The Impact of Macroeconomics on Securities Margin TradingBased on Experimental Analysis

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Abstract—Since China officially opened its securities margin trading in 2010, its trading share has been rising year by year. Securities margin trading is playing an increasing role in China's securities market.It is increasingly meaningful to forecast their trading shares. In this paper, economic data from January 2011 to June 2021 were downloaded from the wind database, and three macroeconomic variables, CSI300, RMB deposit balance and forex loan balance, were screened out through linear correlation analysis and partial correlation analysis. A vector autoregressive model was constructed using these three variables and margin balance,so as to give a mathematical model that can predict margin balance to a certain extent. The result of impulse response analysis and variance decomposition shows the respective contribution of different macroeconomic variables to margin balance.

Keywords-Securities margin trading; Macroeconomics; Correlation analysis; Vector autoregressive model

1. INTRODUCTION

Securities margin trading is a margin or related securities credit transaction in which an investor uses securities or funds to pledge them to a securities firm, negotiates the value of the pledged items and borrows a certain amount of funds from the firm and uses these funds to purchase securities.Since the start of China's securities margin trading system in 2010, the securities margin trading mechanism has provided investors and securities companies with a new mode of profitability, activating the market, improving the stock price formation mechanism and satisfying investment needs and promoting the development of the brokerage industry [1], and the proportion of securities margin trading transactions in the whole stock market has been increasing.

As a mode of trading in the stock market, the volume of securities margin trading is inevitably influenced by the stock market. The macro-economic impact on the stock market is also reflected in securities margin trading. Changes in securities margin trading will also have some

ICEMME 2022, November 18-20, Nanjing, People's Republic of China

DOI 10.4108/eai.18-11-2022.2327122

impact on the stock market and the macro-economy. While many researches currently focus on the impact of securities margin trading on economic markets, it is equally important to examine the macroeconomic impact on the financing and securities margin trading in a financial market where many variables are intricately related to each other. Under this situation, the study of the macroeconomic impact of securities margin trading transactions in China has become more meaningful and relevant.

This study investigates the impact of some macroeconomic indicators on securities margin trading by constructing a vector autoregressive model with selected indicatorsin order to forecast the securities margin trading market analyze the extent that securities margin trading is influenced by different variables and provide investors with some reference for adjusting their investment portfolios.

2. RESEARCH METHODOLOGY

To study the impact of macroeconomics on the securities margin trading, the author downloaded the securities margin trading data from January 2011 to June 2021 in the wind database along with some other macroeconomic data.

Regression analysis was first performed to determine the correlation between the data and to filter out the data that could be fitted with a linear regression. A linear fit is then performed to provide a preliminary analysis of the relationship between margin balance and other macroeconomic variables. The screened data were then used to build a vector autoregressive model to investigate the dynamics and mutual contribution between them. The final conclusions are drawn from impulse response analysis and variance decomposition.

3. VARIABLES SCREENING AND LINEAR FITTING

3.1 Selection of the Variables

In order to study the impact of the macro economy on the whole securities margin trading, the author selected margin balance as representative indicator.

In the national economy, GDP is not taken into consideration in the selection of variables because the amount of data available as annual data is too small. As an index which can reflect the Chinese economic situation more clearly and more suitably than GDP, Keqiang index also reflects the development of the national economy [2]. This index is based on a set of relevant, credible and easy to monitor indicators, including industrial electricity usage, volume of railway freight and medium- and long-term loans.Therefore the author selected industrial electricity use, rail freight volume and RMB loan balance for regression analysis. CPI and PPI, as two main price indices, are also taken into consideration.

In the financial markets sector, the author first selected RMB deposit balance which matched loan balance.As an index reflecting the aggregate movement of share prices of representative stocks with high liquidity and size, CSI 300 Index is selected as an indicator of the stock market. In the bond and futures markets, the author selected futures volume and bond custody volume:

corporate bonds for analysis. RMB to USD exchange rate,forex deposits and loan balances are also of concern.

3.2 Linear Correlation Analysis

Scatter plots are first constructed to initially determine the linear correlation between the margin balance and the variables [Fig.1].

