An Empirical Analysis on the Relationship between Stock Price Index and Macroeconomic Variables in China

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Keywords: Stock Price Index, Macroeconomic Variables, Unit-Root Test, Co-integration Analysis, Granger Test, Impulse Response

Abstract: The relationship between the stock price index and the macroeconomic variables has always been the hot topic in the economics field. From the point of view of empirical analysis, this paper made Unit-Root Test, Co-integration Analysis, Granger Test and Impulse Response Analysis on the relationship between the stock price index and macroeconomic variables such as industrial production, money supply, interest rate, save and price index based on the monthly data from January in 2016 to March in 2021. The result shows that there exists the negative relationship between stock price index and long-term interest rate and save; while the stock price index is positive with industrial production and short-term interest rate; furthermore, there exists the positive relationship between stock price index and the initial stages of the money supply and inflation, while the stock price index is negative with the later period of the money supply and inflation.

1. Introduction

As an important place of direct financing, stock market not only plays the role of resource allocation, but also plays the role of economic prediction and value discovery as a barometer of national economy, the status of the stock market in the national economy has been unprecedented. But since June 2007, China's stock market has taken a nosedive, coming out of a bear market that is completely out of line with the overall trend of the national economy and is the longest in the history of the stock market. Therefore, the relationship between the stock market and the macro-economy has become one of the focuses of discussion in the theoretical and industrial circles, which is not only related to the development of our country's capital market, but also related to the formulation of a country's economic policy and the rapid development of the economy. It has strong theoretical and practical significance. [1]

2. Empirical Analysis

2.1 Selection of Indicators

From an economic perspective, this paper selects short-and long-term interest rates, money supply, savings, industrial value-added and price indices, which are closely related to the stock market, as

macroeconomic variables, the Composite Stock Price Index of Shanghai and Shenzhen stock markets are used as a measure of stock price to examine the relationship between the between stock price index and macroeconomic. [2]

This paper uses monthly data from January 2016 to March 2021 with the annual price level in 2015 as the base period, and converts the monthly CPI data into the regular CPI data, on this basis, the nominal value-added of industry is converted into the real value-added of industry, and at the same time, in order to avoid sharp fluctuations in the indicators, the selected short-term interest rate, long-term interest rate, money supply rate, real industrial value added, savings, price index, Shanghai Composite Index and Shenzhen Composite Index were logarithmically processed. LNRRATE, LNLRATE, LNM1, LnRip, LnSave, LNCPI, LnSZ, LnSH, respectively. [3]

2.2 Methodology

Because the macroeconomic variables interact with each other, the effects of these variables on the stock market may also cancel each other out. Therefore, this paper analyzes the stock price index and the industrial value-added, money supply, interest rate, savings and price index as a system, the unit root test, co-integration test, Granger cause test and impulse response function were used to analyze the relationship between them. [4]

2.3 Results of Empirical Analysis

2.3.1 The Results of Unit Root Test

First, the level sequences of each variable (LnSZ, LnSH, LNCPI, LnRip, LNM1, LnSave, LnRrate, LnLrate) and the first-order difference sequences (DLnSZ, DLnSH, DLnCpi, DLnRip, DLnM1, DLnSave, DLnRrate, DLnLrate) are checked for stability. The results are shown in Table 1.

Table 1: The results of stationary test for each variable.

Variable	ADF test value	Critical value			Probability	Is Smooth or not
		1%	5%	10%		
LnSZ	-1.60572	-3.5402	-2.90921	-2.59222	0.4262	No
LnSH	-1.70011	-3.5402	-2.90921	-2.59222	0.4262	No
LnCpi	-0.8117	-3.5421	-2.91002	-2.59265	0.8086	No
LnRip	-1.11998	-3.56267	-2.91878	-2.59729	0.7013	No
LnM1	-2.14774	-3.56267	-2.91878	-2.59729	0.2275	No
LnSave	0.216176	-3.54406	-2.91086	-2.59309	0.9715	No
LnRrate	-1.54586	-3.5402	-2.90921	-2.59222	0.504	No
LnLrate	-2.29136	-3.5402	-2.90921	-2.59222	0.1779	No
DLnSZ	-7.8119	-3.5421	-2.91002	-2.59265	0	Yes
DLnSH	-3.86324	-3.55747	-2.91657	-2.59612	0.0042	Yes
DLnCpi	-5.52428	-3.54406	-2.91086	-2.59309	0	Yes
DLnRip	-106.738	-3.56543	-2.91995	-2.59791	0.0001	Yes
DLnM1	-5.71746	-3.54821	-2.91263	-2.59403	0	Yes
DLnSave	-4.11675	-3.5504	-2.91355	-2.59452	0.0019	Yes
DLnRrate	-6.28921	-3.54406	-2.91086	-2.59309	0	Yes
DLnLrate	-4.96309	-3.5421	-2.91002	-2.59265	0.0001	Yes

