Assessing the Strength of Implicit Government Guarantees Using the PMC Index

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Abstract: Implicit administration guarantees are widely perceived in financial markets, yet their strength is difficult to quantify. This paper proposes a novel approach to measuring the strength of implicit administration guarantees by text analysis techniques. By analyzing the documents of administration's management of municipal investment bonds, management signals were extracted. Empirical evidence shows that the PMC-Index effectively captures temporal variations in perceived implicit administration guarantee strength from 2008 to 2024, revealing a gradual weakening of implicit administration guarantees over time. The results demonstrate that the PMC-Index provides a useful quantitative tool for measuring implicit administration guarantees.

Keywords: Implicit Administration Guarantee; Municipal Investment Bonds; PMC-Index; Text Analysis

1. Introduction

In many Chinese cities, state-owned enterprises known as city development investment companies play a crucial role in financing urban infrastructure projects by issuing municipal investment bonds. In 2023, a total of 4.89 trillion RMB in municipal investment bonds were issued. In factly, these bonds fall under the category of corporate bonds. However, since city development investment companies are state-owned entities, the funds raised are predominantly allocated to infrastructure development and urban construction. While the repayment of municipal investment bonds is primarily sourced from the company's operating revenue, the long investment cycles and low returns associated with urban infrastructure projects often result in repayment funds indirectly relying on local government revenue. Consequently, municipal investment bonds are widely perceived as being backed by the creditworthiness of local governments, earning them the designation of "quasi-municipal bonds". However, this support is not legally mandated but constitutes an implicit government guarantee. In practice, when a city development investment company faces the risk of default, local governments frequently intervene to support debt repayment, motivated by the need to maintain stable financing channels. This phenomenon exemplifies the concept of implicit government guarantees[1,2]. Although local governments are not legally obligated to guarantee bonds issued by city development investment companies, empirical evidence suggests that the market perceives an implicit government guarantee. Studies have shown no statistically significant difference in credit spreads between unsecured municipal investment bonds and those backed by third-party guarantees. This indicates that investors factor in expectations of government support for unsecured bonds [3]. In the event of a default on municipal investment bonds, the creditworthiness and future financing capacity of the issuing city development investment company would be severely impacted. As a result, local governments are likely to intervene through various channels to support their municipal investment platforms and facilitate bond repayment. Moreover, research suggests that the influence of implicit government guarantees varies across regions, with more pronounced effects in areas with stronger fiscal capacity than those with weaker financial conditions[4,5]. Given these dynamics, analyzing the implicit government guarantees associated with municipal investment bonds and the regulatory policies governing them is essential for understanding their role in mitigating debt risks and advancing market-oriented financial reforms [6,7].

There are three primary approaches to measuring the intensity of implicit government guarantee (IIGG). The first approach relies on indicators such as local government fiscal revenue and economic growth rates to assess the extent of implicit government guarantees. However, this method may introduce significant heterogeneity, as the degree of implicit guarantees can vary across different bonds[8]. The second approach evaluates IIGG based on the extent of government support for state-owned enterprises. While this method provides valuable insights, the data primarily reflects explicit rather than implicit guarantees, limiting its applicability. The third approach involves innovative methodologies, such as the Merton option pricing formula and the orthogonal decomposition method. However, due to the prevalence of non-listed state-owned enterprises in China, obtaining the necessary parameters for the Merton option pricing model presents a significant challenge, restricting its practical implementation.

Reducing reliance on implicit government guarantees for municipal investment bonds can help balance financial risk mitigation and local government debt management, promoting high-quality development in both the financial sector and the broader economy[9]. In response, the central government and relevant regulatory authorities have issued a series of policy documents to regulate the development of municipal investment bonds. For instance, in September 2014, the State Council released the "Opinions on Strengthening the Management of Local Government Debt", commonly called the No. 43 policy, which sought to restrict local governments from borrowing through corporate entities. However, studies indicate that the No. 43 policy, intended to correct investor misconceptions regarding implicit government guarantees for municipal investment bonds, has had limited impact, as it has not led to significant changes in market perceptions [10]. This raises two key questions: Have these policies effectively altered expectations regarding implicit government guarantees for municipal investment bonds? Have they contributed to improved risk management? While some scholars have analyzed specific policies, a comprehensive and systematic examination of their impact remains lacking.

