The Bank of Japan Monetary Policy Meetings and the Behaviour of the Nikkei225 Implied Volatility Index

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Abstract

This study examines the behavior of volatility expectations and market returns around the Bank of Japan's monetary policy meetings. The Nikkei225 implied volatility index is used to estimate changes in market anticipations of future uncertainty associated with these meetings. The evidence suggests that implied volatility increases prior to meetings but tends to drop significantly on the very day of scheduled meetings and thereafter. This pattern is reflective of the incremental uncertainty that such meetings are associated with, and of the significant mitigating effects of the immediate release of policy decisions. The behavior of average returns is also indicative of the significance of monetary policy meetings for equity valuation. However, the observed patterns are also sensitive to the prevailing market conditions and to the frequency and regularity of scheduled meetings.

JEL Codes: E52, E58, G14

Keywords: Bank of Japan, Monetary Policy Meetings, Nikkei225 Implied Volatility Index, Market Expectations

1. Introduction

The issue of how asset markets react to the arrival of new information has occupied the attention of academia as well as economic policymakers, not least because it has important bearing on market efficiency market participant's macro–beliefs and consensus expectations. There is a rich literature on market reaction to economic events, which is focused on the behavior of speculative prices in association with macroeconomic announcements and the release of economic reports. This focus on macroeconomic announcements and released reports is justified given their potential impact on financial markets, the significance of which depends on the discrepancies between the released statistics and consensus forecasts. The empirical evidence suggests that the impact on market returns is an increasing function of the magnitude of deviations from consensus estimates.

However, another important aspect of the reaction of financial markets to macroeconomic news is the fact that changes in market anticipations of future uncertainty are not necessarily confined to the

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exact dates of announcement. Perceptions of increased uncertainty about the informational content of macroeconomic information may be reflected also in volatility expectations over a number of days preceding the announcements. The behavior of *ex ante* volatility expectations does not indeed depend solely on the informational content of announcements, which is rather unknown *a priori*. It is thus, important to examine the fundamental issues as to whether, and to what extent, implied volatility increases in association with not just macroeconomic announcements, but with respect also to important policy meetings such scheduled by monetary authorities. Monetary policy decisions made during such meetings have the potential of influencing the return–generating process, and in turn affect market anticipations of future volatility.

Thus the purpose of this paper is to examine these empirical issues related to market efficiency and the interrelationship between macroeconomic policymaking and market macro–beliefs. The analysis is performed with respect to the scheduled Monetary Policy Meetings (MPM) of the Bank of Japan, following its institutional independence in April 1998. The MPMs constitute indeed an important source of new macroeconomic information, as reflected by published minutes, the Bank's views on economic and financial developments and its guidelines for money market operations. The behavior of volatility expectations in association with the scheduled MPMs is assessed using the forward–looking Nikkei225 implied volatility (IV) index. This model–free volatility index allows for the examination of patterns in market reaction to scheduled MPMs with respect to the second moments implied by the Nikkei225 options prices.

The present study offers thus, new evidence on the relationship between scheduled MPMs, as opposed to subsequent announcements about monetary policy, and market perceptions of future uncertainty. A second key contribution is that this empirical analysis of implied volatility is made using the event–study methodology. This approach tests for recurrent patterns in volatility expectations prior and after scheduled meetings and, in contrast with many studies, it is not based on the dummy–variables approach, which measures the impact of announcement dates only. A third contribution is that new evidence is presented on the asymmetric reaction to scheduled meetings during periods of increasing and decreasing market returns.

The remainder of the paper is structured as follows. The next section reviews in brief the literature on implied volatility insofar as macroeconomic information is concerned. Section 3 discusses the sample of observations and the estimation approach based on the event–study methodology. Section 4 examines the empirical evidence. Section 5 concludes the paper.

2. Review of the Literature——on Implied Volatility

There is an extensive literature on implied volatility, which relates to numerical issues in the estimation procedure, the forecasting performance and reaction to macroeconomic information. There are measurement problems, which stem from the failure of the iterative process to converge toward numerical estimates of volatility that equate market prices with theoretical values. The numerical procedure is based on particular option pricing models such as the Black and Scholes (1973) option

pricing theory, which are not conducive to closed–form solutions. There are also several empirical studies on the information content of implied volatility from stock index options such as Day and Lewis (1992), Canina and Figlewski (1993), and Fleming (1998), inter alia.[1] The growing literature provides strong evidence that implied volatility constitutes a reliable estimate of future market volatility, associated with higher forecasting power than alternative measures including historical volatility, and conditional volatility derived from generalised autoregressive conditional heteroskedasticity models.

The literature on the behavior of implied volatility with respect to macroeconomic information includes the evidence from Neely (2005) that implied volatility from three–month eurodollar interest rates changes in association with major economic events and unanticipated variations in the federal funds target rate. Earlier evidence from Ederington and Lee (1996) suggests that the implied volatility from T–Bond options decreases on the scheduled announcements of macroeconomic information as the incremental uncertainty associated with the expected impact of released information is resolved. This is not true of unscheduled announcements, which have the effect of increasing market uncertainty and the level of implied volatility. There is also evidence from Fornari (2004) that implied volatility from interest rate swaption prices tends to decrease following the release of US economic reports. These patterns do not seem to be function of the significance of the announcement surprise. Nikkinen and Sahlström (2004) provide also evidence that the VIX implied volatility index, based on the S&P 100 options, increases one day prior to the scheduled releases and decreases on the announcement date as well as the subsequent day. Whereas implied volatility decreases on the dates of meetings by the Federal Open Market Committee, there is no evidence of significant changes prior to or after these meetings.

