The Informativeness Research between Stock Price and the Exchange Rate, Interest Rate: Evidence from China 2006-2015

Pinglin He[1, 2], Yuan Yuan[1], Lizhu Xin[1]
[1] School of Economics and Management, North China Electric Power University, Beijing, China
[2] Beijing Key Laboratory of New Energy and Low-Carbon Development, North China Electric Power University, Changping, Beijing, China

***Abstract*—This paper investigates the dynamic relationship between foreign exchange rate, interest rate and stock price in the financial markets over the period from 2006 to 2015 using times series analysis method to establish VAR model. The experimental study indicates that stock price has a positive relationship to the foreign exchange rate. We found that compared to the interbank interest rates and seven-day bond repurchase rate, the Shanghai stock index has a higher degree explanation to the foreign exchange rates.**

***Index Terms*—stock price, foreign exchange rate, interest rate, informativeness**

I. INTRODUCTION

This paper is a review of empirical and theoretical research into the foreign exchange rate, interest rate and stock price in the financial markets. There are at least three reasons why the relation is important.

First, it provides insight into the relationship between financial crisis and foreign exchange rate. In 2007, the Chinese stock market and the CPI rise considerably, meanwhile the Chinese government has repeatedly raise deposit reserve rate to prevent the economy from "overheating" to inflation. Chinese stock market crash and the yuan-dollar exchange rate lower at the same time, which cause the Stock disasters in China in August of 2015. Dornbusch and Fisher (1980) [1] on the Flow - oriented model study revealed that the change of exchange rate will affect the international competitiveness of enterprises, and thus affect the actual income and output. Frankel, J.A.（1987） [2] on the stock - oriented model study think that exchange rate is determined by the supply and demand relationship between different currencies.

Second, it give some opposite-evidence for the efficient market hypothesis, which proposes that asset prices follow a “random walk” and cannot be predicted. Farmar (1970) [3] put forward the efficient market hypothesis, which information can be instantly reflected on asset prices and rational investors have no arbitrage opportunities in efficient markets. Chien-Chiang Lee, Jun-De Lee, Chi-Chuan Lee (2010) [4] show real stock price indices are stationary processes that are inconsistent with the efficient market hypothesis using a state-of-the-art panel data stationarity test.

Third, it indicate the relationship between stock price and foreign exchange rate is important for event studies that use a combination of stock price and foreign exchange rate data from which to draw inferences. Z. Qiao, Y. Li, W.-K. Wong (2008) [5], H. Zhao (2010) [6] C. Walid, A. Chaker, O. Masood, J. Fry (2011) [7] show the investigations in related studies also confirm the strong co-movement between stock price and exchange rate. Lee, YM, Wang, KM(2015) [8] verify the correlation between stock prices and exchange rates, which shows that the stock market and the foreign exchange market are negatively correlated in the short-run.

II. DATA SELECTION

Accounting for the theory of capital market interest rate changes caused by the cost of capital, this paper selects the dollar exchange rate, SHIBOR and the bond repurchase interest rates as a representative of the cost of capital with the benchmark Shanghai composite index on behalf of the asset price. We analyze the granger causality of the above rates and asset prices using EVIEWS. We use daily data from 2006:10:10 until 2015:8:10 from China.

The Shanghai stock market (SHSM) is one of the important components of the Chinese stock market (CSM). This study mainly chooses the benchmark Shanghai composite index (SHCI) as its research subject. SHIBOR is the Chinese version of the London Interbank Offered Rate (LIBOR). We chose the U.S. dollar to research the relationship between exchange rate (ER) and stock price. The bond redemption interest rate (GC007) is regarded as the interest that must be paid, due to borrowing money via Treasury bonds.

III. METHODOLOGY DESCRIPTION

In general models for time series data can have many forms and represent different stochastic processes. In this paper, we applied the VAR model as a prediction tool.

