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An Influence of U.K. and U.S. Stock Market Volatilities in China Stock Markets: Empirical Study of Hong Kong and Shanghai Markets

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Abstract

The empirical results show that the dynamic conditional correlation (DCC) and the bivariate AIGARCH (1, 1) model is appropriate in evaluating the relationship of the Hong Kong's and the Shanghai's stock markets. The empirical result also indicates that the Hong Kong's and the Shanghai's stock markets is a positive relation. The average estimation value of correlation coefficient equals to 0.4868, which implies that the two stock markets is synchronized influence. Besides, the empirical result also shows that the Hong Kong's and the Shanghai's stock markets have an asymmetrical effect. The return volatility of the Hong Kong and the Shanghai stock markets receives the influence of the positive and negative values of the U.K. and the U.S. stock market volatility. For example, under the good news of the U.K. and the U.S. stock markets, the empirical result also shows that the Hong Kong and the Shanghai stock markets can reduce the fixed variation risk.

Key Words: *Stock Mrket, Asymmetric Effect, IGARCH Model, AIGARCH Model.*

Introduction

We known that Hong Kong economical physique belongs an island economy, and it is important financial market in the Asian. We also know that Hong Kong is one of Asian four dragons, also Hong Kong economy of growth in 2006 is 5%, and the forecast value of the grow rate is 4.3% in the future. Hong Kong has a close relationship with the Shanghai based on the trade and the circulation of capital, and the Shanghai is also the powerful global economic nation in the Asian. Besides, Hong Kong and Shanghai have a close relationship based on the trade and the circulation of capital.

When the investor has an investment in the international stock market, he/she will usually care about the international capital the motion situation, the international politics and the economical situation change, in particular, in the stock market changes. There is a close relationship for Hong Kong and Shanghai based on the trade and the circulation of capital with the U.K. and the U.S. stock markets, but the U.K. and the U.S. stock markets are also important financial markets in the global economics. Therefore, the relationship between the Hong Kong and the Shanghai stock markets are worth further discussion with the factors of the U.K. stock and the U.S. stock markets.

The purpose of the present paper is to examine the relations of the Hong Kong's and the Shanghai's stock markets. This paper also further discusses the affect of the U.K. stock and the U.S. stock markets' volatility for the Hong Kong and the Shanghai stock markets. And the positive and negative values of U.K. stock and U.S. stock markets' volatility are used as the threshold. The organization of this paper is as follows: Section 2 descibes the data characteristics; Section 3 presents the proposed model; Section 4 presents the empirical results, and finally Section 5 summarizes the conclusions of this study.

Data Characteristics

Data Sources

The data of this research included the Hong Kong, the Shanghai, the U.K. stock and the U.S. stock prices are collected between January, 2006 and December, 2014. The source of the stock data was the Taiwan economic Journal (TEJ), a database in Taiwan. The Hong Kong's stock price refers to the Hong Kong Hang Seng stock index, the Shanghai's stock price refers to the Shanghai Synthesis stock index, the U.K. stock index price refers to FTSE 100 stock index, and the U.S. stock index price refers to the S&P500 stock index. During the process of data analysis, in case that there was no stock market price available on the side of the Hong Kong and the Shanghai stock market or on the side of the U.K. stock and the U.S. stock markets due to holidays, the identical time stock price data from one side was deleted. After this, the four study variables samples are 2,010.

Returns Calculation and Basic Statistics

To compute the return rate of the Hong Kong stock market adopts the natural logarithm difference, rides 100 again. The return rate of the Shanghai stock market also adopts the natural logarithm difference, rides 100 again.

