KOSPI 200 Futures and Stock Market Volatility

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이 논문은 한국증권시장에서 거래되고 있는 KOSPI 200 선물과 옵션 거래가 주식시장의 변동성에 어떤 영향을 미치는지를 분석하고 있다. KOSPI 200에 대응되는 대응종목을 추출하여 대응표본으로 삼아 주가지수 수준과 개별종목 수준에서 변동성의 차이를 비교분석하였다. 변동성에 영향을 미치는 기업특성변수들과 환위험을 통제한 후에 이루어진 시계열 분석과 횡단면 분석의 결과는 일반적인 예상과는 달리 KOSPI 200 선물(옵션)거래가 주식시장의 효율성을 제고시키고 변동성의 증가를 가져오는 역할을 하지 못했음을 보여준다. 선물거래 도입 이후에 현물시장의 변동성은 상대적으로 감소한 것으로 나타나며 외환위기 이후에 들어서야 변동성이 증가하는 모습을 보여준다. 그러나 선물거래 이후에 나타난 변동성의 변화는 시장마찰요인에 크게 영향을 받고 있으며 현물시장의 규제완화가 크게 이루어진 외환위기 이후의 기간에는 변동성의 증가가 크게 나타나고 있으며 시장마찰요인에 의한 영향도 큰 폭으로 개선되는 것을 보여준다.

I. Introduction

The effect of derivative assets on spot markets has been of great interest both practically and academically. After the introduction of financial futures and options in the 1970s, the effect of financial derivatives on the underlying spot markets has been widely studied. These studies, in general, can be divided into two branches of thought. One is that derivatives trading destabilizes the underlying spot market and reduce investors welfare [Stein (1987)]. The other is that derivatives improve market efficiency by creating new information and reducing market friction [Cox (1976), Brorsen (1991) and Antoniou and

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Holmes (1995)].

These studies, according to their assumptions, showed that spot market volatility could either increase or decrease through derivatives trading. As contradictory conclusions result depending on the assumptions of each study, an extensive and intricate empirical study reflecting actual market conditions is necessary. Studies of the effect of derivatives trading on the spot market volatility generally compared spot market volatility before and after futures (options) trading [Simpson and Ireland (1985), Edward (1988a, 1988b), Skinner (1989), Harris (1989), Conrad (1989), Lee and Ohk (1992) and Antoniou and Holmes (1995), etc.].[1] Previous studies also showed that careful consideration of other variables affecting stock volatility is necessary in order to interpret test results concerning the effect of futures trading [Harris (1989), Brorsen, Oellermann, Farris (1989) and Carlton (1983)].

An empirical study testing spot market volatility changes after the introduction of derivatives and analyzing reasons for these changes is necessary not only to assess the economic usefulness of derivatives but also to build a more effective market operation system. These issues are important, in particular, to those markets such as Korea that have either just introduced or will introduce derivative markets and have distinctive features concerning market operation regulations.

The Korea Stock Exchange (KSE) introduced stock index futures and options on the Korea Composite Stock Price Index 200 (KOSPI 200) in May 1996 and in July 1997, respectively. Those markets are growing dramatically[2]. Emerging markets, such as Korea's, however, have little experience in derivatives trading and their stock markets are

1) Refer to Kamara (1982) on previous studies concerning commodity markets.

2) Futures trading volumes in 1996, 1997 and 1998 were 3,670, 11,137 and 61,279 contracts, respectively, and options trading volumes in 1997 and 1998 were 31, 890 and 110,653, respectively, on a daily basis ("Stock", the KSE journal, from June 1996 to January 1999).

underdeveloped compared to the stock markets of developed countries. When futures trading was introduced, additional sources of market frictions existed in Korean stock markets compared to those of developed countries with respect to strict restrictions on short selling, narrowly-defined daily price change limits and foreign investment ceilings on share-holding. Korean stock markets also have other distinctive features, such as a high percentage of limit orders in total trading volume and a high ratio of individual investors to total market participants.

Glovalization has aroused nationwide interest in Korea throughout the 1990s. Korea has gradually opened its stock market to foreign investors since 1992. The Korean government partially introduced a market exchange rate system in March 1990 and gradually widened the daily exchange rate change limit, which finally gave way to a floating exchange rate system in December 1997. Considering these environmental changes, it is natural to assume that the influence of foreign exchange rate changes on stock market volatility has increased gradually. The importance of foreign exchange risk in the stock market has been demonstrated in previous studies. Fang and Loo (1996) and Choi and Rajan (1997) showed that foreign exchange risk was an important pricing factor for stocks. In light of environmental changes and previous studies, foreign exchange risk is one of the most important variables that should be taken into account when analyzing Korean stock market volatility.

This study examines the effect of KOSPI 200 futures (options) trading on Korean stock market volatility and interprets volatility changes. The empirical model considers not only several firm-specific variables that affect stock volatility but also the exchange rate exposure of individual firms in order to isolate futures trading effects on stock market volatility. Test results show that the volatility of stock market increases after the commencement of futures trading. However, the volatility of futures traded stocks decreases and the market friction of futures traded stocks increases relative to those of non−futures traded stocks during the early stage of futures trading. In the post−crisis period, the difference between the two groups in terms of short−term volatility and market friction virtually disappears statistically. A test of the influence of foreign investment ceilings on the stock market verifies that differences between two groups in volatility and market friction are related to the behavior of foreign investors. This study could not find evidence that KOSPI 200 futures (options) trading reduces market frictions in the underlying stock markets. However, the results of this study suggest that adjustments in market regulations facilitating the transfer of information created in futures markets to spot markets are necessary to maximizing its positive economic functions and authorities planning to organize futures markets should pay heed to these findings.

