8. THE RELATIONSHIP BETWEEN INSURANCE INDUSTRY AND BANKING SECTOR IN CHINA: ASYMMETRIC GRANGER CAUSALITY TEST

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Abstract

With the development of the financial sector, the interaction between insurance and banking gradually increased. Traditional Granger causality tests indicate a long-term relationship between the banking and insurance sectors and the development of insurance industry Granger-causes that of the banking sector. Considering the possibly different causal impacts of positive and negative shocks, this research employs asymmetric Granger causality test to further examine the relation. Results show that negative shocks in the insurance and banking sector Granger-cause each other, the positive shocks in these two sectors do not have significant Granger cause with each other. Moreover, the positive (or negative) shocks in the insurance sector Granger-cause the opposite direction of shocks in the banking sector. According to the test results, regulatory authorities should pay more attention to the systemic risk resulted from the downturn of insurance and banking sectors, and the insurance industry should be further strengthened, since the insurance sector plays a more active role in the insurance-banking nexus and can promote the stability and development of the financial system.

Keywords: insurance industry, banking sector, causality, asymmetric Granger causality test, China

JEL classification: C22, G15

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I. Introduction

Though the insurance industry and the banking sector are thought to be the two main branches of the financial services industry, there are significant differences between them. The basic activities of the banking sector focus on credit and settlement services, while the fundamental function of insurance industry is to indemnify the losses. However, the connections between the banking sector and the insurance industry were observed to increase at different levels lately. At the capital level, mutual holding between the banks and insurance companies, especially the establishment of bank-owned insurance companies, are becoming prevalent. At the business level, based on the development of bancassurance, the expansion of cross-selling has been vigorous among financial (insurance) groups. At the product level, some life insurance products share some features in common with saving business and other investment-link products of banks, which naturally help the insurance companies and the banks to form a competition-substitution relationship, while general insurance can secure banks by covering mortgage losses. Therefore, there is a complex relationship involving both cooperation and competition between the banks and the insurance companies.

Chinese insurance industry started from 1979, when China began to perform its reform and opening policies, while banking business always existed. Insurance industry has achieved rapid progress since its beginning, and ranked the 3rd place around the world in total premiums in 2014. During the process of development, insurance companies cooperate and compete with the banks and have roughly gone through three stages. At the first stage of development (about 1979-1993), insurance companies heavily relied on the banks to sell policies due to limited affiliated agencies, and most of the policies sold belonged to the non-life type. At the second stage (about 1994-2008), insurance industry and banking sector were put under strict separated regulation. Though the operations of the insurance companies and banks were separated, the cooperation at business level became mature and insurance industry was greatly promoted by selling policies through banks' networks. Notably at this stage, life insurance which possesses saving and investment functions in many policies surged, some newly developed life insurance policies even became strong competitors for some products of banks. At the third stage (about 2009-present), share cross-holding of banks and insurance companies was allowed by the regulators, then many large banks were observed to invest in insurance companies, even set up self-owned insurance companies, and vice versa. The relationships between the insurance industry and the banking sector are becoming closer and more complicated with the expansion of products and innovations in organizational forms.

Lewis (1990) explained that banks and insurance companies are similar in rooting their operation on the law of large numbers. Levy-Lang (1990) argued that insurance companies undertake some form of fund management (a banking attribute) through the investment of their technical reserves, which brings them closer to banking. Beyond the similarities, banking sector and insurance industry are generally thought to cooperate and compete with each other. Grace and Rebello (1993) found that insurance activities encourage bank borrowing through the risk protection for the mortgage. Specifically, Zou and Adams (2006) provided the evidence that property insurance activities could promote bank credit market by transferring the risks. More researchers identified that