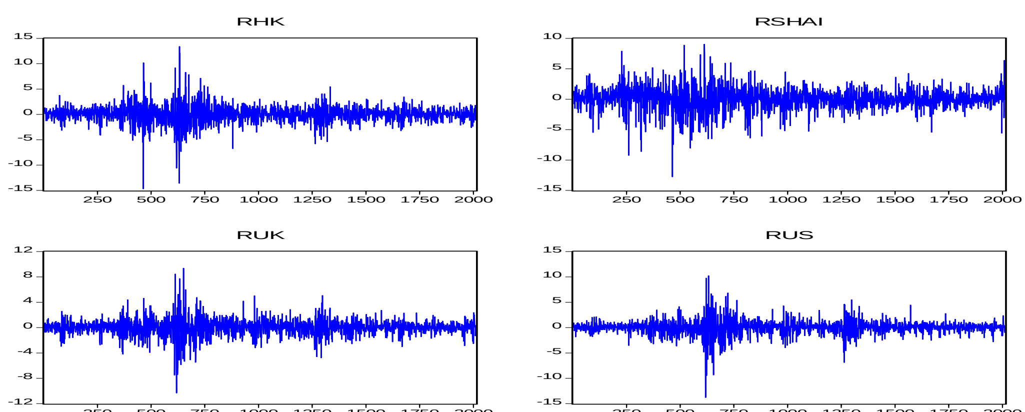

Figure 1. Trend charts of the Hong Kong, the Shanghai, the U.K. stock and the U.S. stock market volatility rates

The return rates of the U.K. stock market and the U.S. stock price market also adopts the natural logarithm difference, rides 100 again. In Figure 1, the Hong Kong, the Shanghai, the U.K. stock and the U.S. stock markets shows the clustering phenomenon, so that we may know the four markets have certain relevance.

Table 1 presents the four sequences kurtosis coefficients are all bigger than 3, which this result implies that the normal distribution test of Jarque-Bera is not normal distribution. Therefore, the heavy tails distribution is used in this paper. And the four markets do have the high correlation in Table 2.

Table 1. Data statistics

Statistics	RHK	RSHAI	RUK	RUS
Mean	0.021909	0.050154	0.006914	0.023914
S-D	1.732965	1.790124	1.301747	1.416925
Skew	-0.261576	-0.471608	-0.171476	-0.645218
Kurtosis	13.40470	7.196768	10.48839	15.15879
J-B N (p-value)	9084.98*** (0.0000)	1548.82*** (0.0000)	4703.87*** (0.0000)	12514.51*** (0.0000)
Sample	2009	2009	2009	2009

Notes: (1) J-B N is the normal distribution test of Jarque-Bera. (2) S-D is denoted the standard deviation. (3) *** denote significance at the level 1%.

Table 2. Unconditional correlation coefficient

Coefficient	RHK	RSHAI	RUK	RUS
RHK	1	0.4861	0.4412	0.2798
RSHAI	0.4861	1	0.1713	0.0879
RUK	0.4412	0.1713	1	0.6277
RUS	0.2798	0.0879	0.6277	1

Unit root and co-integration tests

This paper further uses the unit root test of KSS (Kapetanios et. al., 2003) to determine the stability of the time series data. The KSS examination result is listed in Table 3. It shows that the Hong Kong stock returns, the Shanghai stock returns, the U.K. stock and the U.S. stock returns do not have the unit root characteristic, this is, the four markets are stationary series data, under $\alpha = 1\%$ significance level.

Using Johansen's (1991) co-integration test as illustrated in Table 4 at the significance level of 0.05 (α =5%) does not reveal of λ_{max} statistic. This indicated that the Hong Kong stock market, the Shanghai stock market, the U.K. stock and the U.S. stock market do not have a co-integration relation. Therefore, we do not need to consider the model of error correction.

Table 3. Unit root test of KSS for the return data

KSS	RHK	RSHAI	RUK	RUS
Statistic	-24.415***	-23.262***	-16.771***	-17.975***
Critical value	-2.82	-2.22	-1.92	
Significant level	α =1%	α =5%	α =10%	

Notes: *** denote significance at the level 1%.

Table 4. Co-integration test (Var Lag=6)

H_0	$\lambda_{\max}$	Critical value
None	29.8322	30.8151
At most 1	14.0404	24.2520
At most 2	8.8843	17.1477
At most 3	1.4481	3.8415

Notes: The lag of VAR is selected by the AIC rule [5].
The critical value is given under the level 5%.

ARCH effect test

Based on the formula (1) and (2) as below, we uses the methods of LM test (Engle, 1982) and F test (Tsay, 2004) to test the conditionally heteroskedasticity phenomenon. In Table 5, the results of the ARCH effect test show that the two study markets have the conditionally heteroskedasticity phenomenon exists. This result suggests that we can use the GARCH model to match and analyze it.

