

A Study on the Relationship between Korean Stock Index Futures and Foreign Exchange Markets

Young-Jae Kim* and Sunghee Choi⁺

Abstracts

This paper explores the linkage between stock index futures market and foreign exchange market in an open financial market with a free floating exchange regime, and further investigates whether the effects of stock index futures on exchange rate are significant or not using post-crisis data. It is generally accepted that stock price affects exchange rate in a globalized economy. In this paper, we extend the previous works by showing that stock index futures market also affects foreign exchange market through somewhat complicated channels. This paper finds that the effects of stock index futures market on foreign exchange market are significant supporting portfolio approach and price discovery function of stock index futures market. Therefore, when shocks or big changes hit the futures market, policymakers can avoid possible second shocks and/or stabilize a foreign exchange market by taking appropriate measures in advance.

JEL Classification: E44, F41

Key Words: Stock Index Futures Market, Stock Market, Foreign Exchange Market,
Portfolio Approach, Price Discovery Function

* Professor, Department of Economics, Pusan National University, Jangjeon-Dong, Kumjung-Gu, Pusan, Korea, Phone: +82(51)510-2539, Email: kimyj@pusan.ac.kr

⁺ Graduate student, Department of Economics, Pusan National University, Email: scarlett0429@hotmail.com

1. Introduction

In a small open economy such as Korea, the dependency on external economies is so high that accurate forecasting of foreign exchange rates is very important, especially under the current free floating exchange regime. Lots of researches have been undertaken on what determines and affects foreign exchange rates. Traditional theories focus on inflation rates and interest rates among countries, so called PPP(purchasing power parity) and UIP(uncovered interest rate parity).

Kang (2000), however, finds that ERP(equity return parity)¹ is supported in some countries including Korea, emphasizing equity market's role in the exchange rates determination. As to the relationship between stock market and foreign exchange market, researches investigating the Korean financial market do not show consistent results. Some support traditional approach² (Granger, Huang and Yang, 2000; Abdalla and Murinde, 1997). However, many studies which analyze recent data support portfolio approach. Lee (2002) analyzes Won/Dollar exchange rate and KOSPI using VAR model and finds that stock prices lead exchange rate with negative correlation. Yoon and Kang (2004) examine bond, foreign exchange and stock markets using multivariate GARCH model. They find that a shock occurring in a particular market is transmitted to other markets instantly in the post-crisis period. In particular, stock market plays a leading role in inter-market volatility spillover.

Stock market has relevance to derivatives (or futures) market as well as foreign exchange market. It is known that futures market has price discovery ability, which

¹ ERP explains dynamics of exchange rates. According to ERP, when equity returns in a country are lower than equity returns in another country, the currency associated with the market offering lower returns is expected to appreciate.

² According to traditional approach, foreign exchange market leads stock market with positive correlation.

indicates that new market information spreads in futures market first and spot market later. A number of empirical studies show that there exists price discovery function in futures market. In relation to the Korean financial market, Kim et al.(2000) find that futures market and spot market are cointegrated and the futures market leads the spot market by 35 minutes. Jung et al.(1999) analyze the relation between KOSPI200 index and index futures market in terms of both return and volatility. They find that index futures market leads the spot market for both cases.

The Korean financial market has experienced dramatic changes due to financial liberalization and financial market opening since the early 1990s. Of those changes, financial derivatives are the most representative innovation. Korean financial derivatives market has experienced tremendous growth since KOSPI200 futures market opened in 1996. In terms of trading volumes, KOSPI200 futures³ and options markets ranked the fourth and the first in the global stock index futures and options market in 2002, respectively. The ratio of futures to cash trading values reached almost 8 in June 2004. Some economists insist that there exists 'the tail wagging the dog effect'.