According to Table 1, the ADF test values of Lnsz, LnSH, LNCPI, LnRip, LNM1, Lnsave, LnRrate, LnLrate are all above the critical value of 10% significance level, so the original hypothesis can not be rejected, the level of the sequence is not stable has unit root. The ADF test values of the first-order difference sequences DLnSZ, DLnSH, DLnCpi, DLnRip, DLnM1, DLnSave, DLnRrate and DLnLrate are all less than the critical value of 1% significance level, so the original hypothesis is

rejected, the horizontal sequence is smooth and has no unit root, which is calculated as I (1). [5]

2.3.2 The Results of Co-integration Test

DLnSZ, DLnSH, DLnCpi, DLnRip, DLnM1, DLnSave, DLnRrate, DLnLrate are all I (1). In this paper, the Vector autoregression Johansen co-integration test is applied to examine the relationship between Shanghai Composite Index and Shenzhen Composite Index and macroeconomic variables. The test results are as follows: Table 2 and Table 3:

Table 2: Co-integration test and equation Coefficient of Shanghai stock index and each variable.

Hypothesized No. of CE(s)	Eigenvalue		Max-Eigen Statistic	5% Critical Value		Prob.**	
None *	0.60123		55.16216	46.23142		0.0044	
At most 1	0.474432		38.59653	40.07757		0.0727	
At most 2	0.369471		27.67173	33.87687		0.2291	
At most 3	0.240914		16.53844	27.58434		0.6197	
At most 4	0.125496		8.045879	21.13162		0.9009	
At most 5	0.085808		5.382847	14.2646		0.6929	
At most 6	0.028861		1.757147	3.841466		0.185	
Co-integration coefficient							
LNSH	LNM1	LNRRATE	LNLRATE	LNCPI	LNSAVE	LNRIP	C
1	-0.0477	-0.39554	0.564803	-13.6537	1.645693	-0.00813	36.15924
	-1.91919	-0.25026	-0.38302	-2.49196	-1.83054	0.09214	
Log likelihood	786.157						

Table 2 shows that the maximum eigenvalue corresponds to a statistic larger than the 5% significance threshold, while the second largest eigenvalue corresponds to a statistic smaller than the 5% significance threshold. Therefore, we reject the first original hypothesis and accept the second hypothesis, that is, there is only one co-integration relationship between Shanghai Stock Index and each variable, and the co-integration equation is

$$LnSH=0.0477LnM1-1.645693LnSave+0.39554LnRrate-0.564803LnLrate+13.6537LnCpi$$
$$+0.00813LnRip-36.15924$$

The sequence of its residuals is

$$Vect=LnSH-0.0477LnM1+1.645693LnSave-0.39554LnRrate+0.564803LnLrate -13.6537LnCpi--0.00813LnRip +36.15924$$

Table 3: Co-integration test and co-integration equation Coefficient of Shenzhen stock index and each variable.

Hypothesized No. of CE(s)	Eigenvalue		Trace Statistic	5% Critical Value		Prob.**	
None *	0.537957		141.6525	125.6154		0.0036	
At most 1	0.465825		94.55461	95.75366		0.0603	
At most 2	0.315805		56.30566	69.81889		0.3658	
At most 3	0.247951		33.15544	47.85613		0.5483	
At most 4	0.168249		15.77329	29.79707		0.7281	
At most 5	0.05795		4.53575	15.49471		0.8559	
At most 6	0.014553		0.894227	3.841466		0.3443	
Co-integration coefficient							
LNSZ	LNM1	LNRRATE	LNLRATE	LNCPI	LNSAVE	LNRIP	C
1	-4.69823	-0.01211	3.51245	-26.3387	8.687198	-1.64041	75.2151
	-5.63034	-0.77925	-1.02417	-6.93488	-5.25578	-0.22891	
Log likelihood	727.1605						

