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Risk Management of Local Government Investment and Financing Platform: Evidence from China

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Abstract:

With the rapid development of local government investments and financing platforms, risks due to rapid debt increase have put governments and banks under pressure, these pressures can have very serious consequences. Based on the case study of Henan Investment Group in China, this paper aimed to identify possible risks in Henan Investment Group by evaluating local government investment and financing platform assets. Based on VAR-based Credit Metrics model, the risks of Henan Investment Group were measured and found that its debt risk is being placed in a relatively safe state. But there are still some problems, leading to potential security risks, later corresponding countermeasures to control these risks were proposed based on empirical analysis.

Keywords*: Local government investment, Financing platform, Debt risk, Investment and financing platform, VAR*

I. INTRODUCTION

In 1979, eight counties (districts) borrowed from local governments with liability for reimbursement, marking the beginning of local government financing in China. Local government investment and financing platform (hereinafter the platform) is adopted by local governments to develop an infrastructure for financing; however, the origin of this system goes back to the reform of the fiscal and taxation system issued in 1994. That reform redistributed powers in property and affairs among central and local authorities, increasing the affairs undertaken by local governments and decreasing property power as a financial strain. In addition, according to the Budget Law of the People's Republic of China issued by central government in the same year, offering public bond was not allowed to be executed by local governments (except otherwise stipulated by State Council). In order to solve financial strain problem, local governments began financing through the platform. In 2008, under the effect of global financial crisis, export and consumption in China experienced a sharp decline. Although some achievements and improvements were made by a series of policies and measures placed by central government to cope with the effects of global financial crisis, the platform experienced a rapid expansion throughout the country. This made the platform the most active government investment and financing body. It not only helped the local government completely achieve the 4-trillion-investment plan issued by central government, but also provided financial support for

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the construction of local infrastructure by expanding financing channels. Also, the platform became the main channel for bank funds entering infrastructure construction as it alleviated the deposit pressure of banks. However, the platform caused itself sustained expansion of debt scale and the related risks started to emerge. These risks could result in an imbalance in distribution among entities with inefficient governance. The development of the platform created a variety of problems with considerable danger. If these risks were not governed properly, the potential danger might be transformed into a crisis. After some risk appraisal for the platform enterprises, it was concluded that discovering the inherent mechanism of risk allocation and its existing problems and exploring strategies for achieving risk responsibility, and effective governance were of critical significance to prevent risks in platform companies and capital chain rupture and even the unrest of the whole financial system.

II. AN INTRODUCTION TO THE RISK OF LOCAL GOVERNMENT INVESTMENT AND FINANCING PLATFORM

2.1 Performance of Risk

The risk performance of local government investment and financing platform is mainly consisted of micro and macro aspects. As for micro level, Liu and Zhao (2002) [1] first explored the scale of various government debts and categorized them into four classes according to their degree of association and salience; these categories included implicit direct liability, implicit contingent liability, explicit direct liability and explicit contingent liability. Fang (2014) [2] suggested that local government investment and financing platform faced the following micro risks: high debt ratio itself, unsound governance structure, substantial amounts of top officials and executives, lack of knowledge on business management and risk prevention, and maturity mismatch. Compared with micro risks, macro risks could be of greater concern and have attracted higher attention. Swamy (2015) [3] found that, compared with micro risks, the macro risk of sustained growth of platform debt deserved more attention. For instance, the risk of platform affects central macro policy control, increases the implementation difficulty of development strategies, hinders the reform pace of state-owned enterprises, and damages public credit, influencing the perfection of market economy system and threatening the stability and initiative of money supply.

2.2 Degree of Risk

Researchers hold different views when judging risk degree. Some researchers believe that platform risk is more serious. Liang et al. (2017) [4] believed that the debt of platform was large and risk accumulated quickly and it had to be strictly monitored and controlled. Ying and Pan (2019) [5] calculated debt burden ratio and debt burden rate warning line and showed that local government debt burden rate was still within the scope of international security. However, the debt continued to expand resulting in platform debt to be at inflection point; that is, somewhere between risk and crisis. If debt risk continued, crisis could strike and its consequences could be unimaginable. Contrary to these estimates, some other researchers hold a more optimistic attitude. Liu et al. (2016) [6] suggested that the risk degree of the platform had been exaggerated and will not appear the risk of concentrated outbreak situation Based on practical observations, long-term

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loan program is not pay-off in one time and gradual fractional repayments decrease the risk year after year. In addition, with rapid development of China's economy, financial strength of local government at all levels is constantly increasing and the government's solvency is improved. Therefore, the risk of a loan is unlikely to erupt in short term.

