The role of public information in Japan: Effects of scheduled macroeconomic announcements on the foreign exchange, debt, and stock markets

Suk-Joong Kim* and Lyndsen Kow

School of Banking and Finance
The University of New South Wales
Sydney NSW 2052, AUSTRALIA
Fax. +61 2 9385 6347

JEL Classification: G14, G15, F36

Keywords: Announcement News, Japanese Financial markets

Abstract

We investigate the impact of the announcements of 16 key macroeconomic variables on the Japanese foreign exchange, debt and stock markets. Despite the importance of the Japanese economy in the world stage, there hasn't been a thorough study of role of scheduled information releases in Japan. We find significant first and second moment influences on returns, and this indicates that these announcement news (or surprises) are a source of tradable information, beyond the mere act of releasing economic figures. The announcements in general raise volatility by generating additional uncertainty in the market, with the debt market exhibiting a much greater response to news than the stock market. Exchange rates and interest rate respond more to inflation-related variables, while the stock market responds more to growth-related variables. Overall, markets participants are found to react to different news announcements in a variety of sophisticated and rational ways.

August 2004

* Corresponding author
School of Banking and Finance
The University of New South Wales
UNSW SYDNEY
NSW 2052 Australia
Tel: +61 2 9385-4278
Fax: +61 2 9385-6347
Email: s.kim@unsw.edu.au

1. Introduction

It is well recognised in the financial literature that the flow of information is a major determinant of price movements in the financial market, and as such the impact of information on asset returns has, in its many guises, been covered extensively in existing studies. These flows can take the form of either public or private information. With respect to the former, one of the most common ways in which public information arrives is via scheduled announcements of macroeconomic variables by relevant authorities. This type of information is embargoed until the scheduled release time such that there is no prior leakage of information. Thus, announcement news, if any, reaches all market participants simultaneously, and financial prices will then adjust to incorporate the information surprises. These scheduled announcements also lead to private information flows (in the sense of Lyons, 2001, p.26) to the extent that market participants have heterogeneous interpretations of their implications, thus leading to differing order flows. Indeed, Evans and Lyons (2003) find almost two thirds of price effect from scheduled public information releases is transmitted via order flows, which potentially elicit differential responses from market participants. Overall, this suggests that there is potential for significant first and second moment effects of public information news on asset prices.

There is a voluminous literature in this area for the U.S. announcements. Most of the papers concentrate on the stock market (see *inter alia* Pearce and Roley, 1983, 1985, French and Roll, 1986, McQueen and Roley, 1993, Sun and Tong, 2000, Flannery and Protopapadakis, 2002), the foreign exchange rate market (Ito and Roley, 1987, Hardouvelis, 1988, Ederington and Lee, 1994, DeGennaro and Shreives, 1997, Almeida, Goodhart and Payne, 1998), and the bond market (Becker, Finnerty and Kopecky, 1996, Jones, Lamont and Lumsdaine, 1998, Fleming and Remolona, 1999a). For each of these markets, the impacts of

macroeconomic news announcements on first and second moments of returns are most frequently investigated, although other market aspects have also been examined[1]. In most cases the focus has been on individual macro announcement variable, whereas some examine a comprehensive set of announcement variables (Flannery and Protopapadakis, 2002, examined 17 US announcements whereas Balduzzi et al., 2001 investigated 26 US announcements).

Despite the abundance of studies in the area their coverage is far from comprehensive. While the examination of markets such as the U.S., UK and Australia is rather widespread, the lack of study of Japanese markets is somewhat surprising considering Japan's stature as the world's second largest economy in terms of both trade flows and financial market capitalization[2]. This paper aims to address this void in the literature. We examine the impacts of scheduled announcement news of 16 key macroeconomic variables on return and return volatility in the foreign exchange, debt and stock markets of Japan. This will shed light on the inner workings of this important economy in responding to announcement news, and facilitate comparisons with the previous studies on other major markets (such as the U.S.).

The main results of the paper are: i) The scheduled announcements of macroeconomic variables has a significant impact on return and return volatility in the Japanese financial markets, and market participants respond to different news announcements in a variety of sophisticated and rational ways. Furthermore, the mere fact that an announcement is made does not have a consistent impact on returns; only when we consider the extent to which the

[1] There are also a number of studies that investigate spillover effects of U.S. announcements on foreign markets. These are: Becker, Finnerty and Friedman (1995) on the U.K. stock futures; Becker, Finnerty and Kopecky (1995) on the German and Japanese debt markets; Connolly and Wang (2000) on the U.K and the Japanese stock markets; and Kim (1998), Kim and Sheen (2000) on the Australian foreign exchange and debt markets.

