Market Expectations of Economic Uncertainty around the Bank of Korea Monetary Policy Meetings

Nabil Maghrebi[1]

Graduate School of Economics, Wakayama University

Sakaedani 930, Wakayama 640-8510, Japan

MooSung Kim

College of Business Administration

Pusan National University, Korea

Abstract

This article examines the impact of the Bank of Korea's monetary policy meetings on market anticipations of future volatility. The VXK index of implied volatility based on Kospi200 options is developed to measure the expected levels of market volatility. The evidence from the event-study approach suggests that volatility expectations increase prior to policy meetings. However, there is a significant drop in volatility expectations a day prior to the meetings. This behavior may be reflective of the impact of government pronouncements that often precede the monetary policy announcements. The dissipative effects of government pronouncements are however found to be temporary and short-lived. They can be also construed as disruptive of the announcement effects of the Bank of Korea and even counterproductive, to the extent that post-meeting implied volatility reverts to higher levels of volatility expectations. Under the monetary policy regime of inflation targeting, government signals are not only likely to affect the credibility of these authorities, they have also the potential of weakening the expectations channels and the feedback process involving financial markets.

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1. Introduction

The conduct of monetary policy based on inflation targeting is naturally responsive to changes in the financial and economic environment and the accuracy of inflation forecasts. But, monetary policy decisions aimed at ensuring price stability are also responsive to expectations about future asset price volatility in financial markets. Indeed, the anticipated level of inflation and the direction of monetary policy are function of the degree of economic uncertainty perceived by market participants. Market expectations of future volatility can be indicative, among others, of the degree of prudence or tolerance of financial institutions toward lending, and of the attitudes of firms and individual investors toward borrowing.

Given the importance of measures of economic uncertainty in the conduct of monetary policy and the impact of macroeconomic announcements on financial markets, this study examines the behavior of volatility expectations implicit in options prices around the monetary policy meetings of the Bank of Korea. The issue is whether the regular meetings of monetary policy committee are associated with significant changes in the level of volatility expectations. Since the timing of monetary policy meetings and subsequent announcements are know a prior, the anticipated volatility before meetings is likely to reflect the higher degree of uncertainty reflecting differences in investors' beliefs about the possible impact of policy decisions on market prices. The question also arises as to whether the post-meeting announcements exert a significant impact on market perceptions of economic uncertainty. In particular, if there is an increase in anticipated volatility before these meetings, it is interesting to test whether such announcements have the effect of whittling down the significance of excessive volatility expectations.

There is little empirical evidence on the impact of macroeconomic announcements on volatility expectations in financial markets. The existing literature is primarily focused on the reaction of financial markets to the release of economic reports and macroeconomic information. In particular, the reaction of fixed-income markets to economic announcements is found to depend on the significance of the surprise element, which reflects discrepancies between the released figures and consensus forecasts. The evidence from Ederington and Lee (1996) suggests that implied volatility from a sample of Eurodollar, interest rate and currency options tends to increase prior to the release of macroeconomic information. The scheduled announcements have the effect of decreasing the level of implied volatility since the

incremental uncertainty about the impact of news is resolved. This stands in contrast with unscheduled announcements, which lead to increasing, rather than decreasing volatility expectations. These results are based on implied standard deviations and regression models using dummy variables representing the announcement dates. A similar approach based on dummy variables is also used in Fornari (2004) who tests for changes in the volatility implied by interest rate swaptions during the release of US macroeconomic data. It is shown that that the magnitude of the economic surprise does not explain the significance of pre-announcement changes in implied volatility. There is again evidence that the implied volatility tend to decrease on the announcement dates as the increased uncertainty in anticipation of the impact of macroeconomic news is dissipated. Following the approach by Ederington and Lee (1996), the impact of macroeconomic announcements and meetings of the Federal open market committee on the behavior of the S&P100 implied volatility index is also examined by Nikkinen and Salstrom (2004). The empirical results suggest that while implied volatility increases prior to the release of macroeconomic information and declines thereafter, it only decreases significant on monetary policy meetings, while showing no significant changes prior or after these meetings. The evidence from Carr and Wu (2006) suggests that the new VIX index derived from S&P 500 options is reflective of higher uncertainty in anticipation of monetary policy decisions on the Federal Reserve Fund Rate.

These studies provide strong evidence on the relationship between the conduct of monetary policy and the formation of expectations in financial markets. The growing literature is not based solely on the behavior of market returns and realized volatility, it uses also implied volatility as an ex ante measure for market volatility. This is important because as a forward looking estimate of price fluctuations, the patterns of implied volatility observed over the pre-announcement period, are not necessarily affected by the magnitude of the economic surprise contained in macroeconomic information, as much as realized volatility is. Thus, this study uses the model-free Kospi200 implied volatility index in order to test for the significance of changes in volatility expectations in anticipation of the Bank of Korea monetary policy decisions.

The existing body of evidence relies on the regression modelling of the time series of implied volatility on dummy variables representing the release of economic information and monetary policy meetings. In contrast, this study contributes to this

growing literature with tests based on the event-studies methodology. This approach allows for the examination of implied volatility not only on the date of meeting or the days immediately preceding or following it, but over a longer time horizon. It also allows for the comparison of implied volatilities around monetary policy meetings with the volatility expectations that prevail over period far away from the dates of policy meetings. Thus, the significance of changes in implied volatility can be assessed against observations falling outside the window of days spanning monetary policy meetings.

The Bank of Korea offers an interesting case for the examination of the behavior of implied volatility under the monetary policy regime of inflation targeting.[2] The implementation of monetary policy is not so much based on short-term interest rates, as on the rate of core inflation, which is the price indicator for the inflation target. It can be argued that the requirement for policy transparency through inflation targeting is conducive to lower volatility in financial markets because at least, part of the uncertainty about the future impact of policy decisions is reduced. The evidence from Sohn, Sung and Kwon (2006) indicates that monetary policy signals and announcements have the effect of heightening the volatility of interest rates, exchange rates and stock market returns. It is also shown that government pronouncements, which are often suggestive of loosening monetary policy, have disruptive effects on the tightening announcements by the Bank of Korea, and result in increasing volatility. Another recent study by Sohn and Eom (2007) using transactions data suggests that stock market volatility increases in anticipation of monetary policy announcements, and that such announcements have the effect of decreasing the level of uncertainty.