The strong evidence from these studies is indicative of the significant impact of these events on market volatility but the testing approach is based on the regression of changes in implied volatility on dummy variables for the dates of announcements and meetings as well as the immediately preceding and subsequent days. There is therefore, a need for further tests capable of capturing possible patterns of gradual or alternatively sudden increases in implied volatility prior to macroeconomic events and the monotonous or precipitous decreases thereafter. One of the principal purposes of this study is to examine the behavior of market volatility over a number of days prior and following the Bank of Japan's scheduled monetary policy meetings.

Given the empirical evidence on the informational content of volatility implicit in options prices, and the numerical difficulties in its derivation, there is a tendency in recent studies to use model–free indices of implied volatility such as Blair, Poon, and Taylor (2001), and Nishina, Maghrebi and Kim (2006b), inter alia. The model–free new VIX index based on the S&P500 benchmark is calculated by the Chicago Board of Options Exchange and the underlying approach is critically examined by Carr and Wu (2006) and Jiang and Tian (2007). Using the new VIX index, Carr and Wu (2006) also show

[1] There are interesting reviews by Figlewski (1997) and Poon and Granger (2003) of the literature on forecasting volatility including studies on the usefulness of implied volatility.

that the level of volatility expectations increases prior to the Federal Open Market Committee meetings. The purpose of the present study is also to investigate the impact of the Bank of Japan's MPMs on the behavior of implied volatility, using the Nikkei225 IV index extended from Nishina, Maghrebi and Kim (2006a).[2] The testing approach differs however, from Carr and Wu (2006) in that it examines the statistical significance of average implied volatility and cumulative returns. The MPM effects are thus, measured with respect to the dynamics of volatility expectations and market returns rather than levels of implied volatility only.

3. Data and Methodology

This section briefly describes the estimation approach underlying the Nikkei225 IV index, which does not depend on a particular option pricing model such as the Black–Scholes model. Jiang and Tian (2007) demonstrate that the calculation procedure is based on the fair value of future variance proposed by Demeterfi, et al. (1999) and Britten–Jones and Neuberger (2000). It is possible to extract the implied variance from options with given maturity n and time–to–expiration τ from the observed structure of exercise prices and option premia as follows

$$\sigma_n^2 = \frac{2}{\tau}\sum_i \frac{\Delta k_i}{k_i^2} e^{r\tau} g\left(\tau, k_i\right) - \frac{1}{\tau}\left(\frac{f}{k^*} - 1\right)^2 \tag{1}$$

where k^* denotes the exercise price below the forward level f. The contribution of options with exercise price k_i to the implied variance is reflected by $\left(\Delta k_i / k_i^2\right) e^{r\tau} g\left(\tau, k_i\right)$, which is estimated using closing option prices $g(\cdot)$, given the risk–free interest rate r. Call options are used for exercise prices greater than the forward level and put options otherwise. The average of call and put prices is used for the exercise price k^*. The spread between exercise prices Δk_i is calculated as the mid–point between adjacent prices, except for the lower and upper limits where it is equal to simple differences of exercise prices at the end of the spectrum.

The index is based on the nearest and next–term maturities estimated according to Equation (1). However, in order to avoid potential measurement errors associated with options with imminent expiration, the rollover process toward the second and third expiration series takes place with eight days remaining to maturity of the nearest maturity contract. The implied variance for the hypothetical option with 30 days to expiration can be obtained through the following interpolation process

$$\sigma_{IV}^2 = \left(n_1\sigma_1^2\left[\frac{n_1 - n_{IV}}{n_2 - n_1}\right] + n_2\sigma_2^2\left[\frac{n_{IV} - n_1}{n_2 - n_1}\right]\right) \times \frac{n_Y}{n_{IV}} \tag{2}$$

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[2] The Nikkei225 stock average serves as the underlying asset for derivatives contracts traded on major financial markets, such as the Osaka Securities Exchange, Chicago Mercantile Exchange and Singapore International Monetary Exchange. The Nikkei225 IV index is calculated from the index options traded on the OSE. The estimation approach follows the methodology underlying the new VIX index, which is described in further details in the CBOE documentation and discussed in Carr and Wu (2006).

