

The Correlation of Interest Rate Differential and Exchange Rate over Capital Inflow on Stock

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Abstract

Recently, a question arises how interest rate differential affects the exchange rate over the capital inflow on stock and vice versa. As a matter of fact, the Korean policy interest rate has been higher than that of the United States. while the United States interest rate is, sometimes, higher than that of Korea. Especially, in these days. the United States policy interest rate has been lowered down due to the subprime mortgage problems and the interest rate differential has been widened. Consequently, a serious concern about its effect on the Won/Dollar exchange rate has been arisen in the 4th quarter of 2008.

In this respect, this paper would like to find out the empirical correlation study of interest rate differential and exchange rate between the United States and Korea in Chapter I, and study the theoretical and precedent research works in Chapter II, International Comprison of Interest Differential and Exchange Rate in Chapter III, Correlation of Interest Differential and exchange Rate in Chapter IV, Correlation of BIS Capital Adequacy Ratio, Stock Index, and Exchange Rate: International Comparison in Chapter V, Concluding Remarks: Toward Optimal Exchange Monitoring System in Chapter VI.

Key Words: Interest Rate Differential, Correlation, Uncovered Interest Parity, Keyens.

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I . Empirical Study of Interest Differential and Exchange Rate

1. Interest Differential between the United States and Korea

First of all, we would like to see the interest differential between the United States and Korea during the period of 2000-2007. The periods that the United States interest were higher than Korea, were observed (1) during the period of January, 2000-March, 2000, with the average differential of -1,1%p, (2) during the period of August, 2005-September, 2007, with the average differential of -0.64. The maximum interest differential was 1.5%p.

On the contrary, the periods that Korean interest rate were higher than the United States were seen (1) during the period of April, 2001-December, 2007, with the average differential of 2,09%p, (2) during the period of September-December, 2007, with the average differential of 0.45%p.

2. Trends of Won/Dollar Exchange Rate

The trends of Won/Dollar exchange rate was somewhat stable

at the first part of 2000, but from September 4, 2000, it showed 1,104 Won to \$1 and continuously went up until to hit 1,364 Won to 1\$ on April 4, 2001. After that day, Won/Dollar rate was stable for a year or so. From April 12, 2002, 1,332 Won to \$1 rate went down to 1,165 Won to \$1 on July 22, 2002 due to the U.S. current account deficit and accounting scandals. Since then, about 26 months period, the exchange rate was stable until October 6, 2004. But, from October 6, 2004, 1,165 Won to \$1 exchange rate went down to 900 Won to \$1, the lowest rate in 2000s.

Won was depreciated by 12.4% in average during 2001. Except that year, Won was appreciated 3-5% every year until 2004. Won was continuously appreciated 11.7% in 2005 and 7.2% in 2006 because of weak dollar trends and Korea's favorable export propensity.

But at the end of December, 2007, Won was forced be depreciated due to the U.S.-oriented subprime mortgage problem and global uneasy financial and economic situation.

3. Trends of Interest Differential and Exchange Rate

If we study the trends of interest differential and exchange

rate at the same time, we can find the fact that those two variables moved almost same pattern.

In another words, when the afore-mentioned differential became wider, then, the Won/Dollar exchange rate went upward movement. On the contrary, the said differential became narrower, then, the Won/Dollar exchange rate went downward movement.

However, such three periods as (1) October, 2000-January, 2001, (2) April, 2002-July, 2002, (3) October, 2006-October, 2007, were revealed that the two variables, e.g. interest differential and exchange rate did not moved same pattern.

II . Theoretical and Precedent Studies

1. Theoretical and Oversea's Precedent Studies

The most of theories indicate that the wider interest differentials will bring lower exchange rate, i.e. appreciation of currency. There are many theories, namely balance of payment approach, monetary approach, and portfolio approach, etc. In general, when domestic interest goes up(or oversea's interest goes down), the interest differential will become widen, then,

the capital inflow will increase for investing into domestic bonds and the exchange rate will be down (i.e. appreciation of domestic currency). We should be careful that these theories are imagine the domestic bonds investment, not the stock equities. In Korea, it is noteworthy that the majority of feigners' investment were implemented on stocks, not on bonds.