A. VAR Model

VAR model is the model that using historical data of time series itself as explanatory variable. VAR is used to predict the performance of the variable in the current period, and to assume that they are a linear relationship.

$$y_t = c + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots \beta_p y_{t-p} + \varepsilon_t \quad (1)$$

$$(t= 1, 2, \cdots, T)$$

Where: Parameter C is a constant; β_1, β_2, β_3 are the autoregressive coefficients; P is the autoregressive model order; ε_t is white noise sequence which has 0 as mean value and σ^2 as variance.

B. Cointegration Test

Johansen maximum likelihood method is testing the cointegration relationship between multiple variables by maximum likelihood estimation in the VAR model. The VEC model under the first difference can be expressed as follows:

$$\Delta y_t = \sum_{j=1}^{n-1} \beta_j \Delta y_{t-j} + \beta y_{t-n} + \varepsilon_t \quad (2)$$

Where β_j is the coefficient to describe short term relationship between different time series. β is the coefficient to describe long term information of relationship hint in the regression.

C. Granger Causality Test

While the cointegration relation explains the long-term equilibrium relationships and trends between the variables. Therefore, we conduct a Granger causality analysis based on the cointegration relationships between the variables. Granger proposes that when variable x has been shown to explain the prediction variable y in the past, we consider that statistically, x is the reason for y.

Support that x_t represent the SHCI and y_t represent the ER at time period t. Pairwise Granger causality test on x_t and y_t were based on the following bivariate regressions:

$$x_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i x_{t-i} + \sum_{j=1}^{m} \beta_j y_{t-j} + \varepsilon_t \quad (3)$$

$$y_t = \alpha_0' + \sum_{i=1}^{n} \alpha_i' x_{t-i} + \sum_{j=1}^{m} \beta_j' y_{t-j} + \varepsilon_t' \quad (4)$$

Where α_0, α_0' and α_0'' are constants, ε_0, ε_0' and ε_0'' are disturbance terms with mean zero, t is time, and m and n are lengths long enough to make disturbance terms white noise.

The null hypothesis F test is that:

$$H_0: \beta_1 = \beta_2 = \cdots = \beta_p = 0 \quad (5)$$

$$H_0': \alpha_1 = \alpha_2 = \cdots = \alpha_p = 0 \quad (6)$$

IV. PROCESSING AND RESULTS

The paper focus on the linkage relationship and forecast between the stock price index, the exchange rate, the interest rate, and carried out the following experiments. The experimental process is shown.

A. Unit Root Test

In this paper, we use the ADF statistic to check a single test. The results of the unit root test case in Table I show that the SHCI, ER, SHIBOR and GC007 reach a steady state in the original sequence. This outcome is consistent with the variable stability of the cointegration. Therefore, we need to perform a cointegration analysis between the SHCI, ER, SHIBOR and GC007 to investigate whether there are long-term stable equilibrium relationships between interest rate and the cost of capital.

TABLE I
UNIT ROOT TEST RESULTS

Variables	Differential times	ADF values	5% critical value	conclusion
SHCI	0	-45.57	-3.41	I(0)**
SHOBOR	0	-42.06	-3.41	I(0)**
GC007	0	-46.55	-3.41	I(0)**
ER	0	-44.29	-3.41	I(0)**

Note: * * said original sequence through ADF stationary test under 5% significance level.

Table I shows that the unit root test results of all variable. SHCI, SHIBOR, ER, GC007 are stable without a difference.

B. Cointegration Test

Tables II shows the cointegration test results for the SHCI, SHIBOR, ER, and GC007. Trace test indicates 4 cointegrating eqn(s) at the 0.05 level; therefore, we can object the null hypothesis that the cointegration value is 0 in both the maximum characteristic root test and the locus test. Therefore the results indicate that there is cointegration relationship between the variables.