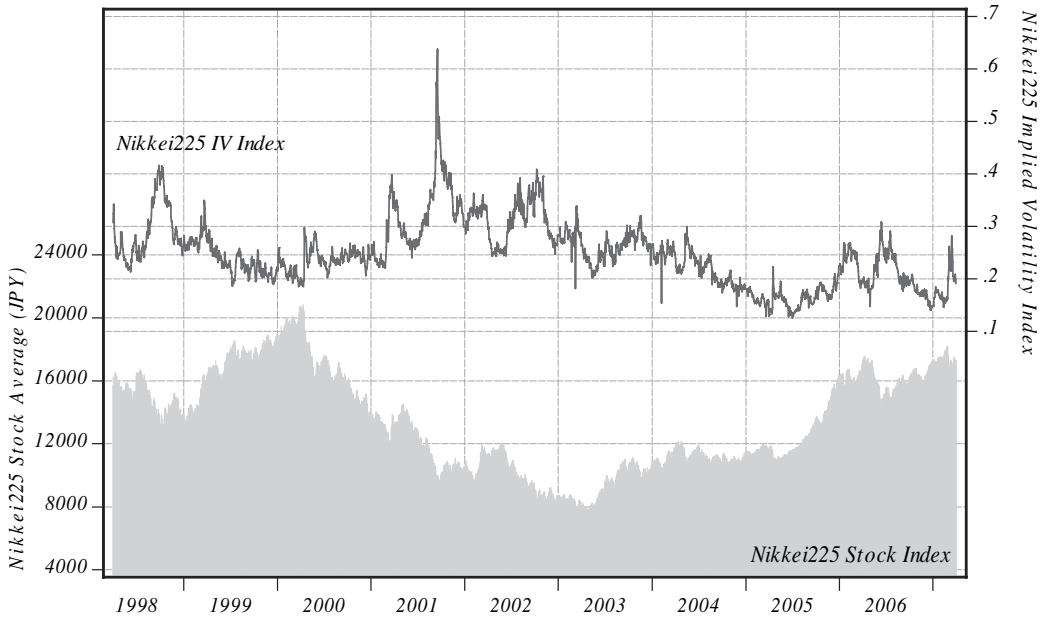

Figure 1. The Behavior of the Nikkei225 Stock Average and Implied Volatility Index

where σ_1^2 and σ_2^2, represent the implied variances expressed in Equation (1) and estimated from options with the near–term and next–term maturities, respectively. The number of minutes remaining to the expiration of near–term and next–term contracts is denoted by n_1 and n_2, respectively. The thirty–day–long time–to–expiration of the hypothetical option n_{IV} is also expressed in minutes whereas the number of minutes over the period of one year is denoted by n_Y. The implied variance expressed by Equation (2) is annualized and its square root σ_{IV} represents the Nikkei225 IV index.

The sample period extends from April 1, 1998, the date on which the Bank of Japan's institutional independence entered into effect, through March 30, 2007. This period spans a total of 108 monthly maturities and 149 scheduled MPMs. It is clear from Figure 1 that the Japanese stock market was characterized by trends toward decreasing prices, which lasted apparently until early 2003. The Nikkei 225 IV index tends to increase sharply in association with the fall in equity prices. Its behaviour over time is characterized by several spikes, which are reflective of increased concerns about the Japanese economic recession as well as external shocks such as the Russian default and the Long–Term Capital Management crisis in 1998. Thus, this volatility index provides an important measure of the future level of economic uncertainty perceived by market participants.[3]

The evidence from Table 1 is also suggestive of zero–average returns over the total sample period. But following years of economic recession, the trend reversals towards higher equity valuation, starting in 2003, ushered in a period of positive returns. These market conditions are also reflected by

[3] Based on the Black–Scholes option pricing model, there is also evidence by Whaley (2000) that the implied volatility index from the S&P 100 options is useful in measuring investors' degree of anxiety, which reflects the anticipated level of future uncertainty.

the time–series of the Nikkei225 IV index, which tends to increase during periods of declining prices. It reaches the average levels of 28% in association with decreasing returns and 21% during periods of increasing returns. There is also evidence that the null of normal distribution is rejected for both series of returns and implied volatility, which are also found to be stationary based on the Augmented Dickey–Fuller unit root tests.

Table 1. Distributional moments and unit–root test results

	Implied Volatility			*Market Returns*		
	Total Period	*First Period A*	*Second Period B*	*Total Period*	*First Period A*	*Second Period B*
Mean	0.2484	0.2796	0.2102	0.0000	–0.0006	0.0007
Std Dev.	0.0629	0.0589	0.0435	0.0138	0.0154	0.0115
Skewness	0.8562	1.1819	0.1961	–0.0851	0.0910	–0.4433
Kurtosis	4.7941	5.4627	1.9873	4.9538	4.7009	4.4683
Jarque–Bera	601.802	627.278	51.846	376.116	157.398	129.316
ADF test	-4.270^{a}***	-4.024^{a}***	-3.545^{b}***	-49.918^{c}***	-37.563^{c}***	-32.503^{b}***

Notes: The sample period extends from April 1998 through March 2007, and it is divided into two sub–periods in mid–March 2003. The total number of daily observations is 2348 is inclusive of 1292 and 1055 observations in the first sub–period A and second 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. *** denotes rejection of the non–stationary null at the 1% level. [a], [b] and [c] refer to stationarity tests with both intercept and trend terms, with intercept only and with neither terms, respectively. The 1% critical values for the ADF unit root tests are –3.965, –3.436, and –2.567 for tests with both intercept and trend terms, with intercept only, and with neither terms, respectively.

The separation between two sample periods in mid–March 2003 can thus, be reflective of distinct trends in market conditions both in terms of price reversals and the levels of implied volatility. It also coincides however, with the change in the Bank of Japan's Governor.[4] Indeed, the annual growth of almost 50% reflected by the Nikkei225 index, subsequent to the change of Governors, represents the highest performance in more than 30 years. It can be argued, as in Ito (2006), that the new leadership is characterized by stronger commitment to fighting deflationary pressures. The main objective of this study does not lie however, in drawing conclusions on the effectiveness of the evaluations monetary policy decisions or the Bank's leadership.[5] There is no attempt thus, to examine the reaction of market returns and volatility with respect to the informational content of monetary policy announcements. The assessment of the effectiveness of such policies is undertaken in the growing literature on the

[4] There were two scheduled monetary policy meetings of the Bank of Japan in March 2003, the month in which the term of the first Bank's Governor ended. The meetings on March 5, and March 25, 2003 were presided by Governor Hayami and Governor Fukui, respectively. Given the fact that these dates were separated by 13 business days only and in order to avoid overlapping observations, the range is set to a maximum of five business days prior and after these meetings. Thus, the first sub–period starts from April 1, 1998 through March 12, 2003, five days after the last meeting of Governor Hayami whereas the second sub–period starts from March 18, 2003, five days preceding the first meeting under Governor Fukui, through March 30, 2007.