banking sector and insurance industry can promote each other and gaining wealth effect by mixing the operation (see Estrella, 2001; Hendershott *et al.*, 2002; Yu, 2003; and Mamun *et al.*, 2005). Carow (2001) provided the evidence of wealth effect by analyzing the case of the merger between Citibank and Travelers Group. However, Allen and Santomero (2001) show that there is a competitive relationship between banking sector and life insurance activities, this kind of relationship can even be applied to the whole insurance activities (Tennant *et al.*, 2010). Along with the process of financial deregulation, the conglomeration in organizational forms, product convergence and cross-industry competition among the banking sector and insurance industry are consolidated (Wallison, 2008), the competition and/or complementation between banks and insurance companies are further strengthened. Billio *et al*. (2012) analyzed the interconnectedness among the banking sector, insurance industry and other financial institutions and discovered that there were 520, 611 and 1224 Granger causality relationships between financial institutions during 1999-2001, 2002-2004 and 2006-2008, respectively, indicating growing interconnectedness between the banking sector and insurance industry. After the global financial crisis starting from 2008, the risks which may endanger the stability of the whole financial system, which is also called 'systemic risk' by many scholars, has drawn much attention, and the relationship between banking system and insurance industry are undoubtedly the key to understand the systemic risks. Cummins and Weiss (2014) found that despite of the relevance among insurance companies, banks and other financial institutions, there is little possibility of systemic risk originating from the insurance industry, due to the limited ways of risk transmission in insurance companies' core business. However, Bernal *et al*. (2014) showed that during 2004-2012 the insurance industry was the most systematically risky financial sector in the USA, while the banking system contributed little to the accumulation of systemic risk, which was opposite to the situations in the Euro Area. Generally speaking, the relation between insurance industry and banking sector was seen to strengthen, but the specific interaction forms are still not clear, the current literature failing to arrive at consistent conclusions. For the case of China, Liu and Lee (2014) identified time-varying causal relationship between bank credit and insurance activities. As Bernal *et al*. (2014) showed, the relation may vary across different economies. China has achieved spectacular economic success in the past three decades, and both the insurance industry and the banking sector experienced high-speed development during this period. When China is going through the transition from a planned economy to a market economy, the relation between banking sector and insurance industry may be different from that of developed economies. In this article, we apply lately developed methodology to investigate the relation between the banking sector and the insurance industry. Our findings show that the insurance industry play an active role in the relationship with banking sector, and in the downturn both sectors are mutually affected, which yield insights for the financial industry development and financial risk management for China and other countries.

So far, researches of the causal relationship between the Chinese insurance industry and the banking sector at the industry level are still rare, and the existing researches are not capable to provide strong evidence of the interconnectedness between the banking sector and the insurance industry. Moreover, in previously published papers on causality tests, it is usually assumed that the impact of a positive shock is the same as

the impact of a negative shock (as in Liu and Lee (2014) and many other works), which as we all know is a too strict assumption. In this paper, the asymmetric Granger causality test method is used to examine the relationship between Chinese insurance industry and the banking sector to reveal the deeper intrinsic relationship between the two industries, the aim of this research is to provide insights for the development of financial policy and corporate strategy.

II. Methodology

The Granger causality test is a common method to analyze a causal relationship between variables. Granger causality between two time series of economic variables X,Y is defined as: provided that the past information of variables X,Y is given, the variable Y is better predicted than under the condition that only the past information of variable Y is given, i.e. variable X is helpful to predict the future change of variable Y, then variable X is called to "Granger-cause" variable Y.

As Clive W.J. Granger noted in a speech after he won the 2003 Nobel Prize in economics, the Granger causality test still had many limitations. For instance, in previously published papers on causality it is usually assumed that the impact of a positive shock is the same as the impact of a negative shock in absolute terms. However, this assumption might be too strict because in many cases there potentially is an asymmetric structure regarding the causal impacts. Neftci (1984) started the study of asymmetric phenomena and found that several measures to deal with unemployment in the United States have different effects at different stages of the economic cycle. Terasvirta & Anderson (1992) studied the industrial output of 13 countries in 1992 and found that the negative shock had a stronger impact on the industrial output than the positive shock. The main reasons for the existence of asymmetric Granger causality are as follows:

(1) People have different degree of sensitivity regarding the positive shock and negative shock. It is widely believed that in the financial market people responds differently to a positive shock and a negative shock which have the same absolute value. Some scholars studied the asymmetry of profits in the financial market and its potential relevance and found that investors are more sensitive to the negative news than the positive news (Longin and Solnik, 2001; Ang and Chen, 2002; Hong *et al.*, 2007; Alvarez-Ramirez *et al.*, 2009).

(2) The asymmetric information might cause different reflection for people. According to the pioneer works of Akerlof (1970), Spence (1973) and Stiglitz (1974), information affects people's decisions in the markets, thus we can expect people to act differently given different conditions of information. Considering this, it is very important to consider the asymmetric structure when conducting causality tests.

