

The Impact of Liquidity Risk on Commercial Banks' Solvency: A Case Study and Theoretical Analysis

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Abstract. Liquidity risk affects a bank's ability to fulfill short-term obligations, while solvency reflects its capacity to absorb losses with its own capital. This paper takes Northern Rock as a case study to examine how liquidity shocks transmit to solvency risk, particularly under a business model heavily reliant on wholesale funding. The results indicate that liquidity disruptions forced banks to conduct asset fire sales, eroding asset values and weakening capital adequacy. Collapsing market confidence raised funding costs and further intensified financial pressure, creating a downward spiral that eventually triggered bank failure. Compared with large commercial banks, small and medium-sized institutions with fragile capital bases and limited funding sources are more vulnerable to liquidity shocks. The Northern Rock case highlights the importance of optimizing stable funding structures and effectively establishing liquidity management. It also suggests that regulators should strengthen early warning systems and intervene earlier to prevent it from becoming systemic solvency risk.

Keywords: Liquidity risk, Solvency, Commercial Banks, Bank Run, Capital Adequacy Ratio

1. Introduction

The interaction between liquidity risk and solvency risk is a key issue in financial stability. With the integration of global financial markets, financial crises have become more frequent and severe. Northern Rock Bank is a typical example of a bank that suffered from a liquidity-solvency risk spiral due to excessive reliance on wholesale funding. Existing studies have initially explored the correlation between liquidity risk and solvency risk, but most of them focus on the macro-level analysis, lacking in-depth exploration of the micro-transmission mechanism of a single typical case, and there is a lack of a clear logical connection between the theoretical framework and the case analysis, which also leaves room for further research in this area.

This paper adopts a case-study approach combined with theoretical analysis, this paper combines the Bank Run Theory, Financial Accelerator Theory and Asset-Liability Mismatch Theory, based on the operational data and crisis disposal data of Northern Rock Bank from 2000 to 2007, aiming to explore the transmission paths between liquidity risk and solvency risk, identify the key factors affecting the intensity of risk transmission, and put forward targeted risk prevention strategies and

policy recommendations. This paper enriches the micro-mechanism framework for liquidity-solvency risk contagion and offers valuable references for peer small- and medium-sized banks.

2. Theoretical foundation and logical framework

2.1. Bank run theory

The Bank Run Theory argues that banks are inherently vulnerable to "borrowing short and lending long," and that information asymmetry between depositors and banks easily leads to herd behavior [1]. When depositors doubt a bank's solvency, they will withdraw their deposits, triggering a bank run. Even a bank with sufficient solvency will face liquidity exhaustion and even collapse due to a large number of sudden deposit withdrawals. This theory provides a theoretical basis for analyzing the liquidity crisis at Northern Rock Bank, especially the massive deposit run triggered by the leak of news about the bank's emergency support from the Bank of England.

2.2. Financial accelerator theory

The Financial Accelerator Theory, put forward by Bernanke, Gertler and Gilchrist, suggests that small external shocks can be amplified through the financial system, leading to large fluctuations in the real economy [2]. Within the banking sector, asset quality deterioration, such as a rising non-performing loan ratio, directly weakens bank capital and lowers the capital adequacy ratio. This further constrains banks' lending capacity and market funding access, forming a vicious spiral in which asset quality deterioration leads to capital erosion, which in turn causes a liquidity shortage, which further worsens asset impairment. This theory explains the transmission process from liquidity risk to solvency risk, providing important theoretical support for analyzing the risk spiral at Northern Rock Bank.

2.3. Asset-Liability Mismatch Theory

Asset-Liability Mismatch Theory holds that banks' core business model is to absorb short-term deposits and issue long-term loans, which inevitably creates a maturity mismatch between assets and liabilities [3]. If a bank relies excessively on short-term wholesale funding to support long-term, illiquid assets, it will face significant liquidity pressure when the wholesale funding market is tight. Once the funding chain is broken, the bank will have to sell assets at a discount, which will damage its solvency. This theory is the core theoretical basis for analyzing the root cause of Northern Rock Bank's crisis. The three theories are closely linked and jointly form the theoretical framework of this paper.