Table 3 shows that the trace statistics corresponding to the largest eigenvalue are larger than the

critical value of 5% significance level, while the trace statistics corresponding to the second largest eigenvalue are smaller than the critical value of 5% significance level. Therefore, the first hypothesis is rejected and the second hypothesis is accepted, that is, there is only one cointegration relationship between Shenzhen index and each variable, which is expressed as:

$$LnSZ=4.69823LnM1-8.687198LnSave+0.01211LnRrate-3.51245LnLrate+26.3387LnCpi$$

$$+1.64041LnRip-75.2151$$

The sequence of its residuals is

$$Vect=LnSZ-4.69823LnM1+8.687198LnSave-0.01211LnRrate+3.51245LnLrate-26.3387LnCpi$$

$$-1.64041LnRip+75.2151$$

ADF test is used to test the stability of the residual sequence, and it is found that the residual sequence is stable, which proves that there is a long-term equilibrium relationship between the Shenzhen and Shanghai Composite Index and the variables, that is, the Shenzhen and Shanghai Composite Index is positively correlated with money supply interest rates, short-term interest rates, price indices and real industrial value-added, and negatively correlated with long-term interest rates and savings. [6]

2.3.3 Granger Cause Test

Granger cause test results show that there is a long-term stable correlation between Stock Price Index and individual variables, but it is not clear whether this relationship has a statistical cause. Therefore, using group objects in eviews 5.0 to do Granger cause test to test whether there is Granger cause between variables. The test results are shown in Table 4.

Table 4: Results of Granger cause test between variables

Null Hypothesis:	Obs	F-Statistic	Probability	Null Hypothesis:	Obs	F-Statistic	Probability
LNSAVE does not Granger Cause LNSH	60	3.71254	0.01692	LNRIP does not Granger Cause LNSZ	61	5.58955	0.00612
LNSH does not Granger Cause LNSAVE		1.54883	0.21270	LNSZ does not Granger Cause LNRIP		0.90116	0.41191
LNLRATE does not Granger Cause LNSH	59	2.24652	0.07718	LNM1 does not Granger Cause LNSZ	61	3.15595	0.05027
LNSH does not Granger Cause LNLRATE		0.67022	0.61571	LNSZ does not Granger Cause LNM1		0.09292	0.91140
LNCPI does not Granger Cause LNSH	58	2.54175	0.04076	LNSAVE does not Granger Cause LNSZ	62	4.82001	0.03208
LNSH does not Granger Cause LNCPI		1.59790	0.17918	LNSZ does not Granger Cause LNSAVE		0.29797	0.58721
LNRRATE does not Granger Cause LNSH	61	0.39858	0.67316	LNLRATE does not Granger Cause LNSZ	50	2.59968	0.02191
LNSH does not Granger Cause LNRRATE		2.51047	0.09033	LNSZ does not Granger Cause LNLRATE		0.91388	0.55342
LNRIP does not Granger Cause LNSH	61	1.04589	0.35814	LNRRATE does not Granger Cause LNSZ	49	2.18457	0.05393
LNSH does not Granger Cause LNRIP		1.00265	0.37340	LNSZ does not Granger Cause LNRRATE		0.64910	0.79417
LNM1 does not Granger Cause LNSH	61	1.26085	0.29133	LNCPI does not Granger Cause LNSZ	48	2.13155	0.06782
LNSH does not Granger Cause LNM1		1.17175	0.31730	LNSZ does not Granger Cause LNC	PI	0.64961	0.79681

From Table 4, for the Shanghai Composite Index, the null hypothesis that LNSAVE does not Granger Cause LNSH, LNCPI does not Granger Cause LNSH and LNRRATE does not Granger Cause LNSH can be rejected at significant levels of 5% and 10% , that is, changes in the savings

index, the price index and long-term interest rates are Granger cause of the change in the Shanghai Composite Index, but other assumptions can not be rejected, therefore, changes in short-term interest rates, real industrial value-added and money supply are not Granger cause of the Shanghai Composite Index, which can partly reflect the economic situation. For the Shenzhen Index, you can reject the null hypothesis that the variables are not Granger cause at 1%, 5% and 10%, respectively, that is, real industrial value-added, money supply, savings, long-term interest rates, short-term interest rates and price indices are the Granger causes of the Shenzhen Index, which can provide a comprehensive picture of macroeconomic conditions. [7]

2.3.4 Impulse Response Function

In order to measure the effect of random disturbance on the relationship between variables and describe the trajectory of these effects, the next part of this paper is impulse response function analysis. We used the Eviews software to analyze the impulse response function, and the results are shown in figures 1 and 2
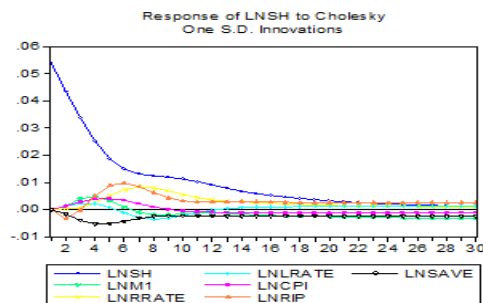

