Market Contagion of Stock Return Based on Information Transfer: Evidence from China

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Abstract: Trade, capital, and information transfer are the three channels of spillover. It is challenge to distinguish them and quantify the effect of each channel. However, the stock market in China is not open yet, and we are able to cleanly identify the channel of market contagion based on the information transfer. In this study, we look at the stock market in China and other 4 major markets. Using the data from January 3, 2000 to June 30, 2017 and Structural Vector Autoregression model, we find that information transfer leads to a spillover effect on China stock market. Further more, the time varying data show that the evolution of market contagion overtime for China stock market, with big events causing peaks of market contagion.

Keywords: information transfer; stock return; Market contagion

1. Introduction

With the acceleration of economic globalization, transnational allocation of production factors has become popular, and the transnational spillover effect of economic and financial development has been widely confirmed (Fan et al., 2019). In the early days when the Chinese stock market was established, the stock market was nearly insulated from outside. Although China's financial liberalization process has once accelerated such as the "8.11 exchange rate reform" in 2015 and the RMB joining the SDR currency basket, the opening of the stock market is still relatively cautious in China,. Under this condition, information transfer is more important as bridge of rapid interaction for markets like China.

Trade, capital flow, and information transfer are the three essential channels for the stock market spillover effect. In terms of the reaction time of the market, trade is the slowest among the three channels because trade requires the fundamental change of the firm. Capital flow is faster than trade while information transfer is the fastest since information can spread across the word within a second. King and Wadhwani (1990)[1] believe that the connections between stock markets, which are difficult to be explained by economic fundamentals, can be explained based on the diffusion of information, and call it market contagion.

Most literature on stock spillover effects focuses on markets with strong economics foundation and opening stock market (Nguyen Ba Trung, 2019[2]). In these studies, trade and capital flow are channels of spillover (Gerrits and Yuce, 1999[3]; Bekaert and Harvey, 2003[4]), while market contagion is another field. Existing studies centering on market contagion mainly refer to special conditions like risk propagation (Baumöhl, 2011[5]; López, 2014[6]), such as the 1997

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Thai exchange rate devaluation and the 2008 financial crisis (Suliman, 2011[7]). However, these studies fail to distinguish the mechanism of information transfer from other channels.

Unlike previous literature, this study mainly focuses on the market contagion channel based on information transfer. China has experienced rapid economic growth but the stock market is not open, which provide a special opportunity to identify the regime of market contagion based on information transfer. In addition, we examine the market contagion mechanism for special conditions, which is called big events. The article is organized as follows: Section II and section III describe data and the methodology, Section IV presents the empirical results and Section V concludes this article.

2. Description about data

In order to examine the spillover effect between the Chinese mainland stock market and the world's major active markets, this paper selects the Chinese mainland stock market, Hong Kong, Japan, the United States, and the United Kingdom stock market data, including the Shanghai Stock Index (SSE), Hang Seng Index (HSI), Nikkei 225 Index (N225), S&P 500 Index (SP), and the FTSE 100 Index (FTSE). Daily frequency transaction data is used, in order to identify the rapid spillover effect and exclude channels of trade. Plus condition of restricted stock market opening, market contagion based on information transfer is identified, since channel of capital flow requires capital liberalization. The sample is from January 3, 2000 to June 30, 2017. All data come from the Wind database.

3. Methodology

DAG-SVAR spillover equation

The article constructs the VAR model as follows:

$$\Delta \ln RR_t = c + \sum_{p=1}^{q} A_p \Delta \ln RR_{t-p} + \varepsilon_t, \tag{1}$$

Where $\Delta \ln RR_t$ is the daily return, A is the dynamic coefficient. We rewrite equation (1) as:

$$\Delta \ln RR_t = \sum_{p=1}^{\infty} B_p \varepsilon_{t-p}, \tag{2}$$

Where $B = A^{-1}$ measures the effect of impulse response. For the i th component of $\Delta \ln RR_t$,

$$\Delta \ln RR_{it} = \sum_{j=1}^{k} (b_{ij}^{(0)} \varepsilon_{jt} + b_{ij}^{(1)} \varepsilon_{jt-1} + b_{ij}^{(2)} \varepsilon_{jt-2} + ...), \tag{3}$$

to identify the spillover effects of other variables, the variance of the variables is constructed:

$$\mathrm{var}(\Delta \ln RR_i) = \sum_{j=1}^{k} \{ \sum_{p=0}^{\infty} b_{jj}^{(p)} \sigma_{jj} \}, \tag{4}$$