Considering the fact that futures market might affect spot market, foreign exchange market might be affected by the impact from futures market if portfolio approach is valid. Therefore, this paper sets the hypothesis that derivatives market, in particular futures market affects foreign exchange market. The purpose of this paper is to prove whether the hypothesis is right or not through empirical analysis. Previous studies on the linkage between financial markets focus on either the relationship between stock market and foreign

³ The underlying asset of KOSPI200 futures is KOSPI200, which is a market value weighted index that consists of 200 stocks selected on the basis of their liquidity and status in the industry. There are four contracts in KOSPI200 futures; March, June, September, and December.

exchange market or the relationship between futures market and spot market. However, this paper extends the previous studies by combining the two frameworks.

To represent a financial derivatives market, we use the prices of KOSPI200 futures since they represent the Korean financial derivatives market in terms of trading volume. The dataset consists of daily closing futures price and nominal Won/Dollar exchange rate for the period from February 1, 1999 to June 30, 2004. This produces a total of 1,328 observations. The VAR analysis is applied to examine the relationship between stock index futures market and foreign exchange market. The major findings are as follows: Granger causality test shows that futures price has explanatory power in forecasting exchange rate. Second, generalized impulse response function shows that both portfolio approach and price discovery function of stock index futures market are supported.

This paper is organized as follows: Chapter 2 describes the Korean financial market and the growth of financial derivatives market briefly. Chapter 3 provides a theoretical background on the linkage among financial markets. Chapter 4 performs empirical analysis. The last chapter contains conclusion.

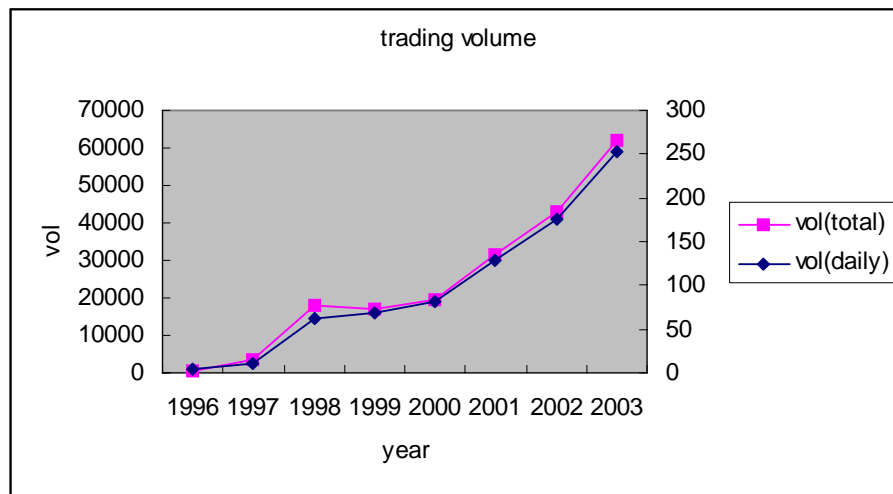
2. The Korean Financial Market

2.1 Financial Derivatives Market

It is the financial derivatives market that is the most representative innovation in Korean financial market. A 'derivative' can be defined as a financial instrument whose value depends on (or derives from) the value of other, more basic underlying variables (Hull, 2003). Korean financial derivatives market has experienced tremendous growth since its launch in 1996. The ratio of KOSPI200 futures to cash trading value jumped from 0.32 in 1996 to 7.4 in June 2004. KOSPI200 futures market, which represents the Korean financial

derivatives market, has been steadily growing (Figure 1). The explosive growth of financial derivatives market can be explained by elimination of capital control, financial liberalization, enormous advances in the technology of storing and transmitting information and low transaction cost. Long-lasting bear cash market in the 1990s and thus high demand for hedging risks can also explain such extreme growth.

