

Research on Financial Crisis Warning Based on Vulnerability Index

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Abstract

After the global financial crisis in 2008, the early warning of financial crisis has become a necessary and urgent issue. It is of great significance to analyze the factors affecting financial crisis and clarify the relationship between credit growth, housing price fluctuation, current account deficit and financial risk in order to objectively and accurately predict the degree of influence of financial risk. This paper takes 41 global economies, including developed economies and emerging economies, from 1980 to 2019 as research objects, and analyzes the early warning ability of financial vulnerability indicators such as credit growth, housing price and current account deficit in a unified framework through panel Logit model. It is found that credit is not the only important indicator to predict crisis: when housing price, current account deficit and credit are under the same research framework, housing price and current account deficit have a lot of leading information, which can predict the occurrence of financial crisis; However, as house prices and current account deficits are added to the model, the early-warning power of credit is significantly lower than that of house prices. Paying attention to house price fluctuations and current account deficits has some implications for future policy making. In view of this, we should do a good job of cross-cycle policy adjustment, persist in curbing real estate financialization and bubbles, pay close attention to the direction and extent of current account adjustment, and prudently manage related financial risks.

Keywords: Financial vulnerability, Panel Logit model, Crisis warning, Financial supervision

1. Introduction

The inspiration for policy makers from the financial crisis is that the leading indicators of economic and financial operations can provide valuable early warning information for potential systemic financial risks, thus laying the foundation for taking precise preventive measures. From the financial crises that have occurred, we can often find some financial vulnerabilities, such as high credit growth of financial institutions or a large number of

maturity mismatches (Zhang Xiaojing and Liu Lei, 2020). Under the complex situation of deepening opening-up of the domestic financial market, increasing uncertainty in the global economy, and far-reaching impact of the post-pandemic period, maintaining financial stability has become a long-term priority in the process of China's financial development and economic reform.

A stable financial system is a necessary prerequisite for high-quality economic development, and the academic community pays special attention to it. It is of great practical significance to choose reasonable early warning methods of financial crisis and determine the leading indicators with remarkable early warning effect for maintaining financial security and maintaining the stable operation of economy. On the basis of building a scientific and reasonable early warning index system for financial stability, quantitative assessment of the situation of financial stability and in-depth analysis of the impact mechanism of financial fragility on the economy and financial fluctuations can not only clarify the impact degree of financial crisis on economic growth, but also scientifically formulate macro-prudential policies and achieve a virtuous cycle of economic and financial development.

In view of this, scholars have explored the causes of financial crisis from different angles. Traditional research shows that credit growth is the root of financial fragility, and credit risk is the most important financial risk. Therefore, since the 2008 international financial crisis, credit growth, as a key factor in monitoring the accumulation of risks, has become a focus of consideration and arrangement in the macro-prudential management framework. However, many practices show that credit, as the main tool for crisis prediction, still has some limitations, and can not truly reflect the complex correlation and nesting relationship between financial institutions and financial forms. Some scholars have conducted relevant research from the perspective of asset price bubble and summarized the key causes of financial crisis, among which 54.84% believe that financial crisis is directly related to the formation of "asset price bubble" (Yang Haizhen et al., 2020). In particular, the global financial crisis caused by the subprime mortgage crisis in the United States in 2007 has made scholars increasingly believe that asset price bubbles play a key role in causing financial crises. In addition to credit and asset prices, the current account deficit has become another factor that scholars have paid attention to in recent years.

The analysis of the causes of the financial crisis helps us to clearly understand the root causes of the crisis, so as to avoid the outbreak of a new round of crisis, and lays a certain foundation for the crisis early warning. Existing literatures pay more attention to single crises such as banking crisis, sovereign debt crisis and currency crisis, and there are few studies on the early warning of financial crisis. Moreover, most literatures study the financial crises of underdeveloped Latin American countries in the 1980s and developed countries after the outbreak of the subprime mortgage crisis in the United States in 2007. There is little literature that transfers research to global economies, including emerging economies.

Based on this, this paper takes 41 global economies, including developed economies and emerging economies, as the research object, analyzes the early warning indicators of crises, and puts forward suggestions on maintaining financial stability and preventing financial

crises from the perspective of policy makers, so as to enrich the theory of debt crisis and provide useful references for subsequent theoretical research and policy making.