Table 5. ARCH effect test

RHK	*Engle LM test*	*Tsay F test*
Statistic	*665.379****	*26.3757****
(p-value)	*(0.0000)*	*(0.0000)*
RSHAI	*Engle LM test*	*Tsay F test*
Statistic	*439.020****	*6.7757****
(p-value)	*(0.0000)*	*(0.0000)*

Notes : *** denote significance at the level 1%.

Proposed Model

Based on the U.K. stock and the U.S. stock index markets will affect the return volatility of the Hong Kong and the Shanghai stock markets, and the U.K. stock and the U.S. stock markets do have the high correlations for the Hong Kong and the Shanghai stock markets. We follows the idea of self-exciting threshold autoregressive (SETAR) model (Tsay, 1989), the idea of double threshold GARCH model (Brooks, 2001), and the ideas of the papers of Engle (2002) and Tse & Tusi (2002), and uses the positive and negative value of the U.K. stock and the U.S. stock returns' volatility rate is as a threshold. After model process selection, in this paper, we may use the bivariate asymmetric GARCH (called AGARCH) model to construct the relationships of the Hong Kong's and the Shanghai's stock market returns, the AGARCH(1, 1) model is illustrated as follows:

$$RHK_t = \phi_{10} + \sum_{j=1}^{2}(\phi_{j1}RHK_{t-j} + \phi_{j2}RSHAI_{t-j} + \phi_{j3}RUK_{t-j} + \phi_{j4}RUS_{t-j}) + a_{1,t} \qquad (1)$$

$$RSHAN_t = \varphi_{10} + \sum_{j=1}^{2}(\varphi_{j1}RHK_{t-j} + \varphi_{j2}RSHAI_{t-j} + \varphi_{j3}RUK_{t-j} + \varphi_{j4}RUS_{t-j}) + a_{2,t}\,, \qquad (2)$$

$$h_{11,t} = \sum_{j=1}^{4} u_{j,t-1}(\alpha_{j0} + \alpha_{j1}a_{1,t-1}^2 + \beta_{j1}h_{11,t-1})\,, \qquad (3)$$

$$h_{22,t} = \sum_{j=1}^{4} u_{j,t-1}(\alpha'_{j0} + \alpha'_{j1}a_{2,t-1}^2 + \beta'_{j1}h_{22,t-1})\,, \qquad (4)$$

$$h_{12,t} = \rho_t \sqrt{h_{11,t}} \sqrt{h_{22,t}} \ , \tag{5}$$

$$\rho_t = \exp(q_t)/(\exp(q_t)+1) \, , \tag{6}$$

$$q_t = \gamma_0 + \gamma_1 \rho_{t-1} + \gamma_2 a_{1,t-1} a_{2,t-1} / \sqrt{h_{11,t-1} h_{22,t-1}} \ , \tag{7}$$

$$u_{1,t} = \begin{cases} 1 & if \ \ RUK_t \le 0; RUS_t \le 0 \\ 0 & if \qquad \quad others \end{cases} , \tag{8}$$

$$u_{2,t} = \begin{cases} 1 & if \ \ RUK_t \le 0; RUS_t > 0 \\ 0 & if \qquad \quad others \end{cases} , \tag{9}$$

$$u_{3,t} = \begin{cases} 1 & if \ \ RUK_t > 0; RUS_t \le 0 \\ 0 & if \qquad \quad others \end{cases} , \tag{10}$$

$$u_{4,t} = \begin{cases} 1 & if \ \ RUK_t > 0; RUS_t > 0 \\ 0 & if \qquad \quad others \end{cases} , \tag{11}$$

with $RUK_t > 0$ and $RUS_t > 0$ denotes good news, $RUK_t \le 0$ and $RUS_t \le 0$ denotes bad news. The white noise of $\vec{a}_t' = (a_{1,t}, a_{2,t})$ is obey the bivariate Student's t distribution, this is,

$$\vec{a}_t \sim T_v(\vec{0}, (v-2)H_t / v) \, , \tag{12}$$

among $\vec{0}' = (0,0)$ and H_t is the covariance matrix of $\vec{a}_t' = (a_{1,t}, a_{2,t})$, and ρ_t is the dynamic conditional correlation coefficient of $a_{1,t}$ and $a_{2,t}$. The maximum likelihood algorithm method of BHHH (Berndt et. al., 1974) is used to estimate the model's unknown parameters. The programs of RATS and EVIEWS are used in this paper.