The remainder of this article is organized as follows. In the following section, the analytical methodology is described. In the third section, empirical tests are performed and the results are reported. The fourth section discusses the effect of market frictions on spot market activity. The final section presents concluding remarks.

Ⅱ. Methodology

2.1. Theoretical Background

Cox (1976) demonstrated that if futures prices were quick to adjust to new information and if these were transferred to the spot market through arbitrage mechanisms, spot market volatility and market efficiency could increase simultaneously. Ross (1989) showed that, under conditions of no−arbitrage and when stock prices follow a martingale process, stock price volatility is proportional to the volume of information created and stock return variance is equal to the variance of information flows. These two studies suggest that if more information is created as a result of futures trading and if such information is reflected quickly in spot prices, spot price volatility could increase after the introduction of futures trading.[3] Brorsen (1991) insisted that theoretical studies supporting the belief that the futures market might reduce spot market volatility assumed that the markets were in equilibrium and their assumptions were not valid in the short-term. Brorsen also pointed out that stock returns could have positive autocorrelation under market friction and insisted that futures trading lessen positive autocorrelation of stock returns by having stock prices adjust to information more quickly. Finally, Brorsen showed analytically that the reduction of market frictions could increase volatility. This relationship between market friction and volatility is more plausible in less developed markets, such as the Korean stock market, than in well-developed markets.

Actual prices in spot markets, due to market frictions such as transaction costs and market regulations, may not move quickly toward equilibrium even though equilibrium prices follow a random walk. If, due to market friction, price adjustments are not instantaneous, but rather follow a partial adjustment process, then the relationship between actual price (ϕ_t) and equibrium price(ϕ_t^*) is as follows[4]

$$\phi_t - \phi_{t-1} = \gamma(\phi_t^* - \phi_{t-1}) \qquad (1)$$

$$\phi_t^* = \phi_{t-1}^* + u_t, \qquad u_t \sim WN(0, \sigma_u^2) \qquad (2)$$

Where prices are measured in logs and γ is a constant that has a value between 0 and 1. The γ indicates the level of reflection to which the actual price reaches the equilibrium price. If market friction increases, γ will decrease in equation (1). The γ can be interpreted as a market operation efficiency coefficient. Under equations (1) and (2), stock return (R_t) is

3) On the contrary, Weller and Yano (1987) concluded that, under particular conditions, futures trading could theoretically decrease spot market volatility. Edward (1988b) and Conrad (1989) showed empirically that spot market volatility did not increase after the introduction of futures and options trading. Only volatility decreases were found.

4) For more detail, readers can refer to Brorsen (1991), p.157, Brorsen, Oellermann and Farris (1989), pp.275-276.

expressed in the following AR(1) representation:

$$R_t = (1-\gamma)R_{t-1} + \gamma u_t \qquad (3)$$

In equation (3), $1-\gamma$ reveals the first order autocorrelation of stock return. Since R_{t-1} and u_t are independent and the variance of R_t is equal to that of R_{t-1} unconditionally, the variance of R_t is as follows:

$$Var(R_t) = \gamma/(2-\gamma)\ Var(u_t) \qquad (4)$$

The partial derivative of equation (4) with respect to γ, $\frac{2}{(2-\gamma)^2}Var(u_t)$ shows the analytical relationship between stock return volatility and the market efficiency coefficient(γ). The market efficiency coefficient and stock return volatility have a positive relationship; in other words the first order autocorrelation of stock return and the volatility of stock return have a negative relationship. As Cox (1976) and Brorsen (1991) described, market friction in the futures market is less than that in the spot market. If futures prices adjust quickly to new information and if the effect is transferred to the spot market through arbitrage between the two markets, then the futures market can function to reduce market friction in the spot market. This implies that the γ in equation (1) could be larger in the presence of the futures market. Futures trading, therefore, can increase short-term spot market volatility..

According to Ross (1989), $Var(u_t)$ in equation (4) is the same as the variance of information flows, $Var(s_t)$.

$$Var(u_t) = Var(s_t) \qquad (5)$$

Therefore, $Var(u_t)$ in equation (4) can be interpreted as the level of information creation and $Var(u_t)$ can be measured by the variance of return in the long-term frequency, such as weekly or monthly data [Brorsen (1991)]. The level of market friction of a company in equation (1) is related to transaction costs, price change limits, restrictions on short sales, investment ceilings, price rounding, and the role of market makers [Schwartz and Whitcomb (1977), Scholes and Williams (1977), Cohen, et al. (1986)]. In this context, the level of autocorrelation of short-term stock returns (such as daily return) can be a proxy for the level of market friction in market operation system.