[2] Kim (2003) is an exception. However, the coverage of the announcements is limited (six news announcements examined), and the focus is only on the Japanese stock market.

announced figure is a surprise to the market do these rational responses become apparent. ii) The debt market exhibits a greater sensitivity to announcements than the stock market, suggesting that while the main source of interest rate movements is macroeconomic news, the stock market tends to respond more to news of a firm-specific or industry-specific nature. iii) In general, the release of macroeconomic figures adds to volatility in the financial markets. Moreover, inflation-related rather than growth-related announcements drove the foreign exchange and interest rate volatilities. However, the reverse is true for the stock market.

The remainder of the paper is organized as follows: Sections 2 and 3 discuss the data and econometric methodologies employed in this paper, respectively; empirical results are discussed in section 4; section 5 then summarizes the results and offers conclusions.

2. Data descriptions

Three types of data are used: i) the announced values and the dates of announcements of various macroeconomic indicators of the Japanese market; ii) a measure of market expectations of these announcements, and iii) daily returns series of the three markets we examine.

Macroeconomic Announcements

Table 1 contains a comprehensive summary of the 16 macroeconomic series studied in this paper. The first thirteen listed are the growth-related (real factors) and the last three (14-16) relate to inflation (nominal factors). With the exception of three (GNP, Tankan DI (an index of business confidence) and Capex DI), for which announcements are made

quarterly, all macroeconomic indicators are announced on a monthly basis[3]. Figure 1 shows a time line of various Japanese macroeconomic announcements. They are made at four different times throughout the announcement days. Out of 16 variables we consider, eight are announced at 8:50 am Japanese time just before financial market opening, three at 9:30 am, four at 2:00 pm and one at 3:30 pm. The Japanese announcement figures were obtained from Money Market Services (MMS) International, which is now a subsidiary of Standard and Poor's.

Market Expectations

The need for a measure of market expectations stems from the fact that the announcement schedule of the different economic variables is known by the market well in advance. As such, leading up to the announcement, the market will form expectations as to the variables' likely announced value. However, consistent with the efficient market hypothesis, only the unexpected or 'surprise component' of each announcement should have an impact on market returns, as anticipated component is already incorporated into the price. We use market expectations proxied by (median) market survey expectations carried out by MMS. While some previous studies have generated expectations using econometric models, survey expectations reflect contemporary market sentiment.[4] Survey participants have easy access to a wide range of informational sources, and since their forecasts are based on current

[3] The announced figures are actual figures for the relevant period (either a month or a quarter) immediately prior to the date of announcements. For example, the trade balance figure for the June 1999 period was announced on the 21th July 1999.

[4] Pearce and Roley (1985) find that MMS survey data also has a lower mean squared error than when residuals from an ARIMA model are used to proxy the unexpected component of an announcement.

(as well as past) information, survey data will prove to be a more relevant indicator of current market expectations.[5]

While surveys were conducted weekly, most announcements were made on a monthly basis. We therefore use the median expectations of the survey immediately prior to the corresponding announcement, as these reflect the most current information. Even so, there is a time lag of a few days between the survey and actual announcement. Several studies have attempted to correct for this time lag but all find that their results are not materially affected.[6] Therefore, we use the unadjusted MMS survey expectations for simplicity.

Financial Market Returns

The markets considered are foreign exchange (Yen/USD), debt (90-day LIBOR Euroyen[7]) and stock (NIKKEI 225[8]) markets of Japan for the period January 1, 1988 to April

[5] Brooks et al. (1999) take a different stance, noting that economists are generally suspicious of survey data. Firstly, they posit that it is well known that survey data exhibits 'herding behaviour'. Secondly, it may be subject to survival bias, in that those forecasters who are more accurate will tend to remain on the survey panel. Finally, they note that while surveys tend to release *median expectations*, there is no reason to believe that the marginal investor would hold this expectation, or that market prices will reflect this median expectation. However, in spite of these criticisms, we still feel that survey data is the most appropriate for our study.

[6] Roley (1982) suggests a correction involving changes in interest rates in the intervening period, but admits that the adjustment is probably unnecessary in the majority of cases. Flannery and Protopapadakis (2002) come to the same conclusion when experimenting with the adjustment of McQueen and Roley (1993). In using a regression to estimate the unexpected component of the announcement, Irwin (1989) incorporates an additional term to capture the additional information made available in the intervening period. He finds that this additional term is insignificant.

[7] The long-term interest rate is not considered here due to lack of available data (10-year Japanese Government Bonds (JGB), the primary benchmark for long term borrowing rates in Japan) for the sample period.

[8] We also carried out a stock market analysis based on TOPIX, with very similar results (unreported).

30, 1999, yielding 2,956 daily observations. We use the midpoints of the quoted bid and ask rates for the foreign exchange rate and the interest rate. All of the data on the Japanese financial markets was obtained from Datastream. Figure 1 shows the trading hours of the Tokyo stock exchange and the data collection time for the exchange rate and the interest rate (5pm London Time, as reported by Barclays Bank International and the Financial Times, respectively).