This paper uses an advanced computational text analysis technique to examine 17 key policy documents related to the standardized development of municipal investment bonds. Furthermore, given that the Policy Modelling Consistency Index (PMC-Index) model is a comprehensive evaluation framework for assessing policy effectiveness[11], this study applies the PMC-Index model to evaluate the impact of these policies on mitigating expectations of implicit government guarantees. This analysis proposes a new method for quantifying the intensity of implicit government guarantees associated with municipal investment bonds.

This paper makes two contributions. First, it evaluates the effectiveness of policies aimed at reducing implicit government guarantees for municipal investment bonds using the PMC-Index model. Second, it proposes a new methodology for quantifying the intensity of implicit government guarantee. This approach provides new insights and analytical tools for investors and regulatory authorities to assess and manage risks associated with municipal investment bonds, thereby improving risk perception, and contributing to the market's sustainable development.

The remainder of this paper is organized as follows. Section 2 introduces a measurement methodology for implicit government guarantees expectation based on the PMC-Index model; Section 3 presents a textual analysis of policy documents pertinent to municipal investment bonds; Section 4 includes both the computation of the PMC-Index and the computation of intensity of implicit government guarantee derived from this textual analysis; Section 5 summarizes the conclusions.

2. IIGG Measurement Based on PMC-Index

The construction of the implicit government guarantee measurement model based on the PMC-Index model follows this process.

The first step is keyword extraction, which entails identifying relevant keywords from policy documents related to municipal investment bonds. This process is a crucial element of financial policy analysis, as it significantly improves the efficiency of recognizing and understanding policy information. The methodology relies on the structured processing of textual data to systematically examine the themes within policy texts and extract key information. This study incorporates all relevant policy texts in its

keyword analysis to facilitate a comprehensive exploration of terms associated with implicit government guarantees in various management documents concerning municipal investment bonds. By synthesizing the results of the TF-IDF and Text-Rank algorithms, this research seeks to identify thematic words that capture the essence of government implicit guarantee policies for municipal investment bonds.

The second step is co-word analysis, which involves a statistical examination of the frequency with which keywords appear across different documents, thereby highlighting their degree of association. The relationships between keywords form a co-word network, where the proximity and connectivity of keywords provide a direct visual representation of the interrelations among the topics each keyword represents. In this study, hierarchical clustering analysis is applied to categorize the extracted thematic words, aiming to elucidate further the underlying characteristics of implicit government guarantee policies related to municipal investment bonds.

Finally, the intensity of implicit government guarantee is computed based on the PMC index. The PMC-index model is particularly effective for analyzing and evaluating complex systems associated with economic and social policies. The series of policy documents related to municipal investment bonds issued by the government aims to reduce public expectations of implicit government guarantees while enhancing the risk management capabilities of all stakeholders. If these policies achieve their objectives, we expect an increase in the PMC-Index and a corresponding reduction in implicit government guarantees. We propose a straightforward yet robust conversion formula that links the PMC-index to implicit government guarantees, offering a new methodology for calculating such guarantees.

In the next section, we will provide a detailed introduction to the PMC index, which evaluates the policy effects related to the standardization of municipal investment bonds.

2.1 Variables of PMC-Index Model

We first conducted a comprehensive collection of relevant policy documents to construct the PMC-Index model for evaluating the consistency of policy documents on municipal investment bonds. We selected samples from various national-level departments and agencies, including the State Council, the Ministry of Finance, the People's Bank of China, and the National Development and Reform Commission. Drawing on existing research on PMC-Index models, we established a set of indicators to assess policy documents aimed at standardizing the development of municipal bond issuance.

(1) Main-variables and Sub-variables

The construction of the PMC-Index involves using forty-two sub-variables distributed across ten main variables. These ten main variables are as follows: characteristics of policy (P_1), validity of policy (P_2), areas of policy application(P_3), policy sources (P_4), incentives and guarantees of policy (P_5), policy functionality (P_6), operational levels of policy (P_7), subjects addressed by policy (P_8), impact levels of policy (P_9), and policy transparency (P_{10}). P_1, P_2, P_4, P_9, and P_{10} assess the quality and transparency of policies based on their fundamental attributes. P_3, P_5, P_6, P_7, and P_8 evaluate policies from the perspectives of coverage, incentive mechanisms, functional positioning, influence scope, and target audience. This study identifies municipal investment bond policies in terms of their ability to manage risks, address implicit government guarantees, and regulate and adjust financial mechanisms. The main variables and sub-variables are presented in Table 1.

