

The Systematic Endogenous Mechanism of Financial Crisis Based on Big Data Analysis and its Quantitative Analysis

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Abstract: By reflecting on the evolution logic of the subprime mortgage crisis in the United States, this paper finds that the subprime mortgage crisis directly triggered by the decline of house prices and the rise of benchmark interest rates in the United States has evolved into a global systemic financial crisis mainly due to the securitization of subprime mortgages and the innovation of various structural financial derivatives, which has led to the evolution of the credit crisis into an asset price crisis, the market-marking pricing rules and dynamic credit rating. The "excessive pro-cyclicality" inherent in the financial system, such as risk management within banking institutions, worsens the capital market crisis. The sharp decline of global asset value, through the role of wealth effect, Tobin Q effect and financial accelerator mechanism, makes the crisis transmitted from financial market to real economy, and through international trade channels and investment channels from consumer countries to productive countries and finally to resource-based countries.

1. Introduction

The subprime mortgage crisis in the United States is essentially a credit crisis caused by the accumulation of credit risks. In fact, compared with the global financial market, the size of the subprime market is very small. By the end of 2006, the total amount of subprime mortgages in the United States was US\$600 billion, accounting for 20% of all mortgages or 6% of all commercial bank assets; the total amount of loans that had been in trouble accounted for only 3% of bank capital. However, the US government's aid funds to financial institutions have exceeded 900 billion US dollars, and the Federal Fund Interest Rate has been lowered from 5.25% to a historic low of 1%. However, it still triggered a global systemic financial crisis. Financial markets in all countries have suffered heavy losses and world economic growth has declined. Why is this? This paper attempts to explain why the subprime crisis has evolved into the internal mechanism of the global financial crisis. It should be analyzed.

2. Innovation of Financial Derivatives Causes Credit Crisis to Evolve into Asset Price Crisis

Before the implementation of securitization, the credit risk related to subprime mortgage loan is entirely borne by loan suppliers (commercial banks or professional loan companies). But through the securitization of housing mortgage loan, the financial institutions of housing mortgage loan will no longer bear the risk of default of the borrower, of course, it will no longer enjoy the right to obtain the interest paid by the borrower and to recover the principal. In this way, creditors transfer risks and benefits. Investors who buy these securities (MBS or CDO, etc.) bear the corresponding risks and benefits of assets, thus realizing the transfer and dispersion of risks from credit market to financial market. At the same time, the securitization of sub-prime loans also plays an important role. Housing financial institutions will pack different mortgage contracts which are not in the secondary market, and make standardized financial products to be sold in the secondary market. Through the issuance of MBS and CDO, the sponsors (banks or other financial institutions that issue housing mortgage loans) do not have to wait for the maturity of housing mortgage loans to recover funds. Mortgage lending institutions have greatly improved their financing functions, enhanced lending capacity, expanded the scale of lending, and expanded the target of lending. Many mortgage lenders over-credit during the boom period. Subprime mortgage-based mortgage-backed

mortgage-backed securities (MBS) in the United States increased from \$81 billion in 2000 to \$732 billion in 2006, a nine-fold increase in seven years. Therefore, in the macroeconomic environment of low interest rates and rising housing prices, through the securitization of subprime mortgages and the innovation of various structural financial derivatives, all levels of participants in the subprime market have realized their own interests maximization. Banks or other financial institutions that issue housing mortgage loans increase their loans to the greatest extent, thereby increasing their profits; standardized financial products rely on rating agencies to reduce the cost of information acquisition for potential investors, thus meeting the needs of investors with different risk preferences for financial assets and improving the portfolio of investors' assets. In the booming stage of asset market, subordinated debt, as an indispensable tool for portfolio optimization, is not only held by the majority of institutional investors such as mutual funds and hedge funds in the United States, but also favored by risk-averse insurance companies, pension funds and foreign central banks. However, the return of structured financial derivatives is highly non-linear (Fender et al, 2008). They usually have stable income streams in a recession, but they cause huge losses in a recession. That is to say, they are highly sensitive to systemic factors such as asset prices and income, which deviate significantly from long-term equilibrium. This sensitivity is highly asymmetric and has a strong Threshold Effect, which makes it difficult for investors to accurately predict the return (loss) of the product in a recession. Therefore, with the rise of the overall default rate of subprime mortgage loans, the default risk of subprime mortgage-backed securities increases correspondingly, and the structural financial products make investors suffer much more losses than expected, exceeding their affordable range, thus losing their confidence, especially when subprime securities are held by a large number of risk-averse investors, which will inevitably lead to large-scale selling. In the situation of short subprime mortgage-backed securities, market liquidity quickly disappeared, which led to the collapse of financial asset prices.