Previous researches showed that many other variables were related to stock return volatility. Those volatility−related variables are stock price levels, systematic risk, trade volumes, market values and macro−economic variables such as inflation [Harris (1989), Brorsen, Oellermann, Farris (1989), Carlton (1983)]. If these volatility−related variables are defined as a set X, then equation (4) is a function of market operation efficiency coefficient γ, level of information creation $Var(u_t)$ and other related variables X as follows:

$$Var(R_t) = f(\gamma, Var(u_t), X) \qquad (6)$$

This study analy zes the effect of futures trading on short−term spot market volatility considering those related variables X, In this study, it is assumed that stock return volatility has a linear relationship with those volatility−related variables.

2.2. Empirical Model

Index futures (options) trading influences non−indexed stocks as well as indexed stocks. Therefore, in order to analyze the effect of futures (options) trading on stock market volatility two approaches could be considered. One is testing volatility changes between the periods before and after the introduction of futures trading. The other is testing volatility differences between companies that are included in the index and companies that are excluded from the index. While comparing indexed and non−indexed companies is superior when considering other volatility−related variables, it is necessary to construct meticulously a matched group of companies (hereafter the matched−KOSPI 200 companies) for comparison with the KOSPI 200 companies. To construct the matched−KOSPI 200 companies, the company with the most similar profile among KSE−listed but KOSPI 200 −excluded companies is paired with each KOSPI 200 company. Systematic risk, market value, turnover ratio, stock price level and industry are considered when pairing the non

−indexed companies with KOSPI 200 companies [5]

Time series and cross−sectional analyses are adopted in order to test the effect of futures trading on stock market volatility. In time series analyses, standard deviation and first−order autocorrelation of the Korea Composite Stock Price Index (KOSPI), the KOSPI 200 and the matched−KOSPI 200 are calculated by sub−period. The matched−KOSPI 200 is a value−weighted index of matched companies and is set at 100 on 3 January 1990, the same as the KOSPI 200. Volatility−related firm characteristic variables need to be considered when analyzing volatility differences by period. Macro−economic variables such as inflation and foreign exchange rate could also affect stock market volatility [Carlton (1983), Fang and Loo (1996) and Choi and Rajan (1997)]. If macro−variables affect each sample group differently then they must be included in empirical tests. Considering foreign dependent structural features of the Korean economy and the behavior of foreign investors in Korean stock markets, exchange rate changes on volatility could

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5) The selection method is basically similar to that adopted by Harris (1989) except that the turnover ratio is used instead of trade frequency and that industry is considered as a criterion to decide similarities. The procedure for selection is as follows: i) KSE−listed companies are divided into two groups, a KOSPI 200 companies group and a non−KOSPI 200 companies group and each group is subdivided by industry. Companies which were either added to or removed from the KOSPI 200 during each sample period or which data are not available are eliminated from consideration. ii) Regression coefficients of the KOSPI 200 companies are estimated by regressing the standard deviation of daily return on firm characteristic variables (i.e., systematic risk, market value, turnover ratio and stock price level). iii) The weighted−sum of distance of characteristics on the vector space between a KOSPI 200 indexed company and the remaining non−KOSPI 200 companies in the same industry calculated. The regression coefficient is weighted in distance calculating. iv) The shortest−distance company is selected as a matched company. v) The KOSPI 200 company and the selected matched company are removed and the process is repeated after iii) until all KOSPI 200 companies are exhausted in the industry.

affect each sample group differently. Moreover, there are several reasons why exchange rate effects have gradually increased in Korea in the 1990s. First, interest of Korean firms in international business has greatly increased. Second, restrictions on foreign investors in the stock market have been steadily removed[6] Third, daily exchange rate change limits steadily widened from March 1990 to December 1997 at which time they were removed[7] The relationship between the exchange rate and stock returns varies company by company, just as the relationship between the market return and individual stock returns varies. Exchange rate exposure is a concept for measuring the effect of exchange rate changes on stock returns. Regression coefficient Ex_i in equation (7), which regresses individual stock return on the KOSPI return and the rate of exchange rate change, is the exchange rate exposure of stock i (Jorion, 1990).

$$R_{i,t} = \delta_i + \beta_i^m R_{m,t} + EX_i \Delta FX_t + \varepsilon_{i,t} \quad (7)$$

$R_{i,t}$ is the return (log price relatives) of stock i at time t, $R_{m,t}$ is the market return and ΔFX_t is the log relatives of the nominal won/dollar exchange rate[8] $\varepsilon_{i,t}$ is an error term with $i.i.d\ N(0,\sigma_\varepsilon^2)$.

6) Ceilings on foreign investors in the stock market were introduced from the opening of the stock market in Korea. On 3 January 1992, ceilings for listed companies were 10% for aggregate foreign ownership and 3% for individuals and ceilings for public companies were 8% and 1%, respectively. The ceilings were gradually widened over time. On 25 May 1998, ceilings for listed companies were removed and ceilings for public companies were increased to 30% and 3%, respectively. Other regulations restricting foreign investor actively include the Telecommunications Act, the Aviation Act, the Fisheries Act, the Banking Act and the Mining Industry Act. Most of the stocks affected by these acts are KOSPI 200 companies..

7) The daily change limit of Korean Won(₩)/U.S. Dollar($) exchange rate started at 0.4% in March 1990 and widened to 0.6% in September 1991, 0.8% in July 1992, 1% in October 1993, 2.25% in December 1995 and 10% in November 1997. On 16 December 1997 the limit was abolished.