We investigate the announcement effects of each information releases over a return holding period that envelopes the announcements. Daily holding periods for all three markets contain the announcements (see Figure 1)[9]. For the exchange rate and the Nikkei 225 stock index we measure the change in price or index value from the close of the previous day to the close of the current day: $R_t^D = \ln(P_t^{close} / P_{t-1}^{close}) \times 100$. This represents continuously compounded rates of return. The interest rate changes are simply defined as the absolute difference from one day to the next: $R_t^D = P_t^{close} - P_{t-1}^{close}$.

The statistical properties of each of the return series are displayed in Table 2. All mean returns are fairly close to zero and we observe significant skewness and excess kurtosis in all series. Significant first and second moment serial correlation in returns is observed in all cases suggesting significant time-varying conditional heteroskedasticity. In addition, the Engle and Ng (1993)'s joint sign bias test, which detects the existence of leverage effects (asymmetric volatility response to unanticipated positive and negative shocks), is significant in all cases. Lastly, the Augmented Dickey-Fuller unit root tests confirm that none of the return series has a unit root. In summary, the returns series generally exhibit significant

[9] The GNP announcements were made thirty minutes after the close of TSE but before the exchange and interest rate collection time of 5pm GMT. Thus, GNP announced at day t is included in holding period $\Delta Nikkei_{t+1}$ and as such the GNP news is used with one day lag in the subsequent analysis for the Nikkei. This complication does not arise for the Yen/USD and EuroYen estimations.

skewness, leptokurtosis, conditional heteroskedasticity and leverage effects, typical of high frequency financial return series. These characteristics must therefore be addressed in empirical modeling of these series.

3. Econometric methodologies

3.1. EGARCH modeling

GARCH family of models has been shown to be effective in addressing the observed statistical characteristics of higher frequency financial return series such as observed in Table 2. In particular, parsimonious GARCH(1,1) model is generally shown to outperform other GARCH specifications (Hansen and Lunde, 2001). The observed leverage effect in the data is addressed by employing exponential GARCH models. An advantage of EGARCH models over other asymmetric models is that it allows negative coefficients in the conditional variance equation which plays a crucial role in the analyses. We chose EGARCH(1,1) models for all three series instead of adopting a different lag structure for each. This is to facilitate straight forward cross equation comparisons of announcement news effects. The base model is the MA-EGARCH(1,1) as shown below:

$$R_{i,t} = \alpha_{i,c} + \alpha_{i\ ,HOL} \cdot HOL_{i,t} + \varepsilon_{i,t} + \sum_{k=1}^{q} \alpha_{i,k} \cdot \varepsilon_{i\ ,t-k} \tag{1a}$$

$$\varepsilon_{i,t} = z_{i,t}\sqrt{h_{i,t}} \sim (0, h_{i,t}), \quad \mathrm{z_{i,t}} \sim iid(0,1)$$

$$\ln h_{i,t} = \beta_{i,c} + \beta_{i,HOL} \cdot HOL_{i,t} + \beta_{i,h} \cdot \ln h_{i,t-1} + \beta_{i,\varepsilon 1} \cdot \frac{\varepsilon_{i,t-1}}{\sqrt{h_{i,t-1}}} + \beta_{i,\varepsilon 2} \cdot \left(\frac{\left|\varepsilon_{i,t-1}\right|}{\sqrt{h_{i,t-1}}} - \sqrt{\frac{2}{\pi}} \right) \tag{1b}$$

Where:

$R_{i,t}$ = Foreign exchange and stock market returns over daily holding periods ($\ln(P_t^{Close} / P_{t-1}^{Close}) \times 100$). Daily interest rate change is measured as $(P_t^{close} - P_{t-1}^{close})$.

$HOL_{i,t}$ = Seasonal dummy that takes the value of the number of days between two successive observations. One for normal weekdays, 3 for Mondays and 2 or higher for days immediately following market closures due to holidays.

$h_{i,t}$ = Conditional volatility of $R_{i,t}$.

q = Number of moving average terms included in the conditional mean equation to remove serial correlation in the estimated standardized residuals z_t.

In addition to the base EGARCH parameters, we adopt the seasonal variable HOL_t to capture the potential effects of asymmetric daily information flows due to holidays and weekends.[10]

The announcement news variables in various forms will enter the right hand sides of (1a) and (1b), and we examine the sign and magnitude (or significance) of their coefficients to determine the sensitivity of the various markets' return and return volatility (respectively) to the public information releases/news[11]. We adopt general to specific modeling strategy in modeling news. We first investigate the aggregate effects of all the information releases on the return and return volatility, then we disaggregate announcements into growth-related and inflation-related announcements. Finally, individual announcement and news effects are investigated. This strategy allows us to ascertain the existence or otherwise of generalized announcement effects in addition of the market reactions in response to specific announcements.

