Credit and liquidity risk of banks in stress conditions
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Chapter 10
Summary and conclusions

10.1 Introduction

The 2007-2009 financial crisis has provided a rich set of data that may help us to understand the dynamics of credit and liquidity risk in stress conditions. It sheds light on the role of banks’ behaviour in the emergence of second round effects in the financial system and the economy. By using these data, this thesis bridges the gap between the theoretical literature on behaviour in financial markets and policy oriented analyses of credit and liquidity risks as, for instance, reported on in financial stability reports.

In line with the macroprudential approach, which examines the stability of the financial system as a whole, the empirical analysis in this thesis is conducted from a macro perspective. This first principle of the analysis is the focus on extreme events and dynamics that can give rise to systemic dimensions of credit and liquidity risks in the banking sector. To grasp how such risks may unfold, a thorough understanding of banks’ behaviour on a micro level in relation to macro-financial developments is needed. This calls for the use of granular data to capture the variations at the portfolio or bank level and the differing responses of institutions. This is taken as the second principle throughout the thesis. Furthermore, the crisis has underscored that systemic risk can originate through the interaction of credit and liquidity risk and, more in particular, at the nexus between funding and market liquidity. Taking that into account, a multi-dimensional and eclectic approach is applied as a third principle in the analyses. This is operationalised by a suite of models in which the various risk factors, which determine credit and liquidity risk, are dynamically related. Another feature of credit and liquidity risk in tail events is the inherent uncertainty with regard to the first round impact of adverse shocks and the second round effects that could occur in the financial system or the economy. Hence, as a fourth principle in the thesis it is recognized that the model results are inherently uncertain. This is taken into account by the use of scenario analyses and the presentation of model outcomes in terms of loss distributions. Furthermore, uncertainty was a main issue for governments and central banks when they designed their crisis measures between 2007 and 2009. This uncertainty is accounted for in the assessment of the crisis measures. The four principles (the macro perspective, use of granular data, a multi-dimensional approach, recognizing uncertainty) are key building blocks throughout the thesis and provide the tools to analyse the three research questions:
1. How did banks adjust their credit and liquidity risk management during the crisis and how do empirical estimates of banks’ reactions relate to the behavioural assumptions as generally used in the theoretical literature?

2. How can the impact of tail events on banks that involve credit and liquidity risk, and banks’ reactions to those risks, be modelled?

3. How should the policy responses to the eruption of credit and liquidity risks during the 2007-2009 crisis be assessed, both with regard to the possible distortionary effects on behavioural incentives and the impact on the economy?

10.2 Bank behaviour

The first research question is addressed by constructing indicators and time series models that analyse banks’ reactions empirically. These are based on firm-specific data of Dutch banks, derived from a unique data source on assets and liabilities available at De Nederlandsche Bank (DNB). In Chapter 2 these micro observations are used to construct indicators, which describe general trends in bank behaviour. These measures capture both the time dimension (‘pro-cyclicality’) and the cross-sectional dimension (‘dependencies’) of systemic risk. Although they are descriptive in nature, the measures identify trends in behaviour that convey forward looking information on market-wide developments. Chapter 3 extends the empirical analysis by modelling bank behaviour in a panel Vector Autoregressive (VAR) framework, based on the same source of data of Dutch banks. Both chapters concentrate on several main assumptions in the literature on banks behaviour in crises, like leveraging, herding, the pecking order in balance sheet adjustments, and on the relation between funding liquidity and lending, liquidity hoarding and fire sales.

The following conclusions can be drawn. First, the result concerning leveraging behaviour indicates that balance sheet adjustments of the banks tend to be asymmetric; deleveraging was more intense in the bust (mid 2007 to early 2009) than leveraging was in the preceding boom. Furthermore, during the crisis the deleveraging of large banks started earlier, was more intense and more advanced than the deleveraging of smaller banks. Second, the results on herding behaviour show that the number and similarity of banks’ reactions substantially increased in the crisis. This confirms the herding assumption in the literature and reflects the pro-cyclical nature of bank behaviour. Third, the results on the pecking order of balance sheet adjustments confirm that banks usually follow a pecking order (by making larger adjustments to the most liquid balance sheet items compared to less liquid items), but that they are more inclined to a static response in crises. Fourth, the outcomes of the panel VAR model for the link between shocks to funding liquidity and lending show that banks react by reducing wholesale lending in response to shocks to money market spreads and repo funding. Fifth, the VAR simulations show that in response to wholesale funding shocks banks hoard liquidity through
accumulating liquid bond holdings and increasing their reliance on the central bank. Finally, the model results show that fire sales of equity holdings are more likely to be triggered by constraints in funding liquidity than by constraints in the solvency position of banks.

The empirical results contribute to our understanding of the role of banks in the transmission of adverse shocks to the financial system and the economy. The findings can also help to improve the micro foundations of financial stability models, especially with regard to the behavioural assumptions of heterogeneous institutions. And the results provide useful insights for macroprudential monitoring frameworks.

10.3 Macro stress-testing models

The second research question concerns modelling the impact on banks of tail events that involve credit and liquidity risk and banks’ reactions to those risks. The question is addressed in a stress-testing framework. This provides for methodologies to map tail events in the macro-environment into indicators that can be used to estimate the implications for banks’ balance sheets, their responses to stress situations and the related second round effects in the financial system and the economy. The framework is operationalised by a suite of models, such as reduced form satellite models, vector autoregressive (VAR) models and calibrated simulation tools. This eclectic approach is motivated by the existence of fundamental uncertainty with regard to risks in tail situations and by the absence of a fully fledged model that integrates all the potential interlinkages.