Meese and Rogoff(1988), Rose(2006) recent exchange models are incomplete to explain the movements of exchange transactions, especially because of the difficulties to find out causes and results between exchange rate and economic fundamentals. Keyens explicitly explained that the investors usually take into consideration upon not only interest and exchange rate but also credit risk, capital flow restriction, and taxation system. This is natural that the verification of hypothesis often gets out of the expected boundary and recently the conditions of Uncovered Interest Parity or Covered Interest Parity increased to take into consideration upon the institutional characters of the research-object countries.

Particularly, since in the case of emerging countries, the weight average of overseas' bond investment is far less than that of stock, it seems to be difficult to induce the prevailing

developed countries' theory into the emerging countries at once. In addition to that fact, the effect of in- and -out flow of capital for stock investment due to stock price differential is getting greater than bond investment capital flow due to interest rate differential in the process of global stock market integration (Hau and Rey, 2003).

If we look the interest differential from the view point of capital movement, there are three ways: (1) stock investment, (2) bond investment, (3) overseas borrowing. First, on the stock investment channel, Korea's policy interest upward movement(or U.S. policy interest downward movement) will cause the interest rate differential wider and the expected return of domestic investors will fall down and consequently domestic stock investment capital will outflow to overseas resulting exchange rate upward movement.

Second, from bond investment point of view, in the above case, the expected rate of return on the bond investment will rise and inflow of bond investment capital will increase, resulting exchange rate downward movement.

Third, on the overseas borrowing case, like bond investment case, domestic expected return of domestic investors will

increase and will result exchange rate downward movement.

2. Domestic Precedent Research Works

Before 1997 IMF Foreign Exchange Crisis, Seung Ho Lee(1997), Myungi Kim, Sosang Moon(1998) insisted that the domestic interest upward movement will cause the downward movement of exchange rate. However, after 1997 and 1998, the overseas stock investment into domestic stock market increased to the great extent, and Jung Geun Oh (2000) wrote that the above theory is only correct in case when we assume the case of bond movement, but if we assume stock investment also take into consideration in the capital movement, the exchange rate will even going upward movement. More precisely, Tae Jun Kim, Jae Won Yoo(2001) insisted that the previous theory is very weak to explain the interest differential and exchange rate because it footed on the bond market capital movement which is somewhat premature in Korean security market at that time. They further insisted that greater interest differential revealed after IMF era because the interest upward movement affects the negative impact upon domestic stock market and the foreign investors made capital flight, resulting exchange rate further

upward movement.

Ki Sung Lee, Jae Won Yoo(2006) insisted that domestic interest upward movement affects the downward movement of stock earnings per share and the decrease of the overseas investors' demand of domestic stock so as to raise up exchange rate to the end.

III. International Comparison of Interest Differential and Exchange Rate

1. Bond-weighted Countries v. Stock-weighted Countries

Such bond-weighted countries as Canada, Australia, New Zealand, Sweden, Norway, Poland, United Kingdom, and Chile extended the results of + correlation between the interest differentials and exchange rate. In another words, widening of interest differential, i.e. domestic interest up(or the U.S. interest down), affects the exchange rate shows down ward movement.

On the contrary, such stock-weighted countries as Korea, South Africa, and Israel extended negative(-) results(exchange rate down or no correlation at all).

2. Country Credit Rating

Such high country credit countries as Norway, Sweden, United Kingdom, Canada, Australia and New Zealand extended the results of + correlation between interest differential and exchange rate., while such low country credit countries as Korea, Mexico, South Africa, Israel, Brazil, and Philippine extended negative(-) results or no correlation.

3. Low Price Rising Countries v. High Price Rising Countries

Such low price rising countries as Sweden, Norway, Canada, Australia, Poland, United Kingdom, New Zealand, and Chile revealed positive(+) correlation between the interest differential and exchange rate.

On the contrary, such high price rising countries as Mexico, Iceland, South Africa, Brazil, and Philippine showed negative(-) correlation between the interest differential and exchange rate.