[5] See Ito (2006) for instance on the critical assessment of monetary policies under the leadership of the Bank Governors Hayami and Fukui, respectively. It is argued that these periods are characterized by less aggressive policies against deflationary pressures during the first term and greater commitment in the second.

Japanese monetary policy under deflationary pressures and it falls outside the scope of this study. The focus here is made instead on the impact of scheduled meetings, not their outcome per se, on the anticipated levels of price fluctuations in financial markets.

The Bank of Japan holds its scheduled MPMs once or twice a month, with the first meeting extending over two business days whereas the second meetings are held over one day only. In order to assess the MPM effects, the random returns $\tilde{R}_t$ and implied volatility σ_t around these meeting dates are pooled and the sample averages are computed for a given day t within five days prior to or after the meetings as follows

$$\overline{R}_t = \sum_{m=1}^{M} \tilde{R}_{t,m}/M \tag{3}$$

$$\overline{\sigma}_{IV,t} = \sum_{m=1}^{M} \sigma_{IV,t,m}/M \tag{4}$$

where M denotes the number of scheduled meetings, $\overline{R}_t$ is the average return and $\overline{\sigma}_{IV,t}$ is the average implied volatility. The statistical significance of average market returns and implied volatility are described respectively by Equations (3) and (4), and assessed using observations that lie outside the predefined range of days surrounding meetings. In order to reduce estimation errors due to overlapping observations when first and second meetings are scheduled within a period as short as two weeks, this range is limited to five business days only. Upon excluding the dates surrounding all scheduled meetings denoted as Ω, it is possible to use the remaining number observations X. These out–of–sample observations can be used to estimate the standard errors as follows

$$v_R^2 = \frac{1}{(X-1)} \sum_{s \notin \Omega} \left(\tilde{R}_s - \overline{R}_X\right)^2 \tag{5}$$

where $\overline{R}_X = (1/X) \sum_{s \notin \Omega} \tilde{R}_s$ represents the average out–of–sample returns. A similar approach is applied to test statistical significance of implied volatility based on the following estimate of standard errors

$$v_{IV}^2 = \frac{1}{(X-1)} \sum_{s \notin \Omega} \left(\sigma_{IV,s} - \overline{\sigma}_{IV,X}\right)^2 \tag{6}$$

where $\overline{\sigma}_{IV,X} = (1/X) \sum_{s \notin \Omega} \sigma_{IV,s}$ denotes the average implied volatility over the period excluding all dates surrounding monetary policy meetings. The statistical significance of average returns in Equation (5) is measured against the null of zero–returns whereas the average level of implied volatility is tested using Equation (6) against the mean of implied volatility over the out–of–sample period excluding days surrounding the meetings.

4. Empirical Evidence

This section examines the impact of the Bank of Japan's MPMs on the behavior of market returns and implied volatility. It tests also for the potential asymmetric effects across the first and second

scheduled meetings as well as for the asymmetric impact of news depending on the underlying market trends for increasing or decreasing returns. The exact dates of the meetings are obtained from the online documentation provided by the Bank of Japan. However, the question arises as to what coustitutes the event date with respect to the first scheduled meetings that continue over two business days. In the absence of information release on the first day, it is assumed for the purposes of these statistical tests, that the effective date of the meeting is defined with respect to the second business day. It can be argued indeed, that though the monetary policy committee is convened on the first business day, the discussions are not officially resolved until the second business day. Thus, market perceptions of future uncertainty can be assumed to be ultimately affected not so much by the ongoing discussions on the first day, as by the official announcements made on the final day of meetings.

4.1. The Effects of the Bank of Japan Monetary Policy Meetings

Following the testing procedure described above, the first issue examined at this level is whether the Bank of Japan's scheduled monetary policy meetings are on average associated with significant

Table 2. The Behavior of Volatility Expectations around the Bank of Japan Monetary Policy Meetings

Days Relative to Meetings	*Average Implied Volatility*	*Average Market Returns*	*Cumulative Average Returns*
–5	0.2496***	0.0005	0.0005
	(2.7568)	(1.1159)	
–4	0.2516***	–0.0017***	–0.0012
	(3.6861)	(–3.6197)	
–3	0.2521***	–0.0009*	–0.0020
	(3.8835)	(–1.8186)	
–2	0.2519***	–0.0004	–0.0024
	(3.7970)	(–0.8469)	
–1	0.2527***	0.0007	–0.0017
	(4.1878)	(1.4752)	
Meeting Date=0	0.2510***	0.0011**	–0.0007
	(3.3815)	(2.2515)	
1	0.2493***	0.0007	0.0001
	(2.6358)	(1.5771)	
2	0.2502***	0.0006	0.0007
	(3.0224)	(1.2785)	
3	0.2493***	–0.0003	0.0003
	(2.6184)	(–0.6744)	
4	0.2497***	0.0005	0.0009
	(2.8192)	(1.1260)	
5	0.2489**	0.0016***	0.0024
	(2.4228)	(3.3577)	

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 March 2007, resulting in a total of 149 meetings. The average implied volatility from out–of–sample observations amounts to 0.2435 with standard deviation of 0.0603. The figures in brackets are t–statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by ***, **and *, respectively.

changes in the behavior of market returns and volatility expectations. Given the significance that markets attach to the informational content of MPMs announcements, it is expected that market perceptions of the levels of uncertainty prior to and following these meetings are significantly different.