Model 1: Aggregated announcement effects

$$R_{i,t} = M(\cdot) + \alpha_{i,ALL} \cdot ALL_t \tag{2a}$$

$$\ln h_{i,t} = V(\cdot) + \beta_{i,ALL} \cdot ALL_t \tag{2b}$$

[10] We also carried out our analyses with an alternate definition for HOL_t. The holiday dummy would take the value of one for days immediately following market closures due to holidays, and zero otherwise. It was used in conjunction with day-of-the-week dummies. Since this alternate specification did not significantly add to our analysis, we have only reported the results of the estimations using the seasonal dummy described above.

[11] Note that monthly and quarterly announcement news variables are transformed to daily frequency by assigning zeros on non-announcement days to match the frequency of the returns data

Where $M(\cdot)$ and $V(\cdot)$ are the right hand sides of Equations (1a) and (1b), respectively. The first set of estimations involves a single ALL_t announcement dummy, which takes the value of one when any announcement is made within the holding period, and zero otherwise. The announcement coefficients, α_{ALL} and β_{ALL}, thus pick up the average effect of the announcements on the conditional mean and variance, respectively.

Model 2: The effect of announcements related to growth and inflation

$$R_{i,t} = M(\cdot) + \alpha_{i,GROW} \cdot GROW_t + \alpha_{i,INFL} \cdot INFL_t \tag{3a}$$

$$\ln h_{i,t} = V(\cdot) + \beta_{i,GROW} \cdot GROW_t + \beta_{i,INFL} \cdot INFL_t \tag{3b}$$

The second set of estimations is a systematic progression from the first and involves two separate announcement dummies, GROW_t and INFL_t. These take the value of one when any growth or inflation related variable, respectively, is announced within the holding period, and zero otherwise. Hence, this involves a simple disaggregation of announcements into real and nominal variables[12]. The announcement coefficients thus measure the average effects of growth and inflation announcements on the financial prices and volatilities. The justification for this separation lies in the fact that real and nominal variables convey distinct pieces of information, and it would be pertinent to observe whether particular markets' movements are driven more by variables belonging to one class or the other.

Model 3: The effects of individual announcements

[12] The three *nominal* variables are *WPI*, *CPI* and *MS*. The remaining 13 are defined as *real* variables.

$$R_{i,t} = M(\cdot) + \sum_{j=TB}^{MS} \alpha_{i,j} \cdot ANN_{j,t} \tag{4a}$$

$$\ln h_{i,t} = V(\cdot) + \sum_{j=TB}^{MS} \beta_{i,j} \cdot ANN_{j,t} \tag{4b}$$

The third set of estimations involves a further disaggregation, with announcement dummies created for each individual announcement series. $ANN_{j,t}$ is the dummy that takes the value of one when an announcement about that particular economic variable *j* (= TB, CAB, GNP, UE, JOS, RET, IND, HS, MO, TNK, CPX, COI, LEA, WPI, CPI and MS, as outlined in Table 1) is made within the holding period, and zero otherwise. Their coefficients will represent the average effect of that particular announcement series.

It is important to note that in this analysis, only 13 out of the 16 macroeconomic announcements have been included. This is because both UE and JOS announcements are always made on the same day and at the same time, as are TNK and CPX announcements, and COI and LEA. In order to avoid the problem of multicollinearity, as well as to avoid the problems involved in isolating the impacts of these simultaneously-announced variables, we chose to drop one out of each of these pairs of announcements. We drop JOS, CPX and COI[13].

Model 4: The effect of announcement news

[13] W dropped *JOS* because *UE* is the indicator to which the market more readily turns for an indication of the state of the job market. We chose to drop *CPX* over *TNK* because only the market expectation of the latter is unbiased, and is therefore also included in our *news variables* regression. The decision to drop *COI* over *LEA* was purely arbitrary. Since the market expectations of the neither was unbiased, neither is included in the later analyses either. It should also be noted that henceforth, any discussion of the effects of *UE*, *TNK* or *LEA* announcements will implicitly be a discussion of *joint* effects. For example, a finding that *UE* announcements raise volatility in general will actually equate to a finding that, in general, the *joint effect* of *UE* and *JOS* announcements is to raise volatility.

$$R_{i,t} = M(\cdot) + \sum_{j=TB}^{MS} \alpha_{i,j} \cdot NEWS_{j,t} \tag{5a}$$

$$\ln h_{i,t} = V(\cdot) + \sum_{j=TB}^{MS} \beta_{i,j} \cdot \left| NEWS_{j,t} \right| \tag{5b}$$

We now use news variables in both the conditional mean and volatility equations. News variable, $NEWS_{j,t}$, is calculated as the difference between the announced and expected value of the economic variable if an announcement is made within the holding period, and zero otherwise. This essentially captures the unexpected component of each announcement, and for the variables expressed as a percentage change from the previous period, news variables are computed as an absolute difference: $NEWS_t = Actual_t - Expected_t$. The Trade Balance (TB) and Current Account Balance (CAB) are expressed in raw dollar figures (see Table 1), and so we calculate the percentage difference: $NEWS_t = \ln(Actual_t / Expected_t) \times 100$.

