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A Study on the International Fisher Effect : An Investigation from South Korea and China

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Abstract

Purpose - This paper aims to verify whether the Fisher effect and the international Fisher effect are significant between China and South Korea in the long and short run, respectively.

Research design, data, and methodology - The annual and monthly data, respectively, are employed to conduct an empirical estimation under the fully modified ordinary least squares(FMOLS). The nominal interest rate is treated as an independent variable. The inflation rate is treated as a dependent variable.

Results - The results exhibit whenever in the long or short run, the Fisher effect exists in China and South Korea. However, the Fisher effect in South Korea is more significant than that of in China. Meanwhile, an empirical analysis is also preformed to investigate the long-run and the short-run international Fisher effect between China and South Korea. The deviation from the equilibrium relationship is that the commodity market and the Financial market have started to integrate in China. But China's integrated level proved to be relatively lower.

Conclusions - To exploit that the Fisher effect and the international Fisher effect hold between China and South Korea can help both countries deal with the sufferings from integration of the commodity market and the financial market.

Keywords: Nominal Interest rate, Inflation Rate, International Fisher Effect, Fisher Effect, Fully Modified Ordinary Least Squares.

JEL Classifications: C58, D53, E31, E43.

1. Introduction

Since China and South Korea establish the diplomatic relation in 1992, China and South Korea have enjoyed a rapid economic growth. With the further opening of the two countries, both the commodity market and the financial market are more closely integrated respectively. Especially, on December 9th, 2015, China's vice commerce minister, Wang Wenwen, exchanges diplomatic notes with South Korea's ambassador to China, Jin Zhangzhu. The two sides jointly confirm that the <Free Trade Agreement between the People's Republic of China and the government of the Republic of South Korea> will take effect on December 20th, 2015. This marks a new spring for the economic development between China and South Korea. These achievements are inseparable from the interest rate policy of the two countries.

The interest rate liberalization refers to the interest rate of financial institutions in money market operating and financing, which is determined by market supply and demand. It includes interest rate decision, interest rate transmission, interest rate structure and marketization of interest rate management. In effect, it gives the decision-making power of interest rates to financial institutions. The financial institutions independently adjust the interest rate based on the financial situation and the judgment of the trend of the financial market, and finally form the basis of the central bank's benchmark interest rate. With the money market interest rate as the intermediary, the market supply and demand determine the market interest rate system and the rate formation mechanism of the deposit and loan interest rate of financial institutions.

Since July 20th, 2013, the people's bank of China has decided to fully liberalize the lending rate control of financial institutions. And up to October 24th, 2015, China has fully realized the interest rate liberalization. Meanwhile, South Korea's interest rate liberalization began in the 1980s. After

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17 years of the interest rate reform, South Korea fully realized the interest rate liberalization, nearly 10 years before that of China. Due to this, this paper tires to explore the relationship between inflation rate and nominal interest rate based on international Fisher effect and Fisher effect. We set China and South Korea as an example to analyze whether the Fisher effect is significant or not in both countries. Then, a time series of annual and monthly data, respectively, will be employed to conduct an estimation under the fully modified ordinary least squares. The findings illustrate that the Fisher effect in South Korea is more significant than that of in China. This results also matches the real situation that South Korea's commodity market and Finance market is more integrated than China's.

The rest of this study will be organized as follows. Section two is the literature review which is mainly focused on previous studies. Section three is the theoretical framework which is a base for the empirical analysis. Section four is the empirical analysis which provides theoretical evidence for this study. Section five is the conclusion which is a summary of this study.

2. Literature Review

The Fisher effect that reveals the relationship between inflation rate expectation and interest rate, is firstly discovered by the famous economist Fisher. It points out that when inflation rate expectation rises up, the interest rate will also rise up. Despite a menu of researches on the Fisher effect's validity which is based on different kinds of methods, no absolute consensus have been achieved in this regard. While there are quantities of reasons for this, the most vital ones can be classified as follows: One reason is to employ the different methods in different countries with different samples; Another reason is that it is very hard to measure the expected inflation rate. For this reason, these studies often find that the delayed rate of inflation causes the expected rate of inflation in the model. The Fisher effect holds that there is a direct relation between long-run inflation and nominal interest rates, and its work and interpretation support the differences.