It appears from the results reported in Table 2 that the average implied volatility on days surrounding these meetings remains at levels significantly higher than volatility expectations associated with out−of−sample periods. Judging from the behavior of implied volatility illustrated by Figure 2, there is a significant increase in volatility expectations at least four days prior to the scheduled MPMs. The evidence suggests also that there is a decrease in implied volatility on the very days of MPM meetings, which are accompanied by announcements on monetary policy. This decrease is reflective of the fact that the uncertainty about monetary policy associated with these meetings is effectively dissipated by subsequent announcements. This empirical evidence is consistent with the results from the US markets by Fornari (2004) and Nikkinen and Sahlström (2004). The fall in implied volatility extends over the day following the meeting and the level of implied volatility remains noticeably lower than on pre−meeting days.

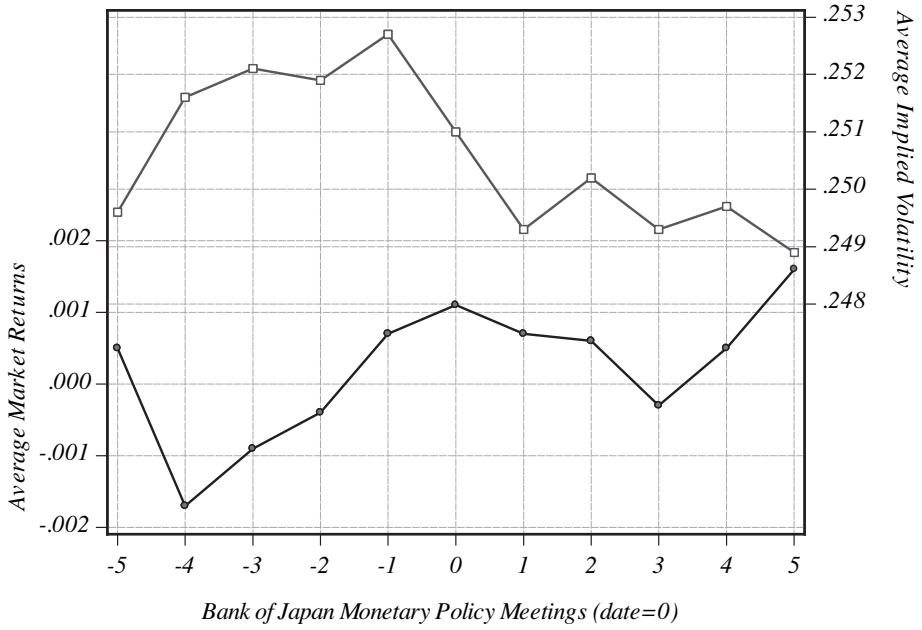

Figure 2. The behavior of Volatility Expectations around the Bank of Japan Monetary Policy Monthly Scheduled Meetings

The impact of these meetings on the behavior of stock market returns is also described by Figure 2. As with implied volatility, the average returns rather decrease significantly four days before MPMs, but rise monotonously until the very date of meeting. The results reported in Table 2 indicate that the prevailing negative returns prior to meetings are likely to be followed by significantly positive returns only on the meeting days themselves. As a result, there is also a tendency for cumulative average

returns to be negative prior to meetings and remain positive thereafter.

These characteristic patterns may be indicative of initial market overreactions, reflecting anticipations of higher uncertainty followed by incremental adjustments, which culminate into positive returns on the scheduled meeting dates. Thus, the empirical evidence lends strong support to the proposition that scheduled MPMs have the effect of decreasing returns and raising volatility expectations prior to meetings. The post–meeting effects are reflected by significant declines in implied volatility and increases in market returns.

4.2. The Impact of Market Conditions and MPM Effects

It is important at this juncture to test whether the MPM effects are sample–dependent. The question that arises is whether the observed patterns of increasing volatility expectations and decreasing returns prior to meetings are sensitive to the underlying conditions of bearish or bullish markets. As explained above, the sample is divided into two distinct periods of decreasing prices versus rising valuation in mid–March 2003, which coincides approximately with the effective change in the Bank's Governor.

The evidence from the left–hand panel of Figure 3 suggests that the increase in volatility expectations prior to MPM meetings is indeed different across sample periods. The average levels of implied volatility in the first period of decreasing stock valuation are significantly lower than those associated with the second period of increasing prices. The evidence remains however that volatility expectations do on average, increase before meetings and decrease thereafter for both periods.

