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Research on the impact of non-financial enterprise leverage ratio on systemic financial risks

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Abstract: *Based on the Spatial Durbin Model, this study aims to examine the connection between the leverage ratio and systemic financial risk. The data utilized in this study is derived from 30 provinces, autonomous regions, and directly administered municipalities in China, covering the period from 2012 to 2022. The research findings indicate that: (1) there is a non-linear relationship between the leverage ratio of non-financial enterprises and systemic financial risk, characterized by a U-shaped curve, suggesting the existence of a threshold for the leverage ratio of non-financial enterprises. (2) The leverage ratio of non-financial enterprises in neighboring provinces affects the systemic financial risk of the focal province. Based on these results, this paper proposes strategies and recommendations for managing the leverage ratio of non-financial enterprises to mitigate systemic financial risks.*

Keywords: *Spatial Durbin Model; Non-Financial Enterprise Leverage Ratio; Systemic Financial Risk*

1. Introduction

In recent years, the leverage ratio of non-financial enterprises has been continuously increasing, raising concerns about systemic financial risk. The leverage ratio, which measures the ratio of debt to net equity, reflects a company's debt level and solvency. A high leverage ratio indicates higher debt risk for companies, and during economic fluctuations, there is a possibility that companies may struggle to repay their debts, triggering a chain reaction that affects the entire financial system. In previous financial crises, the frequent occurrence of bankruptcies and defaults among highly leveraged companies significantly impacted financial markets. Therefore, studying the impact of leverage ratios of non-financial enterprises on systemic financial risk holds both theoretical and empirical significance.

Systemic financial risk refers to the risk in the financial market that can lead to the collapse or paralysis of the entire financial system due to issues in a specific industry or company. Minsky (1995) defined systemic financial risk as a risk that results in the loss of functionality in the financial system and economic disruption [1]. Bernanke (2009) emphasized the contagious nature of systemic financial risk, where risks in one financial institution or sector spread through various channels to the entire economic system [2]. While scholars may have different definitions of systemic financial risk, they generally agree that it has adverse effects on the overall economic system.

After the outbreak of the 2008 financial crisis, an increasing number of scholars began discussing the research on the impact of leverage ratios on systemic financial risk. Jorda (2011) discovered through historical experience analysis that there is a vicious cycle between the unreasonable growth of corporate leverage ratios and systemic financial risk [3]. Alfaro (2019) suggested that when corporate leverage ratios are moderate, cash flow can meet daily operational needs, leading to higher capital utilization rates and contributing to stable economic growth [4]. Zhang Chengsi et al. (2022) constructed a systemic financial risk indicator and used the TVP-FAVAR model to analyze the dynamic relationship between leverage ratios, financialization, and systemic financial risk, further validating the impact of leverage ratios and financialization on systemic financial risk [5].

In summarizing the aforementioned research, it is evident that there is a relationship between leverage ratios and systemic financial risk. However, the current state of research on their relationship is not comprehensive enough, and the literature base is relatively thin, requiring further enrichment to better understand the crucial interconnection between the two.

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2. Theoretical analysis and research hypothesis

The relationship between the leverage ratio of non-financial enterprises and systemic financial risk is characterized by a complex non-linear nature. In the initial stages, an increase in the leverage ratio of non-financial enterprises can bring about positive effects, such as enhancing capital return and expanding investment scale. This is primarily because borrowing can lower corporate costs and increase the efficiency of debt capital utilization. However, as the leverage ratio of non-financial enterprises reaches a certain level, negative effects begin to emerge. At this point, systemic financial risk gradually increases. High leverage ratios make companies more vulnerable, exposing them to a greater risk of default. In the event of market volatility or economic downturns, companies may struggle to meet debt obligations, triggering a chain reaction with adverse effects on the financial system and the overall economy. Hypotheses 1 and 2 are proposed in this regard.

H1: The leverage ratio of non-financial enterprises has an impact on systemic financial risk.

H2: There is a non-linear relationship between the leverage ratio of non-financial enterprises and systemic financial risk, with the existence of a turning point in the leverage ratio of non-financial enterprises.

The increase in the leverage ratio of non-financial enterprises may have a negative impact on the systemic financial risk of neighboring regions. This is mainly because the debt defaults of high-leverage companies can trigger chain reactions in the supply chain and industrial chain, thereby expanding the scope and severity of the risk. When investors perceive an increase in risk in a region, they may withdraw their investments, potentially causing a lack of liquidity in funds and, consequently, negative effects on businesses and financial institutions in surrounding areas. Hypothesis 3 is proposed in this context.

H3: The leverage ratio of non-financial enterprises has an impact on the systemic financial risk of neighboring regions.

