

# RESEARCH ON DEBT RISKS OF CHINESE LOCAL GOVERNMENT FINANCING PLATFORM\*

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## **ABSTRACT**

*Euro Crises triggered highly attention around the world. Many national governments strictly reduce risks about government debt. As an implicit debt of government, the debt of Local government financing platform rose rapidly in order to cope with financial crises. In this context, this paper studies the problem of a Chinese local government financing platform by using modified KMV model. By calculating risks and safety margin scales of outstanding debt, this paper puts forward an approach to measure debt risks of platform enterprises. It finds that when the leverage ratio of financing Platform Company in Guangxi province is under 20%, the probability of default is very small. When the leverage ratio is above, probability of default increases rapidly. When the leverage ratio is about 35%, probability of default approaches to 1. At last, solutions are provided to manage risk including financial innovations, cooperation and information disclosure.*

**Keywords:** government finance, government guarantee, financing platform, debt risk, KMV model

**JEL Classification:** G28

**Paper type:** Research paper

## **1. INTRODUCTION**

Chinese Local Government Financing Platform is a company which can be used by local government to finance. Subprime crises outbreaks in 2008 and the whole world economy have been affected. In order to avoid economic downturn in China, a 4 trillion investment plan has been implemented by Chinese government accompanied by a pro-active fiscal policy and an easy monetary policy. Local Government

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Financing Platforms were encouraged to finance and the scales of debts expanded very quickly. The blind expansion of excessive debt and nonstandard management lead to huge debt risks. The national audit office announced the latest audit results which showed that the outstanding amount of 36 local government debts at the corresponding level are 3847.58 billion RMB by the end of 2012, increased by 12.94%. Meanwhile, debt ratio responsible for government exceeded 100% in 9 provincial capital. This problem once again aroused the concern of the society.

By the end of June 2013, the national government entities at all levels responsible for repayment of the debt of 20.698865 trillion Yuan. In addition, the guarantee responsibilities for the debt are 2.925649 trillion Yuan and the debts with certain rescue responsibility are 6.650456 trillion Yuan, which amounted to 30.27497 trillion Yuan. The debt balance has been more than 50% of GDP.

**Table No. 1 A Debt financing platform measuring report (One trillion Yuan)**

	2009	2010	2011	2012	2013
Balance of Local financing platform loan	7.20	9.37	9.81	8.81	7.00
Annual net increase loans	3.05	2.17	0.44	-1.00	1.81
Repayment amount each year	0.93	1.27	1.78	2.70	2.76
Disposable income of the local government	7.70	8.26	8.97	10.21	11.32
In which: revenue of Local level	3.26	3.59	4.15	4.81	5.40
The local government debt servicing ratio	12.0	15.4	19.8	26.5	24.4

*Source: Cicc research.*

Picture above is from *Cicc*, who published a report of the debt of the financing platform in 2010. Since 2012 local government financing platform loans runs into an intensive repayment period and the loan amount is increasing year by year. Local government debt servicing ratio is from 12.0% in 2009 to 26.6% peak in 2012 and later it will continue to maintain at 20% above the alert level.

Bank credit funds are the main channels of Local government investment and financing platform and debt repayment of capital generally depends on the financial guarantee or appropriated from fiscal revenue. Therefore, the local government investment and financing platform for credit risk is directly related to local government fiscal risks. Compared with disposable financial resources, the actual financing scale is out of the actual capacity of local finance in many places. Once the capital chain rupture, government liquidity crisis will arise. So that the local government investment and financing platform fails to repay the loan principal and interest and credit risk occurs.

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In 1980s, foreign scholars studied the debt risk of government and its financing institution. As a representative of scholars, Brixi (1998) has carried on the comprehensive analysis of debt risk problem about government and its financing institutions. In his research, government debt risk sources are classified into four classes and we deeply discuss the risk of government contingent liabilities by using risk matrix (Brixi, 1998, Page 1). William Easterly (1999) introduced the opportunism that psychological behavior in finance and argued that the traditional budget system make the official draw on advantages and avoid disadvantages (Easterly 1999, Page 1-18).

In Practice, Scholars generally begin to pay close attention to emerging market countries government debt risk problem after Asian financial crisis in 1997 and carried on empirical studies using emerging market debts. Amaud Mehl, Julien Reynaud (2010) carried on empirical research about the composition of government debt and risk and argued that Inflation, economic scale and the width of domestic investors are the important factors influencing the government financial liabilities.

Because our country government statistics caliber changes and the particularity of the local financing platform, Platforms' hidden debt cannot be calculated accurately. Most of the scholars studied from the theoretical level.

