

Early-Warning and Risk Prevention of Sovereign Credit Rating Downgrades -- Empirical Test from 35 Country Panel Data

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Supported by the Fund Project of Research and Planning of Humanities and Social Science in the Ministry of Education (12YJA790125)

Received 17 July 2012; accepted 8 September 2012

Abstract

European debt crisis has seriously affected the global economy, and sovereign credit rating downgrades further affect a country's debt crisis and a country's as well as the global economy. Through the establishment of the panel data Logit model, combined with the 35 country panel data, this paper does an early warning of sovereign credit rating downgrades, analyzes the impact of various factors on the sovereign credit rating downgrades. The results of early warning show that, external debt, short-term non-normal substantial growth of budget deficit will increase the possibility of sovereign credit rating downgrades and government efficiency, and the impact of external debt is larger than budget deficit. The government efficiency, per capita GDP, the short-term improvement of foreign exchange reserves will inhibit the reduction in rating downgrades and the per capita GDP inhibits better.

Key words: Sovereign credit ratings; Influencing factors; Panel Data Logit model; Early-warning analysis; Risk prevention

TIAN Yixiang, LI Chenggang, LU Liucun (2012). Early-Warning and Risk Prevention of Sovereign Credit Rating Downgrades -- Empirical Test from 35 Country Panel Data. *Management Science and Engineering*, 6(3), 51-55. Available from <http://www.cscanada.net/index.php/mse/article/view/j.mse.1913035X20120603.2194> DOI: <http://dx.doi.org/10.3968/j.mse.1913035X20120603.2194>

INTRODUCTION

Recalling that the context of the debt crisis in Europe, the sovereign credit rating agencies are the trigger that set off the crisis. The rating agency lowered the European country's sovereign credit rating is mainly based on European fiscal imbalances, and Afonso's study (Afonso & Rault, 2010, p.731-755) also supports the conclusion that fiscal imbalances will result in downgrades. In August of 2011, Standard & Poor's rating agency lowered the U.S. long-term sovereign credit rating to AA+. The global financial market turmoil, and the stock market, commodity prices fell. This is mainly because the US economic growth slowed, and a large number of government expenditure has resulted in a huge deficit. The short-term debt limit is reached, and it became the reason of the rating agencies downgraded the U.S. sovereign credit rating. In the real context of the frequent occurrence of the debt crisis, global scholars started to pay attention and research sovereign credit rating downgrade warning.

For the emerging market currency crises, Elisabetta Falcetti (2006) utilized dynamic Probit model for early warning analysis, and considered inter-country heterogeneity and autocorrelation error. Matthew Yiu (2009) used the panel data Probit model to establish a model for the early warning of the vulnerability of the banking system, and found the vulnerability of early warning indicators that impacting bank. Aßmann and Boysen-Hogrefe (2011) gave the Bayesian estimation of the panel Probit model, and further improved the early-warning effect of discrete choice models. In the research of Chinese scholars, Shi Zhuxian and Mou Xiaoyun (2005) used ternary Logit model to early warning analyze the foreign exchange risk. Zhang Ran (2005) established

commercial bank customers' default probability prediction model based on the Logit model, and its prediction effect is good. Using panel data Logit modeling, Feng Zongxian *et al.* (2008) constructed early warning models of export anti-dumping allegation possibility. Using panel data Logit model, Lu Yongyan and Wang Weiguo (2010) predicted the company's financial predicament. Tian Yixiang and Lu Liucun (2011) used the panel ordered probability model to analyze the effects of short-and long-term sovereign credit rating impact factors. The above scholars used the econometric model to do the early warning analysis, and this laid the foundation for sovereign credit rating downgrade warning analysis. On the above researches, combined with the panel data of 35 countries, this paper uses Tian Yixiang's (2011) financial econometric analysis method to early warning analyze sovereign credit rating downgrade.

PANEL DATA EARLY WARNING MODEL

Early Warning Indicators and Data Selection

The selection of the early warning indicators is a critical success factor for early warning analysis. A large number of scholars discussed it. Afonso, Gomes and Rother (2011), Hong Lu (2007), Xu Yiping and Hong Lu (2009) analyzed the sovereign credit rating impact factors. We reference Tian Yixiang and Lu Liucun's (2011) researches and chose the early warning indicators. These indicators are the efficiency of government, external debt, per capita GDP, real GDP growth, foreign exchange reserves and fiscal surplus/deficit. We selected sovereign credit rating data of 35 emerging economies from 1996 to 2009, three main international capital form and the political and economic variables. The data is from the World Development Indicators database of World Bank.