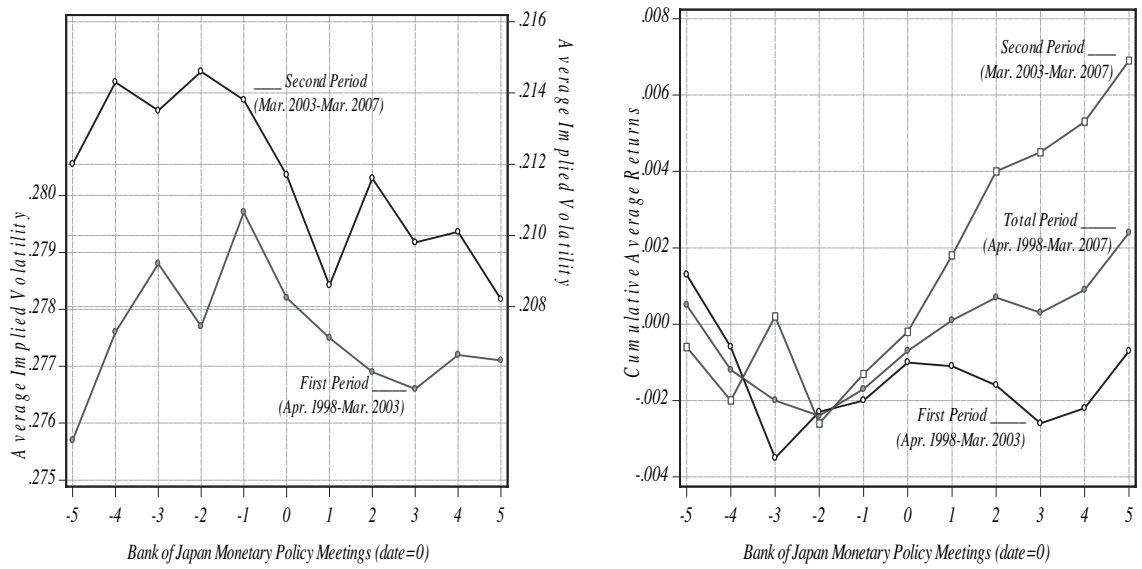

Figure 3. Impact of the Underlying Market Conditions on the Behavior of Implied Volatility and Stock Returns around the Bank of Japan Monetary Policy Meetings

However, judging from the results reported in Table 3, the average implied volatility prior to MPMs is not significantly lower than out–of–sample expectations of market volatility in the first period. The

negative differentials become significant only starting from the day of meetings onward. In contrast, the second period is characterized by pre–meeting levels of average implied volatility that are significantly higher than out–of–sample expected volatilities. However, these differentials tend to be statistically insignificant over the subsequent days.

Table 3. The Behavior of Volatility Expectations around the Bank of Japan Monetary Policy Meetings and the Effects of Market Conditions

Days Relative to Meetings	*Average Implied Volatility*		*Average Market Returns*		*Cumulative Average Returns*	
	First Period	*Second Period*	*First Period*	*Second Period*	*First Period*	*Second Period*
–5	0.2757***	0.2120**	0.0013*	–0.0006	0.0013	–0.0006
	(–2.6099)	(2.0672)	(1.7418)	(–1.0727)		
–4	0.2776*	0.2143***	–0.0019**	–0.0014**	–0.0006	–0.0020
	(–1.9221)	(3.1301)	(–2.4992)	(–2.5009)		
–3	0.2788	0.2135***	–0.0030***	0.0022***	–0.0035	0.0002
	(–1.4545)	(2.7542)	(–3.9399)	(3.8385)		
–2	0.2777*	0.2146***	0.0013*	–0.0028***	–0.0023	–0.0026
	(–1.8612)	(3.2964)	(1.6824)	(–4.8885)		
–1	0.2797	0.2138***	0.0003	0.0013**	–0.0020	–0.0013
	(–1.1409)	(2.9368)	(0.3550)	(2.2787)		
Meeting Date =0	0.2782*	0.2117*	0.0010	0.0011*	–0.0010	–0.0002
	(–1.6809)	(1.9085)	(1.3515)	(1.9410)		
1	0.2775*	0.2086	–0.0002	0.0020***	–0.0011	0.0018
	(–1.9258)	(0.4814)	(–0.2091)	(3.5533)		
2	0.2769**	0.2116*	–0.0005	0.0022***	–0.0016	0.0040
	(–2.1498)	(1.8777)	(–0.6518)	(3.7960)		
3	0.2766**	0.2098	–0.0009	0.0006	–0.0026	0.0045
	(–2.2498)	(1.0436)	(–1.2428)	(1.0092)		
4	0.2772**	0.2101	0.0004	0.0007	–0.0022	0.0053
	(–2.0460)	(1.1699)	(0.5038)	(1.2973)		
5	0.2771**	0.2082	0.0015**	0.0016***	–0.0007	0.0069
	(–2.1012)	(0.2711)	(2.0348)	(2.8580)		

Notes: The averages and cumulative averages of differences in implied volatility and forecast errors are estimated for the first and second sub–periods extending from April 1, 1998 to March 12, 2003, and from March 18, 2003 to March 30, 2007, respectively. These sub–periods are inclusive of 88 and 61 meetings, respectively. The average implied volatility for out–of–sample observations amounts to 0.2829 for the first period and 0.2076 for the second period. The standard errors are estimated to 0.0520 and 0.0421, respectively. The figures in brackets are t–statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by ***, **and *, respectively.

The patterns followed by market returns are also found to differ across periods. The evidence from Table 3 indicates that at the 1% significant level, the average returns with three days remaining to MPM meetings are negative in the first period, but positive in the second period. The post–meeting average returns are also found to be statistically insignificant in the first period but they tend to be, albeit at different levels of significance, rather positive in the second period. The cumulative average returns illustrated in the right–hand panel of Figure 3 clearly indicate the MPM effects under different market conditions. Given the initial fall in returns, the cumulative average returns tend to increase two

days prior to meetings in both periods. However, they seem to reach important crossroads on the very dates of scheduled MPMs. Indeed, the distinct patterns for post–meetings are characterized by persistently low levels of returns under bearish markets in the first period and by the stronger tendency toward higher levels under bullish markets in the second period.