3. Core concepts definition

3.1. Liquidity risk

Liquidity risk refers to the risk that a bank cannot meet the reasonable fund-withdrawal demands of depositors and other creditors in a timely manner, or can do so only at an excessively high cost, which is mainly reflected in the shortage of short-term available funds and the difficulty of asset liquidation. Solvency risk reflects the risk of capital deterioration and potential insolvency when a bank's net assets fail to cover total liabilities due to factors such as deteriorating asset quality and capital losses, resulting in the inability to repay debts as scheduled. Liquidity risk and solvency risk

interact and mutually reinforce each other. A liquidity shortage may lead to forced asset sales, which erode bank capital and further trigger solvency deterioration. A decline in solvency may damage market confidence, leading to deposit runs and interbank funding freezes, thereby exacerbating liquidity pressure [4].

3.2. Evaluation indicators of solvency and liquidity

The Capital Adequacy Ratio (CAR) is primarily used to evaluate a bank's solvency. CAR is defined as the ratio of a bank's tier 1 and tier 2 capital to risk-weighted assets, reflecting the bank's ability to resist risks with its own capital. The CAR is adopted as the primary measure of solvency because it better reflects banks' capital status under the risk-weighted framework [5].

For liquidity risk, this paper mainly selects three major indicators: the proportion of retail deposits in total funding, the maturity mismatch between assets and liabilities, and the Liquidity Coverage Ratio (LCR). Among them, the proportions of retail deposits and maturity mismatches are key indicators for analyzing the liquidity crisis of Northern Rock Bank [6].

4. Construction of risk transmission framework

The three theories respectively explain the cause (Asset-Liability Mismatch Theory), the trigger (Bank Run Theory), and the transmission path (Financial Accelerator Theory) of liquidity risk evolving into solvency risk. Based on this, this study extracts three main transmission paths and presents them in a structural diagram.

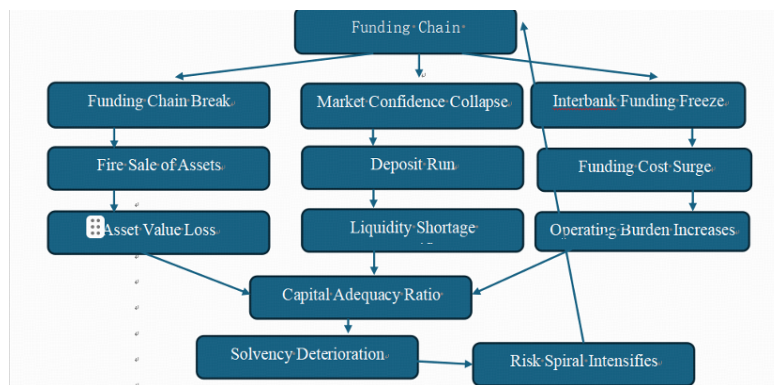


Figure 1. Transmission mechanism of risk spiral (from liquidity to solvency)

As shown in Figure 1, the three transmission paths interact, forming a risk spiral. The break in the funding chain forces the bank to sell assets at a discount, resulting in a loss of asset book value; the collapse of market confidence triggers a mass deposit run, further exacerbating liquidity shortages; the interbank funding freeze leads to a spike in funding costs, increasing the bank's operating burden. These three aspects jointly lead to a decline in the capital adequacy ratio, deterioration of solvency, and, ultimately, the acceleration of the risk spiral, culminating in the bank's crisis.

5. Case analysis: Northern Rock Bank (UK, 2007)

5.1. Case selection applicability

Northern Rock Bank, once the UK's fifth-largest mortgage lender, is a typical case of a solvent institution being destroyed by a sudden liquidity freeze. The bank was highly dependent on

interbank funding on the liability side, with retail deposits accounting for only 25% of its total funding, and its business model was fragile. When the 2007 subprime crisis triggered a global interbank freeze, the bank lost its main funding lifeline, triggering a massive deposit run, and was eventually nationalized. This case is highly representative for exploring the transmission mechanism between liquidity risk and solvency risk, and can effectively reflect the interaction and transmission path between the two risks [7].

5.2. The business model and pre-crisis accumulation of Northern Rock Bank

Northern Rock Bank was established in 1965 as a local small building society and transformed into a mortgage bank after its listing in October 1997. By the first half of 2007, the bank's total assets had reached £113 billion, an increase of 28.3% compared with June 2006. Its mortgage lending market share had risen to 9.7%, making it the fifth-largest mortgage lender in the UK [8]. In terms of business performance, the bank's pre-tax profit reached £346.6 million (up 26.6% year-on-year), and the non-performing loan ratio was only 0.47%, half the industry average [8].

