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Macroeconomic Factors on the Equity Investment Income of National Social Security Funds: An Empirical Analysis Based on Var Model

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Abstract: This study selects the top ten heavily held by stock of National Social Security Funds (NSSF) as the research samples, then uses the VAR model and stress tests to analyze the macroeconomic factors of NSSF and the investment security. The results show that short-term effects of the price factors, the money supply and fixed asset investment are more significant but the mechanism is different significantly. And the interest rate is once again proved that the impact is not significant. The constructed of three macroeconomic scenarios of extreme stress test studies in this study have shown the social security fund to pay equity portfolio will have a certain risk. These conclusions will contribute to improve the investment income of NSSF and reduce the affects of adverse systemic risk of macroeconomic factors, which will provide an important theoretical and empirical basis.

Key words: National social security fund (NSSF), stock portfolio, macroeconomic factors, VAR model, stress test

INTRODUCTION

Facing the social endowment insurance caused by aging population, the Chinese government has constructed the national social security fund in 2000 in order to make up for social security needs. However, with the increasing fund size, how to maintain and appreciate the value of fund has gradually become the focus of the whole society. From the point of existing investment channels then, the fund's investment portfolio still takes the form of bank deposits and bonds, in order to achieve safety and profitability. While, as the potential inflation risks, it cannot guarantee the real security of fund. In order to expand the fund income, entrusted investment channel for stock investment has been gradually expanded and share of investment is rising in recent years. Overall it has achieved good results in the capital market. While, considering the particularity of China stock market and the impact of the international financial crisis, it must pay close attention to the influence of macro environment on stock market risk. Therefore, in order to maintain and appreciate the value of fund, it is necessary to study the effect of the macro factors under the consideration of China's specific situation.

So, what macroeconomic factors do really affect china stock market? And does the influence path and mechanism work well? The existing theoretical researches have given two main points, which are: One is, macro

environmental has a weak affect on stock market (Friedman, 1988); While another is, macroeconomic variables greatly affect the stock markets (Kim and Verrecchia, 1991). According to the review and summary of the previous related documents, Levine (2005) pointed out that the vast majority of economists agree the latter view.

If the macroeconomic variables affect the stock market, so, what would be the impact on the social security fund when the macroeconomic environment changes? Whether social security fund will cause the payment risk or not? And when it happens? The answers to these questions contribute to understand the effects of macroeconomic environment on fund investment from intuition point of view. This study intends to analyze the payment risk of social security fund under the background of stress text and further propose countermeasures for social security fund to deal with macroeconomic risk.

Stress test is to study how the asset portfolio changes based on supposes of adverse market (such as a sudden rise in interest rates or inflation). The stress test was mainly used in the evaluate of risk profile in banks and other financial sectors in previous studies (Kupiec, 1998). Many scholars believe that the use of stress text should under the consideration of various macroeconomic factors (Hoggarth and Whitley, 2003). Most of domestic studies are focus on theoretical study

of stress test. Empirical researches are still relatively scarce. What's more, they mainly focus on banks, securities firms and other financial sector (Wang, 2002), instead of stock market.

The national social security fund is run by the professional investment institutions. And the national social security fund is facing systematic risk. In theory, systematic risk is not easy to be dispersed, while given the situation that national social security fund is run by the professional investment institutions, the investment are professional. Therefore, this study tries to explore how to make the stock investment returns of national social security fund has a better performance in market. In addition, because of the complexity of the stock market in market economy conditions, short-term analysis does not explain the relationship between stock market and macroeconomic environment. From 2004-2010, China has experienced the rapid economic development as well as the more volatile economic times. So, this study selects data from 2004-2010, given the consideration that the data structure is more reasonable. Finally, based on the VAR analysis of stress test research, this study explains the payment risk faced by national social security fund as well as the influence of macroeconomic factors from an evident angle. Taking these aspects into consideration, this study intends to investigate the influencing factors of the national social security fund stock investment from macro perspectives, by using the stock investment data of national social security fund from 2004-2010, combined with the VAR model and the stress test method. In addition, this study also attempts to explore the general rule of the impact of macro environment on national social security fund, efforts to avoid the negative impact of the macro environment and improve the national social security fund stock investment income, to maximize the value of pension funds.