8) The real exchange rate is more appropriate to estimate exchange rate exposure. However, in order to use real exchange rates it is necessary to adjust stock returns to real stock returns. That in turn can create serious measurement errors. In practice, more than a few previous empirical studies used nominal exchange rates in estimating foreign exchange rate exposure [Jorion (1990) and Khoo (1994)].

The most frequently mentioned volatility–related firm characteristic variables are market beta, market value, turnover ratio and stock price level [Harris(1989), Karpoff(1987)]. Equation (8) is a dummy variable regression model used to estimate standard deviation differences by period, considering firm characteristic variables and exchange rate exposure.

$$SM_i = a_0 + \sum_{j=1}^{3} a_{1j} DT_j + a_2(|\beta_i| \times \sigma_m) + a_3 LMV_i + a_4 TOR_i + a_5 INVP_i + a_6 |EX_i| + v_i \quad (8)$$

SM_i is the stock return standard deviation of stock i expressed as a daily rate. Stacking data both of the KOSPI 200 companies and the matched–KOSPI 200 companies by period is used in the estimation. The DT is a period dummy variable (See 3. (1) for the partitions of sample period) and DT_j is a column vector with the same dimension as the stacked data. Dummy variable coefficient a_{1j} is the average difference between the standard deviations of period I(the benchmark period) and those of the subsequent period after accounting for cross–sectional variations due to other independent variables. $|\beta_i|$ is the absolute balue of the stock beta, σ_m is the standard debiation of market return, LMV_i is the log market value, TOR_i is the turnover ratio(equivalent to trade volume divided by the number of registered stocks), $INVP_i$ is the inverse stock price and v_i is an error tern with $i.i.d\ N(0, \sigma_v^2)$ The absolute balue of beta is adopted because this model focuses on the relaqtionship betwwn systematic risk and volatility. The market standard deviation is multiplied to consider the fluctuation of market volatility in sample periods $|EX_i|$ is the abosolute value of foreign exchange rate exposure estimated in equation(7). When the exchange rate changes, the greater the exchange rate exposure(irrespexctive of its sign)the greater the stock return volatility. Therefore, a_6 is expected to be positive.

In cross sectional analyses, the average standard deviation of the KOSPI 200 companies is compared with that of the matched companies, considering firm characteristics and exchange rate exposure. The study adopts a dummy variable regression model as follows:

$$SM_i = b_0 + b_1 DKOSPI_i + b_2(|\beta_i| \times \sigma_m) + b_3 LMV_i + b_4 TOR_i + b_5 INVP_i + b_6 |EX_i| + \eta_i \quad (9)$$

where DKOSPI is a dummy variable that takes the value of I if stock i is included in the KOSPI 200 and 0 oterwise and η_i is an error tern with $i.i.d\ N(0,\sigma_\eta^2)$ Dummy variable coefficient b_1 is the average difference between the standard deviations of the KOSPI 200 companies and those of the matched companies after accounting for cross-sectional variations due to independent varables. Since DKOSPI$_i$ has value of 1 when stock i is in the KOSPI 200, $b_1 < 0$ means that the average standard deviation of the KOSPI200 companies is less than that of the matched-KOSPI 200 companies If $b_1 > 0$ conversely, then the average standard deviation of the KOSPI 200 companies is greater than that of its counterpats.

Ⅲ. Empirical Tests

3.1. Data

The spot and futures data derive from KOSCOM (Korea Securities Computer Corporation) and KSE and the exchange rate data are obtained from the Bank of Korea. The sample period is from January 1990 to December 1998. The sample period is not long enough to analyze the effect of futures trading on the spot market since futures trading was introduced in Korea only on 3 May 1996. To alleviate this problem, the total sample period is partitioned into several sub-periods, based on events related to the futures market. The empirical analysis is performed on sub-periods : period I (3 January 1990 ~14 June 1994) is the period prior to the publication of the KOSPI 200 index, period II (15 June 1994~2 May 1996) is the time after the KOSPI 200 index publication date and before futures trading was introduced, period Ⅲ (3 May 1996~6 July 1997) is the futures trading period before option was introduced and period IV (7 July 1997~28 December 1998) is the period after option trading was introduced. A financial crisis broke out in Korea during the sample period. The financial crisis could have induced structural changes in the Korean economy, including the relationship between the spot market and the futures market. To analyze the volatility difference between the pre and the post financial crisis period, this study performs a parallel analysis for the period (3 May 1996 ~ 28 Dec. 1998) which excludes the abnormal period Nov. ~ Dec. 1997. Period F (3 May 1996~31 October 1997) is the futures trading period before Nov. 1997 and period S (3 Jan. 1998 ~28 Dec. 1998) is the post-crisis period[9] Period I is the reference period for comparing subsequent periods in this study because no futures trading related events took place in this period[10] Where the standard deviation is the same for the two groups in period I and where some changes are observed subsequently, it is more plausible that the changes resulted from the onset of futures trading.

Table I shows the total sample structure that is used in the analyses. The total sample consists of companies that are listed in the KSE and where stock prices, market values and trade volume data are available. Companies added to or deleted from the KOSPI 200 within the sample period are excluded from the total sample. A matched-KOSPI 200 companies is constructed from this total sample, adopting the method described in footnote 5. In the case of manufactures, for example, 136 companies among 262 companies are ultimately selected in period I for comparison.

