)	(-0.58)	(0.32)	(0.49)	(-0.54)	(-0.21)
$Size_{it-1}$	-33.56***	-12.99***	-51.55***	-19.88***	-9.28	-18.22*
	(-6.73)	(-3.12)	(-5.54)	(-2.98)	(-0.71)	(-1.80)
$Sens_{it-1}$	3.01***	2.15**	3.65**	1.72	4.51	3.01
	(3.53)	(2.47)	(2.03)	(0.99)	(1.60)	(1.03)
Individual bank characteristics: all banks, crisis (δ^*, $\delta + \delta^*$ in square brackets)						
$Z_{it-1} * C_t$	3.07***[**2.78**]	2.45*[**2.45**]	6.22***[**3.69**]	6.57***[**5.07**]	-3.85 [**-5.66**]	-1.91 [**-2.04**]
	(2.68)	(1.93)	(3.08)	(3.11)	(-0.97)	(-0.44)
$\frac{TE}{TA}_{it-1} * C_t$	0.95 [**4.08**]	3.44**[**8.59**]	-2.71 [**-0.34**]	-0.82 [**3.57**]	13.66***[**26.64**]	14.52***[**24.92**]
	(0.58)	(2.02)	(-1.06)	(-0.31)	(2.81)	(2.93)
$\frac{TSM}{TA}_{it-1} * C_t$	-1.68 [**-5.26**]	0.56 [**0.07**]	-0.63 [**0.07**]	-0.28 [**0.77**]	6.87* [**5.05**]	6.73* [**6.03**]
	(-0.58)	(0.50)	(-0.30)	(-0.15)	(1.86)	(1.82)
$Size_{it-1} * C_t$	-1.74***[**-35.30**]	-1.92***[**-14.92**]	-2.90***[**-54.45**]	-3.09***[**-22.98**]	-1.55 [**-10.83**]	-1.81 [**-20.03**]
	(-3.07)	(-3.09)	(-2.92)	(-3.09)	(-0.79)	(-0.93)
$Sens_{it-1} * C_t$	-3.87***[**-0.86**]	-1.93*[**0.21**]	-4.94**[**-1.29**]	-1.72 [**0.00**]	-3.87 [**0.64**]	-1.72 [**1.29**]
	(-3.62)	(-1.70)	(-2.28)	(-0.89)	(-1.06)	(-0.42)
Macroeconomic conditions and dummies						
ΔGDP_{t-1}		1.06***		0.95***		1.84***
		(9.61)		(4.37)		(4.35)
C_t	-11.05***	-5.45***	-16.29***	-7.43***	-14.91***	-7.21***
	(-10.34)	(-8.69)	(-8.48)	(-7.15)	(-4.22)	(-3.85)
Hansen test (p-val)	0.19	0.29	0.11	0.31	0.69	0.16
Kleibergen-Paap LM test (p-val)	0.01	0.00	0.02	0.01	0.00	0.00
Kleibergen-Paap rk Wald F (stat)	25.34	26.50	21.18	22.16	30.05	30.01
AR (1) (p-val)	0.00	0.00	0.00	0.00	0.00	0.00
AR (2) (p-val)	0.14	0.13	0.52	0.20	0.11	0.22
Obs	4748	4623	4721	4597	4453	4340

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Stock-Yogo weak ID test critical values: 19.67 (5% maximal IV relative bias); 10.63 (10% maximal IV relative bias); 4.28 (30% maximal IV relative bias)

Moreover, other tests are conducted for each specification in order to test for underidentification (Kleibergen-Paap LM test) and weak instruments (Kleibergen-Paap Wald F statistics). Statistics for Kleibergen-Paap LM test suggest that null of underidentification can be rejected (reported p-values for that test are smaller than 0.05). Kleibergen-Paap Wald F statistics are compared to the tabulated by Stock and Yogo (2002) critical values for their relative bias test for IV estimator. The StockYogo weak-instruments statistic is based on the ratio of the bias of the IV estimator to the bias of ordinary least squares (OLS). The null hypothesis of the test is that the estimator is weakly identified (in other words, weakly correlated with endogenous variables) in the sense that it is subject to bias that is greater than 5%, 10% or 30% of the OLS bias (Baum *et al.*, 2007). Kleibergen-Paap rk Wald F-statistics calculated for the regressions exceed the critical values tabulated by Stock and Yogo (2002) (reported at the end of the table) what indicates that the instruments are not weak.

Overall resulting coefficients are less significant than those obtained in fixed effects regressions. However, the main conclusions remain the same. The crisis dummy has a robust negative impact on growth rates of loans that drop for an average bank by at least 6% during the crisis period (2008–2011).

Z-score and capitalisation have a positive influence on the growth rates of loans, what is especially significant in the crisis period. The growth rates of REML during the crisis are better predicted by bank's Z-score, while the growth rates of CIL by the bank's level of capitalisation. An increase of the bank's Z-score by one unit leads to 2.4%-2.8% (columns 2 and 3, section "all banks, crisis", table 4.18) higher growth rates of total loans during the crisis. A one unit rise in bank Z-score is associated with 3.7%-5% (columns 4 and 5, section "all banks, crisis", table 4.18) higher growth rates of REML for the average bank during the crisis. A one percentage rise in the capital ratio is associated with a 10.4%-13% (columns 6 and 7, section "all banks, normal times", table 4.18) rise in growth rates of CIL during normal times and with a 25%-26.6% (columns 6 and 7, section "all banks, crisis", table 4.18) rise during the crisis. These results once again suggest that during the crisis with an additional unit of capitalisation, banks specialised in CIL were more willing to expand their credit lines than banks specialised in REML. Moreover, the former group of banks had a higher probability of receiving CPP funds during the crisis (see Chapter 3).

Larger banks exhibited smaller growth rates of total, REML and CIL loans both in normal times and during the crisis, thus, confirming the results from fixed effects regressions. More sensitive to changes in aggregate demand banks exhibited a more intensive lending activity before 2007, while this effect disappeared (or even became negative) during the crisis.

4.4.6 System GMM estimator

The effects of CPP funds disbursement and crisis on bank lending activity

One of the advantages of system GMM estimator is the possibility to include time-invariant variables and their interactions with bank-specific variables in the regressions. In this section the full specifications of models 4.2.1 and 4.2.2 are estimated which allow for systemically differential behaviour across bailed-out and non-bailed banks.

Results are presented in a similar to the previous sections way. Regressions include year dummies or macroeconomic variables as controls. Table 4.19 reports individual coefficients for bank-specific variables and for their interactions with dummies (such as δ, δ^*, ω and ω^*) as well as the resulting coefficients that show the full impact of an increase in the underlying variable on credit growth rates of bailed-out or non-bailed banks before and during the crisis (in square brackets).

Table 4.19: Two-step system robust GMM estimator - The effects of CPP funds disbursement and crisis on bank lending activity

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values						

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Table 4.19 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$\Delta ln(TL_{it-1})$	0.263***	0.285***				
	(11.76)	(13.14)				
$\Delta ln(REML_{it-1})$			0.066**	0.066**		
			(2.91)	(2.85)		
$\Delta ln(CIL_{it-1})$					0.001	-0.002
					(0.05)	(-0.09)
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-1.91*	-4.26***	-3.20**	-7.92***	-5.03*	-8.69**
	(-1.95)	(-3.10)	(-2.06)	(-3.25)	(-1.68)	(-2.53)
$\frac{TE}{TA}_{it-1}$	2.27***	3.96***	2.74**	5.77***	6.53***	9.44***
	(2.87)	(4.04)	(2.40)	(4.20)	(2.61)	(3.97)
$Size_{it-1}$	1.59**	2.14**	0.30	1.51	2.20	3.93*
	(2.19)	(2.18)	(0.26)	(1.53)	(0.94)	(1.82)
$Sens_{it-1}$	2.55***	2.15***	4.36***	3.23***	1.57	-0.11
	(4.07)	(2.94)	(4.70)	(3.32)	(1.07)	(-0.07)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta + \delta^*$ in square brackets)						
$Z_{it-1} * C_t$	5.36***[**3.44**]	6.09***[**1.83**]	7.32***[**4.12**]	11.79***[**3.86**]	10.79***[**5.76**]	14.40***[**5.71**]
	(5.23)	(4.22)	(3.65)	(4.15)	(2.72)	(3.79)
$\frac{TE}{TA}_{it-1} * C_t$	-0.74 [**1.53**]	-1.47 [**2.48**]	-2.21 [**0.54**]	-4.30* [**1.47**]	-4.82 [**1.71**]	-7.85** [**1.58**]
	(-0.69)	(-1.18)	(-1.09)	(-1.78)	(-1.24)	(-2.26)
$Size_{it-1} * C_t$	-1.99**[**-0.40**]	-1.90* [**0.24**]	-2.22* [**-1.82**]	-2.79**[**-1.28**]	-1.10 [**1.10**]	-1.88 [**2.05**]
	(-2.21)	(-1.73)	(-1.65)	(-2.36)	(-0.38)	(-0.70)
$Sens_{it-1} * C_t$	-0.47 [**2.08**]	-0.09 [**2.06**]	-4.10*[**0.26**]	-3.27 [**-0.04**]	10.20*[**11.77**]	14.52**[**14.41**]
	(-0.31)	(-0.07)	(-1.84)	(-1.46)	(1.92)	(2.55)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta + \omega$ in square brackets)						
$Z_{it-1} * B_i$	1.61 [**-0.30**]	5.24*** [**0.98**]	2.13 [**-1.07**]	7.79*** [**-0.13**]	7.22 [**2.19**]	8.66 [**-0.02**]
	(1.14)	(2.73)	(0.90)	(2.59)	(1.60)	(1.58)
$\frac{TE}{TA}_{it-1} * B_i$	-0.48 [**1.79**]	-3.73** [**0.22**]	0.60 [**3.34**]	-4.97** [**0.80**]	-2.97 [**3.56**]	-6.41 [**3.03**]
	(-0.33)	(-2.39)	(0.25)	(-2.17)	(-0.74)	(-1.43)
$Size_{it-1} * B_i$	-2.08**[**-0.49**]	-2.32**[**-0.18**]	-0.46 [**-0.16**]	-1.57 [**-0.06**]	-2.47 [**-0.26**]	-2.94 [**0.99**]
	(-2.20)	(-2.14)	(-0.29)	(-1.36)	(-0.98)	(-1.23)
$Sens_{it-1} * B_i$	-0.19 [**2.36**]	0.45 [**2.59**]	-0.06 [**4.29**]	1.30 [**4.53**]	1.00 [**2.57**]	1.66 [**1.55**]
	(-0.20)	(0.45)	(-0.05)	(0.88)	(0.47)	(0.74)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta + \delta^* + \omega + \omega^*$ in square brackets)						
$Z_{it-1} * B_i * C_t$	-2.87** [**2.18**]	-4.80** [**2.27**]	-1.54[**4.71**]	-6.36* [**5.29**]	-10.02* [**2.95**]	-11.89** [**2.48**]
	(-1.98)	(-2.39)	(-0.56)	(-1.85)	(-1.94)	(-2.08)
$\frac{TE}{TA}_{it-1}$	2.90 [**3.95**]	5.63*** [**4.38**]	0.61 [**1.75**]	6.43* [**2.93**]	4.76 [**3.50**]	10.87* [**6.05**]

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Table 4.19 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$*B_i * C_t$	(1.34)	(2.83)	(0.18)	(1.95)	(0.87)	(1.87)
$Size_{it-1}$	1.84* [**-0.64**]	1.06 [**-1.02**]	0.46 [**-1.82**]	0.18 [**-2.67**]	3.30 [**1.93**]	1.68 [**0.79**]
$*B_i * C_t$	(1.66)	(0.83)	(0.29)	(0.13)	(1.03)	(0.55)
$Sens_{it-1}$	-2.38 [**-0.49**]	-2.98* [**-0.47**]	-0.62[**-0.43**]	-1.53 [**-0.28**]	-13.47**[**-0.70**]	-16.58***[**-0.51**]
$*B_i * C_t$	(-1.34)	(-1.91)	(-0.22)	(-0.58)	(-2.22)	(-2.60)
Macroeconomic conditions						
C_t	-6.40***	-4.63***	-10.22***	-8.87***	-9.95***	-6.70***
	(-5.67)	(-5.11)	(-5.77)	(-7.08)	(-3.26)	(-3.18)
B_i	2.48**	1.31	3.42**	2.73	4.58**	2.15
	(2.44)	(1.03)	(2.38)	(1.60)	(2.32)	(0.92)
$B_i * C_t$	-0.75	-0.78	-0.75	2.71	-2.58	-2.40
	(-0.69)	(-0.65)	(-0.47)	(1.53)	(-1.02)	(-0.80)
ΔGDP_{t-1}		0.93***		1.13***		1.83***
		(7.56)		(5.27)		(5.08)
Constant	5.91***	5.43***	9.81***	9.02***	9.35***	7.00***
	(7.91)	(6.91)	(8.49)	(8.00)	(4.84)	(4.21)
Hansen test (p-val)	0.11	0.15	0.20	0.17	0.38	0.16
Kleibergen-Paap LM test (p-val)	0.00	0.00	0.00	0.00	0.00	0.00
Kleibergen-Paap rk Wald F (stat)	30.03	30.80	29.24	28.84	41.64	42.01
AR(1) (p-val)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) (p-val)	0.14	0.13	0.19	0.15	0.72	0.55
Obs	5512	5382	5482	5353	5185	5067

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Stock-Yogo weak ID test critical values: 20.27 (5% maximal IV relative bias); 10.77 (10% maximal IV relative bias); 4.17 (30% maximal IV relative bias)

The same results are presented in a more summarised way in table 4.20. The arrows in this table present the direction of the marginal changes in loan growth rates caused by the rise of the underlying variable by one unit. The sign of the resulting change in credit growth rates (positive or negative) is then shown in brackets.

Table 4.20: Summarized results for the effects of one unit increase in bank-specific variables on loan growth rates for bailed-out/non-bailed banks in normal times/during the crisis

Var-s	**No bailout/ No crisis**	**No Bailout/ Crisis**	**Bailout/ No Crisis**	**Bailout/ Crisis**
Z_{it-1}	$-$	$\uparrow(+)$	$\uparrow(+/-)$	$\downarrow(+)$
$\frac{TE}{TA}_{it-1}$	$+$	$\downarrow(+)$	$\downarrow(+)$	$\uparrow(+)$
$\frac{TSM}{TA}_{it-1}$	$-$	$\uparrow(+)$	$\uparrow(+); CIL(-)$	$\downarrow(-); CIL(+)$
$Size_{it-1}$	$+$	$\downarrow(-); CIL(+)$	$\downarrow(-)$	$\uparrow(-); CIL(+)$
$Sens_{it-1}$	$+$	$TL \approx (+)$; $REML \downarrow (0)$; $CIL \uparrow (+)$	$\uparrow(+)$	$\downarrow(-)$

As in the previous sections, all bank-specific variables are demeaned before entering the regressions, while the parameter estimates for the bank-specific variables are multiplied by their standard deviations. Thus, the resulting coefficients show the change in the growth rate of loans when the underlying variable increases by one unit.

The test of overidentifying restrictions (Hansen's J test) provides the evidence that the instrument set, in general, is appropriate. The null hypothesis of overall valid instruments could not be rejected. The Arellano-Bond test of autocorrelation suggests that there is no autocorrelation in differences of the second order. Regressions are also tested for underidentification (Kleibergen-Paap LM test) and weak instruments (Kleibergen-Paap Wald test). The results show that regressions are identified, instruments are not weak and that they remove a substantial portion of OLS bias.

Similar to the results of the previous section, the crisis dummy has a significant negative effect on the growth rate of both types of loans as well as on that of total loans. The total loan growth rates drop by at least 5-6% (columns 2 and 3, table 4.19) between 2008 and 2011 for the average commercial bank when controlled for the rest of the factors. The REML growth rates decline by 9-10% (columns 4 and 5, table 4.19) during the crisis, which is not surprising considering the scale of the collapse in housing markets. These results correspond well to the preceding observations made from figures 4.3.1, 4.3.2 and 4.3.3.

Figures 4.3.1, 4.3.2 and 4.3.3 suggest that prior to crisis bailed-out banks were expanding their credit lines on a larger scale than non-bailed banks. Indeed, the bailout dummy has a positive coefficient, even though its effect becomes insignificant if the GDP growth is controlled for. Thus, if model 4.2.1 is estimated with system GMM, the resulting coefficients for the bailout dummy are less significant than in IV or Hausman-Taylor regressions, but they seem to be more realistic.

However, the interaction between the bailout dummy and the crisis dummy is not significant for explaining the loans growth rates contrastingly to the results of Brei *et al.* (2011)[20]. Thus, there is no evidence of the fact that the bank-recipient of CPP funds tend to lend less than non-bailed bank between 2008 and 2011 after controlling for bank-specific and macroeconomic conditions.

Let me now move to the bank-specific factors and analyse which of them have contributed to the loans growth and the following slowdown of the loans growth after 2007. Recall that the two "core" factors discussed in this chapter are demand factor and bank's capital constraint[21].

The level of capitalisation is confirmed to have a significant positive effect on banks' credit offers both in normal times and during the crisis. In normal times a one percent rise in the capital ratio leads to a 2.3-4% rise (columns 2 and 3, section "non-bailed banks, normal times", table 4.19) in growth rate of total loans for the average non-bailed bank. This effect remains positive but declines during the crisis time leading to only 1.5-2.5% (columns 2 and 3, section "non-bailed banks, crisis", table 4.19) increase in total loans growth rate.

Hence, during the crisis more capital is required for the non-bailed banks to sustain the growth of credit supply on a pre-crisis level. This finding provides support to the idea that during the crisis additional capital is not that easily translated into extended credit offer by the banks which did not benefit from the CPP program as they prefer to keep a substantial part of it for their internal needs.

[20]Brei *et al.* (2011) find that during the crisis period loan growth rate at a rescued bank is around 8% lower than at non-rescued banks.

[21]The latter one is often referred to in the literature as the "credit crunch" or the "capital crunch", see Bernanke and Lown, 1991.

Brei *et al.* (2011) find the same trend for the impact of regulatory capital ratio (total capital over risk-weighted assets) on bank lending in normal times against the crisis period. Nevertheless, the authors report estimates that are notably smaller than the estimates obtained in this article. For their sample of 108 large international banks from 14 major advanced economies a one percentage point increase in regulatory capital ratio raises lending by around 0.9% in normal times against 0.4% during the crisis.

For the bailed-out banks the rise in equity-to-assets ratio is not as significant for expanding the credit offer during normal times as for the non-bailed banks. On the contrary, during the crisis the positive impact of greater capitalisation on credit growth is higher. A one percent rise in capital ratio of the average bailed-out bank is associated with 0.22-1.8% increase (columns 2 and 3, section "bailed-out banks, normal times", table 4.19) in total loans growth rate in normal times against 4-4.4% rise (columns 2 and 3, section "bailed-out banks, crisis", table 4.19) during the crisis.

These results in a generalised way are also reported in table 4.20. The table suggests that for any bank in any year an increase in capital ratio has a positive effect on the growth rate of total loans, REML and CIL (positive sign in brackets) but it has an increasing positive effect on the bailed-out banks during the crisis (upward arrow in column 5, table 4.20).

This means that liquidity provisions to the banks during the recent crisis supported bank lending in the aftermath of the crisis. The last result is particularly interesting because it provides the evidence that bailed-out banks display higher growth rates of loans during the crisis than in normal times (before 2008) as well as higher growth rates relative to those of non-bailed banks during the crisis, with a one percentage point increase in the capital ratio. Another conclusion that can be made from it is that during the crisis more capital is needed to sustain the same credit growth rates as before the crisis.

This result differs from that of Brei *et al.* (2011) who find that, first of all, in normal times the positive impact of capitalisation is more pronounced for rescued (bailed-out) banks. Secondly, they find that capital injections to rescued banks with very low levels of capitalisation do not produce greater lending during the crisis. More capital is only turned into greater lending when a certain capital ratio (10% in a crisis period) is restored.

Bernanke and Lown (1991) analyse the relationship between the credit crunch and bank lending during the recession of 1990. They argue that capital shortage have contributed to the slowdown in bank lending both on the state and bank level[22]. In their bank-by-bank regressions a 1% increase in the equity capital ratio results in a 2 percentage points increase in loan growth for the full sample and in a 2.5 percentage points increase for their sample of 90 small New Jersey banks. Their results in terms of sensitivity of bank loans to equity capital seem to be closer to the results of this article.

Berrospide and Edge (2010) employ several capital ratios as well as the capital surplus/shortfall measure to estimate the effect of capital shocks on loan growth rates. For the sample of 165 large bank holding companies in the U.S. they find rather small effect of capital on bank lending. According to their results a one percentage point rise in the capital ratio leads to a long-run increase[23] in annualised bank holding company loan growth between 0.7 and 1.2 percentage points.

In general the effect of capital on bank lending always remains positive, however, quantitative results differ from sample to sample which is often attributed to the sizes of the banks in that sample. Large banks are often said to be less sensitive to capital shocks than smaller banks (Bernanke and Lown, 1991).

The growth rates of REML and CIL are affected in a similar way by the rise in the capitalisation level. The effect of an increase in capital ratio on the growth rates of these types of loans declines during the crisis. Again, it seems that the banks more exposed to commercial and industrial lending (the ones that also exhibit higher probability of receiving CPP funds, Chapter 3) with an additional unit of capital tend to increase the growth rates of

[22]The authors use the data on 50 U.S. states and District of Columbia for the first group of regressions. For the bank-by-bank regressions they use the data on 111 New Jersey banks among which 90 are considered small.

[23]Recall that a long-run impact of the bank-specific variables can be obtained from the short-run estimates by taking into account the implied value of the adjustment speed $(1-\eta)$.

CIL more than the banks exposed to REML, especially during the crisis. With one percentage point increase in capital ratio, the bailed-out bank tend to raise its REML growth rates by 1.7-2.9% (columns 4 and 5, section "bailed-out banks, crisis", table 4.19) during the crisis, while CIL growth rates by 3.5-6% (columns 6 and 7, section "bailed-out banks, crisis", table 4.19).

When it is distinguished between the banks that received the CPP funds and those that did not, the impact of Z-score changes between the normal times and during the crisis. In the results for fixed effects and first difference estimators an increase by one point in Z-score (thus, increase in financial "safety" of the bank) was associated with respectively small positive or no effect during normal times and positive and significant effect during the crisis. The results for system GMM show that in normal times safer non-bailed banks expand their credit lines at a lower pace than the non-bailed banks with smaller Z-score.

However, during the crisis the situation changes and safer non-bailed banks contribute more to the rise in credit supply. Among the banks-recipients of CPP funds the impact of Z-score is not very significant in normal times while it is positive during the crisis (even though slightly smaller than for non-bailed banks). Thus, the degree of the financial "safety"[24] of the bank is particularly important for sustaining the growth rates of loans in difficult times.