Panel Data Logit Early Warning Model

In order to construct Logit early warning model, we first define the rating downgrade events as follows:

$$Event_{it} = \begin{cases} 1 & \text{If the } i\text{-th country's rating downgrades in the } i\text{-th period} \\ 0 & \text{If the } i\text{-th country's rating unchanged in the } i\text{-th period} \end{cases} \quad (1)$$

Assuming that the value of $Event_{it}$ depends on another unobserved variables Y_{it} , there is a certain function $Y_{it} = f(X_{i,t-1})$ between Y_{it} and used predictor X_{it} . The value of Y determines weather the Event appear. When $Y > 0$, there are decline signals, that is $Event = 1$. When $Y \leq 0$, there is no crisis signal, that is $Event = 0$.

Therefore, the probability of occurrence of the downward signal is

$$P(Event_{it} = 1) = P(Y_{it} > 0) = P(\varepsilon_{it} > X_{i,t-1}\beta) \quad (2)$$

Assuming that ε obeys Logistic Distribution, there is

$$P(Event_{it} = 1) = \frac{e^{X_{i,t-1}\beta}}{1 + e^{X_{i,t-1}\beta}} \quad (3)$$

This is the probability of rating downgrades.

According to the size of the possibility of downside risks, this article divides predicted probability interval into the following three sections to produce different risk levels:

$$P_{it} = \begin{cases} [0.6, 1) & \text{red crisis} \\ [0.2, 0.6) & \text{yellow crisis} \\ (0, 0.2) & \text{no crisis} \end{cases} \quad (4)$$

Based on this, this paper establishes a panel data Logit model and does empirical analysis by 35 countries rating data.

EARLY WARNING ANALYSIS BASED ON PANEL LOGIT MODEL

We divide sample data into two parts. The model is estimated with the sovereign credit rating data from 1996 to 2008. We do early warning analysis on rating situation in 2009 with the estimated results, and then test the early warning effect by comparing them with the actual rating situation in 2009 of each country.

Estimates of the Model

We use Stata software to estimate the panel Logit model. The estimated results are shown in the following table.

Table 1
Model Estimation Results

Variable	Coefficient	Std error	T value	P value
Constant	-0.9478	0.4016	-2.36	0.0180
Rating	-0.0982	0.0363	-2.70	0.0070
Efficiency of government	-.4694	0.1878	-2.50	0.0110
External debt	3.4993	1.1360	3.08	0.0020
Per capita GDP	-4.2572	1.5162	-2.81	0.0050
Real GDP growth	0.0014	0.0028	0.49	0.6220
Foreign exchange reserves	-0.0104	0.0061	-1.69	0.0900
Fiscal surplus/deficit	-0.1909	0.0778	-2.45	0.0140

Wald chi2(6) = 61.06 Prob> chi2 = 0.0000

In Table 1, the coefficient of real GDP growth is not significant and the symbol is not correct. This is caused by its collinearity with per capita GDP. Because Logit model is very sensitive to collinearity, we exclude the real GDP growth rate, re-estimates the mode and get the results in Table 2.

Table 2
The Final Result

Variable	Coefficient	Std error	T value	P value
Constant	-0.9565	0.4009	-2.39	0.0170
Rating	-0.0976	0.0363	-2.69	0.0070
Efficiency of government	-0.349042	0.1342	-2.60	0.0090
External debt	3.4357	1.1277	3.05	0.0020
Per capita GDP	-4.2040	1.5129	-2.78	0.0050
Foreign exchange reserves	-0.0104	0.0061	-1.71	0.0870
Fiscal surplus/deficit	-0.1899	0.0778	-2.44	0.0150
Wald chi2(6) = 61.00 Prob> chi2 = 0.0000				

As can be seen from the above regression results, foreign debt and short-term non-normal substantial growth of budget deficit will increase the possibility of sovereign credit rating downgrade. With foreign debt accounted for GDP ratio increases one percentage, the opportunity of rating downgrade increases 0.034. Budget deficit increasing one percentage would make the opportunity of rating downgrade increase 0.0019. Government efficiency increasing one percentage point would make the opportunity of rating downgrade fall 0.0035. Per capita GDP increasing one percentage would make the opportunity of rating downgrade decline 0.042. The growth of foreign exchange reserves also inhibits the possibility of rating downgrades, affecting relatively small, but the per capita GDP suppresses rating downgrades better. Finally, seen from the model estimation results, under the same conditions, compared with countries with lower rating grade, the possibility of rating downgrade of countries with higher rating level is smaller.