Hatemi (2009) adapts a method which is based on the asset pricing to obtain the international version of Fisher effect. Namely, the international Fisher effect tests the difference between UK and U.S. in interest rate and inflation rate. He has applied the case of hetero-variance and non-normal, strong case, the case-wise bootstrap technique, which is usually the characteristic of financial data. He also took into account the structural breakthroughs in October 1987. It turns out the international fisher effect is slightly less than unity. Namely, the nominal interest rate differentials are response to changes in the inflation rate differential value is less than point by point. İncekara, Demez, and Ustaoğlu (2012) use the quarterly series data between first quarter of 1989 and fourth quarter of 2011 to verify the validity of Fisher effect for Turkish economy via Johansen cointegration and vector auto-regression method. It can be summarized that, in the long run, the Fisher effect is valid for Turkish economy. At the same time, Shalishali (2012) draws on the history of the eight selected Asian countries exchange rate and carry the data. Each of these countries is interchangeably utilized as the home country, and foreign country to trace the trail of the effect. Although the theory of comparative advantage in the application and assessment must be cautious, but the international fisher effect model in daily currency trading may not be realistic, but its value is that it can clarify expectations of relationship between interest rates, inflation and currency.

Ar (2013) investigates the Fisher effect's validity in Turkey from 1978-Q1 to 2010-Q3. For this purpose, He employs cointegration test with a structural break and time varying parameters approach that considers the system or policy changes on the influence of the relationship between interest rate and inflation rate. The empirical results indicate that the weak form of fisher's effect holds true in the Turkish economy. Benazić (2013) test the Fisher effect in Croatia using vector error correction model. The results suggest that the full Fisher effect in Croatia may de facto hold only in the long-run. El Khawaga, Esam, and Hammam (2013) examine the validity of the international Fisher effect theory for the Egyptian economy. Two case studies are investigated: Egypt vs. USA and Egypt vs. Germany during the period (2003-2012). The long-run relationship between nominal changes in exchange rate and nominal interest rate differential for each of the two case studies, is examined using autoregressive distributed lag bounds test approach to co-integration and error correction model. The short-run relationship is examined through impulse response function and variance decomposition. Besides, the Granger causality test is employed to identify the direction of the relationship. The empirical findings reveal partial significance of international Fisher effect in the case of Egyptian pound vs. US dollars, while no sign of the international Fisher effect is detected in the case of Egyptian pound vs. Euro currency. The irrelevance of international Fisher effect can be attributed to the irrelevance of Purchasing Power Parity theory in Egypt. This is in addition to Egypt's limited financial integration with international financial markets.

Everaert (2014) investigates the Fisher effect in a menu of twenty one OECD countries over the period from the year of 1983 to 2010. A standard panel test reveals the co-integration between inflation rate and nominal interest rates. The regression results are false. For non-stationary common factors, a possible explanation is that it reflects that the due time preference, risk aversion and technology change the steady-state growth rate of real interest rates of permanent change together. Next, he controls for an unobserved non-stationary common factor by using both the common correlated effects estimation methods and updated

bias correction estimators. The estimated slope coefficient on inflation is detected to be insignificantly different from one. Zainal, Nassir and Yahya (2014) try to study the effectiveness of fisher effect on Malaysian money market. The time series between 2000 to 2012 is elected as the study duration. Three variables are targeted in this paper, they are the inflation rate, 3-months treasury bills rate and interbank rate. In order to analyze this relationship, the autoregressive distributed lag boundary test is adopted in this paper, which can test the long-run relationship between variables, regardless of whether the time series is the process of I(0) or I(1). The estimation results show that there is long-run co-integration between variables. Overall, the study provides evidence that the fisher effect exists in Malaysia. Ucak, Ozturk, and Aslan (2014) test the Fisher effect for the selected four transition economies that are also new EU member states. The empirical analysis is conducted by allowing for a structural break that takes place in year 2004. In this study, a case-wise bootstrap approach empirical method which developed by Hatemi-J and Hacker (2005) is used and the results support a tax adjusted Fisher effect in the presence of a structural break. Edirisinghe, Sivarajasingham, and Nigel (2015) investigate the existence and the price confusion of the fisher effect in Sri Lanka. The results of co-integration technology and the error correction estimation show that, in the short term, there is a significant positive correlation between nominal interest rates and expected inflation, but there is no complete fisher effect.