(2) The use of a multi-input-output table

The multi-input-output table serves as an alternative database analysis framework, enabling the storage of large volumes of data to measure individual variables (see Table 2). It serves as the fundamental analytical framework for evaluating the "n" primary variables, each comprising"m"sub-variables. The number of sub-variables within each main variable is not subject to any fixed limit. Consequently, the multi-input-output table does not incorporate any ranking mechanism based on the relative importance of variables.

The main variables encompass various dimensions, including the nature of the policy, its effectiveness, and the policy domain. The sub-variables further refine these dimensions by providing more specific evaluative indicators. Each sub-variable associated with a main variable has been carefully designed to ensure a comprehensive representation of all aspects of the policy. All 42 sub-variables are assigned equal importance (weight), as the objective is to measure a single value—the PMC-Index.

Table 1. Main-Variables and Sub-Variables for the PMC Index

Main-variables		Sub-variables	
P_1	Characteristics of policy	P_{11}	Prediction
		P_{12}	Regulation
		P_{13}	Recommendation
		P_{14}	Describe
		P_{15}	Identification
		P_{16}	Orientation
P_2	Validity of policy	P_{21}	Long-term
		P_{22}	Mid-term
		P_{23}	Short-term
P_3	Areas of policy application	P_{31}	Economy
		P_{32}	Society
		P_{33}	Technology
		P_{34}	Politics
		P_{35}	Environment
P_4	Policy sources	P_{41}	State Council
		P_{42}	Government ministries
		P_{43}	Provincial Government
		P_{44}	Municipal departments and bureaus
P_5	Incentives and guarantees of policy	P_{51}	Legal safeguards
		P_{52}	Technical guidance
		P_{53}	Financial support
		P_{54}	Tax reduction and exemption
		P_{55}	Investment subsidy
P_6	Functional of policy	P_{61}	Standard guidance
		P_{62}	Risk prevention
		P_{63}	Investments Optimizing
		P_{64}	Infrastructure
		P_{65}	Establish a robust system.
P_7	Operational levels of policy	P_{71}	National Development
		P_{72}	Regional Economy
		P_{73}	Industrial structure
		P_{74}	Business operation
		P_{75}	Product Standards
P_8	Subjects addressed of policy	P_{81}	Local government
		P_{82}	Business
		P_{83}	Financial institutions
		P_{84}	The general public
P_9	Impact levels of policy	P_{91}	Laws and regulations
		P_{92}	Administrative Regulations
		P_{93}	Department regulations
		P_{94}	Standards documents
		P_{95}	Industry Standards
P_{10}	Transparency of policy	P_{10}	Transparency of policy

Table 2. Multi-Input-Output Table

Main-variables	Sub-variables
P_1	P_{11}:1 P_{12} :2 P_{13} :3 P_{14} :4 P_{15} :5 P_{16}:6
P_2	P_{21}:1 P_{22} :2 P_{23}:3
P_3	P_{31}:1 P_{32}:2 P_{33}:3 P_{34}:4 P_{35}:5
P_4	P_{41}:1 P_{42}:2 P_{43}:3 P_{44}:4 P_{45} :5
P_5	P_{51}:1 P_{52}:2 P_{53}:3 P_{54}:4 P_{55}:5
P_6	P_{61}:1 P_{62}:2 P_{63}:3 P_{64}:4 P_{65}:5
P_7	P_{71}:1 P_{72}:2 P_{73}:3 P_{74}:4 P_{75}:5
P_8	P_{81}:1 P_{82}:2 P_{83}:3 P_{84}:4 P_{85}:5
P_9	P_{91}:1 P_{92}:2 P_{93}:3 P_{94}:4 P_{95}:5
P_{10}	P_{10}:1

Establishing the multi-input-output table provides a structured analytical framework for policy evaluation, serving as a foundation for subsequent quantitative analysis. By utilizing Table 2, policy indicators can be systematically organized and quantified, facilitating the calculation of the PMC-Index to assess risk reduction and guarantee mechanisms in municipal bond management policies.