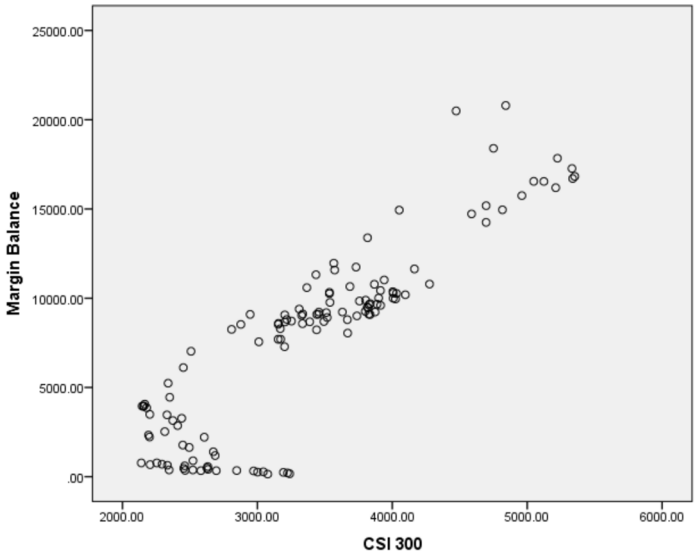

Figure 1. Scatter plot of CSI300 and margin balance

For the scatter plot with data on the Y-axis for the margin balance and on the X-axis for the CSI300, it is obvious to find that most of the points are concentrated on a line from the bottom left to the top right, so it can be tentatively concluded that the two variables are correlated. The value of Pearson's correlation calculated using SPSS is 0.881, and significance (two tails) is close to 0, which means that they have a significant positive correlation.

After analyzing the remaining 12 variables in the same way,the authorconcluded that variables that have a linear correlation with margin balance are CPI (0.786), M0 (0.740), RMB loan balance (0.780), RMB deposits balance (0.809), forex loan balance (0.849), forex deposits balance (0.849), CSI300 (0.881), futures volume (0.802), bond custody volume: corporate bonds (0.727). But rail freight volume (0.163), industrial electricity use (0.586), PPI (-0.371), exchange rates (0.301) do not have a significant linear correlation with margin balance.

3.3 Partial Correlation Analysis

According to the results of linear correlation analysis, nine variables are all potentially linearly correlated with margin balance. However a high level of correlation between two economic variables is sometimes not determined by the intrinsic linkage of themselves, but by the other variable. So a partial correlation analysis of the margin balances with each of the other indicators needs to be conducted.To exclude the effect of transitional variables [3].

First the author noted that the scatterplots of CPI, M0, RMB deposits balance, RMB loan balance and forex deposit balance as x-axis data show a very high degree of similarity and have a more distinct difference from the others.So it can be assumed that the correlation between one of these five variables and the margin balance is influenced by the other two variables. Calculation using SPSS gives the following results: When controlling for the other two variables, the correlation coefficients betweenCPI, M0, RMB deposits balance, RMB loan balance, forex deposit balanceandmargin balance are -0.085, 0.015, 0.124, -0.101 and 0.247 respectively, which confirms our suspicions. Since M0 and CPI is barely linearly related to margin balance when the effect of RMB deposit balance is excluded, the correlation that exists between RMB deposit balance and M0,CPI leads to the correlation of M0 and CPI with margin balance. And with the effect of other variables excluded, the correlation coefficient between RMB deposit balance and margin balance is -0.654, which means they still are more likely to be relevant.

Then the author ran partial correlation analysis on other variables. The results show that with the effect of other variables removed, CSI300 (0.864) and forex loan balance (0.621) are related to margin balance. Futures volume (0.365) and bond custody volume: corporate bonds (0.143) have a low correlation coefficient with margin balance after excluding the effect of other variables and the likelihood of having a correlation is small.

3.4 Multiple Linear Regression Analysis and Modeling

According to the result given by partial correlation analysis, the author selected three variables with regression coefficients above 0.6 (CSI300, forex loan balance and RMB deposit balance) as independent variables for linear regression modeling. Data from January 2011 to March 2021 are selected for the fit. Fitting with SPSS gave the following results.

The adjusted coefficient of determination of this model is 0.943, which means that 94.3% of the change in margin balance can be explained by CSI300, forex loan balance and RMB deposit balance.The statistical significance is close to zero. So theoriginal hypothesis is rejected, which means that the model makes sense.