From this equation, the variance decomposition can be obtained. In this paper, the predicted variance decomposition of each variable is calculated by taking 8 periods forward. Compared with the Cholesky decomposition method, the advantage of the Directed Acyclic Graph (DAG) method is that it determines the instantaneous causal relation between variables from data-driven perspective, which avoids setting errors and theoretical deficiencies caused by randomly setting the variable order (Swanson, 1997). An SVAR model is built on this basis.

Suppose that the correlation between market indexes can be represented by the connection symbol (-) at the beginning, while the causal relationship is unknown yet. Through the DAG algorithm (Spirtes et al., 2000[8]), the instantaneous causal relationship, represented by the symbol (—>) is obtained, and the connection symbol (-) will be deleted if markets are not correlated. We use the software TETRAD II to get the structure as Figure 1 and forms the structural coefficient matrix as Figure 2.

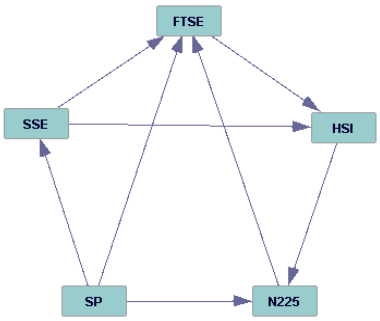

Figure 1 Causality by DAG

$$\begin{pmatrix} 1 & b_{12} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & b_{33} & 0 \\ 0 & b_{42} & 0 & 1 & b_{45} \\ b_{51} & 0 & b_{53} & 0 & 1 \end{pmatrix}$$

Figure 2 Synchronous structural matrix

4. Empirical Results

Network topology analysis

According to the above structural coefficient matrix, the SVAR model is identified and the predicted variance decomposition is calculated. We average the forward 8 periods forecast variance decomposition and use network topology analysis method(Diabold,2011) to form the spillover matrix. The contagion details are shown in Table 1:

Table 1 Spillover matrix

	SSE	*SP*	*FTSE*	*N225*	*HSI*	*OUT*	*Rank*
SSE	97.10	0.21	0.46	1.63	9.37	11.67	2
SP	2.28	99.1	37.40	24.20	22.60	86.48	1
FTSE	0.32	0.387	61.70	3.07	3.60	7.38	4
N225	0.15	0.03	0.25	70.70	10.90	11.32	3
HSI	0.12	0.28	0.24	0.43	53.50	1.07	5
IN	2.87	0.90	38.35	29.33	46.47		
NET OUT	8.80	85.58	-30.98	-18.00	-45.40		
Rank(NET)	2	1	4	3	5		

Note: Each row represents the spillover effect from one market to other markets, and the end of the row is the total spillover effect(OUT). Each column indicates that the spillover effect from other market, and the end of the column is the total spillover effect(IN) from other markets. NET OUT is the net spillover effect (OUT-IN).

First, the results from Table 1 show that mechanism of market contagion based on information transfer actually exists from outside world to China stock market. The second row of the table shows the spillover effect of SP on the stock market in other areas. As we can see, SSE accepts least spillover effect from SP(2.28%). The difference between SSE and other markets is that the capital market is not open in China mainland. Compared to other markets with opening capital markets, more than 20% of spillover effects to which are from SP, the spillover effect from SP to SSE can be attributed to market contagion.

Second, we find that the spillover effect from SSE to other markets varies. From the first row of the Table 1, the return spillover effect from SSE to HSI is 9.37%, which is second to the spillover effect from SP to HSI(22.6%), while the return spillover effect from SSE to other markets are all very low. Considering the close relationship between China mainland and Hong Kong stock market, information transfers more efficient from SSE to HSI than to other markets, which leads to a market contagion phenomenon. Conversely, the spillover effect from HSI to SSE is very low(0.12%). This is connected with the fact that most of the weighting stocks in the Hong Kong stock market are AH equity-linked companies, meaning when the stock return changes in SSE, expectation would lead HSI to move the same way. The information transfer is mainly unidirectional from SSE to HSI.