Puci and Mansaku (2016) analyze the international Fisher effect considering United State Dollar and Chinese Yuan Renminbi for the period 2002–2014. In order to reach this objective Augmented Dickey Fuller and Phillip Peron unit root tests are performed to check for stationary. Moreover, the Engle-Granger and the Johansen co-integration techniques are performed to identify long-run relationships. Even if the international Fisher effect might not be successful to apply in daily currency transaction, its usefulness consists in its capability to illustrate the expected relation among exchange rates, interest rates and inflation. Further, this information is beneficial in searching export possibilities for countries and in assessing the price of foreign imports. Uyaebo, Bello, Omotosho, Karu, Stephen, Ogbuka, and Mimiko (2016) test for the validity of the Fisher hypothesis in Nigeria during the period 1970–2014. The Gregory and Hansen's co-integration test ensures a long-run relationship between inflation rate and nominal interest rates, albeit with a structural break in October 2005. In addition, the obtained Fisher coefficient in the cointegrating relation is 0.08, implying a weak form of Fisher effect in the long-run. On the basis of these findings, they uphold a weak Fisher effect in the long run and non-existence of Fisher effect in the short run. This implies that the short-run nominal interest rate is a good characterization of monetary policy stance. Also, the obtained partial Fisher effect indicates that changes in monetary policy are capable of altering the long-term real interest rate and influencing economic growth through the interest rate channel. They therefore recommend a more forward looking monetary policy as a way of anchoring inflationary expectations and ensuring low and stable prices in Nigeria.

Alam, Alam, and Shuvo (2017) try to find the empirical evidences of the international Fisher effect between Bangladesh and two other trading partners, China and India. The international Fisher effect applies the interest rate differentials to interpret why exchange rates change over time. Considering a time series approach to tracking the relationship between nominal interest rates and exchange rates in these countries, the estimated value, by applying ordinary least squares, is used to determine the random relationship between interest rates and exchange rates in quarterly data from 1995-Q4 to 2008-Q2. The empirical results show that the exchange rate and interest rate differences between Bangladesh and China, Bangladesh and India are weak, and the relationship between variables is not worthy of Bangladesh's attention. Moreover, these trends argue that it is unrealistic for these countries to use the assumptions of the international fisher effect to predict exchange rates. Adam and Ofori (2017) investigate the validity of the international Fisher effect in the West African Monetary Zone. The conventional Engle-Granger and fractional cointegration tests are employed on nominal exchange differentials and exchange rates change of all the countries within the West African Monetary Zone except Liberia due to lack of data. They observe cointegrating relationship in fifteen out of the twenty country pairs; indicating evidence of common stochastic drift in nominal exchange differentials and exchange rates change. However, the assumptions necessary for the validity of very weak international Fisher effect are met for only between Ghana and Cape Verde and between Ghana and Sierra Leone at five percent significance level; An evidence of lack of macroeconomic coordination. It is important to note that macroeconomic coordination is necessary condition for currency union and seen as alternative to member countries meeting the convergence criterion. These findings are seen as a setback to the common currency agenda of West African Monetary Zone because the findings signify lack of macroeconomic coordination among will be currency union countries, which is a necessary condition for conduct of monetary policy.

3. Theoretical Framework

3.1. Model

Fisher (1930) describes the nominal interest rate of the bond as the sum real interest rate and the expected price change during the term of the financial instrument in valid. More formally, the nominal interest rate gives:

$$1+i=(1+r)(1+\pi) \quad (1)$$

Where r represents the real interest rate; π represents the expected rate of inflation for financial instruments in valid. i represents the real interest rate.

Rewriting equation (1) gives:

$$1+i=1+r+\pi+\pi r \quad (2)$$

If the inflation rate is moderate, then the cross term, πr, will be quite small, which is usually ignored in the formula.

Simplified Form gives:

$$i=r+\pi \quad (3)$$

Fisher further points out that in the case of full expectations the change between nominal interest rates and expected inflation rates is one-to-one. Any change in the price of a product will be reflected in the cost of money. At this point, the currency holding cost and the product investment cost are basically equivalent. This equation can be employed to test the Fisher effect in both China and South Korea. Assuming that the Fisher effect holds in China and South Korea, the variables of China and South Korea are, respectively, represented by subscripts c and sk.

Rewriting equation (1) gives:

$$1+i_c=(1+r_c)(1+\pi_c) \quad (4)$$

$$1+i_{sk}=(1+r_{sk})(1+\pi_{sk}) \quad (5)$$

Assume that $r_c=r_{sk}$ holds, dividing equation (4) by equation (5) gives:

$$\frac{1+i_c}{1+i_{sk}}=\frac{1+\pi_c}{1+\pi_{sk}} \quad (6)$$

For simplification, the international Fisher effect formula gives:

$$i_c-i_{sk}=\alpha(\pi_c-\pi_{sk})+c \quad (7)$$

Where i_c-i_{sk} represents the nominal interest rate differential between China and South Korea. $\pi_c-\pi_{sk}$ represents the inflation rate differential between China and South Korea.

