Some Preliminary Evidence on the Relation between Market Volatility Expectations and Leading Indicators of the Japanese Economy *

Nabil Maghrebi[a]
Mark J. Holmes[b]

Abstract

This paper explores the relation between model-free volatility index and the leading diffusion index for the Japanese economy. The empirical evidence from the unrestricted vector autoregressive models indicates that there is a negative linkage between this forward-looking indicator of real economy and *ex ante* volatility expectations. There is a decrease in market perceptions of economic uncertainty following positive shocks to the term spread, consumer confidence and investment climate index. The sign of the impulse responses remains negative with respect to interest rate spreads and consumer confidence, and the impact of the investment climate index is rather short-lived. The results indicate also that shocks to volatility expectations may be transmitted into the leading diffusion index, through the deterioration of consumer confidence, a decrease in the investment climate index and flattening of the term structure of interest rates.

1. Introduction

The significant increase in financial instability in the wake of the U.S. credit crisis and euro-area sovereign debt problems is partly reflected by the unprecedented levels of volatility expectations in financial markets. Given the degree of economic uncertainty, forward-looking economic indicators and market expectations can play a crucial role in shaping the monetary policy responses to financial crises. Though there is a

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[a] *Corresponding author: Wakayama University, Sakaedani 930, Wakayama, 640-8510 Japan tel. +81-73-457-7658 fax. +81-73-457-7659 e-mail. nebilmg@eco.wakayama-u.ac.jp*

[b] *Waikato University Management School, New Zealand*

rich literature on the relation between asset prices and macroeconomic variables, the need remains for the examination of the interrelations between leading economic indicators and forward looking volatility expectations. Indeed, with the development of model-free volatility indices implied by options prices, it is now possible to assess the usefulness of *ex ante* volatility expectations for monetary policymaking. Thus, the objective of this study is to provide some empirical evidence on the linkage between model-free implied volatility index and some leading indicators of economic conditions.

The conventional wisdom is that stock market prices provide important signals and financial information based on expectations about future dividend streams that feedback back into macroeconomic policymaking decisions. The evidence from early studies by Fama (1981) and Stulz (1986) suggests a negative association between stock returns and inflation, and further results from Lee (1992) lend support to the proposition that stock market returns explain real activity. Stock market returns can be considered among the leading economic indicators, the changes of which tend to precede those of the economy. There is evidence from Estrella and Mishkin (1996) that stock prices convey additional information to yield curve spreads, which is useful in assessing the likelihood of recessions over short-term forecasting horizons. The results from Chen (2009) suggest that yield curves and inflation rates have the potential of predicting bear stock market periods. Also, the evidence from Henry, Olekalns and Thong (2004) indicates that the usefulness of stock returns in forecasting output growth is most significant under conditions of economic recession.

In contrast to the growing literature on the relation between macroeconomic variables and asset market returns, there is a relatively limited body of studies on the linkage between macroeconomic indicators and market volatility. The behaviour of market volatility is related to the business cycle, increasing during economic recessions and falling during expansions. Diebold and Yilmaz (2010) provide evidence from a large sample of countries that stock market fluctuations are indeed cross-sectionally related to GDP volatility. However, judging from the behavior of market returns over an extended sample period, Gerlach, Ramaswamy and Scatigna (2006) suggest that there is no clear relation between macroeconomic volatility and fluctuations in financial markets. The results from Guo (2002) also suggest that stock market volatility has the potential of affecting the cost of capital and thereby future economic output. The paucity of studies on the connection between macroeconomic variables and *ex ante* volatility expectations, as opposed to historical market volatility based on backward looking measures of standard deviations, is even more pronounced. The focus of the present study on forward-looking expectations is important in light of evidence from Nadenichek (2007) that the Japanese economic stagnation in the 1990s may be explained by self-fulfilling expectations.