In all, we calculate the net spillover effect by subtracting IN from OUT, and get the net spillover effect of SSE(NET OUT) as 8.8%, which is second to the spillover effect of SP(85.58%), while the net spillover effect of other markets are all below zero. This may prove that although the capital market is not open, the market contagion drives the stock market to spillover rapidly.

Time-varying spillover effect

We use 500 trading days as a window to run a piecewise rolling regression to obtain the time-varying spillover effect coefficient. The results are used to find the peaks of market contagion. As Figure 3 shows, the spillover effect from SP to SSE continually increased from 2% at the beginning to 7.52% on February, 2012, during which the increase accelerated after the 2008-2009 financial crisis, while the spillover effect from other markets to SSE are all very low. Consistent with results of previous studies, some big events can cause market contagion (Caramazza,2004[9]). We can see that big events, such as the 2008-09 financial crisis and the minimum unemployment in 4 years in U.S. in February, 2012, happened at peaks of time-varying spillover effect(Luchtenberg,2015[10]).

Figure 4 shows the spillover effect from SSE to other markets. The spillover effects from SSE to other markets are all very low before 2008. Starting from October, 2007, the spillover effect from SSE to HSI increased from 5% to 25.2% on August, 2014. Similarly, the spillover effect from SSE to other markets gradually increases. We can see that the big event of Shanghai-Hongkong stock connect, which means the beginning of stock market opening, happened when the spillover effect climbs to the peak.

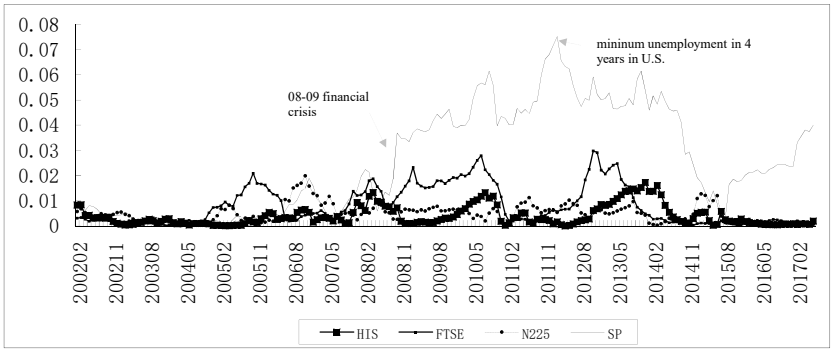

Figure 3 Spillover effect from other markets to SSE

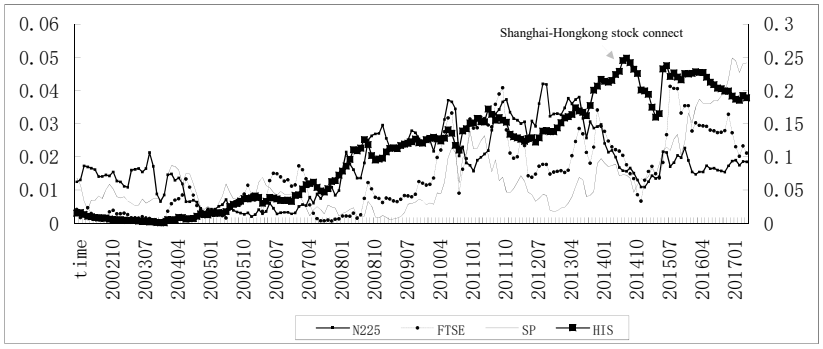

Figure 4 Spillover effect from SSE to other markets

5. Conclusion

We investigate the spillover effect from other markets to SSE and from SSE to others, including Hong Kong market which has close relationship with the China mainland stock market. We find that without stock market opening, market contagion leads the SSE to spillover and the effects varies depends on the direction of information transfer. For time-varying spillover effects, market contagion changes over time, where there is market contagion from SSE to other markets, mainly to HSI. Big events such as financial crisis and Shanghai-Hong Kong stock connect can cause market contagion. Our findings have enriched the research on market contagion mechanism.

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