IV. Correlation of Interest Differential and Exchange Rate

1. Analysis Methodology and Data

In order to find out the correlation of capital movement and interest differential, cross correlation analysis and Granger causality analysis were utilized.

The time series data is used from 2002 to November, 2007, because Korea repaid all the borrowings from IMF on August 23, 2002 and wiping out some noise stemmed from IMF crisis. It is true that the country credit risk rating was more overweighted for the capital movement than the interest differential during IMF crisis era.

2. Interest Differential and Capital Movement

1) Interest Differential and Stock Investment

As a result of cross correlation and Granger causality analysis, stock investment net capital inflow and nominal interest rate differential has a negative(-) correlation effect, especially after 2004. It meant that the wider spread of interest differential forced the net capital outflow of stock investment fund while

the narrower gap of interest differential arises the net inflow of stock investment fund.

2) Interest Differential and Bond Investment

Both short and long nominal interest differential and bond investment capital movement has a positive(+) correlation effect, particularly after 2004 due to afore-mentioned reasons. In details, the wider spread of interest differential made the net inflow of bond investment fund. On the contrary, the narrower margin of interest differential decreases the net inflow of bond investment fund.

3) Interest Differential and Overseas' Borrowing

Net overseas borrowing has no or little correlation effect with both short and long nominal interest differential.

As a result of correlation analysis of interest differential and exchange rate, the nominal long interest rate differential showed negative(-) correlation effect. But the nominal short interest rate differential has no or little correlation with exchange rate. It is noteworthy, however, that the short nominal interest differential has negative(-) effect on exchange rate and the exchange rate movement was usually ahead of short-term nominal interest differential.

V. Correlation of BIS Capital Adequacy Ratio, Stock Index, and Exchange Rate: International Comparison

Author examined regression equation upon (1) current account, (2) interest rate differentials, (3) inflation or price level differentials by purchasing power parity not only Korea but also Taiwan, Hong Kong, Singapore, Malaysia, Indonesia, and Philippines.

It was found that the change of current account had generated the demand of each currency. As to the interest differentials, the fund moved from lower interest rate countries to higher interest countries in general. If there were price level differentials between country A and country B, the currency of the relatively high price level country was forced to be devalued.

One of the most important item was 8% of capital adequacy ratio of BIS (Bank International Settlement) for commercial banks. Some comparison survey was made between Japanese commercial banks in the most seriously affected year of 1992 and Korean commercial banks before and after IMF crisis in 1990-1998.

First study was made the correlation among BIS 8% capital

adequacy ratio, stock price (Nikkei Average Index), and foreign exchange rate for Japanese commercial banks according to scenario method. The conclusion of the study was as follows: If Nikkei Average Stock price drops 1,000 Yen, BIS capital adequacy ratio will go down 0.22%. If Japanese Yen gets 5 Yen stronger to US \$1, BIS ratio will go up 0.13%. On the contrary, Japanese Yen gets 5 Yen weaker to US \$1, BIS ratio will go down 0.13%. Thus, to keep BIS ratio high, then, Japan should take a policy to boost the stock price and to make stronger Yen. This lesson should be taken in the mind of recent Korean Monetary and Foreign Exchange Authorities to manipulate BIS Capital Adequacy ratio, interest rate, stock price, and foreign exchange rate.*

Due to the limited data available, author studied Korean commercial banks performance of BIS ratio for 8 years starting from 1990. The results turned out that the Korean Won to US dollar rate had 0.31 correlation to BIS ratio and Korean Stock Price Index (KOSPI) had 0.48 correlation coefficient, respectively.

KOSPI is weighted average index not like Japanese Nikkei Average. In any case, there were strong meaningful correlation

*Note: J.W.Lee, Global Finance, Dasarang, 2004, pp. 66-67.

between Japanese and Korean banking, stock and foreign exchange rate. Comparison of financial supervision system between Japan and Korea revealed some similarity. The difference could be seen rather in philosophy or object of Japanese financial supervising restructuring than the mechanism. The object of Japanese financial reform could be summarised in three catch phrases: Free, Fair, and Global. It stressed the roots on the international competitiveness more in security, investment, and insurance industries than proper banking industry.