THEORETICAL ANALYSIS AND DATA DESCRIPTION

Theoretical analysis: Because there are many differences in sample selection and research methods, it has not reach a consensus about the influence of macro environment on stock returns and its mechanisms in existing research. Therefore, for China's practical situation, this study combs the theory study about the influence of macro environment on stock returns and further puts forward the main points and basic hypothesis. Considering that macro environment affected by many factors, this study mainly analyzes the following factors on the basis of existing theory, such as inflation rate, interest rate, money supply, economic growth and exchange rate and so on. Selection

of the indicators fully considerate the price factor which affects the stock market and these indicators have solid theoretical basis. The analysis of influence mechanism is as follows.

First is about the influence of inflation rate. In theory, if public regard stock as a hedge against inflation, with the rising of domestic inflation rate, the public will put a lot of money in the stock market, further leads the stock price rising, therefore there has a positive correlation between inflation rate and stock returns. While, Fama (1981) found that inflation is negatively related to the stock market. This may be related to government's monetary policy. When inflation is rising quickly, the government generally adopts a tight monetary policy; monetary supply reduction will reduce the public demand for the stock market, which will have a negative impact on the stock market. This study uses two indicators CPI and PPI to analyze the influence of inflation from both consumer and supplier perspective.

Secondly is about the influence of money supply and interest rate. Fama (1981) argues that the increasing of money supply will increase public inflation expectations for the future, leading to the increase of the discount rate, so that the stock price will decline; at the same time, the increase of money supply will lead to economic expansion, which is conducive to the rise in price. Therefore, the impact of money supply on stock price still needs empirical test. By using VAR model, Dhakal *et al.* (1993) found that money supply can not only directly affect the stock market but also has an indirect effect on stock by interest rate, inflation rate and so on. In China, Hu and Chen (2003) believe that the money supply has a great influence on the stock market and there has a positive causal relationship between them. But Sun and Ma (2003) found that the quantity of money has no effect on the stock market by conducting VAR model by broad money supply, bank rate, stock market value, real GDP, stock price and CPI. They exclude the possibility of using quantity of money to affect stock market but the central bank interest rates have a certain little impact on stock prices. Thus it can be seen that, the influence of the money supply and interest rates also need to empirical test.

Thirdly is about the impact of economic growth. As a barometer of the economy, there has no doubt that economic growth is an important factor affecting the stock price. Demirguc-Kunt and Levine (1996) argue that per capita GDP has a positive correlation relationship with stock market development. Generally, countries with higher per capita GDP, the higher degree of stock market development. Zheng and Yuan (2000) pointed out that the development of China's capital market is not only related

to the economic growth but also related to the system transformation. Because China's total fixed asset investment is positively related to economic growth, therefore, this study intends to use total fixed assets on behalf of the economic growth.

The last is about the influence of exchange rate. At present, there are mainly two kinds of theories to explain the relationship between the exchange rate and stock price. One is the flow oriented model, it considers the currency movements affect the international competitiveness of enterprises, trade balance and the real output of a country, thus it has an impact on the company's cash flow and stock prices. Therefore there exists one-way causation from exchange rate to stock price and there is a negative relationship between both. Second is stock oriented model, it considers the exchange rate as well as other commodities is also determined by the market demand and supply. When the stock price rising, it will attract foreign investors, the action to sell foreign currency and buy domestic stock will lead to currency appreciation; In addition, the price rise will increase the wealth of domestic investors, promote the growing demand for the currency, thus promote domestic interest rates rise and further stimulate the capital inflow. Therefore, there is a one-way causal causation from stock price to exchange rate and there is a positive correlation between them. But the conclusions of empirical research on the relationship between exchange rate and stock market at home and abroad are inconsistent; it still needs to be tested in practice (Cheng and Zhou, 2009).

Variable selection and data specification: Dependent variables: the logarithmic return rate of portfolio. The object is the equity portfolios of National Social Security Fund open published in September 30, 2010, then we will select the top ten heavily held as the study sample. Because the daily average yield or the average monthly return rate, average annual yields of the constituent stocks are not readily available, this study will use the same methods like the Dow Jones index to calculate the price index using the daily arithmetic average closing price of the portfolio and then based on the price index calculate the portfolio daily logarithm return as the daily return of the combination, finally convert for the quarterly logarithmic yield of sample portfolio.

Explanatory variable: through theoretical analysis, this study selects the model variables as following, CPI (x_1) and PPI (x_2), average exchange rate against dollar (x_3), one-year deposit rate (x_4), monetary aggregate (x_5) and total investment of fixed assets (x_6). All data use the real value, for example, the fixed assets investment will be deflated by CPI.