Thus, the present study contributes to the literature on the relation between macroeconomic variables and financial market volatility in three important respects. First, it focuses on market volatility rather than asset prices, and the emphasis is made on *ex ante* expectations about economic uncertainty based on implied volatility from stock index options. It provides evidence based on a model-free volatility index computed using the Nikkei 225 options traded on the Osaka Securities Exchange. Second, it tests the relation between volatility expectations and forward-looking indicators of economic activity based on vector-autoregression models that allow for the assessment of impulse responses to shocks in the volatility-generating process and economic indicators. Third, it uses some components of the leading diffusion index including the consumer confidence index, investment climate index, and interest rate spreads in order to assess the mechanism through which shocks to volatility expectations in financial markets can be transmitted to the real economy and affect anticipations about the turning points in the business cycle.

The remainder of the paper is organized as follows. The next section presents the vector autoregression modelling of the linkage between the leading indicators of the real economy and volatility expectations in financial markets. Section 3 briefly introduces the leading diffusion index and some of the component indicators for the Japanese economy, as well as the model-free volatility index. Section 4 discusses the empirical results based on VAR model estimations and impulse response functions. Section 5 concludes the paper.

2.Modelling the relation between volatility expectations and economic conditions

The econometric approach for testing the relation between volatility expectations and leading economic indicators follows the general pth order vector autoregressive model

$$\boldsymbol{y_t} = \boldsymbol{\omega} + \boldsymbol{\varphi_1 y_{t-1}} + \boldsymbol{\varphi_2 y_{t-2}} + \cdots + \boldsymbol{\varphi_p y_{t-p}} + \boldsymbol{\varepsilon_t} \tag{1}$$

where $\boldsymbol{\omega}$ is the intercept and $\boldsymbol{y_t}$ represents the $n \times 1$ vector of endogenous variables. The matrix $\boldsymbol{\varphi}$ includes pn^2 parameters. The assumption underlying this multivariate system is that the shocks are independently and identically distributed $\varepsilon_t \sim iid\ N(0,\Omega)$. The error covariance matrix can thus be consistently estimated with the $n \times 1$ vector of regression residuals $\boldsymbol{\hat{\varepsilon}_t}$.

$$\boldsymbol{\hat{\Omega}} = \frac{1}{T}\sum_t \hat{\varepsilon}_t \hat{\varepsilon}'_t \tag{2}$$

It is important that the variables are tested for stationary in order to avoid spurious regressions. The appropriate lag order is determined on the basis of the Schwarz information criterion. Based on the estimates of this unrestricted VAR system, the impulse response functions can be also derived in order to assess the reaction of endogenous variables to shocks over time. It may be possible as noted by Christiano, Eichenbaum and Evans (1996) to assess the reaction to exogenous policy actions without a complete structural model of the economy. No attempt is made here to identify or assess the impact of monetary policy during different phases of the business cycle, which falls beyond the scope of this study. It is possible however to identify the effects of shocks in volatility expectations v_t and diffusion index d_t.

The leading diffusion index disseminated by the Economic and Social Research Institute (ESRI) at the Japanese Cabinet Office is used as an indicator of aggregate economic conditions. In contrast to the composite indices used to estimate quantitatively the volume of economic fluctuations and the significance of peaks and troughs, the diffusion indices are rather useful in assessing the turning points in business cycles. They are based on changes in direction of selected economic indicators that are believed to be related to business cycle movements.[1] Because they measure the proportion of series that are improving, economic expansion is reflected by values above the 50 percent threshold.

Following the initial tests using the leading diffusion index as endogenous variable, a multivariate VAR system including alternative economic indicators can also be used to shed light on the interactions between volatility expectations, consumer confidence, interest rate spreads and perceptions about the investment climate, which are also disseminated by ESRI. In the same way that the implied volatility index can be used a gauge of investors fear levels, the leading index of consumer confidence can be regarded as a proxy for investor sentiment. This is consistent with many studies in behavioural finance such as Schmeling (2009), which examine the impact of investor sentiment on market returns.[2] The interest rate spread or term spread defined as the

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[1] The composition of the composite and diffusion indices of business conditions are revised upon the completion of each business cycle. The changes in the components of these indices were introduced in June 1996, December 2001, November 2004, and October 2011. Despite these significant revisions, the investment climate index for the manufacturing sector remains as a leading index, while consumer confidence index and interest rate spreads are considered as new leading indices following the revisions in 2001.