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9) In empirical tests, the period of November and December 1997 is excluded from the analysis arbitrarily. During this period the Korean government requested relief funding from the IMF and the exchange rate rose sharply. In the KOSPI 200 futures markets, circuit breakers occurred in 36 of the 47 total trading days. It suffices to say that the market was not normal during this period.

10) Publication of the KOSPI 200 is one of the futures trading related events because the KSE constructed the KOSPI 200 in order to use it as the underlying asset for futures trading.

Table I

Total Sample Structure Involved in the Construction of the Matched-KOSPI 200

Periods	Manufactures	Construcition	Circulative Services	Financial Services	Total
I	136/262	14/28	16/36	25/59	191/385
II	125/310	13/29	12/41	23/61	173/441
III	125/341	14/34	13/47	28/66	180/488
IV	109/347	13/33	15/40	25/57	162/477
F	119/334	13/33	13/47	28/66	173/480
S	114/365	15/35	15/42	27/57	171/499

* In industry classification, electricity and gas is classified as manufacturing and communication is classified as a circulative service because there is no counter company in the non-KOSPI 200 companies group. ** The number on the left hand side of "/" is the number of the KOSPI 200 companies included in empirical tests and the right hand side number is the pool of non-KOSPI 200 companies from which the matched-KOSPI 200 companies group is constituted.

3.2. Effect of Futures (Options) Trading on the Stock Market

The standard deviations of the indexes presented in tabl II show that standard deviations increased after the introduction of futures trading, irrespective of data frequency. In comparing the KOSPI 200 and the matched-KOSPI 200, the daily standard deviation of the KOSPI 200 becomes lower than that of the matched-KOSPI 200 in period II and period F. However, the standard deviation of the KOSPI 200 is again greater than that of the matched-KOSPI 200 in period S. The weekly standard deviation, which is a proxy for information flows in equation (4)[11], shows a similar pattern with the daily

11) It is assumed that information creation could differ in each period and that $Var(u_t)$ could change by period

standard deviation. These results indicate that the amount of information in the spot market increased continuously since the commencement of futures trading. In comparing the two groups, the information creation of the KOSPI 200 is less than that of the matched-KOSPI 200 in period II and period F. However, in period S, the information creation concerning the KOSPI 200 is greater than that of the matched-KOSPI 200.

Table II

Daily and Weekly Standard Deviations of Indexes

Periods	Daily Return			Weekly Return		
	KOSPI	K-200	MK-200	KOSPI	K-200	MK-200
I	0.0139	0.0143	0.0136	0.0342	0.0350	0.0346
II	0.0096	0.0102	0.0106	0.0252	0.0260	0.0304
III	0.0125	0.0134	0.0155	0.0334	0.0354	0.0397
IV	0.0285	0.0303	0.0250	0.0734	0.0767	0.0741
F	0.0138	0.0147	0.0155	0.0372	0.0390	0.0411
S	0.0284	0.0304	0.0244	0.0730	0.0768	0.0702

* KOSPI: Korea Composite Stock Price Index, K-200: Korea Composite Stock Price Index 200, MK-200: matched-KOSPI 200 companies stock price index.

The autocorrelation coefficients of indexes presented in table III show that first order autocorrelations of daily return are large and significant. In the weekly data, however, the autocorrelation coefficient is small and no longer significant except in periods III and F for the matched-KOSPI 200. This means that the standard deviation of the weekly return can be a proxy for information flows. The daily autocorrelation of the KOSPI 200 increases in period F while that of the matched-KOSPI 200 decreases during the same period compared with period II. In period S, however, the autocorrelation of the KOSPI 200 decreases from 0.1904 to 0.1228 while the autocorrelation of the matched-KOSPI 200 increases from 0.1832 to 0.2254. This result could be interpreted to conclude that the market operation efficiency of the KOSPI 200 improved in period S relative to that of the matched-KOSPI 200. This is consistent with an interpretation of the greater increase in the daily standard deviation of the KOSPI 200 in period S (table Ⅱ). However, the autocorrelation increase after period I on the whole is inconsistent with the assertion that stock index futures trading could reduce market friction in stock markets.

Table Ⅲ

Daily and Weekly Autocorrelation of Indexes

Periods	Daily Return			Weekly Return		
	KOSPI	K-200	MK-200	KOSPI	K-200	MK-200
I	0.0704*	0.0683*	0.0951**	-0.0620	-0.0582	-0.0721
Ⅱ	0.1277**	0.1119**	0.1842**	-0.0051	0.0100	-0.0427
Ⅲ	0.1994**	0.1986**	0.1451**	-0.0866	-0.0465	-0.2743*
Ⅳ	0.1702**	0.1542**	0.2872**	-0.0348	-0.0996	0.1328
F	0.2021**	0.1904**	0.1832**	-0.0660	-0.0762	-0.2311*
S	0.1324*	0.1228*	0.2254**	0.0582	0.0267	0.0820

* ** and * means significant at 1% and 5% level, respectively.

KOSPI: Korea Composite Stock Price Index, K-200: Korea Composite Stock Price Index 200, MK-200: matched-KOSPI 200 companies stock price index.