Under this background, this paper based on the theory of modern finance, adopted demonstration analysis and theoretical analysis to look at and appraise union method, related research achievements at home and abroad, started from the debt risk and debt security marginal scale and use improved KMV model to measure Guangxi province local financing platform debt and obtained financing platform margin of safety scale under the different proportion of financing. In the last part, In the view of the current debt risk problem of financing platform, we put forward related suggestions to the government, bank and financing platform and think that they should help each other and work together to strengthen the debt risk management and find the balance point in the risk control, economic growth and their development.

### **2. MODELING**

The credit risk of the debt is mainly refers to the fact that one party cannot fulfill the contract obligations and the possibility to bring economic loss to the other party. The debtor's solvency and debt repayment willingness is the two decisive factors influencing the size of credit risk. The credit risk evaluation theory and method of measurement research is quite mature. Among these models, the KMV model is based on the modern corporate finance theory and option theory.

KMV model applies the idea of option pricing to estimate the volatility of company asset value and asset returns and etc. by observing company stock market value in order to estimate the probability of default of a company. The basic principle of KMV model is to view creditor's rights as a put option based on the company's assets. The exercise price is the book value of the companies' debt. Business owners

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are equivalent to have default or no default options. If the market value of enterprise assets exceeds its liabilities value, enterprises are willing to pay and the rest of which are profits. If the enterprise's asset value is less than debt levels, enterprises will choose default and company's assets will hand over to the creditors.

The following three steps are needed when using the default probability of KMV model.

Step 1: Assuming that the probability distribution of asset returns does not change with time. We apply the option pricing model to evaluate the company's assets value  $V$  and their volatilities  $\sigma_A$ :

$$E = AN(d_1) - De^{-rt}N(d_2) \quad (1)$$

Of which:  $E$  is the equity value (market value),  $A$  is market value of company's asset.  $\sigma_A$  is the volatility of company's asset value,  $D$  is the book value of debt,  $r$  is risk-free rate and  $t$  is remaining lifetime of the option.  $N$  is the cumulative probability distribution function of normal distribution variable.

$$d_1 = \frac{\ln(V/D) + \left(r + \frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}}$$

$$d_2 = d_1 - \sigma_A\sqrt{T}$$

There exists theoretical relation between volatilities of enterprise's equity market value and volatilities of enterprise's asset market value.

$$\sigma_E = g(\sigma_A)$$

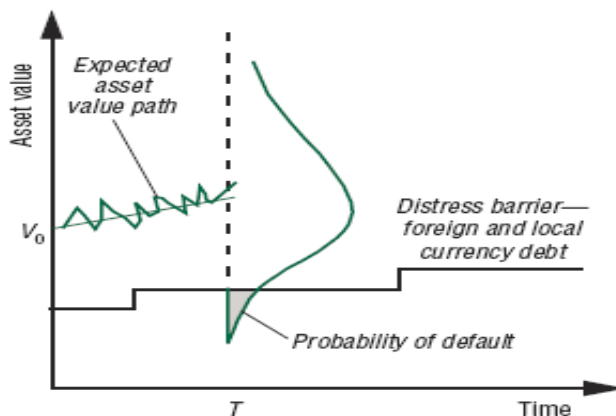
The specific form of the function  $g$  is:

$$\sigma_E = \frac{N(d_1)A\sigma_A}{E} \quad (2)$$

This can be derived from Ito Lemma.

In the formula (1) and (2), the known variables are  $E$  (can be observed from equity market),  $\sigma_E$  (can be estimated from historical data),  $D$  (the book value of debt),  $t$  (General set for one year),  $r$  (can be observed). The remaining two unknowns,  $\sigma_A$  and  $A$ , Need to solve the equations consist of formula (1) and (2).

Step 2: Calculating the Distance to Distress



**Graph 1 Distribution of enterprise assets value at T**

Default occurs when enterprise assets value distribution curve below the debt line. Assume that the company's future assets value obeys normal distribution and the mean value is  $A$  and the variance is  $\sigma_A$  and we can use the following formula company to calculate default distance within a year:

$$DD \text{ (Distance to Distress)} = \frac{A - D}{\sigma_A}$$

Step3: Calculating probabilities of default

Assume that the value of the asset is normal distribution and we can calculate probabilities of default according to Distance to Distress.

$$EDF = P_t = P[V_t \leq L_t : V_0 = V] = P[\ln V_t \leq \ln L_t : V_0 = V]$$

Of which,  $V_0$ : The initial value of the company's assets

$V_t$ : The future value of the company's assets

$L_t$ : Corporate debt value in the future

The market value of the company's assets for t moments is:

$$\ln V_t = \ln V_0 + \left( \mu - \frac{\sigma_A^2}{2} \right) t + \sigma_A \sqrt{t} \varepsilon$$

Of which,  $\mu$  is the expected return of assets to the company,  $\varepsilon$  is random variable obeyed the standard normal distribution.