2.3 Cause of Risk

Several internal and external factors can affect platform risk. Firstly, the external factors are significant to the cause. According to Zhang and Dong (2018)[7], the main reasons for financial difficulty in grass-roots governments are the mismatch between financial powers and rights in affairs and the imperfection of financial management system, which leads to relevant risks. Chen et al. (2017)[8] showed that local officials place themselves in a “political tournament”, in which increasing GDP during their term of office was a criterion in assessing their performance. This external assessment mechanism allows officials to vigorously promote infrastructure construction, which expands platform debt and increases its risk. Ware and Banhalmi (2020)[9] assumed that the mismatch between local government and financial institutions was the main reason for the increase of platform debt and risk. Second the internal factors matter. Compared with external reasons, the causes for the platform itself are much less discussed. According to Research Group of Macroeconomic Research Institute of National Development and Reform Commission, the reasons for the development of platform debt risk could be summarized as follows: lack of supervision and restriction mechanism, lack of debt management system, lack of repayment guarantee and over-reliance on land revenue.

2.4 Management of Risk

Based on government budget management, Silaghi and Sarkar (2021)[10] proposed government debt risk management method. First, expose to public the size and composition of debts, the categories and harm of risk, and the possibility of government debt repayment. Second, government debt risk management and its decision-making were brought into the range of government budgets. Third, the behavior of government borrowing debts and taking risks were limited. Fourth, the government was expected to rely on market mechanisms to transfer “contingent risks” to market. Yi et al.(2018) [11] investigated solutions to the problem from the cause of the risk, suggesting that risk salience was mainly caused by the lack of establishment and operation standardizations of the platform and the absence of restraint mechanism. Therefore, he suggested that a set of specific rules and regulations had to be issued for the management of the platform with classified plan on loans making and relevant control on the loan limit and in a meanwhile, the performance appraisal of the platform should be improved. To enhance the financial strength of local government, Liu et al. (2016)[6] proposed that persuasion had to be paid attention to defuse the risks with solutions from the system of organization.6 Officials need to rearrange tax relationship between central and local governments, reasonably divide central and local taxes, increase the government receipts of local governments, to match the local government’s fiscal levy and affairs to be undertaken. The platform is the direct target of risk management. Olejnik (2021) [12] suggested that it was necessary to establish the risk control mechanism of the platform. First, platform transparency had to be

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improved. Then, the marketization of platform financing needed to be promoted. In the next step, banks had to promote more prudent measures for platform's risk management. Finally, responsibility assessment system for local government's financing had to be established. Credit metrics risk control model for computing value at risk (VaR) introduced by JP. Morgan can measure the magnitude of risk of credits and markets, which is considered as a new risk management approach. It enables financial institutions and regulators to intuitively understand the degree of risk, based on which the risk can be monitored and managed.

In summary, concerning infrastructure construction, local government investment and financing platform for financing has rarely been applied abroad; therefore, few relevant research works have been published in the literature. Research on the risk management of local government investment and financing platform is mainly focused on theoretical aspects, which are seldom noticed domestically. The risk research is mostly focused on social integration with the lack of a concrete analysis of risk allocation. Therefore, relevant studies on risk allocation still stays at the stage of macro interpretation, lacking detailed demonstration.

III. HENAN INVESTMENT GROUP: INVESTIGATION AND RISK ANALYSIS

3.1 An Introduction to Henan Investment Group

Henan Province Investment Group Co. Ltd., founded in October 2007, serves as a wholly state-owned company approved by Henan provincial government. It is merged and recombined by former Henan Provincial Construction Investment Corporation and Henan Provincial Economic and Technological Development Company. Henan Provincial People's Government authorizes Henan Provincial Development and Reform Commission as the sole investor for the issuer to fulfill relevant responsibilities. The company has registered capital of 1 billion RMB making it the main body of investment and financing of Henan provincial government. In the "A Group of Companies" development mode of Henan Province, Henan Province Investment Group has become the core of provincial platform as "A Group" holding more than 40 enterprises by investment, involving financial and infrastructure industries such as electricity, cement, paper making, and transportation. The group owns four listed companies of Henan An Cai high tech Co. Ltd, Henan Yu Neng Shareholding Co. Ltd, Henan Tong Li Cement Co. Ltd, and Zhong Yuan Securities Co. Ltd.

The main business scopes of Henan provincial investment group include: investing management, project investment, construction projects for industrial production materials, machinery and equipment, investment projects for required raw materials, and house rental business. According to the annual financial statement of 2014, the company's assets, liabilities and profits accounted for 97.15 billion, 67.814 billion, and 3.819 billion yuan, respectively, with net profit of 3.49 billion yuan.

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3.2 Risk Performance of Henan Investment Group

3.2.1 Financial risk

The main financial indicators of Henan Investment Group are summarized in TABLE I.