The proxy for demand factor – sensitivity of the bank net revenues to the changes in GDP – is also significant for explaining banks' lending. In normal times the banks (both the recipients and non-recipients of CPP funds) with higher sensitivity to the increase in consumer's demand exhibit higher loan growth rates: a one unit increase in demand sensitivity is associated with 2.15-2.55% rise (columns 2 and 3, section "non-bailed banks, normal times", table 4.19) in total loans growth rate for the average non-bailed bank. Hence, the rise in demand for bank products contributed to the increase in bank lending in good times.

However, during the crisis the situation changes, especially for the different types of loans. For instance, after 2007 demand factor has no impact on the growth rates of REML

[24]Altman's Z-score defines the financial "safety" of the bank mostly based on the earnings and revenues, see Appendix B.1.

for non-bailed banks. With the collapse in housing markets and generally unstable economic situation consumers were less willing to take new mortgages. In that case demand factor did not contribute to the rise in REML.

In contrast, increased demand seems to be one of the main reasons for the rise in the growth rates of CIL at the banks which did not participate in the CPP program during the crisis. A one unit rise in bank's sensitivity to the changes in GDP is associated with 11.8-14.4% higher growth rates of CIL during the crisis. This effect totally disappears in case of bailed-out banks in the same period: banks with one unit higher demand sensitivity exhibit 0.5-0.7% (columns 6 and 7, section "bailed-out banks, crisis", table 4.19) smaller growth rates of CIL loans than the average bailed-out bank. That may be caused by the preferences of individuals and businesses to take loans at the banks that experienced less financial troubles during the crisis (in other words, more reliable banks) what implies that the latter ones did not need to participate in the government recapitalisation schemes to continue their operations.

Besides, for bailed-out banks demand factor has a negative impact on the growth rates of REML as well as that of total loans during the crisis. A one unit increase in demand sensitivity of the average bank-recipient of CPP funds leads to a 0.5% (columns 2 and 3, section "bailed-out banks, crisis", table 4.19) lower total loans growth rate during the crisis. Thus, demand dropped in general for any kind of credit products offered by the bailed-out banks during the crisis.

The significance of bank size changes significantly for the bailed-out and non-bailed banks. While in the results from the previous sections larger banks were always associated with smaller growth rates of loans both in normal times and during the crisis, here the impact of size even becomes positive but only for non-bailed banks in normal times. However, that positive effect mostly disappears during the crisis. These are smaller non-bailed banks that contributed more to the growth of REML during the crisis, while larger banks continued to expand CIL. For the growth rates of total loans the size of the bank does not matter. In case of the bailed-out banks larger banks tended to lend less both in normal times and during the crisis.

The effects of CPP funds repayment and crisis on bank lending activity

The link between bank-specific variables and bank lending during the recent recession relative to the period before 2007 is now analysed for a smaller sample of 252 banks which received the CPP funds in 2008-2009. This group of regressions allows to study whether the factors affecting the bank lending (and particularly its slowdown between 2008 and 2011) are different for the banks that repaid the CPP funds and the banks that did not.

Regressions are run in the similar to the previous sections way. Results are reported in table 4.21. Bank-specific variables are now interacted with repayment dummy as well as with crisis dummy. Hansen test cannot reject the hypothesis of validity of the instruments (p-values reported at the end of table 4.21 are larger than 0.05). Besides, no autocorrelation is detected in levels what suggests that the instruments are not endogenous. The test for underidentification reports that all regressions are identified, while Kleibergen-Paap Wald test shows that the instrument set is not weak.

Table 4.21: Two-step system robust GMM estimator - The effects of CPP funds repayments and crisis on bank lending activity

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values						
$\Delta ln(TL_{it-1})$	0.22***	0.24***				
	(7.25)	(8.97)				
$\Delta ln(REML_{it-1})$			0.01	0.03		
			(0.25)	(1.05)		
$\Delta ln(CIL_{it-1})$					-0.06*	-0.07**
					(-1.76)	(-2.05)
Individual bank characteristics: banks that did not repay CPP funds, normal times (γ)						
Z_{it-1}	-1.82	-1.50	-2.07	-1.73	-6.82	-8.00
	(-1.45)	(-1.24)	(-1.17)	(-0.93)	(-1.05)	(-1.44)
$\frac{TE}{TA}_{it-1}$	2.56**	1.83**	2.12	1.50	13.03***	13.64***

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Table 4.21 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(2.07)	(2.05)	(1.43)	(0.98)	(2.65)	(2.78)
$Size_{it-1}$	-0.80	-1.43	0.73	-0.09	4.98	5.02
	(-0.83)	(-1.49)	(0.55)	(-0.06)	(1.51)	(1.51)
$Sens_{it-1}$	1.79	1.36	3.62**	3.16**	0.62	0.31
	(1.49)	(1.12)	(2.42)	(2.06)	(0.24)	(0.12)
Individual bank characteristics: banks that did not repay CPP funds, crisis (γ^*, $\gamma+\gamma^*$ in square brackets)						
$Z_{it-1}*C_t$	5.12***[**3.30**]	5.28***[**3.78**]	7.44***[**5.38**]	8.37***[**6.65**]	7.08 [**0.26**]	8.49 [**0.49**]
	(3.02)	(3.39)	(3.58)	(3.89)	(1.01)	(1.33)
$\frac{TE}{TA}_{it-1}*C_t$	-2.03 [**0.53**]	-1.04 [**0.79**]	-2.21 [**-0.08**]	-1.43 [**0.07**]	-8.02 [**5.02**]	-7.23 [**6.41**]
	(-1.18)	(-0.61)	(-1.09)	(-0.71)	(-1.32)	(-1.12)
$Size_{it-1}*C_t$	0.25 [**-0.55**]	1.26 [**-0.18**]	-3.79**[**-3.06**]	-2.47**[**-2.56**]	0.92 [**5.90**]	1.51 [**6.53**]
	(0.208)	(1.05)	(-2.02)	(-2.13)	(0.17)	(0.27)
$Sens_{it-1}*C_t$	-2.61*[**-0.82**]	-2.32*[**-0.96**]	-2.92*[**0.70**]	-2.59* [**0.57**]	-3.61 [**-2.99**]	-3.35 [**-3.04**]
	(-1.91)	(-1.89)	(-1.85)	(-1.91)	(-0.88)	(-0.78)
Individual bank characteristics: banks that repaid CPP funds, normal times (γ, $\gamma+\kappa$ in square brackets)						
$Z_{it-1}*R_i$	1.30 [**-0.52**]	1.20 [**-0.40**]	0.97 [**-1.10**]	1.33 [**-0.40**]	5.74 [**-1.08**]	6.52 [**-1.48**]
	(0.72)	(0.62)	(0.41)	(0.57)	(0.77)	(1.08)
$\frac{TE}{TA}_{it-1}*R_i$	-2.20 [**0.36**]	-2.17 [**-0.34**]	-0.56 [**1.56**]	-1.16 [**0.34**]	-11.79**[**1.25**]	-13.04**[**0.60**]
	(-1.28)	(-1.27)	(-0.24)	(-0.50)	(-2.14)	(-2.43)
$Size_{it-1}*R_i$	0.64 [**-0.16**]	1.87 [**0.43**]	-1.49 [**-0.76**]	-0.15 [**-0.23**]	-5.29 [**-0.31**]	-4.24 [**0.78**]
	(0.54)	(1.54)	(-0.95)	(-0.09)	(-1.48)	(-1.21)
$Sens_{it-1}*R_i$	0.64 [**2.42**]	1.17 [**2.53**]	0.26 [**3.88**]	0.91 [**4.07**]	2.23 [**2.85**]	2.28 [**2.59**]
	(0.47)	(0.84)	(0.14)	(0.50)	(0.75)	(0.82)
Individual bank characteristics: banks that repaid CPP funds, crisis (κ^*, $\gamma+\gamma^*+\kappa+\kappa^*$ in square brackets)						
$Z_{it-1}*R_i*C_t$	-2.39 [**2.21**]	-2.90 [**1.99**]	-2.62 [**3.73**]	-4.58 [**3.39**]	-3.67 [**2.34**]	-5.10 [**1.91**]
	(-1.11)	(-1.45)	(-0.89)	(-1.60)	(-0.45)	(-0.74)
$\frac{TE}{TA}_{it-1}$	6.05**[**4.38**]	5.93**[**4.55**]	4.09 [**3.45**]	4.38 [**3.29**]	14.18* [**7.41**]	14.72**[**8.08**]
$*R_i*C_t$	(2.50)	(2.54)	(1.24)	(1.28)	(1.90)	(2.03)
$Size_{it-1}$	-2.96**[**-2.87**]	-4.58***[**-2.89**]	1.94 [**-2.62**]	-1.25 [**-3.96**]	-1.50 [**-0.89**]	-3.76 [**-1.47**]
$*R_i*C_t$	(-2.19)	(-3.02)	(0.86)	(-0.53)	(-0.27)	(-0.65)
$Sens_{it-1}$	0.26 [**0.07**]	-0.09 [**0.12**]	-3.78[**-2.82**]	-3.50 [**-2.03**]	6.44 [**5.69**]	7.35 [**6.60**]
$*R_i*C_t$	(0.14)	(-0.05)	(-1.30)	(-1.18)	(1.12)	(1.26)
Macroeconomic conditions						
C_t	-9.85***	-8.43***	-14.53***	-10.54***	-8.95*	-6.50*
	(-6.45)	(-6.99)	(-6.29)	(-5.58)	(-1.96)	(-1.89)
R_i	-0.96	-1.62	0.89	-0.70	1.41	1.37
	(-0.70)	(-1.21)	(0.48)	(-0.35)	(0.35)	(0.32)

Continued on next page

Table 4.21 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$R_i * C_t$	3.23**	3.86**	2.06	3.82	-0.86	-1.75
	(2.18)	(2.33)	(0.86)	(1.54)	(-0.18)	(-0.33)
ΔGDP_{t-1}		0.84***		0.68***		2.51***
		(4.98)		(2.64)		(5.25)
Constant	9.27***	8.73***	12.44***	12.84***	12.60***	8.19**
	(8.22)	(8.00)	(7.02)	(8.01)	(3.58)	(2.26)
Hansen test (p-val)	0.71	0.74	0.77	0.45	0.88	0.75
Kleibergen-Paap LM test (p-val)	0.00	0.01	0.00	0.00	0.00	0.00
Kleibergen-Paap rk Wald F (stat)	23.12	22.57	26.11	27.94	30.00	31.09
AR(1)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2)	0.11	0.19	0.16	0.18	0.72	0.76
Obs	2734	2665	2971	2897	2615	2552

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Stock-Yogo weak ID test critical values: 20.27 (5% maximal IV relative bias); 10.77 (10% maximal IV relative bias); 4.17 (30% maximal IV relative bias)

Figures 4.3.1, 4.3.2 and 4.3.3 as well as summary statistics presented in table 4.2 suggest that the banks that repaid the CPP funds on average exhibited higher growth rates of loans in crisis period. It is indeed confirmed by the parameter estimates from table 4.21. Interaction between repayment dummy and crisis dummy has a positive and significant influence on the total loans growth rate. It may be explained by the fact that the banks that reimbursed CPP funds totally by July 2012 had received enough additional capital to support their operations during the crisis and to continue providing credits to enterprises and individuals.

Among bank-specific variables it is the capitalisation level that plays an important role in explaining the growth rate of loans. For the banks that did not redeem their stock issued under the CPP an increase in capital ratio by one percentage point leads to a 1.8-2.6%

(columns 2 and 3, section "banks that did not repay CPP funds, normal times", table 4.21) higher growth rates of total loans in normal times. The impact is particularly large for the growth rates of CIL; the same rise in capital ratio is associated with 13-13.6% (columns 6 and 7, section "banks that did not repay CPP funds, normal times", table 4.21) higher growth rates of CIL.

The banks that repaid CPP funds are less sensitive to higher capitalisation in normal times. The impact of capital on total lending is close to zero, while the growth rates of CIL rise by 0.6-1.2% (columns 6 and 7, section "banks that repaid CPP funds, normal times", table 4.21) with one percentage point increase in bank capitalisation. The situation changes during the crisis period. The banks that repaid CPP funds with one percentage point increase in capitalisation raised their total lending by 4.4-4.55% (columns 2 and 3, section "banks that repaid CPP funds, crisis", table 4.21). This effect is a lot smaller for the banks that did not repay the CPP funds.

These results again provide support to the idea that the banks that redeemed their stake from the Treasury had obtained enough additional capital to refinance their activities and to contribute to the higher credit offer during the crisis.

It is also in line with the results of Brei *et al.* (2011), who argue that the banks-recipients of CPP funds start to translate additional capital into greater lending during the crisis once their capitalisation exceeds a critical threshold. That critical threshold should also account for the commitment to reimburse the CPP funds. The bank that is not capable to repurchase its stake form the Treasury cannot be expected to expand the credit offer to the enterprises and individuals. It is more probable that such bank is going to adjust its assets portfolio to meet the capital requirements by cutting the number of new-issued loans.

The growth rates of REML of the banks that did not repay CPP funds are partly explained by demand factor. An increase in sensitivity to the shocks on aggregate demand by one percentage point is associated with a 3.2-3.6% rise (columns 4 and 5, section "banks that did not repay CPP funds, normal times", table 4.21) in REML growth rates. As expected, the effect almost disappears in the crisis period. A one unit increase in demand sensitivity leads to a 0.8-1.0% (columns 2 and 3, section "banks that did not repay CPP funds, crisis", table 4.21) lower growth rates of total loans during the crisis while REML still rise but only by 0.6-0.7% (columns 4 and 5, section "banks that did not repay CPP funds, crisis", table 4.21), with the same increase in capitalisation.

For the banks that repaid CPP funds the coefficients for demand factor are positive in normal times and close to zero or negative during the crisis. The size is not that significant for predicting bank lending when controlled for the other bank-specific variables and the fact of CPP funds repayment/non-repayment. In general larger bank that did not repay CPP funds exhibit smaller growth rates of REML during the crisis (the effect on total loans is close to zero). Larger banks that repaid CPP funds also tend to lend less during the crisis.

4.4.7 Summary results

The resulting coefficients from the various estimations are summarised in Tables 4.22, 4.23 and 4.24 for the growth rates of total loans, real estate mortgage loans and commercial and industrial loans, respectively. The presented coefficients are taken from the regressions after controlling for real GDP growth for the following five samples of banks: (i) non-bailed-out banks (NB in tables); (ii) bailed-out banks (B); (iii) bailed-out banks that repurchased their stakes from the U.S. Treasury (B-R); (iv) bailed-out banks that did not repurchase their stakes from the U.S. Treasury (B-NR); and (v) the full sample of banks.

The estimated parameters are reported for three balance sheet characteristics: Altman's Z-score, the capital ratio and sensitivity to changes in consumer demand. The share of Treasury securities to total assets is omitted because of its low significance, while the size coefficients are not reported as they are confirmed to be similar across different estimations, periods of time and samples of banks[25]. The coefficients are presented in the format "normal times/during the crisis" to allow for the results to be compared across different estimations,

[25]Larger banks are associated with lower growth rates of loans both in normal times and during the crisis for all subsamples of banks.

samples of banks and periods of time.

The coefficients obtained from the different estimations are rather similar. The parameters estimated for Altman's Z-score show that while in the period prior to 2007 the financial stability of banks did not affect the growth rates of loans (and even affected loan growth negatively in the case of non-bailed-out banks), this factor became crucial during the crisis period. Financially healthy banks extended their credit lines more than other banks during tough times.

The impact of additional capital on the growth rates of loans changes depending on the sample of banks, period of time and estimation. In general, a higher level of capitalisation is associated with higher growth rates of loans. Bailed-out banks (both those that repaid CPP funds and those that did not) significantly increased the loans offered during the crisis relative to normal times for every additional unit of capital. Moreover, for non-bailed-out banks, higher capitalisation had less impact on the growth rates of loans during the crisis relative to normal times, while the sensitivity of loan growth to capital remained the same or changed insignificantly. Thus, it seems as though CPP funds were distributed in order to provide liquidity to banks for which extra capital was crucial for sustaining loan supply during the crisis.

The effectiveness of additional capital for bailed-out banks that did not repay CPP funds to the U.S. Treasury is unclear. The results from the system GMM suggest that these banks barely increased loan supply during the crisis for every additional unit of capital, whereas the results from the other estimations suggest that they significantly increased loan supply-and did so to an even larger extent than those banks that repaid CPP funds. The first reason for the ambiguity of these results is the small size of that subsample that, moreover, includes those banks that had the worst financial position during the crisis and that experienced the most difficulties repurchasing their stakes from the Treasury. Secondly, these results might be related to the conclusions drawn by Brei *et al.* (2011): banks only started to translate additional capital into larger loan offers if their capitalisation level reached a certain threshold. In that sense, banks that did not repay CPP funds may not have reached this threshold. Further, as shown in graphs 4.3.1, 4.3.2 and 4.3.3, the difference in sustaining loan supply across the subsamples of banks starts around 2009, which means that the time period to capture these differences only contains two years (i.e. 2009 and 2010).

The growth rates of commercial and industrial loans are more sensitive to the rise of bank capital than other types of loans. This finding is also in line with those presented in the previous chapter: banks that specialised in commercial and industrial lending were more likely to be bailed out and thus they were more likely to increase commercial and industrial loan offers after receiving CPP funds from the Treasury.

Capital was less effective during the crisis than in normal times for the growth rates of mortgage loans at non-bailed-out banks. Thus, during the crisis non-bailed-out banks did not support mortgage lending as much as before the crisis, for every additional unit of capital. For bailed-out banks (both those that repaid CPP funds and those that did not), a higher capitalisation level led to higher growth rates of mortgage loans during the crisis.

Across all subsamples of banks, the higher sensitivity of a bank's income to GDP growth is positively related to the growth rates of loans in normal times. However, during the crisis more sensitive banks suffered to a larger extent from the drop in consumer demand for bank products. Shrinking consumer demand also contributed to the collapse of the growth rates of total loans as well as those of mortgage and commercial and industrial loans.

4.5 Conclusion

Resuming the banks' loan supply to enterprises and individuals was not a primary goal of the CPP. However, restoring the U.S. financial system involved recovering banks' intermediation capacity including loans provision. Two factors that influence bank lending are analysed: a financial shock that affects banks' willingness to lend and the contraction of aggregate demand due to the overall decline in economic activity. This chapter uses the

Table 4.22: Summary results - ΔTL

Var	Estimator	NB	B	B-R	B-NR	ALL
		Growth rates of total loans				
Z-score	Fixed Ef (full spec.)	-0.73/3.07		1.96/2.52	-0.34/4.55	-0.14/3.10
	Fixed Ef (ind)	-0.77/3.50		1.72/2.22	-0.28/3.89	
	Fixed Ef in dif-ces					0.44/2.46
	Mundlak	-0.93/2.81	0.58/3.53	0.83/2.75	-0.16/2.87	
	Hausman	-0.71/3.15	0.75/3.41	1.77/2.76	-0.10/2.66	
	IV	-1.27/3.62	0.65/4.22			
	Difference GMM					-0.01/2.45
	System GMM	-4.26/1.83	0.98/2.27	-0.40/1.99	-1.50/3.78	
Capital ratio	Fixed Ef (full spec.)	4.00/5.11		0.64/4.43	2.23/5.50	3.18/5.07
	Fixed Ef (ind)	4.57/5.75		0.45/3.09	1.94/5.02	
	Fixed Ef in dif-ces					-1.00/1.98
	Mundlak	4.17/4.98	1.80/5.24	0.90/2.39	2.06/6.08	
	Hausman	4.00/5.03	1.76/5.41	0.46/2.16	1.93/6.14	
	IV	4.90/4.77	2.62/3.01			
	Difference GMM					5.16/8.59
	System GMM	3.96/2.48	0.22/4.38	-0.34/4.55	1.83/0.79	
Sensitivity to ΔGDP	Fixed Ef (full spec.)	4.08/1.29		7.09/2.79	4.94/-0.43	4.73/0.86
	Fixed Ef (ind)	0.93/0.29		4.83/1.81	4.51/-0.41	
	Fixed Ef in dif-ces					0.12/0.24
	Mundlak	4.08/1.72	5.59/0.64	7.31/-0.21	3.87/0.43	
	Hausman	3.87/1.07	4.32/-1.05	7.52/-0.64	4.51/0.86	
	IV	4.51/1.50	6.87/-0.01			
	Difference GMM					2.15/0.21
	System GMM	2.15/2.06	2.59/-0.47	2.53/0.12	1.36/-0.96	

NB stands for non-bailed banks; B for bailed-out banks; B-R for bailed out banks that repaid CPP funds;
and B-NR for bailed-out banks that did not repay CPP funds.
Coefficients are presented in the format "A/B" where A refers to those estimated for in normal times, while B to those during the crisis period.
Fixed Ef (full spec.) are results from section 4.4.1; Fixed Ef (ind) are results from estimation by bank subsamples in section 4.4.1.
Fixed Ef in dif-ces are results from section 4.4.1; other results can be found in the respective sections with identical name.

Table 4.23: Summary results - $\Delta REML$

Var	Estimator	**NB**	**B**	**B-R**	**B-NR**	**ALL**
			Growth rates of REML			
Z-score	Fixed Ef (full spec.)	-1.32/4.62		4.33/5.65	-0.50/8.04	-0.06/5.38
	Fixed Ef (ind)	-1.37/5.55		3.79/4.99	-0.42/6.87	
	Fixed Ef in dif-ces					0.31/4.05
	Mundlak	-1.62/3.78	1.56/6.54	1.03/5.47	0.90/5.56	
	Hausman	-1.31/4.80	1.83/6.60	3.41/5.65	0.30/5.20	
	IV	-3.59/4.53	-0.48/6.06			
	Difference GMM					-1.51/5.07
	System GMM	-7.92/3.86	-0.13/5.29	-0.40/3.39	-1.73/6.65	
Capital ratio	Fixed Ef (full spec.)	4.73/4.00		-2.62/1.37	2.88/4.12	3.14/3.39
	Fixed Ef (ind)	5.26/4.18		-2.01/0.93	2.44/3.84	
	Fixed Ef in dif-ces					-1.03/1.06
	Mundlak	5.11/4.25	0.39/3.27	-0.37/0.37	1.59/5.41	
	Hausman	4.64/3.74	0.26/3.44	-1.83/-0.37	1.96/5.94	
	IV	4.86/1.47	3.10/1.26			
	Difference GMM					4.48/3.57
	System GMM	5.77/1.47	0.80/2.93	0.34/3.29	1.50/0.07	
Sensitivity	Fixed Ef (full spec.)	2.79/-0.43		4.51/-1.93	5.59/1.93	3.65/-0.21
to ΔGDP	Fixed Ef (ind)	0.64/-0.10		2.87/-1.81	5.33/1.84	
	Fixed Ef in dif-ces					-0.48/-0.12
	Mundlak	3.65/0.21	4.94/0.00	4.73/-3.87	5.16/2.36	
	Hausman	2.79/-0.43	4.11/-0.84	4.94/-6.02	5.37/3.22	
	IV	4.30/0.65	6.88/-0.64			
	Difference GMM					1.72/0.00
	System GMM	3.23/-0.04	4.53/-0.28	4.07/-2.03	3.16/0.57	

NB stands for non-bailed banks; B for bailed-out banks; B-R for bailed out banks that repaid CPP funds;
and B-NR for bailed-out banks that did not repay CPP funds.
Coefficients are presented in the format "A/B" where A refers to those estimated for in normal times, while B to those during the crisis period.
Fixed Ef (full spec.) are results from section 4.4.1; Fixed Ef (ind) are results from estimation by bank subsamples in section 4.4.1.
Fixed Ef in dif-ces are results from section 4.4.1; other results can be found in the respective sections with identical name.