These news variables measure the extent to which the announcements contain new information, and as such it is now possible to draw more meaningful inferences from the analysis. This is especially true for the mean equation since we are now considering both the direction and the magnitude of the surprise component of each announcement. For this final analysis, we only use the 10 series for which market expectations have been deemed unbiased.[14] This is because Model 4 essentially involves a joint test, in that we are also relying on the accuracy of market expectations. If the market systematically under- or over-estimates the value of a particular economic indicator, the results from our EGARCH(1,1) model will not be meaningful. Only when MMS survey expectations are unbiased predictors

[14] *JOS* will appear in Model 4, even though it was omitted from Model 3. The reason is that while it was always announced on the same day and at the same time as *UE*, the direction and magnitude of the surprise component of each announcement differs between the two series. The previous problem of multicollinearity is therefore no longer applicable.

of the announced figures will we be able to treat deviations of the actual from the expected as 'news'[15].

3.2 First and second moment responses to news

The first moment (mean) news effects occur via two basic channels. The first is due to 'equilibrium adjustments', whereby financial prices change to restore the equilibrium relationship between the economic variable and that particular financial market. For example, assuming informationally efficient markets, the exchange rate observed prior to macroeconomic announcements represents equilibrium, given market participants' best forecasts at the time. Thus, if the announced figure differs significantly from prior expectations, this new information will then be (quickly) incorporated to restore equilibrium. The second channel by which first moment effects may arise is in anticipation of a policy response by the central bank, either via monetary policy and/or foreign exchange intervention. This is the 'policy anticipation hypothesis', support for which has been found in past studies such as Urich and Wachtel (1984), Hardouvelis (1988), Deravi et al. (1988) and Hogan et al. (1991) in the U.S. In the context of our study, the policy change or intervention would be that of the Bank of Japan. In a similar fashion to the process above, given the injection of new information, market equilibrium must be restored by incorporating the expected future policy response of the central bank.[16] Of course, this will be based on the monetary and foreign exchange intervention policy objectives prevailing at the time of the announcement, and whether or not the market believes that these stated policy objectives are credible.

[15] Unbiased tests of survey expectations are reported in last two columns of Table 1.

[16] While the Bank of Japan does not directly intervene in the stock market in any way, any intervention via monetary and/or foreign exchange intervention policies (which will have an impact on interest rates and exchange rates) will still have indirect flow-on implications for the stock market, and thus still affect the equilibrium value of a stock index such as the Nikkei 225.

Turning to the second moment effects, volatility can respond in one of two ways on the days of announcements. A higher volatility may result from the announcement of a 'low-volatility' variable, for which a widespread consensus about its importance and relevance develops easily. Thus, following a degree of homogeneity of beliefs in the days leading up to its announcement, a surprise in the announced value will have a market exciting effect on trading volumes (more specifically order flow) and thus, conditional volatility. Conversely, a fall in volatility may result from the announcement of a variable about which some market participants may have a poor understanding of importance or relevance. Following elevated trading levels based on the diversity of opinions in the preceding days, the announcement will reduce the amount of speculative trading based on incorrect information, and thus also reduce conditional volatility.[17]

3.3 Expected results

The majority of studies in the literature concentrates on only a handful, at best, of announcement variables and thus allow conjecturing specific hypotheses for each of the variables considered. The approach taken in this paper is to study the effects of up to 16 macroeconomic announcements on three financial market segments in Japan. As a result, this multitude of both announcements and markets renders the formulation of individual expectations less manageable. We have chosen to be comprehensive, rather than specific, in our analysis. While this is inevitably at the expense of the detailed rationale and explanations

[17] Ideally, we would have carried out an analysis of the effect of macroeconomic announcements on trading volume to reaffirm our findings on second moment movements. While data on traded volumes was available at a *daily* level, we feel that a volume study requires data at a much higher frequency. Indeed, past studies have settled for no less than minute-by-minute volume data. We performed OLS regressions using volume data from Datastream, but felt that due to the relatively low frequency of observations, they did not significantly contribute to our study. The results are therefore unreported to conserve space.

contained in earlier studies in the area, it facilitates the analysis of, and allows insight into, cross-market movements and interactions (or lack thereof). Nonetheless, we provide three *a priori* expectations on the estimation results for the four models.

First, announcements themselves may not lead to any discernible or consistent first moment response in the Japanese financial markets, rather only when we consider the news content of each announcement should patterns emerge. This can be verified by comparing the results of Models 1 through to 3 with Model 4. Of course, this does not imply that significance in any of the coefficients from the first three Models is of less importance. However, these coefficients capture only the average effect of each announcement.