However, the business model had fatal flaws. As shown in Figure 2, retail deposits accounted for about 25% of total funding in 2007, while securitized notes accounted for 40%, overseas bond issuance 24%, and other wholesale funding 11%, with total wholesale funding exceeding 75% [8]. In addition, the bank's lending business expanded rapidly, and its market share in the secured financing market tripled in three years. The rapid expansion of lending was not matched by stable funding sources, which laid hidden dangers for the subsequent liquidity crisis.

Funding Structure of Northern Rock
(2007)



Figure 2. Funding structure of Northern Rock (2007) [9]

5.3. Risk transmission paths of Northern Rock Bank

5.3.1. Asset fire sales and mark-to-market losses

As illustrated in Figure 3, three core indicators of Northern Rock Bank deteriorated significantly during the crisis period. The 2007 subprime crisis outbreak froze the interbank market and stalled securitization, cutting off Northern Rock's primary wholesale funding channels. To meet the demand for cash from depositor withdrawals and interbank debt repayment, the bank had to sell its assets at a discount on a large scale. The assets sold mainly included mortgage loans and securitized products. Due to the market downturn, the selling price was well below book value, resulting in significant mark-to-market losses. Data show that the bank's capital adequacy ratio plummeted from 11.6% to 8.6% over a short period, and its solvency deteriorated sharply [10]. This path directly reflects how liquidity risk erodes the bank's core capital, consistent with the Financial Accelerator Theory.

5.3.2. Deposit runs and further liquidity shortage

On September 13, 2007, the news of the bank's request for emergency support from the Bank of England leaked, triggering mass panic-driven withdrawals. Driven by herd behavior, depositors withdrew more than £2 billion in a few days, accounting for about 10% of its total retail deposits [10]. The massive deposit run further exacerbated the bank's liquidity shortage, making it impossible for it to obtain sufficient funds from the interbank and securitization markets. The liquidity shortage forced the bank to continue selling assets, making it impossible to obtain funds from the interbank or securitization markets [11].

5.3.3. Interbank funding freeze and funding cost spike

Affected by the subprime crisis, the interbank market was in a serious freeze. Northern Rock Bank, which had long relied on interbank funding, was unable to obtain short-term funding, and the cost of that funding soared. Data in Figure 3 shows that the UK's overnight interbank lending rate soared to 6.49% on August 10, 2007, 74 basis points above the central bank's policy rate, and the three-month interbank lending rate rose to 6.85% in early September, significantly above the normal level [10]. The sharp rise in funding costs increased the bank's operating burden, further eroding its profits and capital, and accelerating its solvency deterioration. At the same time, the interbank funding freeze also made it impossible for the bank to roll over its short-term debt, further breaking its funding chain [12].

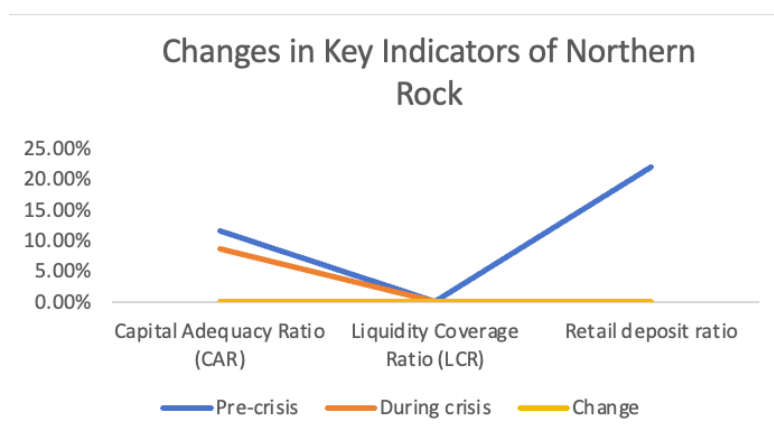


Figure 3. Changes in key risk indicators of Northern Rock Bank before and during the 2007 crisis

6. Key variables affecting the intensity of risk transmission

The severity of the liquidity-solvency risk spiral is greatly affected by several structural variables: the bank scales and market position, asset-liability maturity mismatch, and the macroeconomic environment.