The present study provides thus, new evidence on the impact of the conduct of monetary policy, on financial markets under the regime of inflation targeting. The empirical results from event-study tests indicate that changes in the Kospi200 implied volatility observed around monetary policy meetings are significant. There is evidence of increasing volatility expectations before meetings, which is consistent with the higher uncertainty about the impact of policy decisions. However, it is also found that implied volatility falls sharply on the day preceding the meetings, raising concerns

[2] The Monetary Policy Committee of the Bank of Korea is responsible for the conduct of monetary policy by pursuing price stability. It holds its scheduled meetings called by its chairman at least once a month.

about the role of government pronouncements issued ahead of the central bank's announcements. The absence of announcement effects and the significant increase in implied volatility two days after policy meetings can be also reflective of the disruptive effects of government pronouncements on market expectations and the effective conduct of monetary policy. The results also suggest that the behavior of implied volatility is sensitive to the underlying market conditions of stagnant versus rising equity valuation.

The remainder of the paper is structured as follows. The next section reviews the methodology underlying the model-free implied volatility index while section 3 briefly describes the event-study methodology used for testing the significance of changes in implied volatility in association with the policy meetings. Section 4 discusses the distributional properties of VXK index and the empirical results of the event-study. Section 5 concludes the paper.

2. Estimation of the implied volatility index

In order to provide a measure of the expected level of volatility in the Korean stock market, this study develops the new implied volatility index (VXK), based on the Kospi200 option prices. This index is not available in the existing financial databases and it was first introduced in Maghrebi, Kim and Nishina (2007). The VXK index is based on the methodology underling the new VIX, which is disseminated by the Chicago Board of Options Exchange. Particular attention has been focused on this model-free approach to implied volatility estimation, given the numerical difficulties in deriving standard deviations from theoretical option pricing models such as the Black-Scholes model. Using out-of-sample forecasting tests, there is also evidence from Blair, Poon and Taylor (2003) that implied volatility has higher predictive power than alternative measures based on historical data. There is also evidence from Nishina, Maghrebi and Kim (2006) that the implied volatility index developed for the Japanese market, based on the Nikkei225 options traded on the Osaka Securities Exchange, has higher forecasting power than historical volatility and conditional volatility derived from GARCH models.[3]

[3] Implied volatility indices are also found to be useful in assessing market sentiment as shown by Whaley (2000) and Simon (2003). Volatility indices can be also used in Value-at-Risk analysis for risk management purposes as demonstrated by Giot (2005).

The calculation approach underlying the VXK index, which is examined in further detail by Carr and Wu (2006) and Jiang and Tian (2007), is briefly described hereafter. As demonstrated by Jiang and Tian (2007), the procedure is based on the concept of fair value of future variance, which was introduced by Demeterfi, et al. (1999) and Britten-Jones and Neuberger (2000). Given the actual stock price S^{o} and an arbitrary price that falls closest to the forward price level $S^{\bullet}$, it is possible to define the fair value of future variance given the risk-free interest rate r, as follows

$$\sigma^2 \equiv \frac{2}{T}\left\{rT - \left[\frac{S^{o}}{S^{\bullet}}e^{rT} - 1\right] - \ln\left(\frac{S^{\bullet}}{S^{o}}\right) + e^{rT}\int_{0}^{S^{\bullet}}\frac{P(T,X)}{X^2}dX + e^{rT}\int_{S^{\bullet}}^{\infty}\frac{C(T,X)}{X^2}dX\right\} \quad (1)$$

where C and P refer to call and put prices, respectively, which are function of maturity T and strike price X. Jiang and Tian (2007) demonstrate that the model-free approach underlying the new VIX index is theoretically consistent with the fair value of future variance.

Given the limited range of exercise prices, the new VIX methodology derives the variance of the underlying asset returns v^2 from options prices as follows

$$v^2 = \frac{2}{T}\sum_{i}\frac{\Delta X_i}{X_i^2}e^{rT}\,Q(T,X_i) - \frac{1}{T}\left(\frac{F}{X^{o}} - 1\right)^2 \quad (2)$$

where $Q(.)$ denotes the option premium and the forward index level $F = X^{\bullet} + e^{rT}\left(C^{\bullet} - P^{\bullet}\right)$ is determined on the basis of the minimum difference between call and put premia $\left(C^{\bullet} - P^{\bullet}\right)$ and its corresponding strike price $X^{\bullet}$. The exercise price that falls immediately below F is denoted as X^{o}. With respect to the near-term and next-term maturities, put options with $X_i < X^{o}$ and call options with $X_i > X^{o}$ are selected for each trading date. The marginal contribution of each option to the implied variance is computed as $\left(\Delta X_i / X_i^2\right)e^{rT}Q(T,X_i)$ based on the strike interval $\Delta X_i = \frac{1}{2}\left(X_{i+1} - X_{i-1}\right)$, which represents the mid-point between adjacent prices. For the lowest and highest strike prices however, this spread is calculated as the difference with the adjacent exercise prices.[4]

The literature on forecasting volatility is reviewed by Figlewski (1997) and Poon Granger (2003).

