

A mathematical statistics-based study on stock market development

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Abstract. This study investigates the effects of fiscal conditions on China's stock market using annual national macroeconomic data from 2005 to 2025. A simple linear regression model and statistical methods are applied. Stock transaction value in the Shanghai and Shenzhen markets is used as a proxy for market activity, while general public budget revenue and the outstanding balance of central government debt serve as the main fiscal explanatory variables. General public budget expenditure and stock trading volume are introduced as alternative indicators for robustness checks. The sample is also divided at 2015 to examine temporal heterogeneity. The results show clear positive relationships between both fiscal revenue and central government debt and stock market transaction value. In the baseline regressions, the estimated coefficients of general public budget revenue and central government debt are 1.5981 and 1.4611, respectively, and both are positive and statistically significant at the 1% level. These findings indicate that fiscal expansion significantly increases stock market activity. The subperiod analysis further shows that the effect of fiscal revenue is stronger during 2016-2025, whereas the stimulative effect of central government debt is more pronounced during 2005-2015. By distinguishing the stage-specific effects of two major fiscal instruments, this study clarifies how fiscal conditions influence stock market performance. The findings provide empirical support for macro-fiscal policy formulation and the maintenance of stable stock market operations.

Keywords: fiscal conditions, stock market, regression analysis

1. Introduction: background

1.1. Practical background

Fiscal conditions represent a comprehensive reflection of government revenue and expenditure, debt levels, budget execution, and the orientation of fiscal policy. They embody the government's capacity for resource allocation, income redistribution, and macroeconomic regulation, encompassing key dimensions such as the scale and structure of fiscal revenue and expenditure, fiscal deficits, government debt, taxation policies, fiscal subsidies, transfer payments, and the allocation of special-purpose bonds. As such, fiscal conditions serve as an important indicator of macroeconomic fundamentals and policy direction. The stock market, as the primary platform for direct financing, performs essential functions including capital mobilization, price discovery, risk pricing, and resource allocation. It not only provides an important financing channel for enterprises and

supports industrial upgrading but also reflects household wealth allocation and broader macroeconomic performance. The stable operation of the stock market is therefore closely associated with financial security, the resilience of the real economy, and market expectations.

Fiscal policy constitutes a fundamental pillar of macroeconomic regulation and economic stability by facilitating countercyclical adjustment, industrial support, and risk management. Meanwhile, the stock market is a vital component of the modern financial system, promoting the transformation of savings into investment, improving the efficiency of resource allocation, and fostering innovation-driven development. Both fiscal policy and the stock market play indispensable roles in maintaining economic and financial stability. A close interaction exists between fiscal conditions and stock market performance. Fiscal revenue and expenditure, taxation, government debt, and industrial policies directly affect corporate profitability, market liquidity, and stock valuations. Conversely, a prosperous stock market can strengthen fiscal revenue through wealth and financing effects. Together, these two systems shape market expectations, influence capital flows, and determine the effectiveness of macroeconomic regulation. Against the backdrop of China's ongoing economic transformation and capital market reform, a systematic investigation of their interaction is of considerable theoretical and practical significance.

1.2. Theoretical background

The literature most closely related to this study focuses on the relationship between fiscal policy and stock market development. Wang Zhenxia and Hao Zhang [1] constructed indicators of fiscal policy communication using news text data and combined them with listed company data to examine the influence of fiscal policy communication on stock price movements. Xing Liu and Ping Yi [2] investigated the economic consequences of tax policy from the dual perspectives of stock market reactions and corporate investment, demonstrating that tax policy generates spillover effects along industrial supply chains to upstream industries. Lei Cui [3] argued that expansionary fiscal policy has a positive effect on China's A-share market and analyzed the underlying reasons for periods of weak market performance. Fengjuan Zhang [4] employed a two-way fixed-effects panel model to explore the impact of local government debt on corporate stock returns.

In addition, a substantial body of research has examined the relationship between macroeconomic policies and stock market performance. Jinzhou Chen [5] found, based on fixed-effects regression analysis, that economic policy uncertainty exerts a significant negative effect on stock liquidity. Jianlei Yang and Xiwen Hao [6] applied the event study method to systematically investigate investor sentiment during periods in which the Chinese government introduced expansionary financial stability policies after 2018. Existing studies have also conducted comprehensive assessments of systemic financial risk in China by considering both internal channels of risk transmission and the influence of external policy factors [7]. Other researchers have examined stock price synchronicity in China's A-share market from the perspective of economic policy uncertainty, providing theoretical and practical insights into improving pricing efficiency, optimizing resource allocation, and promoting the healthy development of the capital market [8]. Furthermore, previous studies have employed the TVP-VAR model to estimate dynamic spillover and absorption indices of financial risk, analyzed the major transmission channels and their evolution during special periods through directed network topology, and subsequently used the TVP-FAVAR model to evaluate the effectiveness of macroeconomic policies in regulating financial risk spillovers [9]. On the basis of clarifying the concept of systemic financial risk and examining its relationship with economic policy uncertainty in China, Xuan Lü [10] established a measurement index system, selected monthly data from China's financial market covering January 2007 to December 2021, applied the DCC-GARCH model to estimate indicator weights and construct a China

Financial Stress Index, and further employed the MSAR model to analyze the regime-switching dynamics of systemic financial risk.