2.2 IIGG Measurement

Measuring the intensity of implicit government guarantees based on the PMC-Index involves five steps. The first step is to put the 10 main variables and 42 sub-variables into the multi-input-output table.

$$P_{ij} = \begin{cases} 1, The\ feature\ is\ showed\ in\ the\ policy\ text. \\ 0, The\ feature\ is\ not\ showed\ in\ the\ policy\ text. \end{cases} \quad (1)$$

P_{ij} is the *j-th* sub-variables of *i-th* main-variables.

The second step is to evaluate sub-variables by sub-variables according to the parameters mentioned above Eq(1).

$$P_i = \frac{\sum_{j=1}^{n_i} P_{ij}}{n_i} \quad (2)$$

The third step is to calculate the value of each main-variable. This value is the sum of all sub-variables divided by the total number of sub-variables.

$$PMC = \sum_{i=1}^{10} \sum_{j=1}^{n_i} \frac{P_{ij}}{n_i} \quad (3)$$

n_i is the number of sub-variables.

The fourth step is the actual measurement of the PMC. The last step is measuring the intensity of the implicit government guarantees. The calculation of the intensity of the implicit government guarantee is presented in formula (4). A series of policies issued by various levels of government and departments aimed at managing municipal investment bonds are intended to eliminate investors' expectations of

implicit government guarantees. Therefore, if these policies effectively reduce implicit guarantee expectations and lower the risks associated with municipal investment bonds, the potential demand for implicit government guarantees will decrease, and the intensity of implicit government guarantees will accordingly decrease. Therefore, based on the municipal investment bond policy, the intensity of implicit government guarantee (IIGG) is defined as follows, referring to the distribution of the PMC-Index.

$$IIGG = 10 - PMC \quad (4)$$

In the above Eq. (4), IIGG is a measurement of the intensity of the government's implicit guarantee. According to the definition of variables, the PMC-Index falls within the range of 0-10, so the IIGG also falls within the same range. Table 3 provides the meaning of the intensity of implicit government guarantee at the four levels.

Table 3. Four Levels of Implicit Government Guarantee

Intensity of implicit government guarantee	The significance of the calculation results
[5,10)	Powerful implicit government guarantee expectation
[3,5)	Stronger implicit government guarantee expectation
[1,3)	Lower implicit government guarantee expectation
[0,1)	Significantly low implicit government guarantee expectation

Finally, the PMC-Surface is constructed to provide a graphical representation of all results contained within the PMC-Matrix. It visually illustrates the strengths and weaknesses of policy modeling within a multidimensional coordinate space. Its construction is based on the results of the PMC-Matrix, which is a three-by-three matrix containing the individual evaluations of all nine variables.

$$PMC\ Surface = \begin{bmatrix} P_1 & P_2 & P_3 \\ P_4 & P_5 & P_6 \\ P_7 & P_8 & P_9 \end{bmatrix} \quad (5)$$

3. Textual Analysis of Policy Documents

We selected the 17 most relevant policy documents issued by various government departments between 2008 and 2024 concerning the development of municipal investment bonds. Keyword statistical analysis is the first step in the textual analysis of policy documents on implicit government guarantees for municipal investment bonds. In this study, keyword statistical analysis was conducted using the Jieba library in Python. Additionally, we performed a comprehensive and systematic analysis of all policy documents related to municipal investment bonds and local government debt. We constructed a specialized vocabulary dictionary to enhance the accuracy and professionalism of text segmentation. The word frequency statistics of the standardized policy documents on implicit government guarantees for municipal investment bonds are presented in Table 4.

According to Table 4, "municipal investment bonds" and "implicit government guarantee" are the core terms in policies related to municipal investment bonds. In addition to these key terms, the issuance of municipal investment bonds also involves fiscal, risk, regulatory, and market-related aspects, covering infrastructure and public service sectors, with local governments and financing platforms as primary focal points. Furthermore, the policy framework emphasizes standardizing the issuance and utilization of municipal investment bonds to ensure the healthy development of the municipal bond market. This is achieved by regulating local government financing behavior, controlling the debt risks of municipal investment enterprises, maintaining financial market stability, and promoting sustained economic growth.