The idea of transforming data into both cumulative positive and negative changes originates from Granger and Yoon (2002). Researchers used this method to test for cointegration, which they entitled as hidden cointegration. Hristu-Varsakelis and Kyrtsou (2008) and Hatemi-J (2011) consider an asymmetric structure in the application of nonlinear causality test and linear causality test. The basic idea of this method is as follows:

First, let us assume that we are interested in two variables which subject to random walk:

$$y_{1t}=y_{1t-1}+\varepsilon_{1t}=y_{10}+\sum_{i=1}^{t}\varepsilon_{1i} \tag{1}$$

and

$$y_{2t}=y_{2t-1}+\varepsilon_{2t}=y_{20}+\sum_{i=1}^{t}\varepsilon_{2i} \tag{2}$$

where: $t=1,2,\ldots,T$, the constants $y_{1,0}$ and $y_{2,0}$ are the initial values, and the variables ε_{1i} and ε_{2i} represent white noise disturbance terms.

The definitions of positive and negative shocks are as follows:

$$\varepsilon_{1i}^{+}=\max(\varepsilon_{1i},0), \quad \varepsilon_{1i}^{-}=\min(\varepsilon_{1i},0) \tag{3}$$

$$\varepsilon_{2i}^{+}=\max(\varepsilon_{2i},0), \quad \varepsilon_{2i}^{-}=\min(\varepsilon_{2i},0) \tag{4}$$

Accordingly, the disturbance terms can be transformed into:

$$\varepsilon_{1i}=\varepsilon_{1i}^{+}+\varepsilon_{1i}^{-} \tag{5}$$

$$\varepsilon_{2i}=\varepsilon_{2i}^{+}+\varepsilon_{2i}^{-}, \tag{6}$$

It follows that:

$$y_{1t}=y_{1t-1}+\varepsilon_{1t}=y_{10}+\sum_{i=1}^{t}\varepsilon_{1i}=y_{10}+\sum_{i=1}^{t}\varepsilon_{1i}^{+}+\sum_{i=1}^{t}\varepsilon_{1i}^{-} \tag{7}$$

$$y_{2t}=y_{2t-1}+\varepsilon_{2t}=y_{20}+\sum_{i=1}^{t}\varepsilon_{2i}=y_{20}+\sum_{i=1}^{t}\varepsilon_{2i}^{+}+\sum_{i=1}^{t}\varepsilon_{2i}^{-} \tag{8}$$

Finally, the positive and negative shocks of each variable can be defined in a cumulative form as

$$y_{1t}^{+}=\sum_{i=1}^{t}\varepsilon_{1i}^{+}, \; y_{1t}^{-}=\sum_{i=1}^{t}\varepsilon_{1i}^{-} \tag{9}$$

$$y_{2t}^{+}=\sum_{i=1}^{t}\varepsilon_{2i}^{+}, \; y_{2t}^{-}=\sum_{i=1}^{t}\varepsilon_{2i}^{-} \tag{10}$$

The cumulative values contain the information of shocks, thus we can investigate the relationship between shocks of different directions through testing these constructed time series. Next in this paper, we will exemplify the application by demonstrating the case of testing for causal relationship between positive cumulative shocks. The procedure is mainly as follows:

(1) Assuming $y_t^{+}=(y_{1t}^{+}, y_{2t}^{+})$, establish the following vector autoregressive model of order p:

$$y_t^{+}=v+A_1 y_{t-1}^{+}+\ldots+A_p y_{t-p}^{+}+\mu_t^{+}, \tag{11}$$

where: y_t^{+} is the 2×1 vector of the variables, and matrix A_r is a 2×2 matrix of parameters for lag order r $(r=1,\ldots, p)$.

(2) Hatemi-J (2003) recommends the use of HJC information criterion to select the lag order (p) of the model, where $HJC=\ln\left(\left|\hat{\Omega}_j\right|\right)+j\left(\frac{n^2\ln T+2n^2\ln(\ln T)}{2T}\right)$, $j=0,\ldots,p$. In this

formulation, $\left|\widehat{\Omega}_j\right|$ represents the determinant of the estimated variance-covariance matrix of the error terms in the VAR model based on lag order j, n is the number of equations in the VAR model and T is the number of observations.

(3) After selecting the optimal lag order, the null hypothesis is that κ_{th} element of y_t^+ does not Granger-cause the ω_{th} element of y_t^+. That is, the following null hypothesis is tested:

H_0:the row ω, column κ element in A_r equals zero for $r=1,\ldots,p$.

In this paper, the Wald test is used to perform the Granger causality test and the critical value of Wald statistic is obtained by using Bootstrap simulation method, as discussed in detail in Davison and Hinkley (1999), Hacker and Hatemi-J (2006) and Hatemi-J (2012).