TABLE I. The main financial indicators of Henan Investment Group

Financial Indicators	Time			
	2014	2013	2012	2011
Total asset (100 million yuan)	970.15	938.6	845.25	774.57
Including: Monetary fund (100 million yuan)	165.72	130.66	135.38	122.12
Current asset (100 million yuan)	451.49	355.19	275.28	275.41
Inventory (100 million yuan)	50.51	55.96	46.84	42.60
Total liability (100 million yuan)	678.14	703.01	631.74	562.72
Including: Current liability (100 million yuan)	410.21	490.64	419.09	375.11
Total owner's equity (100 million yuan)	292.01	235.6	213.52	211.85
Equity attributable to owners of the parent company (100 million yuan)	192.34	164.93	154.31	154.58
Net cash flow of operation (100 million yuan)	71.78	2.94	51.61	-23.18
Operating income (100 million yuan)	204.29	188.78	194.93	193.44
Total profit (100 million yuan)	38.19	27.26	11.94	8.09
Net profit (100 million yuan)	30.49	20.58	8.05	4.52
Current ratio (%)	110.06	72.39	65.69	73.42
Quick ratio (%)	97.75	60.99	54.51	62.06
Debt asset ratio (%)	69.90	74.90	74.74	72.65
Cash ratio (%)	40.40	26.63	32.30	32.56
Working capital	41.28	-135.45	-143.81	-99.7
Equity ratio (%)	232.23	298.39	295.87	265.62

First, the risk of structure of assets and liabilities. With continuous development of Henan Investment Group, its assets and liabilities have increased with asset-liability ratios during 2011 to 2014 accounting to 72.65%, 74.74%, 74.9%, and 69.9%, respectively, which were slightly higher, and in the same period, property rate was high. In the next few years, with the gradual promotion of enterprise strategy, the implementation of mergers and restructuring plans require continuous increase in company funds. Also, in the next three years, Henan Investment Group plans to make investments with the sum of more than 30 billion yuan, but further expansion of debt scale could bring about a certain degree of negative impact on the long-term solvency of the enterprise. Generally, the current solvency of enterprises are not strong enough, but with more investment plans in the future, the scale of debt could further increase. If its profitability is not improved timely, companies may face greater debt pressure in the long term.

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Second, the greater risk of short-term debt repayment. The cash liabilities of companies from 2011 to 2014 were 37.511 billion, 41.909 billion, 49.64 billion, and 41.21 billion yuan, taking up 66.66%, 66.34%, 69.79% and 60.49 % total liabilities, respectively. In addition, their current assets are 27.541 billion, 27.528 billion, 35.519 billion, and 45.149 billion yuan, respectively, and working capital was negative in the first three years and rebounded in 2014. The current ratio and quick ratio of enterprise are not high, but increasing trends indicated that short-term solvency had gradually increased, but short-term liquidity risks were reduced year by year. It should be noted that if the enterprise faced difficulties in subsequent financing, it could have severe challenges regarding cash flow and short-term debt servicing pressure could further increase.

Third, the risk of future capital expenditure. As the main body of provincial fixed asset investment management in Henan Province, Henan Investment Group takes the responsibility of maintaining and increasing the value of the assets it manages. With the expansion of investment scale, more money is required in electricity, infrastructure and cement industries. From 2014 to 2016, it was expected that the Group could make total investment of 20 billion yuan. As a result, higher capital expenditure in the future could increase the debt ratio of enterprise and debt payment pressure of company.

Fourth, the security risk. Up to September 30th, 2014, the total guaranteed amount of Henan Investment Group's accounted for 6 billion 126 million 920 thousand yuan, including which the share-holding company guarantee balance within the consolidated statements was 5 billion 872 million 950 thousand yuan. On the contrary, non-share-holding company guarantee balance was 253.975 million yuan and the total amount of external guarantee took up 0.98% of consolidated net assets by the end of September 2014. The company's internal security needed to bear joint liability for the related company and the corporations for external guarantee mainly are Zhengzhou Xin Li Power Co. Ltd., Zhong Yuan Petroleum and Chemical Co Ltd, etc. It currently guarantees in a normal state with no overdue phenomenon. If some decline or downturn happens in the financial status of the company and it cannot repay full debt, joint guarantee liability or compensation risk can happen.

3.2.2 Operational risk

First, the macroeconomic fluctuations and cyclical risks in industry. Henan Investment Group's core business scopes such as electricity, cement, paper, and finance are influenced by economic cycle and macroeconomic environment fluctuations. Since 2015, economic growth of China has continued to pullback and its downward pressure has been relatively obvious. The country applies a strategic adjustment in economic structure, especially in the fields of iron, steel, cement and other industries with overcapacity adjustment. Thanks to these adjustments, China has accumulated physical human capital, continuing to release the potential of economic development to find a new growth point. Whether the reform bonus could be released in the future is still uncertain, which could affect the overall profitability of the enterprise.

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Second, the risk for energy supply. The main business income source of Henan Investment Group is the traditional electric power industry accounting for about 40% of its total revenue, which affects the operation of the company. Under the effect of domestic industrial policy adjustment, international macroeconomic situation and impact of natural environment, electricity consumption in the whole society is slowly growing and power surplus could occur in some areas in the future, which could have adverse effects on the operation of power enterprises.