Table 4. Word Frequency Analysis of Policy Documents

Keyword	Frequency	Keyword	Frequency	Keyword	Frequency
Government	668	Mechanism	101	Banking industry	39
Debt	477	Guarantee	101	Major	38
Place	411	Regulations	100	Regulation	38
Project	321	According to the law.	99	Fund	38
Fundraising	314	Investment	97	System	38
Management	298	Standard	97	Comprehensive	38
Risk	289	Construction	95	Unity	37

Platform	216	provincial	91	Newly added	37
Department	195	Bank	88	Law	37
Funds	177	Income	86	Effective	47
Loan	173	Implement	86	Monitoring	36
Bond	165	Disposal	84	Combine	36
Budget	164	Policy	83	Market	36
Fiscal	232	Emergency	81	Rectification	36
Business	136	Credit	76	Make sure	35
Institution	133	Strict	75	Approval	34
Development	130	Society	71	Plan	34
Finance	129	Assets	69	Carry out	34
Expenditure	121	Violation	68	State-owned	34
Governmental	103	Borrow money	67	Program	34
Perfection	67	Nation	62	Leadership	59
Reform	67	Security	61	Take on	58
Service	66	Capital	61	Key point	55
Specialized	64	Public	60	Arrange	53
Payment	63	Principle	59	In time	53
Incorporate	51	In practice	47	Condition	41
Pay back	50	Prevention	46	Economy	41
Pay off debt	50	Breaking the Law	46	Organization	41
Supervision	49	Size	45	Land	40
Problem	49	Existing stock	44	Check	39
People	49	Reasonable	44	Ability	39
Evaluation	48	Measures	44	Adjustment	42
Transfer	48	Healthy	42	Foundation	42

4. Assessment of Implicit Government Expectation Intensity

4.1. Descriptive Statistics of Calculation Results

Based on the textual analysis of the 17 files, we calculated the PMC index and the intensity of implicit government guarantee expectation. The descriptive statistical results are shown in Table 5. According to Table 5, it can be shown that the main variables have the following characteristics:

(1) Except for transparency of policy(P_{10}), the variable with the highest mean is the policy sources (P_4), with an average value of 0.87, indicating that policies to regulate implicit government guarantees for municipal investment bond issuance are usually issued by higher-level institutions, which have significant impacts on national development, regional economies, and industrial structures.

(2) The lowest mean among the first-level variables is the areas of policy application (P_3), with an average value of 0.39, indicating that the policy of municipal investment bond has relatively low coverage in specific areas, which may limit the implementation effect of the policy.

(3) The average scores for validity of policy (P_2), incentives and guarantees of policy (P_5), and subjects addressed of policy (P_8) are all below 0.60, indicating that there is much improvement for improvement in the diversity of policy impact objects regarding the implicit government guarantee of municipal investment bonds.

Table 5. Descriptive Statistics of Main-Variables and PMC Index

Variables	Number	Mean	Standard deviation	Minimum value	Maximum value
P_1	17	0.51	0.20	0.17	0.83
P_2	17	0.86	0.17	0.67	1.00
P_3	17	0.39	0.21	0.00	0.60
P_4	17	0.87	0.13	0.75	1.00
P_5	17	0.34	0.20	0.00	0.60
P_6	17	0.64	0.20	0.40	1.00
P_7	17	0.52	0.22	0.20	1.00

P_8	17	0.51	0.19	0.25	0.75
P_9	17	0.75	0.09	0.60	0.80
P_{10}	17	1.00	0.00	1.00	1.00
PMC	17	6.39	0.97	4.80	7.77
IIGGE	17	3.61	0.97	2.23	5.20

4.2 Trend of Intensity of Implicit Government Guarantee

Table 6 shows the trend of the PMC index calculated between 2008 and 2024, which can be used to analyze the evolution trend of policy consistency and effect from the perspective of time change.

From Table 6 and Table 7, the trend of the PMC index, which regulates the implicit government guarantee policy, exhibits the following characteristics:

(1) Validity of policy (P_2) reflects the timeliness and responsiveness of policy to market changes. According to the data, the P_2 index reached its peak of 1.00 in 2008 and 2009, indicating that the government responded quickly during the financial crisis to ensure the timeliness of its policies. However, it dropped to 0.67 in 2011, reflecting the gradual stabilization of the market and the reduced need for policy adjustment. In 2016 and beyond, the $P2$ stabilized at 1.00 again, indicating that policymakers continued to pay attention to market dynamics and maintained the timeliness of their policies. (2) Function of policy (P_6) measures the effectiveness of policies in achieving predefined objectives. According to the data, the P_6 index increased from 0.60 in 2008 to 1.00 in 2016 and beyond, indicating that the policy function has significantly improved over time, with policies becoming more effective in achieving their predefined objectives.