[4] The strike interval for the Kospi200 index options is set at 5.00 points for the contract months from the quarterly cycle and 2.50 for the remaining options. For the purposes of calculating the VXK index, only the near-term and next term options are

The implementation of new VIX procedure may result in various types of measurement errors, as shown by Jiang and Tian (2007). There are truncation errors to the order of $\Theta = -\frac{2}{T}e^{rT}\left(\int_{0}^{X^l}\frac{P(T,X)}{X^2}dX + \int_{X^h}^{\infty}\frac{C(T,X)}{X^2}dX\right)$ which result from ignoring the tails of the distribution and the reduction of the infinite spectrum of strike prices to the limited and finite series of available option contracts, with exercise prices ranging from the lowest X^l to the highest X^h prices. Due to numerical integration, the restriction of $\int_{X^l}^{X^o}\frac{P(T,X)}{X^2}dX + \int_{X^o}^{X^h}\frac{C(T,X)}{X^2}dX$ to the term $\sum_i \frac{\Delta X_i}{X_i^2}e^{rT}Q(T,X_i)$ can be also conducive to discretization errors. Also, the reduction of the log function $\frac{2}{T}\left\{rT - \left[\frac{S^o}{S^\bullet}e^{rT} - 1\right] - \ln\left(\frac{S^\bullet}{S^o}\right)\right\}$ to the term $-\frac{1}{T}\left(\frac{F}{X^o} - 1\right)^2$ through Taylor expansion can lead to additional measurement errors.

The implied variance from the nearest v_1^2 and next-term contracts v_2^2 is estimated, according to Equation (2), using the Kospi200 option prices. In order to reduce other measurement errors due to the non-synchronous trading, we use options prices $Q(.)$ recorded at 15:00, which coincides with the closing trades at the underlying market. The average price of call and put options is used with respect to the exercise price X^o. The last trading day for the European-style Kopsi200 options is the second Thursday of the contract month. When the expiration of the nearest-term options draws as near as eight calendar days, the rollover to the second and third expiration contracts takes place in order to reduce measurement errors due to trades of options with very short-horizon. The term structure of implied variance is assumed to be linear in the time to maturity in order to approximate the volatility implicit in the hypothetical option with thirty-days to maturity that underlies the implied volatility index. This linear interpolation, which may induce further approximation errors as noted by Jiang and Tian (2007), obeys the following expression

$$v^2 = \left(T_1 v_1^2\left[\frac{N_2 - N_v}{N_2 - N_1}\right] + T_2 v_2^2\left[\frac{N_v - N_1}{N_2 - N_1}\right]\right) \times \frac{N_Y}{N_v} \qquad (3)$$

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used however. This implies that option contracts from the quarterly cycle are not used and the strike interval remains at 2.50.

where N_1 and N_2 denote the number of days to expiration for the two maturities, N_v is the 30-days to expiration for the hypothetical option underlying the index, and N_Y is the days per year. These numbers are expressed in minutes for the sake of greater conformity with the actual calculations of options traders. The extrapolated variance is then annualized and its square root is taken to arrive at the VXK index, which is comparable with the new VIX index.

3. Event-Study Methodology

The VXK implied volatility index computed according to the methodology described above is used in testing the hypothesis of whether volatility expectations in financial markets are affected by the timing of meetings of the monetary policy committee of the Bank of Korea and by subsequent policy announcements. In order to assess the impact of policy meetings on volatility expectations, it is possible to open a window W of days surrounding each meeting, and focus on the time-series observations of implied volatility v, realized volatility σ and market returns y, falling within this window. For a given day t defined in relation to meetings in the event window, the sample average of implied volatility $\bar{v}_t$ over the number of meetings m can thus be expressed as follows

$$\bar{v}_t = \sum_{i=1}^{m} v_{ti} / m \tag{4}$$

The extent to which volatility expectations increase or decrease on a given day representing t days before or after the policy meeting (date 0), can be assessed using the sample average of implied volatility for each of the window days. In order to reduce measurement errors due to overlapping observations, the event window is set to the range of five trading days, amounting to two weeks surrounding each policy meeting. Similarly, the average values of changes in implied volatility $\Delta\bar{v}_t$ and returns $\bar{y}_t$ can be respectively computed, for each day before or after the meeting, as

$$\Delta\bar{v}_t = \sum_{i=1}^{m} \Delta v_{ti} / m \tag{5}$$

$$\bar{y}_t = \sum_{i=1}^{m} y_{ti} / m \tag{6}$$

In order to assess the statistical significance of these sample means, the standard errors are computed using observations that fall outside the window days surrounding each meeting. The approximation of standard errors from the set of observations not contained in the event windows is meant to reduce estimation errors.

$$SE_v = \frac{1}{\sqrt{K-1}} \sum_{s \notin W} \left(v_s - \bar{v}_K \right)^{1/2} \tag{7}$$

where $\bar{v}_K = \frac{1}{K} \sum_{s \in \Omega} v_s$ represents the average implied volatility estimated from the sample observations K, which are exclusive of the set W. Under the assumption of normally distributed volatilities, the statistical significance of the average implied volatilities for each day is assessed using the t-statistic

$$TSTAT_{vt} = \frac{\bar{v}_t}{SE_v} \tag{8}$$

Similarly, it is possible to test for the statistical significance of changes in implied volatility and market returns, based on the respective values of t-statistics $TSTAT_{\Delta v}$ and $TSTAT_y$, as well as standard errors $SE_{\Delta v}$ and SE_y, computed along the lines of equations (7) and (8). Whereas the statistical significance of average market returns is assessed against the null of zero-means, the significance of implied volatility and changes in implied volatility around policy meetings is assessed against the corresponding average levels prevailing over periods where no policy announcements are anticipated.