[2] The empirical evidence from Schmeling (2009) suggests that investor sentiment as measured by consumer confidence can significantly affect market returns. There is strong inverse relation between returns and investor sentiment, which implies a tendency for future returns to decrease as investment sentiment improves independent of forecasting horizons and value or growth stock classifications.

difference between the yields on ten-year and three-month government bonds is also included as endogenous variable in the VAR system. There is evidence from Humpe and Macmillan (2009) suggests that stock prices in the U.S. markets are negatively related to the consumer price index and long-term interest rates. Also, the recent evidence from Bollerslev, Tauchen and Zhou (2009) indicates that in addition to the differences between model-free VIX index and realized volatility, the term spread is useful in explaining the time-series variations of stock market returns.

The model-free volatility index based on the closing prices of Nikkei 225 options is calculated following the methodology underlying the VIX index. The methodology adopted by the Chicago Board Options Exchange constructs an index of volatility implicit in S&P 500 options without reference to a particular theoretical model of option pricing. The theoretical foundations of this approach lies in the concept of fair value of future variance discussed by Demeterfi, Derman, Kamal and Zou (1999), and with the model-free implied variance Britten-Jones and Neuberger (2000) as shown by Jiang and Tian (2007)

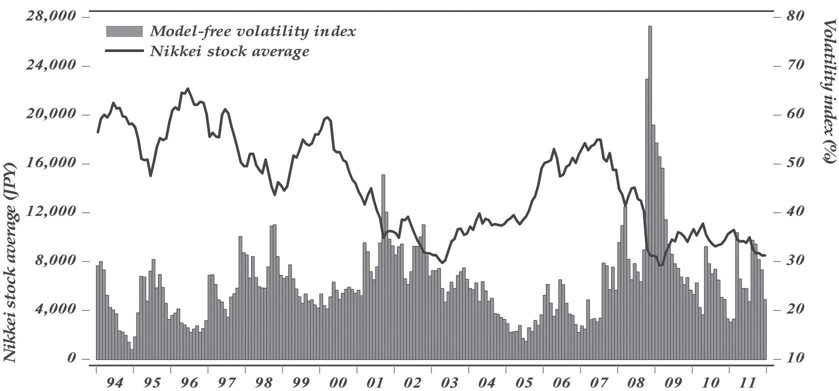
$$v^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} exp(rT)\, Q(T,K) - \frac{1}{T}\left(\frac{F}{K_0} - 1\right)^2, \quad (3)$$

where F is the forward index level stock price, K is the exercise price, K_0 is the exercise price equal or immediately below the forward level, and $Q(T,K)$ is the option quote, which depends naturally on time to maturity and exercise price. The individual contribution $\frac{\Delta K}{K^2} exp(rT) Q(T,K)$ to the implied variance is function of the prices of out-of-the-money put and call options. Thus, the calculation approach aggregates market expectations from information contained in the relation between the quadratic variations of strike prices and volatility. The estimation approach is based on the pricing of variance swap assuming a hypothetical option with strike price equal to the forward price level and with thirty days to expiration.[3] As with earlier studies by Nishina, Maghrebi and Kim (2009) and Nishina, Maghrebi and Holmes (2012), it is possible to reconstruct the time-series of volatility index using daily observations on the Nikkei 225 options, but monthly averages of these annualized values are used to match the monthly frequency of observations for the diffusion indices.