(3) The Subjects addressed by policy (P_8) reflect the breadth and depth of policy impact. The P_8 increased from 0.25 in 2008 to 0.75 in 2016 and beyond, indicating that the policy's scope of influence has expanded to include more market participants and areas.

Table 6. Main-Variables, PMC Index, and IIGG

	2008	2009	2010	2011	2012	2013	2014	2015	2016
P_1	0.33	0.50	0.17	0.17	0.33	0.33	0.50	0.67	0.67
P_2	1.00	1.00	1.00	0.67	0.67	1.00	1.00	0.67	1.00
P_3	0.20	0.40	0.20	0.20	0.20	0.20	0.60	0.60	0.60
P_4	0.75	0.75	1.00	0.75	0.75	0.75	1.00	1.00	0.75
P_5	0.20	0.40	0.00	0.20	0.20	0.20	0.20	0.60	0.60
P_6	0.60	0.40	0.60	0.40	0.40	0.40	0.40	0.80	0.80
P_7	0.40	0.40	0.20	0.40	0.40	0.40	0.40	0.60	0.80
P_8	0.25	0.50	0.50	0.50	0.25	0.25	0.25	0.75	0.75
P_9	0.60	0.80	0.80	0.60	0.60	0.60	0.80	0.80	0.80
P_{10}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PMC	5.33	6.15	5.47	4.88	4.80	5.13	6.15	7.48	7.77
IIGG	4.67	3.85	4.53	5.12	5.20	4.87	3.85	2.52	2.23

By analyzing the above key variables, it is evident that these changes indicate that policymakers are constantly optimizing policies to adapt to market changes and needs, thereby enhancing the effectiveness of reducing the implicit government guarantee expectations.

Table 7. Main-Variables, PMC Index, and IIGG

	2017	2018	2019	2020	2021	2022	2023	2024
P_1	0.67	0.67	0.33	0.50	0.83	0.67	0.67	0.67
P_2	1.00	0.67	0.67	1.00	1.00	1.00	0.67	0.67
P_3	0.00	0.20	0.40	0.40	0.60	0.60	0.60	0.60
P_4	0.75	0.75	1.00	0.75	1.00	1.00	1.00	1.00
P_5	0.00	0.40	0.60	0.60	0.40	0.40	0.40	0.40
P_6	1.00	1.00	0.60	0.60	0.80	0.60	0.60	0.80
P_7	1.00	0.40	0.60	0.60	0.40	0.80	0.20	0.80
P_8	0.75	0.50	0.50	0.50	0.75	0.50	0.75	0.50
P_9	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

P_{10}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PMC	6.97	6.38	6.50	6.75	7.58	7.37	6.68	7.23
IIGG	3.03	3.62	3.50	3.25	2.42	2.63	3.32	2.77

According to Table 6, the mean intensity of implicit government guarantee was determined to be 3.61, with a minimum of 2.23 and a maximum of 5.20, alongside a standard deviation of 0.97. This suggests there remains potential for enhancing policies regarding the de-implicit government guarantee expectations for municipal investment bonds. Specifically, the expectation surrounding implicit government guarantees persists at a relatively elevated level. Overall, the trend indicates that the implicit government guarantee intensity has fluctuated from 4.67 in 2008 to 2.77 in 2024, exhibiting a significant decline since 2015—an indication that policy effectiveness and intensity have markedly improved over time (see Fig.1). In summary, while there is an overall downward trajectory in the intensity index, this reflects the gradual impact of governmental efforts aimed at regulating implicit guarantee policies.

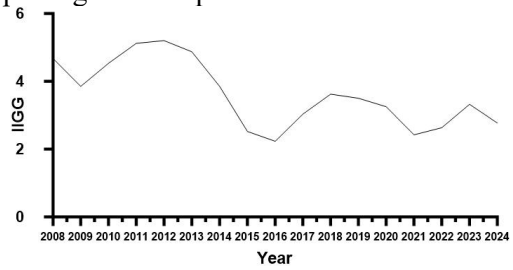

Figure 1. Intensity of Implicit Government Guarantee

Before 2013, the intensity of implicit government guarantees was relatively high, indicating that during this period, the government's management of municipal investment bonds was relatively weak and that the early policies were not strong enough. The policy effects had not been fully manifested, resulting in a relatively large implicit government guarantee. After 2014, the intensity of the implicit government guarantee increased. Decreased and stabilized at a lower level, indicating that the effects of the government's policy to regulate implicit government guarantees for municipal investment bonds are gradually being realized, and the government's potential implicit guarantee is reduced.