<Figure 1> KOSPI200 Futures Trading Volume



Source: Korea Futures Exchange(KOFEX), www.kofex.or.kr

2.2 Foreign Exchange Market

As to foreign exchange, Korea shifted to a free-floating exchange rate system on December 16, 1997. In late 1997, the currency crisis broke out and Korea turned to the IMF on November 21, 1997. Taking advantage of the opportunity presented by the crisis, Korea accelerated the speed of capital account liberalization. It made Korea change the exchange rate system. Further, Korean government announced a plan to liberalize foreign exchange

transactions. In April 1999, with introduction of the new Foreign Exchange Transaction Act, current account transactions by corporations and banks were fully liberalized. Regulations on foreign direct investment were streamlined in order to match the OECD standards. In January 2001, the remaining ceilings on current account transactions by individuals have been eliminated, including the ceilings on overseas travel expenses.

3. Theoretical Backgrounds

3.1 Portfolio Approach

Two approaches can be applied in analyzing the linkage between stock market and foreign exchange market. One is 'portfolio approach'⁴, which argues that stock market leads foreign exchange market with a negative correlation. The other is 'traditional approach', which suggests that foreign exchange market leads stock market with positive correlation. Aggarwal(1981) argues that a change in foreign exchange rates could alter the stock prices of multinational firms directly and those of the domestic firms indirectly. In the case of a multinational firm, a change in exchange rates will affect the value of that firm's foreign operation, which will be reflected on its balance sheet. Consequently it contributes to current account imbalance. From this viewpoint, a change in exchange rate is expected to give rise to stock price change supporting traditional approach.

However, as capital markets become more and more integrated, changes in both stock prices and exchange rates may reflect more of capital movement than current account imbalance. The key point of the portfolio approach lies in the following mechanism: A decrease in stock prices causes a reduction in the wealth of domestic investors, which in turn leads to a lower demand for money with ensuring lower interest rates. The lower

⁴ See Krueger(1983)

interest rates encourage capital outflows, *ceteris paribus*, which in turn is the cause of currency depreciation. According to the portfolio approach, exchange rates adjust to equate supply and demand for financial assets such as stocks and bonds. The direction of the causality is from stock prices to exchange rates in portfolio approach and stock price is expected to lead exchange rates with negative correlation and interest rate with positive correlation. Interest rate is expected to lead exchange rates with negative correlation.

The results of previous empirical studies vary from countries and by sample periods. As to the Korean financial market, however, many studies using recent data conclude that portfolio approach is supported (Yoon and Kang, 2004; Lee, 2002).

3.2 Price Discovery Function

One of the benefits of futures market is its price discovery ability, which indicates that new market information spreads in futures market first and spot market later. In an efficient capital market where all available information is fully and instantaneously utilized to determine the market price of securities, futures prices should move concurrently with their corresponding spot prices without any lead and lag in price movements from one market to another. However, due to market frictions such as transaction costs or the capital market microstructure effects, significant lead and lag relationships between the two markets are observed.

Numerous studies have examined the price discovery in the futures markets for various financial assets with various methods. Most of them conclude that futures market leads spot market supporting price discovery ability in the futures market (Pizzi et al., 1998; Zhong et al., 2004; Min et al., 1999; Kim et al., 2000; Jung et al, 1999).

3.3 The Effects of Foreign Investors

Foreigners' stock investment has been increasing since the opening of stock market in 1992. The ratio of stock holdings of foreign investors reaches 43.7% in terms of aggregate value of listed stock in May 2004. The volumes of foreign capital inflow and outflow are rapidly increasing, too. KOSPI(Korea Composite Stock Price Index) has been shown to fluctuate along with foreign investors' stock purchasing. Given such economic environments, it is expected that the linkage between the stock market and the foreign exchange market has been strengthened. Thus, stock market might be a major channel to explain the fluctuation of exchange rates.

Park (1999) shows foreign inward stock investment is a significant variable in explaining the fluctuation of Won/Dollar exchange rate using the structural VAR model. Park (2003) investigates the relation between exchange rates and foreigners' stock investment in Korea using VAR GARCH-M model. She finds that the foreign exchange market and the stock market have been more closely related after liberalization of Korean stock market, using daily data from January 3, 1997 to September 30, 2002. Changes in foreigners' stock investment are shown to affect exchange rate the next day.