Third, the market competition risk. With the maturity of new dry process cement technology, production capacity is increasing. At the same time, under the influence of macro-control, the growth rate of social fixed asset investment has continuously declined and cement production could result in oversupply, which could affect the economic benefits of cement enterprises of Henan Investment Group. In the process of global economic integration, papermaking enterprises affiliated to Henan Investment Group are not only facing domestic competitors such as Chen Ming Paper, Jin Dong Paper, Hua Tai Group and Sun Paper, but also compete with Swedish, Stora and other well-known foreign paper-making enterprises. In the field of power plate, compared with the five major domestic power groups, the overall strength of Henan Investment Group is still relatively weak. Also, under the effect of coal price, the overall profitability of the electricity sector of Henan Investment Group is greatly affected by market competition, which could influence the overall profitability of the enterprise.

Fourth, the risk on raw material price fluctuation. The electricity power enterprises affiliated to Henan Investment Group are all thermal power plants and the prices of major raw materials and coal have decisive effects on production cost. Under the effect of macroeconomic situations, coal price has been decreased and the production cost of thermal power industry has greatly reduced since 2013, resulting in great profit for power sector enterprises. In recent years, the prices of major raw materials for paper-making enterprises have increased, decreasing the profit margins of paper-making enterprises.

Fifth, the environmental risk. Henan Investment Group's main businesses involve cement, paper making and other industries that cause environmental pollution. Although current production targets of the enterprises have reached or exceeded the environmental standards required by the state and industry, unexpected accidents in daily production and operation could cause adverse effects on environmental safety affecting the normal operation of the main business enterprise.

3.2.3 Management risk

First, the risk of diversification. The operation scopes of Henan Investment Group mainly includes electricity, transportation, paper making, cement, traditional advantage industries and two major sectors of modern financial industry with more share-holding companies. Diversified management has increased the difficulty of enterprise management in terms of investment decision-making and internal control. Ill management could affect the development of the main businesses of enterprise, causing danger to enterprise management.

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Second, the risk of managing and controlling subsidiaries. By the end of 2018, there were 43 wholly-owned and share-holding subsidiaries in consolidated statements. These subsidiaries belong to different industries including cement, pulp and paper, agriculture and forestry, processing industries, financial industries, modern services, infrastructure and basic industries. The group can reduce and diversify its business risks by diversification, but it also brings about management difficulties. How to carry out strategic, financial and market coordination on the subsidiary company, as far as the Group is concerned, its management ability is facing severe challenges.

Third, the risk of safety production. There are many subsidiaries affiliated to Henan Investment Group, therefore, safety production is the basis of the normal production and operation of these subsidiaries as well as guarantee of economic benefits. Due to the presence of many factors affecting production safety, in case of emergency incidents affecting production safety in one or more of its subsidiaries, the normal operation of the enterprise will be negatively affected.

3.2.4 Policy risk

First, the adjustment risk of state-owned asset management system. The state-owned capital operation of the company is affected by relevant requirements of the state on state-owned asset management. Guiding opinions on deepening the reform of state owned enterprises issued by the State Council and Opinions on reforming and improving the management system of state-owned assets issued by the State Council emphasize on deepening state-owned enterprise reform to improve state-owned asset management system and promote the transformation of the functions of state-owned asset supervision institutions. Adjustment of this kind of policy affects the state-owned capital operations of the company. On March 10th, 2015, Henan province officially issued Opinions on the investment and financing mechanism in key areas of innovation and the encouragement of social investment, which highlighted the need to vigorously promote PPP （Public-Private-Partnership）model, asset securitization, establishment of industrial investment fund, and equity financing to help and guide social capital, especially private capital investment, public services, infrastructure and other key areas. The adjustment of investment and financing mechanism is undoubtedly a good news for Henan Investment Group; however, future policy direction is uncertain and policy risk still needs to be evaluated.

Second, the risk of cement policy. On February 6th, 2010, State Council issued NO. 7 documents of Notice on further strengthening the elimination of backward production capacity, which emphasized changing economic development mode and promoting industrial structure adjustment and optimization. The Notice also classified the contents of cement industry targets. The macro-control policies of cement industry might have an adverse impact on existing projects and future investment plans, bringing uncertainties to the normal production and operation of enterprises.

Third, the risk of environmental policy. The main pollutants produced by thermal power generation industries of Henan Investment Group include sulfur dioxide and nitrogen hydride. Based on new requirements for atmospheric governance in China, State Environmental Protection Administration plans

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to gradually execute flue gas denigration after initial control of sulfur dioxide. Cement and paper industries are also highly polluting industries; therefore, in recent years, the state has put forward higher requirements for environmental protection standards. For instance, the Guiding opinions on energy saving and emission reduction in cement industry issued by the Ministry of Industry and Information Technology and Standard for discharge of water pollutants in pulp and paper industry issued by the Ministry of Environmental Protection will increase investment and costs in enterprise affiliated enterprises, which further affects line operation.