4.3 PMC Surface of Implicit Government Guarantees Intensity

Based on the PMC index model, PMC surfaces were constructed (See Figure 2-5), and the spider web diagrams (Figure 6) were constructed by combining the input-output table and the government implicit guarantee index (G), which provide a clear analysis of the overall changes in the levels of implicit government guarantee based on the PMC index.

According to the PMC surface, 17 policies stand out regarding policy effectiveness, issuing authority, and legal level, indicating that these policies can respond quickly to market changes, are issued by authoritative institutions, and have high legal effectiveness. However, these policies have shortcomings in terms of the clarity of policy nature, coverage of policy fields, and incentive and guarantee measures, which may be key factors affecting the overall removal of implicit government guarantees.

As shown in Figure 2, the policy on implicit guarantee for municipal investment bonds scored high in terms of policy timeliness, indicating that the policy could adapt quickly to market changes, indicating that regulatory authorities were able to identify the existence of market expectations for implicit guarantee of municipal investment bonds promptly and also that they found that such implicit guarantee expectations were not reasonable for the risk management of municipal investment bonds, so they promptly issued relevant policies. However, the scores of all policies in terms of the clarity of policy nature were low. This may mean that the policy objectives and implementation standards are not clear enough, leading to uncertainty in market expectations and responses to the policy. If the policy has higher clarity, it may enhance market confidence and stability, reducing the government's implicit guarantee. At the same time, it was also found that if the policy could provide reasonable incentives and guarantees, it may more effectively promote the active participation of market participants and reduce potential moral hazard, thereby reducing the government's implicit guarantee.

From Figure 3, policies with robust implicit government guarantees, although they score low in terms of policy domain and incentive assurance, perform well in terms of policy timeliness and the authority of the issuing institution, indicating that these policies can be

timely issued by authoritative institutions, but need to be strengthened in terms of coverage in specific areas and incentives for market participants.

From Figure 4, policies with stronger implicit government guarantees generally score higher in most indicators, especially in terms of policy timeliness and the authority of the issuing institution, but also have shortcomings in terms of policy nature and incentive assurance, indicating that although these policies perform well in certain key areas, improvements are still needed in terms of clarity and incentives.