4. Empirical Evidence

4.1. Distributional Properties

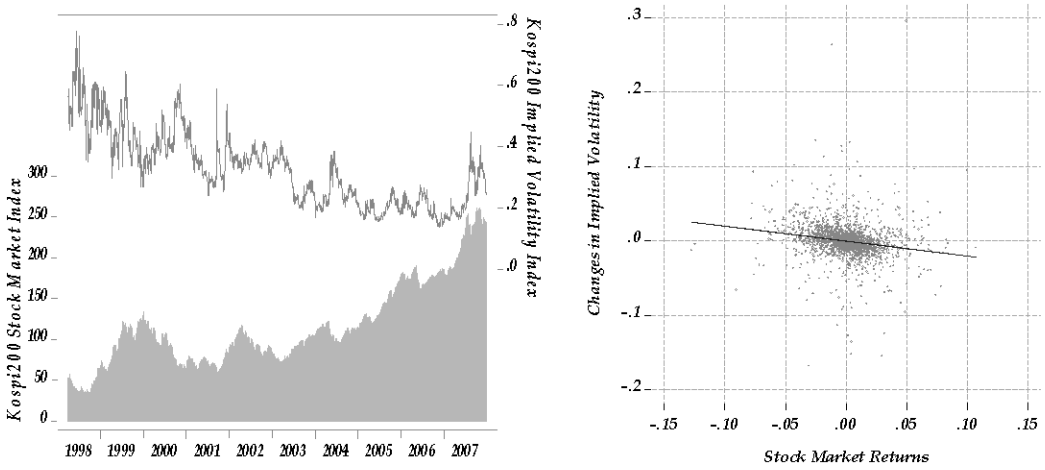
The sample period extends from April 1998, with entry to effect of The Bank of Korea Act, revised in December 1997, through December 2007. The revision reinforces the Bank's institutional independence and neutrality, and defines its functions in terms of the pursuance of price stability through monetary policies based on inflation targeting.[5] The Bank of Korea holds its scheduled meetings at least once a month, but the historical records include a total of 211 meetings over the sample period from April 1998 through December 2007. There are 116 first scheduled meetings and 95 subsequent meetings, held during the same month. The frequency of subsequent meetings was significantly higher during the onset of the Asian financial

[5] The annual inflation target based on the core inflation measure was decided by the Monetary Policy Committee, to set at 9% for 1999, 3% for 2000, 2.5% for 2001, 3% for 2002 and 2003, within a 1% band. The intermediate targeting system provided for a 2.5% to 3.5% mid-term target for the period 2004-2006. The medium term inflation target based on Consumer Price Index was adjusted to 3% within a 0.5% band for the period 2007-2009.

crisis in July 1997 and subsequent years.[6] Indeed, the period from 1998 to 2002 includes 59 subsequent meetings compared with the much lower number of 36 in the remaining years until 2007. Judging from the decrease in additional meetings from 20 in 1998 to just 5 in 2007, there is a clear tendency for a stronger focus of monetary policy decisions on the first scheduled meetings of the month.[7]

It is clear from Figure 1 that following the onset of the Asian currency crisis in 1997-98, there was an increase in the level of Kospi2000 index during 1999. But this was seemingly affected by the burst of the information technology bubble in early 2000 and Latin American debt crisis in 2002. The uncertainties about the prospects of sustainable economic growth in the post-crisis period until 2002 are also reflected in the behaviour of the VXK implied volatility index, which still exhibits high average values, despite its clear downward trend. There is a clear tendency for lower volatility expectations starting from early 2003, which coincides with increasing equity valuation. Changes in implied volatility are negatively related to market returns, as shown by the right-hand panel of Figure 1. As such, the VXK index seems to decrease at during bullish markets and take higher values for decreasing equity. These leverage effects lend further support to the proposition that implied volatility index constitutes a gauge of the level of investors' fear and anxiety, as noted by Whaley (2000).

Figure 1. The time series of the Kospi200 price index and its VXK implied volatility



[6] The month of July 1997 also coincides with the initiation of trading on the Kospi200 index options. While the time series of implied volatility index VXK is reconstructed from the start of options trading, the sample period is adjusted in consideration of the revised Bank of Korea Act, with effect on April 1998.

[7] In order to avoid sampling errors, the exact dates of meetings held by the monetary policy committee were thankfully, provided by The Bank of Korea and corroborated with online publications.

Table 1. Distributional moments and unit-root test results

Sample Period	*Mean*	*Std Dev.*	*Skewness*	*Kurtosis*	*Jarque-Bera*	*ADF test*
	Implied Volatility					
Total Period	0.3254	0.1210	0.6458	2.8623	178.78	-5.646 [a***]
Period A	0.4192	0.0941	0.7683	3.1735	123.53	-5.121 [a***]
Period B	0.2362	0.0619	0.8766	2.9447	167.03	-3.146 [b**]
	Changes in Implied Volatility					
Total Period	-0.0001	0.0217	1.4616	34.0928	103301.09	-26.629 [c***]
Period A	-0.0002	0.0285	1.2734	23.1287	21251.40	-20.206 [c***]
Period B	-0.0001	0.0120	0.6519	9.0954	2109.40	-22.358 [c***]
	Stock Market Returns					
Total Period	0.0006	0.0207	-0.1040	6.3412	1187.01	-48.778 [c***]
Period A	0.0003	0.0260	-0.0290	4.7782	163.42	-33.965 [c***]
Period B	0.0008	0.0138	-0.3577	4.8546	214.52	-35.301 [b***]

Notes: The sample period extends from April 1998 through December 2007, and it is divided into subperiod A, which extends from April 1998 to December 2002, and subperiod B, which starts in January 2003 through December 2007. The total period includes 2543 daily observations, 1240 and 1303 observations in sub-period A and sub-period B, respectively. ADF refers to the Augmented Dickey-Fuller unit root test. In all cases, the lag length is selected according to the Schwarz Information Criterion. The superscripts *** and ** denote rejection of the non-stationary null at the 1% and 5% level, respectively. The superscripts [a], [b] and [c] refer to stationarity tests with both intercept and trend terms, with intercept only and with neither terms, respectively. The respective 1% critical values are -3.965, -3.435, and -2.567.

The distributional moments reported in Table 1, indicate also that implied volatility is highest in the aftermath of financial crises. During the second sample period however, the average volatility expectations are significantly lower, as much as half the average implied volatility during period of declining prices. Implied volatility itself tends to be less volatile during periods of increasing equity valuation. This is reflective of the market perceptions of lower uncertainty in the absence of negative shocks. The daily changes in implied volatility are on average, negative irrespective of the prevailing market conditions. This is indicative of the negative autocorrelation of implied volatility and the tendency for mean reversion. There is also a tendency for market returns to be on average, positive for all sample periods. The time series of returns and volatility are found to be stationary judging from the results of Augmented Dickey-Fuller unit-root tests.