Empirical Results

From the empirical results, we know that the Hong Kong's and the Shanghai's stock return volatility may be constructed on the DCC and the bivariate AIGARCH (1, 1) model. Its estimate result is stated in Table 6. The empirical results show that the good news and bad news of the U.K. stock and the U.S. stock returns' volatility will produce the different stock return rates on the Hong Kong and the Shanghai stock markets. And the stock return volatilities of the U.K. stock and the U.S. stock index will also affect the variation risks of the Hong Kong and the Shanghai stock markets. The Hong Kong stock return does not receive 2nd period's impact of the U.K. stock return volatility. The Hong Kong stock return volatility receives fist period's impact of the Hong Kong stock return volatility (ϕ_{11}=-0.1521). The Hong Kong stock return also receives before 1 period's impact of the Shanghai stock return volatility (ϕ_{12}=-0.0278). The Hong Kong stock return volatility also receives before 1 period's impact of the U.K. stock return volatility (ϕ_{13}=0.0627). The Hong Kong stock return also receives before two period's impact of the U.S. stock return volatility (ϕ_{14}=0.5300, ϕ_{24}=0.1374). The Shanghai stock return volatility receives fist period's impact of the Hong Kong stock return volatility (φ_{11}= -0.0671). And the Shanghai stock return volatility does not receive before two period's impact of the Shanghai stock return volatility. The Shanghai stock return volatility does not also receive before two period's impact of the U.K. stock return volatility. The Shanghai stock return volatility receives fist period's impact of the U.S. stock return volatility (φ_{14}= 0.1912). The

Shanghai stock return does not receive 2nd period's impact of the U.S. stock return volatility rates. The stock return volatilities of the U.K. stock and the U.S. stock markets are also truly influent the return volatility of the Hong Kong and the Shanghai stock markets. On the other hand, the correlation coefficient average estimation value ($\hat{\bar{\rho}}_t$ =0.4868) of the Hong Kong and the Shanghai stock return volatility is significant. This result also shows the Hong Kong and the Shanghai stock return's volatility is mutually synchronized influence. In additional, estimated value of the degree of freedom for the Student's t distribution is 5.1698, and is significant under the significance level of 0.01($\alpha = 1\%$). This also demonstrates that this research data has the heavy tailed distribution.

Table 6. Parameter estimation of the DCC and the bivariate AIGARCH(1, 1) model

Parameters	ϕ_{10}	ϕ_{11}	ϕ_{12}	ϕ_{13}	ϕ_{14}
Coefficient	0.0073	-0.1521	-0.0278	0.0627	0.5300
(p-value)	(0.7556)	(0.0000)	(0.0845)	(0.0652)	(0.0000)
Parameters	ϕ_{21}	ϕ_{22}	ϕ_{23}	ϕ_{24}	φ_{10}
Coefficient	-0.0127	-0.0011	-0.0055	0.1374	0.0432
(p-value)	(0.5924)	(0.9461)	(0.8722)	(0.0000)	(0.1241)
Parameters	φ_{11}	φ_{12}	φ_{13}	φ_{14}	φ_{21}
Coefficient	-0.0671	0.0228	0.0560	0.1912	-0.0348
(p-value)	(0.0194)	(0.3734)	(0.1745)	(0.0000)	(0.1738)
Parameters	φ_{22}	φ_{23}	φ_{24}	α_{10}	α_{11}
Coefficient	0.0163	0.0045	0.0294	0.1282	0.0858
(p-value)	(0.5120)	(0.9094)	(0.4362)	(0.0004)	(0.0001)
Parameters	β_{11}	α_{20}	α_{21}	β_{21}	α_{30}
Coefficient	0.9142	0.0519	0.1786	0.8214	0.0160
(p-value)	(0.0000)	(0.2858)	(0.0000)	(0.0000)	(0. 7988)
Parameters	α_{31}	β_{31}	α_{40}	α_{41}	β_{41}
Coefficient	0.1969	0.8031	-0.0285	0.0727	0.9273
(p-value)	(0.0000)	(0.0000)	(0.2406)	(0.0003)	(0.0000)
Parameters	α'_{10}	α'_{11}	β'_{11}	α'_{20}	α'_{21}
Coefficient	0.0234	0.0434	0.9566	0.0389	0.0592
(p-value)	(0.5066)	(0.0007)	(0.0000)	(0.4788)	(0.0050)
Parameters	β'_{21}	α'_{30}	α'_{31}	β'_{31}	α'_{40}
Coefficient	0.9408	-0.0358	0.1140	0.8960	0.0375
(p-value)	(0.0000)	(0.6153)	(0.0003)	(0.0000)	(0.2560)
Parameters	α'_{41}	β'_{41}	γ_0	γ_1	γ_2
Coefficient	0.0781	0.9219	1.2392	-2.6782	0.0250
(p-value)	(0.0000)	(0.0000)	(0.4679)	(0.4429)	(0.6033)
Parameters	v	$\bar{\rho}_t$	min ρ_t	max ρ_t	
Coefficient	5.1698	0.4868	0.3465	0.7145	
(p-value)	(0.0000)	(0.0000)			