The overview of macro stress-testing methods in Chapter 4 is followed by several applications of models for stress-testing credit and liquidity risk in Chapters 5, 6 and 7. Chapter 5 concentrates on scenario analysis and macro stress-testing of credit risk. More in particular, a multi-factor approach is used to simulate deterministic and stochastic scenarios, which take into account simultaneous changes in macro variables and changing correlations between risk factors. Both are typical features of stress situations. The link between the macro variables and micro risk drivers of banks’ portfolios is established in reduced form satellite models. These models are estimated using disaggregated data of individual banks and portfolio break-downs, to capture the different responses of banks and portfolio sensitivities in stress situations. The variation in credit loss distributions is explored by estimating both the probability of default and the loss given default in bank loan books. This is based on nonlinear specifications, since ignoring non-linearities in the relationship between macro variables and credit risk can lead to a substantial underestimation of risk, particularly when considering large shocks. The outcomes of the stochastic scenario simulations are presented in terms of loss distributions. They provide insight in the extreme losses that banks could face in stress events.

Chapter 6 presents the framework of a stress-testing model for liquidity risk of banks, which is extended in Chapter 7 with the new liquidity regulation of Basel III and the possible interactions with
monetary policy operations and credit supply by banks. The liquidity stress-testing model basically is a calibrated simulation tool which combines the multiple dimensions of liquidity risk (funding and market liquidity risk) into a quantitative measure of banks’ liquidity position. The model takes into account the first and second round (feedback) effects of shocks, induced by reactions of heterogeneous banks. Moreover, it allows for simulating the impact of reputation risk on banks that react in order to restore their deteriorated liquidity position. A Monte Carlo approach is used to simulate the impact of stress scenarios on the liquidity buffers of banks, including the probability of a liquidity shortfall. The main outcome of the model simulations is that the second round effects in specific scenarios could have more impact than the first round effects and hit all types of banks. This confirms that shocks to the liquidity position of banks entail systemic risk through the behavioural responses of individual banks. While the addition of credit supply effects in Chapter 7 is an attempt to link liquidity risk to credit risk, a more complete integration of credit and liquidity risk is an area for future work. It requires deeper analysis of the potential linkages and interactions between credit quality on the one hand and funding and market liquidity on the other hand. Such research will, amongst other issues, have to deal with the different nature of the risks (for instance with regard to the driving forces and the time horizon) and with the behaviour of counterparties that could link liquidity to credit risk.

The extended version of the model assumes that the new liquidity regulation proposed by Basel III is a binding constraint for banks’ behaviour. This is operationalised by the rule that banks restore their liquidity ratio through raising additional liquid assets and improving the stability of funding, as a reflection of the liquidity hoarding and the scramble for stable funding sources by banks during the crisis. The model simulations provide quantifications of the potential wider effects of the new liquidity regulation, for instance with regard to the impact on credit supply. This impact is found to be limited in the model simulations of liquidity stress scenarios. Another result is that second round effects and tail risks of a stress scenario are substantially lower if banks would adjust to Basel III by holding a higher quality of liquid assets. In particular a narrowly defined liquidity buffer - made up by high quality government bonds - makes a big difference in limiting the tail risks of banks. The flip side of larger bond holdings is that monetary policy conducted through asset purchases has more impact on banks’ behaviour, relative to central bank refinancing operations. We also simulate the consequences of an exit from extended refinancing operations on banks’ funding liquidity. The outcomes indicate that the liquidity ratios of banks actually improve compared to the pre-exit situation, if alternative stable funding is available.
10.4 Policy responses to the crisis

The third research question, on the policy responses to the credit and liquidity risks of banks in the crisis, is first addressed by assessing the short-term crisis measures taken by central banks and governments in 2007-2009 (in Chapter 8) and secondly by analysing the effects of longer-term measures taken by regulators, in particular the macroeconomic effects of Basel III (in Chapter 9).

To preserve financial stability and limit the impact of financial stress on the economy, central banks and governments had to respond swiftly and under great uncertainty to the eruption of risks in the banking sector. Although the measures were successful as they contributed to safeguarding financial stability, they also had distortionary effects. Potential distortions relate to the level playing field between supported and non-supported institutions and the capital flows between market segments, including cross-border flows. However, the influence of government interventions here appears to be hard to disentangle from market incentives. We do find some evidence of a short-term favourable effect of government support in the market prices of financial institutions, but this faded away several months after the interventions took place and even turned into a negative effect. This concurs with the longer term disadvantages of the interventions by governments and central banks, which may create wrong incentives with regard to risk taking and moral hazard of market participants. The main policy conclusion of the analysis is that such negative side effects can be limited through appropriate design of the support measures (market compatibility) and of the exit strategy (timely withdrawal).

Regulation also plays an important role in influencing the behaviour of banks, both in the transitional phase and in the new steady state in which the banks comply with the new regulation. The new capital and liquidity standards of Basel III will affect the intermediation function of banks, and thereby credit supply and economic growth. Simulation outcomes of reduced form satellite models and DNB’s structural macroeconomic model indicate that the negative impact of Basel III on real GDP will be limited to a few tenths of a percent during the transitional phase. Another result is that a sufficiently long transitional period will limit the costs in the early years, because it gives banks more scope to adapt. Moreover, once the banks have adapted to the new standards, the benefits of a more solid financial system will outweigh the disadvantages. Although a precise quantification of the benefits is complicated because of the uncertain effects of Basel III on the strategies of banks and their clients, it seems obvious that higher buffers of banks make a financial crisis in the future both less likely and less deep, while economic growth would be more stable in normal times.