On the other hand, the objectives of Korean financial reform were the strengthening competitiveness, convenience of clients, the creditworthiness of financial institutions. It, therefore, stresses the unity of command and financial supervision, the authority of entry and outgoing of financial institutions by Ministry of Finance and Economy, at that time. Korean financial reform bill was enacted in back 1997, but due to the IMF system imposed on December 3, 1997, and to the transition of Presidential Election on December 18, 1997, it was passed National Assembly early in 1998.*

*Note: Ditto, pp. 67-68.

VI. Concluding Remarks: Toward an Optimal Exchange Rate Monitoring System

1. Brief History of Korea's Foreign Exchange System

In general, exchange rate system can be classified into two major categories: the fixed exchange rate system and the floating exchange rate system. After the World War II, the International Monetary Fund was established at Bretton Woods, and the fixed exchange rate system was introduced by establishing 'Par Value System'. As a reserve key currency, US dollar is set such that 35 US dollars are equal to one troy ounce of pure gold.

After the liberalization in 1945, the Republic of Korea also adopted the 'fixed exchange system'. Then, a nominal floating rate exchange rate system was introduced in 1964, which actually was a de facto fixed exchange rate system. In 1980, Korea adopted a 'multi-currency baskets pegged floating exchange rate system', following IMF which shifted from Bretton Woods system to Kingston floating exchange rate system in 1976. Korea successfully became IMF Article 8th and GATT Article 11th country right after Seoul Olympic. In 1990, Korea adopted

'market average weighted exchange rate system' under the pressures from the United States and the other OECD countries, which criticised Korea for maintaining an artificial floating exchange rate system and dumping export. Under this new exchange rate system, after opening up of Korean capital market in 1992, an enormous amount of current account deficit amounted to about U.S. \$23 billion and total external debt reached to U.S. \$110 billion. Therefore, at that time, author raised a fundamental question whether the 'market average weighted exchange rate, system was optimal system to cope with the most challenging foreign debt servicing problem. At present global financial and economic crisis, author would like to design a creative methodology to bench mark a effective monitoring and feed back system. Following a several ideas would be recommended to the foreign exchange and monetary authorities.*

2. Target Zone Rate System

In 1985, 'Target Zone Rate' system was proposed, for the first time, by French Delegation at Bonn Summit Meeting as a Reformation of Bretton Woods IMF system. The idea was to set

*Note: J.W.Lee, Textbook of Global FX and Finance, Dasarang, pp. 320-322.

a band in which intervene U.S, Dollar, EURO, Japanese Yen, etc. to maintain a stability of international monetary system. Although French government was trying to propose this idea of 'Target Zone Rate' system to General Assembly of International Monetary Fund, it was rejected by the majority vote holder, the United States of America. Instead, the U.S. initiated the restructuring the international trade system, a coin's the other side, such as Uruguay Round, NAFTA and WTO. Finally, Dr. Bergstein, Director of American International Economics Research Institute, agreed to the idea of the 'Target Zone Rate'. But it was only superficially consented and in reality, no or little proceeding was made so far. We shall see the future proceedings carefully since Wall Street oriented financial and economic crisis going on.

3. Reference Zone Rate System

Upon the consideration of foreseen difficulties for 'Target Zone Rate' system, the 'Reference Zone Rate' system was proposed not to keep clear-cut strict target zone of exchange rate but to observe the rough reference exchange rate zone. This system aims for the government of 'Reference Zone Rate'

to recover the confidence of stabilizing the exchange rate and to avoid exchange rate speculation. In the bygone days, it was quite meaningful that the Bank of Korea intervene the forward foreign exchange market and recovered 860 Won to \$1 in February, 1997.

Although the 'Reference Zone Rate' is not to keep that zone strictly, the monetary and foreign exchange authorities should make a public announcement of the 'Reference Zone Rate' at the beginning of the year head to keep aside the exchange speculation before hand. Looking back upon Korean situation, this 'Reference Zone Rate' system is more feasible idea to stabilize foreign exchange rate together with following monitoring system of 'New Multi-Currency Basket Floating Exchange Rate System' as an ex-post facto feed-back mechanism.