Because the interest rate and exchange rate changes frequently, so we use the weighted average method to cope with this issue. For strong seasonal data, such as CPI, PPI, M1, total fixed asset investment amount, etc., which are used Tramo/Seats method to eliminate the seasonal effects.

EMPIRICAL ANALYSIS

On the basis of theoretical analysis, this study uses VAR model to study the effect of various factors on stock returns, thus further analysis the macro factors on national social security fund investment. First is about the stationary test of data.

Macro factors analysis: The stationary of data is the basis to analyze VAR model, therefore, this study uses ADF unit root testing. The results show the variables are non-stationary series at the significance level of 5%. And first order differences are stationary series under the significance level of 5%. Therefore, this study uses the first order difference of sequence in VAR analysis. Then comes about the function profiling of impulse response function between various variables, the results are shown in Fig. 1.

CPI: In the short term, the impact of CPI on the return rate of the investment portfolio is relatively large. When given a shock on Δx_1 in the current period, Δy will decrease and on the second period reaches the lowest point and in the fourth period this effect tends to be stable. Therefore, CPI and stock returns is negatively correlated in the short-term but in the long term they will be positive but the effect is waning. The main reason is probably that when economic phenomenon is inflation, the government generally takes the tight monetary policy, so which will have a negative impact on the stock market but with the reduction of inflation, the tight policy begins to withdraw, the moderate inflation is conducive to economic growth and thus have a positive impact on the stock market.

PPI: When Given a shock on Δx_2 in the current period, Δy will decrease and reach the lowest point at the second period, then reach highest point at the third period, from the fourth period the effect is stable. Therefore, the impact of PPI on stock returns is firstly negative and then positive in the short-term but in the long-term the effect is not obvious. Possible explanations are: due to use a new technology or other reasons, which may result in product prices increased in the short term and impact profits, so that the stock returns will fall;