Notes： p-value< α denotes significance. (α =1%, α =5%).

min ρ_t denotes the minimum ρ_t and max ρ_t denotes the maximum ρ_t .

From the Table 6, the estimated coefficients of the conditional variance equation will produce the different variation risks under the bad news and good news in Hong Kong and Shanghai stock markets. The empirical results show that the Hong Kong stock market conforms the conditionally supposition of the AIGARCH model.

The empirical results also show that the Shanghai stock market return is the AIGARCH model. This result also demonstrates the DCC and the bivariate AIGARCH (1, 1) model may catch the Hong Kong and the Shanghai stock return volatilities' process. The empirical result shows that the Hong Kong stock market has the fixed variation risk, and the Shanghai stock market has also a fixed variation risk.

In Table 6, the Hong Kong and the Shanghai stock market returns have the different conditional variation risks. This result demonstrates that the good news and bad news of the U.K. stock and the U.S. stock markets will produce the different variation risks on the Hong Kong and the Shanghai stock markets. Under the good news of the U.K. and the U.S. stock markets, the variation risk of the Hong Kong stock market is larger than the variation risk of Shanghai's stock market.

Under the $RUK_t \leq 0$ (bad news) and $RUS_t \leq 0$ (bad news), the empirical result shows that the variation risk of the Shanghai stock market is larger than the variation risk of the Hong Kong stock market. Besides, under the $RUK_t > 0$ (good news) and $RUS_t > 0$ (good news), the empirical result also shows that the Hong Kong stock market can reduce the fixed variation risk. Therefore, the explanatory ability of the DCC and the bivariate AIGARCH(1, 1) model is better than the traditional model of the bivariate GARCH (1, 1).

To test the inappropriateness of the DCC and the bivariate AIGARCH(1, 1) model, the test method of Ljung & Box (1978) is used to examine autocorrelation of the standard residual error. This proposed model does not show an autocorrelation of the standard residual error. Therefore, the DCC and the bivariate AIGARCH(1, 1) model are more appropriate.

Conclusions

The empirical results show that the Hong Kong stock market return's volatility does have an asymmetric effect and the Shanghai stock market return's volatility does have the asymmetric effect. The Hong Kong and the Shanghai stock market return volatility may construct in the DCC and the bivariate AIGARCH (1, 1) model with a positive (good news) and negative (bad news) threshold of the U.K. stock and the U.S. stock return volatility rates. From the empirical result also obtains that the dynamic conditional correlation coefficients' average estimation value ($\hat{\rho}_t$ =0.4868) of the Hong Kong and the Shanghai stock return volatility is positive. The positive and negative values of the U.K. stock and the U.S. stock return volatility affects the stock return volatility rates of the Hong Kong and the Shanghai stock markets. The Hong Kong and the Shanghai stock market returns are truly received the impact of the U.K. stock and the U.S. stock return volatility rates.

Under the good news of the U.K. and the U.S. stock markets, the variation risk of the Hong Kong stock market is larger than the variation risk of the Shanghai stock market. Under the $RUK_t > 0$ and $RUS_t \leq 0$, the empirical result shows that the variation risk of the Shanghai stock market is also larger than the variation risk of the Hong Kong stock market. Besides, under the $RUK_t > 0$ and $RUS_t > 0$, the empirical result also shows that the Hong Kong stock markets can reduce the fixed variation risk.

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