A Study of the Influence of Capital Market Opening on Stock Market Volatility Based on a Vector Autoregressive (VAR) Model - Evidence from China

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Abstract- In response to the increasing requirement of trading and cultural exchanges among countries, the capital market opening may be an irresistible trend that sweeps across the major economies. However, a large influx of foreign funds may put the stock market in danger considering its unstable and vulnerable characteristics. Therefore, the latent effect of free cross-border capital flows on the stock market is worth thinking over. This paper investigates how the openness of the capital market affects the stock market volatility by constructing a vector autoregressive (VAR) model. In addition to two major research objects, another two control variables are added to this model. Empirical results suggest that capital market opening may have a gradually declining negative effect on fluctuations of the stock market in the first half-year. Nonetheless, the stock market will respond positively to an increased mobility degree of capital after six months. Furthermore, stock market volatility may be more closely related to output level than interest rate or capital market opening, while the influence of itself is the most difficult to ignore. As for suggestions, this paper proposes that strict supervision can provide investors more confidence and prevent the irrational stock market volatility caused by massive capital flows in long term.

Keywords-stock market volatility; capital market opening; VAR model

1 INTRODUCTION

Stock market volatility is not only associated with corporate behavior but also influences household wealth and consumption. According to a panel analysis conducted in Australia, annual consumption will increase 6 to 9 cents if stock market wealth rises in one Australian dollar [1]. Also, the capital market opening is an unstoppable tendency as trade between countries is more frequent nowadays. Even though capital market opening can attract more foreign investment and promote domestic economic development, the stock market which is vulnerable and unstable may react dramatically to such stimulation. Therefore, this paper discusses the impact of capital market opening on the stock market. Several kinds of research with similar topics have been conducted in recent years. In an analysis of panel data, researchers point that the mobility of international capital has no significant influence on the fluctuation of output and household consumption [2]. Nonetheless, the openness of the capital market is proven to cause fluctuations of output level in developing countries through currency and external-debt crisis in another paper [3]. As for the relationship between stock market volatility and capital market opening, by defining the opening degree as the extent to which

shares can be held by foreign investors, empirical results of a study show a significant positive correlation between them [4]. Oppositely, in a study of 17 emerging markets, 13 of them have constant or lower stock market fluctuations after liberating the capital market [5].

2 METHODS

2.1 Model.

Considering the inter-temporal interaction between economic indicators, a vector autoregressive (VAR) model is used in this paper to analyze the influence of the openness of the financial market on the stock market volatility. This model consists of four variables, which respectively represent the stock market volatility (vol), the open degree of the stock market (open), the output level (y), and the benchmark interest rate (int). Specifically, output level and interest rate are two control variate, which makes the model more comprehensive.

The VAR model can be written in the following matrix form:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \cdots + A_k Y_{t-k} + \epsilon_t$$

where t = 1, 2, ..., T, is a vector containing values of variables in period t, C is a vector of constants, is a 4×4 matrix whose components represent the lagged effect of variables in previous periods on current values of variables, k is the number of lagged periods, and is a vector of error terms which has a zero mean value.

2.2 Data

The monthly standard deviation of the daily yield of the Shanghai composite index is used to depict the volatility of China's stock market. The closing price of the Shanghai composite index can be found in the National Bureau of Statistics of China. As for the opening degree of the capital market, this paper refers to Shanghai-Hong Kong stock connect, which permitted investors in one area to trade stocks listed on the exchange of the other region through local securities companies. The policy can be regarded as another big step forward that China's capital market opening up process has taken. Even though the qualified foreign institutional investor (QFII) program had allowed foreign investors to participate in China's security market before Shanghai-Hong Kong stock connect, it had limited influence on China's capital market due to its constrains on the threshold and total amount of investment [6]. Therefore, this paper uses the monthly net capital inflows from Hong Kong investors to the Shanghai stock market through the stock connect to measure the stock market's opening degree. In addition, the output level is represented by the growth rate of industrial added value above the designated size, which is taken from the National Bureau of Statistics of China. And refers to previous research, Shanghai inter-bank Offered Rate (SHIBOR) collected from the national inter-bank funding center is chosen to describe the market interest rate [7]. Because the implementation of Shanghai-Hong Kong Stock Connect started in November 2014, all data is taken from November 2014 to December 2020.

3 EMPIRICAL ANALYSIS

3.1 Stationary Test of Variables

Because all indicators are time series, stationary tests are required to avoid spurious regression. The results of the tests are shown in table 1. It is obvious that p-values for all variables are less than 0.05. Therefore, null hypotheses are rejected and variables are stationary at a 1% level of significance.