In the empirical sample analysis, equation (7) can be used to test the existence degree of the international Fisher effect between China and South Korea. If the estimated result is $\bar{\alpha}$=1, there will be a strict international Fisher effect. Namely, the real interest rates between China and South Korea are equal. If the estimated result $0<\bar{\alpha}<1$, and the parameter is significant, at this point, the inflation rate differential between China and South Korea holds for the nominal interest rate differential. Therefore, there is a weaker international Fisher effect. If the estimated result $\bar{\alpha}$>1, and the parameter is significant, at this point, the inflation rate differential between China and South Korea holds for the nominal interest rate differential. Therefore, there is a stronger international Fisher effect. This is the standard for testing international Fisher effect.

3.2. Variable Description

In this paper, the long-run and short-run fisher effect of China and the long-run and short-run international Fisher effect between China and the South Korea will be examined. The long-run datum are the annual data from 2000 to 2017. The short-run datum are monthly data from 2000 to June 2017. The nominal interest rate adopts the loan interest rate of financial institutions, and the expected inflation data is difficult to collect the complete time series. Therefore, the consumer price index will be adopted as the usual practice. The datum are all collected from OECD. Their sources and definitions will be shown in <Table 1>.

<Table 1> Definition and Source

Variable	Definition	Source
i_c	Real interest rate of China	OECD
i_{sk}	Real interest rate of South Korea	OECD
π_c	Inflation rate of China will be represented by consumer price index	OECD
π_{sk}	Inflation rate of South Korea will be represented by consumer price index	OECD
i_c-i_{sk}	Real interest rate differential Between China and South Korea	OECD
π_c - π_{sk}	Inflation rate differential Between China and South Korea	OECD

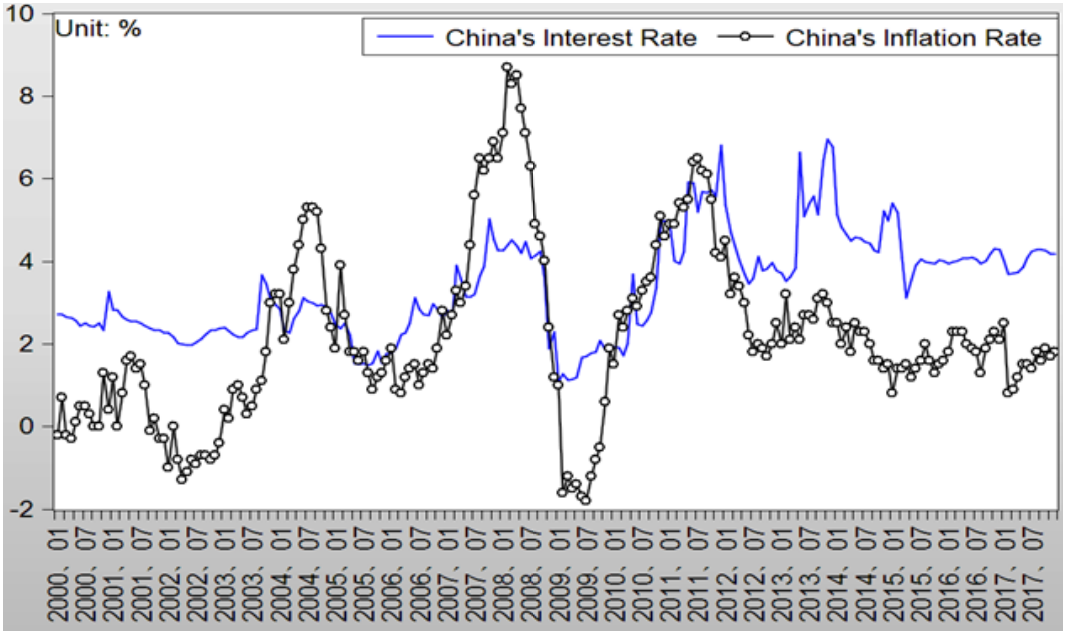
Note: Organization for Economic Co-operation and Development.

3.3. Figure Description

The purpose of drawing the figures of all variables is that we can extrapolate their changing regulation and property via their figures. All of them will be shown in <Figure 1>, <Figure 2>, <Figure 3>, and <Figure 4>.