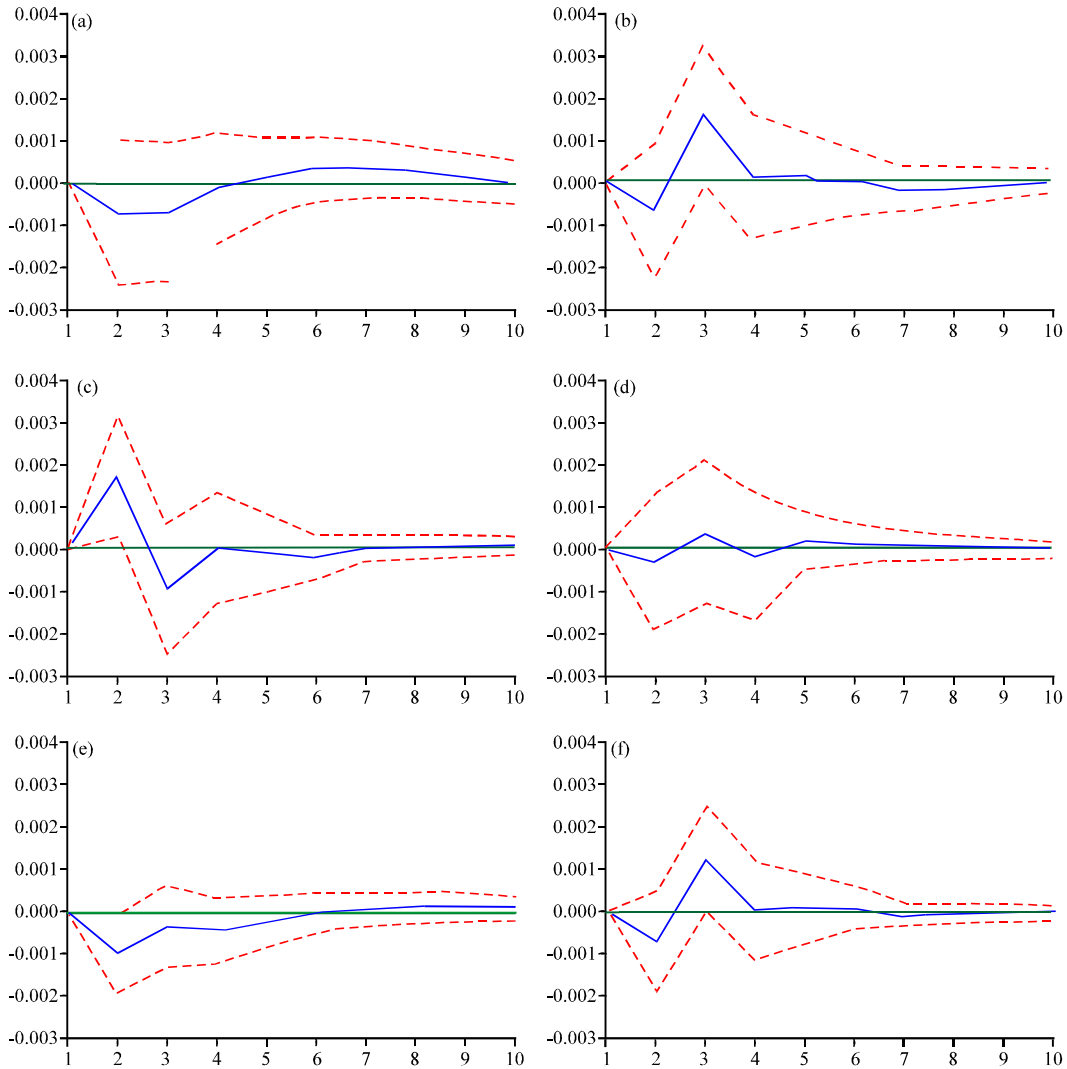


Fig. 1(a-f): Effect picture of impulse response, (a) Response DY to Dx1, (b) Response DY to Dx2, (c) Response DY to Dx3, (d) Response DY to Dx4, (e) Response DY to Dx5 and (f) Response DY to Dx6

however, because of the scale effect, corporate profits also will be expanded, so that the stock price will rise again. In the long run, by the impact of interest-oriented, the other companies have also imitate the industry outstanding enterprises to introduce advanced technology and so on, making the convergence of corporate profits in the industry, so the stock price in the long term will reach steady state. Thus, the price factor on the social security fund equity portfolio effects are gone from negative to positive in the process, the study distinguishes between short-term effects and long-term effects, it is very well to integrate the different conclusions of vary short-term and long-term research.

Exchange rate. When Given a shock on $\Delta \ln x_t$ in the current period, Δy will make increase rapidly and reached its peak in the second period and then quickly fall to the lowest value and this volatility tends become stable after the fourth period. Therefore, the impact of exchange rate on stock returns is firstly positive and then negative in the short-term but in the long-term the effect is not obvious. This indicates that the impact of exchange rate on the stock market is more complex in the short term. Since the exchange reform since 2005, the exchange rate of the Renminbi against the U.S. dollar has appreciated a lot, so it is adversely for the China's exports, which may be caused by the psychological expectations. But at the same time, China's economy has been in a stage of rapid

development, which can effectively weaken the exchange-rate appreciation adverse impact on the stock market. However, it really has happen both the appreciation of currencies in the process and the depreciation of the domestic market, so it can be said that the impact is very complex.

Interest rates. When given a shock on Δx_4 in the current period, Δy will change little, the impact is not too strong in the long term. This shows that the impact of China's one-year bank deposit interest rate on stock returns is not very significant. The reason, perhaps because of increased deposit interest rates lead to flow a part of cash into the bank from the stock market but due to the limited deposit interest rates increased, the directional flow of capital is not significantly affected. This conclusion is similar to most existing research.

The money supply. When given a shock on $\Delta \ln x_5$ in the current period, Δy will decrease to the lowest point at the second period and then lowly increase to fifth period and then become stable. However, this effect is also not very significant in the long term. Therefore, the narrow money supply will yield the negative effect on the social security fund portfolio in the short term. According to the theoretical analysis, the increase in money supply will increase public awareness of future inflation expectations, resulting in the improvement of the discount rate and thus make the stock price declines; while the increase in the money supply will lead to economic expansion, thus contributing to the rise in share price (Fama, 1981). It is apparently for our country, the money supply increased did not lead to increase of stock portfolio yields of China's National Social Security Fund. This is also consistent with the actual situation of our country, China's monetary has growth largely in recent years but the performance of the stock market gains is more poorly.