There are two main reasons why this paper adopts transnational panel data instead of relying solely on Chinese data: First, the financial crisis occurred only in 1998 in China's history, and the frequency of large-scale financial crises is extremely low, so it is difficult to use Chinese data to measure financial risks (economic activities). Second, China's real estate price data began in 2005, the time series is short, and can not be analyzed under the unified panel framework with other economic data. Although this study has this limitation, it can still form an effective supplement to the existing research and provide a useful reference for the research of related issues in China.

There are two innovations in this paper: First, it constructs the panel data of 41 economies including emerging economies, expanding the existing research which only covers developed economies; Second, compared with the existing literature, the three financial vulnerability indicators of economic activity, credit growth, housing price and current account deficit are placed in the same analytical framework, which effectively improves the early warning ability of the model.

2. Literature Review

Most of the existing literature focuses on the early warning of financial crisis by a single factor, such as credit growth, asset prices, and current account deficit.

2.1 Research on the Influence of Credit Growth on Financial Crisis

Credit growth is a highly effective predictor of financial crises and should be a major concern for policymakers (Schulafick and Taylor, 2009). Classical theoretical studies show that credit growth can not only support investment and consumption through income effect and investment effect, but also have a positive impact on economic growth (Mckinnon, 1973); it may also cause the economy to fall into recession after reaching a certain extent (Fisher, 1986). Minsky (1994) in Fisher's "Debt. On the basis of the "deflation" theory, the financial instability hypothesis is proposed, that is, after a long period of prosperity, debt constraints are tightened, forming a vicious circle of high debt and deflation, further restraining aggregate demand and aggravating economic recession. A large number of empirical studies also show that the rise of leverage ratio may promote the formation of asset bubbles, cause economic recession, and even trigger economic crisis, and is the best early warning indicator of the outbreak of economic crisis (Borio and Drehmann, 2009; Reinhart and Rogoff, 2010). Jorda et al. (2013) argue that a large accumulation of credit exacerbates the consequences of both a normal recession and an economic crisis. Therefore, the increase of leverage ratio in the early stage can not only be used as an early warning indicator of the occurrence of economic crisis, but also can measure the degree of economic recession after the crisis. This predictive power can be seen in both advanced and emerging economies (Elekdag and Wu, 2011).

2.2 Research on the Influence of Asset Prices on Financial Crisis

Fisher (1933) first explored the impact of the fragility of the financial system on the real economy and created the classic "debt-deflation" theory. Wilson, Scylla and Jones (1990) explored the correlation between four stock market crashes and financial tsunamis in American history and found a high correlation between the two. Kaminsky and Reinhart (1995) found that in the evaluation system of financial crisis, the short-term rapid decline of asset prices is an extremely key indicator, and most studies mainly analyzed the relationship between the real estate market and financial systemic risk from the perspective of real estate bubble: When the housing price is too high, it leads to a bubble in the real estate market, brewing financial risks, and will lead to a financial crisis when it is serious. Wen Fenghua et al. (2012) believe that the real estate market affects financial stability mainly through credit structure and macro economy. Beltraa and Morana (2010) established a vector autoregressive model to make an empirical analysis of the important role of real estate price fluctuations in the impact on the global macro economy, with an impact of about 40%. The empirical results of Peng Junhua (2020) show that abnormal housing price fluctuations will evolve into systemic financial risks through asset allocation.

2.3 Current Account Deficit on the Impact of Financial Crisis

In recent years, the problem of global current account imbalance has attracted wide attention from scholars, especially before the outbreak of the subprime mortgage crisis in the United States in 2007, the current account showed a continuous deficit, and the current account of countries in the European debt crisis also showed a high level of deficit (Kuang Keke, 2014). Some research pointed out that, persistent current account surpluses or deficits can be a reflection of structural imbalances, macroeconomic distortions, and financial vulnerabilities in a country's economy, and can also have serious negative economic consequences (IMF, 2019). Some crisis forecasting models show that the current account is the leading indicator of financial crises in advanced economies. Scholars have conducted related research on this issue from different angles. Reinhan and Rogoff (2011), famous American economists, used comparative analysis to study the crises of major countries after World War II and found that compared with the previous crises, the global financial crisis had the characteristics of lower sovereign debt level and inflation rate, and higher current account deficit level. The current account deficit was the cause of the crisis. After analyzing the causes of Turkey's financial crisis, Du Jiayun (2018) believed that the severe current account deficit was one of the main causes leading to the outbreak of the financial crisis, and pointed out that the fiscal deficit was a double-edged sword, which should be controlled within a reasonable range. The crowding out effect and inflation brought about by the long-term high fiscal deficit would lead to the surge of debt and even the crisis.