TABLE II
UNRESTRICTED COINTEGRATION RANK TEST(TRACE)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob. **
None *	0.19063	1569.618	63.8761	1.000
At most 1 *	0.17154	1116.574	42.91525	1.000
At most 2 *	0.16778	713.476	25.87211	0.000
At most 3 *	0.1388	320.0754	12.51798	0.000

Note: Trace test indicates 4 cointegrating eqn(s) at the 0.05 level.

C. Granger Causality Test

Table III shows that the Granger Causality Test of ER and SHCI. From the results of Grainger causality statistical, we can find that the Shanghai composite index is the Granger Causality of dollar exchange rate. However, GC007 and SHIBOR and SHCI do not show a short - term Granger Causality. This can attribute to the high degree of interest rates control in China, interest rates can only adjust itself a little along with the changes in the market, interest rate in China still low marketlized. On the other hand, China is an export-oriented country, which indicate that it have more frequent foreign currency exchange. Therefore, the exchange rate is more sensitive to the stock price index.

Through studying and researching the changes of investment, consumption and export in China from 1992 to 2002 and from 2003 to 2013, this paper try to fully elaborate the close relationship between exchange rate

and asset price.

TABLE III
GRANGER CAUSALITY TEST

Null Hypothesis	Obs	F-Statistic	Prob.
ER does not Granger Cause SHCI	2142	2.24547	0.0474
SHCI does not Granger Cause ER		2.33539	0.0399
SHIBOR does not Granger Cause SHCI	2142	0.66546	0.6497
SHCI does not Granger Cause SHIBOR		1.167	0.323
GC007 does not Granger Cause SHCI	2142	0.27092	0.9292
SHCI does not Granger Cause GC007		0.12036	0.9879

V. CONCLUSIONS

As for the interest rate, Granger causality do not exist between Chinese interbank interest rates and seven day repurchase bond rates and the Shanghai Composite Index (only two items mentioned, one is Chinese interbank interest rates and seven day repurchase bond rates, other one is the Shanghai Composite Index), which shows that the interest rate of our country is trying to be more market-oriented, the interest rate market is not fully liberalized, therefore there is no obvious Grainger causality exist between the stock index and the interest rate. As for the exchange rate there is a Grainger relationship existing between the exchange rate and the Shanghai Composite Index, and the Shanghai composite index is Grainger reason for the dollar exchange rate. This mainly because China is an export-oriented country and trade with foreign country frequently, so the change of exchange rate can be reflected by the change of asset price.

Different countries has different degree of openness, it is found that the stock index of foreign trade oriented country. The correlation relationship between stock index and currency exchange rate in foreign trade-oriented country is more active than that in domestic-oriented country.

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Pinglin.He, born in Shaanxi Province, January 1977. He studied accounting and financial management at North China Electric Power University and Central University of Finance and Economics between 2000–2008 and finished his PhD in 2008. The focus point of his PhD study was the accounting and management, the capital symbiosis mechanism and development of various industries.

He has been working in North China Electric Power University after the completion of his PhD study. He is acting as the director of the Chinese Accounting Society now. He has published more than 30 papers in the environment, accounting and other magazines and awarded for national top hundred excellent management case in 2013. He received a National Social Science Fund in 2018.

Prof. He, membership in Beijing Key Laboratory of New Energy and Low-Carbon Development.

Yuan.Yuan, born in Shanxi Province, August 1994. She studied bachelor of accounting at Northeast Dianli University and received a bachelor's degree in accounting in 2016 and studing accounting acadamic graduate at North China Electric Power University. She will finish master's in accounting in 2018. The field of her research contains environmental tax and the relationship between governance structure of board of directors and corporate performance.

Lizhu.Xin, born in Shandong Province, November 1993. He studied financial management at North China Electric Power University from 2010 to 2014 and studing accounting professional graduate at North China Electric Power University from 2015 to 2018. He will finish his Master degree's study in 2018. The focus of his Master degree was the financial early-warning models of listed companies. After his Master degree, he will take up PhD study in Renmin University of China in 2019.