Total fixed asset investment. In the short term, the impact of the fixed assets on portfolio yield of pension fund investment is relatively large. When given a shock on $\Delta \ln x_6$ in the current period Δy will decrease to lowest point at the second period, then increase to the highest point at the third period and become stable. So in the short term, the impact of total fixed asset investment amount on return of the social security fund portfolio is firstly negative and then positive. The reason may be that the increase in fixed asset investment funds will attract the capital flow to fixed assets from the financial markets, which result the fall of the stock market prices in the short term, when normal operation after the completion of fixed assets and making profits for the enterprise, the stock price will rise. In the long run, inherent self-regulating capacity of capital markets will eliminate these instabilities.

Table 1: Macro stress test

| Compression project | Stress situation | | |
|----------------------|------------------|------------|------------|
| | Mild (%) | Medium (%) | Severe (%) |
| CPI | 5 | 15.00 | 25.00 |
| Exchange rate | 5 | 10.00 | 15.00 |
| Deposit rate | 10 | 20.00 | 30.00 |
| PPI | 10 | 20.00 | 30.00 |
| M1 | -5 | -10.00 | -15.00 |
| Fixed assets | -10 | -20.00 | -30.00 |
| Investment portfolio | 0.72 | 0.51 | 0.19 |

Payment risk analysis: This article uses the scenario analysis method; each macro variable settings are mainly by observing the historical data. In this study, based on historical data, we will set three pressure scenarios. This study selects the data from the fourth quarter of 2004 to the third quarter of 2010, where the maximum value of CPI is 08.0333, the minimum value is 98.4667, considering the current economic situation, we will set CPI changing including the mild, moderate and severe cases (+5, +15, +25%). The remaining variables have the same scenario.

Stress test results: Firstly, we construct the stress test model by using the linear regression equation to evaluate the return volatility of social security fund portfolio, the basic regression model is as follows:

$$y = 0.001x_1 + 0.072x_2 - 0.389x_3 - 0.0004x_4 - 0.064x_5 + 0.068x_6$$

We will get the comprehensive value by substituting the data into the estimated linear regression models, the results shown in Table 1.

Deposit interest rate is 2.25% at third quarter of 2010, the quarterly geometric mean logarithmic yield of the Shanghai Composite Index is -0.0307%, it can be seen from Table 1, in the three pre-set pressure situations, although investment portfolio yield of social security fund is higher than quarterly geometric mean logarithmic yield of the Shanghai Composite Index, which is lower than deposit interest rate, therefore, the portfolios of the social security fund will be loss even mild pressure. Due to the aging population trend is irreversibility in the short term and the rigidity of the social security benefit levels, if the social security fund portfolio is in actual loss, so it cannot meet the requirements of higher future payments. The portfolio of social security fund will increase the risk facing the volatility of macroeconomic environment, so the social security bears a great pressure.

MAIN CONCLUSIONS AND POLICY IMPLICATION

This study analyzes the macro factors on stock investment returns of national social security fund by VAR model and further studied the stress test to examine

payment risks of stock portfolio. The main conclusions are: Price has important influence on the stock market returns; CPI and PPI have negative influence on national social security fund investment at first and then becomes the positive effect in the short term, while long-term effect is not significant; the influence of interest rate is not significant. The short-term effect of money supply is negative and the short-term effect of fixed investments first is negative and then becomes positive. Stress test research shows that national social security fund investment is still facing a greater payment risk. Although the conclusion is drawn under the condition of deteriorating investment, the influence of macro factors on national society fund cannot be neglected.

Therefore, China must create a good environment for the healthy development of stock market in order to avoid the adverse effect of macroeconomic environment on social security fund investment, thus further improve the yields of national social security fund. China should give full scope to the positive impact of price factors on stock market, especially to straighten out the rate transmission mechanism and promote coordinated development of macroeconomic environment and stock market. Secondly, China should pay attention to the continuity and stability of the monetary policy, stabilize consumer expectations and give full scope to the positive impact of monetary policy on economic development, thus further promote the healthy development of stock market. Finally, fixed assets investment does not have the absolute positive effect on stock returns. Therefore, the transformation of economic growth mode makes China's economy turns from investment stimulating into consumer driven. This will not only make China's economy development much healthier but also promote the healthy operation of stock market, further improve yields of national social security fund investment. In order to avoid payment risk caused by dramatic changes of macroeconomic environment, national social security fund stock portfolio should achieve dynamic adjustment mechanism and be prepared to potential losses caused by fluctuating macroeconomic environment.

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