2.4 Brief Review

By combing the existing literature, the ideas of studying financial crisis early warning can be summarized in the following two aspects: First, in terms of research methods, improve the prediction ability of the model by improving and expanding the classical model or applying new methods and technologies; The second is to explore the variables with better early

warning effect and stronger explanation from the financial crisis events as early warning indicators. On the whole, the existing literature has been relatively rich, but the research measurement methods are limited by the number of variables, and the selection of indicators is relatively subjective, so the problem of missing variables often occurs. Most studies only focus on the early warning of financial crisis caused by a single factor, but do not comprehensively consider the causes of financial crisis. Since 1970, there have been more than 400 financial crises in the world (Wang Keda, 2019), covering many economies including developed economies and emerging economies, and the rich samples have created strong conditions for research. Based on this, this paper incorporated three financial vulnerability indicators of credit growth, housing price fluctuation and current account deficit into the same research framework to build a financial crisis early warning model. Through the panel Logit model, AUROC statistics were used to judge the significance of the model and analyze the characteristics of crisis early warning indicators.

3. The Selection and Data Explanation of Crisis Warning Indicators

This paper is based on the Bank for International Settlements (BIS) database of total non-financial sector credit (Dembiermont, Drehmann and Muksakunratana, 2013), the Real Estate Price Database and the Financial Crisis Database (Laeven and Valencia, 2018), constructed panel data for 41 major economies from 1980 to 2019. The main variables include: the financial crisis, credit growth, property prices and the current account deficit. Among them, the financial crisis is the explained variable, which is a dummy variable. If a financial crisis occurs in an economy in the next five years, the value is 1, otherwise it is 0. Credit growth, property prices and the current account deficit are explanatory variables.

3.1 Early Warning Index Selection

The countries that had financial crises in the 1990s had similar macroeconomic characteristics. For example, Southeast Asia has problems such as increasing current account deficit, increasing external debt burden and asset price bubble. Latin America suffers from trade deficits and high debt burdens. When the crisis occurs, the macro economy of different countries shows similar characteristics, indicating that the outbreak of financial crisis is tracable. If we can find reasonable early warning indicators of financial crisis, it will be helpful to the early warning of financial crisis. In determining whether a particular indicator should be included in the risk assessment framework, the most important criterion is whether the indicator can provide policymakers with actionable advance warnings about the build-up of risks in the financial system.

Aikman et al. (2018) searched 37 literatures on bank crisis warning indicators in the UK through Google Scholers and identified 29 financial stability risk indicators that intuitively described the evolution of the financial cycle in the past 30 years. The most frequently cited indicators include: credit levels and growth rates (cited in 24 studies), current accounts (cited in 10 studies), and house prices (cited in 11 studies).

3.2 Financial Crisis Data

There are many types of financial crisis, which can be divided into systemic banking crisis,

currency crisis and sovereign debt crisis according to their characteristics, conditions and consequences. The specific year of the financial crisis in this paper is derived from the JST dataset, Reinhart and Rogoff (2009) and Laeven and Valencia (2018) databases. Laeven and Valencia (2018) specifically give three types of crisis: banking crisis, currency crisis and sovereign debt crisis. Among them, banking crisis is defined as the signs of financial distress in the banking system (such as a large number of bank runs, losses, liquidity difficulties, etc.), and the introduction of relevant policy measures to deal with major losses in the banking system; A currency crisis is defined as a "sharp" nominal devaluation of the country's currency relative to the US dollar, that is, a depreciation rate of more than 30% for the year and 10% higher than the previous year. A sovereign debt crisis is defined as a debt default or debt restructuring. It should be noted that historical data show that the three kinds of crises tend to be associated with each other. Therefore, this paper draws on the method of Ji Yang et al. (2021), does not distinguish the types of crises, and uniformly regards them as financial crises.