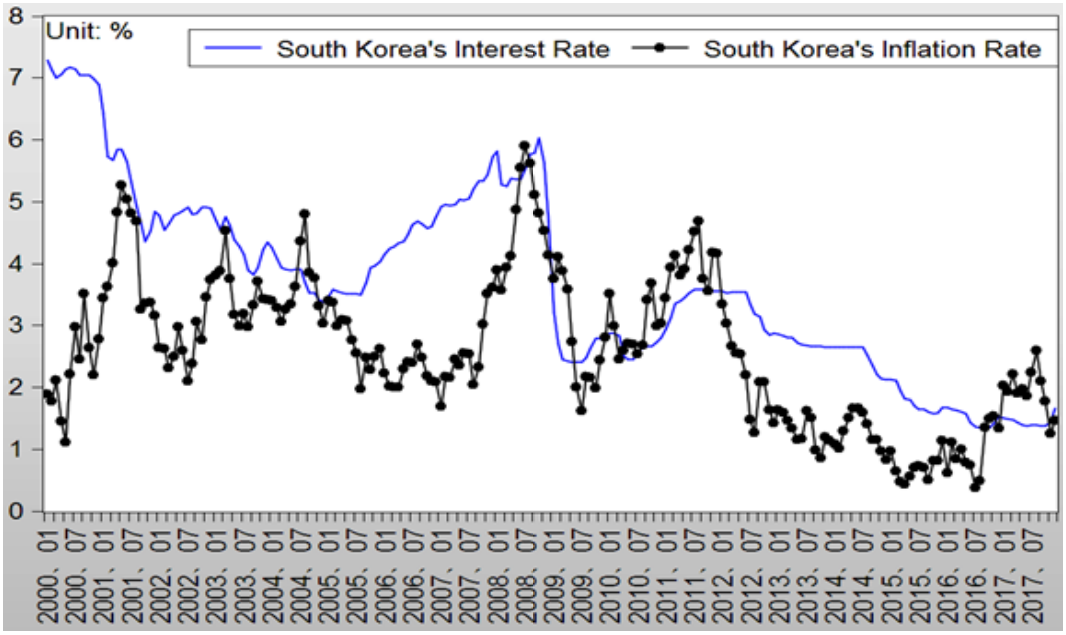
<Figure 1> exhibits that the China's interest rate and the China's inflation rate probably move in the same direction in the short run. But compared the China's inflation rate, the China's interest rate runs relatively steady. As a matter of fact, both of them have a common point is that there is a fierce decrease from the first month of 2008 to the seventh month of 2009. Then, both of them start to increase intensively until the seventh month of 2011. These drastic fluctuations owe to the global economic crisis in 2008. Meanwhile, <Figure 1> described matches the Fisher effect.

<Figure 2> reports the changes of the South Korea's interest rate and the South Korea's inflation rate in the short run.



Note: Organization for Economic Co-operation and Development.

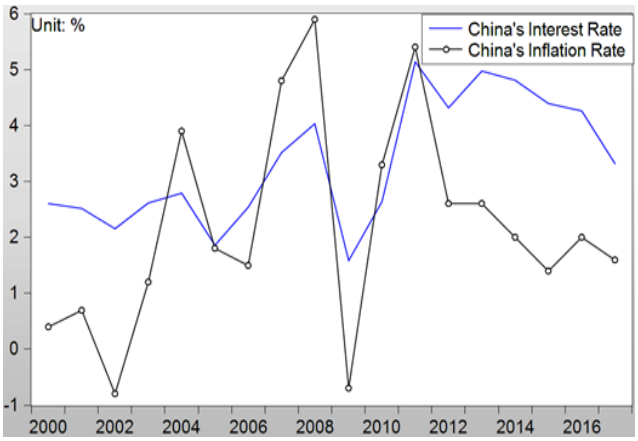
<Figure 1> Change of China's Interest Rate and China's Inflation Rate (Short-run)



Note: Organization for Economic Co-operation and Development.

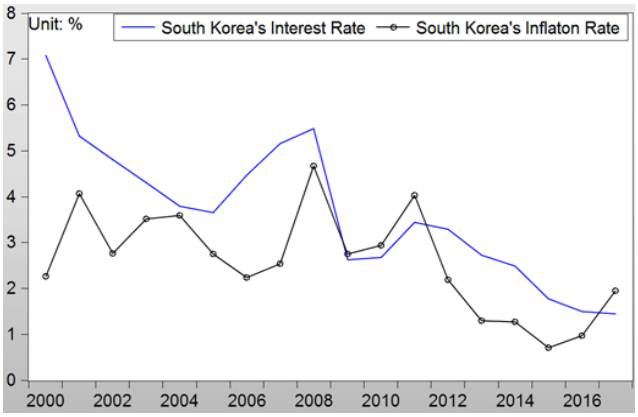
<Figure 2> Change of South Korea's Interest Rate and South Korea's Inflation Rate (Short-run)

<Figure 2> shows the changes of the South Korea's interest rate and the South Korea's inflation rate. It can concluded that the South Korea's inflation rate goes relatively. Both of them also have a down-up fluctuation due to the global economic crisis. However, compared with that of China's, the South Korea's interest rate and the South Korea's inflation rate fluctuates relatively smaller. Generally speaking, <Figure 2> described also is in keeping with the Fisher effect. Then, the long-run changes of interest rate and inflation rate between China and South Korea show in <Figure 3> and <Figure 4>.