3. Research design

3.1. Data source

This paper analyzes the relationship between the leverage ratio of non-financial enterprises and systemic financial risks, as well as the spatial spillover effects between different provinces, using data from 30 provinces, autonomous regions, and municipalities directly under the Central Government from 2012 to 2022. The index data and control variables are derived from the provincial statistical Yearbook, China Financial Yearbook, the official website of the National Bureau of Statistics, and the official website of the People's Bank of China. The non-financial corporate leverage ratio is derived from the Wind database.

3.2. Model construction

This paper examines the spatial spillover mechanism of non-financial enterprise leverage ratio on systemic financial risks from a spatial perspective and aims to incorporate the spatial Dubin model. Following the approach of Yang Jingyan and Li Yulong (2023) [6], the following formula is derived:

$$risk_{it} = \alpha_0 + \rho W risk_{it} + \alpha_1 lev_{it} + \alpha_2 lev_{it}^2 + \beta_1 W lev_{it} + \beta_2 W lev_{it}^2 + \alpha \sum controls + \beta W \sum controls + \mu_i + \gamma_t + \varepsilon_{it} \quad (1)$$

In this paper,W represents the economic distance matrix as a spatial matrix,$Wrisk_{it}$ represents the spatial lag term of systemic financial risk,$Wlev_{it}$ represents the spatial lag term of non-financial enterprise leverage ratio,$\beta_2 Wlev_{it}^2$ represents the spatial lag term of non-financial enterprise leverage ratio square,$W\sum controls$ represents the spatial lag term of control variable,μ_i represents individual fixed effect,γ_t represents year fixed effect,ε_{it} represents random error term,α_0 is a constant term.

3.3. Variable selection and definition

3.3.1. The dependent variable

The dependent variable is provincial systemic financial risk. This study uses the entropy method to measure the size of systemic financial risk. By referring to the index system established by scholars such

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as Tao Ling and Zhu Ying (2016) [7], this paper divides the indicators into eight dimensions: financial institutions, stock market, real estate market, government departments, bond market, foreign exchange market, and insurance market, as well as institutional environment, to construct a regional systemic financial risk assessment system. Considering data availability, this paper selects 19 secondary indicators from 30 provinces and cities from 2012 to 2022,as shown in Table 1, to measure regional systemic financial risk. The data sources include the Wind database, provincial statistical yearbooks, the website of the Chinese National Bureau of Statistics, and the China Economic Net data statistics database. Missing data is filled in using interpolation. After standardizing the indicators, the entropy method is used to synthesize the systemic financial risk indicators.

Table 1: Construction indicators of systemic financial risks

Index level	Indicator code	name of index	Indicator meaning	Relationship with systemic financial risk
macro-economy	X1.1	GDP rate of rise	Reflecting the macroeconomic growth	reverse
	X1.2	Year-on-year CPI growth rate	Reflect the inflation levels	syntropy
financial institution	X2.1	Non-performing loan ratio	Reflect the quality of bank asset quality	syntropy
	X2.2	Deposit and loan ratio	Loan balance / deposit balance, reflecting the ability of financial institutions to withstand risks	syntropy
	X2.3	Short-term loan growth	Reflect the change in the loan size	syntropy
stock market	X3.1	Stock market size	Total stock market value / GDP	syntropy
	X3.2	Stock circulation market value growth rate	Growth rate of stock circulation market value	syntropy
foreign exchange market	X4.1	Growth rate of total imports and exports	The higher the foreign trade volume, the economy The higher the degree of prosperity	reverse
	X4.2	Growth rate of foreign exchange reserves	Reflect China's trade volume and hot money flow situation	reverse
	X4.3	Real effective exchange rate index	Reflect the change of the relative purchasing power of the RMB	reverse
real estate product market	X5.1	Average selling price of the housing	Residential sale price / sales area	syntropy
	X5.2	Real estate investment growth rate	Real-estate investment growth rate	syntropy
insurance market	X6.1	Growth in premium income	Premium income growth rate	reverse
	X6.2	Insurance depth	Premium income / GDP	reverse
	X6.3	insurance density	Insurance premium amount / local population number	reverse
government sector	X7.1	financial deficit	(Fiscal expenditure-fiscal revenue) / GDP	syntropy
	X7.2	Growth rate in fixed-asset investment	Growth rate of fixed-asset investment	reverse
Institutional environment	X8.1	7-day interbank pledge type repurchase	Reflect the capital supply and demand situation	syntropy
	X8.2	China debt composite index	Reflecting overall bond yields	syntropy

3.3.2. Explanation of Variables

The core explanatory variable is the micro leverage ratio of non-financial enterprises. This study focuses on the non-financial listed companies in each province. We use the debt-to-asset ratio as the leverage ratio of companies, which is calculated as total debt divided by total assets. In processing the data, we referred to the approach used by Zhang Chengsi (2022) [5], which involved selecting A-share non-financial listed companies from the Wind database for the years 2012-2022 and excluding companies in the real estate industry, S companies, ST companies, and *ST companies.