Table 4.24: Summary results - ΔCIL

Var	Estimator	**NB**	**B**	**B-R**	**B-NR**	**ALL**
			Growth rates of CIL			
Z-score	Fixed Ef (full spec.)	1.80/0.77		3.68/0.14	-1.53/-5.05	1.27/-0.27
	Fixed Ef (ind)	1.92/0.38		3.25/0.10	-1.31/-4.38	
	Fixed Ef in dif-ces					0.66/-1.68
	Mundlak	1.34/0.36	1.27/-0.55	3.87/0.59	-2.51/-4.95	
	Hausman	1.44/1.98	1.49/-0.40	3.99/1.03	-2.89/-4.68	
	IV	-0.57/1.86	1.36/1.01			
	Difference GMM					-0.14/-2.04
	System GMM	-8.69/5.71	-0.02/2.48	-1.48/1.91	-8.00/0.49	
Capital ratio	Fixed Ef (full spec.)	8.55/16.84		3.18/11.21	14.14/21.87	7.91/15.08
	Fixed Ef (ind)	9.87/19.70		2.34/7.86	12.75/19.14	
	Fixed Ef in dif-ces					-0.98/6.55
	Mundlak	7.82/15.90	6.83/11.82	1.59/6.67	11.82/17.50	
	Hausman	8.46/14.82	7.61/12.33	2.06/6.27	12.08/16.33	
	IV	6.79/13.36	7.99/9.49			
	Difference GMM					10.40/24.92
	System GMM	9.44/1.58	3.03/6.05	0.60/8.08	13.64/6.41	
Sensitivity	Fixed Ef (full spec.)	6.02/4.73		10.75/7.74	-0.86/-4.30	5.37/2.79
to ΔGDP	Fixed Ef (ind)	1.38/1.03		7.69/5.43	-0.82/-4.30	
	Fixed Ef in dif-ces					1.31/0.36
	Mundlak	5.16/7.31	4.51/0.21	11.39/6.66	-0.64/-3.87	
	Hausman	4.94/4.94	6.62/2.32	10.96/6.88	-0.86/-4.08	
	IV	3.44/3.23	3.23/0.01			
	Difference GMM					3.01/1.29
	System GMM	-0.11/14.41	1.55/-0.51	2.59/6.60	0.31/-3.04	

NB stands for non-bailed banks; B for bailed-out banks; B-R for bailed out banks that repaid CPP funds;
and B-NR for bailed-out banks that did not repay CPP funds.

Coefficients are presented in the format "A/B" where A refers to those estimated for in normal times, while B to those during the crisis period.

Fixed Ef (full spec.) are results from section 4.4.1; Fixed Ef (ind) are results from estimation by bank subsamples in section 4.4.1.

Fixed Ef in dif-ces are results from section 4.4.1; other results can be found in the respective sections with identical name.

methodology of Brei *et al.* (2011) in order to estimate the impact of bank capital, other balance sheet characteristics and sensitivity to demand shocks on bank lending. This framework allows us to introduce structural changes in parameter estimates for the period of the crisis as well as for normal times for bailed-out and non-bailed-out banks.

First, the results of the estimations suggest that bailed-out banks displayed higher growth rates for all types of loans than non-bailed-out banks both in normal times and during the crisis. Moreover, for every one percentage point increase in the capital ratio, bailed-out banks displayed higher growth rates of loans during the crisis than in normal times as well as higher growth rates than those of non-bailed-out banks during the crisis. In addition, bailed-out banks that repurchased their shares from the U.S. Treasury provided more loans during the crisis than those banks that did not. These results provide evidence that (i) in general, the CPP was efficient in terms of supporting loan growth during the crisis and (ii) banks that did not repay CPP funds experienced severe financial problems and did not translate additional capital into new loans to enterprises and individuals.

This empirical evidence on the effects of capital shortages supports the theory. Banks that have higher levels of capitalisation tended to lend more both during the crisis and in normal times. In tough times, additional capital was not easily translated into extended credit offers by banks that did not benefit from the CPP, as they preferred to keep a substantial proportion of it for their internal needs.

Moreover, the positive shock on aggregate demand had a positive effect on bank lending in good times, while that effect disappeared during the crisis. Banks (both the recipients and non-recipients of CPP funds) that have higher sensitivity to increases in consumer demand displayed higher loan growth rates. However, during the crisis the situation changed, especially in the case of mortgage lending. With the collapse of housing markets and the generally unstable economic situation, consumers were less willing to take on new mortgages, which negatively affected the growth rates of bank loans.

Chapter 5

Conclusion

The financial crisis of 2007 increased the attention paid to financial stability issues on the sides of both academics and policymakers. The financial sector has received much criticism for the excessive freedom that it benefited from because of financial deregulation, excessive margins that were a product of predatory lending, securitisation and trading, and the absence of adequate punishment that these banks should have experienced during the crisis.

In this thesis, I focused on the performance of the banking sector and analysed its role in the recent crisis in terms of (i) affecting the performance of the non-financial sector during the crisis; (ii) receiving CPP funds and their subsequent repayment; and (iii) restoring credit offers to enterprises and individuals during the crisis and following the initiation of the CPP.

Chapter 2 evaluated how the shock on demand expectations and the credit crunch influenced the non-financial firms' performance. The cross-sectional changes in the stock prices of U.S. non-financial firms were investigated over nine large and small periods between July 31, 2007 and March 31, 2010. Both the credit supply shock and the contraction of product demand were shown to have negatively influenced the stock returns of U.S. firms between July 31, 2007 and March 09, 2009 (the period in which the stock returns of firms were negative). Further, the near-collapse of Bear Stearns and bankruptcy of Lehman Brothers were characterised by liquidity contractions (financially fragile firms were affected the most) as well as the overall negative tendency of the market and its high volatility.

The presented findings showed that the improvement in demand expectations positively affected the performances of U.S. non-financial firms in the early months of recovery. In later periods, however, neither the amelioration in demand expectations nor the improvement of financial conditions could explain their performances.

Between October 2008 and December 2009, the U.S. Treasury offered a substantial amount of liquidity to 707 banks in 48 states through the purchases of preferred equity stakes under the voluntary CPP. The Federal Reserve and U.S. Treasury had to distinguish between bailing out a bank and allowing it to fail. Many judgments and decisions during the crisis were made on a case-by-case basis. The debate over the effectiveness of U.S. rescue packages for commercial banks continues.

Chapter 3 focused on the determinants of the liquidity provisions under the CPP. It first defined the factors that contributed to the final bailout allocation and to bailout repayments. Based on that, the effectiveness of the allocation of CPP funds was then assessed according to the goals of the program and the realised risks for taxpayers. The results of that chapter showed that the CPP was designed for larger financial institutions that contributed to systemic risk to a larger extent. This allocation of CPP funds was effective from the point of view of taxpayers as such banks reimbursed CPP funds at short notice. By contrast, smaller banks exposed to mortgage-backed securities, mortgages and non-performing loans were less likely to be bailed out and, furthermore, it took them longer to repurchase their shares from the Treasury if they received CPP funds.

Chapter 4 contributed to the literature on the efficacy of public capital injections during the crisis. It provided a framework in which the sensitivity of the bank's credit offer to financial distortions and its sensitivity to decline in aggregate demand were separated from each other. The relationship between bank balance sheet characteristics, sensitivity to demand shock and bank credit growth was analysed for banks that received CPP funds and those that did not both in normal times and during the crisis. Moreover, the same relationship was then investigated for the subsample of financial firms that received CPP funds in order to distinguish between banks that repurchased their stakes from the U.S. Treasury by July 2012 and those that did not.

The empirical evidence on the effects of capital shortage supports the theory. Banks that have a higher level of capitalisation tended to lend more both during the crisis and in normal times. Moreover, during the crisis, bailed-out banks displayed higher growth rates of loans than in normal times and higher rates than those of non-bailed-out banks during the crisis for every one percentage point increase in the capital ratio. This finding means that the liquidity provisions offered to banks during the recent crisis supported bank lending. In tough times, additional capital was not that easily translated into extended credit offers by banks that did not benefit from the CPP program, as they preferred to keep a substantial part of it for their internal needs.

It also seems as though banks that specialised in commercial and industrial lending and those that displayed a higher probability of receiving CPP funds (see Chapter 3 for details) also contributed to a larger extent to the growth rates of loans (mostly commercial and industrial loans, as they specialised in that type of lending).

This thesis covered several aspects of banking sector performance. First, the role of the banking sector in maintaining the functioning of the economy cannot be underestimated. The influence of the financial sector on the real economy is constantly growing and thus it requires continuous research. In that vein, the impact of credit market developments on changes in the relationship between the banking sector and real economy is one of the issues that has attracted scholarly attention in the aftermath of the crisis. The further development of financial instruments is also expected in the future because of the competition between regulated and unregulated financial sectors, which might continue driving down interest rates and triggering the extension of credit lines to riskier borrowers. The credit misallocation (as occurred in the residential real estate sector during the recent crisis) that might result from such a process as well as the ways in which to anticipate and counteract it are additional issues for future research.

Several challenges arise when examining the unregulated sector of an economy as well as new financial instruments. First, the data on the unregulated sector are rather scarce compared with the regulated sector. In addition, even with the available information on bank balance sheets, it is relatively difficult to judge the real financial positions of banks and their weaknesses and vulnerabilities in the case of global negative shocks.

The role of market funding and securitisation also needs more investigation, especially for the purposes of future prudential regulation. Tightening regulation standards and new capital requirements (including the new buffers imposed by Basel III) will impose more costs on the regulated financial sector and may decrease the risks related to future financial crises. However, off-balance sheet exposures in the shadow banking system that served to amplify the impact of the recent crisis on banks remain and demand further research.

Second, the econometric approaches and models used to analyse the performance of the banking system must take into account the non-linearities of the system and structural breaks. This means investigating changes in linkages through which banking performance and loan supply are affected (i) in downturn periods relative to periods of growth and (ii) before and after implementing new regulatory frameworks such as Basel III or any other revisions of the institutional or regulatory features of an economy. From an econometric point of view, such studies require more frequent data, because daily market data are often more informative than quarterly (or yearly) balance sheet data. As discussed in this thesis, the estimation of dynamic models often poses more problems than the estimation of static ones, because several types of endogeneity biases may arise that require suitable instruments in order to obtain consistent estimates.

Further research must also explore the efficacy of the injection of public funds into the banking sector during the crisis (as opposed to market-based interventions). Here, one of the issues regarding the selection of commercial banks to be bailed out is distinguishing temporarily illiquid banks whose activity deteriorated because of the global shock from those banks that became insolvent due to their business strategies. This distinction is crucial but rather ambiguous, as any bank's activity is affected by the global financial crisis, while risk-taking, degree and its interconnectedness with other factors that influence a bank's performance differ, too.

Moreover, as highlighted in Chapter 3, more freely available data on bailout schemes and other allocations, such as the applications for CPP participation as well as rejections and approvals by the authorities, could greatly improve the quality of the analysis of banking performance before and after the disbursement of funds. In that line, the moral hazard problem that arises from frequent government bailouts must be taken into account and its effect on a bank's strategy and loan supply investigated more in detail. Further, some of the other consequences of capital injections into the financial sector, such as the government holding bank shares, also require investigation in future research.

The importance of too-big-to-fail institutions cannot be ignored, and this issue must be addressed with additional requirements for such entities. The contribution to systemic risk and to the systemic interconnectedness of financial institutions has already been taken into account by Basel III. However, the implications of such measures for the banking sector as well as for its linkages with the real economy must be investigated during the times of economic stability and growth as well as during recession.

Finally, research on the role and impact of demand in the banking sector should continue. While demand for daily use goods is mostly driven by consumption needs, demand for investment goods such as real estate or machinery is often triggering that for bank credit. In this sense, expectations of future investment opportunities might actually be reflected in demand for bank credit.

Appendix E

Correlation tables

Table E.1: Correlation coefficients for within-transformed dependent and main explanatory variables interacted with both bailout and crisis dummy

Var	$\Delta ln (TL)_{it}$	$\Delta ln (REML)_{it}$	$\Delta ln (CIL)_{it}$	$Z_{it-1} * B * C$	$\frac{TE}{TA}_{it-1} * B * C$	$Size_{it-1} * B * C$	$\frac{MBS}{TA}_{it-1} * B * C$	$\frac{TSM}{TA}_{it-1} * B * C$	$Sens_{it-1} * B * C$	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}
$\Delta ln (TL)_{it}$	1.00															
$\Delta ln (REML)_{it}$	0.68	1.00														
$\Delta ln (CIL)_{it}$	0.37	-0.07	1.00													
$Z_{it-1} * B * C$	0.22	0.16	0.09	1.00												
$\frac{TE}{TA}_{it-1} * B * C$	0.08	0.04	0.06	0.43	1.00											
$Size_{it-1} * B * C$	-0.20	-0.14	-0.09	-0.35	0.04	1.00										
$\frac{MBS}{TA}_{it-1} * B * C$	-0.03	-0.03	-0.01	-0.22	-0.04	0.13	1.00									
$\frac{TSM}{TA}_{it-1} * B * C$	0.12	0.09	0.05	0.29	-0.07	-0.49	-0.23	1.00								
$Sens_{it-1} * B * C$	0.15	0.08	0.08	0.24	0.15	-0.42	-0.04	0.16	1.00							
C_t	-0.23	-0.14	-0.12	-0.09	-0.05	0.32	-0.03	-0.21	-0.27	1.00						
B_i	0.04	0.00	0.02	-0.15	-0.02	0.36	0.04	-0.22	-0.19	0.00	1.00					
B_iC_t	-0.13	-0.07	-0.09	-0.18	-0.07	0.56	-0.03	-0.37	-0.43	0.64	0.44	1.00				
R_i	0.05	0.02	0.03	-0.08	0.09	0.25	0.03	-0.17	-0.10	-0.02	**0.70**	0.27	1.00			
R_iC_t	-0.09	-0.05	-0.06	-0.14	0.05	0.45	-0.02	-0.31	-0.29	0.48	0.33	**0.76**	0.48	1.00		
GDP_{t-1}	0.31	0.20	0.16	0.25	0.03	-0.37	-0.07	0.22	0.37	-0.62	-0.01	-0.41	0.01	-0.32	1.00	
FF_{t-1}	0.22	0.13	0.11	0.24	0.03	-0.28	-0.07	0.17	0.35	-0.38	-0.01	-0.26	-0.00	-0.20	**0.84**	1.00

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Table E.2: Correlation coefficients for within-transformed dependent and main explanatory variables interacted with repayment dummy

Var	Δln $(TL)_{it}$	Δln $(REML)_{it}$	Δln $(CIL)_{it}$	Z_{it-1} * R	$\frac{TE}{TA}_{it-1}$* R	$Size_{it-1}$* R	$\frac{MBS}{TA}_{it-1}$* R	$\frac{TSM}{TA}_{it-1}$* R	$Sens_{it-1}$* R	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}
Δln $(TL)_{it}$	1.00															
Δln $(REML)_{it}$	0.68	1.00														
Δln $(CIL)_{it}$	0.37	-0.07	1.00													
$Z_{it-1} * R$	0.15	0.10	0.07	1.00												
$\frac{TE}{TA}_{it-1} * R$	0.04	0.01	0.03	0.44	1.00											
$Size_{it-1} * R$	-0.17	-0.10	-0.07	-0.19	0.08	1.00										
$\frac{MBS}{TA}_{it-1} * R$	-0.02	-0.02	-0.01	-0.11	-0.01	0.16	1.00									
$\frac{TSM}{TA}_{it-1} * R$	0.09	0.06	0.03	0.14	0.03	-0.43	-0.22	1.00								
$Sens_{it-1} * R$	0.16	0.07	0.10	0.27	0.03	-0.40	-0.03	0.12	1.00							
C_t	-0.23	-0.14	-0.12	-0.11	0.01	0.22	-0.05	-0.09	-0.24	1.00						
B_i	0.04	0.01	0.02	0.03	0.01	0.26	0.01	-0.20	-0.08	0.00	1.00					
B_iC_t	-0.13	-0.07	-0.09	-0.12	0.02	0.39	-0.05	-0.20	-0.34	0.64	0.44	1.00				
R_i	0.05	0.01	0.03	0.05	0.02	0.38	0.02	-0.29	-0.12	-0.02	**0.70**	0.27	1.00			
R_iC_t	-0.09	-0.05	-0.06	-0.14	0.03	0.54	-0.06	-0.28	-0.43	0.49	0.33	**0.76**	0.48	1.00		
GDP_{t-1}	0.31	0.20	0.16	0.20	-0.02	-0.23	-0.04	0.10	0.38	-0.62	-0.01	-0.41	0.01	-0.32	1.00	
FF_{t-1}	0.22	0.13	0.11	0.16	-0.04	-0.09	-0.05	0.04	0.32	-0.38	-0.01	-0.26	-0.00	-0.20	**0.84**	1.00

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Table E.3: Correlation coefficients for within-transformed dependent and main explanatory variables interacted with repayment and crisis dummies

Var	Δln $(TL)_{it}$	Δln $(REML)_{it}$	Δln $(CIL)_{it}$	Z_{it-1} * $R*C$	$\frac{TE}{TA}_{it-1}$* $R*C$	$Size_{it-1}$* $R*C$	$\frac{MBS}{TA}_{it-1}$* $R*C$	$\frac{TSM}{TA}_{it-1}$* $R*C$	$Sens_{it-1}$* $R*C$	C_t	B_i	B_iC_t	R_i	R_iC_t	GDP_{t-1}	FF_{t-1}
Δln $(TL)_{it}$	1.00															
Δln $(REML)_{it}$	0.68	1.00														
Δln $(CIL)_{it}$	0.37	-0.07	1.00													
$Z_{it-1}*R*C$	0.14	0.11	0.07	1.00												
$\frac{TE}{TA}_{it-1}*R*C$	0.03	0.00	0.03	0.36	1.00											
$Size_{it-1}*R*C$	-0.13	-0.09	-0.06	-0.32	0.26	1.00										
$\frac{MBS}{TA}_{it-1}*R*C$	0.00	-0.01	-0.00	-0.19	0.03	0.14	1.00									
$\frac{TSM}{TA}_{it-1}*R*C$	0.09	0.07	0.03	0.28	-0.15	-0.55	-0.21	1.00								
$Sens_{it-1}*R*C$	0.12	0.05	0.08	0.31	-0.00	-0.44	-0.01	0.21	1.00							
C_t	-0.23	-0.14	-0.12	-0.08	0.01	0.24	-0.03	-0.17	-0.23	1.00						
B_i	0.04	0.01	0.02	-0.11	0.04	0.28	0.03	-0.18	-0.16	0.00	1.00					
B_iC_t	-0.13	-0.07	-0.09	-0.15	0.03	0.43	-0.02	-0.29	-0.36	0.64	0.44	1.00				
R_i	0.05	0.01	0.03	-0.16	0.06	0.40	0.05	-0.26	-0.23	-0.02	0.70	0.27	1.00			
R_iC_t	-0.09	-0.05	-0.06	-0.21	0.04	0.58	-0.02	-0.40	-0.48	0.48	0.33	0.76	0.48	1.00		
GDP_{t-1}	0.31	0.20	0.16	0.18	-0.05	-0.28	-0.04	0.18	0.31	-0.62	-0.01	-0.41	0.01	-0.32	1.00	
FF_{t-1}	0.22	0.13	0.11	0.17	-0.05	-0.21	-0.05	0.13	0.30	-0.38	-0.01	-0.26	-0.00	-0.20	0.84	1.00

The correlation coefficients between dependent and explanatory variables smaller than 0.1 in their absolute values are highlighted in grey.