Second, we expect that inflation-related announcements would have a greater impact on the foreign exchange and debt markets, while growth-related announcements would have a greater impact on the stock market. This is due to the fact that inflation is a major driver of interest rate changes, with flow-on effects on exchange rates. On the other hand, the stock index movements should be more closely tied to the state of the economy.

Third, the debt market would exhibit a greater response to macroeconomic announcements than the stock market. The rationale behind this is summed up well by DeGoeij and Marquering (2002), who posit that the bond market reacts almost exclusively to news of a macroeconomic nature. In relation to our particular study, this might be due to the fact that the Euoryen (LIBOR) interest rate is not 'traded' in the same way that foreign exchange and stocks are, and hence movements in interest rates will only occur at certain times. One of the main occasions that this occurs will be when information on macroeconomic variables is released to the public. On the other hand, it is argued that most large stock market shocks are not directly related to macroeconomic news, but rather to firm-specific or industry-specific news.

4. Empirical Results

The Quasi ML estimation results of the four models are reported in Tables 3, 4 and 5 for the foreign exchange, debt and stock markets, respectively. In general, the EGARCH models have more than adequately addressed the daily return characteristics reported in Table 2. All EGARCH parameters (except for the leverage effect coefficient, $\beta_{\varepsilon 1}$, for EuroYen) are significant at one percent. High volatility persistence is observed in all cases (β_h is close to unity), and positive and negative asymmetric leverage effect is reported for the EuroYen and the Nikkei 225, respectively. The diagnostics of the estimations suggest that the generated standardized residuals are white noise[18].

4.1 Foreign exchange: Effects on the Yen/USD exchange rate

The results for the Yen/USD spot exchange rate are reported in Table 3. Panel A contains the results from the conditional mean equations, Panel B the conditional volatilities and Panel C the regression diagnostics. It should be noted that a positive movement in the Yen/USD spot rate equates to a Yen depreciation.

Model 1 results show that the aggregated news dummy did not significantly affect the exchange rate. This is in line with our first *a priori* expectation, since we have not distinguished which announcement was being made, nor the sign or magnitude of the unexpected component of the announcement. It is likely that the differential reactions to various announcements offset each other over the entire sample period. Similarly, Model 2 shows that while inflation-related announcements led, on average, to a significant Yen

[18] More detailed discussion on the EGARCH estimations and their diagnostics are not included in this paper to conserve space. It is available upon request.

appreciation, growth-related announcements did not. This may simply reflect the fact that, as in Model 1, the differential reactions to various growth-related announcements offset each other over the sample period, while the inflation-related variables, on average, appreciated the Yen. However, it is shown that announcements in general led to a higher volatility, indicating that macroeconomic announcements generally created additional uncertainty. All three dummies (β_{ALL}, β_{GROW} and β_{INFL}) are significant at 1%. However, β_{INFL} (0.06) is more than twice as large as β_{GROW} (0.0276), indicating that in line with our expectations, nominal variables were more newsworthy in explaining the exchange rate volatility.

Model 3 shows that whilst only a handful of announcements caused significant price movements (Panel A), all but three are highly significant in the conditional volatility equation (Panel B). While CPI and PPI announcements appreciated the Yen, UE announcement led to a depreciation. As for the volatility, there are evidence for both volatility increasing and reducing influences. Of those raising volatility, *UE* has the largest coefficient of 0.6189, which is in line with the numerous U.S. studies that find that the *US Employment Report* has the greatest impact on market volatility (Ederington and Lee, 1993; Bollerslev et al., 2000; Christie-David and Chaudhry, 2000)[19]. These studies also find that inflation announcements are also of considerable influence, which is supported by our findings with *WPI* (0.1610) and *MS* (0.1748).

The finding that *RET* had one of the greatest market calming effect is consistent with the findings of Kim (1998) for the USD/AUD exchange rate. Interestingly, while the market responded to *TB* announcements, *CAB* had no effect. This could indicate that participants in the foreign exchange market only speculated over the trade balance component of the current account, although the results may simply be a manifestation of the frequency of the

[19] Recall that this coefficient is in fact capturing the *joint effect* of *UE* and *JOS* announcements.

announcements (*TB* are monthly, while *CAB* are quarterly, and the market may respond more to the more frequent announcement).

Model 4 estimations show that of the three announcements that had a significant effect on the mean (*UE*, *WPI* and *CPI*) in Model 3, only *CPI* remained significant (although at 10%) once we consider only the news component of the announcement. An unexpected rise in *CPI* by 1% appreciated the Yen by 0.165%, however, there is no corresponding effect in the conditional volatility. This initially seems counter-intuitive, and against purchasing power parity. However, a closer analysis reveals that the market most likely anticipated future monetary policy intervention, and there is overwhelming support for this explanation. The combination of significant mean and insignificant volatility effect suggests an existence of market consensus on the policy response, such that a new equilibrium is reached without volatility being affected. In other words, the fact that only one of the inflation measures (*CPI*, not *WPI*) affected the exchange rate shows that the market expected the Bank of Japan to tighten monetary policy in response to unanticipated *CPI* inflation. This conjecture receives more support in Table 4, which shows that unexpected CPI inflation (and *not WPI*) announcements led to an interest rate rise. Thus, we conjecture that the market might have expected a monetary tightening and this would lead to higher real interest rates and a Yen appreciation[20].