Note: Organization for Economic Co-operation and Development.

<Figure 3> Change of China's Interest Rate and China's Inflation Rate (Long-run)



Note: Organization for Economic Co-operation and Development.

<Figure 4> Change of South Korea's Interest Rate and South Korea's Inflation Rate (Long-run)

In general, the trend of <Figure 3> and <Figure 4> is approximately the same as <Figure 1> and <Figure 2> reported. Therefore, it can be concluded that, in the long run, the interest rate and the inflation rate between China and South Korea also accord with the Fisher effect.

4. Empirical Analysis

4.1. Unit Root Test

The purpose of the unit root test is to verify the stationarity of a time series variable. The null hypothesis is usually defined as the existence of a unit root, while the other is based on the stability, trend stability or explosive root of the test used. The reason for the need of the unit root test is that the stationarity or other properties of a series strongly influence its behavior and properties. And if the variables are trending over time, on the other, a regression maybe have a high R^2 even if the two are totally unrelated(Spurious regressions). In order to avoid this problem mentioned above, the Augmented Dickey–Fuller test(ADF) will be employed in this paper. The results will be shown in <Table 2> and <Table 3>.

<Table 2> Results of Unit Root Test (long run)

Variable	t-Statistic	5% Test critical value	Prob.*
π_c^l	-1.551	-3.760	0.763
π_{sk}^l	-2.260	-3.052	0.195
$(\pi_c - \pi_{sk})^l$	-2.223	-3.081	0.207
i_c^l	-2.120	-3.052	0.240
i_{sk}^l	-2.073	-3.052	0.256
$(i_c - i_{sk})^l$	-1.772	-3.052	0.380
$\Delta\pi_c^l$	-7.039	-3.081	0.000
$\Delta\pi_{sk}^l$	-4.170	-3.081	0.007
$\Delta(\pi_c - \pi_{sk})^l$	-5.977	-3.081	0.000
Δi_c^l	-4.647	-3.081	0.003
Δi_{sk}^l	-3.699	-3.081	0.016
$\Delta(i_c - i_{sk})^l$	-4.421	-3.066	0.004

Note: Δ represents the first difference operator.

<Table 2> reports that results of unit root test in the long run. The null hypothesis that the sequence exists unit root is non-rejected for each variable at its own level. Namely, all variables are non-stationary at their own levels. However, when processed the first difference, the null hypothesis that the sequence exists one unit is rejected for each variable at 5% level. In other word, all variables become stationary.

<Table 3> Results of Unit Root Test (short run)

Variable	t-Statistic	5% Test critical value	Prob.*
π_c^s	-2.755	-2.876	0.067
π_{sk}^s	-1.462	-2.876	0.551
$(\pi_c - \pi_{sk})^s$	-2.379	-2.876	0.149
i_c^s	-0.803	-1.942	0.367
i_{sk}^s	-2.005	-2.875	0.284
$(i_c - i_{sk})^s$	-1.969	-2.875	0.300
$\Delta\pi_c^s$	-6.295	-2.876	0.000
$\Delta\pi_{sk}^s$	-6.031	-2.876	0.000
$\Delta(\pi_c - \pi_{sk})^s$	-5.786	-2.876	0.000
Δi_c^s	-15.984	-2.875	0.000
Δi_{sk}^s	-8.727	-2.875	0.000
$\Delta(i_c - i_{sk})^s$	-15.323	-2.875	0.000

Note: Δ represents the first difference operator.

<Table 3> reports that results of unit root test in the short run. The null hypothesis that the sequence exists unit root is non-rejected for each variable at its own level. Namely, all variables are non-stationary at their own levels.

However, when processed the first difference, the null hypothesis that the sequence exists one unit is rejected for each variable at 5% level. In other word, all variables become stationary.

4.2. Long-run Fisher Effect

The long-run steady relationship of time series data can be represented as cointegration relationship. In general, the Engle-Granger two-step method and Johansen cointegration are often used to exploit the long-run relationship while both of them exist defects, respectively. Specifically, the Engle-Granger two-step method has the inherent deviation with an ordinary least square in a small sample. The Johansen cointegration not only does not fit in a small sample, but also it is sensitive to the lag order.