(4) Under different significance level α, compare the critical value and the Wald statistic. If Wald statistic is larger than the critical value, the null hypothesis is rejected at this level of significance. That is, the κ_{th} element of y_t^+ Granger-cause the ω_{th} element of y_t^+.

III. Data and Empirical Results

III.1 Data

In this paper, we use the stocks index of insurance companies and banks of A share in the Shanghai Stock Exchange to represent the development of these two industries. In the past decade or so, the growth mode of insurance companies and the banks are gradually transiting from epitaxial growth to intensive growth. Accordingly, the measurement of industrial development should not focus on the current business income but the ability of the sustainable development of the industry. Stock prices reflect investors' expectations about the future profitability of the assets, which conform to the intrinsic characteristic of intensive growth and make it a reasonable index of the development level of the industry.

By April 2014, there were four listed insurance companies of A shares at the Shanghai Stock Exchange, namely Ping An Insurance (Group) Company of China, LTD, New China Life Insurance Company, LTD, China Pacific Insurance (Group) Company, LTD and China Life Insurance Company, LTD. Although the number of insurance companies registered at the Shanghai Stock Exchange is small, they account for a large percent of life and non-life insurance market share. In fact, listed life insurance company's market share is higher than 60%, so that the insurance stocks index is very representative. Meanwhile, there are 16 listed banks of A shares at the Shanghai Stock Exchange. In 2013, the listed banks accounted for 68% of deposits in the national banking system, so the banking stock index is also very representative.

The time span of the data in this study is from January 24, 2007 to April 18, 2014 and all the 1756 pairs of data are taken from Tongdaxin database.

III.2 Unit root test

First of all, this paper uses ADF method to test the stationarity of the two variables; the lag order is automatically selected according to the Schwarz criterion. The test results are shown in Table 1.

The test results show that all the original data are non-stationary time series, and the first-difference data of banking sector and insurance sector index are stationary at the 1% significance level.

III.3 Cointegration test

The insurance sector index and banking sector index are integrated of order one, so we can use the Johansen cointegration test to find the long-term relationship between these two variables. The results are shown in Table 2.

The test results show that when the null hypothesis is that no cointegration relationship exists between the insurance sector index and the bank sector index, the trace statistic equals 25.07, which is greater than critical value 15.49 at significance level of 0.05, which means that at the 95% confidence level the null hypothesis that there is no cointegration relationship between two variables is rejected. When the null hypothesis is that there is at most 1 cointegration relationship between these two variables, the trace statistic equals 3.58 and is less than the critical value 3.84 at significance level of 0.05. That is to say, at the 95% confidence level, the null hypothesis cannot be rejected. To sum up, there is only one cointegration relationship between the insurance sector index and the banking sector index, indicating a long-term equilibrium relationship between the development of the banking and the insurance industries.

III.4 Traditional Granger causality analysis

The cointegration test shows the existence of a long-term equilibrium relationship between the development of banking and insurance industry. The Granger causality tests are applied for further analysis of the relationship between the two variables. The results in Table 3 indicate that one-way Granger causality from insurance industry to banking sector exists, while the reverse does not hold. Specifically, the null hypothesis that insurance industry does not Granger-cause the banking sector (I≠>B) is rejected at 5% significance level, indicating that changes in the insurance industry are ahead of that of the banking industry. On the contrary, the null hypothesis (B≠>I) cannot be rejected at 5% significance level, which indicates that the banking sector cannot Granger-cause the insurance sector, so that changes in the banking sector are not identified to lead the changes in the insurance sector. Since traditional Granger causality test cannot distinguish the impacts of different directions of shocks of insurance sector on the banking sector and vice versa, we will use the asymmetric Granger causality test to conduct further analysis on the relationship between these two variables.

III.5 Asymmetric Granger causality test

Firstly, according to the formula (1) and (2), we define the variables I_t and B_t to proxy for the development of insurance industry and banking sector:

$$I_t=I_0+\sum_{i=1}^t \varepsilon_i \tag{12}$$

$$B_t=B_0+\sum_{i=1}^t \mu_i \tag{13}$$

Then, we construct variables to indicate the changes of different directions according to the formula (3) and (4):

$$I+=\sum_{i=1}^t \varepsilon_i^+, \; I-=\sum_{i=1}^t \varepsilon_i^- \tag{14}$$

$$B+= \sum_{i=1}^{t} \mu_i^+ , B-= \sum_{i=1}^{t} \mu_i^- \qquad (15)$$

where: I+ represents the positive change of insurance index, I- represents the negative changes of insurance index.