3. Model-free volatility index and leading diffusion index

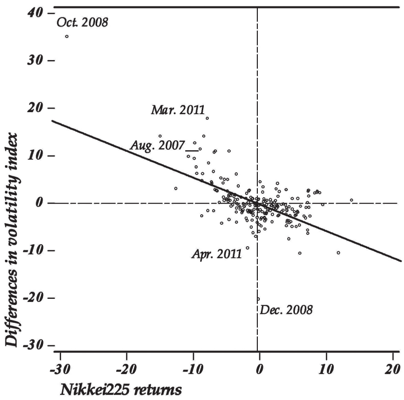
The monthly time-series of the Nikkei stock average and volatility expectations are described by Figure 1 for the sample period from January 1994 to December 2011. Following the burst of the Japanese asset bubble, the general tendency for decreasing equity prices continued though interrupted by few temporary surges. It is clear that a decrease in stock prices is associated with an increase in the anticipated level of market volatility. The significant jumps in the model-free volatility index are usually followed by monotonous decreases. The highest level of expected volatility is reached in relation with the onset of the U.S. credit crisis in 2008, but the euro-area sovereign debt problems since 2010 do not seem to affect the perceived level of economic uncertainty in the Japanese markets to the same extent.

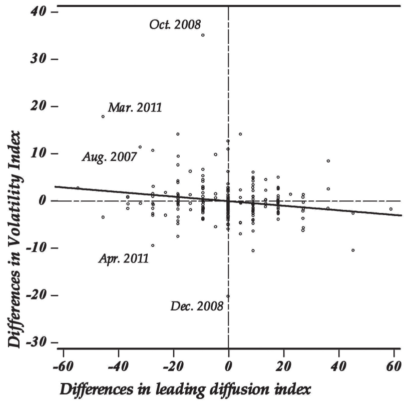
Figure 1. The behavior of volatility expectations and leading diffusion index



[3] The methodology underlying the VIX index is thoroughly explained in CBOE documentation and further details on the approximation errors and measurement difficulties in the construction of a similar volatility index for the Japanese market are discussed in Nishina, Maghrebi and Kim (2009).

Figure 2. The relation between model-free volatility and leading diffusion index





The tendency for market volatility increases in bear markets and decreases in bull markets seems to apply equal force to volatility expectations. Indeed, judging from Figure 2, the relation between stock returns and changes in the volatility index appears to be negative. The relation between these variables may not be linear, but the simple regression of expected volatility on market returns suggests that a percentage fall in market returns is likely to be associated with a 0.56% increase in volatility expectations. Given the forward-looking properties of volatility expectations, it is interesting to examine also its relation with the leading diffusion index. Judging from the monthly changes in the diffusion index, there is also a negative relation with volatility expectations. Bearing in mind that the diffusion index provides a measure of the general direction of a set of economic series, the positive change in the diffusion index can be regarded as a sign of future improvement in economic conditions. The evidence of a negative relation between the diffusion index and volatility expectations is therefore consistent with the similarly negative linkage of the latter with market returns.

It is also noted from Figure 2 that the East-Japan earthquake in March 2011 had the effects of diminishing market returns, and significantly increasing volatility expectations. This impact is not limited to the financial sector as it is also reflected by the sharp decrease in the leading diffusion index, which constitutes a sign of deterioration in future economic conditions. The onset of the U.S. credit crisis in 2007-08 is associated with relatively lower changes in the diffusion index but sharper decreases in returns and jumps in volatility expectations.

It is also possible to examine the basic statistics of market volatility and diffusion index, together with the consumer confidence, investment climate and interest rate spreads, which constitute some of the component series of the leading diffusion index. It appears that the expected level of market volatility exceeds 25% on average over the total sample period, but it is found to approach 30% over the last five-year period from 2007 to 2011 of increased financial instability. The diffusion index is also found to be on average close to the neutral threshold value of 50% whereas the interest rates spread does not exceed 1.30% and the term structure of interest rates is found to be rather flat, with the term spread averaging 0.77% over the recent period of financial crises. The indices of investment climate and consumer confidence also fall to the respective averages of 1.70 and 38.56 over this period. For the purposes of estimating the VAR system, it is important to note that all series appear to be stationary, albeit with different tests structures and significance levels.