3.3.3. Controlling Variables

Controlling variable. This paper adopts the research method of Xia Yue et al. (2019), including per capita GDP (pgdp), inflation rate (cpi), financial industry added value growth (kjp), urbanization rate

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(urb), unemployment rate (ur) and actual utilization of foreign capital (fdi) as control variables [8].

4. Empirical analysis

4.1. Benchmark regression analysis

As shown in table 2, a Moran test for the explained variable risk found spatial autocorrelation in risk.

Table 2 Global Moran's I Index of systemic financial risks in Chinese provinces from 2012 to 2022

year	2012	2013	2014	2015	2016	2017
Moran's I	0.1188**	0.1774***	0.1791***	0.2515***	0.2422***	0.2342***
year	2018	2019	2020	2021	2022	
Moran's I	0.2548***	0.2039**	0.2149***	0.2787***	0.3271***	

Note: * * *, * *, and * indicate passing the significance test at the 1%, 5%, and 10% levels, respectively

Based on the approach of Yang Jingyan et al. (2023) [6], a ordinary least squares analysis was conducted on the core explanatory variables to determine if there was a quadratic term. The results, shown in columns (1) and (2) of table 3, indicate a non-linear relationship between the leverage ratio of non-financial enterprises and systemic financial risk, possibly in a U-shaped pattern. This confirms hypotheses 1 and 2.

Table 3: The regression results

	(1)	(2)	(3)	(4)
risk	OLS	OLS	SDM（Main）	SDM（Wx）
lev	0.090***	-1.875***	-1.712**	-3.457*
	(0.033)	(0.291)	(0.725)	(1.962)
lev2		1.828***	1.686**	3.355**
		(0.269)	(0.676)	(1.686)
cpi	0.622	0.631	0.619	1.354
	(0.506)	(0.473)	(0.579)	(1.008)
urb	0.094**	0.116***	0.129**	-0.175*
	(0.039)	(0.037)	(0.057)	(0.094)
fdi	-0.389***	-0.306***	-0.277	0.211
	(0.112)	(0.114)	(0.187)	(0.307)
kjp	-0.046*	-0.035	-0.041*	-0.019
	(0.028)	(0.025)	(0.022)	(0.057)
ur	-1.555***	-1.471***	-1.673**	0.574
	(0.408)	(0.383)	(0.746)	(1.266)
pgdp	0.006***	0.005***	0.007	-0.000
	(0.002)	(0.002)	(0.009)	(0.016)
rho			0.203*	
			（0.06）	
sigma2_e			0.001***	
			(0.00)	
Observations	330	330	330	330
R-squared	0.712	0.752	0.277	0.277
Year	YES	YES	YES	YES
Number of id	30	30	30	30

Note: * * *, * * and * indicate the significance test at the 1%, 5% and 10% levels, respectively, and the robust standard error is shown in parentheses.

Columns (3) and (4) of table 3 display the regression results of the main effects (Main) and spatial autocorrelation term (Mx) of the spatial Durbin model. The spatial autocorrelation coefficient is 0.203, and the significance test at the 10% level shows the presence of spatial spillover effects in systemic financial risk, meaning that the systemic financial risk of one province will affect the systemic financial risk of neighboring provinces. From the results of the main effects (Main), it can be seen that the first-order term of the leverage ratio of non-financial enterprises is negative at the 5% significance level, and the quadratic term is positive at the 5% significance level. In the spatial autocorrelation term (Mx), the first-order term of the leverage ratio of non-financial enterprises is negative at the 10% significance level, and the quadratic term is positive at the 5% significance level. This indicates that the leverage ratio of non-financial enterprises in other provinces also has a significant impact on the systemic financial risk of this province, and it exhibits a U-shaped relationship.

Table 4 provides a detailed breakdown of the direct effects, indirect effects, and total effects of the

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model regression results. The indirect effects reflect the extent to which a unit change in the core explanatory variable of the surrounding region affects the explained variable of this region. From the perspective of the explanatory variables, the direct effect of the first-order term of the leverage ratio of non-financial enterprises is -1.865, and the indirect effect is -4.586; the direct effect of the quadratic term of the leverage ratio of non-financial enterprises is 1.831, and the indirect effect is 4.482. These effects pass the significance test of at least 5%. In the indirect effects, the absolute values of the coefficients are greater than those in the direct effects, indicating that spatial spillover effects are the main influencing factors.