Table E.4: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13

Var	Δln TL	Δln $REML$	Δln CIL	$L.\Delta ln$ TL	$L.\Delta ln$ $REML$	$L.\Delta ln$ CIL	$L2.\Delta ln$ TL	$L2.\Delta ln$ $REML$	$L2.\Delta ln$ CIL	$L3.\Delta ln$ $(TL)_{it}$	$L3.\Delta ln$ $REML$	$L3.\Delta ln$ CIL	$L4.\Delta ln$ TL	$L4.\Delta ln$ $REML$	$L4.\Delta ln$ CIL	$D.L.\Delta ln$ TL	$D.L.\Delta$ $REML$	$D.L.\Delta$ CIL
$\Delta lnTL$	1.00																	
Δln $REML$	0.65	1.00																
Δln CIL	0.37	-0.12	1.00															
$L.\Delta ln$ TL	0.40	0.27	0.13	1.00														
$L.\Delta ln$ $REML$	0.24	0.11	0.10	0.65	1.00													
$L.\Delta ln$ CIL	0.17	0.15	-0.01	0.36	-0.13	1.00												
$L2.\Delta ln$ TL	0.23	0.16	0.05	0.36	0.24	0.11	1.00											
$L2.\Delta ln$ $REML$	0.17	0.08	0.06	0.23	0.09	0.09	0.66	1.00										
$L2.\Delta ln$ CIL	0.09	0.07	-0.02	0.15	0.14	-0.01	0.34	-0.12	1.00									
$L3.\Delta ln$ TL	0.15	0.10	0.03	0.21	0.14	0.06	0.35	0.24	0.08	1.00								
$L3.\Delta ln$ $REML$	0.08	0.04	0.04	0.16	0.09	0.08	0.23	0.10	0.09	0.67	1.00							
$L3.\Delta ln$ CIL	0.07	0.07	-0.03	0.06	0.04	-0.03	0.12	0.10	-0.05	0.31	-0.13	1.00						
$L4.\Delta ln$ TL	0.16	0.11	0.02	0.18	0.13	0.04	0.26	0.18	0.07	0.42	0.29	0.09	1.00					
$L4.\Delta ln$ $REML$	0.09	0.04	0.04	0.10	0.07	0.05	0.20	0.12	0.07	0.30	0.14	0.11	0.70	1.00				
$L4.\Delta ln$ CIL	0.06	0.05	0.02	0.09	0.07	-0.01	0.09	0.08	-0.01	0.19	0.15	-0.03	0.36	-0.04	1.00			
$D.L.\Delta ln$ TL	0.14	0.10	0.07	0.56	0.36	0.22	-0.57	-0.39	-0.17	-0.12	-0.06	-0.05	-0.07	-0.08	-0.00	1.00		
$D.L.\Delta ln$ $REML$	0.05	0.01	0.02	0.31	0.67	-0.17	-0.32	-0.68	0.19	-0.07	-0.01	-0.04	-0.04	-0.04	-0.00	0.55	1.00	
$D.L.\Delta ln$ CIL	0.05	0.06	0.01	0.14	-0.19	0.71	-0.16	0.15	-0.71	-0.01	-0.01	0.01	-0.02	-0.02	-0.00	0.27	-0.25	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.5: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (2)

Var	$L2.\Delta ln$ TL	$L2.\Delta ln$ $REML$	$L2.\Delta ln$ CIL	$L3.\Delta ln$ TL	$L3.\Delta ln$ $REML$	$L3.\Delta ln$ CIL	$L4.\Delta ln$ TL	$L4.\Delta ln$ $REML$	$L4.\Delta ln$ CIL	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.$ $Size$	$D.L.\frac{TSM}{TA}$	$D.L.$ $Sens$	$D.L.$ $Z*C$	$D.L.\frac{TE}{TA}*C$	$D.L.$ $Size*C$	$D.L.\frac{TSM}{TA}*C$	$D.L.$ $Sens*C$
$L2.\Delta ln$ TL	1.00																		
$L2.\Delta ln$ $REML$	0.66	1.00																	
$L2.\Delta ln$ CIL	0.32	-0.15	1.00																
$L3.\Delta ln$ TL	0.32	0.22	0.06	1.00															
$L3.\Delta ln$ $REML$	0.20	0.08	0.08	0.67	1.00														
$L3.\Delta ln$ CIL	0.11	0.11	-0.05	0.32	-0.12	1.00													
$L4.\Delta ln$ TL	0.23	0.16	0.05	0.38	0.26	0.08	1.00												
$L4.\Delta ln$ $REML$	0.17	0.09	0.07	0.26	0.12	0.11	0.69	1.00											
$L4.\Delta ln$ CIL	0.08	0.07	-0.00	0.16	0.14	-0.02	0.35	-0.07	1.00										
$D.L.Z$	0.06	0.05	0.01	-0.02	-0.01	-0.02	-0.03	-0.04	0.01	1.00									
$D.L.\frac{TE}{TA}$	0.00	-0.00	-0.02	0.00	0.00	-0.01	-0.01	-0.02	0.00	0.47	1.00								
$D.L.Size$	0.27	0.18	0.10	0.19	0.15	0.03	0.16	0.08	0.07	-0.05	-0.10	1.00							
$D.L.\frac{TSM}{TA}$	-0.00	0.00	0.01	0.02	0.02	-0.01	0.03	0.03	0.03	-0.01	0.02	0.00	1.00						
$D.L.Sens$	-0.02	-0.00	0.00	-0.11	-0.08	-0.05	-0.09	-0.08	-0.02	0.08	0.01	0.04	-0.01	1.00					
$D.L.$ $Z*C$	0.00	0.00	0.02	-0.07	-0.04	-0.02	-0.08	-0.09	0.01	0.64	0.36	0.07	0.00	0.15	1.00				
$D.L.$ $\frac{TE}{TA}*C$	0.02	-0.00	0.00	0.01	-0.00	0.01	-0.03	-0.03	0.03	0.30	0.39	-0.01	-0.01	0.02	0.56	1.00			
$D.L.$ $Size*C$	0.03	0.03	0.01	-0.00	-0.01	0.01	-0.01	0.00	0.00	-0.02	0.08	0.08	0.01	0.06	-0.00	-0.03	1.00		
$D.L.$ $\frac{TSM}{TA}*C$	-0.02	-0.01	-0.01	-0.04	-0.02	-0.02	-0.05	-0.03	-0.04	0.08	0.03	0.00	0.25	0.05	0.10	-0.01	-0.06	1.00	
$D.L.$ $Sens*C$	-0.01	0.00	0.00	-0.06	-0.04	-0.04	-0.00	-0.01	-0.01	0.03	-0.01	0.00	-0.02	0.82	0.05	-0.01	0.01	-0.01	1.00

D. in this table stands for first difference, *L*. stands for the lagged value.

Table E.6: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (3)

Var	$L2.\Delta ln$ TL	$L2.\Delta ln$ $REML$	$L2.\Delta ln$ CIL	$L3.\Delta ln$ $(TL)_{it}$	$L3.\Delta ln$ $REML$	$L3.\Delta ln$ CIL	$L4.\Delta ln$ TL	$L4.\Delta ln$ $REML$	$L4.\Delta ln$ CIL	$D.L.$ $Z*B$	$D.L.$ $\frac{TE}{TA}*B$	$D.L.$ $Size*B$	$D.L.$ $\frac{TSM}{TA}*B$	$D.L.$ $Sens*B$	$D.L.$ $Z*B*C$	$D.L.$ $\frac{TE}{TA}*B*C$	$D.L.$ $Size*B*C$	$D.L.$ $\frac{TSM}{TA}*B*C$	$D.L.$ $Sens*B*C$
$L2.\Delta ln$ TL	1.00																		
$L2.\Delta ln$ $REML$	0.66	1.00																	
$L2.\Delta ln$ CIL	0.32	-0.15	1.00																
$L3.\Delta ln$ TL	0.32	0.22	0.06	1.00															
$L3.\Delta ln$ $REML$	0.20	0.08	0.08	0.67	1.00														
$L3.\Delta ln$ CIL	0.11	0.11	-0.05	0.32	-0.12	1.00													
$L4.\Delta ln$ TL	0.23	0.16	0.05	0.38	0.26	0.08	1.00												
$L4.\Delta ln$ $REML$	0.17	0.09	0.07	0.26	0.12	0.11	0.69	1.00											
$L4.\Delta ln$ CIL	0.08	0.07	-0.00	0.16	0.14	-0.02	0.35	-0.07	1.00										
$D.L.Z*B$	0.07	0.05	0.01	-0.00	-0.02	0.00	-0.01	0.00	-0.01	1.00									
$D.L.$ $\frac{TE}{TA}*B$	-0.00	-0.02	-0.02	0.01	0.01	-0.01	-0.01	-0.01	0.02	0.51	1.00								
$D.L.$ $Size*B$	0.18	0.12	0.08	0.12	0.12	0.01	0.10	0.04	0.04	-0.07	-0.09	1.00							
$D.L.$ $\frac{TSM}{TA}*B$	-0.01	-0.00	-0.00	0.02	0.01	0.00	0.01	-0.00	0.03	0.01	0.04	-0.03	1.00						
$D.L.$ $Sens*B$	-0.03	-0.01	-0.00	-0.10	-0.08	-0.03	-0.04	-0.03	-0.02	-0.00	-0.03	0.02	-0.01	1.00					
$D.L.$ $Z*B*C$	0.01	0.01	0.01	-0.04	-0.03	-0.01	-0.04	-0.03	0.01	0.76	0.35	0.06	0.00	0.03	1.00				
$D.L.$ $\frac{TE}{TA}*B*C$	0.02	-0.01	0.01	0.00	0.00	-0.00	-0.02	-0.02	0.03	0.32	0.50	-0.03	0.01	-0.08	0.47	1.00			
$D.L.$ $Size*B*C$	0.01	0.01	0.01	-0.01	-0.02	0.01	-0.02	0.00	0.00	-0.03	0.14	0.07	0.03	0.06	0.01	0.05	1.00		
$D.L.$ $\frac{TSM}{TA}*B*C$	-0.00	-0.00	-0.00	-0.02	-0.01	-0.01	-0.02	-0.01	-0.03	0.05	-0.00	-0.02	0.23	-0.01	0.07	0.02	-0.10	1.00	
$D.L.$ $Sens*B*C$	-0.01	0.08	0.00	-0.05	-0.04	-0.03	0.01	0.01	-0.02	-0.03	-0.07	-0.01	-0.03	0.85	-0.03	-0.09	0.01	-0.05	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.7: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (4)

Var	$L2.Z$	$L2.\frac{TE}{TA}$	$L2.Size$	$L2.\frac{TSM}{TA}$	$L2.Sens$	$L2.Z*C$	$L2.\frac{TE}{TA}*C$	$L2.Size*C$	$L2.\frac{TSM}{TA}*C$	$L2.Sens*C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B*C$	$R*C$
$L2.Z$	1.00																		
$L2.\frac{TE}{TA}$	0.56	1.00																	
$L2.Size$	0.05	-0.22	1.00																
$L2.\frac{TSM}{TA}$	-0.01	-0.04	-0.01	1.00															
$L2.Sens$	-0.16	0.06	-0.12	-0.06	1.00														
$L2.Z*C$	0.45	0.22	-0.01	0.04	0.05	1.00													
$L2.\frac{TE}{TA}*C$	0.26	0.38	-0.03	-0.01	0.01	0.57	1.00												
$L2.Size*C$	-0.00	-0.03	0.37	-0.02	0.01	-0.01	-0.07	1.00											
$L2.\frac{TSM}{TA}*C$	0.06	-0.02	-0.03	0.29	0.03	0.13	-0.05	-0.07	1.00										
$L2.Sens*C$	0.11	0.02	0.00	0.04	0.19	0.25	0.06	0.01	0.16	1.00									
$D.L.Z$	-0.44	-0.19	0.01	0.03	-0.01	-0.06	-0.05	0.03	0.04	0.02	1.00								
$D.L.\frac{TE}{TA}$	-0.14	-0.45	0.14	0.04	-0.13	-0.00	-0.15	0.05	0.04	0.03	0.46	1.00							
$D.L.Size$	-0.08	0.11	-0.08	-0.06	0.21	0.06	0.08	-0.04	-0.00	0.03	0.05	-0.17	1.00						
$D.L.\frac{TSM}{TA}$	0.07	-0.02	-0.01	-0.32	-0.00	0.02	0.02	-0.02	-0.04	0.01	-0.06	0.03	0.02	1.00					
$D.L.Sens$	0.01	-0.00	0.01	0.01	-0.42	-0.10	0.01	-0.04	-0.05	-0.55	0.05	0.01	0.02	-0.00	1.00				
B_i	-0.10	-0.14	0.25	-0.09	-0.02	-0.08	-0.04	0.10	-0.06	-0.02	0.01	0.07	0.04	-0.01	0.01	1.00			
R_i	-0.03	-0.09	0.33	-0.03	-0.04	-0.02	0.00	0.14	-0.02	-0.01	0.02	0.08	0.04	-0.00	0.00	0.70	1.00		
$B*C$	-0.07	-0.06	0.07	-0.05	0.03	-0.07	-0.05	0.18	-0.08	-0.03	-0.01	0.08	-0.07	-0.00	-0.00	0.45	0.28	1.00	
$R*C$	-0.02	-0.06	0.14	-0.02	0.02	-0.02	-0.02	0.11	-0.01	0.01	0.03	0.10	-0.04	-0.00	0.01	0.34	0.49	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.8: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (5)

Var	$L2.Z*B$	$L2.\frac{TE}{TA}*B$	$L2.Size*B$	$L2.\frac{TSM}{TA}*B$	$L2.Sens*B$	$L2.Z*B*C$	$L2.\frac{TE}{TA}*B*C$	$L2.Size*B*C$	$L2.\frac{TSM}{TA}*B*C$	$L2.Sens*B*C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B*C$	$R*C$
$L2.Z*B$	1.00																		
$L2.\frac{TE}{TA}*B$	0.48	1.00																	
$L2.Size*B$	0.12	-0.19	1.00																
$L2.\frac{TSM}{TA}*B$	0.03	0.05	-0.11	1.00															
$L2.Sens*B$	-0.09	0.14	-0.14	-0.05	1.00														
$L2.Z*B*C$	0.45	0.16	0.03	0.05	0.04	1.00													
$L2.\frac{TE}{TA}*B*C$	0.21	0.36	0.03	0.01	-0.00	0.46	1.00												
$L2.Size*B*C$	0.03	0.04	0.38	-0.03	0.01	0.06	0.07	1.00											
$L2.\frac{TSM}{TA}*B*C$	0.08	0.01	-0.04	0.28	0.02	0.18	0.04	-0.12	1.00										
$L2.Sens*B*C$	0.09	-0.00	0.01	0.03	0.21	0.21	0.00	0.02	0.10	1.00									
$D.L.Z$	-0.32	-0.15	0.03	0.01	-0.01	-0.06	0.00	0.02	0.02	0.01	1.00								
$D.L.\frac{TE}{TA}$	-0.05	-0.29	0.10	0.01	-0.08	0.01	-0.06	0.02	0.01	0.03	0.46	1.00							
$D.L.Size$	0.05	0.08	-0.02	-0.03	0.11	0.06	0.08	-0.05	0.01	0.03	0.05	-0.17	1.00						
$D.L.\frac{TSM}{TA}$	0.10	-0.02	-0.01	-0.20	0.00	0.01	-0.01	-0.02	-0.01	0.01	-0.06	0.03	0.02	1.00					
$D.L.Sens$	0.00	-0.03	0.01	0.00	-0.29	-0.06	-0.01	-0.03	-0.01	-0.38	0.05	0.01	0.02	0.00	1.00				
B_i	-0.05	-0.19	0.25	-0.08	-0.08	-0.03	-0.04	0.09	-0.04	-0.02	0.01	0.07	0.04	0.00	0.01	1.00			
R_i	0.03	-0.13	0.37	0.00	-0.10	0.04	0.04	0.14	0.01	-0.00	0.02	0.07	0.04	0.00	0.00	0.70	1.00		
$B*C$	-0.06	-0.07	0.07	-0.04	0.02	-0.07	-0.08	0.19	-0.09	-0.04	-0.01	0.08	-0.00	0.00	0.00	0.45	0.29	1.00	
$R*C$	-0.00	-0.08	0.15	-0.00	0.01	-0.00	-0.01	0.12	-0.00	0.02	0.03	0.10	-0.04	0.00	0.01	0.34	0.49	0.54	1.00

D. in this table stands for first difference, *L.* stands for the lagged value.

Table E.9: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (6)

Var	$L2.Z*R$	$L2.\frac{TE}{TA}*R$	$L2.Size*R$	$L2.\frac{TSM}{TA}*R$	$L2.Sens*R$	$L2.Z*R*C$	$L2.\frac{TE}{TA}*R*C$	$L2.Size*R*C$	$L2.\frac{TSM}{TA}*R*C$	$L2.Sens*R*C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B*C$	$R*C$
$L2.Z*R$	1.00																		
$L2.\frac{TE}{TA}*R$	0.44	1.00																	
$L2.Size*R$	0.12	-0.17	1.00																
$L2.\frac{TSM}{TA}*R$	0.02	0.08	-0.17	1.00															
$L2.Sens*R$	-0.07	0.18	-0.17	-0.06	1.00														
$L2.Z*R*C$	0.46	0.12	0.06	0.04	0.02	1.00													
$L2.\frac{TE}{TA}*R*C$	0.13	0.42	0.05	0.01	0.03	0.29	1.00												
$L2.Size*R*C$	0.06	0.06	0.45	-0.06	0.00	0.12	0.10	1.00											
$L2.\frac{TSM}{TA}*R*C$	0.05	-0.01	-0.05	0.23	0.02	0.11	-0.01	-0.12	1.00										
$L2.Sens*R*C$	0.08	-0.00	0.01	0.03	0.13	0.17	0.00	0.02	0.10	1.00									
$D.L.Z$	-0.32	-0.16	0.03	0.01	-0.02	-0.07	-0.04	0.01	0.02	0.01	1.00								
$D.L.\frac{TE}{TA}$	-0.04	-0.22	0.08	-0.01	-0.06	0.00	-0.10	0.05	0.01	0.03	0.46	1.00							
$D.L.Size$	0.06	0.04	0.00	-0.03	0.07	0.05	0.05	-0.04	0.01	0.03	0.05	-0.17	1.00						
$D.L.\frac{TSM}{TA}$	0.11	-0.00	-0.00	-0.16	0.00	0.01	-0.01	-0.01	-0.01	0.01	-0.06	0.03	0.02	1.00					
$D.L.Sens$	0.01	-0.03	0.01	0.00	-0.20	-0.00	-0.04	0.00	0.00	-0.01	-0.38	0.05	0.01	-0.00	1.00				
B_i	0.00	-0.16	0.30	-0.03	-0.03	-0.10	0.00	-0.03	0.13	-0.04	-0.02	0.01	0.07	0.04	-0.01	1.00			
R_i	0.00	-0.23	0.42	-0.04	-0.15	0.00	-0.05	0.19	0.01	-0.00	0.02	0.08	0.04	-0.00	0.00	0.70	1.00		
$B*C$	-0.00	-0.01	0.10	-0.01	0.02	0.01	-0.08	0.30	-0.09	-0.04	-0.01	0.08	-0.07	-0.00	-0.01	0.45	0.28	1.00	
$R*C$	-0.02	-0.14	0.18	-0.02	0.00	-0.00	-0.03	0.15	0.24	0.01	0.02	0.03	0.10	-0.04	0.01	0.34	0.49	0.53	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.10: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (7)

Var	$L3.Z$	$L3.\frac{TE}{TA}$	$L3.Size$	$L3.\frac{TSM}{TA}$	$L3.Sens$	$L3.Z * C$	$L3.\frac{TE}{TA} * C$	$L3.Size * C$	$L3.\frac{TSM}{TA} * C$	$L3.Sens * C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B * C$	$R * C$
$L3.Z$	1.00																		
$L3.\frac{TE}{TA}$	0.56	1.00																	
$L3.Size$	0.05	-0.23	1.00																
$L3.\frac{TSM}{TA}$	-0.03	-0.04	-0.02	1.00															
$L3.Sens$	-0.19	0.06	-0.13	-0.08	1.00														
$L3.Z * C$	0.31	0.16	-0.02	0.01	0.01	1.00													
$L3.\frac{TE}{TA} * C$	0.18	0.29	-0.03	-0.02	0.00	0.57	1.00												
$L3.Size * C$	-0.02	-0.02	0.27	-0.01	0.01	-0.05	-0.09	1.00											
$L3.\frac{TSM}{TA} * C$	0.02	-0.03	-0.02	0.20	0.01	0.08	-0.10	-0.06	1.00										
$L3.Sens * C$	0.08	0.04	0.02	0.03	0.04	0.25	0.13	0.10	0.15	1.00									
$D.L.Z$	-0.05	-0.12	0.04	0.04	-0.07	-0.02	-0.02	0.02	0.02	0.00	1.00								
$D.L.\frac{TE}{TA}$	-0.15	-0.37	0.12	0.03	-0.09	-0.05	-0.10	0.01	0.02	0.02	0.50	1.00							
$D.L.Size$	-0.01	0.09	-0.03	-0.05	0.12	0.05	0.06	-0.03	0.00	0.01	-0.08	-0.20	1.00						
$D.L.\frac{TSM}{TA}$	0.01	0.03	-0.02	-0.22	0.03	0.02	0.02	-0.03	-0.02	0.02	-0.00	0.00	0.02	1.00					
$D.L.Sens$	-0.01	-0.08	0.02	0.00	-0.39	-0.18	-0.09	-0.04	-0.11	-0.65	0.06	0.02	0.01	-0.01	1.00				
B_i	-0.10	-0.15	0.25	-0.09	-0.01	-0.08	-0.05	0.07	-0.05	-0.01	0.02	0.07	0.06	-0.01	0.01	1.00			
R_i	-0.03	-0.11	0.33	-0.03	-0.04	-0.03	-0.01	0.10	-0.02	0.01	0.04	0.08	0.07	-0.01	0.00	0.70	1.00		
$B * C$	-0.07	-0.08	0.07	-0.05	0.04	-0.07	-0.06	0.13	-0.05	0.02	-0.01	0.07	-0.07	-0.00	0.00	0.47	0.30	1.00	
$R * C$	-0.02	-0.07	0.15	-0.02	0.00	-0.00	-0.00	-0.01	-0.00	-0.01	0.03	0.11	-0.03	-0.01	0.00	0.36	0.51	0.54	1.00

D. in this table stands for first difference, *L.* stands for the lagged value.

Table E.11: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (8)

Var	$L3.Z*B$	$L3.\frac{TE}{TA}*B$	$L3.Size*B$	$L3.\frac{TSM}{TA}*B$	$L3.Sens*B$	$L3.Z*B*C$	$L3.\frac{TE}{TA}*B*C$	$L3.Size*B*C$	$L3.\frac{TSM}{TA}*B*C$	$L3.Sens*B*C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B*C$	$R*C$
$L3.Z*B$	1.00																		
$L3.\frac{TE}{TA}*B$	0.47	1.00																	
$L3.Size*B$	0.12	-0.21	1.00																
$L3.\frac{TSM}{TA}*B$	0.02	0.05	-0.12	1.00															
$L3.Sens*B$	-0.12	0.15	-0.15	-0.06	1.00														
$L3.Z*B*C$	0.30	0.09	0.01	0.04	0.01	1.00													
$L3.\frac{TE}{TA}*B*C$	0.11	0.25	0.03	0.01	-0.00	0.37	1.00												
$L3.Size*B*C$	0.01	0.03	0.28	-0.02	0.01	0.02	0.06	1.00											
$L3.\frac{TSM}{TA}*B*C$	0.06	0.01	-0.03	0.20	0.00	0.20	0.04	-0.11	1.00										
$L3.Sens*B*C$	0.07	0.00	0.03	0.02	0.05	0.22	-0.00	0.13	0.08	1.00									
$D.L.Z$	-0.05	-0.08	0.02	0.00	-0.01	0.04	0.04	0.02	0.03	0.01	1.00								
$D.L.\frac{TE}{TA}$	-0.08	-0.23	0.09	-0.01	-0.04	0.03	-0.02	0.00	0.02	0.03	0.50	1.00							
$D.L.Size$	0.01	0.05	-0.00	-0.03	0.08	0.05	0.06	-0.03	0.00	0.02	-0.08	-0.20	1.00						
$D.L.\frac{TSM}{TA}$	-0.01	-0.05	0.01	-0.17	0.01	0.01	-0.01	-0.02	-0.00	0.02	-0.00	0.00	0.02	1.00					
$D.L.Sens$	-0.01	-0.06	0.01	0.00	-0.28	-0.13	-0.00	-0.04	-0.05	-0.46	0.06	0.02	0.01	0.00	1.00				
B_i	-0.05	-0.20	0.26	-0.07	-0.10	-0.03	-0.04	0.07	-0.03	-.02	0.02	0.07	0.06	-0.01	0.01	1.00			
R_i	0.03	-0.15	0.38	0.01	-0.11	0.01	0.01	0.10	0.01	0.04	0.04	0.08	0.07	-0.01	0.00	0.70	1.00		
$B*C$	-0.07	-0.12	0.07	-0.05	0.02	-0.06	-0.09	0.14	-0.06	0.04	-0.01	0.07	-0.07	-0.00	0.00	0.47	0.30	1.00	
$R*C$	-0.01	-0.10	0.16	-0.01	-0.03	0.01	0.01	-0.02	0.01	-0.01	0.03	0.11	-0.03	-0.01	0.00	0.36	0.51	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.12: Correlation coefficients between the instruments and the variables from first difference (Arellano-Bond) Equation 4.2.13. Continued (9)