Table 1. Basic statistics of market volatility and economic indicators

	Volatility index	Market returns	Diffusion index	Interest rate spread	Investment climate index	Consumer confidence index
Mean	25.63	-0.364	52.25	1.29	1.82	40.43
Stand. Dev.	8.53	5.146	24.07	0.56	1.61	4.84
Skewness	2.31	-0.78	-0.33	0.60	-1.20	-0.16
Kurtosis	12.52	6.67	2.22	2.76	4.80	2.88
ADF statistics	-4.915***[b]	-11.379***[c]	-4.519***[b]	-3.144**[a]	-3.782***[b]	-3.0540**[b]

Notes: ADF statistics refer to the augmented Dickey-Fuller tests of stationarity. The unit-root tests with both trend and intercept terms, with intercept only, and with neither terms are denoted by superscripts [a], [b] and [c], respectively. Significance at the 1% and 5% levels is denoted by *** and **, respectively.

4. Estimation of VAR models and impulse functions

The results of Granger-causality tests reported in Table 2 are useful in assessing whether the movements of the volatility series precede those of the diffusion index or otherwise. It is difficult to reject the hypothesis that the diffusion index does not Granger-cause volatility expectations at the lag order of six, but not with lower orders. Therefore, Granger causality is likely to run one way from diffusion index to volatility expectations but not in the other way. With regard to tests of the relation between volatility index and some components of the leading diffusion index, it is also noted that the index of investment climate is likely to lead expected volatility, but the reverse is not true.

Table 2. Pairwise Granger causality tests

Granger causality null hypothesis	Number of lags used		
	2	4	6
■ Diffusion index does not Granger cause volatility index	3.971**	1.994*	1.376
Volatility index does not Granger cause diffusion index	5.945***	5.319***	3.405***
■ Investment climate does not Granger cause volatility index	0.464	0.430	0.278
Volatility index does not Granger cause investment climate	7.850***	4.757***	8.533***
■ Interest rate spread does not Granger cause volatility index	3.901**	2.538**	1.826*
Volatility index does not Granger cause interest rate spread	1.953	1.160	0.938
■ Consumer confidence does not Granger cause volatility index	10.279***	4.392***	3.351***
Volatility index does not Granger cause consumer confidence	6.272***	5.150***	4.312***
■ Interest rate spread does not Granger cause consumer confidence	3.452**	1.063	1.663
Consumer confidence does not Granger cause interest rate spread	0.307	0.920	0.648
■ Consumer confidence does not Granger cause investment climate	8.296***	4.418***	3.158***
Investment climate does not Granger cause consumer confidence	5.031***	1.281	1.721
■ Interest rate spread does not Granger cause investment climate	17.547***	9.213***	6.539***
Investment climate does not Granger cause interest rate spread	0.861	2.669**	1.667

Notes: Granger-causality tests performed for the sample period from 1994 to 2011. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, ** and *, respectively.

In contrast, it appears that movements in the volatility index are more likely to lead those in the term spreads. There is no evidence however of Granger-causality between the consumer confidence index and volatility expectations. There appears to be a two-way Granger-causality between consumer confidence and interest rate spreads. There is also a higher likelihood that movements of the index of investment climate lead those of consumer confidence and term spreads. Thus, the likelihood remains that shocks to volatility expectations can be transmitted to the leading diffusion index and affect market and policymakers perceptions about the economic conditions and the turning points in the business cycle.

In light of the Granger-causality tests, the relation between these forward-looking economic indicators and volatility expectations may be governed by lead-lag dynamics. The multivariate VAR system described in equation (1) can be estimated to assess the extent of this relation and the impulse responses of these variables to shocks either to the volatility expectations or each of the leading economic indicator.