Table 4: Effect results of spatial spillover

	(5)	(6)	(7)
risk	Direct	Indirect	Total
lev	-1.865***	-4.586**	-6.451***
	(0.01)	(0.04)	(0.00)
lev2	1.831***	4.482**	6.313***
	(0.00)	(0.02)	(0.00)
cpi	0.726	1.860	2.586**
	(0.24)	(0.14)	(0.01)
urb	0.122**	-0.193	-0.070
	(0.05)	(0.11)	(0.61)
fdi	-0.306	0.152	-0.155
	(0.17)	(0.69)	(0.77)
kjp	-0.043**	-0.034	-0.077
	(0.04)	(0.64)	(0.37)
ur	-1.615**	0.208	-1.408
	(0.02)	(0.89)	(0.33)
pgdp	0.007	0.002	0.009
	(0.38)	(0.92)	(0.37)

Note: * * *, * * and * indicate the significance test at the 1%, 5% and 10% levels, respectively, and the robust standard error is shown in parentheses.

4.2. Analysis of Heterogeneity

According to the nature of enterprise ownership, they are divided into two categories: state-owned enterprises and non-state-owned enterprises, and respectively conducted spatial durbin model regression. The results are as follows in Table 5.

Table 5: Durbin regression results for different enterprise types

	state-owned enterprises		Non-state-owned enterprises	
risk	Main	Mx	Main	Mx
lev	-1.311***	-3.533***	-0.764***	-1.879**
	(0.500)	(1.356)	(0.254)	(0.733)
lev2	1.217***	3.253***	0.694***	1.784***
	(0.464)	(1.155)	(0.223)	(0.666)
control	YES	YES	YES	YES

Note: * * *, * * and * indicate the significance test at the 1%, 5% and 10% levels, respectively, and the robust standard error is shown in parentheses.

As can be seen from Table 5, the leverage ratio of state-owned non-financial enterprises and the leverage ratio of non-state non-financial enterprises are significant at the confidence level of 1%, the first item is significantly negative and the second item is significantly positive, which is consistent with the previous results.

4.3. Robustness Testing

In this paper, the explanatory variable lags by one period. The leverage ratio of non-financial enterprises, including real estate enterprises, was substituted for the original leverage ratio of non-financial enterprises. Furthermore, the time period was modified to 2013-2022, and the findings remained consistent with those of the previous article (Table 6).

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Table 6: Test of robustness

	The lagging one-phase explanatory variable		Change explanatory variables		Change years	
risk	Main	Mx	Main	Mx	Main	Mx
lev	-1.671**	-3.291	-1.801**	-2.259	-1.710**	-3.287*
	(-2.07)	(-1.56)	(-2.46)	(-0.73)	(-2.54)	(-1.70)
Lev2	1.630**	3.124*	1.602**	2.049	1.688***	3.239*
	(2.17)	(1.74)	(2.46)	(0.79)	(2.68)	(1.93)
control	YES	YES	YES	YES	YES	YES

Note: * * *, * * and * indicate the significance test at the 1%, 5% and 10% levels, respectively, and the robust standard error is shown in parentheses.

5. Conclusion

5.1. Research conclusion

This paper analyzes the influence of China's non-financial leverage ratio on systemic financial risks. The main conclusions are as follows:

(1) The leverage ratio of non-financial enterprises has a significant impact on systemic financial risks, showing a U-shaped relationship. When the leverage ratio is below the threshold, the rise in leverage suppresses systemic financial risk, and the rise in it promotes systemic financial risk.

(2) The leverage ratio of non-financial enterprises has a spatial spillover effect on systemic financial risks, that is, the systemic financial risks of a certain province will affect the systemic financial risks of surrounding provinces, and show a U-shaped relationship.

5.2. Policy Recommendations

Based on the above conclusions, this paper puts forward the following policy suggestions:

(1) Strengthen supervision and risk management: Regulatory authorities should strengthen the monitoring and evaluation of the leverage ratio of non-financial enterprises to ensure that the debt level of enterprises is controllable. At the same time, a risk management system should be established, including stress testing and risk assessment, as well as an early intervention mechanism, to timely find and deal with potential risks.

(2) Optimize the debt structure: Government agencies should encourage non-financial enterprises to enhance their debt structure by reducing the amount of short-term external debt and increasing the availability of long-term financing. This will help reduce sensitivity to short-term market fluctuations. Additionally, enterprises are encouraged to diversify their financing channels and reduce their dependence on bank loans to lower concentrated risks in the financial system.

(3) Improve the level of corporate governance: Enterprises should strengthen internal governance, improve the financial information disclosure system, and improve the level of transparency and standardization. This helps investors and regulators better understand the financial position and risk exposure of companies, reducing information asymmetry and market uncertainty.

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