Var	$L3.Z*R$	$L3.\frac{TE}{TA}*R$	$L3.Size*R$	$L3.\frac{TSM}{TA}*R$	$L3.Sens*R$	$L3.Z*R*C$	$L3.\frac{TE}{TA}*R*C$	$L3.Size*R*C$	$L3.\frac{TSM}{TA}*R*C$	$L3.Sens*R*C$	$D.L.Z$	$D.L.\frac{TE}{TA}$	$D.L.Size$	$D.L.\frac{TSM}{TA}$	$D.L.Sens$	B_i	R_i	$B*C$	$R*C$
$L3.Z*R$	1.00																		
$L3.\frac{TE}{TA}*R$	0.45	1.00																	
$L3.Size*R$	0.11	-0.20	1.00																
$L3.\frac{TSM}{TA}*R$	0.01	0.09	-0.18	1.00															
$L3.Sens*R$	-0.10	0.18	-0.19	-0.08	1.00														
$L3.Z*R*C$	0.34	0.07	0.04	0.04	-0.02	1.00													
$L3.\frac{TE}{TA}*R*C$	0.07	0.33	0.02	0.01	0.01	0.22	1.00												
$L3.Size*R*C$	0.03	0.02	0.38	-0.06	-0.00	0.09	0.02	1.00											
$L3.\frac{TSM}{TA}*R*C$	0.05	0.01	-0.08	0.27	-0.01	0.14	0.04	-0.21	1.00										
$L3.Sens*R*C$	-0.03	0.02	-0.02	-0.01	0.19	-0.08	0.08	-0.08	-0.05	1.00									
$D.L.Z$	-0.04	-0.09	0.02	0.00	-0.02	0.00	0.00	0.03	-0.01	-0.01	1.00								
$D.L.\frac{TE}{TA}$	-0.06	-0.20	0.07	-0.01	-0.05	0.01	-0.06	0.01	0.01	-0.01	0.50	1.00							
$D.L.Size$	0.02	0.01	0.01	-0.03	0.04	0.03	0.05	-0.06	0.00	-0.03	-0.08	-0.20	1.00						
$D.L.\frac{TSM}{TA}$	-0.01	-0.05	0.01	-0.16	0.01	0.01	-0.01	-0.03	-0.01	0.00	-0.01	0.00	0.02	1.00					
$D.L.Sens$	-0.02	-0.06	0.01	0.00	-0.19	-0.07	0.01	-0.02	-0.02	-0.13	0.06	0.02	0.01	0.01	1.00				
B_i	0.00	-0.18	0.30	-0.02	-0.12	-0.01	-0.07	0.12	-0.01	-0.04	0.02	0.07	0.06	-0.01	0.01	1.00			
R_i	0.00	-0.25	0.43	-0.03	-0.17	-0.01	-0.09	0.17	-0.02	-0.05	0.04	0.08	0.07	-0.01	0.00	0.70	1.00		
$B*C$	-0.01	-0.07	0.10	-0.02	0.01	-0.02	-0.14	0.25	-0.03	-0.08	-0.01	0.07	-0.07	-0.00	0.00	0.47	0.30	1.00	
$R*C$	-0.01	-0.17	0.19	-0.03	-0.04	-0.01	-0.15	0.14	-0.03	-0.13	0.03	0.11	-0.03	-0.01	0.00	0.36	0.51	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.13: Correlation coefficients between the instruments and the variables from level equation (system GMM)

Var	$L2.D.Z$	$L2.D.\frac{TE}{TA}$	$L2.D.Size$	$L2.D.\frac{TSM}{TA}$	$L2.D.Sens$	$L2.D.Z*C$	$L2.D.\frac{TE}{TA}*C$	$L2.D.Size*C$	$L2.D.\frac{TSM}{TA}*C$	$L2.D.Sens*C$	TL	$REML$	CIL	$L.TL$	$L.REML$	$L.CIL$	B_i	R_i	$B*C$	$R*C$
$L2.D.Z$	1.00	$L2.D.\frac{TE}{TA}$	0.36	1.00																
$L2.D.Size$	-0.19	-0.32	1.00																	
$L2.D.\frac{TSM}{TA}$	-0.08	0.04	0.01	1.00																
$L2.D.Sens$	0.04	0.03	0.02	0.01	1.00															
$L2.D.Z*C$	0.35	0.17	-0.00	0.01	0.15	1.00														
$L2.D.\frac{TE}{TA}*C$	0.13	0.18	-0.03	-0.02	-0.01	0.56	1.00													
$L2.D.Size*C$	-0.03	0.07	0.04	0.01	0.07	-0.02	-0.03	1.00												
$L2.D.\frac{TSM}{TA}*C$	0.05	-0.01	-0.02	0.13	0.11	0.09	-0.09	-0.05	1.00											
$L2.D.Sens*C$	0.03	-0.05	0.08	0.02	0.49	0.10	-0.08	0.05	0.09	1.00										
TL	0.01	-0.04	0.23	0.01	0.01	0.08	0.09	-0.02	-0.00	0.04	1.00									
$REML$	-0.01	-0.05	0.17	0.01	0.00	0.02	0.03	-0.02	0.01	0.02	0.66	1.00								
CIL	0.00	0.00	0.06	0.02	-0.00	0.08	0.07	-0.01	-0.01	0.02	0.35	-0.11	1.00							
$L.TL$	0.00	-0.12	0.31	-0.01	0.01	0.07	0.08	-0.07	0.00	0.05	0.41	0.29	0.13	1.00						
$L.REML$	0.01	-0.08	0.22	-0.02	-0.02	0.07	0.05	-0.04	-0.01	0.01	0.26	0.11	0.11	0.66	1.00					
$L.CIL$	-0.01	-0.05	0.10	0.01	0.05	0.01	0.03	-0.02	0.03	0.05	0.15	0.14	-0.02	0.34	-0.12	1.00				
B_i	-0.01	0.07	0.04	-0.01	-0.01	-0.06	0.00	0.07	-0.05	-0.01	0.05	0.02	0.01	0.05	0.02	0.02	1.00			
R_i	0.00	0.08	0.04	0.00	-0.00	0.00	0.04	0.10	-0.02	-0.01	0.07	0.04	0.03	0.05	0.03	0.03	0.70	1.00		
$B*C$	-0.00	0.10	-0.06	-0.00	-0.00	-0.06	-0.02	0.12	-0.06	-0.03	-0.23	-0.14	-0.12	-0.17	-0.09	-0.10	0.47	0.29	1.00	
$R*C$	0.00	0.07	-0.05	-0.00	0.03	-0.01	-0.01	0.17	-0.01	0.01	-0.08	-0.04	-0.05	-0.04	-0.02	-0.03	0.36	0.51	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.14: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (1)

Var	$L2.D.Z*B$	$L2.D.\frac{TE}{TA}*B$	$L2.D.Size*B$	$L2.D.\frac{TSM}{TA}*B$	$L2.D.Sens*B$	$L2.D.Z*B*C$	$L2.D.\frac{TE}{TA}*B*C$	$L2.D.Size*B*C$	$L2.D.\frac{TSM}{TA}*B*C$	$L2.D.Sens*B*C$	TL	$REML$	CIL	$L.TL$	$L.REML$	$L.CIL$	B_i	R_i	$B*C$	$R*C$
$L2.D.Z*B$	1.00																			
$L2.D.\frac{TE}{TA}*B$	0.35	1.00																		
$L2.D.Size*B$	-0.16	-0.22	1.00																	
$L2.D.\frac{TSM}{TA}*B$	-0.15	0.05	-0.00	1.00																
$L2.D.Sens*B$	0.02	0.06	0.00	0.00	1.00															
$L2.D.Z*B*C$	0.44	0.26	0.03	0.02	0.08	1.00														
$L2.D.\frac{TE}{TA}*B*C$	0.18	0.30	-0.02	0.01	-0.04	0.46	1.00													
$L2.D.Size*B*C$	-0.03	0.13	0.03	0.03	0.09	0.03	0.06	1.00												
$L2.D.\frac{TSM}{TA}*B*C$	0.05	-0.01	-0.04	0.11	0.04	0.15	0.03	-0.08	1.00											
$L2.D.Sens*B*C$	-0.02	-0.03	0.06	0.00	0.50	-0.00	-0.07	0.05	0.01	1.00										
TL	0.01	-0.02	0.15	0.01	-0.01	0.09	0.06	-0.03	0.03	0.01	1.00									
$REML$	0.01	-0.04	0.12	-0.00	-0.01	0.04	0.02	-0.02	0.01	0.02	0.66	1.00								
CIL	-0.00	0.01	0.03	0.02	-0.01	0.06	0.03	-0.01	0.02	-0.01	0.35	-0.12	1.00							
$L.TL$	0.04	-0.07	0.19	-0.03	0.02	0.08	0.04	-0.08	0.02	0.03	0.41	0.29	0.13	1.00						
$L.REML$	0.04	-0.03	0.12	-0.01	-0.00	0.08	0.03	-0.05	-0.01	0.01	0.26	0.11	0.11	0.66	1.00					
$L.CIL$	0.01	-0.03	0.05	-0.01	0.03	0.01	0.03	-0.03	0.04	0.03	0.15	0.14	-0.02	0.34	-0.12	1.00				
B_i	-0.01	-0.02	0.17	-0.00	-0.01	-0.02	-0.02	0.06	-0.03	-0.02	0.05	0.02	0.01	0.05	0.02	0.02	1.00			
R_i	0.01	0.03	0.13	0.01	0.00	0.04	0.05	0.10	0.01	-0.01	0.07	0.04	0.04	0.05	0.03	0.03	0.70	1.00		
$B*C$	-0.00	0.10	-0.06	-0.00	-0.00	-0.06	-0.02	0.12	-0.06	-0.03	-0.23	-0.14	-0.12	-0.17	-0.09	-0.10	0.47	0.29	1.00	
$R*C$	0.00	0.07	-0.05	-0.00	0.03	-0.01	-0.01	0.17	-0.01	0.01	-0.08	-0.04	-0.05	-0.04	-0.02	-0.03	0.36	0.51	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.15: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (2)

Var	$L3.D.Z$	$L3.D.\frac{TE}{TA}$	$L3.D.Size$	$L3.D.\frac{TSM}{TA}$	$L3.D.Sens$	$L3.D.Z*C$	$L3.D.\frac{TE}{TA}*C$	$L3.D.Size*C$	$L3.D.\frac{TSM}{TA}*C$	$L3.D.Sens*C$	TL	$REML$	CIL	$L.TL$	$L.REML$	$L.CIL$	B_i	R_i	$B*C$	$R*C$
$L3.D.Z$	1.00																			
$L3.D.\frac{TE}{TA}$	0.41	1.00																		
$L3.D.Size$	0.03	-0.18	1.00																	
$L3.D.\frac{TSM}{TA}$	-0.08	0.04	0.01	1.00																
$L3.D.Sens$	0.03	0.05	-0.01	0.00	1.00															
$L3.D.Z*C$	0.16	0.07	-0.02	-0.00	0.18	1.00														
$L3.D.\frac{TE}{TA}*C$	0.03	0.01	-0.00	-0.02	0.04	0.59	1.00													
$L3.D.Size*C$	-0.03	0.07	0.02	0.01	0.06	-0.04	-0.02	1.00												
$L3.D.\frac{TSM}{TA}*C$	0.04	0.00	-0.03	0.03	0.11	0.08	-0.11	-0.08	1.00											
$L3.D.Sens*C$	0.03	-0.00	0.05	-0.00	0.66	0.27	0.06	0.08	0.16	1.00										
TL	0.03	-0.02	0.17	-0.01	0.01	0.03	0.08	0.00	0.01	0.04	1.00									
$REML$	0.03	-0.01	0.13	0.00	0.01	0.06	0.08	-0.03	-0.02	0.02	0.66	1.00								
CIL	0.02	-0.03	0.04	-0.02	0.01	0.00	0.04	0.04	-0.02	0.03	0.35	-0.13	1.00							
$L.TL$	0.02	-0.04	0.24	0.02	-0.01	0.05	0.08	-0.04	-0.01	0.02	0.41	0.29	0.12	1.00						
$L.REML$	0.01	-0.05	0.18	0.01	-0.01	0.00	0.02	-0.04	0.00	0.02	0.25	0.10	0.10	0.65	1.00					
$L.CIL$	0.02	0.01	0.09	0.04	-0.01	0.08	0.08	-0.03	-0.02	-0.00	0.16	0.17	-0.04	0.35	-0.15	1.00				
B_i	-0.02	0.06	0.04	-0.00	-0.01	-0.08	-0.03	0.07	-0.06	-0.00	0.04	0.02	0.01	0.04	0.02	0.00	1.00			
R_i	-0.01	0.07	0.03	0.00	0.00	-0.04	0.00	0.10	-0.02	0.01	0.07	0.03	0.04	0.05	0.03	0.02	0.70	1.00		
$B*C$	0.00	0.07	-0.06	-0.00	-0.00	-0.06	-0.06	0.13	-0.05	0.01	-0.24	-0.15	-0.12	-0.18	-0.10	-0.11	0.49	0.30	1.00	
$R*C$	-0.00	0.02	-0.05	-0.02	0.00	-0.02	0.01	0.00	-0.02	0.01	-0.08	-0.04	-0.05	-0.04	-0.02	-0.02	0.37	0.52	0.53	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.16: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (3)

Var	$L3.D.Z*B$	$L3.D.\frac{TE}{TA}*B$	$L3.D.Size*B$	$L3.D.\frac{TSM}{TA}*B$	$L3.D.Sens*B$	$L3.D.Z*B*C$	$L3.D.\frac{TE}{TA}*B*C$	$L3.D.Size*B*C$	$L3.D.\frac{TSM}{TA}*B*C$	$L3.D.Sens*B*C$	TL	$REML$	CIL	$L.TL$	$L.REML$	$L.CIL$	B_i	R_i	$B*C$	$R*C$
$L3.D.Z*B$	1.00																			
$L3.D.\frac{TE}{TA}*B$	0.31	1.00																		
$L3.D.Size*B$	-0.21	-0.23	1.00																	
$L3.D.\frac{TSM}{TA}*B$	-0.18	0.04	-0.00	1.00																
$L3.D.Sens*B$	0.03	0.07	-0.01	0.00	1.00															
$L3.D.Z*B*C$	0.26	0.17	0.01	0.00	0.13	1.00														
$L3.D.\frac{TE}{TA}*B*C$	0.05	0.12	-0.01	-0.00	0.05	0.38	1.00													
$L3.D.Size*B*C$	-0.04	0.14	0.02	0.03	0.08	0.02	0.09	1.00												
$L3.D.\frac{TSM}{TA}*B*C$	0.04	-0.03	-0.04	0.03	0.05	0.17	0.00	-0.10	1.00											
$L3.D.Sens*B*C$	0.03	0.02	0.07	0.03	0.67	0.20	-0.06	0.12	0.07	1.00										
TL	0.00	-0.03	0.07	-0.00	0.00	0.03	0.08	-0.02	0.02	0.01	1.00									
$REML$	0.03	-0.01	0.13	0.00	0.01	0.06	0.08	-0.03	-0.02	0.02	0.66	1.00								
CIL	0.02	-0.02	0.01	-0.02	0.01	0.03	0.04	0.04	-0.01	0.02	0.35	-0.13	1.00							
$L.TL$	-0.01	-0.03	0.14	0.01	-0.02	0.06	0.07	-0.04	0.02	0.00	0.41	0.29	0.12	1.00						
$L.REML$	-0.01	-0.05	0.11	-0.00	-0.01	0.02	0.02	-0.03	0.01	0.02	0.25	0.10	0.00	0.65	1.00					
$L.CIL$	-0.02	-0.00	0.02	0.04	-0.02	0.06	0.04	-0.02	0.03	-0.02	0.16	0.17	-0.03	0.35	-0.15	1.00				
B_i	-0.01	-0.04	0.19	-0.00	-0.01	-0.02	-0.05	0.07	-0.02	0.01	0.04	0.02	0.01	0.04	0.02	0.00	1.00			
R_i	-0.00	0.01	0.14	0.01	0.01	0.01	0.02	0.10	0.01	0.02	0.07	0.03	0.02	0.05	0.03	0.02	0.70	1.00		
$B*C$	0.01	0.06	-0.02	-0.00	0.03	-0.04	-0.10	0.14	-0.05	0.02	-0.24	-0.15	-0.12	-0.18	-0.10	-0.11	0.49	0.30	1.00	
$R*C$	0.01	-0.01	-0.02	-0.02	0.00	0.01	0.02	-0.03	0.01	0.02	0.25	0.10	0.00	0.02	-0.02	-0.02	0.37	0.52	0.53	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.17: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (4)

Var	$L2.D.Z*R$	$L2.D.\frac{TE}{TA}*R$	$L2.D.Size*R$	$L2.D.\frac{TSM}{TA}*R$	$L2.D.Sens*R$	$L2.D.Z*R*C$	$L2.D.\frac{TE}{TA}*R*C$	$L2.D.Size*R*C$	$L2.D.\frac{TSM}{TA}*R*C$	$L2.D.Sens*R*C$	TL	$REML$	CIL	$L.TL$	$L.REML$	$L.CIL$	B_i	R_i	$B*C$	$R*C$
$L2.D.Z*R$	1.00																			
$L2.D.\frac{TE}{TA}*R$	0.34	1.00																		
$L2.D.Size*R$	-0.21	-0.16	1.00																	
$L2.D.\frac{TSM}{TA}*R$	-0.24	0.04	0.02	1.00																
$L2.D.Sens*R$	0.02	0.07	-0.01	0.00	1.00															
$L2.D.Z*R*C$	0.45	0.27	0.02	0.02	0.06	1.00														
$L2.D.\frac{TE}{TA}*R*C$	0.18	0.41	-0.02	0.02	0.00	0.43	1.00													
$L2.D.Size*R*C$	-0.03	-0.03	0.07	0.02	0.03	0.11	-0.10	1.00												
$L2.D.\frac{TSM}{TA}*R*C$	0.00	0.04	-0.02	0.14	0.02	0.01	0.08	-0.19	1.00											
$L2.D.Sens*R*C$	-0.01	-0.02	0.05	0.00	0.34	0.02	-0.02	0.01	0.01	1.00										
TL	0.02	-0.01	0.14	0.03	-0.01	0.03	0.01	-0.07	0.01	0.01	1.00									
$REML$	-0.04	-0.01	0.11	0.02	-0.01	0.02	-0.01	-0.04	-0.01	0.02	0.66	1.00								
CIL	0.01	-0.01	0.04	0.01	0.01	0.04	0.02	-0.05	0.01	0.02	0.35	-0.11	1.00							
$L.TL$	0.01	-0.03	0.15	0.01	0.01	-0.00	0.04	-0.01	0.04	-0.03	0.41	0.29	0.13	1.00						
$L.REML$	0.02	-0.02	0.09	0.02	-0.03	0.05	-0.01	0.03	-0.02	0.00	0.25	0.11	0.11	0.66	1.00					
$L.CIL$	-0.00	-0.02	0.05	-0.01	0.03	-0.00	-0.01	0.02	-0.02	0.03	0.15	0.14	-0.02	0.34	-0.12	1.00				
B_i	0.01	0.01	0.15	0.01	-0.01	0.02	0.02	0.08	-0.01	-0.02	0.05	0.02	0.01	0.05	0.02	0.02	1.00			
R_i	0.00	0.02	0.21	0.01	0.01	0.02	0.02	0.11	-0.01	-0.01	0.07	0.03	0.03	0.05	0.03	0.03	0.70	1.00		
$B*C$	0.03	0.13	-0.06	-0.00	0.02	0.03	0.03	0.04	0.17	-0.02	-0.04	-0.23	-0.14	-0.17	-0.09	-0.10	0.47	0.29	1.00	
$R*C$	0.01	0.07	-0.00	-0.00	0.06	-0.01	-0.04	0.22	-0.02	0.02	-0.08	-0.04	-0.05	-0.04	-0.02	-0.03	0.36	0.51	0.54	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.18: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (5)

Var	$L2.D.Z$	$L2.D.\frac{TE}{TA}$	$L2.D.Size$	$L2.D.\frac{TSM}{TA}$	$L2.D.Sens$	$L2.D.Z*C$	$L2.D.\frac{TE}{TA}*C$	$L2.D.Size*C$	$L2.D.\frac{TSM}{TA}*C$	$L2.D.Sens*C$	$L.Z$	$L.\frac{TE}{TA}$	$L.Size$	$L.\frac{TSM}{TA}$	$L.Sens$	$L.Z*C$	$L.\frac{TE}{TA}*C$	$L.Size*C$
$L2.D.Z$	1.00																	
$L2.D.\frac{TE}{TA}$	0.43	1.00																
$L2.D.Size$	-0.03	-0.18	1.00															
$L2.D.\frac{TSM}{TA}$	-0.07	0.04	0.01	1.00														
$L2.D.Sens$	0.04	0.03	0.02	0.00	1.00													
$L2.D.Z*C$	0.31	0.17	0.00	0.01	0.19	1.00												
$L2.D.\frac{TE}{TA}*C$	0.12	0.15	-0.03	-0.02	0.03	0.58	1.00											
$L2.D.Size*C$	-0.02	0.06	0.04	0.01	0.09	-0.03	-0.08	1.00										
$L2.D.\frac{TSM}{TA}*C$	0.05	0.01	-0.02	0.11	0.10	0.09	-0.08	-0.04	1.00									
$L2.D.Sens*C$	0.04	-0.04	0.07	0.02	0.50	0.12	-0.05	0.05	0.08	1.00								
$L.Z$	0.13	0.15	-0.10	0.01	0.20	0.35	0.20	0.02	0.08	0.14	1.00							
$L.\frac{TE}{TA}$	0.06	0.10	-0.01	-0.00	0.07	0.20	0.26	0.01	-0.01	0.05	0.63	1.00						
$L.Size$	0.00	0.12	0.03	-0.01	0.03	0.00	0.00	0.27	-0.02	0.01	0.07	-0.12	1.00					
$L.\frac{TSM}{TA}$	-0.01	0.05	-0.05	0.09	0.04	0.04	-0.00	-0.02	0.22	0.05	0.02	-0.01	-0.04	1.00				
$L.Sens$	0.04	-0.07	0.24	-0.02	0.06	0.04	0.03	0.01	0.04	-0.17	-0.14	-0.04	-0.09	-0.07	1.00			
$L.Z*C$	0.18	0.12	0.00	0.00	0.24	0.49	0.28	0.03	0.11	0.20	0.71	0.36	0.01	0.07	0.01	1.00		
$L.\frac{TE}{TA}*C$	0.09	0.06	0.00	-0.01	0.10	0.36	0.48	0.00	-0.01	0.10	0.45	0.55	0.01	0.00	0.00	0.64	1.00	
$L.Size*C$	-0.02	0.06	0.00	-0.01	0.06	0.01	0.00	0.57	-0.04	0.01	0.02	0.01	0.48	-0.04	-0.00	0.03	0.00	1.00