4.2. Behavior of VXK implied volatility index around monetary policy meetings

The results of the event-study tests of the impact of the Bank of Korea monetary policy meetings and announcements on market anticipations of economic uncertainty are reported hereafter. The analysis is performed with respect to the full sample period as well as the subperiods of stagnant versus increasing equity. The tests also allow for differences in the effects of first meetings of the month vis-à-vis subsequent meetings scheduled during the same month. In the rare instance of meetings scheduled over two consecutive business days, the assumption is made that the date of policy meeting falls on the second business day. This assumption is based on the fact the uncertainty about the impact of policy decisions remains over the first day and cannot be resolved until the end of the second bay of meeting. In the absence of official announcement on the first business day of meeting, market perceptions of economic uncertainty can be plausibly assumed to be unaltered.

Table 2. Bank of Korea Monetary Policy Meetings and the Behavior of Volatility Expectations and Market Returns

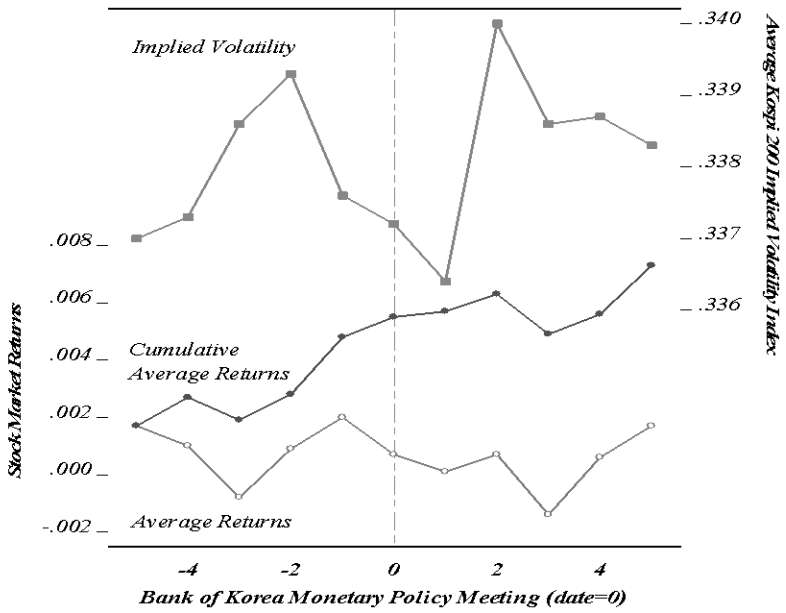
-5	*-4*	*-3*	*-2*	*-1*	*Date of Meeting*	*1*	*2*	*3*	*4*	*5*
Average Market Returns										
0.0017[b]	0.0010	-0.0008	0.0009	0.0020[a]	0.0007	0.0001	0.0007	-0.0014[c]	0.0006	0.0017[b]
(2.1061)	(1.2848)	(-1.0246)	(1.1684)	(2.4845)	(0.9230)	(0.1596)	(0.8576)	(-1.7724)	(0.7876)	(2.1668)
Average Changes in Implied Volatility										
-0.0034[a]	0.0002	0.0013[b]	0.0008	-0.0017[a]	-0.0004	-0.0008	0.0035[a]	-0.0013[b]	0.0001	-0.0004
(-5.1778)	(0.3740)	(1.9613)	(1.1591)	(-2.5462)	(-0.6241)	(-1.1733)	(5.2832)	(-2.0054)	(0.1005)	(-0.5379)
Average Implied Volatility										
0.3370[a]	0.3373[a]	0.3386[a]	0.3393[a]	0.3376[a]	0.3372[a]	0.3364[a]	0.3400[a]	0.3386[a]	0.3387[a]	0.3383[a]
(7.0447)	(7.1015)	(7.3989)	(7.5747)	(7.1885)	(7.0939)	(6.9159)	(7.7172)	(7.4130)	(7.4283)	(7.3467)

Notes: The averages implied volatility and market returns are estimated with respect to all scheduled monetary policy meetings. The sample period extends from April 1998 to December 2007, resulting in 211 meetings. The average implied volatility from out-of-sample observations amounts to 0.3061 with standard deviation of 0.1068. The figures in brackets are t-statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by [a], [b] and [c], respectively.

It is clear from Table 2 that the average returns are significant at the 1% level, only on the day preceding policy meetings. This coincides with a significant decrease in changes in implied volatility on the same day. This downward adjustment in volatility expectations follows a more pronounced decrease five days prior to meetings. There is also evidence of a significant increase in implied volatility two

days following policy announcements. These results indicate that the dynamics of volatility expectations are significantly altered in association with monetary policy meetings. The average implied volatilities are also found to be significantly higher than the average levels of volatility expectations prevailing during days not associated with policy meetings.

Figure 2. Average Implied Volatility and Market Returns around the Bank of Korea Monetary Policy Meetings



Given these dynamics, the resulting patterns of implied volatility are described by Figure 2. There is a monotonous increase in volatility expectations until two days before policy meetings. The significant drop in volatility expectations stands in sharp contrast with the increasing cumulative average returns. The evidence lends little support to the proposition that the uncertainty about monetary policy is dissipated by subsequent announcements, as suggested by the results of Nikkinen and Sahlström (2004), and Fornari (2004). The significant fall in implied volatility may be reflective of market adjustments of volatility expectations following earlier days of overreaction. It can be also indicative of the impact of government pronouncements about monetary policy on volatility expectations. The uncertainty about policy decisions by the Bank of Korea may be to some extent, dissipated by government pronouncements and official signals on the direction of monetary policy. However, this dissipative effect is rather temporary and short-lived, judging from the sharp increase in market perceptions of uncertainty two days after policy meetings. It is important to note the absence of significant announcement effects. Indeed, the *ex ante*

measure of volatility expectations does not exhibit significant changes neither on the day of announcement nor on the following day. These results are consistent with Sohn, Sung and Kwon (2006) that government pronouncements have disruptive effects on the monetary policy announcements. The evidence suggests that given the higher levels of post-meeting volatility expectations, such pronouncements can be even counterproductive and have the potential of undermining the credibility of fine-tuning policies and weakening the expectations channels, which are important in the conduct of inflation targeting.