To confirm, however, whether the above mentioned result is caused by futures trading requires the consideration of other variables that affect return volatility. Equation (8) is estimated in order to test differences of short-term standard deviations by periods, considering volatility- related variables. Betas are computed with respect to KOSPI returns from overlapping 6-day returns within the sample periods. The exchange rate exposure in equation (8) is estimated by equation (7). In estimating exchange rate exposure, KOSPI returns and exchange rate changes are overlapped 6-days in order to alleviate small sample problems. Coefficients of dummy variables presented in table Ⅳ show that the standard deviation of period Ⅱ increases by 0.001 compared with that of period I. The standard deviations of period F and period S also increase by 0.0059 and 0.

0108, respectively. The test results of both indexes and companies taking into account volatility-related variables show that short-term volatility in the stock market increased after the commencement of futures trading.

Table IV

Changes in Standard Deviation after Considering Volatility-Related Variables

$$SM_i = a_0 + \sum_{j=1}^{3} a_{1j} DT_j + a_2(|\beta_i| \times \sigma_m) + a_3 LMV_i + a_4 TOR_i + a_5 INVP_i + a_6 |EX_i| + v_i$$

Coeffocoemts	α_0	α_{11}	α_{12}	α_{13}	α_2	α_3	α_4	α_5	α_6
	0.0456	0.0010	0.0059	0.0108	6.1201	-0.0010	0.1156	13.703	0.0012
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)	(0.002)	(0.00)
Durbin-Watson Statistics				2.005					
Adjusted R-Square				0.882					
Observations				1.416					

* Numbers in the parentheses are heteroscedasticity adjusted significance levels.

The standard deviation difference of the two groups is tested by equation (9), taking into account not only firm characteristic variables but also the exchange rate exposure. Table V contains the coefficient of the dummy variable, i.e. b_1, Considering adjusted R-squares and Durbin-Watson statistics, the data fitted the model well. Panel A of table V shows the standard deviation difference between the two groups after considering firm characteristics and exchange rate exposure. Coefficient b_1 in period I is insignificant at conventional significance levels. This supports the interpretation that the changes of standard deviation in subsequent periods are related to futures trading. The standard deviation difference of the two groups widen as the periods progress I → II → F. However, the standard deviation difference in period S is statistically insignificant. These results indicate that at an early stage of futures trading (period F) the volatility of the KOSPI 200 companies decreases relatively compared with that of the non-futures traded matched-KOSPI 200 companies. In the post-crisis period (period S), however, the volatility of the KOSPI 200 companies relative to the matched KOSPI 200 companies increases to the point where the volatility difference is statistically insignificant. This means that, while short-term volatility in the market increases, the short-term volatility of the KOSPI 200 companies decreases relative to that of the matched-KOSPI 200 companies during the period right after the commencement of futures trading.

Table V

Standard Deviation Differences of the KOSPI 200 Companies and the Matched-KOSPI 200 Companies

A. After Considering Firm Characteristics and Foreign Exchange Rate Exposure

$$SM_i = b_0 + b_1 DKOSPI_i + b_2(|\beta_i| \times \sigma_M) + b_3 LMV_i + b_4 TOR_i + b_5 INVP_i + b_6 |EX_i| + \eta_i$$

	I	II	III	IV	F	S	Pooled data
b_1	0.00018	−0.0009	−0.00178	−0.00173	−0.00193	−0.00108	−0.0030
	(0.375)	(0.003)	(0.000)	(0.018)	(0.000)	(0.230)	(0.000)
b_6	0.0001	0.0006	0.0013	0.0124	0.0013	0.0156	0.0013
	(0.501)	(0.007)	(0.000)	(0.018)	(0.000)	(0.003)	(0.000)
AR^2	0.690	0.455	0.629	0.401	0.621	0.457	0.756
D-W	2.110	2.139	2.099	1.891	2.027	2.007	1.887
Nob.	382	346	360	324	346	342	2.100

B. After Considering Firm Characteristics Only

	I	II	III	IV	F	S	Pooled data
b_1	0.00017	−0.00100	−0.0018	−0.0025	−0.0018	−0.0020	−0.00318
	(0.420)	(0.001)	(0.000)	(0.001)	(0.000)	(0.025)	(0.000)
AR^2	0.690	0.448	0.589	0.338	0.585	0.378	0.753
D-W	2.111	2.130	2.116	1.961	2.063	2.052	1.891
Nob.	382	346	360	324	346	342	2,100

* Numbers in the parentheses are heteroscadasticity-adjusted significance levels.

** AR2: Adjusted R-square, D-W: Durbin-Watson Statistic, Nob.: Number of observations.

Panel B in table V shows the standard deviation difference between the two groups after considering firm characteristic variables only. The standard deviation difference of the two groups widens as the periods progress I → II → F → S. The adjusted R-squares decrease after period I compared to the results in panel A. One of the plausible explanations to the higher standard deviations of the matched-KOSPI 200 companies in period S in panel B is that the foreign exchange rate exposure has a greater influence on the standard deviation of the matched-KOSPI 200 companies than on the KOSPI 200 companies in that period. The difference between panel A and panel B demonstrate the importance of foreign exchange rate exposure in analyzing stock market volatility.