Early Warning Effect Test of the Panel Logit Model

For evaluation of the early warning effect of Logit model, we take advantage of the above risk grade range and the early warning model based on the panel Logit to track rating dynamic of the samples in 2009, according to the results of the estimation results, and to early warning the risk of rating downgrade. The results are shown in Table 3 below.

Table 3
Early Warning Results

	Number of signals	Correct number	The probability
Red signal	1	1	100%
Yellow signal	5	3	60%

In 2009, the sample countries have occurred 7 rating downgrade events. As you can see from Table 3, the

model has issued 6 early warning signals, wherein Latvia issued red signal in 2009. When the Latvia's rating are downgraded two grades, as shown in Figure 1. This indicates that when the early warning model issues red warning signal, the likelihood of rating downgrade is high.

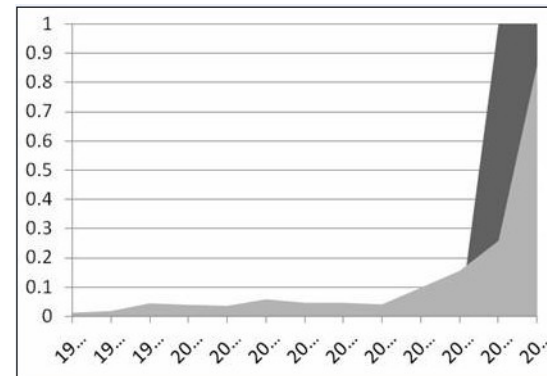


Figure 1
Warning Effect Test (Latvia)

Note: Black presents rating downgrade, and gray presents the probability of rating downgrade. This is the same from Figure 2 to Figure 5.

The model has issued 5 yellow warning signals, wherein 3 times the corresponding national ratings downgrade. The yellow signals are in Greece, Lithuania and Spain, and these three countries are in the euro area. As the fuse of European debt crisis, the warning effect of Greece in 2009 is shown in Figure 2. As can be seen from the graph, since the sovereign credit ratings are lowered by rating agencies in 2004, Greece failed to take effective measures to reduce the possibility of their ratings downgrades. Its probability of rating downgrade increases continuously from 2005, and the probability of rating downgrade increases yellow signal interval in 2009.

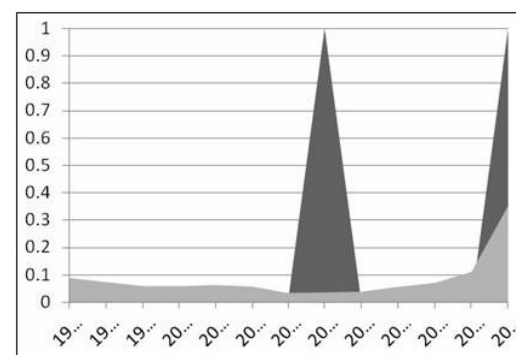


Figure 2
Warning Effect Test (Greece)

For other two euro area countries whose rating are downgrade, Spain and Lithuania, their dynamical early warning effects are shown in Figure 3 and Figure 4. In 2009, the probability of downgrades has increased dramatically than before, reached a yellow signal range, and ultimately triggers a sovereign credit rating downgrade.