The expression of default probability is obtained:

$$P_t = P \left[ \ln V_t \left( \mu - \frac{\sigma_A^2}{2} \right) t + \sigma_A \sqrt{t} \varepsilon \leq X_t \right]$$

Arrange to get:

$$P_i = P \left[ \frac{\ln V_A \left( \mu - \frac{\sigma_A^2}{2} \right) t}{\sigma_A \sqrt{t}} \geq \varepsilon \right]$$

### 3. MODEL TRANSFORMATION

Local government loan process is regarded as the income right of local finance is transferred to bank and at the same time, Local governments can redeem local financial right to income by repaying the loan. If the local fiscal revenue can cover the debt when the loan due, Local financing platform can repay the loan and redeem the right of finance income. If the local finance income cannot full repayment of the debt, default occurs. At the same time, according to the standard & poor's or moody's KMV margin of safety of EDF, we can reverse down marginal scale of safety.

Based on this, we reform the KMV model moderately. Enterprise assets value  $V$  is replaced with the variable  $M$  that is used to guarantee the local finance income. The volatility  $\sigma_A$  is replaced with the volatility of local finance income  $\sigma_E$ , which can be observed directly.

We assume that the local finance income follows geometric Brownian motion and  $L_t$  is the value of loan. If  $V_t < L_t$ , default occurs. Due to the local fiscal revenue  $V$  is a flow data, so we get the value and generate into the formation. We assume  $t=1$  in empirical analysis and the default probability of local government financing platform loans in one year can be calculated. We can get:

$$g = \frac{1}{n-1} \sum_{t=1}^{n-1} \ln \frac{M_{T+1}}{M_T} + \frac{1}{2} \sigma_M^2 \quad (3)$$

And,

$$\sigma_M = \sqrt{\frac{1}{n-2} \sum_{t=1}^{n-1} \left( \ln \frac{M_{T+1}}{M_T} - \frac{1}{n-1} \sum_{t=1}^{n-1} \ln \frac{M_{T+1}}{M_T} \right)^2} \quad (4)$$

And then, the distance to distress and the probability of default are:

$$DD = \frac{\ln \frac{M_T}{L_T} + \left( g - \frac{\sigma_M}{2} \right) T}{\sigma_M \sqrt{T}}$$

And,

$$P = N(-DD) = N \left[ - \frac{\ln \frac{M_T}{L_T} + (g - \frac{\sigma_M^2}{2})T}{\sigma_M \sqrt{T}} \right]$$

In which, M is revenue of local government, g is the growth rate of Local fiscal revenue,  $\sigma_M$  is the volatility of local finance income.

#### **4. Empirical research on local financing platform in GuangXi Province**

##### **4.1 Sample selection**

This part analyzes the local financial revenue and expenditure of urban infrastructure investment of Guangxi province in 1978-2012. Assuming that probability of default is in a year. We will forecast probability of default in 2013.

##### **4.2 Model calculation and analysis**

###### **4.2.1 Calculating local disposable financial resources (g and $\sigma_M$ )**

Autoregressive analyses are used to forecast local financial revenue in 2013. First-order autoregressive model is as follows:

$$M_t = -21.96480 + 0.014152 GDP + 1.049575 M_{t-1}$$

GDP in 2013 and local finance income in 2012 are substituted into the formula and then we get the local finance income in 2013 is 37.95( $M_T$ ) billion Yuan.

The local fiscal revenue data in 1994-2013 and  $n = 20$  are generated into the formula (3) and (4) and we get the result:

$$\sigma_M = 0.024453, g = 0.070993$$

###### **4.2.2 Calculating the principal and interest needed to repay**

Debt repayment fund mainly includes two parts: Government subsidies and project benefits. According to PENG YUAN credit rating co., LTD, government subsidies accounted for proportion is as follows:

**Table No. 2 Government subsidies accounted for proportion**

The government level	Operating profit/total profit	Subsidies income/profit
provincial level	26.16%	65.00%
city level	16.38%	89.73%

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county level	-25.73%	126.00%
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According to the principle of weighted average, China's local government debt in the composite proportion of the total amount of profit as the subsidies accounted for:  
 $65.00\%*29.96\%+89.73\%*43.51\% +126.00\%*26.53\% = 91.94\%$  (About 92%)

And then we can conclude that Up to 8% of local government debt is repaid by the project proceeds and the remaining 92% of debt financing is repaid by the disposable financial resources.