2. Research content

2.1. Research design

2.1.1. Variable selection

The dependent variable in this study is stock market activity, for which the transaction value of stocks traded on the Shanghai and Shenzhen stock markets is employed as the proxy indicator. The explanatory variable is fiscal policy, represented by general public budget revenue and the outstanding balance of central government debt. In addition, general public budget expenditure and stock trading volume on the Shanghai and Shenzhen stock markets are adopted as alternative indicators for robustness tests.

2.1.2. Data sources

The empirical analysis focuses on mainland China, with the observation period covering 2005–2025. All sample data are obtained from the National Bureau of Statistics of China. To improve estimation accuracy and reduce potential heteroscedasticity, all variables are transformed into their natural logarithms prior to the empirical analysis.

2.1.3. Research model

This study employs a simple linear regression model, specified as follows (equation (1)):

$$Y = \alpha X + \beta + \varepsilon \quad (1)$$

where Y denotes the dependent variable representing stock market activity, X denotes the core explanatory variable representing fiscal policy, and ε is the random error term.

2.2. Empirical analysis

2.2.1. Correlation analysis

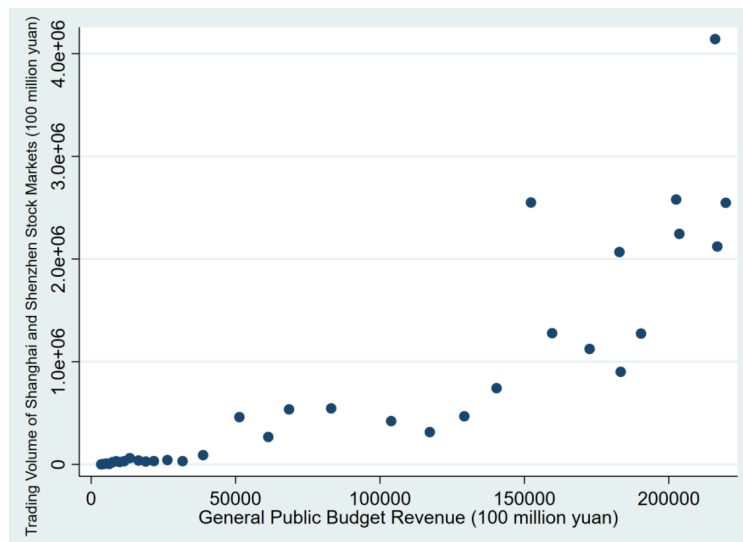


Figure 1. Correlation between stock market activity and general public budget revenue in China

Figure 1 illustrates the relationship between stock market activity and general public budget revenue, one of the key fiscal policy indicators. As shown in the figure, the transaction value of stocks traded on the Shanghai and Shenzhen stock markets increases as general public budget revenue rises, indicating a positive correlation between the two variables. Moreover, when general public budget revenue remains below a certain threshold, the increase in stock transaction value is relatively modest. Once fiscal revenue reaches a comparatively high level, however, stock transaction value grows much more rapidly. Figure 2 presents the relationship between stock market activity and the outstanding balance of central government debt. The figure shows that the transaction value of stocks traded on the Shanghai and Shenzhen stock markets increases in tandem with the outstanding balance of central government debt, suggesting a positive correlation characterized by a relatively stable rate of growth. Nevertheless, the relationship between stock market activity and fiscal policy requires further verification through the regression analysis conducted in this study.

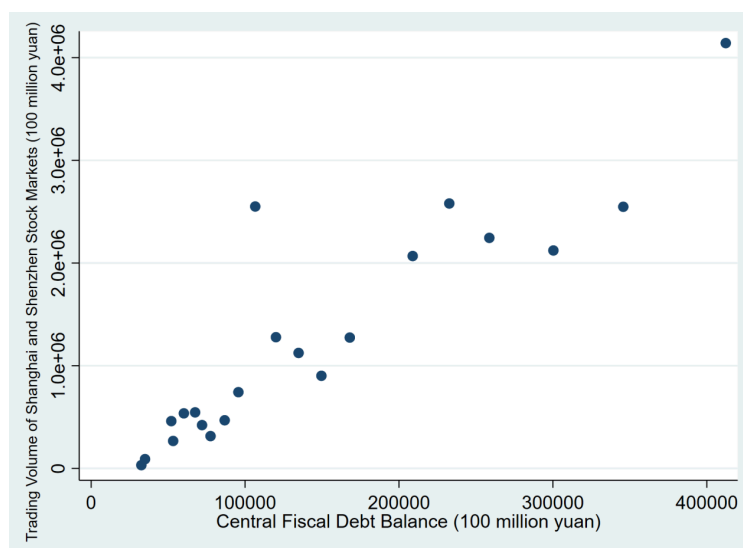


Figure 2. Correlation between stock market activity and the outstanding balance of central government debt in China