Meanwhile, unexpectedly good *CAB* news of 1% *depreciated* the Yen by 0.004%. While also seemingly counter-intuitive, this could be rationalized as an anticipation of a potential future political retaliation from the U.S., which runs trade deficits against Japan. Japan's current account and trade balance had been in surplus throughout the entire sample period. This theory is given support by the fact that *CAB* surprises significantly lowered

[20] If it was in fact the *nominal* interest rate that was rising, then Table 4 should also have shown that interest rates rose when *WPI* and *MS* were higher than expected.

conditional volatility (β_{CAB} is –0.0026 in Model 4), indicating that official government announcements are the only credible source of information on the *CAB*.

4.2 Debt market: Effects on the Euroyen interest rate

The results for the Euroyen (LIBOR) interest rate are reported in Table 4. The results of each of the four models are discussed in turn. Model 1 results show that the average effect of the announcements is to lower the interest rate by 0.004 percentage points and to raise volatility (β_{ALL} is 0.1561 and significant). However, Model 2 seems to indicate that while growth-related announcements caused this higher volatility, the nominal variables had a market calming effect (β_{INFL} is –0.0896 and significant). This suggests that interest rate is most sensitive to information relating to inflation.

While we find that inflation announcements generally lowered interest rate volatility, the results from Model 3 indicate that this was driven solely by WPI. CPI and MS announcements actually raised volatility. The fact that WPI is announced in the middle of each month (shortly before *MS*), while *CPI* is announced towards the end, may explain the ability of *WPI* to drive the results in Model 2. Since it is the first nominal variable announced during each period, the market may respond more strongly to this initial indication (*WPI*) of current levels of inflation in the economy, and less so to the subsequent indicators (*CPI* and *MS*) as they are really just reaffirming the initial *WPI* announcement. Several studies find support for this phenomenon (Ederington and Lee, 1993; Christie-David and Chaudhry, 2000; Christie-David et al., 2002; Andersen et al., 2002), however this 'sequence hypothesis' received less support for the U.S. stock market (Flannery and Protopapadakis, 2002). Furthermore, when we consider the magnitude of the surprise component (Model 4), we find

that larger inflation surprises always led to greater uncertainty in the market, even for *WPI* surprises.

Interestingly, every single announcement had a significant effect on the volatility (evenly divided between market calming and exciting effects). This overwhelming evidence that the debt market responds to public macroeconomic announcements is *prima facie* support in favour of our third *a priori* expectation that while most *stock* market shocks are due to firm-specific and/or industry-specific news, the major source of interest rate movements is news of a macroeconomic nature.

A comparison of Panel A of Models 3 and 4 again illustrates the additional information provided by the surprises especially when investigating the mean effects. We see that the variables whose announcements (Model 3) had an effect on the interest rate were not necessarily the same as those whose news content (unexpected portion, Model 4) moved it. The conditional volatility results for Model 4 show that macroeconomic shocks had a significant impact on the volatility. In fact, all except *TB* are significant, giving yet more weight to the aforementioned expected findings in the previous subsection. We also find further support for the U.S. studies that report the importance of *the Employment Report,* followed by inflation announcements, in influencing interest rate volatility (Ederington and Lee, 1993; Bollerslev et al., 2000, Christie-David and Chaudhry, 2000). Table 4 shows that the coefficients on *JOS* (5.9966) and *UE* (–2.0734) (our two employment-related variables) are by far the largest, with *MS*, *CPI* and *WPI* (our three inflation-related variables) the next largest (0.5522, 0.5496 and 0.4208 respectively).

Turning to the mean results for Model 4, it appears that in general, higher than expected figures for growth-related variables lowered the interest rate, which is consistent with an anticipation of future monetary policy easing. However, the suggestion that the

Japanese market tends to anticipate a policy response to inflation, rather than growth, was first given support in our foreign exchange results.[21] Some support is shown in Table 4 where the *CPI* surprises elicited a significant response while the *UE* news did not. An unexpected 1% *CPI* inflation raised the interest rate by approximately 0.0286 percentage points. As in the foreign exchange market, it is *CPI* rather than *WPI* to which the market responds, even though announcements on the latter are made earlier in the month. The coefficient on *CPI* in Panel A is significant at 1%, while the coefficient on *WPI* is insignificant. When viewed in conjunction with the exchange rate findings in Table 3, we have support for conjecture that the rise in the interest rate was due to Japanese market participants anticipating a rise in the *real* (rather than nominal) rate, possibly resulting from a future monetary tightening in response to positive *CPI* surprises. These findings are consistent with the U.S. studies investigating the 'money supply puzzle' (Engel and Frankel, 1984; Urich and Wachtel, 1984; Hoffman and Schlagenhauf, 1985). Finally, contrary to the previous U.S. studies (but consistent with our foreign exchange findings), *TB* surprises had no effect on the interest rate.

