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When liquidity risk becomes a systemic issue: Empirical evidence of bank behaviour☆

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ABSTRACT

This article provides empirical evidence of behavioural responses by banks in the recent crisis. Using firm-specific balance sheet data, we construct aggregate indicators of systemic risk. Measures of size and herding show that balance sheet adjustments have been pro-cyclical in the crisis, while responses became increasingly dependent across banks and concentrated on certain market segments. Banks reacted less according to a pecking order, as an indication of reduced flexibility in their risk management opportunities. The behavioural indicators are useful tools for monetary and macro prudential analyses and can contribute to the micro foundations of financial stability models.

1. Introduction

1.1. Dimensions of liquidity risk

The 2007–2009 crisis showed that liquidity risk stemming from collective reactions by market participants can exacerbate financial instability. Liquidity hoarding by funding constrained banks added to the tense liquidity situation in financial markets, underscoring the strong link between banks' funding risk (the ability to raise cash to fund asset holdings, see Matz and Neu (2007) and Drehmann and Nikolaou (2010)) and market liquidity (the ability to convert assets into cash at a given price at short notice). Through this channel liquidity risk led to solvency problems and banks had to write off illiquid assets. These developments have induced policymakers to focus on the interactions between funding and market liquidity risk and related systemic risk, as part of the macro-prudential approach (De Larosière Report, 2009). Getting a better grip on such dynamics requires an understanding of firms' behaviour on a micro level in relation to macro-financial developments. In practice, liquidity risk is either analysed, managed and regulated from the perspective of banks' funding positions (e.g. by supervisors) or on the level of the financial system as a whole (by central banks). However, recent events have underscored that systemic risk can originate at the nexus of funding and market liquidity and is influenced by market participants who react to market-wide shocks.

The relevance of behavioural reactions of market participants for financial stability is recognised in literature describing the macro-prudential approach. According to Borio (2006), this approach focuses on the financial system as a whole, including the underlying correlations. Dependencies relate to similar investments and risk management strategies of financial institutions that have common exposures. This cross-sectional dimension is measured by the correlation between institutions' balance sheets and by the marginal contribution of each institution to total systemic risk (Borio et al., 2010). Next to this cross-sectional dimension of systemic risk, the macro-prudential approach distinguishes the time dimension. This concerns how risks evolve over time (which can be measured by macro economic variables like credit growth (BIS, 2009)) and whether pro-cyclicality plays a role. Pro-cyclicality is caused by collective behaviour of financial institutions that reinforces the interaction between the financial system and the

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real economy. In the literature these feedback mechanisms are attributed to increasing risk tolerance, overextension of balance sheets and high leverage during an expansion, which are reversed in a downturn. The increased link between market and funding liquidity is another driving factor (e.g. through increased use of collateral in secured financing).

1.2. Modelling bank behaviour

Endogenous cycle models, where risk is endogenous with respect to collective behaviour of market participants, are still primitive, with very limited behavioural content (Borio and Drehmann, 2009). This also holds for macro stress-testing models that are used by central banks and supervisory authorities to simulate shocks to the system as a whole. Even in the most sophisticated stress-testing models, the behaviour of financial institutions is included by rules of thumb rather than through empirical estimations. Responses are usually assumed to be triggered by shocks that lead to a declining solvency ratio of banks below a certain threshold level. This default risk can be caused by a drying up of market liquidity which depresses the value of banks' assets, as in Cifuentes et al. (2005). This triggers fire sales of assets, depresses market prices and induces further sales. In the financial sector model of the Bank of England, behavioural responses are related to funding liquidity risks of banks (Aikman et al., 2009). In this model, funding strains increase the default risk of banks, which at a certain stress level resort to fire sales of assets. This leads to liquidity feedbacks through depressed market prices of assets. In the Liquidity Stress-Tester model of Van den End (2010), banks' responses are triggered by a certain decline of the liquidity buffer. The subsequent second round effects are mechanically determined by the number and size of reacting banks and the similarity of their reactions.

Stress-testing models often lack empirical foundations of bank behaviour. For this, information on the effects of management actions on the stability of the financial system and the economy is required, based on balance sheet data and market indicators in extreme situations. The recent crisis provides a rich set of such data, which helps to assess behavioural responses by banks and their contribution to system-wide liquidity stress.