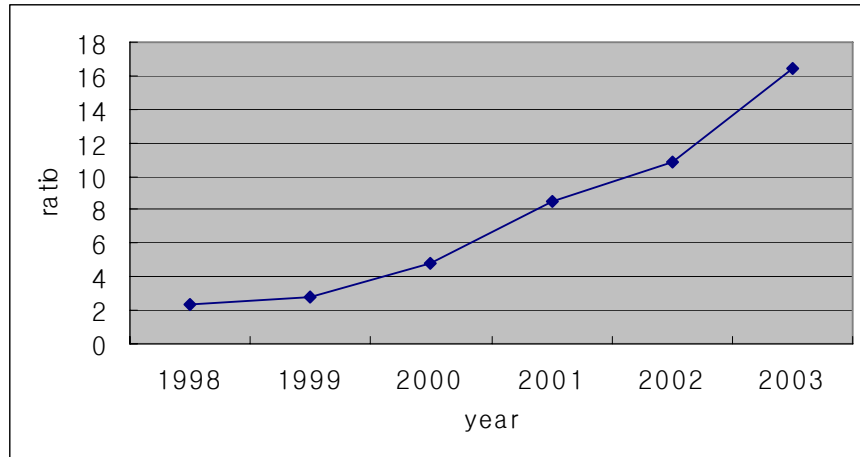
4. Empirical Analysis

4.1 Analytical Framework

The purpose of this paper is to examine the relationship between stock index futures market and foreign exchange market. There are two channels, direct channel and indirect channel, in the linkage between the two markets. Direct channel is explained by foreign investors' futures trading. <Figure 2> shows that stock index futures trading of foreign investors has been steadily increasing. It is expected that the effects of foreigners'

investment in Korean stock index futures market will increase. Such effects might lead to the fluctuation of exchange rate.

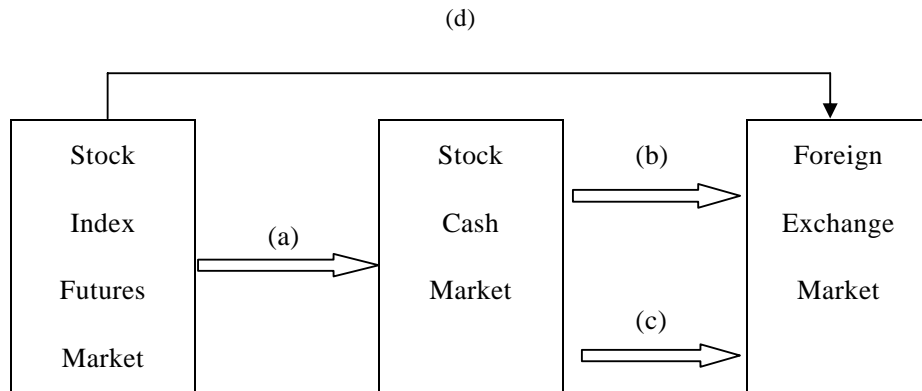
<Figure 2> Ratio of foreign investors in futures trading



Source: Korea Stock Exchange, www.kse.or.kr

Indirect channel is explained through stock market. The relationship between stock cash market and stock index futures market can be explained by a price discovery function in futures market. The relationship between stock market and foreign exchange market can be explained by portfolio approach together with the effect of foreign investors in Korean financial market. <Figure 3> describes the above relations: price discovery function, portfolio approach, effects of foreign investors in stock cash market and effects of foreign investors in stock index futures market. Based on such causal relations, the effects of stock index futures market on foreign exchange market might be significant.