4.3. Asymmetric Effects of First–Scheduled and Second–Scheduled Meetings

The results so far do not take into consideration possible asymmetries in the effects of the first and second scheduled meetings. It is however important to test for the sensitivity of MPM effects to the degree of regularity and frequency of these meetings. The distinction is justified on the basis that whereas the first meetings continue over two business days, the second meetings are held rather on irregular basis and last for one day only. As noted also by Fujiwara (2003), the second meetings are inclusive of reviews of the Bank's decisions made at the first meetings.

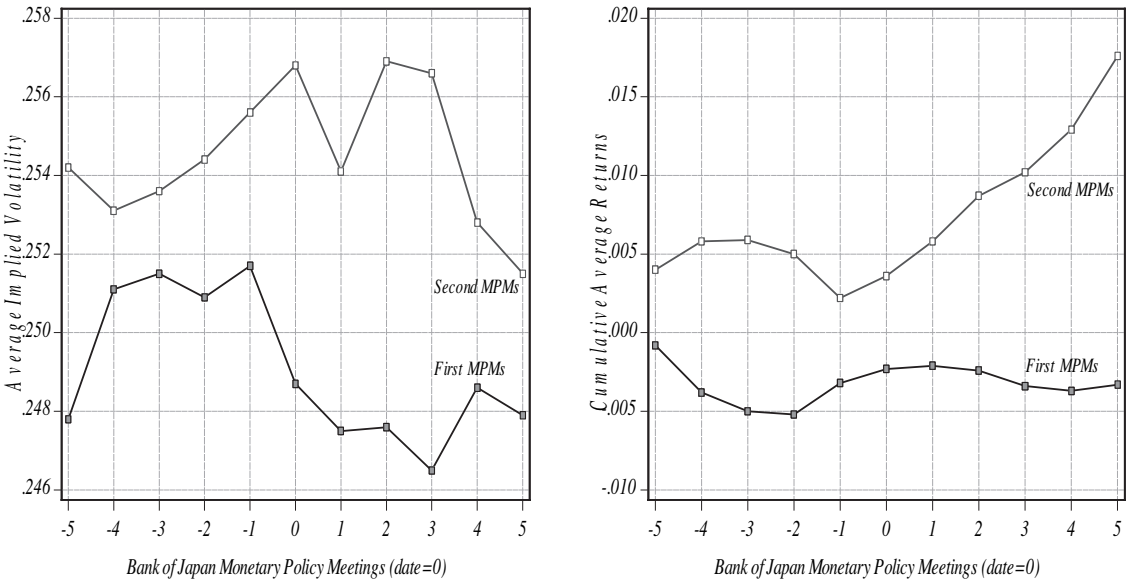

Figure 4. The Asymmetric Behavior of Volatility Expectations and Market Returns with respect to First and Second Meetings of the Bank of Japan Monetary Policy Board

The average implied volatilities and cumulative returns for both the first–scheduled and second–scheduled MPMs are estimated with respect to the total sample period. There is evidence from Figure 4 that the volatility expectations associated with the second meetings are on average, higher than those relative to first meetings. Bearing in mind that the frequency of second meetings has decreased over the years, falling from seven in 1999 to only two in 2006, and that the majority of such meetings have taken place during the period of bearish markets, the higher levels of volatility expectations associated with second meetings is not surprising. An important distinction between the observed patterns is that whereas the average level of implied volatility falls on days in which first–scheduled MPMs are held and continues to fall thereafter, it does drop only on the first day following the second–scheduled

Table 4. The Behavior of Volatility Expectations around the First and Second Meetings of the Bank of Japan Monetary Policy Committee

Days Relative to Meetings	*Average Implied Volatility*		*Average Market Returns*		*Cumulative Average Returns*	
	First Meetings	*Second Meetings*	*First Meetings*	*Second Meetings*	*First Meetings*	*Second Meetings*
–5	0.2478	0.2542***	–0.0008**	0.0040***	–0.0008	0.0040
	(0.0764)	(4.9354)	(–2.0162)	(12.7074)		
–4	0.2511*	0.2531***	–0.0030***	0.0019***	–0.0038	0.0058
	(1.9174)	(4.1749)	(–7.8195)	(6.0170)		
–3	0.2515**	0.2536***	–0.0012***	0.0001	–0.0050	0.0059
	(2.1357)	(4.5601)	(–3.1060)	(0.3165)		
–2	0.2509*	0.2544***	–0.0002	–0.0010***	–0.0052	0.0050
	(1.8161)	(5.0998)	(–0.4495)	(–3.1321)		
–1	0.2517**	0.2556***	0.0020***	–0.0028***	–0.0032	0.0022
	(2.2417)	(5.8835)	(5.1768)	(–8.9983)		
Meeting Date=0	0.2487	0.2568***	0.0009**	0.0015***	–0.0023	0.0036
	(0.5885)	(6.7205)	(2.2860)	(4.7373)		
1	0.2475	0.2541***	0.0002	0.0022***	–0.0021	0.0058
	(–0.1004)	(4.8358)	(0.4849)	(6.9904)		
2	0.2476	0.2569***	–0.0003	0.0029***	–0.0024	0.0087
	(–0.0375)	(6.7437)	(–0.7379)	(9.3874)		
3	0.2465	0.2566***	–0.0010**	0.0015***	–0.0034	0.0102
	(–0.6712)	(6.5478)	(–2.5567)	(4.7390)		
4	0.2486	0.2528***	–0.0003	0.0027***	–0.0037	0.0129
	(0.4804)	(3.9972)	(–0.7516)	(8.6020)		
5	0.2479	0.2515***	0.0004	0.0046***	–0.0033	0.0176
	(0.0837)	(3.0921)	(1.0308)	(14.8884)		

Notes: The averages and cumulative averages of differences in implied volatility and forecast errors are estimated with respect to the first scheduled monetary policy meetings only. The sample period extends from April 1, 1998 to March 30, 2007, resulting in 108 first scheduled meetings and 41 second scheduled meetings. The average implied volatility for out–of–sample observations amounts to 0.2477 for the first meetings and 0.2469 for the second meetings while the standard errors are estimated to 0.0601 and 0.0640, respectively. The figures in brackets are t–statistics for the estimated parameters. Significance at the 1, 5 and 10% levels is indicated by ***, **and *, respectively.