As for the small sample estimation, Hansen presents the fully modified ordinary least squares to effectively work out the small sample cointegration. Its major idea is that it can process the non-parametric modification to the ordinary least squares estimation. And it also can eliminate the parametric noise that can affect the asymptotic distribution of estimator. The long-run results of fully modified ordinary least squares show in <Table 4>, <Table 5> and <Table 6>.

<Table 4> Regression Results of South Korea's Long-run Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
π_{sk}^{l}	0.772	0.286	2.698	0.016
c	1.673	0.802	2.087	0.043
$R^2 = 0.853$		$Adjusted - R^2 = 0.795$		$D.W. = 2.074$

<Table 4> shows that the fisher effect is relatively significant in South Korea. Namely, South Korea's inflation rate can reflect change of nominal interest rate well. Concretely, 1% increase in the inflation rate will lead to 0.772% increase in the nominal interest. $R^2 = 0.853$ indicates that π_c^l has a good explanation to i_c^l. Meanwhile, $D.W. = 2.074$ also displays that the auto-regression does not exist. This result demonstrates that South Korea's macroeconomic regulators have a more precise to forecast the change of inflation rate.

<Table 5> shows the fisher effect in China in the long run.

<Table 5> Regression Results of China's Long-run Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
π_c^l	0.328	0.123	2.953	0.017
c	2.616	0.354	7.393	0.000
$R^2 = 0.831$		$Adjusted - R^2 = 0.805$		$D.W. = 2$

<Table 5> shows that the fisher effect is very little significant in China in the long run. Specifically speaking, 1% increase in the inflation rate will lead to 0.328% increase in the nominal interest in China. rate. $R^2 = 0.831$ indicates that π_c^l has a good explanation to i_c^l. Meanwhile, $D.W. = 2.143$ also displays that the auto-regression does not exist. The reason why the fisher effect is very weaker in China maybe contain the real interest rate fluctuation, the government intervention and failure of interest rate market mechanism operating. additionally, the inflation rate is represented by the consumer price index. If both of them are not equal, which may also lead to a derivation.

<Table 6> shows the international Fisher effect between China and South Korea.

<Table 6> Regression Results of Long-run International Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$(\pi_c - \pi_{sk})^l$	0.729	0.240	3.033	0.008
c	-0.520	0.044	-11.951	0.014
$R^2 = 0.891$		$Adjusted - R^2 = 0.847$		$D.W. = 2.641$

<Table 6> shows that there is a relative strong international fisher effect between China and South Korea. However, it's little lower than South Korea's fisher effect and much higher than China's. More concretely, 1% increase in $(\pi_c - \pi_{sk})^l$ will lead to 0.729% increase in $(i_c - i_{sk})^l$. $R^2 = 0.891$ indicates that $(\pi_c - \pi_{sk})^l$ has a good explanation to $(i_c - i_{sk})^l$. Mean while, $D.W. = 2.641$ also displays that the auto-regression does not exist. The result also shows that China's market integration is lower than that of South Korea. The major reason is that the real interest rate between China and South Korea is not equal. As the arbitrage between the two countries is more frequent, this gap will be narrowed.

4.3. Short-run Fisher Effect

As for the short-run Fisher effect, the monthly data from China and South Korea will be employed to conduct an estimation. The fully modified ordinary squares will still be used to analyze the relationship between nominal interest rate and inflation rate. The short-run Fisher effect show in <Table 7>, <Table 8>, <Table 9>, and <Table 10> between China and South Korea.

<Table 7> Regression Results of China's Short-run Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
π_c^s	0.125	0.034	3.676	0.000
c	2.647	0.103	25.690	0.000
$R^2 = 0.825$		$Adjusted - R^2 = 0.814$		$D.W. = 2.247$

<Table 7> indicates that short-run fisher effect is much weaker in China. Specifically, 1% increase in i_c^s will result in 0.125% increase in π_c^s. Meanwhile, this point also manifests

that China's government may intervene too boldly to China's interest rate market.

<Table 8> Regression Results of China's Short-run Fisher Effect with a Cycle

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\pi_c^s(-3)$	0.309	0.035	8.864	0.000
c	2.689	0.106	25.356	0.000
$R^2 = 0.867$		$Adjusted - R^2 = 0.839$		$D.W. = 2.165$

Due to that inflation rate has hysteresis effect, each lag order of inflation rate will be applied to conduct an estimation. The estimated results show that the coefficient of lag three is approximately to the long-run fisher effect which is shown in <Table 5>. Namely, one cycle that the change of nominal interest rate to adjust the inflation rate in China is about a quarter.