<Figure 3> Linkage between stock index futures market and foreign exchange market



Note : (a) Price discovery function

(b) Portfolio approach

(c) The effects of foreign investors in stock cash market

(d) The effects of foreign investors in stock index futures market

4.2 Empirical Model

We use daily closing futures prices of KOSPI200 and nominal Won/Dollar exchange rate for the period from February 1, 1999 to June 30, 2004⁵. For futures prices, the nearest-term month contracts are used. This produces a total of 1,328 observations. Continuously compounded futures returns and exchange rate changes(returns) are calculated as the difference between the natural logarithms of the closing values for two consecutive trading days,

⁵ Yoon and Kang (2004) estimate foreign currency crisis period using 'three state Markov switching model'. The result shows that the crisis started on October 20, 1997 and ended on January 25, 1999. In this paper, however, we consider post-crisis period only.

$$DFU = \ln(P_t^f) - \ln(P_{t-1}^f),$$

$$DEX = \ln(P_t^e) - \ln(P_{t-1}^e)$$

where P_t^f and P_t^e are the futures price and the exchange rate at period t, respectively.

Then, we employ VAR model, which is now popular in the analysis of financial market.

The model in this paper consists of four variables: Won/Dollar exchange rate return(DEX),

KOSPI200 futures return(DFU), KOSPI return(DST) and first differenced CD return(DCD).

We estimated VAR models of lag 1, 2, 3, and 4 and choose the length of lags using the AIC

and SC. The results show that the model with 2-day lags is favored.

$$y_t = A + \sum_{j=1}^2 B_j y_{t-j} + \epsilon_t$$

where y_t : 4×1 vector

A : intercept vector

B_j : coefficient matrix

$\epsilon_t \sim N(0, \Sigma)$, Σ : non-diagonal matrix

4.3 Estimation Results

<Table 1> presents the results of Granger causality test. They show that futures price has explanatory power in forecasting stock price and exchange rate. The results also suggest that stock price has explanatory power in forecasting exchange rate supporting portfolio approach.

<Table 1> Granger causality test results

A not cause B	lag = 2
DEX → DCD	4.75*
DCD → DEX	2.11
DFU → DCD	1.93
DCD → DFU	1.86
DST → DCD	1.41
DCD → DST	1.50
DFU → DEX	7.83*
DEX → DFU	1.67
DST → DEX	5.87*
DEX → DST	0.63
DST → DFU	2.91
DFU → DST	9.70*