MPMs, and only on temporary basis. It increases again to pre–meeting levels on the second day before falling further.

The estimation results reported in Table 4 indicate that the second meetings are indeed associated with average implied volatilities that are consistently higher than out–of–sample volatility expectations, irrespective of the pre–meetings and post–meetings days. In contrast, the average implied volatilities reach levels significantly higher than out–of–sample means, albeit not at the 1% level, only up to two days before the first scheduled meetings and the differentials become insignificant thereafter. The average returns associated with first MPMs are also found to be negative and significant until one day preceding the meeting. They are significantly positive also on the meeting day itself, albeit at the 5% level. This evidence is indicative of the reaction of market returns to greater uncertainty associated with the first MPMs. In contrast, the average returns become significantly negative two days before the second MPMs and there is a reversion toward significantly

positive returns over the post–meeting days. The asymmetric patterns are reflected by the cumulative average returns, which are illustrated by the right–hand panel of Figure 4. Given the decreasing frequency of second–scheduled MPMs, it is the pattern associated with first–scheduled MPMs, which is likely to prevail in the future. There is a tendency for average returns to decrease and for average implied volatility to increase prior to meetings and to revert respectively toward zero–average returns and out–of–sample levels of volatility expectations thereafter.

5. Conclusion

The main purpose of this study is to examine the impact of scheduled meetings of the Bank of Japan monetary policy committee on the behavior of volatility expectations, which are measured using the Nikkei225 implied volatility index. The focus is not made so much on the informational content of monetary policy decisions as on the scheduled meetings per se and the perceived level of uncertainty. These meetings are scheduled to decide on the guidelines for open market operations but they are also shown to be accompanied by market anticipations of greater uncertainty. The observed increase in average implied volatility prior to meetings is indeed indicative of the significance of the scheduled meetings, irrespective of their ultimate outcome. The average implied volatilities are significantly higher than out–of–sample volatility expectations that do not fall close to these meetings. The evidence that average volatility expectations decreases on the meeting date suggests that the mounting uncertainty regarding future monetary policy can be dissipated through immediate post–meeting announcements.

Market returns are also reflective of the marginal increase in uncertainty, with negative average returns prevailing prior to meetings. It is only subsequent to meeting days associated with positive returns that a reversal in the sign of cumulative average returns takes place. The increasing returns and decreasing volatility expectations over the post–meeting days are consistent with the proposition that market anticipations of future uncertainty do not remain unaltered around these meetings. Part of the uncertainty associated with these MPMs is absorbed on the very day of meeting following monetary policy announcements. Thus, the immediate release of the Bank's decisions has the important mitigating effects of decreasing uncertainty over the post–meetings period.

The effects of monetary policy meetings are found to be conditional on market conditions of higher or alternatively lower equity valuation. Whereas average returns three days before meetings are found to be negative under bearish markets, they tend to increase under bullish markets. They remain generally insignificant over both the pre–meeting and post–meeting days under bearish market conditions. In contrast, there is a tendency for average returns to become positive one day before meetings under bullish market valuations. As a result, the post–meetings cumulative average returns remain negative with respect to the first period and become positive relative to the second period.

There is also evidence that the effects of these meetings differ across the first–scheduled and second–scheduled meetings. Whereas the first meetings continue over two business days, the second meetings are held rather irregularly and last only one business day. The analysis suggests that average

implied volatilities associated with the second meetings are typically higher than those associated with the first–scheduled meetings. Part of the reason for this asymmetric behavior is that the frequency of second MPMs has been decreasing significantly over the second sample period of bullish market conditions and lower volatility. The increase in average volatility expectations is extended over the very date of second meetings. This stands in sharp contrast with the observed patterns reflecting anticipations of reduced uncertainty on the day of first meetings. There is also evidence of diverging patterns across these scheduled meetings based on the behavior of cumulative average returns, which remain negative for the first meetings and positive for the second meetings.

It may be possible to make inferences on the profitability of trading strategies based on the observed patterns of returns and implied volatility around the Bank of Japan's monetary policy meetings. But, such tests fall beyond the scope of this study. The empirical evidence may also provide interesting insights into the effectiveness of different monetary policies against deflationary pressures. The introduction of the zero–interest–rate policy in 1999, its discontinuation in 2000, the inception of quantitative easing policy in 2001, and its termination in 2006 have direct and indisputable effects on equity valuation and market perceptions of future economic uncertainty. Again, no conclusions are drawn here with respect to the impact of changes in monetary policiy, as the analysis is not intended to quantify the impact of such important shifts in monetary policy, on market returns and volatility expectations. These interesting issues warrant indeed further examination that takes into account not only the timing of scheduled meetings, but also the equally important information content of monetary policy decisions on volatility expectations.

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