3.3. Testing on the Reason for the Change of Volatility Difference

Market friction in the stock market and changes in information flows could explain the short-term volatility change observed in this study. The weekly standard deviation is r-egressed on the futures dummy variable, firm characteristic variables and the exchange rate exposure to examine the role of information flows. The daily first order autocorrelation is also regressed on the same independent variables to test the role of market frictions. Table VI shows test results. The information creation of the KOSPI 200 companies decreases relative to that of the matched-KOSPI 200 companies in periods II and F. In period S, however, the gap between the two groups narrows. The first order autocorrelation of the KOSPI 200 companies increases relative to that of the matched-KOSPI 200 companies in periods II and F. However, the autocorrelation of the KOSPI 200 companies decreases relative to that of the matched-KOSPI 200 companies in period S. One of the plausible explanations for the changes in the information creation and the autocorrelation during the early period of futures trading (period F) is that information created in the futures market influence the matched-KOSPI 200 companies more than the KOSPI 200 companies. This is possible if the information created in the futures market is not new information that induces price changes of the KOSPI 200 companies but is valuable new information concerning the matched-KOSPI 200 companies. This interpretation is persuasive when information created in the KOSPI 200 futures market could not be transferred easily to futures traded stocks. Actually, program trading, which is a mechanism for information transmission from the futures market to the spot market, was not active in the stock market during this period.

Table VI

Differences in Weekly Standard Deviation and Daily First order Autocorrelation of the KOSPI 200 Companies and the Matched-KOSPI 200 Companies.

	I	II	III	IV	F	S
Weekly standard deviations difference						
	−0.00251	−0.00448	−0.00578	−0.00629	−0.00761	−0.00667
	(0.000)	(0.000)	(0.001)	(0.018)	(0.000)	(0.019)
Daily first order autocorrelation difference						
	−0.0349	−0.0173	−0.0089	−0.0223	−0.0132	−0.0197
	(0.000)	(0.029)	(0.228)	(0.004)	(0.081)	(0.009)

* Numbers in the parentheses are heteroscedasticity adjusted significance levels.

The empirical test results are summarized as follows: Short-term standard deviation increases on the whole after the introduction of futures trading. However, at an early stage of futures trading (period F) the short-term standard deviation and information creation of the KOSPI 200 companies decrease relative to those of the matched-KOSPI 200 companies, and the autocorrelation of the KOSPI 200 companies increases relative to that of the matched-KOSPI 200 companies. This is a contrary result to the assertion made by Brorsen (1991). However, the relative gaps between the two group companies narrow in the post-crisis period (period S). A discussion of the market friction existing in the Korean stock market will shed some light on the interpretation of this unexpected finding.

IV. Discussion

Empirical test results in section III show that short-term volatility and market operation efficiency of the KOSPI 200 companies relatively shrank compared with those of the matched-KOSPI 200 companies in the period immediately following the commencement of futures trading. In this period several regulations existed in market operation system and these served as market friction in Korean stock markets. However, the volatility and market efficiency of the KOSPI 200 companies increased relative to the matched-KOSPI 200 companies in the post-crisis period, narrowing the gap between the two groups. Those regulations, notably restrictions on foreign investors, had been substantially removed after the financial crisis. Considering these environmental changes and empirical test results, market friction can be conjectured as a major factor explaining changes of the short-term volatility difference. This is possible because the effect of market friction on the KOSPI 200 companies and on the matched-KOSPI 200 companies can differ and the relationship can change with the commencement of futures (options) trading.

The mean of daily trading volumes of the two groups presented in table VII shows that the trading volume of KOSPI 200 companies decreased just after the introduction of futures trading. Trading volume of the KOSPI 200 companies decreased about 12% in period F compared to period II, whereas the trading volume of the matched-KOSPI 200 companies increased about 28% during the same period. In period S, however, the rate of the KOSPI 200 companies (312%) was much greater than that of the matched-KOSPI 200 companies (141%). Turnover ratio shows the similar pattern. The decrease of trading volume of the KOSPI 200 companies after futures market introduction does not coincide with the general idea that futures trading encourages the trade of related stocks through program trading and arbitrage transaction.

Table VII
Daily Mean Trade Volumes of the KOSPI 200 Companies and the Matched-KOSPI 200 Companies

	I	II	III	IV	F	S
KOSPI200	61,030	87,859	75,991	264,137	77,195	318,022
	(0.0048)	(0.0053)	(0.0045)	(0.0092)	(0.0042)	(0.0115)
Matched-KOSPI 200	19,935	27,968	37,202	67,686	34,889	83,972
	(0.0047)	(0.0071)	(0.0099)	(0.0110)	(0.0093)	(0.0121)

* Number in the parenthesis is the mean of turnover ratios. ** Turnover ratio = daily trade volume of common stocks divided by number of registered common stocks