Similarly, B+ and B- indicate the positive and negative changes of banking sector, respectively. Asymmetric Granger causality between I+, I- and B+, B- is examined and the results are shown in Table 4 and 5.

Table 4 shows the results of asymmetric Granger causality test between insurance industry and banking sector index with the shocks in the same direction. Table 4 shows that I- Granger-causes B-, that is, negative shocks of insurance sector significantly lead to the negative shocks of banking sector, which means that the downturn of the insurance industry will result in poor performance of the banking sector. However, I+ does not Granger-cause B+, indicating that the growth of the insurance industry has no significant effect on the growth of the banking sector.

Only when the significance level is greater than 5%, the negative shocks of the banking sector will Granger-cause the negative shocks of insurance industry. That is to say, when the economy is on the downturn trend, the downward of the banking sector puts great pressure on the development of the insurance industry. However, the positive shocks of the banking sector is not found to be the Granger cause for the development of insurance industry at any significance level, which means that the positive trend of the banking sector has no effect on the insurance industry.

According to the test results in Table 4, there is a strong correlation between the two industries and the downturn of each one will be a burden for the other. However, when the insurance and banking industries are in the rapid development process, they usually do not provide strong support for the development of the other one.

Table 5 lists the results of asymmetric Granger causality test between insurance industry and banking sector index with the shocks in the opposite direction. As one may see in Table 5, the null hypotheses "positive shocks of the insurance industry do not Granger-cause the negative shocks of the banking sector (I+≠>B-)" and "negative shocks of the insurance industry do not Granger-cause the positive shocks of the banking sector (I-≠>B+)" are both rejected at 1% significance level. This result indicates that both positive and negative shocks of insurance industry significantly lead to the changes in the banking sector in the opposite direction. This phenomenon might be explained by the fact that there is a substitution effect between the life insurance premium incomes and banking deposits, according to the relation, changes in the insurance industry can cause the banking sector to change in the opposite direction.

The null hypotheses "positive shocks of the banking sector do not Granger-cause the negative shocks of the insurance industry (B+≠>I-)" and "negative shocks of the banking sector do not Granger-cause the positive shocks of the insurance industry (B-≠>I+)" cannot be rejected at any significance level. This means that neither the positive shocks nor the negative shocks of the banking sector can cause the insurance industry to change in the opposite direction. Empirical results might indicate that the substitution effect of insurance industry to the banking sector is relatively weak. The prosperous development of the banking sector does not compress the development of the insurance

industry and the stagnation or recession of the banking sector does not contribute to the rapid development of the insurance industry.

From Table 5 we find that the banking sector has a strong substitution effect on the insurance industry, however, the substitution effect of insurance industry on the banking sector is not significant.

IV. Economic explanation and policy implications

First, though the results of traditional Granger causality test show that the insurance industry Granger-causes the banking sector and the banking sector does not Granger-cause the insurance industry, the results of asymmetric Granger causality tests indicate that there is a complex relationship between the development of the insurance industry and the banking sector. For instance, the asymmetric Granger causality test shows that the negative shocks of the insurance industry Granger-cause the negative shocks of the banking sector, while the positive shocks of the insurance industry is not the Granger cause for the positive shocks of the banking sector. What is more, the negative shocks of the banking sector do Granger-cause the negative shocks of the insurance industry at 5% significance level. Asymmetric Granger causality test provide richer evidence than traditional Granger causality test and it also verifies the existence of asymmetric structure in the insurance-banking nexus.

Second, the test results show that the growth of the insurance industry and the banking sector is not stable, but a long-term equilibrium relationship between the two industries exists. The insurance industry and the banking sector are at the stage of reform, so both industries are significantly affected by many similar factors, such as the regulatory policy, the demand, the opening-up policy and so on. After all, the insurance industry and the banking sector are parts of the financial market and the coordinated development is the inherent requirements for both of them, thus a long-term equilibrium relationship is reasonable.

Third, results of asymmetric Granger causality test show that the lead-lag effect is not significant when the insurance industry or the banking sector is at the stage of upward development. This might indicate that these two sectors' development can hardly contribute to each other. It is worth noting that the downward trend of one industry tends to cause the other's adverse situation. Such relationship could be the root of systemic risk in the financial markets. Therefore, the mechanism of risk transmission between the insurance industry and the banking sector should be carefully studied; the risk of recession of the insurance industry and the banking sector should get close watch.