In 2012, the infrastructure construction fund is 163.15 billion Yuan in Guangxi province. According to above 6.55% of the current five-year lending rate, and loan principal and interest in 2013 of local financing platform under various sizes are:

**Table No.3 Loan principal and interest of Local financing platform in 2013**  
**(A hundred million Yuan)**

Financing ratio of infrastructure construction	Financing amount	Loan principal and interests in 2013	Local disposable financial resources to repay the debt financing ( 92%)
10%	163.15	173.84	159.93
20%	326.30	347.67	319.86
30%	489.45	521.51	479.79
40%	652.60	695.35	639.72
50%	815.75	869.18	799.65
60%	978.90	1043.02	959.58
70%	1142.05	1216.85	1119.51
80%	1305.20	1390.69	1279.44



**4.2.3 Calculating the expected probabilities of default**

According to

$$DD = \frac{\ln \frac{M_T}{L_T} + \left( g - \frac{\sigma_M}{2} \right) T}{\sigma_M \sqrt{T}}$$

And,

$$P = N(-DD) = N \left[ - \frac{\ln \frac{M_T}{L_T} + \left( g - \frac{\sigma_M}{2} \right) T}{\sigma_M \sqrt{T}} \right],$$

The results are obtained:

**Table No.4 Expected probabilities of default (a hundred million Yuan)**

Financing ratio of infrastructure construction	Financing amount	Local disposable financial resources to repay the debt financing ( 92%)	Distance to Distress	Expected Probability of Default
10%	163.15	159.93	18.60128504	1.56849E-77
20%	326.3	319.86	6.290730273	1.57988E-10
30%	489.45	479.79	-0.910482627	0.81871598
40%	652.6	639.72	-6.019824491	0.999999999
50%	815.75	799.65	-9.982937934	1
60%	978.9	959.58	-13.22103739	1
70%	1142.05	1119.51	-15.95881147	1
80%	1305.2	1279.44	-18.33037926	1

According to the table above, when the leverage ratio of financing Platform Company in Guangxi province is under 20%, the probability of default is very small. When the leverage ratio is above, probability of default increases rapidly. When the leverage ratio is about 35%, probability of default approaches to 1.

#### 4.3 Estimation of the safety scale of the debt

According to KMV company's statistical data analysis, the loan is safe when the credit rating is above BBB (Standard & Poor) or Ba1 (**Error! Hyperlink reference not valid.**). The relationship between EDF and credit rating is as follows:

**Table No.5 Credit Rating and EDF**

EDF	Standard & Poor	Moody
2-4 bp	$\geq AA$	$\geq Aa2$
4-10 bp	AA/A	A1
10-19 bp	A/BBB+	Baa1
19-40 bp	BBB/BBB+	Baa3
40-72 bp	BBB-/BB	Ba1
72-101 bp	BB/BB-	Ba3

*Sources: Standard & Poor and Moody*

That means the expected default probability should be within 40 basis points. This shows that the financing proportion of Guangxi local financing platform should be controlled fewer than 25% and this equals to 10% of local financial revenue.

According to news reports and the amount of the infrastructure financing value of Guangxi province, Guangxi local financing platform financing scale ratio is generally far exceeds more than 30%, and the potential risk of default cannot be ignored.

#### 5. CONCLUSIONS

When we measure the credit risk of local financing platform, the main factors are Local disposable income, Funding Ratio and Government spending on infrastructure. Financing proportion and government infrastructure spending have positive correlation with credit risk. The larger the disposable income is, the smaller the probability of default. So, to increase the fiscal revenue, promote economic growth and improve people's income is a long-term plan.

When measuring the credit risk, the debt used to finance infrastructure spending in Guangxi Province is large and it contains a larger risk. This phenomenon is alarming.

In order to ensure the safety of local debt financing platform, three parties (local government, financing platform and Bank) need to work together. Under the premise of in effective control of debt, government should open source throttling and ensure the source of debt repayment. Local financing platform should be standardized operation. Especially we need to improve the governance structure, Improve Information Disclosure System and adopt the system of responsibility for profit and

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loss. Banks should keep their independence and establish the Credit mechanism for financing platform loan. Financial innovations and cooperation should be adopted to reduce risks.

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