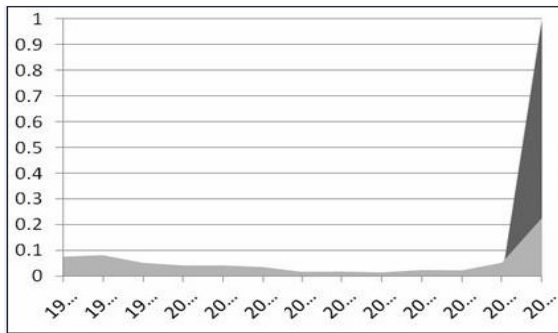


Figure 3
Warning Effect Test (Spain)

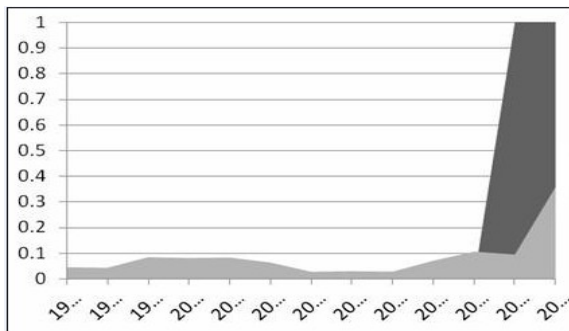


Figure 4
Warning Effect Test (Lithuania)

Compared to actually occurred downgrade event in 2009, there are three countries are still not issued a warning. The possible causes are that the warning model selects representative indicators, but can not be completely generalize all reasons for rating downgrades. There are other factors to cause rating downgrades.

Finally, using the early warning model, this paper tracks Chinese rating dynamic, as shown in Figure 5. As can be seen from the figure, since the Asian financial crisis in 1997, the probability of Chinese rating downgrade is very high, and the rating downgrade event eventually took place in 1999. Subsequently the economic situation in China improved, the probability of rating downgrade declined to almost zero, and the security is very high.

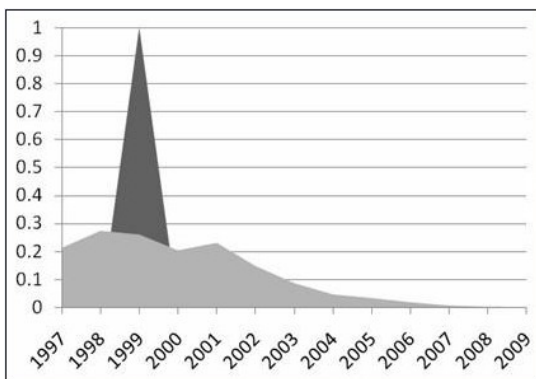


Figure 5
Warning Effect Test (China)

CONCLUSION AND RISK PREVENTION

Conclusion

This paper builds panel Logit model for early warning analysis of the sovereign credit rating downgrade. The analysis results are as follows:

(1) Foreign debt and short-term non-normal substantial growth of budget deficit will increase the possibility of sovereign credit rating downgrade. Foreign debt accounted for GDP ratio increases one percentage, the opportunity of rating downgrade increases 0.034. Budget deficit increasing one percentage would make the opportunity of rating downgrade increase 0.0019. The impact of foreign debt is bigger than the budget deficit. This is to say that the impact of the external debt is greater than domestic debt.

(2) The short-term improvement of government efficiency, the per capita GDP and the foreign exchange reserves will inhibit the rating downgrade. Government efficiency increasing one percentage point would make the opportunity of rating downgrade fall 0.0035. Per capita GDP increasing one percentage would make the opportunity of rating downgrade decline 0.042. The growth of foreign exchange reserves also inhibits the possibility of rating downgrades, affecting relatively small, but the per capita GDP suppresses rating downgrades better.

Suggestions of Risk Prevention

(1) Because foreign debt and budget deficit will increase the possibility of sovereign credit rating downgrade, and the impact of the external debt is greater than domestic debt, we have to control the size of the bonds issued in China, strictly monitor the size of the local debt irrational, and beware of the deficit size of local government debt too large. Especially the issue size of external debt should be rational. Of course, the scale of Chinese foreign debt is not large, but we should always pay attention to avoid ratings downgrades.

(2) The short-term improvement of government efficiency, the per capita GDP and the foreign exchange reserves will inhibit the rating downgrade, and he per capita GDP suppresses rating downgrades better. Therefore, China needs to change the traditional extensive, excessive reliance on export-led economic growth, speed up the adjustment of industrial structure, expanding domestic demand, grasp macroeconomic policies, maintain economic continuous growth, which is one of the most important aspects to prevent rating downgrades. Second, the reform of the political system and the improvement of government efficiency are also factors to avoid downgrade. Finally, the appropriate maintenance of a certain foreign exchange reserves are also beneficial to the stability of the rating.

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