Last but not the least, the asymmetric Granger causality test results of different shocks of the insurance industry and the banking sector show that the banking sector has a strong substitution effect on the insurance industry, but the reverse is not true. Nowadays, 2/3 of the premiums in the Chinese insurance market are from the lines of life insurance which have the saving or investment function, and this part of the business has a high degree of overlapping with the banking business. So, when the insurance business (especially life insurance business) changes, the banking business can respond timely to the needs of saving or investment. However, the scope of banks' business is relatively broad, including deposits, loans, foreign exchange, savings and

other services. Insurance companies have poor substitution effect in these areas, which make it hard for insurance companies to respond to the fluctuations in the banking sector.

V. Conclusion

This paper uses stock price index data to study the lead-lag relationship between the development of insurance industry and banking sector in China. Applying traditional Granger causality test only finds one-way Granger causality running from insurance industry to banking sector at 5% significance level. However, the relationship is found to be complicated when considering the asymmetric impacts of shocks from different directions. The results of asymmetric Granger causality test show that there is no significant Granger causality between the positive shocks of the insurance industry and that of the banking sector. However, there is significant round-way Granger causal relationship between the negative shocks of the insurance industry and that of the banking sector. The positive (negative) shocks of the insurance industry Granger-cause the negative (positive) shocks of the banking sector, but the vice versa does not hold. According to the results of examination, the supervision department should pay more attention to the systemic risk when the insurance industry and the banking sector do not perform well. At the same time, the insurance industry is found to be an active and positive part in the insurance-banking nexus and plays a key role in the security and development of the financial system.

Acknowledgements

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Appendix

Sample Index and Stationarity Test Results

Index	T statistic	P value	Sig	Critical Value	Test Results
Banking sector	-1.909244	0.3282	1%	-3.433873	Non- stationary
D(Banking sector)	-41.95663	0.0000	1%	-3.433876	Stationary
Insurance sector	-1.83988	0.3613	1%	-3.433901	Non- stationary
D(Insurance sector)	-9.641070	0.0000	1%	-3.43901	Stationary

Note: D represents the data of first-order difference.

Unrestricted Cointegration Rank Test (Trace) Results

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	P value
None	0.012165	25.06502	15.49471	0.0014
At most 1	0.002040	3.584718	3.841466	0.0583

Results of Granger Causality Test

Granger Causality	χ^2 Statistic	Degree of Freedom	P value	Test Results
I≠＞B	14.32102	1	0.0002	Rejected
B≠＞I	3.545464	1	0.0597	Accepted

Note: (1) This test is performed at the 5% significance level.
(2) The symbol "X≠>Y" means variable X doesn't Granger-cause variable Y.
(3) The symbol I and B represent insurance sector index and banking sector index, respectively.

Asymmetric Granger Causality Test Results (1)

Null Hypothesis	Wald Statistic	Wald Critical Value	Lag Order	Test Results
I+≠＞B+	0.226	7.826	1	Accepted
		4.174		
		2.826		
I-≠＞B-	7.641***	0.160	1	Rejected
		0.000		
		0.000		
B+≠＞I+	1.045	7.257	1	Accepted
		3.502		
		2.452		
B-≠＞I-	5.385**	6.234	1	Accepted
		3.573		Rejected
		2.700		Rejected

Note: (1) The lag order is automatically selected according to the HJC criterion provided by Hatemi-J (2003)
   (2) The symbol "X≠>Y" means variable X doesn't Granger-cause variable Y.
   (3) The critical values corresponds to the significance levels of 1%, 5% and 10%, respectively. ** And *** indicate the significance level of 5% and 1%, respectively.

Table 5
Asymmetric Granger Causality Test Results (2)

Null Hypothesis	Wald Statistic	Wald Critical Value	Lag Order	Test Results
I+≠＞B-	14.709***	5.755	1	Rejected
		3.512		
		2.672		
I-≠＞B+	23.841***	13.679	4	Rejected
		9.761		
		8.315		
B+≠＞I-	4.944	13.049	4	Accepted
		9.501		
		7.833		
B-≠＞I+	1.642	5.92	1	Accepted
		3.620		
		2.646		

Note: (1) The lag order is automatically selected according to the HJC criterion provided by Hatemi-J (2003)
   (2) The symbol "X ≠> Y" means variable X doesn't Granger-cause variable Y.
   (3) The critical values correspond to the significance levels of 1%, 5% and 10%, respectively. *** indicates the significance level of 1%.