The fitted multiple linear regression equation can be expressed as:$\mathrm{MB} = -23535.715 + 0.438 \times \mathrm{FLB} - 0.005 \times \mathrm{RDB} + 4.778 \times \mathrm{CSI300}$

4. CONSTRUCTING VECTOR AUTOREGRESSIVE MODELS

To further investigate the dynamic relationship and mutual contribution between margin balance, CSI300, foreign exchange loan balance and RMB deposit balance. A VAR (vector autoregressive) model needs to be built.

4.1 Stability Checks

All data in the entire research process are time series, and the time series requires that the sample itself must be a stationary series. ADF (Augmented Dickey-Fuller Test) test is adopted to check whether the sequence with time trend is a stationary sequence [4].

For margin balance, the models with trend and intercept terms, with intercept terms only, and without intercept and trend terms were tested separately and all had significant levels greater

than 0.05. Therefore the original hypothesis cannot be rejected and margin balance is not a stationary time series.

Next, the data were tested again after the first order difference. The original hypothesis can be rejected when choosing a model without the intercept and trend terms, which indicates that the differential margin balance is a stationary time series.

The other three variables were analyzed in the same way. The result shows that CSI300, differential forex loan balance and differential RMB deposit balance are stationary time series.

Therefore researcher chose CSI300, differential forex loan balance, differential RMB loan balance and margin balance to build the vector autoregressive model.

4.2 Optimal Lag Order Selection

The most data containing "*" are found when the lag order is 1 and 2. The author chose to build a 2nd order model [Fig.2].

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4181.829	NA	1.40e+26	71.55263	71.64706	71.59097
1	-3952.097	439.8277	3.62e+24	67.89910	68.37127*	68.09079*
2	-3929.274	42.13460	3.22e+24*	67.78247*	68.63237	68.12752
3	-3920.774	15.11108	3.67e+24	67.91067	69.13831	68.40908
4	-3910.063	18.31078	4.04e+24	68.00107	69.60644	68.65283
5	-3898.409	19.12389	4.38e+24	68.07537	70.05847	68.88048
6	-3875.244	36.43066	3.92e+24	67.95289	70.31372	68.91135
7	-3864.148	16.69121	4.33e+24	68.03672	70.77528	69.14854
8	-3844.799	27.78280*	4.17e+24	67.97947	71.09577	69.24465

Figure 2. Result of lag length criteria

4.3 Granger Causality Test

When the significance level is set at 5%, differential margin balance and differential forex loan balance have a two-way Granger causality. There is a predictive effect between them. The same relationship also exists between CSI300 and differential margin balance. Differential margin balance is predictive of differential RMB deposit balancebutnot vise versa.

4.4 Calculation of Models

The function can be written as:

$$\begin{pmatrix} \mathrm{DFLB}_t \\ \mathrm{CSI300}_t \\ \mathrm{DMB}_t \\ \mathrm{DRDB}_t \end{pmatrix} = \begin{pmatrix} 922.0703 \\ 64.78311 \\ 438.0682 \\ 1803.301 \end{pmatrix} + \begin{pmatrix} 0.122351 & 0.949033 & -0.322270 & -0.000864 \\ -0.027310 & 0.974889 & 0.088949 & 0.001587 \\ -0.077861 & 1.107287 & 0.439571 & 0.001543 \\ 2.087743 & 20.81921 & -1.404663 & -0.124538 \end{pmatrix} \begin{pmatrix} \mathrm{DFLB}_{t-1} \\ \mathrm{CSI300}_{t-1} \\ \mathrm{DMB}_{t-1} \\ \mathrm{DRDB}_{t-1} \end{pmatrix}$$
$$+ \begin{pmatrix} 0.023850 & -1.148270 & 0.394954 & -0.000864 \\ 0.009481 & -0.002480 & -0.066172 & 0.001587 \\ 0.156285 & -1.220898 & -0.255871 & 0.001543 \\ 0.631596 & -16.06140 & 2.042564 & -0.124538 \end{pmatrix} \begin{pmatrix} \mathrm{DFLB}_{t-2} \\ \mathrm{CSI300}_{t-2} \\ \mathrm{DMB}_{t-2} \\ \mathrm{DRDB}_{t-2} \end{pmatrix}$$

From the equation it can be known that differential RMB deposit balance has a smaller influence on other three variables. And CSI300 has the most significant effect on the other three variables.

4.5 Impulse Response Analysis and Variance Decomposition

After the stability of the model passes the test, the conditions for conducting impulse response analysis and variance decomposition are met [Fig.3].