Note: * indicates 5% significance

<Table 2> VAR Estimates

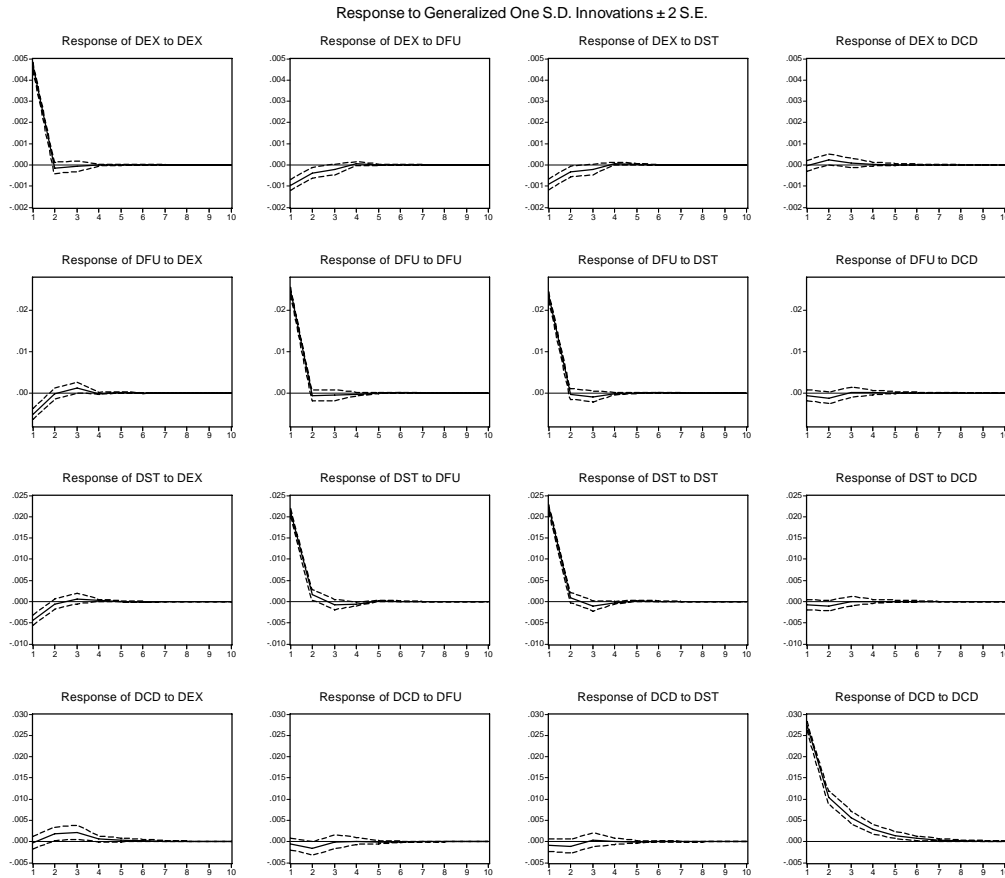
	DEX	DFU	DST	DCD
DEX(-1)	—	—	—	0.360 (2.19)
DEX(-2)	—	—	—	0.365 (2.23)
DFU(-1)	-0.040 (-2.45)	—	0.311 (3.98)	-0.255 (-2.64)
DFU(-2)	—	—	0.251 (3.24)	—
DST(-1)	—	—	-0.300 (-3.38)	0.249 (2.31)
DST(-2)	—	—	-0.297 (-3.54)	0.240 (2.31)
DCD(-1)	—	—	—	0.382 (13.91)
DCD(-2)	—	—	—	0.059 (2.14)
C	—	—	—	—
Adj. R-squared	0.010883	0.004577	0.016435	0.177387

F-statistic	2.820993	1.760996	3.765466	36.68825
-------------	----------	----------	----------	----------

Notes: 5% significant coefficients only

() indicates t-value

<Figure 4> Response to Generalized One S.D. Innovation



<Table 2> and <Figure 4> present VAR estimates and impulse response functions, respectively. For impulse response function, we used 'generalized impulse function', where ordering is not necessary. Response of DEX to DFU and response of DEX to DST show that shocks from the stock index futures market and the stock cash market have negative effects on the foreign exchange market. The effect lasts four days. This outcome supports the

portfolio approach. Positive shock from the stock index futures market has positive effect on the stock cash market and so does the reverse. This means that stock index futures market and stock cash market have bidirectional relation. However, F-statistic of futures variable is statistically insignificant, which indicates that other variables in the equation such as exchange rate, the interest rate and the stock price do not have explanatory power on the variable 'futures price'. It also shows that price discovery function in stock index futures market is supported.

5. Conclusion

This study explores the linkage between financial markets, especially stock index futures market and foreign exchange market, and further investigates whether the effects of stock index futures on exchange rate are significant or not. The ultimate purpose of this study is to forecast the fluctuations of exchange rates more accurately. There have been many studies that analyze the relationship among financial markets. Many of them focus on bond market, stock market and foreign exchange market without including futures market, the most dominant innovation in recent financial markets. Therefore, we add futures variable explicitly in the model. We use KOSPI200 futures return for futures market. For empirical model, we use VAR analysis including Granger causality test, impulse response function and variance decomposition.

Daily return data of KOSPI200 futures, Won/Dollar exchange rate, KOSPI, and interest rate(CD) are used and the sample period is from February 1, 1999 to June 30, 2004. For rigorous analysis, both pre-crisis and crisis period are excluded in this paper. Major findings are as follows;

First, Granger causality test indicates that futures price has explanatory power in forecasting stock price and exchange rate. Second, generalized impulse response function shows that both portfolio approach and price discovery function of stock index futures market are supported. Through this analysis, it is shown that the effects of stock index futures market on foreign exchange market are significant.