Table 3. The Behaviour of Implied Volatility around Monetary Policy Meetings under different Stock Market Conditions

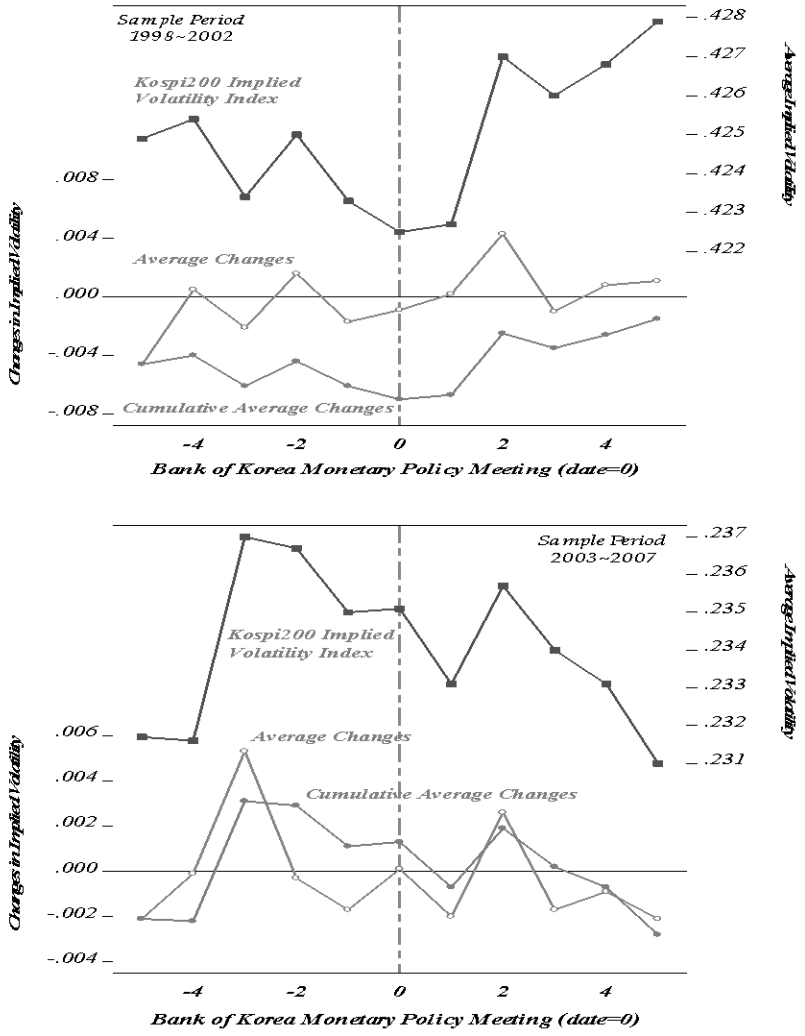
Sample Period	*-5*	*-4*	*-3*	*-2*	*-1*	*Date of Meeting t*	*1*	*2*	*3*	*4*	*5*
						Average Market Returns					
Period A	-0.0003 (-0.1610)	0.0006 (0.3969)	-0.0020 (-1.2254)	0.0014 (0.8552)	0.0028 [c] (1.7511)	0.0025 (1.5359)	-0.0003 (-0.1758)	0.0005 (0.3358)	-0.0010 (-0.5913)	-0.0006 (-0.3578)	0.0016 (1.0047)
Period B	0.0040 [a] (5.1288)	0.0015 [c] (1.9060)	0.0006 (0.7242)	0.0004 (0.5129)	0.0010 (1.2576)	-0.0013 [c] (-1.7190)	0.0006 (0.7926)	0.0009 (1.0973)	-0.0020 [a] (-2.5215)	0.0021 [a] (2.6527)	0.0019 [a] (2.3867)
						Average Changes in Implied Volatility					
Period A	-0.0046 [a] (-3.1647)	0.0005 (0.3796)	-0.0021 (-1.4217)	0.0016 (1.1359)	-0.0017 (-1.1516)	-0.0009 (-0.6059)	0.0002 (0.1673)	0.0043 [a] (2.9493)	-0.0010 (-0.6991)	0.0008 (0.5860)	0.0011 (0.7647)
Period B	-0.0021 [a] (-3.8450)	-0.0001 (-0.2030)	0.0053 [a] (9.7963)	-0.0003 (-0.4998)	-0.0017 [a] (-3.1786)	0.0001 (0.2508)	-0.0020 [a] (-3.6861)	0.0026 [a] (4.8139)	-0.0017 [a] (-3.1652)	-0.0009 (-1.5951)	-0.0021 [a] (-3.8795)
						Average Implied Volatility					
Period A	0.4249 [a] (4.4809)	0.4254 [a] (4.5761)	0.4234 [a] (4.2198)	0.4250 [a] (4.5045)	0.4233 [a] (4.2158)	0.4225 [a] (4.0640)	0.4227 [a] (4.1059)	0.4270 [a] (4.8451)	0.4260 [a] (4.6699)	0.4268 [a] (4.8167)	0.4279 [a] (5.0084)
Period B	0.2317 [a] (-3.5709)	0.2316 [a] (-3.6036)	0.2370 [b] (-2.0261)	0.2367 [b] (-2.1066)	0.2350 [a] (-2.6185)	0.2351 [a] (-2.5781)	0.2331 [a] (-3.1716)	0.2357 [a] (-2.3965)	0.2340 [a] (-2.9061)	0.2331 [a] (-3.1630)	0.2310 [a] (-3.7877)

Notes: The averages and cumulative averages of changes in implied volatility and market returns are estimated for the first and second sub-periods extending from January 1998 to December 2002 (Period A), and from January 2003 to December 2007 (Period B), respectively. These sub-periods are inclusive of 115 and 96 meetings, respectively. The average implied volatility for out-of-sample observations amounts to 0.3990 for the first period and 0.2438 for the second period. The standard errors are estimated to 0.0890 and 0.0637, respectively. The figures in brackets are t-statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by [a], [b] and [c], respectively.