D. in this table stands for first difference, *L.* stands for the lagged value.

Table E.19: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (6)

Var	$L2.D.Z*B$	$L2.D.\frac{TE}{TA}*B$	$L2.D.Size*B$	$L2.D.\frac{TSM}{TA}*B$	$L2.D.Sens*B$	$L2.D.Z*B*C$	$L2.D.\frac{TE}{TA}*B*C$	$L2.D.Size*B*C$	$L2.D.\frac{TSM}{TA}*B*C$	$L2.D.Sens*B*C$	$L.Z$	$L.\frac{TE}{TA}$	$L.Size$	$L.\frac{TSM}{TA}$	$L.Sens$	$L.Z*C$	$L.\frac{TE}{TA}*C$	$L.Size*C$
$L2.D.Z*B$	1.00																	
$L2.D.\frac{TE}{TA}*B$	0.35	1.00																
$L2.D.Size*B$	-0.17	-0.21	1.00															
$L2.D.\frac{TSM}{TA}*B$	-0.16	0.06	0.00	1.00														
$L2.D.Sens*B$	0.02	0.07	0.01	0.00	1.00													
$L2.D.Z*B*C$	0.44	0.26	0.03	0.02	0.09	1.00												
$L2.D.\frac{TE}{TA}*B*C$	0.18	0.30	-0.02	0.01	-0.02	0.47	1.00											
$L2.D.Size*B*C$	-0.03	0.13	0.03	0.02	0.08	0.02	0.05	1.00										
$L2.D.\frac{TSM}{TA}*B*C$	0.05	0.00	-0.04	0.11	0.03	0.15	0.03	-0.10	1.00									
$L2.D.Sens*B*C$	-0.00	-0.02	0.06	0.00	0.52	0.02	-0.05	0.04	0.00	1.00								
$L.Z$	0.06	0.11	-0.03	0.03	0.09	0.19	0.11	0.02	0.04	0.08	1.00							
$L.\frac{TE}{TA}$	-0.02	0.07	-0.03	0.02	0.01	0.08	0.14	0.03	-0.00	0.01	0.63	1.00						
$L.Size$	0.02	0.09	0.07	0.01	0.04	0.02	0.03	0.22	-0.02	0.01	0.07	-0.12	1.00					
$L.\frac{TSM}{TA}$	-0.03	0.05	-0.05	0.07	0.02	0.03	0.01	-0.02	0.15	0.02	0.02	-0.01	-0.04	1.00				
$L.Sens$	0.00	-0.04	0.12	0.01	0.03	0.02	-0.00	0.01	0.02	-0.11	-0.14	-0.04	-0.09	-0.07	1.00			
$L.Z*C$	0.12	0.11	0.01	0.01	0.10	0.27	0.16	0.03	0.06	0.11	0.71	0.36	0.01	0.07	0.01	1.00		
$L.\frac{TE}{TA}*C$	0.06	0.08	0.00	-0.00	0.01	0.16	0.25	0.04	-0.00	0.03	0.45	0.55	0.01	0.00	0.00	0.64	1.00	
$L.Size*C$	-0.03	0.06	-0.00	0.01	0.05	0.04	0.05	0.48	-0.06	0.01	0.02	0.01	0.48	-0.04	-0.00	0.03	0.00	1.00

D. in this table stands for first difference, L. stands for the lagged value.

Table E.20: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (7)

Var	$L3.D.Z$	$L3.D.\frac{TE}{TA}$	$L3.D.Size$	$L3.D.\frac{TSM}{TA}$	$L3.D.Sens$	$L3.D.Z*C$	$L3.D.\frac{TE}{TA}*C$	$L3.D.Size*C$	$L3.D.\frac{TSM}{TA}*C$	$L3.D.Sens*C$	$L.Z$	$L.\frac{TE}{TA}$	$L.Size$	$L.\frac{TSM}{TA}$	$L.Sens$	$L.Z*C$	$L.\frac{TE}{TA}*C$	$L.Size*C$
$L3.D.Z$	1.00																	
$L3.D.\frac{TE}{TA}$	0.41	1.00																
$L3.D.Size$	0.04	-0.17	1.00															
$L3.D.\frac{TSM}{TA}$	-0.08	0.05	-0.01	1.00														
$L3.D.Sens$	0.02	0.03	0.01	0.01	1.00													
$L3.D.Z*C$	0.15	0.07	-0.02	-0.00	0.18	1.00												
$L3.D.\frac{TE}{TA}*C$	0.03	0.00	-0.01	-0.02	0.04	0.60	1.00											
$L3.D.Size*C$	-0.03	0.07	0.02	0.01	0.07	-0.06	-0.06	1.00										
$L3.D.\frac{TSM}{TA}*C$	0.04	0.00	-0.03	0.03	0.11	0.108	-0.11	-0.05	1.00									
$L3.D.Sens*C$	0.03	0.00	0.05	-0.00	0.66	0.27	0.07	0.10	0.16	1.00								
$L.Z$	0.08	0.08	-0.15	-0.01	0.17	0.29	0.15	0.01	0.06	0.13	1.00							
$L.\frac{TE}{TA}$	0.04	0.07	-0.04	-0.02	0.08	0.19	0.24	0.01	-0.00	0.05	0.63	1.00						
$L.Size$	0.00	0.12	0.04	0.00	0.03	-0.02	-0.01	0.28	-0.02	0.03	0.07	-0.09	1.00					
$L.\frac{TSM}{TA}$	-0.03	0.05	-0.05	0.04	0.05	0.03	-0.02	-0.03	0.22	0.04	0.01	-0.01	-0.05	1.00				
$L.Sens$	0.05	-0.10	0.21	-0.06	-0.18	-0.10	-0.03	-0.03	-0.06	-0.36	-0.13	-0.05	-0.08	-0.08	1.00			
$L.Z*C$	0.12	0.11	0.01	0.01	0.10	0.27	0.16	0.03	0.06	0.11	0.71	0.36	0.01	0.07	0.01	1.00		
$L.\frac{TE}{TA}*C$	0.06	0.06	0.00	-0.02	0.08	0.29	0.39	0.00	-0.01	0.08	0.49	0.61	0.02	0.06	0.00	0.64	1.00	
$L.Size*C$	-0.02	0.05	0.01	-0.00	0.06	-0.02	-0.02	0.56	-0.03	0.07	0.02	0.03	0.50	-0.04	-0.01	0.03	0.02	1.00

$D.$ in this table stands for first difference, $L.$ stands for the lagged value.

Table E.21: Correlation coefficients between the instruments and the variables from level equation (system GMM). Continued (8)

Var	$L3.D.Z*B$	$L3.D.\frac{TE}{TA}*B$	$L3.D.Size*B$	$L3.D.\frac{TSM}{TA}*B$	$L3.D.Sens*B$	$L3.D.Z*B*C$	$L3.D.\frac{TE}{TA}*B*C$	$L3.D.Size*B*C$	$L3.D.\frac{TSM}{TA}*B*C$	$L3.D.Sens*B*C$	$L.Z$	$L.\frac{TE}{TA}$	$L.Size$	$L.\frac{TSM}{TA}$	$L.Sens$	$L.Z*C$	$L.\frac{TE}{TA}*C$	$L.Size*C$
$L3.D.Z*B$	1.00																	
$L3.D.\frac{TE}{TA}*B$	0.32	1.00																
$L3.D.Size*B$	-0.21	-0.22	1.00															
$L3.D.\frac{TSM}{TA}*B$	-0.18	0.04	-0.00	1.00														
$L3.D.Sens*B$	0.03	0.08	0.01	0.00	1.00													
$L3.D.Z*B*C$	0.26	0.18	0.00	0.01	0.14	1.00												
$L3.D.\frac{TE}{TA}*B*C$	0.07	0.12	-0.01	0.00	-0.03	0.40	1.00											
$L3.D.Size*B*C$	-0.04	0.13	0.02	0.03	0.10	0.01	0.08	1.00										
$L3.D.\frac{TSM}{TA}*B*C$	0.04	-0.03	-0.05	0.02	0.06	0.18	0.01	-0.10	1.00									
$L3.D.Sens*B*C$	0.03	0.03	0.07	0.02	0.69	0.20	-0.04	0.14	0.09	1.00								
$L.Z$	0.07	0.07	-0.07	0.00	0.08	0.21	0.09	0.02	0.07	0.06	1.00							
$L.\frac{TE}{TA}$	-0.00	0.07	-0.04	0.01	0.03	0.09	0.12	0.04	0.01	0.01	0.63	1.00						
$L.Size$	0.00	0.10	0.09	0.02	0.04	0.02	0.04	0.23	-0.02	0.03	0.07	-0.09	1.00					
$L.\frac{TSM}{TA}$	-0.04	0.04	-0.04	0.04	0.03	0.03	-0.00	-0.04	0.16	0.01	0.01	-0.01	-0.05	1.00				
$L.Sens$	-0.00	-0.06	0.06	-0.02	-0.14	-0.06	0.00	-0.02	-0.03	-0.25	-0.13	-0.05	-0.08	-0.08	1.00			
$L.Z*C$	0.07	0.06	-0.05	0.01	0.08	0.29	0.13	0.04	0.09	0.08	0.74	0.41	0.01	0.06	0.00	1.00		
$L.\frac{TE}{TA}*C$	0.03	0.05	-0.00	0.01	0.02	0.16	0.23	0.04	0.03	0.02	0.49	0.60	0.02	0.00	0.00	0.66	1.00	
$L.Size*C$	-0.03	0.06	0.01	0.01	0.07	0.02	0.06	0.48	-0.05	0.07	0.02	0.03	0.50	-0.04	-0.00	0.03	0.02	1.00

D. in this table stands for first difference, *L.* stands for the lagged value.

Appendix F

Selection of lags of the instrumenting variables used in first-difference and level equations

Table F.1: Lags for generated GMM-style instruments in difference and system GMM

Var	Name	**Diff eq TL growth**	**Level eq TL growth**	**Diff eq REML growth**	**Level eq REML growth**	**Dif eq CIL growth**	**Level eq CIL growth**
				Dependent variables			
TL growth	$\Delta ln(TL)$	lag(3 .)*	lag(2 .)*				
REML growth	$\Delta ln(REML)$			lag(3 .)*	lag(3 .)*		
CIL growth	$\Delta ln(CIL)$					lag(2 .)*	lag(2 .)*
				Individual bank characteristics: no bailout, normal times (δ)			
Altman's Z-score	Z_{it}	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(3 3)
Capital ratio	$\frac{TE}{TA}_{it}$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)
Size	$Size_{it}$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)
Sensitivity to ΔGDP	$Sens_{it}$	lag(2 3)	lag(2 3)	lag(2 3)	lag(2 3)	lag(2 2)	lag(2 2)
				Individual bank characteristics: no bailout, crisis (δ^{*})			
Altman's Z-score	$Z_{it} * C$	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)

Continued on next page

Table F.1 – *Continued from previous page*

Var	Name	**Diff eq TL growth**	**Level eq TL growth**	**Diff eq REML growth**	**Level eq REML growth**	**Dif eq CIL growth**	**Level eq CIL growth**
Capital ratio	$\frac{TE}{TA}_{it} * C$	lag(3 3)	lag(3 3)	lag(2 3)	lag(3 3)		
Size	$Size_{it} * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Sensitivity to ΔGDP	$Sens_{it} * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Individual bank characteristics: bailout, no repayment, no crisis (ω)							
Altman's Z-score	$Z_{it} * B$	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Capital ratio	$\frac{TE}{TA}_{it} * B$	lag(2 2)	lag(3 3)	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)
Size	$Size_{it} * B$	lag(2 2)	lag(3 3)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Sensitivity to ΔGDP	$Sens_{it} * B$	lag(2 3)	lag(3 3)	lag(2 3)	lag(2 3)	lag(2 2)	lag(2 2)
Individual bank characteristics: bailout, no repayment, crisis (ω^*)							
Altman's Z-score	$Z_{it} * B * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Capital ratio	$\frac{TE}{TA}_{it} * B * C$	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 3)	lag(2 3)	lag(2 3)
Size	$Size_{it} * B * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Sensitivity to ΔGDP	$Sens_{it} * B * C$	lag(2 3)	lag(2 3)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Individual bank characteristics: bailout, repayment, no crisis (κ)							
Altman's Z-score	$Z_{it} * R$	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Capital ratio	$\frac{TE}{TA}_{it} * B * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)	lag(2 2)
Size	$Size_{it} * R$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Sensitivity to ΔGDP	$Sens_{it} * R$	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Individual bank characteristics: bailout, repayment, crisis (κ^*)							
Altman's Z-score	$Z_{it} * R * C$	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Capital ratio	$\frac{TE}{TA}_{it} * B * C$	lag(3 3)	lag(3 3)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)
Size	$Size_{it} * R * C$	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)	lag(3 3)
Sensitivity to ΔGDP	$Sens_{it} * R * C$	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)	lag(2 2)

Star (*) indicates the use of ”collapse” option in Stata

Appendix G

Within estimator (FE). The effects of CPP funds disbursement and crisis on bank lending activity. Regression without autoregressive component

Table G.1: Fixed effects robust estimator - Regressions with autoregressive component

Variable	Name	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values							
Lagged total	$\Delta ln(TL_{it-1})$	0.12***	0.14***				
loans growth		(7.39)	(9.02)				
Lagged REML	$\Delta ln(REML_{it-1})$			-0.07**	-0.06**		
growth				(-3.25)	(-2.62)		
Lagged CIL	$\Delta ln(CIL_{it-1})$					-0.13***	-0.13***
growth						(-5.92)	(-6.10)
Individual bank characteristics: all banks, normal times (δ)							
Altman's	Z_{it-1}	1.10*	1.19**	0.11	0.39	2.32	2.16
Z-score		(1.90)	(2.14)	(0.13)	(0.47)	(1.61)	(1.50)
Capital ratio	$\frac{TE}{TA}_{it-1}$	2.13***	1.97***	2.52***	2.19**	5.50***	5.44***
		(3.61)	(3.31)	(2.68)	(2.32)	(3.43)	(3.36)
TSM to	$\frac{TSM}{TA}_{it-1}$	0.89***	1.05***	0.67	0.80	-0.35	-0.19
total assets		(2.91)	(3.29)	(1.21)	(1.43)	(-0.38)	(-0.19)
Size	$Size_{it-1}$	-22.25***	-21.87***	-22.85***	-21.95***	-18.41***	-19.26***
		(-15.43)	(-15.66)	(-9.69)	(-9.42)	(-5.20)	(-5.34)
Sensitivity	$Sens_{it-1}$	4.00***	3.70***	4.85***	4.38***	5.65***	5.19***
to ΔGDP		(6.33)	(6.29)	(4.15)	(3.95)	(2.86)	(2.65)
Individual bank characteristics: δ^*, $\delta + \delta^*$ in square brackets							
Altman's	$Z_{it-1} * C_t$	1.89** [**2.99**]	1.54** [**2.73**]	5.85*** [**5.96**]	5.52*** [**5.90**]	-1.07 [**1.26**]	-1.23 [**0.93**]
Z-score		(2.55)	(2.16)	(4.85)	(4.71)	(-0.51)	(-0.58)
Capital ratio	$\frac{TE}{TA}_{it-1} * C_t$	2.50** [**4.63**]	3.22*** [**5.19**]	-0.18 [**2.33**]	0.69 [**2.89**]	6.31** [**11.81**]	7.29** [**12.74**]
		(2.40)	(3.16)	(-0.12)	(0.45)	(2.15)	(2.51)
TSM to	$\frac{TSM}{TA}_{it-1} * C_t$	0.35 [**1.25**]	0.37 [**1.42**]	-0.94 [**-0.27**]	-0.98 [**-0.17**]	3.10 [**2.74**]	2.97 [**2.78**]
total assets		(0.69)	(0.68)	(-1.04)	(-1.07)	(1.53)	(1.45)
Size	$Size_{it-1} * C_t$	-0.88** [**-23.13**]	-1.22*** [**-23.09**]	-2.47*** [**-25.32**]	-2.88*** [**-24.83**]	0.45 [**-17.96**]	-0.07 [**-19.33**]
		(-2.05)	(-2.85)	(-1.45)	(-4.10)	(0.34)	(-0.06)
Sensitivity	$Sens_{it-1} * C_t$	-4.36*** [**-0.36**]	-3.57*** [**0.13**]	-6.04*** [**-1.19**]	-4.78*** [**-0.40**]	-4.44* [**1.21**]	-3.42 [**1.76**]
to ΔGDP		(-5.26)	(-4.24)	(-4.26)	(-3.52)	(-1.71)	(-1.25)
Macroeconomic conditions and dummies							
GDP growth	ΔGDP_{t-1}		1.31***		1.57***		2.12***
			(10.22)		(6.52)		(4.71)
Crisis	C_t	-9.67***	-6.40***	-13.05***	-8.33***	-18.70***	-8.70***
		(-7.65)	(-12.81)	(-6.20)	(-10.06)	(-5.08)	(-5.73)
	Constant	12.87***	10.49***	15.92***	13.97***	19.39***	13.11***
		(11.51)	(22.18)	(9.57)	(16.25)	(7.56)	(8.29)
	R-sq	0.338	0.313	0.141	0.126	0.079	0.072
	Obs	6512	6382	6482	6353	6185	6067

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Appendix H

Mundlak estimator. The effects of CPP funds disbursement and crisis on bank lending activity. Regression with autoregressive component

Table H.1: Mundlak-Krishnakumar Estimator - The effects of CPP funds disbursement and crisis on bank lending activity (with autoregressive component)

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values						
$\Delta ln(TL_{it-1})$	0.16***	0.17***				
	(9.41)	(10.99)				
$\Delta ln(REML_{it-1})$			-0.05**	-0.04*		
			(-2.48)	(-1.83)		
$\Delta ln(CIL_{it-1})$					-0.12***	-0.12***
					(-5.37)	(-5.53)
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	0.63	0.68	-1.32	-1.03	1.93	1.91
	(1.03)	(1.30)	(-1.28)	(-1.17)	(1.23)	(1.16)
$\frac{TE}{TA}_{it-1}$	1.49*	1.79**	3.24***	3.48***	2.54	2.94
	(1.96)	(2.39)	(2.97)	(3.26)	(1.34)	(1.53)
$\frac{TSM}{TA}_{it-1}$	0.02	0.33	-0.22	0.04	0.01	0.44

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Table H.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(0.06)	(0.79)	(-0.30)	(0.06)	(0.01)	(0.35)
$Size_{it-1}$	-17.52***	-16.22***	-18.25***	-16.80***	-18.43***	-18.01***
	(-8.88)	(-8.45)	(-6.19)	(-6.07)	(-3.66)	(-3.28)
$Sens_{it-1}$	1.70**	1.71**	2.62**	2.41*	3.20	3.16
	(2.19)	(2.24)	(1.97)	(1.88)	(1.29)	(1.23)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta+\delta^*$ **in square brackets**)						
$Z_{it-1} * C_t$	3.71*** [**4.35**]	2.89*** [**3.57**]	7.71*** [**6.39**]	6.73*** [**5.70**]	1.49 [**3.42**]	0.65 [**2.56**]
	(3.89)	(3.12)	(4.89)	(4.35)	(0.44)	(0.19)
$\frac{TE}{TA}_{it-1} * C_t$	0.36 [**1.85**]	1.15 [**2.94**]	-2.43 [**0.81**]	-1.25[**2.22**]	5.17 [**7.71**]	6.40 [**9.35**]
	(0.28)	(0.92)	(-1.35)	(-0.70)	(1.28)	(1.61)
$\frac{TSM}{TA}_{it-1} * C_t$	1.18 [**1.21**]	0.65 [**0.98**]	0.77 [**0.56**]	0.06 [**0.10**]	3.14 [**3.16**]	2.30 [**2.74**]
	(1.55)	(0.84)	(0.64)	(0.05)	(1.16)	(0.86)
$Size_{it-1} * C_t$	-0.78 [**-18.30**]	-0.33 [**-16.55**]	-2.86** [**-21.12**]	-2.42* [**-19.23**]	2.12 [**-16.31**]	2.84 [**-15.16**]
	(-0.90)	(-0.37)	(-2.17)	(-1.81)	(0.72)	(0.97)
$Sens_{it-1} * C_t$	0.22 [**1.93**]	0.63 [**2.35**]	-1.74 [**0.88**]	-0.85 [**1.56**]	3.98 [**7.18**]	4.69 [**7.85**]
	(0.13)	(0.36)	(-0.75)	(-0.36)	(0.82)	(0.92)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta+\omega$ **in square brackets**)						
$Z_{it-1} * B_i$	1.16 [**1.79**]	0.91 [**3.81**]	3.11* [**10.82**]	2.67* [**9.40**]	0.82 [**2.32**]	0.48 [**1.13**]
	(1.03)	(0.85)	(1.84)	(1.67)	(0.28)	(0.16)
$\frac{TE}{TA}_{it-1} * B_i$	0.11 [**1.60**]	-0.49 [**1.30**]	-2.70 [**0.55**]	-3.38* [**0.10**]	5.15* [**7.69**]	4.46 [**7.40**]
	(0.10)	(-0.42)	(-1.47)	(-1.85)	(1.73)	(1.46)
$\frac{TSM}{TA}_{it-1} * B_i$	1.51** [**1.54**]	1.29** [**1.62**]	1.98* [**1.77**]	1.79* [**1.84**]	-1.56 [**-1.55**]	-2.00 [**-1.56**]
	(2.43)	(2.01)	(1.88)	(1.65)	(-0.85)	(-1.04)
$Size_{it-1} * B_i$	-4.22* [**-21.74**]	-6.15**[**-22.37**]	-3.92 [**-22.17**]	-5.33 [**-22.14**]	0.97 [**-17.46**]	-0.90 [**-18.91**]
	(-1.71)	(-2.45)	(-1.00)	(-1.37)	(0.16)	(-0.13)
$Sens_{it-1} * B_i$	2.43**[**4.13**]	2.17** [**3.88**]	3.40* [**6.02**]	3.20* [**5.61**]	2.69 [**5.89**]	2.28 [**5.44**]
	(2.27)	(2.04)	(1.86)	(1.79)	(0.76)	(0.64)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta+\delta^*+\omega+\omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-2.83** [**2.67**]	-1.72 [**2.77**]	-3.27 [**6.23**]	-1.85 [**6.52**]	-4.38 [**-0.14**]	-3.18 [**-0.14**]
	(-2.01)	(-1.22)	(-1.42)	(-0.81)	(-1.02)	(-0.74)
$\frac{TE}{TA}_{it-1}$	3.13 [**5.09**]	3.36* [**5.81**]	4.78 [**2.90**]	4.58 [**3.42**]	-1.38 [**11.48**]	-1.21 [**12.59**]
$*B_i * C_t$	(1.60)	(1.75)	(1.61)	(1.57)	(-0.24)	(-0.21)
$\frac{TSM}{TA}_{it-1}$	-1.60 [**1.13**]	-0.74 [**1.53**]	-3.25* [**-0.71**]	-2.12 [**-0.22**]	0.43 [**2.02**]	1.70 [**2.45**]
$B * C_t$	(-1.57)	(-0.69)	(-1.90)	(-1.23)	(0.11)	(0.43)
$Size_{it-1}$	-0.12 [**-22.64**]	-1.29 [**-23.99**]	0.02 [**-25.01**]	-1.19 [**-25.75**]	-1.40 [**-16.74**]	-3.12 [**-19.19**]
$*B_i * C_t$	(-0.12)	(-1.27)	(0.01)	(-0.77)	(-0.41)	(-0.93)
$Sens_{it-1}$	-4.41** [**-0.05**]	-4.34** [**0.17**]	-4.67* [**-0.39**]	-4.69* [**0.07**]	-9.12 [**0.75**]	-9.16 [**0.97**]
$*B_i * C_t$	(-2.22)	(-2.07)	(-1.73)	(-1.67)	(-1.58)	(-1.52)
Macroeconomic conditions						
C_t	-8.48***	-6.51***	-13.27***	-9.02***	-11.80***	-7.70***
	(-8.75)	(-10.15)	(-8.28)	(-8.96)	(-3.55)	(-3.72)
B_i	0.71*	0.94**	-0.00	0.17	4.92***	4.98***