4. New Multi-Currency Basket Floating Exchange Rate System as a ex-post facto feed-back mechanism

Under the present 'Free Market Foreign Exchange Rate' system, Korean Won has once been over 1,500 Won to \$1 during the early 4th quarter, 2008, not stabilized until The Bank of Korea and the U.S. Federal Reserve announced \$30 billion

central bank swap facility on October 30, 2008(Korean Time). The Federal Reserve further mentioned that this facilities, like those already established with other central banks, designed to help improve liquidity conditions in global financial markets and to mitigate the spread of difficulties in obtaining U.S. dollar funding in fundamentally sound and well managed economies. It further stated that the Bank of Korea will have access to U.S. dollar funds up to \$30 billion an exchange for Korean Won through the reciprocal currency arrangement with Federal Reserve and this awap facility will expires on April 30. 2009.*

Looking back upon this event, it is recommended that prompt feed-back system is urgently necessitated monitoring foreign exchange market to accomplish optimal foreign exchange rate for continuous stability. One of the designing such an idea can be expressed in a simple equation as follows:

$$EX = a \times \text{trade weighted basket} + b \times \text{invisible trade}$$

*On Feb. 3, 2009, U.S. Fed renewed the \$30 billion central bank swap from end-April, 2009 to end-October, 2009. Consequently, the exchange rate down and KOSPI rebounded.

In addition, the Bank of Japan offered \$20 billion central bank swap and also Peoples' Bank of China offered 180 billion Yuan(equivalent to 38 trillion won) central bank swap with maturity of 3 years.

weighted basket + c x long-term capital trade basket
+ d x short-term capital trade basket

where $a + b + c + d = 1$ and the trade weighted basket,
invisible trade weighted basket, long and short term
capital trade basket will be calculated in 10 major
countries' currencies.

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Table 1. Foreigner' Ownership of Stock and Bond Ratio
Trends (in billion won, %)

	2002	2003	2004	2005	2006	2007
Stock Holding:						
Amount	97.1	147.9	178.0	269.8	273.1	325.4
Holding %	32.8	37.7	40.1	37.2	35.2	30.9
Bond Holding:						
Amount	0.6	1.8	3.2	3.2	4.6	37.0
Holding %	0.1	0.3	0.5	0.5	0.6	4.5

*Source: The Bank of Korea, Monthly Bulletin, ISSN 1975-4906

**Note: KOSDAQ market included.

Table 2. Cross-Correlation and Granger Causality of Interest Rate Differential and Stock Investment

	Jan.,2002–Nov.,2007				Jan.,2004–Nov., 2007			
Cross- correlation Coefficient	-3mon	-2mon	-1mon	D-m	-3mon	-2mon	-1mon	D-m
Long-term Nominal Interest Change	-0.02	-0.09	-0.13	-0.34	-0.07	-0.14	-0.18	-0.42
Short-term Nominal Interest Change	-0.10	-0.10	-0.30	-0.32	-0.27	-0.27	-0.54	-0.57
Granger Causality	Time Lag (Mons)							
	1mon	2mon	3mon	4-m	1mon	2mon	3mon	4-m
Long-term Nominal Interest Differentials to Stock Investment	0.09	0.92	0.60	0.95	0.08	0.85	0.69	0.94
Short-term Nominal Interest Differentials to Stock Investment	2.75	1.01	0.31	0.35	5.45	2.28	0.75	0.58

*Source: Ditto.

**Note: Cross-correlation coefficient of domestic /overseas' interest differentials and investment capital movement at 'k' time lag.