2.2.2. Baseline regression analysis

Table 1. Baseline regression results

	(1)	(2)	(3)	(4)	(5)
	y	y	y	y	y
x	1.5981*** (20.9038)	1.4611*** (8.9973)	1.6050*** (9.3269)	1.4997*** (9.9885)	1.2409*** (11.5414)
_cons	-5.0993*** (-6.1585)	-3.4384* (-1.8158)	-5.4448** (-2.6670)	-6.3773*** (-3.6245)	-3.2673** (-2.6059)
N	34	21	21	21	21
R ²	0.9318	0.8099	0.8207	0.8752	0.8400

Note: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Fitting the scatter points in the above figure according to the linear regression equation (1), Model (1) in Table 1 reports the baseline regression results for the effect of general public budget revenue on stock market activity in China. Specifically, the estimated coefficient of the core explanatory variable is 1.5981, which is positive and statistically significant at the 1% significance level. Model (2) in Table 1 presents the baseline regression results for the effect of the outstanding balance of central government debt on stock market activity. The estimated coefficient of the core explanatory variable is 1.4611, which is likewise positive and statistically significant at the 1% significance level. Overall, the baseline regression results provide preliminary evidence that fiscal expansion exerts a positive and significant effect on the activity of China's stock market.

2.2.3. Robustness tests

To assess the stability and reliability of the baseline regression results, this study conducts robustness tests by replacing the measures of both stock market activity and fiscal policy, then fitting with linear regression equation (1). First, general public budget expenditure is used as an alternative fiscal policy indicator to replace general public budget revenue and the outstanding balance of central government debt. The corresponding regression results are reported in Models (3) and (4) of Table 1. Second, stock trading volume on the Shanghai and Shenzhen stock markets is used as an alternative proxy for stock market activity, replacing stock transaction value. The corresponding results are reported in Model (5) of Table 1. The empirical findings indicate that general public budget expenditure continues to exert a significantly positive effect on the transaction value of stocks traded on the Shanghai and Shenzhen stock markets. Likewise, general public budget revenue and the outstanding balance of central government debt remain significantly and positively associated with stock trading volume. These results confirm the robustness of the baseline findings.

2.2.4. Heterogeneity analysis

To investigate whether the effects of fiscal policy vary over time, the sample period is divided into two subperiods using 2015 as the cutoff year, subject to data availability. Fitting with linear regression equation (1), Models (1) and (2) in Table 2 report the regression results for the effects of general public budget revenue on the transaction value of stocks traded on the Shanghai and Shenzhen stock markets during 2005–2015 and 2016–2025, respectively. The estimated coefficients are 1.7404 and 3.2905. The coefficient for the 2005–2015 period is positive and statistically significant at the 1% level, whereas the coefficient for the 2016–2025 period is positive and statistically significant at the 5% level.

Table 2. Temporal heterogeneity analysis

	(1)	(2)	(3)	(4)
	Before 2015	After 2015	Before 2015	After 2015
	General Public Budget Revenue		Outstanding Balance of Central Government Debt	
x	1.7404*** (4.3365)	3.2905** (3.2068)	2.6196*** (5.7667)	1.0194*** (6.0036)
_cons	-6.8388 (-1.5096)	-25.6350* (-2.0520)	-16.1686** (-3.2184)	1.9042 (0.9126)
N	11	10	11	10
R ²	0.6763	0.5625	0.7870	0.8184

Note: ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Models (3) and (4) in Table 2 report the regression results for the effects of the outstanding balance of central government debt on stock market transaction value during the same two periods. The estimated

coefficients are 2.6196 and 1.0194, respectively. Both coefficients are positive and statistically significant at the 1% level. The regression results indicate that the positive effect of general public budget revenue on stock market transaction value is strongest during 2016–2025, while remaining significant, though comparatively weaker, during 2005–2015. In contrast, the stimulative effect of the outstanding balance of central government debt is more pronounced during 2005–2015 and becomes relatively weaker during 2016–2025.

3. Conclusion

Drawing upon the findings from the correlation analysis, baseline regressions, robustness tests, and temporal heterogeneity analysis, this study reaches two principal conclusions. First, fiscal expansion exerts a stable and statistically significant positive effect on stock market activity in China. Increases in general public budget revenue and expansions in the outstanding balance of central government debt both significantly raise the transaction value of stocks traded on the Shanghai and Shenzhen stock markets, with the estimated coefficients of the core explanatory variables remaining statistically significant at the 1% level. Furthermore, the positive relationship persists after replacing the original measures with general public budget expenditure and stock trading volume, confirming the robustness of the baseline results. Second, the impact of fiscal policy on the stock market exhibits substantial temporal heterogeneity. During 2005–2015, the estimated coefficient of the outstanding balance of central government debt reached 2.6196, indicating a stronger short-term stimulative effect on market activity. By contrast, during 2016–2025, the coefficient of general public budget revenue increased to 3.2905, suggesting that fiscal revenue became a more important driver of the long-term development of the capital market. These findings imply that macroeconomic regulation should adopt differentiated fiscal strategies across different stages of economic development. Specifically, policymakers should appropriately combine fiscal revenue expansion and government debt financing to manage market expectations more effectively while promoting both the stable development of the capital market and the sustainable growth of the real economy.

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