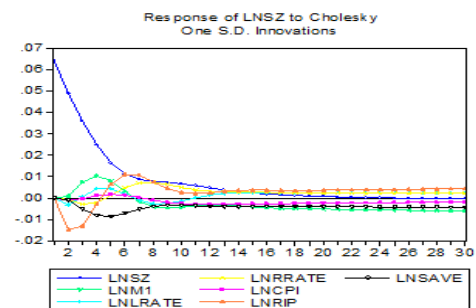Figure 1: Response of LNSH to Cholesky One S.D. Innovations

Figure 2: Response of LNSZ to Cholesky One S.D. Innovations

From the impulse response function chart, the Shanghai Composite Index and Shenzhen Composite Index are basically the same, the following Shanghai Composite Index as an example to illustrate the Stock Price Index response to the impact of various variables. [8]

The Shanghai Composite Index (Lnsh) has a strong reaction to its standard deviation information without any lag, reaching about 0.055 in the current period, then gradually decreased, and tends to be stable to the 20th month.

For long-term interest rates, a standard new spread has a positive response in the second month, a negative response in the sixth month, and then gradually levelled off to zero. This shows that the long-term interest rate and the stock price negative correlation, the higher the long-term interest rate, the lower the stock price. This is in line with the intrinsic value of the stock, because the higher the discount rate, the lower the value of the stock, and thus the lower the price of the stock. [9]

And the disturbance of a standard new spread of short-term interest rates had a negative effect in the second month. From the third month, the effect changed from negative to positive, reaching a maximum of 0.005 in the seventh month or so, and then gradually decreased, but the impact has been positive. That short-term interest rates are positively correlated with stock prices, mainly because companies increase their capital requirements while increasing their cash flows and year-end dividends, thus driving up stock prices, under the condition of interest rate marketization, the interest rate will rise, therefore, the stock price and the short-term interest rate are positively correlated, in line with the actual economic phenomenon. [10]

The disturbance of savings peaked at -0.005 in the 4th month and levelled off in the 9th month, but the relationship remained negative. This suggests that savings and stock prices move in the opposite direction, because the more savings there are, the less money flowing into the stock market and thus the lower the stock price, in line with economic phenomena.

The fluctuation of a standard new interest rate spread of CPI has a positive effect in the second month, reaches a maximum of 0.003 in the fifth month, and then gradually decreases, from the 10th month to a negative effect, this suggests that inflation initially drives up share prices, but later causes them to fall, mainly because the Means of production price does not rise sharply immediately and the cost of production does not increase significantly, but the sales increase sharply with the price increase, which leads to the increase of the profit of the enterprise, which leads to the rise of the nominal income of the stock and the increase of the demand for the stock, and finally drives the corresponding rise of the stock price. But with rising production costs and inflation expectations, profits have fallen and share prices have fallen, which is in line with reality. [11]

The money supply disturbance had a positive effect on the Shanghai Composite Index in the second month, reaching a maximum of about 0.003 in the fourth month, then gradually decreased, and leveled off in the eighth month, but remained a negative effect all the time. This is mainly due to the money supply increase in the cash flow of the stock market and the expansionary effect on the investment of companies, hence the rise in the stock price, but over time the increase in the money supply increases inflation expectations, it increases the incentive for households to hold money and reduces the demand for stocks; this, coupled with the reluctance of commercial banks to lend, has led to a shortage of corporate capital and hence to a fall in share prices.

For the disturbance of a standard new spread of industrial value added, the Stock Price Index had a negative reaction in the 2nd month, but turned positive from the 3rd month and reached a maximum of 0.01 in the 6th month, then gradually reduced until the 10th month began to level off, but has maintained a positive impact. The Stock Price Index of our country is positively related to the national economy, the better the economic development, the higher the stock price, thus reflecting the stock price is the "Barometer" function of the national economy. [12]

3. Conclusion

The empirical analysis of the relationship between stock price index and macroeconomic variables shows that stock price index has negative correlation with long-term interest rate and savings, positive correlation with short-term interest rate and industrial value added, and positive correlation with money supply rate and early stage of inflation, in the later stage, it is negative correlation, which is basically consistent with economic phenomenon. However, the Stock Price Index of our country has a weak response to other macro-economic variables except its own changes, which shows that the stock market of our country is not effective and there are certain obstacles to the processing of information, therefore, we should speed up the reform of the capital market, increase the construction of transparency and standardization, and make the transmission channel of macroeconomic variables to the stock market unblocked, thus better play the capital market resource allocation and the macroeconomic economic forecast and value discovery functions.

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