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Table H.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(1.79)	(2.34)	(-0.01)	(0.26)	(3.95)	(3.84)
$B_i * C_t$	0.99	0.66	2.28*	1.88	-2.00	-2.10
	(1.25)	(0.82)	(1.84)	(1.49)	(-0.77)	(-0.80)
ΔGDP_{t-1}		0.99***		1.10***		2.06***
		(9.69)		(5.34)		(5.65)
Means						
Mean	0.79***	0.79***				
$\Delta ln(TL_{it-1})$	(20.69)	(20.44)				
Mean			0.87***	0.86***		
$\Delta ln(REML_{it-1})$			(21.13)	(20.64)		
Mean					0.75***	0.75***
$\Delta ln(CIL_{it-1})$					(13.69)	(13.10)
Mean Z_{it-1}	-15.06**	-9.68	-7.91	-3.58	-32.14*	-26.48
	(-2.48)	(-1.60)	(-0.68)	(-0.33)	(-1.72)	(-1.27)
Mean $\frac{TE}{TA}_{it-1}$	-0.18	-0.29	-0.63*	-0.72**	0.05	-0.10
	(-0.80)	(-1.26)	(-1.95)	(-2.22)	(0.09)	(-0.19)
Mean	0.03	0.00	0.07	0.05	0.08	0.04
$\frac{TSM}{TA}_{it-1}$	(0.39)	(0.04)	(0.66)	(0.45)	(0.44)	(0.20)
Mean $Size_{it-1}$	11.40***	10.60***	11.44***	10.54***	11.39***	11.04***
	(9.34)	(9.05)	(6.16)	(6.06)	(3.76)	(3.38)
Mean	-0.11**	-0.10**	-0.08	-0.07	-0.12	-0.10
$Sens_{it-1}$	(-2.29)	(-2.16)	(-1.01)	(-0.89)	(-0.85)	(-0.71)
Mean $Z_{it-1} * C_t$	5.20	3.12	-6.58	-11.41	13.65	8.75
	(0.35)	(0.21)	(-0.35)	(-0.63)	(0.40)	(0.25)
Mean	0.17	-0.25	1.03	0.46	-1.20	-1.65
$\frac{TE}{TA}_{it-1} * C_t$	(0.17)	(-0.25)	(0.85)	(0.38)	(-0.49)	(-0.68)
Mean	-0.29	-0.22	-0.39	-0.23	-0.28	-0.11
$\frac{TSM}{TA}_{it-1} * C_t$	(-1.35)	(-1.00)	(-1.16)	(-0.66)	(-0.38)	(-0.14)
Mean	-1.51	-1.48	-0.43	-0.01	2.24	2.89
$Size_{it-1} * C_t$	(-0.81)	(-0.77)	(-0.15)	(-0.00)	(0.38)	(0.48)
Mean	-0.06	-0.21	-0.83	-0.91	-2.56	-2.89
$Sens_{it-1} * C_t$	(-0.11)	(-0.41)	(-0.64)	(-0.69)	(-0.92)	(-0.99)
Mean $Z_{it-1} * B_i$	10.80	7.31	-0.64	-3.82	22.85	22.51
	(1.09)	(0.75)	(-0.04)	(-0.26)	(0.84)	(0.79)
Mean	-0.38	-0.19	0.38	0.59	-1.55*	-1.35
$\frac{TE}{TA}_{it-1} * B_i$	(-1.11)	(-0.57)	(0.75)	(1.19)	(-1.84)	(-1.55)
Mean	-0.16*	-0.16*	-0.19	-0.19	0.08	0.12
$\frac{TSM}{TA}_{it-1} * B_i$	(-1.66)	(-1.66)	(-1.22)	(-1.20)	(0.28)	(0.40)
Mean	1.43	2.59*	1.32	2.24	-0.49	0.81
$Size_{it-1} * B_i$	(0.95)	(1.71)	(0.55)	(0.93)	(-0.13)	(0.20)
Mean	-0.08	-0.08	-0.19*	-0.18*	-0.08	-0.06
$Sens_{it-1} * B_i$	(-1.44)	(-1.43)	(-1.89)	(-1.86)	(-0.44)	(-0.34)

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Table H.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Mean	-15.67	-14.54	-22.74	-17.96	8.93	14.82
$Z_{it-1} * B_i * C_t$	(-0.82)	(-0.76)	(-0.86)	(-0.68)	(0.18)	(0.30)
Mean	-0.54	-0.65	-0.79	-0.83	0.58	0.32
$\frac{TE}{TA}_{it-1} * B_i * C_t$	(-0.49)	(-0.58)	(-0.52)	(-0.56)	(0.19)	(0.10)
Mean	0.00	-0.07	0.21	0.02	-1.03	-1.29
$\frac{TSM}{TA}_{it-1} * B_i * C_t$	(0.01)	(-0.23)	(0.39)	(0.03)	(-0.93)	(-1.12)
Mean	3.97*	4.87*	6.25*	6.62*	-3.97	-3.73
$Size_{it-1} * B_i * C_t$	(1.67)	(1.95)	(1.68)	(1.74)	(-0.56)	(-0.51)
Mean	1.84***	1.83***	2.68*	2.45	4.82	4.92
$Sens_{it-1} * B_i * C_t$	(2.69)	(2.77)	(1.80)	(1.59)	(1.61)	(1.56)
Constant	-0.55	-1.57***	1.70	0.63	0.97	-2.07
	(-0.85)	(-2.93)	(1.47)	(0.67)	(0.48)	(-1.21)
Overall R^2	0.43	0.41	0.21	0.20	0.12	0.11
Obs	5512	5382	5482	5353	5185	5067

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Appendix I

Mundlak estimator. The effects of CPP funds repayment and crisis on bank lending activity. Regression with autoregressive component

Table I.1: Mundlak-Krishnakumar Estimator - The effects of CPP funds repayment and crisis on bank lending activity. Subsample of bailed-out banks. Regressions with autoregressive component

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
			Lagged values			
$\Delta ln(TL_{it-1})$	0.11***	0.13***				
	(5.08)	(6.53)				
$\Delta ln(REML_{it-1})$			-0.09***	-0.07***		
			(-3.15)	(-2.48)		
$\Delta ln(CIL_{it-1})$					-0.15***	-0.15***
					(-4.40)	(-4.67)
Individual bank characteristics: banks that did not repay CPP funds, normal times (γ)						
Z_{it-1}	0.90	0.51	0.96	0.58	1.26	-0.07
	(0.95)	(0.52)	(0.56)	(0.33)	(0.36)	(-0.02)
$\frac{TE}{TA}_{it-1}$	2.29**	2.17**	1.82	1.65	14.78***	15.78***
	(2.20)	(2.03)	(0.97)	(0.86)	(4.27)	(4.47)

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Table I.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$\frac{TSM}{TA}_{it-1}$	0.13	0.04	0.21	-0.03	-3.79	-3.81
	(0.15)	(0.04)	(0.15)	(-0.02)	(-1.55)	(-1.50)
$Size_{it-1}$	-25.46***	-24.03***	-27.05***	-23.66***	-14.68**	-14.20**
	(-11.61)	(-10.59)	(-6.84)	(-5.82)	(-2.16)	(-2.05)
$Sens_{it-1}$	3.22***	3.01***	6.28***	6.06***	1.44	1.35
	(3.63)	(3.31)	(3.91)	(3.73)	(0.54)	(0.50)
Individual bank characteristics: banks that did not repay CPP funds, crisis (γ^*, $\gamma + \gamma^*$ **in square brackets**)						
$Z_{it-1} * C_t$	1.73 [**2.63**]	2.27* [**2.78**]	5.26** [**6.22**]	6.46*** [**7.04**]	-5.27 [**-4.01**]	-4.77 [**-4.84**]
	(1.50)	(1.92)	(2.54)	(3.07)	(-1.43)	(-1.28)
$\frac{TE}{TA}_{it-1} * C_t$	2.99** [**5.28**]	5.31*** [**7.48**]	2.29 [**4.11**]	4.39* [**6.05**]	5.75 [**20.53**]	8.60** [**24.38**]
	(2.06)	(3.65)	(0.88)	(1.68)	(1.30)	(1.96)
$\frac{TSM}{TA}_{it-1} * C_t$	0.79 [**0.92**]	1.68 [**1.72**]	-0.27 [**-0.06**]	0.55 [**0.52**]	4.95 [**1.16**]	6.04* [**2.23**]
	(0.70)	(1.45)	(-0.13)	(0.26)	(1.44)	(1.74)
$Size_{it-1} * C_t$	-2.15***[**-27.61**]	-3.26***[**-27.29**]	-4.84***[**-31.88**]	-5.95***[**-29.61**]	0.78 [**-13.90**]	-0.67 [**-14.87**]
	(-2.99)	(-4.49)	(-3.72)	(-4.57)	(0.36)	(-0.31)
$Sens_{it-1} * C_t$	-2.75** [**0.47**]	-2.32* [**0.69**]	-3.50 [**2.77**]	-2.92 [**3.14**]	-4.19 [**-2.75**]	-3.93 [**-2.58**]
	(-2.06)	(-1.70)	(-1.45)	(-1.19)	(-1.05)	(-0.98)
Individual bank characteristics: banks that repaid CPP funds, normal times (κ, $\gamma + \kappa$ **in square brackets**)						
$Z_{it-1} * R_i$	1.18 [**2.09**]	1.60 [**2.11**]	1.29 [**2.25**]	1.66 [**2.24**]	1.59 [**2.85**]	2.83 [**2.76**]
	(0.92)	(1.21)	(0.55)	(0.70)	(0.37)	(0.64)
$\frac{TE}{TA}_{it-1} * R_i$	-1.03 [**1.25**]	-1.32 [**0.85**]	-1.92 [**-0.10**]	-2.44 [**-0.79**]	-10.15** [**4.63**]	-11.56** [**4.22**]
	(-0.75)	(-0.93)	(-0.77)	(-0.96)	(-2.31)	(-2.57)
$\frac{TSM}{TA}_{it-1} * R_i$	2.04** [**2.17**]	2.29** [**2.33**]	2.24 [**2.45**]	2.71 [**2.68**]	3.46 [**-0.32**]	3.25 [**-0.55**]
	(2.14)	(2.28)	(1.30)	(1.50)	(1.19)	(1.08)
$Size_{it-1} * R_i$	3.94 [**-21.51**]	2.10 [**-21.93**]	4.03 [**-23.02**]	1.05 [**-22.61**]	-0.04 [**-14.72**]	-3.63 [**-17.83**]
	(1.51)	(0.76)	(0.85)	(0.21)	(-0.00)	(-0.43)
$Sens_{it-1} * R_i$	2.79**[**6.02**]	2.64** [**5.65**]	-0.17 [**6.11**]	-0.39 [**5.68**]	11.18***[**12.62**]	10.58*** [**11.93**]
	(2.168)	(2.01)	(-0.07)	(-0.16)	(2.86)	(2.68)
Individual bank characteristics: banks that repaid CPP funds, crisis (κ^*, $\gamma + \gamma^* + \kappa + \kappa^*$ **in square brackets**)						
$Z_{it-1} * R_i * C_t$	-1.24 [**2.58**]	-1.80 [**2.58**]	-1.47 [**6.04**]	-2.57 [**6.13**]	2.89 [**0.47**]	2.69 [**0.68**]
	(-0.86)	(-1.22)	(-0.56)	(-0.97)	(0.64)	(0.59)
$\frac{TE}{TA}_{it-1}$	0.12 [**4.37**]	-2.34 [**3.82**]	-1.01 [**1.18**]	-3.46 [**0.14**]	-0.85 [**9.53**]	-3.73 [**9.09**]
$*R_i * C_t$	(0.07)	(-1.39)	(-0.33)	(-1.14)	(-0.16)	(-0.74)
$\frac{TSM}{TA}_{it-1}$	-2.16* [**0.80**]	-2.91** [**1.10**]	-3.91* [**-1.72**]	-4.42* [**-1.18**]	-2.82 [**1.80**]	-3.75 [**1.73**]
$R * C_t$	(-1.72)	(-2.26)	(-1.72)	(-1.91)	(-0.74)	(-0.97)
$Size_{it-1}$	1.83** [**-21.84**]	2.37*** [**-22.81**]	2.88** [**-24.97**]	3.28** [**-25.28**]	-0.30 [**-14.23**]	0.42 [**-18.08**]
$*R_i * C_t$	(2.31)	(2.95)	(2.02)	(2.28)	(-0.12)	(0.17)
$Sens_{it-1}$	-4.62*** [**-1.35**]	-4.34** [**-1.01**]	-9.07*** [**-6.47**]	-8.34*** [**-5.59**]	-1.66 [**6.77**]	-0.97 [**7.03**]
$*R_i * C_t$	(-2.79)	(-2.57)	(-3.00)	(-2.73)	(-0.33)	(-0.19)
Macroeconomic conditions						
C_t	-11.48***	-7.23***	-17.49***	-10.65***	-11.10***	-7.76***
	(-8.25)	(-9.86)	(-7.06)	(-8.17)	(-2.68)	(-3.60)

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Table I.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
R_i	0.99	0.62	1.78	0.900	2.30	2.56
	(1.42)	(0.91)	(1.41)	(0.74)	(1.07)	(1.25)
$R_i * C_t$	-1.71	-0.17	-1.67	1.338	-1.075	-0.47
	(-1.61)	(-0.21)	(-0.87)	(0.96)	(-0.33)	(-0.20)
ΔGDP_{t-1}		0.78***		0.40		2.75***
		(4.73)		(1.36)		(5.61)
Means						
Mean	0.86***	0.86***				
$\Delta ln(TL_{it-1})$	(21.76)	(21.09)				
Mean			0.98***	0.97***		
$\Delta ln(REML_{it-1})$			(14.58)	(14.19)		
Mean					0.97***	0.97***
$\Delta ln(CIL_{it-1})$					(11.38)	(11.26)
Mean	5.58	11.19	1.46	6.23	14.12	33.47
Z_{it-1}	(0.56)	(1.03)	(0.09)	(0.36)	(0.32)	(0.78)
Mean	-0.61	-0.64*	-0.53	-0.49	-2.98***	-3.15***
$\frac{TE}{TA}_{it-1}$	(-1.63)	(-1.71)	(-0.82)	(-0.78)	(-2.41)	(-2.52)
Mean	14.810***	14.01***	16.12***	14.43***	9.19*	8.94*
$Size_{it-1}$	(10.74)	(9.66)	(6.73)	(5.67)	(1.91)	(1.82)
Mean	0.08	0.05	0.16	0.15	0.20	0.27
$\frac{TSM}{TA}_{it-1}$	(0.53)	(0.33)	(0.73)	(0.72)	(0.37)	(0.50)
Mean	-0.18***	-0.18***	-0.36***	-0.36***	0.06	0.10
$Sens_{it-1}$	(-3.65)	(-3.51)	(-4.04)	(-3.99)	(0.40)	(0.66)
Mean	(-3.83)	(-3.56)	(-5.34)	(-5.14)	(0.35)	(0.61)
$Z_{it-1} * C_t$	(-1.21)	(-1.68)	(-0.66)	(-0.99)	(-0.07)	(-0.20)
Mean	-0.52	-1.15	-1.15	-2.01	-2.62	-4.26
$\frac{TE}{TA}_{it-1} * C_t$	(-0.43)	(-0.91)	(-0.51)	(-0.88)	(-0.71)	(-1.15)
Mean	5.98*	6.13**	7.44	5.96	1.18	1.93
$Size_{it-1} * C_t$	(1.96)	(1.97)	(1.34)	(1.06)	(0.13)	(0.20)
Mean	-0.443	-0.48	-1.11	-1.12	-0.37	-0.94
$\frac{TSM}{TA}_{it-1} * C_t$	(-0.63)	(-0.66)	(-0.87)	(-0.85)	(-0.17)	(-0.43)
Mean	2.30**	2.07**	3.53**	3.24*	-0.22	-0.87
$Sens_{it-1} * C_t$	(2.56)	(2.24)	(2.16)	(1.95)	(-0.08)	(-0.31)
Mean	-13.71	-20.72	-10.41	-16.90	-27.35	-44.59
$Z_{it-1} * R_i$	(-0.86)	(-1.26)	(-0.36)	(-0.57)	(-0.55)	(-0.878)
Mean	0.10	0.32	0.36	0.56	1.71	1.86
$\frac{TE}{TA}_{it-1} * R_i$	(0.19)	(0.60)	(0.39)	(0.58)	(1.10)	(1.18)
Mean	-1.60	-0.61	-2.35	-1.01	0.26	2.20
$Size_{it-1} * R_i$	(-0.91)	(-0.33)	(-0.74)	(-0.30)	(0.05)	(0.39)
Mean	-0.31*	-0.30	-0.42	-0.45	-0.07	-0.13
$\frac{TSM}{TA}_{it-1} * R_i$	(-1.65)	(-1.57)	(-1.25)	(-1.30)	(-0.12)	(-0.23)
Mean	-0.06	-0.05	0.18	0.21	-0.82**	-0.88***

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Table I.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$Sens_{it-1} * R_i$	(-0.53)	(-0.44)	(0.90)	(1.02)	(-2.52)	(-2.63)
Mean	16.50	31.53	-3.99	14.46	28.43	36.41
$Z_{it-1} * R_i * C_t$	(0.67)	(1.25)	(-0.09)	(0.31)	(0.38)	(0.48)
Mean	0.116	0.33	1.70	2.08	2.34	3.73
$\frac{TE}{TA}_{it-1} * R_i * C_t$	(0.10)	(0.26)	(0.77)	(0.93)	(0.66)	(1.03)
Mean	-5.43*	-4.85	-4.50	-2.35	-4.44	-3.40
$Size_{it-1} * R_i * C_t$	(-1.65)	(-1.44)	(-0.75)	(-0.38)	(-0.44)	(-0.34)
Mean	0.318	0.39	1.42	1.44	-0.77	-0.21
$\frac{TSM}{TA}_{it-1} * R_i * C_t$	(0.48)	(0.57)	(1.18)	(1.16)	(-0.37)	(-0.10)
Mean	-0.10	0.08	-0.02	-0.12	4.94	5.87
$Sens_{it-1} * R_i * C_t$	(-0.07)	(0.05)	(-0.01)	(-0.04)	(1.13)	(1.33)
Constant	1.83	-0.35	3.07	2.06	2.46	-3.05
	(1.63)	(-0.41)	(1.55)	(1.42)	(0.76)	(-1.31)
Overall R^2	0.44	0.41	0.23	0.21	0.15	0.14
Observations	2734	2665	2718	2650	2615	2552

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Appendix J

Hausman-Taylor estimator. The effects of CPP funds disbursement and crisis on bank lending activity. Regression with autoregressive component

Table J.1: Hausman-Taylor Estimator - The effects of CPP funds disbursement and crisis on bank lending activity (with autoregressive component)

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values-endogenous						
$\Delta ln(TL_{it-1})$	0.12***	0.14***				
	(9.78)	(10.88)				
$\Delta ln(REML_{it-1})$			-0.07***	-0.06***		
			(-5.37)	(-4.36)		
$\Delta ln(CIL_{it-1})$					-0.13***	-0.13***
					(-9.75)	(-9.78)
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	0.43	0.46	-1.33	-1.05	1.70	1.80
	(0.84)	(0.88)	(-1.39)	(-1.08)	(0.97)	(1.01)