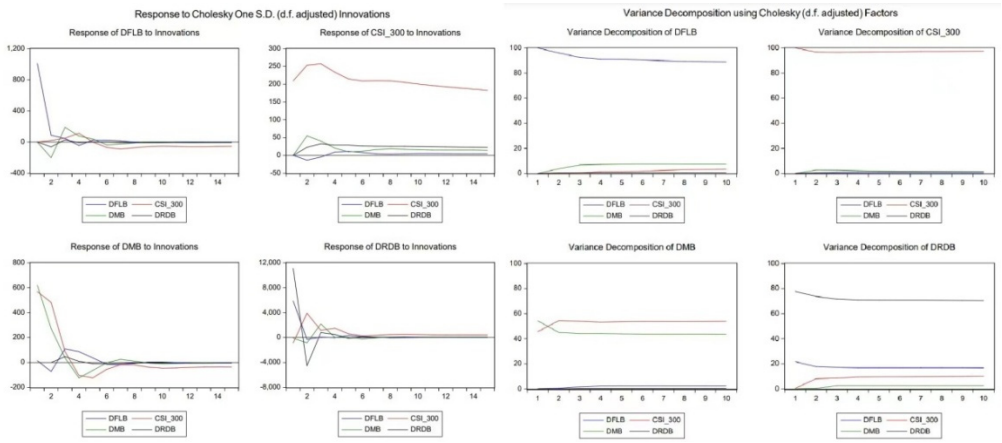

Figure 3. Result of impulse response analysis and variance decomposition

When the author gave differential forex loan balance a positive shock, differential margin balance first shows a reverse response, which reaches its maximum in the second period. After that the effect diminishes and switches to an isotropic response, which reaches its maximum in the third period and then gradually diminishes. An extremely weak reversal occurs in the sixth period, after which it gradually decreases to zero.

When the author gave CSI300 a positive shock, differential margin balance shows an isotropic response, which reaches a maximum in phase 2. It then gradually decreases, but there is a weak increase in periods 6 to 8, after which it gradually decreases to zero.

When the author gave a positive shock to differential RMB deposit balance, differential margin balance response was essentially the same as when a shock is given to differential forex loan balance. The difference is that the reverse response of differential margin balance when given a positive shock to differential RMB deposit balance is smaller than the response when given a shock to differential forex loan balance.

Result of variance decomposition shows that 55% of the variation in differential margin balance can be explained by CSI300. About 40% can be explained by own data, and the other two have little effect on it.Most of the changes in the other three figures can be explained by their data. The results indicate that CSI300 has some effect on differential margin balance. Other interactions between these four variables are not significant.

5. CONCLUSION

After linear regression analysis, it can be seen that among the variables studied in this study, all macroeconomic variables except rail freight volume, industrial electricity use, PPI, exchange

rates have a positive relationship with margin balance. However, after excluding the effects of some other variables, CPI, M0, RMB deposit and loan balance, forex deposit balance shows a negative correlation with margin balance. The authors finally chose margin balance, CSI300, RMB deposit balance and forex loan balance to construct a linear model.

After building a VAR model Using the four variables above and run impulse response analysis and variance decomposition, it can be seen that a large part of the change in differential margin balance(the amount of variation in margin balance), can be explained by CSI300 and is not significantly influenced by differential RMB deposit balance and differential forex loan balance. In addition, most of the changes in CSI300, differential RMB deposit balance and differential forex loan balance can be explained by their own data and are less affected by the remaining three variables.

This research analyses the impact of securities margin trading on the macro economy and illustrates the interaction between margin balance and the factors by building a VAR model. However, there is still much improvement thatcan be made in this study. Firstly, the range of macroeconomic variables selected in this study is not broad enough and does not fully cover all aspects of the macro economy. Secondly, there is too little relevant data for the post-epidemic period to allow for separate analysis of the pre- and post-epidemic periods, therefore it is not able to separately study the macroeconomic impact of the two periods on securities margin trading. Thirdly, according to Tian [5], the growth rate of margin financing is much more correlated to the market than the growth rate of securities lendingto the market. It would be meaningful to study the impact of macroeconomics on them separately. Finally, this study is mainly a quantitative analysis, giving only the possible mathematical links without an analysis of the underlying reasons for the links. Further analysis can be carried out subsequently focusing on these three aspects.

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