1.3. Contribution to the literature

This article contributes to the literature by exploring data on bank behaviour in the crisis, with the focus on liquidity risk. We analyse a unique dataset from the Dutch supervisory liquidity report, which comprises a detailed break-down of liquid assets and liabilities, including cash in- and outflows. Since the dataset is collected from banks, it mainly provides information on funding liquidity risk. We first analyse the type of instruments used by Dutch banks in response to the crisis. Statistical tests show that while banks usually follow a pecking order in their balance sheet adjustments (by making larger adjustments to the most liquid balance sheet items compared to less liquid items), in the crisis they were more inclined to a static response (by reacting with instruments proportional to the composition of their balance sheet). This suggests that banks have less room for a pecking order in their liquidity risk management during stressed circumstances.

Next, we construct aggregate measures of bank behaviour with data of individual banks. This follows the macro-prudential approach. Herein, risks to the financial system can either be measured by aggregate balance sheet indicators (IMF, 2008), market prices, or by composite indicators. All of these have their limitations in assessing common exposures and interactions (see Borio and Drehmann, 2009). We go a step further than traditional balance sheet indicators, by defining measures for behavioural reactions and testing them empirically. The main drivers of systemic risk are measured, i.e. the time dimension and the cross-sectional dimension. The time dimension is quantified by indicators of size and direction of balance sheet adjustments. The cross-sectional dimension by indicators of the dependency of behaviour across banks. Herding is seen as having both a time and cross-sectional dimension; as a point in time indicator it reflects the commonality of exposures, while the time series of the herding indicator reflects whether bank's reactions are pro-cyclical. By analysing the measures for size and herding also on an instrument by instrument basis, we assess the similarity of reactions and the concentration of trades in particular market segments, indicative of the cross-sectional dimension of macroprudential risk. We show that the indicators are robust to different specifications and distributions of the data. Applied to Dutch banks, the measures illustrate that the size and number of responses (time dimension) and the dependency (cross-sectional dimension) substantially changed in the crisis.

The structure of the article is as follows. Section 2 describes the data and developments of liquid assets and liabilities during the crisis. In Section 3, measures of bank behaviour are constructed and statistical tests on the type of instruments used to react are performed. Section 4 concludes.

2. Data and trends

2.1. Data

Our analysis of bank behaviour is based on a unique dataset from the Dutch supervisory liquidity report. It covers a detailed break-down of liquid assets and liabilities including cash in- and outflows of banks. The report includes on and off-balance sheet items for all Dutch banks (85 on average, including subsidiaries of foreign banks) with a rather detailed break-down per item (average granularity of around 7 items per bank). The report contains end of month data, which are available for the 2003m10–2009m3 period. Appendix A provides a detailed overview of the items in the report. According to the supervisory requirements, actual liquidity of a bank must exceed required liquidity, at both a one week and a one month horizon. Actual liquidity is defined as the stock of liquid assets (weighted for haircuts) and recognised cash inflows (weighted for their liquidity value) during the test period. Required liquidity is defined as the assumed calls on contingent liquidity lines, assumed withdrawals of deposits, drying up of wholesale funding and liabilities due to derivatives. In this way, the liquidity report comprises a combined stock and cash flow approach, in which respect it is a forward looking concept. The weights (w_i) of the assumed haircuts on liquid assets and run-off rates of liabilities are presented in last two columns of the table in Appendix A. In the report, the weights are fixed values (DNB, 2003) and reflect a mix of a bank specific and market wide scenario. The values of w_i are based on best practices of values of haircuts on liquid assets and run-off rates of liabilities of the industry and rating agencies.

The various balance sheet and cash flow items in the prudential report are assumed to reflect the instruments (i) which banks (b) use in the liquidity risk management in response to shocks. The instruments are expressed in gross amounts (I_i^b). To enhance the economic interpretation we define coherent groups (g) of instruments and the sum of item amounts per group as I_{ig}^b. The first column of the table in Appendix A provides the group classification (items not classified were deemed to be irrelevant for the analysis in this article). Fig. 1 shows the time series of the instrument groups.