Table 3. VAR modelling of the relation between volatility and diffusion indices

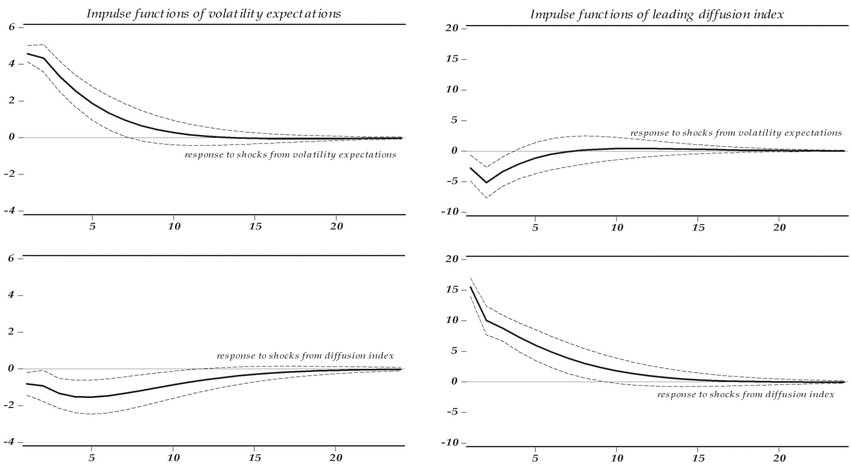
	ω	φ_1^v	φ_2^v	φ_1^d	φ_2^d
Volatility	8.693***	0.940***	-0.191***	-0.010	-0.034*
index	(5.030)	(13.509)	(-2.793)	(-0.473)	(-1.680)
Diffusion	11.170*	-0.755***	0.771***	0.609***	0.167***
index	(1.908)	(-3.204)	(3.324)	(8.890)	(2.410)

Notes: The VAR model equation (1) includes the model-free volatility index and diffusion index as endogenous variables. The estimation period runs from 1994 to 2011. The appropriate number of lags is determined on the basis of the Schwartz information criterion. The multivariate LM test statistic 6.050 is insignificant with a p-value of 0.195, suggesting no serial correlation in the VAR residuals up to the third order. Statistical significance at the 1%, and 10% levels is denoted by ***, and *, respectively.

The estimation results of the VAR model tests of the relation between the diffusion index and volatility expectations are reported in Table 3. It is clear that the autoregressive terms are associated with positive coefficients for both regression equations. However, the impact of the past values of the diffusion index on volatility expectations tends to be negative, albeit not always statistically significant. This implies that signs of improving economic conditions have the potential of decreasing the expected level of volatility in financial markets. Though significant, not all coefficients of volatility expectations in the diffusion index equation are associated with the expected negative sign.

In order to grasp a better understanding of the impact of shocks to the volatility index and diffusion index on these endogenous variables, it is possible to assess the impulse functions. Figure 3 describes the impact of a generalized shock of a unit standard error over a time period of two years. As noted by Pesaran and Shin (1998), the generalized impulses are based on an orthogonal set of innovations that is independent of the ordering of endogenous variables in the VAR system. It is clear that the effects of shocks to one endogenous variable extend to the other. The initial increases in both volatility and diffusion indices in reaction to their own innovations are followed by responses of smaller magnitude that decay over time. The decrease in impulse responses is rather monotonous.

Figure 3. The impulse functions of volatility expectations and diffusion index



Note: The impulse responses are based on the VAR system described by equation (1) including the model-free volatility index, and diffusion index as endogenous variables. The period of impulse responses derived with respect to generalized shocks extends over twenty-four months.

In contrast, there is an initial fall in volatility expectations following innovations from the diffusion index, but the subsequent responses become insignificant within approximately ten months, as suggested by the upper and lower boundaries using two standard errors. There is a sharp initial decrease in the diffusion index in reaction to volatility innovations, which is followed by responses of lower magnitude resulting in a short V-shaped curve. The negative responses of the diffusion index are relatively short-lived, with a tendency to become insignificant after less than five months. Thus, the impulse functions for both the diffusion and volatility indices tend to be rather similar in shape but different in terms of the periods of decay.

In light of these impulse responses, it is possible to examine the VAR system including the volatility index v_t and some of the diffusion index components represented by the consumer confidence index c_t, investment climate index i_t and interest rate spreads r_t. This may be useful in shedding light on the individual impact of leading economic indicators and the transmission channels through which shocks to volatility expectations can be transmitted to the leading diffusion index. The estimation results for the four endogenous variables are reported in Table 4. It appears that the autoregressive terms in the equation describing the behaviour of the volatility index are all significant. The interest rate spread is the only variable that seems to affect volatility expectations. An increase in the term spread is more likely to result in anticipations of lower market volatility. This is consistent with the theoretical implications of widening gap between long-term and short-term interest rates, which may provide signals of economic expansions, increasing returns and lower volatility. The index of investment climate seems also to depend on changes in the term spread as well as the autoregressive terms. It is noted that volatility expectations have the potential of affecting the consumer confidence index, with an increase in anticipated market volatility exerting downward pressures on consumer confidence. An increase in term spread has however the effect of increasing consumer confidence. In this multivariate