Fourth, the risk of regulatory policy on electricity prices. Electricity price is a critical factor affecting the profitability of power industry. Currently, electricity price is still increasing by the state. China increased sales price and electricity price twice in April and November 2011. On August 20th, 2014, benchmark tariff for coal-fired power generation enterprises was decreased. On December 22nd, 2016, the pricing method of power transmission and distribution tariff for provincial power grids (trial implementation, NO. NDRC [2016]2711) issued by National Development and Reform Commission stipulated the pricing principle and price calculation method of power transmission and distribution for provincial power grids. The reform of electricity market is ongoing; therefore, the profitability of power generation enterprises is facing uncertainties.

Fifth, the risk of transportation policy. Transportation is a basic industry in national economy which has been supported by the country in a certain period of time. Increase of investment in transportation industry by Henan Investment Group is closely related to the industry policies issued by the country; however, in the future, national or local government industry policies may be adjusted. Regulations on toll highway administration issued by the State Council in September 2004 and came into effect in November of the same year argued that non-toll highways had to be developed and the maximum toll period for highways in central and eastern regions had to be 25 years. The policy will have a certain impact on the long-term sustainable development of subordinate transportation industry.

IV. THE RISK OF HENAN INVESTMENT GROUP: AN EMPIRICAL RESEARCH

4.1 Design of Credit Metrics Model

Credit Metrics model is a statistical analysis-based risk measurement technique to calculate the VAR value. We usually call it “risk value” or “value at risk”. Credit Metrics is the maximum loss value of a financial asset that may occur at a certain time in the future at a certain confidence level; that is, the market value of financial assets at risk in some period of time.

Three hypothetical conditions could be considered for Credit Metrics Model: First, there is no market risk; second, credit risk is normally distributed; and third, the risk lasts for one year. This is subject to the credit rating transition matrix of rating agencies, and these transition matrices have a limited time of one year.

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Credit Metrics model is divided into three steps for measuring the risk of a bond or a single loan.

4.1.1 Determining credit transition matrix

In Credit Metrics model, credit risk is related not only to breach of contract, but also to credit level change in company. Credit ratings fall into 8 categories, as summarized in TABLE II. Among the categories, Class AAA has the highest credit rating, indicating that the company has a very good credit position and Class D presents the lowest rating, meaning that the company is not able to repay the debt.

TABLE II. Default risk corresponding to credit

Level	Default Risk
Class AAA	Excellent credit, strongest solvency, and lowest risk of default
Class AA	Better credit, stronger solvency, and lower risk of default
Class A	Good credit, non-difficulty solvency under normal circumstances, and low risk of default
Class BBB	General credit, general solvency, and general risk of default
Class BB	Poor credit, weak solvency, and high risk of default
Class B	Poorer credit, weaker of solvency, and higher risk of default
Class CCC	Poorest credit, weakest of solvency, and highest risk of default

Credit rating agencies in China are still in developing stage and there is not a good credit risk transfer matrix. Internationally, the credit rating conversion matrix used to calculate bank credit risk management is mostly from the world's three largest rating agencies, including standard & Poor's, Moody's, and Fitch. However, as for Shanghai which developed financial market earlier since 1998, Shanghai branch of the people's Bank of China has conducted credit rating for enterprises from which more complete data could be obtained. Therefore, it is of higher practical significance to study the transition probability matrix of credit rating for credit enterprises in Shanghai, as given in TABLE III.

TABLE III. Credit rating transition probability matrix of Shanghai loan enterprise within one year

Level	Year-end rating								
Initial Grade	AAA	AA	A	BBB	BB	B	CCC	CC	C
AAA	90.68	6.01	3.31	0	0	0	0	0	0
AA	13.15	66.7	12.58	4.47	3.1	0	0	0	0
A	1.02	20.21	65.3	11.06	2.01	0.4	0	0	0
BBB	0	1.51	21.41	58.34	13.95	3.17	1.62	0	0
BB	0	0	4.73	18.22	55.41	16.67	3.65	1.32	0
B	0	0	0	3.17	27.92	45.63	17.65	3.82	1.81
CCC	0	0	0	1.58	1.09	10.67	68.45	15.82	2.39

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CC	0	0	0	3.67	1.01	4.56	12.1	65.78	12.88
C	0	0	0	0	0	0	0	9.12	90.88

4.1.2 Estimation of the forward loan value of each credit rating

We divided the credit rating into two categories; one was default event D, and the other was the remaining credit rating. Since the rating of loan was very similar to that of bond, we used zero-yield curve of corporate bond to estimate loan value. According to credit grade change and zero-yield curve, we reappraised the residual cash flow of bonds for each credit level within a certain risk range.

Once defaulted loan appeared, cash flow was ceased and only recycling value was recovered. Therefore, we applied default recovery method to conduct the estimate. According to the bank rating issued by Standard & Poor's, if we conducted default recovery rate according to the credit level of the loan, recovery rate would be statistically different for different credit ratings, as presented in TABLE IV.