In order to test whether the results are sensitive to leverage effects and the underlying market conditions, the analytical tests are performed with respect to the period of lower returns and higher implied volatility from 1998 to 2002, and with respect to the period of higher returns and lower implied volatility from 2003 to 2007. The results reported in Table 3 indicate that average market returns are not significant in the first sample period following the financial turmoil, irrespective of days prior or after policy meetings. The frequency of significant returns increases for the second

period, suggesting that stock market is more responsive to monetary policy decisions during periods of lower volatility and increasing equity. The average changes in implied volatility are also found to be insignificant over the event window days, except for the negative change five days prior to meetings and the significant increase two after announcements. Again, the significance of these changes in volatility expectations increases during the second period and there is a stronger tendency to take the negative sign. The level of implied volatility during the first (second) period is also found to be significant higher (lower) than the comparative average volatility on days not associated with policy meetings.

Figure 3. Volatility expectations around the Bank of Korea monetary policy meetings



The patterns observed in Figure 3 indicate sharp discrepancies in the behavior of implied volatility in association with monetary policy meetings under different market conditions. There is a tendency for the cumulative average changes in implied volatility to increase during bearish markets, driving volatility expectations higher irrespective of the timing of policy meetings. In contrast, the cumulative

changes tend to decrease during the second period of higher returns, thereby pulling implied volatility lower. The decrease in implied volatility on the day preceding policy meetings observed in Figure 2 for the total sample period is in fact, significant only with respect to the second period. This implies that the disruptive effects of government pronouncements cannot be justified by the efforts to alleviate market perceptions of higher uncertainty during the first period of financial turmoil.

Table 4. The Behavior of Implied Volatility around the First and Subsequent Meetings of the Bank of Korea Monetary Policy Committee

	Average Market Returns		*Average Changes in Implied Volatility*		*Average Implied Volatility*	
	First Meetings	Subsequent Meetings	First Meetings	Subsequent Meetings	First Meetings	Subsequent Meetings
-5	0.0019[a]	0.0014[a]	-0.0044[a]	-0.0023[a]	0.3181[a]	0.3601[a]
	(3.1658)	(2.9688)	(-8.7618)	(-4.5070)	(-2.6387)	(17.6385)
-4	0.0013[a]	0.0006	0.0038[a]	-0.0041[a]	0.3219	0.3560[a]
	(2.2337)	(1.3472)	(7.6966)	(-8.0394)	(-1.5454)	(16.1535)
-3	0.0003	-0.0022[a]	0.0000	0.0029[a]	0.3219	0.3589[a]
	(0.5295)	(-4.6174)	(-0.0363)	(5.6804)	(-1.5505)	(17.2028)
-2	0.0040[a]	-0.0029[a]	-0.0008	0.0027[a]	0.3211[c]	0.3616[a]
	(6.7623)	(-6.0281)	(-1.6133)	(5.2422)	(-1.7797)	(18.1712)
-1	0.0017[a]	0.0023[a]	0.0006	-0.0045[a]	0.3217	0.3571[a]
	(2.8865)	(4.8025)	(1.1983)	(-8.7376)	(-1.6095)	(16.5571)
Date of Meeting	0.0016[a]	-0.0003	0.0017[a]	-0.0030[a]	0.3234	0.3541[a]
	(2.6949)	(-0.7036)	(3.4567)	(-5.8872)	(-1.1184)	(15.4696)
1	0.0006	-0.0004	0.0015[a]	-0.0035[a]	0.3249	0.3505[a]
	(0.9953)	(-0.9332)	(2.9777)	(-6.8988)	(-0.6955)	(14.1951)
2	0.0018[a]	-0.0007	0.0023[a]	0.0050[a]	0.3272	0.3556[a]
	(3.0186)	(-1.4427)	(4.5357)	(9.8147)	(-0.0511)	(16.0082)
3	-0.0020[a]	-0.0007	-0.0016[a]	-0.0010[c]	0.3255	0.3546[a]
	(-3.3581)	(-1.4342)	(-3.2388)	(-1.9290)	(-0.5113)	(15.6519)
4	0.0007	0.0006	0.0003	-0.0002	0.3258	0.3544[a]
	(1.1306)	(1.1919)	(0.5101)	(-0.3153)	(-0.4388)	(15.5936)
5	0.0022[a]	0.0011[a]	0.0014[a]	-0.0025[a]	0.3272	0.3519[a]
	(3.7088)	(2.3617)	(2.8220)	(-4.8879)	(-0.0379)	(14.6907)

Notes: The averages and cumulative averages of changes in implied volatility and market returns are estimated for 116 first-meetings of the month and for 95 subsequent meetings, over the sample period extending from April 1998 to December 2007. The average implied volatility for out-of-sample observations amounts to 0.3273 for the first meetings and 0.3110 for subsequent meetings. The standard errors are estimated to 0.1249 and 0.1115, respectively. The figures in brackets are t-statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by [a], [b] and [c], respectively.

Finally, it is also important to test for differences in the reaction of implied volatility to the first meetings of the month, as opposed to subsequent meetings which are held rather irregularly. As noted earlier, the distinction is justified on the grounds that the frequency of subsequent meetings has been decreasing over the years. There