6.1. Bank scale and market position

Bank scale and market position are important factors that affect the intensity of risk transmission. Large-scale banks with stable retail deposit bases are better able to absorb liquidity shocks and benefit from strong implicit government guarantees. In contrast, small and medium-sized banks such as Northern Rock Bank are plagued by volatile funding sources and high dependence on interbank

funding. When facing liquidity shocks, they are more likely to face funding chain breaks and asset fire sales, and the degree of solvency deterioration is significantly greater [13].

6.2. Asset-liability maturity mismatch

The maturity mismatch between assets and liabilities is the fundamental factor that affects banks' vulnerability. The core business model of banks is "borrowing short and lending long", but excessive reliance on short-term liabilities (such as overnight interbank borrowing) to fund long-term illiquid assets will greatly amplify the vulnerability of banks. Northern Rock Bank's excessive reliance on short-term wholesale funding to support long-term mortgage loans led to a serious maturity mismatch. When the wholesale funding market froze, the bank's short-term liabilities could not be rolled over, and long-term assets could not be realized in a timely manner, directly triggering a liquidity crisis [3]. The greater the degree of maturity mismatch, the faster the risk transmission speed and the greater the intensity.

6.3. Macroeconomic environment

The macroeconomic environment is the external environment that shapes the intensity of risk transmission. Economic downturns will create a perfect storm for banks: rising corporate defaults will deteriorate bank asset quality and erode capital; at the same time, public cash hoarding behavior will accelerate deposit outflows. These two pressures act simultaneously, significantly increasing the probability of concurrent liquidity and solvency crises. The 2007 subprime crisis triggered a global economic downturn, which not only froze the interbank market but also heightened uncertainty in the real economy, further exacerbating the risk spiral at Northern Rock Bank [14].

7. Strategic countermeasures and policy recommendations

7.1. Internal bank management strategies

Banks should optimize their maturity structure, reduce their reliance on unstable wholesale funding, and actively cultivate sticky retail deposits. For small and medium-sized banks, in particular, they should proactively cap their interbank liabilities to insulate themselves from market freezes. Northern Rock Bank's excessive reliance on wholesale funding was the root cause of its crisis, underscoring the need for banks to monitor the stability of funding sources and avoid excessive dependence on a single funding channel [15]. At the same time, banks should establish a dynamic liquidity buffer mechanism. Banks should set stricter internal targets, such as an LCR above 130% for small and medium-sized mortgage banks, backed by deep reserves of high-quality liquid assets such as government bonds, to cope with sudden liquidity shocks [16]. In addition, banks should conduct rigorous stress testing, routinely simulate severe distress scenarios, including sudden wholesale funding freezes and mass deposit flight to improve their ability to respond to risks [17].

7.2. Enhancements to external regulation

Regulators should establish a differentiated regulatory framework. Regulators should enforce more stringent liquidity requirements (e.g., an LCR floor of 120%) for smaller, more volatile institutions, while mandating systemic buffers for large systemically important banks (D-SIBs) to avoid the "one-size-fits-all" regulatory model [18]. Regulators should further strengthen monitoring and early intervention, establish a more sensitive risk early warning mechanism, and timely detect and resolve

potential liquidity and solvency risks of banks [19]. In terms of deposit insurance, regulators should transition toward a fiercely risk-based premium mechanism. Banks exhibiting dangerous liquidity profiles or weak solvency metrics should face punitive insurance premiums to enforce market discipline and urge banks to strengthen risk management [20].

8. Conclusion

This paper uses the case of Northern Rock Bank to explore the mechanism by which a commercial bank's liquidity risk eventually evolves into solvency risk. The bank's fragile funding structure, combined with evaporated market confidence amid the 2007 financial crisis, triggered a severe liquidity crunch. Once the wholesale funding market stopped functioning properly, Northern Rock quickly faced liquidity pressure and had to sell assets to raise cash. Those sales were not made under normal conditions, so they naturally reduced the value of its balance sheet.

At the same time, concerns among depositors continued to rise, making the situation even harder to stabilize. What this case makes clear is that banks with heavy dependence on short-term or wholesale funding are much more sensitive to changes in market sentiment. When confidence disappears, liquidity pressure can build quickly and begin to affect capital strength. The Northern Rock experience shows that liquidity risk and solvency risk are closely connected in practice. Once trust in a bank weakens, problems can develop faster than expected, even if the initial fundamentals do not look extremely weak.

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