TABLE IV. Loan recovery of various levels

Level	**AAA**	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**
rate of recovery (%)	78	77	57	53	42	35	17

TABLE V shows the discount rate data obtained by JP Morgan, which was used to discount future cash flows. The access to the market values of different credit rating loans is from the use this form of data to discount future cash flows into current values.

TABLE V. Discount rates of different credit ratings

Level	**First Year**	**Second Year**	**Third Year**	**Fourth Year**
AAA	3.60%	4.17%	4.73%	5.12%
AA	3.65%	4.22%	4.78%	5.17%
A	3.72%	4.32%	4.93%	5.32%
BBB	4.10%	4.67%	5.25%	5.63%
BB	5.55%	6.02%	6.78%	7.27%
B	6.05%	7.02%	8.03%	8.52%
CCC	15.05%	15.02%	14.03%	13.52%

The most significant characteristic of Credit Metrics model is that it takes into account the company's credit. If the credit rating of company is increased, default risk is decreased and loan value is increased. On the other hand, if credit rating is decreased, default risk is also increased and loan value is decreased. The equation of loan value after one year is as follows:

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$$p = R + \sum_{i=1}^{n-1} \frac{R}{(1+r_i+S_i)^i} + \frac{R+F}{(1+r_n+S_n)^n} \quad (1)$$

where R is a fixed annual interest rate, N is loan period, F is the amount of loan, ri is long-term zero interest rate for year i, which is called risk-free interest rate, and Si is first year credit risk spreads for certain credit rating loans.

4.1.3 Calculation of VaR value

First, the average value of forward loan "V" was calculated based on the loan valuation for each credit rating.

$$V = \sum_i (v_i * p_i) \quad (2)$$

where subscript i represents 8 credit ratings, Vi is loan valuation for each credit rating, and pi is the probability of transferring to credit level at the end of the year.

Then, the standard deviation of the loan was obtained as:

$$\sigma = \sqrt{\sum_i p_i * (v_i - v)^2} \quad (3)$$

Finally, VAR was calculated when the return on asset value obeyed normal distribution.

$$VAR = \emptyset(c)^{-1} * \sigma * F \quad (4)$$

Where c is confidence degree and F is loan value.

4.2 Calculation of VAR and Its Result Analysis

On March 13th, 2015, Henan Investment Group issued medium-term bond for sum of 1 billion yuan. The bond was fixed rating for 10 years with nominal interest rate of 5.88%. The credit rating of Henan Investment Group was Class AAA, which was the same to its bond credit rating. Bonds were issued without security, which explained the recognition of capital market for the investment and financing platform of Henan Investment Group. Of the funds raised by the bonds, 700 million yuan was used by Henan Investment Group and its subsidiaries to supply operating capital and repay bank loans, and the remained 300 million yuan was used for project construction by Xinxiang Zhong Yi Power Company Limited and Hebi Tong Li Power Company with Limited Liability.

Credit Metrics model was used to measure the risks of the issued bonds based on the following analysis process:

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4.2.1 Determination of credit transition matrix

We applied credit rating transition matrix sorted out by the Shanghai Branch of People's Bank of China. Currently, both credit rating and bond credit rating of Henan Investment Group are Class AAA and the migration probabilities of other credit ratings are shown in Figure 1:

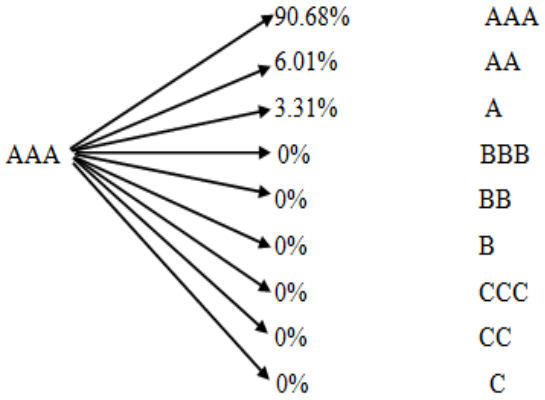

Fig 1: Migration probabilities of r credit ratings of Henan Investment Group

In Fig. 1, AAA on the left is the existing credit rating of bond issuer and that on the right is a possible credit transfer. The maximum possibility (90.68%) is to maintain the original credit rating.

4.2.2 Estimation of the forward loan value of each credit rating

As presented in Fig. 1, when we found out the credit level corresponding to the issuer, we could determine discount rate for each year and calculate the value of each credit rating at the end of each year. For any credit bond (loan) that is known to us, we could calculate long-term values at various interest rates. As was seen in the figure, the total amount of securities issued by Henan Investment Group was 1 billion yuan with nominal interest rate of 5.88%. Then, we calculated fixed annual interest as R=10×5.88%=0.0588 billion.