It is widely accepted in Korea that foreign investors have superior analytical ability and trading techniques relative to domestic investors and foreign investors have considerable influence on Korean stock markets. At the beginning stage of futures trading, in particular, domestic investors who had insufficient experience in futures trading could have been influenced by foreign investor behavior. The Financial Supervisory Services impose an investment ceiling on foreign investors share holding. This ceiling is a market friction that hinders the effect of futures trading from spilling over into stock markets. The ratio of foreign investor daily trading volume over registered stocks gives some hints for inferring the effect of the ceiling. The ratio presented in table VIII show that foreign investors increase their trade of KOSPI 200 companies in accordance with the ceiling adjustment schedule. However, the ratios of the matched-KOSPI 200 companies decrease as ceilings are raised. In period S, foreign investors greatly increased their trades of the KOSPI 200 companies and decreased their trades of the matched-KOSPI 200 companies. This trend is shown more clearly in the analysis of the top 50 companies in which foreign investors trade. Interestingly, the ratio of the matched-KOSPI 200 companies increased also in period III along with the KOSPI 200 companies. Ceilings are a problem when foreign investors exhaust the allowed limit. When ceilings are exhausted, foreign investors are not able to buy more of the stock except buying from other foreign investors. The effect of ceilings on the stock market increased continuously in the pre-crisis period. Among the sample companies, only three companies approached their foreign ownership quota by over 99% on 28 March 1996; two of them were among the KOSPI 200 companies and the other was one of the matched-KOSPI 200 companies. The number of companies approaching their foreign ownership quota (over 99%) increased after futures trading commenced. For example, on 27 December increased afrer futures trading commenced. For example, on 27 December 1996 the number of companies increased to 39 and on 27 December 1997 increased again to 47 companies. The KOSPI 200 included companies were 25(64%) companies and 32 (68%) companies, respectively.[12] These indicate that ceilings on foreign investors effectively restrict spot market trading, especially trading in KOSPI 200 stocks, resulting in a hindrance of both program trading and arbitrage between futures market and stock market made by foreign investors. Actually, program trading was not active in the stock market during this period[13] This may also have motivated foreign investors to have more interest in the matched-KOSPI 200 companies in the early stage of futures trading.

12) Source: the Korea Stock Exchange. This study investigates only a few specific dates due to data availability.

13) Program trading is about 0.58% of the total trading volume in period F. However, that ratio increases to 2.11% in period S (Statistics derive from monthly figures in the KSE journal, Stock, in the period of December 1996-January 1999).

Table VIII

Ratio of Foreign Investors Trading Volume to Registered Stocks

Peridos	II	III	IV	F	S
Total sample companies					
KOSPI 200	0.042	0.048	0.084	0.053	0.080
Matched−KOSPI 200	0.035	0.038	0.021	0.033	0.023
Top 50 companies					
KOSPI 200	0.045	0.035	0.101	0.062	0.114
Matched−KOSPI 200	0.046	0.055	0.028	0.049	0.033

* Period II starts from 3 May 1995 due to data availability.

** Top 50 companies are companies which foreign investors trade volumes are ranked within the top 50 for each group.

The examination of trade volumes and the effect of ceilings on foreign investors verify the interpretation that the relative decrease of the standard deviation of the KOSPI 200 companies is due to market frictions. As futures trading increases, investors have become more interested in the stock market and additional information is created in the futures market. If stock prices adjust quickly to the new information, this new information plays a role in reducing frictions in the stock market. Some of the information created in the futures market, however, although not new information concerning the KOSPI 200 companies, could be valuable new information concerning the matched−KOSPI 200 companies[14)]

The effect of the KOSPI 200 futures (options) trading on stock markets can be summarized as follows: i) Market frictions such as ceilings on foreign investors make it

14) This can be a positive effect of futures trading on the stock market, if, in particular, the spot market is underdeveloped. However, it is not possible to test this effect separately within the empirical model of this study

difficult for the KOSPI 200 stock prices to adjust immediately to the information created in futures market. ii) The increased foreign investor interest in the stock market due to the introduction of futures (options) trading find an outlet in the matched-KOSPI 200 companies, which have more room in ceilings relative to the KOSPI 200 companies. iii) Futures trading gives some valuable information on the matched-KOSPI 200 companies, which are less scrutinized than the KOSPI 200 companies. In sum, KOSPI 200 futures trading improve market conditions of the matched-KOSPI 200 companies in respect to information creation and information transfer relative to those of the KOSPI 200 companies.

V. Conclusion and Remarks

This study analyzes the relationship between the KOSPI 200 futures (options) trading, and the stock market volatility by focusing on frictions in the stock market. Test results show that standard deviations of stock market increased after the commencement of futures trading. However, the standard deviation of the futures traded KOSPI 200 companies decreased relative to that of the non-futures traded matched-KOSPI 200 companies before the financial crisis (period F). During this period, relatively strong market frictions existed in stock markets. Meanwhile, in the post-crisis period, the standard deviation of KOSPI 200 companies increased to the point where the difference of standard deviation between the KOSPI 200 companies and the matched-KOSPI 200 companies became statistically insignificant. During the post-crisis period, those market frictions were greatly mitigated. Considering the analytical model and empirical test results, changes in standard deviation gaps between the KOSPI 200 companies and the matched-KOSPI 200 companies before and after the financial crisis have interacted with frictions in stock markets. It could be asserted that the ceiling on foreign investors is a more restricted regulation on the KOSPI 200 companies than on the matched-KOSPI 200 companies and futures trading amplifies the effect of this friction.

Contrary to wide spread belief, these test results do not support the assertion that KOSPI 200 futures trading reduces frictions in the stock market. However, this study shows that KOSPI 200 futures (options) trading could potentially reduce market friction in the stock market in future periods. The results of this study suggest that adjustments in market regulations facilitating the transfer of information created in the futures market to spot markets are necessary to maximize its positive economic functions. Authorities planning to organize futures markets should pay heed this finding. The results also show that foreign exchange rate factors should be considered in the stock market research where foreign investors and foreign economies have considerable influence, such as Korea.

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