<Table 9> Regression Results of South Korea's Short-run Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
π_{sk}^s	0.664	0.074	8.961	0.000
c	1.951	0.211	9.253	0.000
$R^2 = 0.827$		$Adjusted - R^2 = 0.822$		$D.W. = 2.054$

<Table 9> exhibits that the short-run Fisher effect is a little weaker than the long-run fisher effect in South Korea. Concretely speaking, 1% increase in i_{sk}^s will result in 0.664% increase in π_{sk}^s in South Korea. However, compared with China's interest rate market, South Korea's interest rate marketization is deeper.

<Table 10> Regression Results of South Korea's Short-run Fisher Effect with a Cycle

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\pi_c^s(-6)$	0.309	0.035	8.864	0.000
c	2.689	0.106	25.356	0.000
$R^2 = 0.867$		$Adjusted - R^2 = 0.839$		$D.W. = 2.165$

<Table 10> depicts that the long-run Fisher effect is quite closed to the long-run Fisher effect. each lag order of inflation rate in South Korea will be applied to conduct an estimation. The estimated results show that the coefficient of lag six is approximately to the long-run Fisher effect which is shown in <Table 4>. Namely, one cycle that the change of nominal interest rate to adjust the inflation rate in South Korea is almost two quarters. In other word, the South Korea's nominal interest rate and inflation rate are more stable than that of China's. Meanwhile, Compared the Fisher effect in China, it is obvious that the Fisher effect in South Korea is more significant.

<Table 11> Regression Results of Short-run International Fisher Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$(\pi_c - \pi_{sk})^s$	0.625	0.063	9.951	0.000
c	-0.641	0.130	-4.965	0.000
$R^2 = 0.832$		$Adjusted - R^2 = 0.813$		$D.W. = 2.128$

<Table 11> shows the short-run international Fisher effect between China and South Korea is less significant than that of long-run. As the estimated result displays, 1% increase in $(\pi_c - \pi_{sk})^s$ will lead to 0.625% increase in $(i_c - i_{sk})^s$. The coefficient of $(\pi_c - \pi_{sk})^s$ is deviated from 1. The reason that may lead to this result is that China still has a strict capital controls, especially in the short-run capital flow. However, it is this arbitrage behavior that can promote the commodity market and the financial market integrated between China and South Korea.

5. Conclusion

This paper tries to investigate whether the Fisher effect and the international Fisher effect is significant or not between China and South Korea in terms of long run and short run. the annual and monthly data will be employed to perform an empirical estimation under the fully modified ordinary least squares. The estimated results exhibit whenever in the long run or short run, the Fisher effect exists in China and South Korea. However, the Fisher effect in South Korea is more significant than that of in China. The long-run and short-run international Fisher effect between China and South Korea are also deviate from one. It means that the commodity market and the Financial market have started to integrate. But their integrated level is relatively lower.

Through the empirical estimation, it can be predicted that China's interest rate liberalization is major reason that leads to a weak international Fisher effect between China and South Korea. The micro-subject market is the state-owned enterprises which are not sensitive to the interest rate policy. Therefore, the interest rate policy will be short of efficient transmission mechanism and reaction mechanism, which will result in that interest rate has a weak ability to predict the change of price level. Strictly speaking, China's nominal interest rate is still located in controlled periods. Usually, the interest rate policy is implemented via the administrative behavior. This action does not match the market economy development, which leads to that China's Fisher effect is weaker than South Korea's.

As matter of fact, quantities of scholars have studied the Fisher effect and the international Fisher effect by using different kinds of approaches with different samples. For example, Shilishali (2012) set China, India, Japan, South Korea, South Korea, Malaysia, Thailand, Vietnam and

Indonesia as an example, respectively. He only applies the annual data to verify the validity of international Fisher effect country by country. Due to the great fluctuation of interest rate, exchange rate and inflation rate from year to year, this point results in that the international Fisher effect cannot fit in every country selected. In order to avoid this limitation, this paper not only sets the annual data as a sample but also sets the monthly data as a sample. Then, the two samples will be analyzed one by one by using the fully modified ordinary least squares. According to two empirical analyses, we can conduct a comparison so as to distinguish whether the Fisher effect and the international Fisher effect hold or not. Of Course, this is a biggest innovation in this paper when compared with other achievements.

In summary, the empirical analyses in this paper show that the South Korea's Fisher effect is more significant than that of China's. This results also certifies that the South Korea's marketization of the economy is higher than that of China's. In fact, this result supports the economic reality between China and South Korea. Meanwhile, China's government should spare no effect to proceed the interest rate marketization more completely. Simultaneously, China's government still needs to reduce intervention in exchange rates.

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