The issuance of bonds of the Group was as follows: Henan Investment Group issued 10-year fixed rate bonds for 1 billion yuan with the nominal interest rate of 5.88% with credit rating of Class AAA which was the same for its issuer's and in the condition of stability in March, 2015. The value at the end of each credit rating was as follows (100 million):

$$V_{AAA} = 0.588 + \frac{0.588}{(1+3.6\%)} + \frac{0.588}{(1+4.17\%)^2} + \frac{0.588}{(1+4.73\%)^3} + \frac{10+0.588}{(1+5.12\%)^4} = 10.88$$

$$V_{AA} = 0.588 + \frac{0.588}{(1+3.65\%)} + \frac{0.588}{(1+4.22\%)^2} + \frac{0.588}{(1+4.78\%)^3} + \frac{10+0.588}{(1+5.17\%)^4} = 10.86$$

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$$V_A = 0.588 + \frac{0.588}{(1+3.72\%)} + \frac{0.588}{(1+4.32\%)^2} + \frac{0.588}{(1+4.93\%)^3} + \frac{10+0.588}{(1+5.32\%)^4} = 10.8$$

$$V_{BBB} = 0.588 + \frac{0.588}{(1+4.1\%)} + \frac{0.588}{(1+4.67\%)^2} + \frac{0.588}{(1+5.25\%)^3} + \frac{10+0.588}{(1+5.63\%)^4} = 10.7$$

$$V_{BB} = 0.588 + \frac{0.588}{(1+5.55\%)} + \frac{0.588}{(1+6.02\%)^2} + \frac{0.588}{(1+6.78\%)^3} + \frac{10+0.588}{(1+7.27\%)^4} = 10.15$$

$$V_B = 0.588 + \frac{0.588}{(1+6.05\%)} + \frac{0.588}{(1+7.02\%)^2} + \frac{0.588}{(1+8.03\%)^3} + \frac{10+0.588}{(1+8.52\%)^4} = 9.76$$

$$V_{CCC} = 0.588 + \frac{0.588}{(1+15.05\%)} + \frac{0.588}{(1+15.02)^2} + \frac{0.588}{(1+14.03\%)^3} + \frac{10+0.588}{(1+13.52\%)^4} = 8.32$$

The bonds issued by Henan Investment Group were unsecured with the credit rating of Class AAA and recovery rate of 78%. Therefore, we could calculate that:

$$V_D = 10 * 78\% = 7.8(100 \text{ million})$$

In conclusion, we could obtain the actual distribution of loan value at the end of the year by combining loan value at different levels with transition probability, as summarized in TABLE VI.

TABLE VI. The values of grade AAA bonds at various credit levels at the end of the first year

Year-end Credit Rating	Probability of Ranking Transition (%)	Forward Value (100million)
AAA	90.68	10.88
AA	6.01	10.86
A	3.31	10.8
BBB	0	10.7
BB	0	10.15
B	0	9.76
CCC	0	8.32
D	0	7.8

4.2.3 Calculation of VaR value

First, the long-term average valuation (V) of loans was calculated based on loan valuation for each credit rating as:

$$V = \sum_i (V_i * p_i) \quad (5)$$

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V=90.68%*10.88+6.01%*10.86+3.31%*10.8+0%*10.7+0%*10.15+0%*9.76+0%*8.32+0%*7.8=10.88（100 million）

Then, the standard deviation of the loan was obtained according to the following equation.

$$\sigma = \sqrt{\sum_i p_i * (v_i - v)^2} \tag{6}$$

$$\sigma^2 = 90.68\% * (10.88 - 10.88)^2 + 6.01\% * (10.86 - 10.88)^2 + 3.31\% * (10.8 - 10.88)^2 + 0\% * (10.7 - 10.88)^2 + 0\% * (10.15 - 10.88)^2 + 0\% * (9.76 - 10.88)^2 + 0\% * (8.32 - 10.88)^2 + 0\% * (7.8 - 10.88)^2 = 0.00023588$$

$$\sigma = 0.015$$

Eventually, VaR value was obtained for the case that return on asset value followed a normal distribution at the confidence degree of 95% as:

$$VAR = \phi(c)^{-1} * \sigma * F \tag{7}$$

$$VAR = 1.65^{-1} * 0.015 * 10 = 0.09(100 \text{ million})$$

The results indicated that under the condition that loan value followed a normal distribution, if some risk happened in the bonds for 1 billion yuan issued by Henan Investment Group within a year, there was a 5% chance that the Group could suffer a maximum loss of 9 million yuan. The debt risk of Henan Investment Group is in a relatively safe state. However, when analyzing some specific indicators, it was found that this platform company faced the problems of lack of solvency, relatively weak profitability, strong dependence on government finance, etc. Its debt risk still got in hidden trouble of security and needed more prevention.