3. The "excessive pro-cyclicality" Inherent in the Financial System Worsens the Capital Market Crisis

The root cause of the financial crisis lies in the risk-taking and excessive credit expansion in good economic and financial conditions. In the past few decades, a prominent feature of the financial market has been the "boom-bust cycle" of credit and asset prices, which is inherent in the financial system. Borio et al. (2001) showed that the perception of risk and willingness to take risks will change with economic fluctuations. Deposit-loan spreads, asset prices, bank internal risk ratings and accounting estimates such as expected loan losses are pro-cyclical, which leads to further deterioration of the whole capital market crisis.

Firstly, the pro-cyclicality of market-to-market pricing rules. Mark-to-market (fair) accounting requires companies to value securities in their portfolios at market prices. Although mark-to-market pricing rules can bring greater transparency to investors, they also magnify the losses of financial institutions in times of crisis. Once the asset price bubble burst, the financial market plunged into bear market and asset prices plummeted, and companies reported losses in accordance with market prices (Table 2). Although these financial institutions did not sell devalued subprime mortgage backed securities, that is, no real losses occurred, especially when financial assets suffered liquidity exhaustion, asset market transaction prices could be much lower than the actual value, according to fair prices. Value measurement magnifies the losses of financial institutions and aggravates market panic.

Secondly, the procyclicality of dynamic credit rating. For capital market, credit rating agencies reduce information asymmetry between issuers and investors through independent and specialized information collection and analysis activities, thus improving market efficiency. However, professional rating agencies can only evaluate the credit risk of specific securities (mainly bonds) by building models based on historical data and experience, i.e. the reliability and default probability of principal and interest payments on time, or the credit status and solvency of enterprises, institutions or other entities issuing relevant securities, and determine the corresponding credit rating. Therefore, dynamic credit rating must have strong pro-cyclicality. However, structural

financial products derived from subprime mortgages are too complex, and investors rely heavily on credit rating for the risk distribution of these products. Therefore, in the asset price rising cycle, most structural financial derivatives are given higher credit rating, which leads investors to allocate a large number of such so-called "low-risk" high-quality assets in their portfolios, and even risk-averse investors such as insurance companies, pension funds are involved in a large number, which plays a role in fuelling the overheating of the market. But when asset prices plummet, credit rating agencies often drop financial assets previously rated AAA/Aaa to below BBB (investment grade) in a few weeks or even days, which aggravates panic selling in the market and leads to a further sharp drop in asset market prices, thus the market enters a vicious circle.

Thirdly, the procyclicality of risk management within banking institutions. The advanced capital measurement method relies on the bank's internal risk model and implements the value at risk.