Table 1 Results of Augmented Dickey-Fuller tests

variables	(c,t,n)	Augmented Dickey-Fuller test statistic	p-value
vol	(C,0,0)	-3.767206	0.0049
open	(C,0,0)	-7.198384	0.0000
y	(C,0,1)	-6.504835	0.0000
int	(C,0,1)	-4.347464	0.0008

3.2 Establishment of Model

This paper refers to Akaike information criterion to decide how many lags of variables should be included in the VAR model. As figure 1 shows, the optimal length of lag intervals should be 3. In addition, figure 2 presents that all AR roots lie in the unit circle. Thus, the constructed VAR model is stable and more analysis about the relationship between variables can be applied.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-508.3227	NA	41.13316	15.06831	15.19887	15.12005
1	-430.0628	145.0110	6.597532	13.23714	13.88994*	13.49580*
2	-407.7477	38.72329	5.507671	13.05140	14.22644	13.51699
3	-387.1656	33.29445*	4.875293*	12.91664*	14.61391	13.58915
4	-381.4734	8.538327	6.763907	13.21981	15.43931	14.09924
5	-369.3270	16.79068	7.885335	13.33315	16.07489	14.41951
6	-359.3813	12.57836	10.01543	13.51121	16.77520	14.80450

Figure 1 lag length criteria

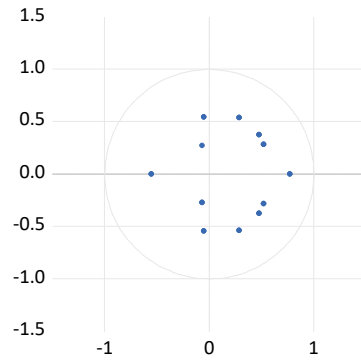Inverse Roots of AR Characteristic Polynomial

Figure 2 AR roots graph

3.3 Impulse Response

The impulse response reveals how one variable will change with an increase of one unit in another variable, which intuitively presents the influence of one variable on another. As shown in Figure 3, the volatility of the Shanghai composite index responds dramatically to its own impulse. It reaches the largest response of about 0.045 in the first period. Then it falls quickly in subsequent periods and gradually moves toward zero. The hugely positive response suggests that the wave of the stock market always has a significant effect on the wave after it while the shadow fades and decreases as time goes on.
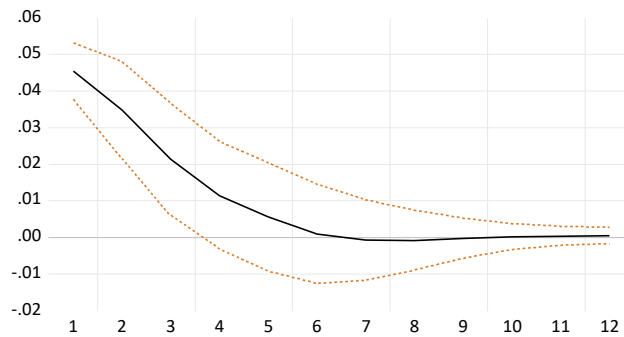

Figure 3 The response of volatility to the impulse of itself

Given an impulse of interest, the response of stock market volatility is shown in figure 4. The stock market volatility responds negatively to the impulse at first, which reaches its minimum at -0.007 immediately after the impulse. Then, the negative response starts to decline while it turns to be a slightly positive response in period 3. Before returning to baseline after 12 months, the response turns to have a gradual downward negative trend again after the fifth period. One possible explanation for the scenario is that investors prefer debts and deposits to stocks when interest rates increase. Therefore, capital flows from the stock market to other securities, which suppresses the stock market volatility.
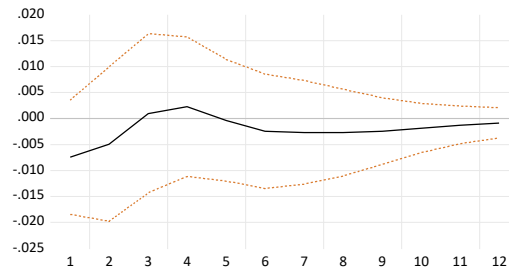
Figure 4 The response of volatility to the impulse of interest rate

Figure 5 presents the response of the stock market wave to growing industrial added value. Volatility responds positively to the output break and reaches its maximum at 0.005 in the first period while it gradually declines to be negative before returns to zero after ten periods. Intuitively, the growing output level always represents a progressive economic situation, which leads to an increase in investor confidence and more capital inflow of the stock market. As a result of the increasing trading volume and investment, the volatility of the stock market fluctuates dramatically in short term. However, the stock market returns to be rational and less volatile in long term.
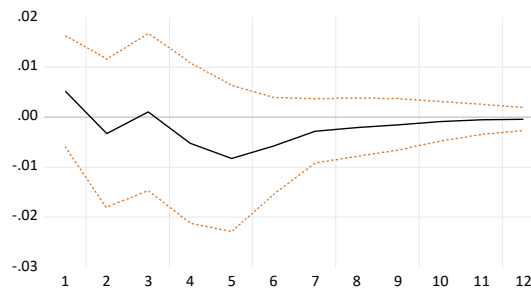