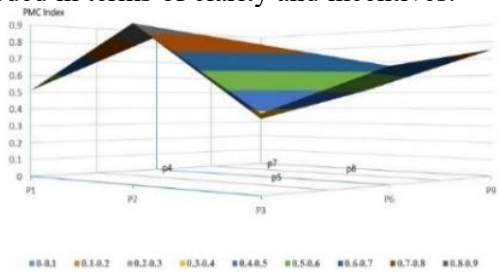

Figure 2. PMC Surfaces of 17 Policies

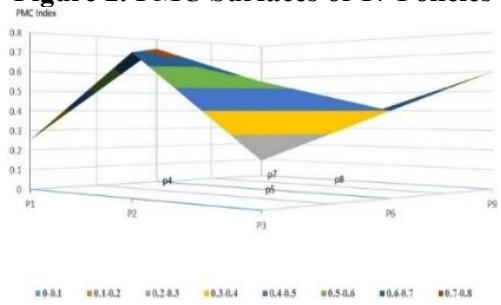

Figure 3. PMC Surfaces with Very Strong Implicit Government Guarantee

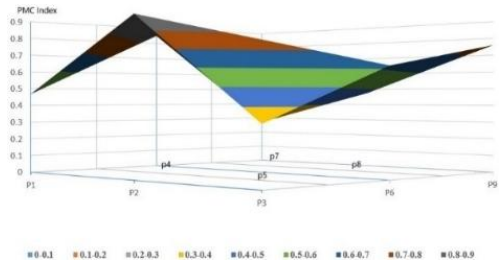

Figure 4. PMC Surfaces with a Stronger Implicit Government Guarantee

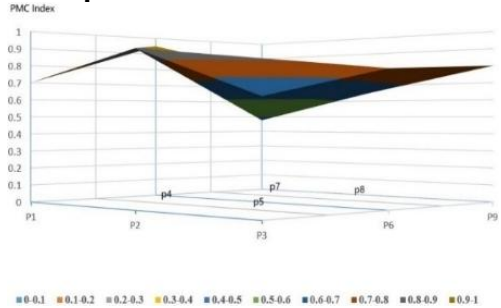

Figure 5. PMC Surfaces with Lower Implicit Government Guarantee

As shown in Figure 5, policies with lower implicit government guarantee scored lower in terms of policy effectiveness, policy function, and impact at different levels, indicating that although these policies are issued by authoritative institutions with high legal validity, they need to be further improved in terms of timeliness, comprehensiveness of functions, and impact at different levels.

It is worth noting that policies with strong guarantee intensity may neglect guarantee intensity in some aspects, leading to underestimating market risks and increasing moral risks. Therefore, these policies need to be further improved in terms of timeliness, comprehensiveness, and their impact at different levels to achieve a more balanced and sustainable market development.

Overall, whether it is a policy with firm guarantees, a policy with stronger guarantees, or a policy with lower guarantees, all need to be strengthened regarding the clarity of policy nature, the coverage of policy fields, and the incentive and guarantee measures. In particular, incentive and guarantee measures are a common weakness that affects the intensity of all policy guarantees. By improving these aspects, we can reduce market expectations of implicit government guarantees and thus promote market stability and investor confidence more effectively.

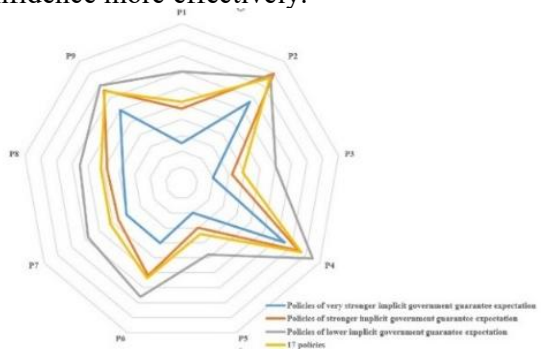

Figure 6. The Spider Web Diagrams

In China's current economic and financial context, the government's implicit guarantee policy for city investment bonds is crucial to the stability of the market and investor confidence. A comprehensive analysis of the spider web diagram shows that lowering the government's implicit guarantee intensity, clarity, timeliness, incentive assurance, coverage scope, and risk control is the key to achieving stability and healthy development of the city investment bond market. Policy makers must consider and balance these aspects to ensure the policy can

effectively support the market without triggering excessive dependence and risk accumulation.

5. Conclusions

This study employs textual analysis methods and the PMC index to evaluate the effectiveness of these policies and introduces a novel approach for calculating the intensity of implicit government guarantees. The measurement of implicit government guarantee intensity is inversely related to the effectiveness of policies aimed at reducing implicit guarantees—more substantial policy effectiveness corresponds to lower implicit guarantee intensity, and vice versa. The research findings indicate that implementing a series of policies has indeed contributed to a reduction in implicit government guarantees, demonstrating the effectiveness of risk management policies for municipal investment bonds at various levels of government.

Our study also found that changes in the intensity of implicit government guarantee expectations stem from various policy aspects. For instance, government agencies at different levels received high scores in the timeliness of policy formulation for municipal investment bonds, indicating their ability to swiftly adapt to market changes and implement timely risk control measures to address implicit guarantee expectations. However, the PMC evaluation score for policy clarity was lower, suggesting that policy objectives and implementation standards may not be sufficiently well-defined, leading to uncertainty in market expectations and responses. Additionally, weaknesses in the policy incentive and guarantee system highlight the need for further improvements to eliminate implicit government guarantee expectations effectively.

In summary, this study employs text mining techniques to analyze 17 policy documents related to municipal investment bonds issued over the past decade. It proposes a novel method for measuring the intensity of implicit government guarantee expectations. Additionally, it provides an objective and scientifically grounded evaluation tool for investors and regulatory authorities. However, further refinements are needed, particularly in precisely identifying keywords in the text analysis process and optimizing various indicators within the PMC policy rating framework.

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