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Table J.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$\frac{TE}{TA}_{it-1}$	2.32***	2.75***	3.61***	4.00***	4.04**	4.34**
	(4.22)	(4.89)	(3.55)	(3.84)	(2.26)	(2.36)
$\frac{TSM}{TA}_{it-1}$	0.28	0.56	-0.14	0.14	0.35	0.91
	(0.65)	(1.34)	(-0.20)	(0.18)	(0.30)	(0.67)
$Size_{it-1}$	-21.20***	-19.93***	-21.87***	-20.97***	-8.55**	-10.29**
	(-15.06)	(-13.39)	(-8.54)	(-7.74)	(-2.29)	(-2.51)
$Sens_{it-1}$	2.79***	2.79***	3.44***	3.01**	4.51**	4.30**
	(4.08)	(3.96)	(2.61)	(2.36)	(2.28)	(2.13)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta + \delta^*$ **in square brackets**)						
$Z_{it-1} * C_t$	3.54*** [**3.96**]	2.46*** [**2.92**]	7.59*** [**6.26**]	6.31*** [**5.26**]	1.70 [**3.40**]	0.92 [**2.72**]
	(4.33)	(2.98)	(4.95)	(4.08)	(0.66)	(0.35)
$\frac{TE}{TA}_{it-1} * C_t$	1.20 [**3.52**]	2.28** [**5.03**]	-1.89 [**1.72**]	-0.47[**3.52**]	5.76* [**9.80**]	6.79** [**11.13**]
	(1.30)	(2.45)	(-1.14)	(-0.28)	(1.94)	(2.27)
$\frac{TSM}{TA}_{it-1} * C_t$	1.19* [**1.47**]	0.63 [**1.19**]	0.98 [**0.84**]	0.21 [**0.35**]	2.73 [**3.08**]	1.82 [**2.73**]
	(1.65)	(0.83)	(0.70)	(0.14)	(1.16)	(0.77)
$Size_{it-1} * C_t$	-1.61** [**-22.81**]	-0.91 [**-20.84**]	-2.95** [**-24.82**]	-2.26[**-23.24**]	1.27 [**-7.28**]	2.10 [**-8.19**]
	(-2.05)	(-1.14)	(-2.04)	(-1.54)	(0.50)	(0.81)
$Sens_{it-1} * C_t$	-3.44*** [**-0.64**]	-2.79** [**0.00**]	-5.16** [**-1.72**]	-3.87* [**-0.86**]	-1.72 [**2.79**]	-0.86 [**3.44**]
	(-2.96)	(-2.37)	(-2.47)	(-1.90)	(-0.49)	(-0.28)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta + \omega$ **in square brackets**)						
$Z_{it-1} * B_i$	1.83** [**2.26**]	1.61* [**2.07**]	3.65** [**2.31**]	3.18** [**2.13**]	1.56 [**3.27**]	1.11 [**2.91**]
	(2.20)	(1.88)	(2.36)	(2.01)	(0.55)	(0.38)
$\frac{TE}{TA}_{it-1} * B_i$	-0.99 [**1.33**]	-1.89** [**0.86**]	-3.61** [**0.00**]	-4.51*** [**-0.52**]	4.00 [**8.03**]	3.39 [**7.73**]
	(-1.15)	(-2.13)	(-2.26)	(-2.78)	(1.38)	(1.15)
$\frac{TSM}{TA}_{it-1} * B_i$	1.26** [**1.54**]	1.05* [**1.61**]	1.68 [**1.54**]	1.54 [**1.68**]	-2.03 [**-1.68**]	-2.52 [**-1.61**]
	(2.13)	(1.78)	(1.58)	(1.37)	(-1.12)	(-1.32)
$Size_{it-1} * B_i$	-0.46 [**-21.66**]	-2.54[**-22.47**]	2.00 [**-19.87**]	0.81 [**-20.16**]	0.24 [**-8.30**]	-0.21 [**-10.50**]
	(-0.25)	(-1.30)	(0.62)	(0.23)	(0.05)	(-0.04)
$Sens_{it-1} * B_i$	2.36**[**5.16**]	1.93* [**4.73**]	3.22* [**6.66**]	2.79 [**5.80**]	1.29 [**5.80**]	0.86 [**5.16**]
	(2.34)	(1.85)	(1.72)	(1.47)	(0.44)	(0.31)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta + \delta^* + \omega + \omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-3.14*** [**2.66**]	-1.75 [**2.78**]	-3.39 [**6.52**]	-1.57 [**6.86**]	-4.51 [**0.46**]	-3.36 [**0.47**]
	(-2.70)	(-1.48)	(-1.57)	(-0.72)	(-1.20)	(-0.89)
$\frac{TE}{TA}_{it-1}$	2.62* [**5.16**]	2.71* [**5.84**]	4.51* [**2.62**]	4.12 [**3.14**]	-2.49 [**11.30**]	-2.02 [**12.50**]
$*B_i * C_t$	(1.86)	(1.90)	(1.74)	(1.57)	(-0.55)	(-0.44)
$\frac{TSM}{TA}_{it-1}$	-1.40 [**1.33**]	-0.42 [**1.82**]	-3.22 [**-0.70**]	-2.03 [**-0.14**]	1.47 [**2.52**]	2.80 [**3.01**]
$*B_i * C_t$	(-1.28)	(-0.37)	(-1.63)	(-1.01)	(0.43)	(0.81)
$Size_{it-1}$	0.94 [**-21.32**]	-0.55 [**-23.94**]	0.46 [**-22.36**]	-1.12 [**-23.55**]	0.02 [**-7.02**]	-1.82 [**-10.23**]
$*B_i * C_t$	(1.00)	(-0.58)	(0.26)	(-0.65)	(0.01)	(-0.60)
$Sens_{it-1}$	-1.93 [**-0.21**]	-1.72 [**0.21**]	-1.93 [**-0.43**]	-1.72 [**0.21**]	-3.01 [**1.07**]	-3.01 [**1.29**]
$*B_i * C_t$	(-1.21)	(-1.07)	(-0.61)	(-0.55)	(-0.61)	(-0.59)

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Table J.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
			Macroeconomic conditions			
C_t	-10.44***	-6.72***	-14.69***	-9.46***	-17.00***	-7.02***
	(-8.70)	(-10.85)	(-6.81)	(-8.38)	(-4.48)	(-3.57)
B_i	53.67***	64.97***	53.83***	63.77***	27.16***	39.13***
	(4.02)	(4.32)	(3.73)	(4.08)	(2.75)	(3.21)
$B_i * C_t$	1.04	0.60	2.50*	1.97	-3.60	-3.73
	(1.39)	(0.78)	(1.81)	(1.41)	(-1.50)	(-1.53)
State	0.15	0.14	0.16	0.14	0.12	0.13
	(0.66)	(0.61)	(0.65)	(0.59)	(0.67)	(0.66)
ΔGDP_{t-1}		1.05***		1.15***		2.17***
		(9.98)		(6.04)		(6.49)
Constant	-18.94**	-25.25***	-15.73*	-20.75**	3.15	-11.49
	(-2.15)	(-2.70)	(-1.65)	(-2.14)	(0.41)	(-1.45)
Sargan-Hansen test (p-value)	0.30	0.10	0.53	0.11	0.49	0.14
Obs	5512	5382	5482	5353	5185	5067

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

Appendix K

Hausman-Taylor estimator. The effects of CPP funds repayment and crisis on bank lending activity. Regression with autoregressive component

Table K.1: Hausman-Taylor Estimator - The effects of CPP funds repayment and crisis on bank lending activity. Subsample of bailed-out banks. Regressions with autoregressive components

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values-endogenous						
$\Delta ln(TL_{it-1})$	0.12***	0.14***				
	(9.78)	(10.88)				
$\Delta ln(REML_{it-1})$			-0.07***	-0.06***		
			(-5.37)	(-4.36)		
$\Delta ln(CIL_{it-1})$					-0.13***	-0.13***
					(-9.75)	(-9.78)
Individual bank characteristics: banks that did not repay CPP funds, normal times (γ)						
Z_{it-1}	1.07	0.70	0.80	0.52	-0.41	-2.01

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Table K.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(1.11)	(0.70)	(0.46)	(0.29)	(-0.12)	(-0.56)
$\frac{TE}{TA}_{it-1}$	1.71*	1.44	0.71	0.53	15.14***	16.91***
	((1.71)	(1.38)	(0.55)	(0.44)	(4.15)	(4.48)
$\frac{TSM}{TA}_{it-1}$	-0.13	-0.29	-0.44	-0.86	-3.96*	-4.09*
	(-0.17)	(-0.33)	(-0.30)	(-0.56)	(-1.70)	(-1.66)
$Size_{it-1}$	-26.20***	-25.29***	-22.06***	-20.34***	-1.35	-2.60
	(-11.48)	(-10.66)	(-6.55)	(-5.97)	(-0.33)	(-0.55)
$Sens_{it-1}$	4.17***	3.78***	6.97***	6.45***	0.17	0.32
	(4.25)	(3.76)	(3.95)	(3.55)	(0.07)	(0.11)
Individual bank characteristics: banks that did not repay CPP funds, crisis (γ^*, $\gamma + \gamma^*$ **in square brackets)**						
$Z_{it-1} * C_t$	1.25 [**2.32**]	1.70 [**2.40**]	5.31** [**6.11**]	6.39*** [**6.91**]	-2.67 [**-3.08**]	-2.32 [**-4.33**]
	(1.00)	(1.30)	(2.36)	(2.80)	(-0.72)	(-0.62)
$\frac{TE}{TA}_{it-1} * C_t$	3.50*** [**5.21**]	6.04*** [**7.48**]	2.58 [**3.30**]	4.75* [**5.28**]	2.90 [**18.03**]	5.84 [**22.75**]
	(2.40)	(4.14)	(1.05)	(1.95)	(0.65)	(1.31)
$\frac{TSM}{TA}_{it-1} * C_t$	0.86 [**0.72**]	1.72 [**1.44**]	-0.28 [**-0.72**]	0.39 [**-0.47**]	4.91 [**0.95**]	5.78* [**1.69**]
	(0.77)	(1.53)	(-0.18)	(0.21)	(1.45)	(1.69)
$Size_{it-1} * C_t$	-2.04***[**-28.24**]	-3.16***[**-28.45**]	-4.55***[**-26.61**]	-5.75***[**-26.09**]	1.06 [**-0.29**]	-0.64 [**-3.24**]
	(-2.88)	(-4.37)	(-3.61)	(-4.48)	(0.49)	(-0.30)
$Sens_{it-1} * C_t$	-3.83***[**0.34**]	-3.12**[**0.67**]	-4.62* [**2.34**]	-3.68 [**2.77**]	-3.35 [**-3.18**]	-3.27 [**-2.95**]
	(-2.72)	(-2.17)	(-1.78)	(-1.33)	(-0.84)	(-0.80)
Individual bank characteristics: banks that repaid CPP funds, normal times (κ, $\gamma + \kappa$ **in square brackets)**						
$Z_{it-1} * R_i$	2.12 [**3.19**]	2.48* [**3.17**]	2.53 [**3.33**]	2.46 [**2.98**]	4.62 [**4.21**]	6.17 [**4.16**]
	(1.59)	(1.80)	(1.11)	(1.14)	(1.06)	(1.37)
$\frac{TE}{TA}_{it-1} * R_i$	-0.95 [**0.76**]	-1.21 [**0.24**]	-1.66 [**-0.95**]	-2.06 [**-1.53**]	-10.39** [**4.75**]	-12.81***[**4.10**]
	(-0.66)	(-0.81)	(-0.64)	(-0.77)	(-2.29)	(-2.72)
$\frac{TSM}{TA}_{it-1} * R_i$	2.17** [**2.04**]	2.51** [**2.22**]	2.52 [**2.08**]	3.13* [**2.27**]	3.23 [**-0.73**]	3.12 [**-0.97**]
	(2.26)	(2.47)	(1.45)	(1.71)	(1.17)	(1.07)
$Size_{it-1} * R_i$	7.54***[**-18.66**]	6.21**[**-19.08**]	8.68**[**-13.38**]	7.83* [**-12.51**]	-3.01 [**-4.37**]	-4.45 [**-7.05**]
	(2.82)	(2.18)	(1.99)	(1.70)	(-0.64)	(-0.81)
$Sens_{it-1} * R_i$	2.84**[**7.01**]	2.52* [**6.30**]	0.15 [**7.12**]	-0.24 [**6.21**]	11.42***[**11.59**]	10.56** [**10.88**]
	(2.05)	(1.79)	(0.06)	(-0.09)	(2.76)	(2.52)
Individual bank characteristics: banks that repaid CPP funds, crisis (κ^*, $\gamma + \gamma^* + \kappa + \kappa^*$ **in square brackets)**						
$Z_{it-1} * R_i * C_t$	-1.60 [**2.84**]	-1.99 [**2.89**]	-2.01 [**6.63**]	-2.69 [**6.68**]	0.06 [**1.60**]	-0.12 [**1.72**]
	(-1.08)	(-1.31)	(-0.75)	(-0.99)	(0.01)	(-0.03)
$\frac{TE}{TA}_{it-1}$	-0.27 [**3.99**]	-2.96* [**3.32**]	-1.23 [**0.40**]	-3.91 [**-0.69**]	0.73 [**8.38**]	-1.96 [**7.98**]
$* R_i * C_t$	(-0.15)	(-1.72)	(-0.40)	(-1.27)	(0.14)	(-0.38)
$\frac{TSM}{TA}_{it-1}$	-1.78 [**1.11**]	-2.45** [**1.49**]	-3.42 [**-1.62**]	-3.69* [**-1.03**]	-1.87 [**2.31**]	-2.49 [**2.32**]
$* R_i * C_t$	(-1.40)	(-1.98)	(-1.47)	(-1.70)	(-0.49)	(-0.64)
$Size_{it-1}$	2.15***[**-18.54**]	2.66***[**-19.58**]	3.16** [**-14.77**]	3.53** [**-14.73**]	0.73 [**-2.57**]	1.54 [**-6.15**]
$* R_i * C_t$	(2.71)	(3.30)	(2.20)	(2.43)	(0.31)	(0.64)
$Sens_{it-1}$	-4.71** [**-1.53**]	-4.34** [**-1.16**]	-9.09*** [**-6.60**]	-7.89** [**-5.35**]	-1.03 [**7.20**]	0.06 [**7.68**]

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Table K.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
$*R_i * C_t$	(-2.50)	(-2.26)	(-2.73)	(-2.34)	(-0.19)	(0.01)
Macroeconomic conditions						
C_t	-10.01***	-7.53***	-14.59***	-10.72***	-23.49***	-8.80***
	(-6.86)	(-10.02)	(-5.75)	(-8.03)	(-4.76)	(-4.06)
R_i	36.86***	87.89***	28.03**	78.86***	5.73	11.15
	(3.36)	(3.78)	(2.45)	(3.18)	(0.64)	(0.90)
$R_i * C_t$	-2.09*	-0.28	-1.91	1.18	-1.60	-1.06
	(-1.92)	(-0.35)	(-0.97)	(0.83)	(-0.49)	(-0.46)
State	0.12	0.15	0.13	0.18	0.01	0.05
	(0.52)	(0.45)	(0.54)	(0.56)	(0.07)	(0.21)
ΔGDP_{t-1}		0.83***		0.50*		2.95***
		(5.01)		(1.69)		(6.09)
Constant	-12.18	-43.48**	-5.20	-34.42*	24.36***	4.33
	(-1.28)	(-2.55)	(-0.51)	(-1.93)	(2.77)	(0.43)
Sargan-Hansen test (p-value)	0.20	0.28	0.23	0.19	0.48	0.11
Obs	2734	2665	2718	2650	2615	2552

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

Appendix L

IV estimator. The effects of CPP funds repayment and crisis on bank lending activity. Regression with autoregressive component

Table L.1: Instrumental variables 2SLS - The effects of CPP funds disbursement and crisis on bank lending activity. Dynamic model with instrumented bailout dummy

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
Lagged values-endogenous						
$\Delta ln(TL_{it-1})$	0.28***	0.29***				
	(19.17)	(19.94)				
$\Delta ln(REML_{it-1})$			0.05***	0.06***		
			(3.24)	(4.01)		
$\Delta ln(CIL_{it-1})$					-0.10***	-0.11***
					(-6.43)	(-6.93)
Individual bank characteristics: non-bailed banks, normal times (δ)						
Z_{it-1}	-0.66	-0.48	-2.82***	-2.38***	0.35	0.89
	(-1.32)	(-0.95)	(-3.16)	(-2.63)	(0.21)	(0.52)
$\frac{TE}{TA}_{it-1}$	1.50***	1.46***	2.49***	2.28***	3.82**	4.00**
	(3.27)	(3.15)	(3.04)	(2.79)	(2.43)	(2.41)
$\frac{TSM}{TA}_{it-1}$	-0.42	-0.21	-0.28	-0.14	-0.42	0.21

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Table L.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(-1.25)	(-0.58)	(-0.55)	(-0.19)	(-0.37)	(0.19)
$Size_{it-1}$	-0.52	-0.34	-0.72	-0.50	-0.88	-1.07
	(-1.21)	(-0.79)	(-0.94)	(-0.67)	(-0.48)	(-0.52)
$Sens_{it-1}$	2.36***	2.36***	4.08***	4.08***	2.58	2.58
	(4.77)	(4.88)	(4.76)	(4.77)	(1.57)	(1.49)
Individual bank characteristics: non-bailed banks, crisis (δ^*, $\delta+\delta^*$ **in square brackets**)						
$Z_{it-1} * C_t$	4.04*** [**3.38**]	3.38*** [**2.90**]	7.44*** [**4.62**]	6.35*** [**3.97**]	2.12 [**2.47**]	1.15 [**2.04**]
	(4.60)	(3.84)	(4.84)	(4.13)	(0.81)	(0.43)
$\frac{TE}{TA}_{it-1} * C_t$	-0.13 [**1.37**]	0.21 [**1.68**]	-2.41 [**0.09**]	-1.76[**0.52**]	7.78*** [**11.60**]	8.72*** [**12.72**]
	(-0.13)	(0.22)	(-1.45)	(-1.06)	(2.61)	(2.87)
$\frac{TSM}{TA}_{it-1} * C_t$	1.05 [**0.63**]	0.56 [**0.35**]	0.77 [**0.49**]	0.14 [**0.00**]	1.75 [**1.33**]	0.91 [**1.12**]
	(1.36)	(0.70)	(0.57)	(0.10)	(0.74)	(0.37)
$Size_{it-1} * C_t$	-1.61** [**-2.13**]	-0.91 [**-1.25**]	-2.95** [**-3.67**]	-2.26[**-2.76**]	1.27 [**0.39**]	2.10 [**1.03**]
	(-2.05)	(-1.14)	(-2.04)	(-1.54)	(0.50)	(0.81)
$Sens_{it-1} * C_t$	-3.22** [**-0.86**]	-2.58* [**-0.21**]	-5.16** [**-1.07**]	-3.65 [**0.43**]	0.00 [**2.58**]	1.07 [**3.65**]
	(-2.22)	(-1.78)	(-2.09)	(-1.53)	(-0.00)	(0.28)
Individual bank characteristics: bailed-out banks, normal times (ω, $\delta+\omega$ **in square brackets**)						
$Z_{it-1} * B_i$	0.89** [**0.23**]	0.57* [**0.09**]	1.34** [**-1.48**]	0.82** [**-1.56**]	1.98 [**2.33**]	1.67 [**2.56**]
	(1.19)	(0.76)	(1.02)	(0.62)	(0.77)	(0.62)
$\frac{TE}{TA}_{it-1} * B_i$	1.25 [**2.75**]	0.99 [**2.45**]	1.85 [**4.34**]	1.50* [**3.78**]	4.90 [**8.72**]	4.51 [**8.51**]
	(-1.15)	(-2.13)	(-2.26)	(-2.78)	(1.38)	(1.15)
$\frac{TSM}{TA}_{it-1} * B_i$	0.98** [**0.56**]	0.56 [**0.35**]	1.05 [**0.77**]	0.63 [**0.49**]	-1.26 [**-1.68**]	-2.17 [**-1.96**]
	(2.15)	(1.25)	(1.37)	(0.78)	(-0.78)	(-1.23)
$Size_{it-1} * B_i$	-1.60***[**-2.12**]	-1.47**[**-1.81**]	-1.86* [**-2.57**]	-1.68 [**-2.18**]	-2.70 [**-3.58**]	-3.01 [**-4.09**]
	(-2.61)	(-2.37)	(-1.74)	(-1.57)	(-1.18)	(-1.17)
$Sens_{it-1} * B_i$	1.93**[**4.30**]	1.50** [**3.87**]	2.58* [**6.66**]	2.15 [**6.23**]	2.15 [**4.73**]	1.93 [**4.51**]
	(2.56)	(1.96)	(1.93)	(1.55)	(0.83)	(0.72)
Individual bank characteristics: bailed-out banks, crisis (ω^*, $\delta+\delta^*+\omega+\omega^*$ **in square brackets**)						
$Z_{it-1} * B_i * C_t$	-1.71 [**2.56**]	-0.88 [**2.58**]	-1.19 [**4.78**]	0.12 [**4.91**]	-2.98 [**1.47**]	-2.40 [**1.31**]
	(-1.41)	(-0.73)	(-0.56)	(0.06)	(-0.81)	(-0.64)
$\frac{TE}{TA}_{it-1}$	0.09 [**2.71**]	0.56 [**3.22**]	-0.69 [**1.25**]	-0.39 [**1.63**]	-7.61 [**8.89**]	-7.18 [**10.05**]
$*B_i * C_t$	(0.05)	(0.34)	(-0.24)	(-0.14)	(-1.62)	(-1.50)
$\frac{TSM}{TA}_{it-1}$	-1.89 [**-0.28**]	-0.98 [**-0.07**]	-3.93* [**-2.38**]	-2.80 [**-2.17**]	2.45 [**2.52**]	3.93 [**2.87**]
$*B_i * C_t$	(-1.60)	(-0.83)	(-1.95)	(-1.38)	(0.72)	(1.13)
$Size_{it-1}$	1.60 [**-2.13**]	0.64 [**-2.08**]	2.08 [**-3.45**]	0.88 [**-3.56**]	1.30 [**-1.01**]	0.18 [**-1.8**]
$*B_i * C_t$	(1.33)	(0.53)	(1.00)	(0.43)	(0.38)	(0.05)
$Sens_{it-1}$	-2.36 [**-1.29**]	-2.58 [**-1.29**]	-2.57 [**-1.07**]	-3.01 [**-0.43**]	-4.08 [**0.64**]	-4.94 [**0.64**]
$*B_i * C_t$	(-1.22)	(-1.28)	(-0.77)	(-0.91)	(-0.73)	(-0.89)
Macroeconomic conditions						
C_t	-1.73	-0.81	-4.25*	-0.07	-2.95	-0.17
	(-1.20)	(-0.62)	(-1.69)	(-0.03)	(-0.80)	(-0.06)
$\hat{B}_i$	10.65***	10.15***	15.89***	15.15***	21.77***	26.35***

Continued on next page

Table L.1 – *Continued from previous page*

Var	ΔTL Time-fixed	ΔTL Macro var	$\Delta REML$ Time-fixed	$\Delta REML$ Macro var	ΔCIL Time-fixed	ΔCIL Macro var
	(4.82)	(4.48)	(4.16)	(3.89)	(2.65)	(2.85)
$B_i * C_t$	-9.59***	-9.32***	-14.14***	-13.76***	-14.95***	-15.68***
	(-4.25)	(-4.03)	(-3.62)	(-3.45)	(-2.98)	(-3.30)
ΔGDP_{t-1}		1.06***		1.26***		2.14***
		(8.17)		(5.65)		(5.93)
Constant	1.54	0.87	3.78*	2.16	0.81	-4.07
	(1.28)	(0.71)	(1.80)	(1.01)	(0.18)	(-0.81)
Sargan-Hansen test (p-value)	0.18	0.16	0.73	0.60	0.27	0.51
Kleibergen-Paap LM test (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Obs	4485	4381	4467	4364	4257	4161

Notes: t-statistics in parentheses; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively.

Sargan-Hansen test is a test of overidentifying restrictions with a null hypothesis of validity of excluded instruments.

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