Figure 5 The response of volatility to the impulse of industrial added value

The response of stock market volatility facing the impulse of opening capital market is depicted in figure 6. After encountering the impulse of the openness of the capital market, stock market volatility responds negatively at -0.006 in the first month. Whereas, the passive reaction of volatility declines until zero in the following periods, while it increases from zero to 0.001 in the seventh month and returning to normal after ten months. Specifically, the openness of the capital market associates the domestic stock market with worldwide security markets, which may increase the risk of investing in stocks and thus cause the fall of investor confidence. Therefore, the market opening cools the stock market first off. Nonetheless, with more foreign capital injected into the stock market and stringent regulation on the opening degree, the stock market will finally turn to be diverse and volatile.
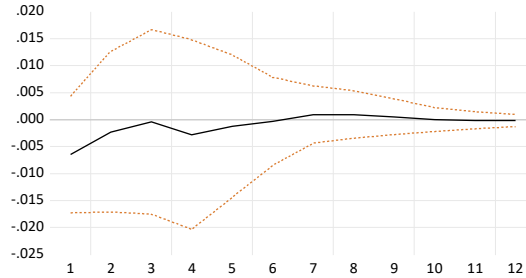
Figure 6 The response of volatility to the impulse of capital market opening

3.4 Variance Decomposition

The forecast error variance decomposition of one variable directly describes the proportion of its future uncertainty caused by other indicators, which is a distinct way to compare the effect of different factors. As table 2 depicts, the stock market fluctuation is majorly influenced by itself, while such influence gradually decreases to only account for 91% of stock market waves after 10 periods. As for other factors, the output level indicator plays the largest role in explaining the stock market volatility, which increases from 1.2% to 4.3% after 8 months. In contrast, interest rate and capital market opening have an unchanging impact on the stock market fluctuation, which is respectively 2.7% and 1.3%.

Table 2 The variance decomposition of volatility

Period	S.E.	IAV	INT	OPEN	VOL
1	2.307168	1.214805	2.549259	1.936703	94.29923
2	2.636897	1.081067	2.329508	1.384028	95.20540
3	2.680414	0.981114	2.080951	1.226823	95.71111
4	2.735108	1.616803	2.116130	1.371802	94.89527
5	2.741143	3.221676	2.067980	1.377025	93.33332
6	2.743175	3.985743	2.193867	1.367079	92.45332
7	2.744713	4.157557	2.357324	1.380625	92.10449
8	2.745417	4.245315	2.524649	1.395827	91.83421
9	2.745555	4.290952	2.663266	1.398334	91.64745
10	2.745573	4.305274	2.743422	1.396943	91.55436
11	2.745604	4.309133	2.779252	1.397175	91.51444
12	2.745615	4.311891	2.796686	1.397738	91.49368
Cholesky One S.D. (d.f. adjusted) Cholesky orderig: IAV INT OPEN VOL					

4 CONCLUSION

In conclusion, the capital market opening may have a negative effect on the rise and fall of the stock market due to suppressed investor confidence in the first six months. However, after a half-year period, stock market waves are stimulated by increasing capital inflows and become volatile once more. As for suggestions of capital market opening, the government should carry

out draconian supervision about foreign capitals to make investors keep confident about the stock market. In addition, excessive capital inflows and outflows should be avoided, which can prevent the stock market from fluctuating irrationally.

This study has potential limitations. The number of observed samples may not be enough to depict the complete circumstance of China's financial market. Specifically, the monthly data is taken from November 2014 when Shanghai-Hong Kong stock connects came into effect, which includes less than 100 observations. Even though the sample size may be appropriate for a VAR model consisting of four variables with a lag period of 3, using daily data or changing the measurement of capital market opening to expand the time period of observation may give more general results. In addition, the research result in this paper may not be representative enough to reflect global security markets. For instance, China's stock market is a developing market which is closely related to government policies, while some security markets have grown to be developed and are hardly dependent on government inventions. Therefore, further research may improve model by choosing a more appropriate indicator to depict the opening degree of the capital market. Also, either a horizontal comparison among diverse security markets or a vertical contrast of industries in one stock market can provide more details about the influence of capital market opening on stock market fluctuations.

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