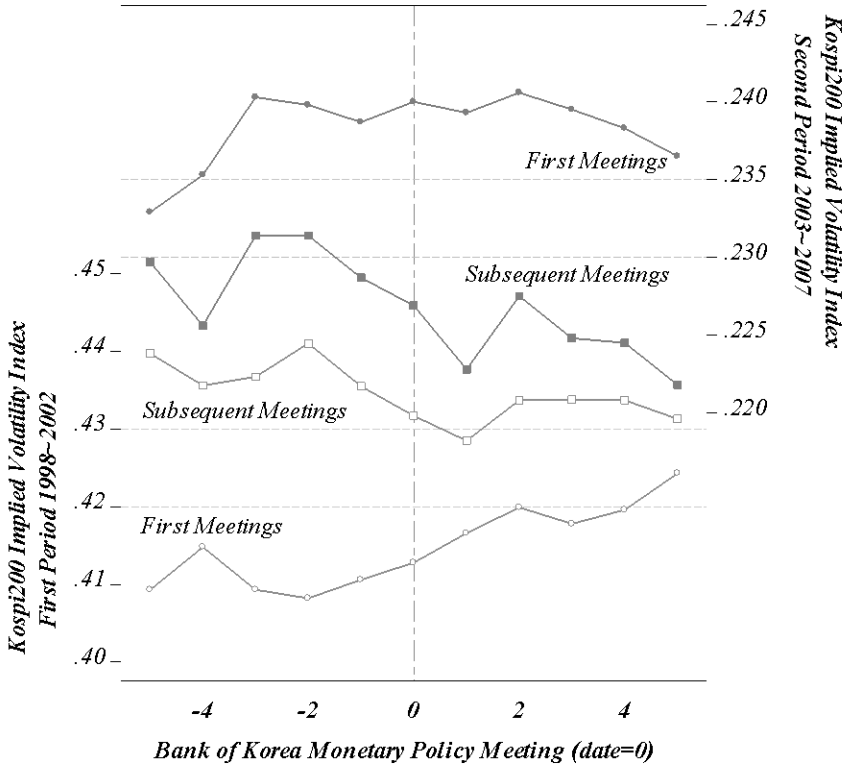
is a tendency to limit monetary policy decisions to the first scheduled meeting of the month. The significance of the effects of first meetings versus subsequent meetings on implied volatility and market returns is tested following the same event-study approach. The results reported in Table 4 indicate that market returns tend to take the positive sign over the window days and to be significant until the very date of first meetings. In contrast, the returns tend to decrease significantly with two and three days prior to subsequent meetings and increase only on the day of meetings. These different patterns may be attributed to market perceptions that additional meetings may be reflective of increased concerns about monetary policy and thereby, conducive to higher levels of uncertainty. This is consistent with the positive and significant changes in implied volatility with two and three days remaining to meetings, which are reported only with respect to subsequent meetings. The significant decrease in implied volatility one day prior to meetings, observed in Figures 2 and 3, seems to be attributable to subsequent meetings rather than to first scheduled meetings.

It is interesting to test whether government pronouncements are focused on the dissipation of uncertainty surrounding additional policy meetings, but this issue falls beyond the scope of this study. The question remains also as to what factors are responsible for the significant increases in volatility expectations two days after policy meetings, irrespective of whether such meetings are held at the beginning of the monthly or on subsequent basis. The average levels of implied volatility are not found to be significant different from comparative levels of volatility expectations on days not associated with first meetings. This implies that subsequent meetings are more conducive to market perceptions of higher uncertainty, which provides a rationale for the recent tendency towards the conduct of monetary policy through regular single monthly meetings.

Because an important number of subsequent meetings were held during the period of bearish markets, it is important to separate the impact of market conditions on the results reported in Table 4. The patterns of implied volatility described in Figure 4 are based on the simultaneous tests of the asymmetric impact of first meetings versus subsequent meetings and the effects of leverage effects. It is noted that the average implied volatilities associated with the first meetings are higher (lower) that those for subsequent meetings during the first (second) period. This suggests that subsequent meetings, which used to take place during periods of turmoil,

are no longer associated with higher uncertainty than first meetings of the month. Also, it is noted that the pattern of monotonously increasing volatility expectations associated with first meetings during the first period is not observed during the second period. There is still a decrease in volatility expectations one day before meetings and of an increase two days following the meetings, but the magnitude of these changes is significantly reduced.

Figure 4. Implied Volatility around the First Meetings and Subsequent Meetings of the Bank of Korea Monetary Policy Committee



The evidence suggests that in testing the significance of the impact of monetary policy meetings and announcements on market expectations, it is important to take simultaneously into consideration the asymmetric relationship between market returns and volatility as well as the frequency and regularity of policy meetings.

5. Conclusion

This study examined the impact of the Bank of Korea monetary policy meetings and policy announcements on market expectations of future volatility. The anticipated level of market volatility is estimated using the VXK index of implied volatility derived from Kospi 200 options. Because this volatility index is not

available on financial databases, its time series constructed for the sample period starting from April 1998, which coincides with the institutional independence of the Bank of Korea and its pursuance of price stability through the conduct of monetary policy under the regime of inflation targeting. The issue is not so much whether market perceptions of uncertainty are significantly affected by policy decisions as to whether volatility expectations are reflective of the heightened uncertainty about the impact of policy decisions, and whether they are responsive to policy announcements.

We follow the event-study methodology, which is not used in the existing literature, in order to assess the reaction of implied volatility over the window days surrounding the policy meetings. Because such meetings constitute a renewed opportunity to reassess the effectiveness of monetary policy and respond to changes in inflation expectations, they are understandably accompanied with market expectations of higher uncertainty regarding the important changes in policy. The evidence is consistent with this proposition, as it suggests that the VXK index of implied volatility increases prior to meetings. However, there is also a sharp fall in volatility expectations one day prior to the meetings. The timing of this significant decrease in implied volatility precludes the policy announcement effects and leaves room for a number of possible justifications.

The significant pre-announcement decrease may be reflective of market revision of volatility expectations in adjustment to earlier overreactions. It can be also indicative of the impact of government pronouncements about monetary policy on volatility expectations, which usually occur ahead of policy announcements. The dissipative effects of government pronouncements are found to be temporary and short-lived. They can be also construed as disruptive of the announcement effects of the Bank of Korea and even counterproductive, to the extent that post-meeting implied volatility reverts to higher levels of volatility expectations. It is important to avoid even the semblance of interfering in the conduct of monetary policy by the independent monetary authorities because government signals do not only affect the credibility of these authorities, they do also weaken the expectations channels and the feedback process involving financial markets. It is also shown that there is a need for tests of the impact of monetary policy meetings on volatility expectations to take into consideration the underlying market conditions and the frequency and regularity of scheduled meetings. This open avenues also for further research on the impact of

announcements effects on the formation of rational expectations of future market volatility.

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