3.3 Test on the Significance of Warning Index

First, we look at what influences increased significantly before the financial crisis. According to the total sample and the samples five years before the financial crisis, the average values of seven indicators are calculated respectively. Then, through the unilateral t test, the sample average values of each indicator before the crisis are significantly higher than the total sample average values, so as to preliminarily judge whether this indicator has indicative significance for the financial crisis. The original hypothesis of the unilateral T-test is that the mean of the five years before the financial crisis is no different from the mean of the full sample, and the alternative hypothesis is that the mean of the five years before the financial crisis is greater than the mean of the full sample. In order to eliminate the interference caused by the reversal of the growth rate of each index in the year when the crisis occurred, all indicators were taken with a lag of 4 periods. Through unilateral t test, it is found that housing price and current account level have significant indicative significance in predicting financial crisis.

4. Empirical Results and Analysis

4.1 Model Setting

The appropriate financial crisis early warning model can predict the probability of future crisis according to the change of some macro variables. In this paper, there are two reasons for choosing Logit model among many early-warning models of financial crisis to conduct early-warning analysis of financial crisis. First, Logit model builds an early-warning system by testing whether explanatory variables have a significant impact on the probability of crisis events, which is the mainstream early-warning model of economists and international institutions such as IMF. Second, considering that the duration of non-financial crisis is much longer than that of financial crisis in history, Logit model is more suitable for samples with tail distribution (Kumar, Moorthy, and Perraudin, 2003).

In recent years, most studies focus on whether credit growth is an early warning indicator of

financial crisis, but when discussing the influencing factors of financial crisis, some literatures put more emphasis on house price volatility (Cecchetti, 2008) or current account deficit. Examples of the latter include a very large current account deficit and rapid house price growth in the United States during the subprime crisis (Laibson and Mollerstrom, 2010; Dokko et al., 2011), as well as in the eurozone countries that experienced the European debt crisis, we can also see rising house prices and large current account deficits. Based on this, the paper also considers house prices and current account levels, including current account deficits, in order to study the impact of negative current account positions (i.e. net borrowing from abroad) on financial stability.

4.2 Empirical Result Analysis

The coefficients of house price change and current account deficit are much larger than the credit coefficients. Statistics show that the current account deficit preceded the crisis, but the surplus did not significantly reduce the likelihood of a crisis. The current account deficit remains a very important predictor of crises. A review of several high-profile international financial crises - the Latin American debt crisis of the 1980s, the Asian financial crisis of the 1990s and the subprime crisis of 2007 - shows that they were all closely linked to current account deficits. Since the 1970s, most developing countries in Latin America have run current account deficits. Southeast Asian countries also ran current-account deficits from 1980 to 1997; The US has also run a consistent current account deficit since 1992. From the regression results, we can find that compared with credit growth, housing price and current account deficit have a lot of leading information and have a greater impact on predicting the probability of financial crisis. This finding flies in the face of conventional wisdom that focuses on debt accumulation.

5. Robustness Test

5.1 Increased Tests of Income Inequality for Explanatory Variables

A large number of theoretical studies have shown that the increasing inequality has become a factor leading to the crisis through debt accumulation and other channels. Because income inequality can lead to inadequate aggregate demand, deflationary pressures, and excessive credit growth by distributing income to those with low marginal propensity to consume, it can lead to endogenous financial crises.

Income inequality magnified the recession and even contributed to the financial crisis. Some scholars believe that higher income inequality in the United States may have contributed to the accumulation of housing debt. This is especially true of households with stagnant and less stable incomes who were lured into subprime loans, and high household leverage played a key amplifying role in the classic "financial recession" of the global financial crisis. Because low-income households have a greater need to borrow, if the supply of credit becomes more plentiful, it could encourage them to over-take on debt. Most scholars also believe that such a mechanism would trigger a global financial crisis.