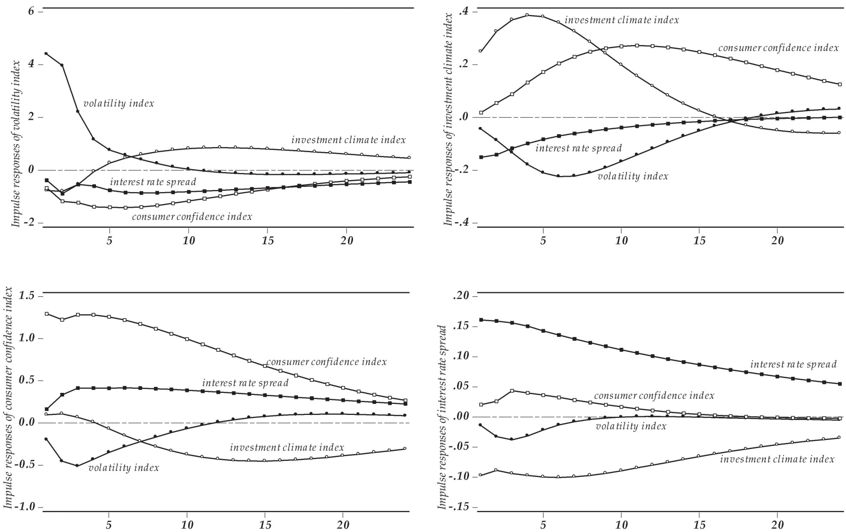
VAR setting, it appears that only interest rate spreads have the potential of significantly influencing the remaining endogenous variables.

Table 4. Multivariate VAR modelling of the relation between volatility expectations and economic indicators

VAR parameters	volatility index	Investment climate index	Consumer Confidence	Interest rate spread
ω	28.212***	-0.153	1.593	0.092
	(5.016)	(-0.478)	(0.962)	(0.447)
φ_1^v	0.842***	-0.003	-0.053***	-0.004
	(11.438)	(-0.697)	(-2.459)	(-1.492)
φ_2^v	-0.312***	0.001	0.036	0.002
	(-3.384)	(0.165)	(1.318)	(0.583)
φ_3^v	0.076	-0.003	0.011	0.001
	(1.027)	(-0.594)	(0.504)	(0.411)
φ_1^i	-2.598	1.478***	0.527	0.016
	(-1.590)	(15.935)	(1.096)	(0.268)
φ_2^i	4.517	-0.412***	-0.951	-0.106
	(1.629)	(-2.616)	(-1.165)	(-1.044)
φ_3^i	-1.644	-0.128	0.279	0.085
	(-1.079)	(-1.479)	(0.622)	(1.521)
φ_1^c	-0.347	0.011	0.886***	0.002
	(-1.405)	(0.816)	(12.186)	(0.239)
φ_2^c	0.006	-0.006	0.107	0.012
	(0.017)	(-0.317)	(1.113)	(1.000)
φ_3^c	-0.088	0.005	-0.021	-0.014
	(-0.351)	(0.385)	(-0.281)	(-1.528)
φ_1^r	-5.558**	0.484***	1.540**	0.991***
	(-2.207)	(3.386)	(2.078)	(10.729)
φ_2^r	8.724**	-0.326	-1.533	-0.129
	(2.321)	(-1.526)	(-1.386)	(-0.938)
φ_3^r	-4.169*	-0.203	-0.038	0.085
	(-1.705)	(-1.459)	(-0.053)	(0.945)

Notes: The VAR model equation (1) is extended to include the model-free volatility index, investment climate index, consumer confidence index, and interest rate spreads as endogenous variables. The estimation period runs from 1994 to 2011. The appropriate number of lags is determined on the basis of the Schwartz information criterion. The multivariate LM test statistic 22.812 is insignificant with a p-value of 0.119, suggesting no serial correlation in the VAR residuals up to the fourth order. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, ** and *, respectively.