Stock cash and index futures markets usually fluctuate in a similar way showing high correlation. According to portfolio approach, stock market leads foreign exchange market with negative correlation. When these are considered, stock index futures market might lead foreign exchange market with negative correlation. The empirical results of this paper support this hypothesis.

In addition, this paper can provide the following policy implication. When shocks or big changes occur in futures market, policymakers can avoid possible second shocks and/or stabilize foreign exchange market by taking appropriate measures in advance. One possible limitation is that we use VAR model in this paper. For the next research, VECM with level variables can be applied to investigate the relationship among financial markets.

<Reference>

- Gilhwan Kang and Kyutae Kim, 2002, “A Study on Price Discovery Ability of Stock Index Futures: A Focus on Models and Data”, 4th Conference, Korean Securities Association.
- Sangkoo Kang, 2002, “Who lead the market? Interaction of domestic and foreign investors in KOSPI 200 futures market”, Master thesis, Korea University.
- Heejoon Kang, 2000, “The analysis of foreign exchange rate movements under the parity conditions of goods, bonds, and equities”, 9th International Conference, The Korean Economic Association.
- Junghan Kim, Haesik Park, Wonchang Jang and Baekin Cha, 2001, *Capital Flow and Foreign Exchange Rate: Analysis and Forecasting*, Korea Institute of Finance.
- Hanghwa Park, 2003, “Relationship between Foreign Exchange Rate and Foreigners’ Stock Investment: VAR GARCH-MI”, Master Thesis, Chonnam National University.
- Haesik Park, 1999, “The Effects of Foreigners’ Stock Investment on Foreign Exchange Rate”, *Financial Studies*, Korea Institute of Finance.
- Ookja Yoon and Kyuho Kang, 2004, “A Study on Volatility of Interest rate, Foreign Exchange Rate and Stock price before and after Foreign Currency Crisis”, *Economic Analysis* 10(1), pp.54- 81.
- Gunyoung Lee, 2002, “Causal Relation between Foreign Exchange Rate and Stock Price”, *The Korean Economic Review* 50(4), pp.231-266.

- Abdalla, I. S. A. and Murinde V., 1997, "Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan, and Philippines", *Applied Financial Economics*, Vol.7.
- Aggarwal, R., 1981, "Exchange rates and stock prices: A Study of the US capital markets under floating exchange rates", *Akron Business Economic Review*, Vol.12.
- Franklin, R. Edwards and Cindy W. Ma, 1992, *Futures & Options*, McGraw-Hill.
- Granger, C. W., Bwo-Nung Huang and Chin-Wei Yang, 2000, "A bivariate causality between stock prices and exchange rates: evidence from recent Asian flu", *The Quarterly Review of Economics and Finance*, Vol.40, pp. 337-354.
- Hull, C. John, 2003, *Options, Futures, and Other Derivatives*, 5th edition, Prentice Hall.
- Krueger, A. O., 1983, *Exchange-Rate Determination*, Cambridge University Press.
- Min, H. Jae and Mohammad Najand, 1999, "A further investigation of the lead-lag relationship between the spot market and stock index futures: early evidence from Korea", *The Journal of Futures Markets*, Vol.19, No.2, pp. 217-232.
- Pizzi, A. Michael, Andrew J. Economopoulos and Heather M. O'Neill, 1998, "An examination of the relationship between stock index cash and futures markets: A cointegration approach", *The Journal of Futures Markets*, Vol.18, No.3, pp. 297-305.
- Zhong, Maosen Ali F. Darrat and Rafael Otero, 2004, "Price discovery and volatility spillovers in index futures markets: Some evidence from Mexico", *Journal of banking & finance*, pp.1-18.

<Website>

www.kofex.or.kr (Korean Futures Exchange)

www.kse.or.kr (Korea Stock Exchange)