6. Basic Conclusions and Policy Recommendations

6.1 Conclusion and Enlightenment

Different from the traditional view that only focuses on credit growth, this paper gradually adds housing price and current account deficit into the model that only includes credit, which is not only a further test of the early warning ability of credit to financial crisis, but also a mining of the early warning ability of other factors acting together on financial crisis. The research findings are as follows: First, the Logit financial crisis early warning model constructed in this paper has a good crisis early warning ability. With the continuous addition of early warning indicators, the aggregate statistical indicators such as AUROC or Pseudo R2 in the model increase significantly, that is, the model's forecasting ability improves significantly. Second, when housing price, current account deficit and credit are under the same research framework, housing price and current account deficit have a lot of leading information, which can predict the occurrence of financial crisis, and the early warning ability of credit is significantly lower than that of housing price and current account deficit.

This study draws three implications and considerations: First, models that emphasize the interaction between house prices, current account deficits (external borrowing), and credit growth may help explain the above empirical results. Second, the view that current financial conditions or macro indicators can help predict financial crisis is credible, but the occurrence of financial crisis is a rare and extreme result of economic growth, and more attention should be paid to the overall distribution of future economic growth and the tail risk in economic growth. Third, the Basel Committee's guidance on counter-cyclical capital buffers has focused on levels of debt relative to income, partly because debt has been found to be predictive of crises. Similarly, research on the effects of monetary policy on financial stability has focused on the effects of monetary policy on debt. So a focus on house prices and the current account deficit may have implications for future policy making.

6.2 Policy Proposal

First, we will make good cross-cycle policy adjustments, maintain the continuity, stability, and sustainability of macro-control policies, and make them more forward-looking and precise. In particular, we should pay attention to short-term economic fluctuations and counter-cyclical adjustment, improve the cross-cycle design and adjustment of macro-control, and balance the dynamic relationship between short-term regulation and long-term development to achieve a long-term balance between stable growth and risk prevention. At the same time, on the basis of smoothing out economic fluctuations and promoting sustained growth, we will promote the coordination of various policies in time series, continue to increase support for scientific and technological innovation, small and micro enterprises, green development and other fields, and comprehensively build a system and mechanism for effective financial support for the real economy.

The second is to insist on curbing the financialization and bubble of real estate, and take the macro-control policy of real estate as an important part of the macro-prudential policy framework. In the regulation of real estate prices, we should try to avoid sharp fluctuations

and excessive declines in housing prices, and strive to improve the macro environment of the real estate market, from the source of the risk caused by sharp fluctuations in housing prices. In this regard, on the one hand, differentiated tax rate system can be adopted for different regions and different demand groups to balance market supply and demand; On the other hand, the government can build a corresponding housing supply system according to different income groups, and fundamentally solve the problem of imbalance between supply and demand through reasonable guidance.

Third, pay close attention to the direction and extent of current account adjustment to avoid exacerbating asset price volatility due to the deterioration of current account. Supporting reasonable policies to adjust large changes in the current account; At the same time, policymakers also need to pay close attention to the potential risks caused by frequent current account reversals to avoid adverse impacts on domestic asset prices and prevent the transfer of external financial risks to the domestic sector.

Fourth, prudently manage financial risks related to climate change, and promote the stress test of climate change on the financial system. Climate change-related financial risks have been identified as one of the important sources of systemic financial risks. On the one hand, all industries in various regions should formulate carbon emission reduction plans with strong binding force, clarify carbon emission reduction paths and targets, and lay the foundation for accurate assessment of financial risks related to climate change. On the other hand, it is necessary to strengthen the top-level design of climate risk response, integrate climate change-related factors into the macro-prudential policy framework, and require financial institutions to conduct stress tests on the impact of climate change on the financial system as soon as possible.

6.3 Research Directions in the Future

There are still some limitations in this study, which need to be further improved. First, this paper attempts to analyze the early warning of financial crisis by multiple financial vulnerability indicators under a unified framework, and provides empirical evidence, but does not provide a theoretical framework to analyze the impact of each indicator on the early warning mechanism of financial crisis, which is the issue that should be paid attention to in subsequent studies. Second, due to the availability of data, this paper only uses transnational panel data to discuss the early warning ability of financial crisis early warning indicators. In the future, with more abundant data, it can try to use China's financial vulnerability indicator data for analysis, so as to enhance the applicability of research conclusions to China and provide theoretical references for the formulation of relevant macro policies in China.

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