Table 3. Cross–Correlation Coefficient and Granger Causality of Foreign Exchange Rate and Capital Movement

	Jan.,2002–Nov.,2007				Jan.,2004–Nov., 2007			
	-3mon	-2mon	-1mon	D-m	-3mon	-2mon	-1mon	D-m
Cross- correlation Coefficient Capital Movement	-0.15	-0.13	-0.08	-0.38	-0.06	-0.10	-0.13	0.50
	<i>Time Lag(Month)</i>				<i>Time Lag(Month)</i>			
	1	2	3	4	1	2	3	4
Granger Causality: 1. FX/Capital Movement	1.18	1.01	0.59	0.70	0.23	0.32	0.40	0.50
2.Capital Movement/ FX	0.01	0.63	0.48	0.34	0.31	0.54	0.53	0.86

*Note: Correlation coefficient between Capital Movement and Foreign Exchange Rate at the time lag k of Capital Movement.

Table 4. Correlation of Japanese Commercial Banks' BIS Capital Adequacy Ratio, Foreign Exchange Rate and NIKKEI Stock Index(as of November, 1992)

Exchange Rate		Yen/Dollar(U.S.) Rate					
		¥132.5	¥130.0	¥127.5	¥125.0	¥122.5	¥120.0
Stock Price							
	¥25,000	8.75(%)	8.81(%)	8.87(%)	8.94(%)	9.00(%)	9.09(%)
Nikkei	¥24,000	8.53	8.59	8.66	8.72	8.79	8.85
Stock	¥23,000	8.31	8.38	8.44	8.51	8.57	8.63
Price	¥22,000	8.10	8.18	8.23	8.29	8.35	8.42
Index	¥21,000	7.88	7.95	8.01	8.07	8.14	8.20
(Average)	¥20,000	7.60	7.73	7.79	7.86	7.92	7.98
Conclusions	Nikkei Average Stock Price Index	±¥1,000 BIS Capital Adequacy Rate ±0.22%					
	Yen/\$ Rate	±¥5.00 BIS Capital Adequacy Rate ±0.13%					

*Source: J.W.Lee, Global Finance, Dasarang 2004, p.81

Table 5. Korean Commercial Bank BIS Ratio Correlation to Foreign Exchange Rate and KOSPI Stock Index

Classification		Fiscal Year							Correlation
		90	91	92	93	94	95	96	
BIS	5 Big Commercial Banks(Average)	7.7	7.4	10.24	10.14	10.46	9.21	8.86	0.90
Capital	Commercial Banks (Average)	8.5	8.2	10.40	10.40	10.19	8.97	8.97	0.98
Adequacy	Local Banks (Average)	13.5	11.6	16.34	14.86	13.11	11.44	10.15	0.85
Ratio(%)	Total Commercial Banks(Average)	9.1	8.7	11.18	11.00	10.62	9.33	9.14	1.00
FX Rate	Year End Korean Won to 1 US \$	716.40	760.80	788.40	808.00	788.70	794.70	844.20	0.31
KOSPI	Year End KOSPI	676.1	610.9	678.0	866.2	1,027.4	882.0	651.2	0.48

*Source: Ditto, p.81.

**Note 1: Citizen' Narional Bank became commercial bank from special(National Bank in 1995).

***Note 2: After entering into IMF system on Dec. 3, 1997, above correlation coefficients have been changed as follows:

Periods	1990-1996	1990-1997	1990-1998
BIS/FX Correlation	0.313876	-0.695048	-0.725684
BIS/KOSPI Correlation	0.473781	0.742284	0.764097

Table 6. Comparison of Old Multi-Currency Basket Floating Exchange Rate System and New Ex Post Facto Monitoring System

1. Old Multi-Currency Basket Floating Exchange Rate System (198-1990)

$$Ex = a \times \text{SDR Basket} + b \times \text{Weighted Trade Basket} + P$$

where Ex = Exchange Rate

coefficient a + coefficient b = 1

SDR = Special Drawing Right in 1980:

US\$ = 42% weight

P = arbitrary adjusting variable set by Deputy Governor,
BOK & Vice Minister, Ministry of Finance

2. New Ex Post Facto Monitoring Multi-Currency Basket Floating Exchange Rate System

$$Ex = a \times \text{Trade Weighted Basket} + b \times \text{Invisible Trade Weighted Basket} + c \times \text{Long-term Capital Trade Weighted Basket} + d \times \text{Short-term Capital Trade Weighted Basket}$$

where coefficient a + coefficient b + coefficient c + coefficient d = 1

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