V. SUGGESTIONS FOR RISK MANAGEMENT OF LOCAL GOVERNMENT INVESTMENT AND FINANCING PLATFORM

After measuring the risk of the bonds issued by Henan Investment Group based on Credit Metrics Model, it was be found that the risk was within the controllable range. However, the particularity of the platform determined that its development mainly relied on future local economic growth, driven by the increase of local fiscal revenue, land appreciation, investment attraction and other factors, which had systemic risks. The emergence of financing platform debt was a result of historical development with a series of political and economic reasons. We had to improve the relevant system and simultaneously protect ourselves against its risks when the platform performed its functions. The Chinese government has issued a series of documents to regulate local government investment and financing platforms, such as the State Council's Opinions on Strengthening Local Government Debt Management (No. 43) issued by the

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State Council of China in 2014, allowing local governments to appropriately borrow. [13] At the same time, local government investment and financing platforms can no longer obtain loans from banks with land as collateral; they also have to adhere to the principle of "borrowing, using, and returning" and require the establishment of local government debt risk warning mechanism, which regulates platform debt management.

The risk of local government financing platform is multi-faceted; hence, credit risk is prevented not only in terms of financial institutions. We had to fundamentally reduce and defuse local government financing platform risk based on loan risk characteristics, risk causes and factors, government, platforms, financial institutions and other aspects of the combination. Related suggestions are as follows:

5.1 Suggestions for Local Government

5.1.1 Changing government functions and enhancing awareness of risk liability

The government is expected to take a more active part in risk management, clearly define risk liability and scope, specifically define risk behaviors and their corresponding liabilities, and actively assume relevant risk responsibilities.

5.1.2 Innovating local government financing tools to strengthen investment and financing management

Recently, the debt ratio of local government financing platform has increased and the proportion of direct financing has decreased. Government can adopt different financing or management subjects and implement various financing methods according to the characteristics of each project. By promoting asset securitization and listing financing, government can promote qualified investment and finance companies to be listed as a whole or just for controlling share companies. Government can also finance through stock market to expand the financing scale of the equity. Also, government can finance creditor's right of trust or insurance funds and strengthen cooperation with equity institutions and foreign-funded enterprises. At the same time, government can help domestic and foreign investment and financing mechanisms, construction and management advantages, and make finance with BOT, TOT, PPP in public facilities, environmental protection, medical care and other social undertakings for the introduction of funds and technology.

5.1.3 Establishing a supervision system for local government debt

Local government should continue to implement strict administrative control and management measures including formulating a regular system of local government debt as well as providing a comprehensive and detailed reporting system, the annual amount control system of the local government, approval system for single bond issuance and debt management accountability and correction mechanism. Government should also improve local government debt monitoring system and bring all government revenue and expenditure into budget management. Furthermore, we have to establish a comprehensive monitoring system through cooperation with National People's Congress, financial sector, people's Bank,

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audit department and judicial departments. Reasonably designing a scientific special index system and objectively reflecting the level of local government debt management can other methods to enhance the predictability of risk.

5.2 Suggestions for Local Government Financing Platform

5.2.1 Transforming management concept and following market principle

On the one hand, we need to appropriately reduce investment scope in the government investment and financing platform, allow the market be managed by itself, and give full play to the decisive role of market in resource allocation so as to achieve mutual benefit between government and enterprises. On the other hand, we should use market-oriented methods to promote the standardization of investment and financing platform companies, enhance the adaptability of market, and improve the efficiency of platform operation. As for the platforms that have completed the initial integration of resources within the region with total assets reaching a certain scale, enterprise value can be improved through reconstructing entities and ultimately improving the level of enterprise management and operation to adapt to changing internal and external environments.

5.2.2 Integrating platform resources and properly dealing with debt stock

It is suggested that we realize the real situation and integrate local government financing platform for the company. For some platform companies without project qualifications, search and liquidation should be carried out. We should make job reorganization and integration for platform companies with overlapping functions to improve the efficiency of platform operation. We should also integrate its internal resources and urban advertising, culture, talent and other resources to enhance the core competitiveness of the platform and improve its profitability. Also, we have to continuously develop and expand profitable businesses and select long-term businesses with high return on investment and stability to reduce debt burden and related risks. Through the integration of platform resources, we can form the layout of state-owned assets to meet the requirements of developing modern urbanization and provide tension for coordinated development among regions.

5.2.3 Introducing capitals from central and private enterprises to promote mixed ownership reform

Introducing social capital into urban infrastructure construction by means of PPP can not only resolve debt crisis but also strengthen the vitality of the platform itself. We have to gradually promote large-scale investment and financing platforms and strengthen docking and cooperation with financial institutions to enhance indirect financing capability. After the completion of resource integration and organizational restructuring, we also have to constantly optimize their debt structure, dissolve platform debt stock and control the increment of platform debt.

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5.2.4 Building risk early warning system

Platform risk warning is a result of multiple tools for joint analysis. In order to reduce debt risk, we have to consider various risk-related factors in the same system and strictly control them to finally realize dynamic monitoring and whole process supervision of risk pre-warning. According to the target of risk control, platform can warn the debt out of bounds or irrational public debt structure in advance. If the situation is serious, immediate measures should be taken to limit the further expansion of debt financing scale. In another words, for government debt whose accumulated scale is below the level of debt risk control, risk is within the controllable range and moderate debt financing can be allowed for platform companies.

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