Figure 4. The impulse responses of volatility expectations and economic indicators



Note: The impulse responses are based on the VAR system described by equation (1) including the model-free volatility index, consumer confidence index, investment climate index, and interest rate spreads as endogenous variables. The period of impulse responses derived with respect to generalized shocks extends over twenty-four months.

Judging from the impulse response functions described in Figure 4, it is clear that the initial reactions of volatility expectations to generalized shocks from the other endogenous variables tend to be negative. There is indeed a decrease in market perceptions of economic uncertainty following shocks with a magnitude of one standard error, from term spread, consumer confidence or investment climate index. Whereas the sign of these impulse responses remains negative for the former two variables, the subsequent impact becomes positive with respect to the investment climate after less than five months. Thus, the desired effects of increases in the investment climate index on volatility expectations may not be long-lived.

The reaction of the index of investment climate to shocks from volatility expectations is also negative, with the U-curve response reaching a trough after more than five months. There is also a negative impact of shocks from the term spread, which tend to become rapidly insignificant, as well as a positive lasting response to innovations from consumer confidence. Judging from the impulse responses of consumer confidence, there is clear evidence that consumer confidence is negatively affected by increases in volatility expectations. The response of consumer confidence to innovations from the investment climate index may be initially positive, albeit insignificant, but it rapidly fades away as negative impulses become more persistent. The innovations from the term spread are likely to result in positive and significant responses from consumer confidence. Finally, following unit shocks to the term spread, the gap between long-term and short-term interest rates is likely to widen further. Compared with the responses of other endogenous variables to their own innovations, there is rather a monotonous decrease in the magnitude of the term spread responses over time. The shocks from the investment climate index are more likely to exert significant effects on the term spreads. The impact is negative and seems to be persistent over time, unlike the responses to shocks from the consumer confidence and volatility expectations.

Thus, the empirical evidence suggests that the sign and magnitude of the responses of these endogenous variables may vary over time. But it is clear that the responses of the leading economic indicators to shocks from volatility expectations are likely to be negative and U-shaped. This implies that jumps in volatility expectations are likely to be transmitted into the leading diffusion index, through a deterioration of consumer confidence, decline in the index of investment climate, and flattening of the term structure of interest rates.

5. Conclusions

This paper presents some preliminary evidence on the relation between forward-looking volatility expectations and leading indicators of turning points in the business cycle for the Japanese economy. The econometric approach is based on the unrestricted vector autoregressive modelling of movements in the model-free volatility index derived from Nikkei 225 options and the leading diffusion index disseminated by the Economic and Social Research Institute. The behaviour of the volatility index is reflective of the asymmetric impact of increased financial instability such as the U.S. credit crisis and the euro-are sovereign debt problems on market expectations and the perceived level of uncertainty about the Japanese economy.

The empirical results invite two basic conclusions. First, there seems to be a negative relation between the forward-looking diffusion index, which provides signals on the future economic conditions and the model-free volatility index, which provide a measure of financial instability and economic uncertainty. Second, the empirical analysis reveals that this negative relation prevails with respect to some important components of the leading diffusion index, including the consumer confidence index, investment climate index and interest rate spreads. Thus as far as the Japanese economic conditions are concerned, shocks to volatility expectations may be transmitted into the leading diffusion index, through the deterioration of consumer confidence, a decrease in the investment climate index and flattening of the term structure of interest rates. Further tests of the dynamics of volatility expectations and economic indicators taking into account the role of structural breaks and nonlinearities may shed more light on these key relations and the mechanism of volatility transmission from financial markets to the real economy. A better understanding of the relation between financial market volatility and economic indicators may be useful for policymaking purposes as shocks to volatility expectations during periods of increased financial instability can also have wide implications for the anticipations of turning points in the business cycle.

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