(VAR) based asset liability management method. The VAR-based risk prediction model encouraged by the New Basel Accord assumes that the prediction of credit risk has no impact on future volatility, but this assumption has defects. Market volatility is largely influenced by participants' expectations, or market risk is endogenous. In the crisis period, investors' panic expectations are contagious. Such unilateral and consistent expectations will inevitably lead investors to adopt the same investment strategy and form the so-called "herd effect". In particular, commercial banks, investment banks and other financial institutions have adopted the leveraged operation model, that is, the scale of assets of financial institutions is much higher than the scale of their own capital. The assets of financial institutions have varying degrees of risk, and the core idea of VAR management is that the financial institutions' own capital should be able to compensate for the total risk they bear. If the overall risk of financial institutions rises, they will have to reduce the leverage ratio of their own operations, the so-called de-leveraging process. This process can be accomplished either by attracting new equity investments, increasing private capital, or by selling risky assets to pay off debts and reducing the scale of risky assets. In the crisis period, the difficulty of new equity investment is too great, and the only way for financial institutions to seek self-rescue is to choose to sell risky assets. The large-scale sale of risky assets by many financial institutions at the same time will naturally depress the price of risky assets, which on the one hand causes market turbulence, on the other hand, causes the market value (book value) of risky assets that have not yet been sold by financial institutions to further decline. This eventually evolved into a vicious circle, that is, the decline in asset prices triggered the de-leveraging process of financial institutions, and the de-leveraging process led to further decline in asset prices.

4. Portfolio Adjustment of Financial Institutions Leads to the Evolution of the Crisis into a Global Systemic Financial Crisis

After the outbreak of the subprime lending crisis, in addition to the financial markets of developed countries such as Europe and Japan, the financial markets of developing countries, including China, have also been seriously affected. The linkage and risk transmission of the global stock market, foreign exchange market, bond market and commodity market are constantly increasing. The global financial market is in a disordered state, and the financial market fails and credit market fails. The crisis has evolved from credit market crisis and financial market crisis to systemic global financial crisis. One of the important reasons is that transnational financial institutions reduce the proportion of risky assets globally. With the continuous improvement of economic and financial globalization, institutional investors with strong financial strength in developed countries, including pension funds, mutual funds, insurance funds, investment banks, often allocate assets globally in order to better disperse non-systemic risks and national systemic risks. But this global portfolio investment strategy, on the one hand, does reduce the risk of institutional investors and improve investment returns, but at the same time, it will lead to increased volatility of global short-term capital flows, thereby improving the linkage of global financial markets. Since the first half of 2008, the stock markets of emerging market countries and the stock markets of the United States have declined synchronously, which is largely due to the actions of transnational financial institutions to adjust their portfolios of risky assets and reduce the proportion

of risky assets globally.

5. Wealth Effect, Financial Accelerator Mechanism and so on lead to Crisis Transmission to Real Economy

The risks brought to the real economy by the financial crisis originate from the shrinkage of consumer demand. Since the late 1990s, the consumption pattern of American residents has changed from "income-driven" to "wealth-driven". As the value of household wealth rises due to rising asset prices, many American households are increasingly favoring debt consumption in which current consumption exceeds current income. After the subprime mortgage crisis, the decline of asset prices will restrain household consumption through the negative mechanism of wealth effect. Residents' willingness to borrow and consume (risk preference) and ability (asset value) will decline significantly, which may return to the "income-driven" model. Secondly, the subprime crisis has caused a sharp decline in the stock value of American companies and a significant decrease in Tobin Q value, which weakens the incentive for enterprises to increase investment. At the same time, the subprime crisis has resulted in a decline in cash flow and net asset value of enterprises, which weakens the internal market. The source of Ministry financing, on the other hand, causes the value of corporate collateral to decline and the scale of bank loans to be obtained to decline, thus weakening the ability of enterprises to increase investment through the financial accelerator effect. Moreover, in the context of economic globalization, the real economic recession in the United States will restrain the growth of the global economy through international trade channels and investment channels. The recession in the United States will lead to a decline in import demand in the United States, which will have an impact on the export industries of trading partners. For export-oriented emerging market economies such as China, the US economic downturn will directly reduce imports from the US, on the one hand, and on the other hand, affect imports from other countries by affecting macroeconomic growth in other countries around the world. For export-oriented economies, this will significantly drag down their macroeconomic growth. In addition, with the deepening of the financial crisis, in order to protect themselves, western multinational financial institutions and even industrial capital have been selling overseas assets and arbitraging in order to cope with the crisis, which leads to the weakening of the ability of developing countries to use foreign funds directly and affects their macroeconomic growth.

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