4.3 Stock market: Effects on the Nikkei 225 stock index

The results for the Nikkei 225 stock index are reported in Table 5. Models 1 and 2 show that the aggregate announcement dummies are insignificant. The volatility effects shown in Panel B suggest that growth and inflation announcements both created additional uncertainty in the market, and combined to raise the volatility on the days of announcements (all three dummies from Models 1 and 2 are highly significant in the variance equation). However, unlike the case of exchange and interest rates, growth-related announcements (coefficient of 0.0752) had a greater impact on the volatility than the

[21] Kim and Sheen (2000) find that the Australian market also tends to anticipate inflation-related policy responses. However, the U.S. market tends to anticipate growth-related policy responses.

inflation-related announcements (coefficient of 0.0467). It thus appears that nominal variables do not have the same impact on the stock market as in the foreign exchange and debt markets. This is a rather intuitive finding consistent with our expectations. Since the equity value of firms in the economy will tend to move systematically with the state of the economy (as well as responding to firm-specific events), the variables related to economic growth should play a greater role in stock market movements.

Several announcements have a significant effect on the volatility, as reported in Model 3, and as in the foreign exchange and debt markets, both volatility increasing and reducing effects are found. Contrary to the findings of Flannery and Protopapadakis (2002), the impact on the Nikkei volatility is not restricted to the real variables alone. However, consistent with the results from Model 2, it appears that they had a greater impact on the volatility. The variables with sizeable coefficients include *TNK*, *IND*, *TB*, *MO*, *GNP* and *CAB* announcements, all of which are related to economic growth. Thus, the reasoning that equity values are more closely tied to the state of the economy is also supported by the results from Model 3.

The Model 4 estimations include significant individual news effects on the mean equation. While *HS* and *WP*I announcements (Model 3) had an effect on the stock index, news on those particular variables (Model 4) had no effect. We also observe that *TB* is the lone news variable to have had a consistent impact on Nikkei 225 returns, with unexpectedly good trade balance news actually causing negative returns. A resulting potential conflict with the U.S. might explain this negative association. As for the volatility effect of the news, on the whole, macroeconomic shocks did not have a significant effect on the volatility. This evidence, along with the findings in Table 4, confirms that the debt market exhibited a greater

response to macroeconomic shocks than the stock market. Put another way, while the main source of interest rate movements is macroeconomic shocks, this is not the case with the stock market. Hence, we have overwhelming evidence in favour of our *a priori* expectation.

5. Conclusion

The importance of the Japanese market in the entire scope of the global economy is undoubted. In terms of trade flow and market capitalization, Japan is the world's second largest economy. However, there have been disproportionately few studies on the effects of public information in this market. More specifically, the precise extent of the impact of macroeconomic announcements has not, to date, been explored in detail. Our study fills this gap, and makes a significant contribution, by extending the literature to include the effects of news on financial market returns and volatility in Japan.

Overall, we find that the scheduled announcements of macroeconomic variables have a significant impact on returns and volatility in the Japanese market, and our results reflect an interesting array of responses and interactions between the different market segments. We find that while announcements themselves do not have a discernible or consistent effect on returns, patterns emerge once we consider only the unexpected component of each announcement. In general, the release of macroeconomic figures creates additional uncertainty, leading to increased market volatility. Furthermore, the finding that the debt market responds more than the stock market is evidence that the main source of interest rate movements is macroeconomic news, whereas stock markets are influenced more by news of a firm-specific or industry-specific nature. While interest rate and exchange rate volatility are due more to inflation-related announcements, it is growth-related announcements to which the stock market is more sensitive.

In conclusion, we have found that the Japanese financial markets do respond to these disaggregated flows of public information. The impact on market volatility is especially evident. Market participants are found to respond in a sophisticated and rational manner, indicating that news releases are indeed a source of tradable information, and not just an act of releasing economic figures. Our study has managed to uncover some of the underlying drivers of market movements in Japan. This paper is thus adding to the literature by shedding light on the inner workings of the Japanese financial market.

References

Andersen, T.G., Bollerslev, T., Diebold, F.X. and Vega, C. 2002. Micro effects of macro announcements: real--time price discovery in foreign exchange, Working paper, National Bureau of Economic Research.

Balduzzi, P., Elton, E.J. and Green, T.C. 2001. Economic news and bond prices: evidence from the U.S. Treasury market, *Journal of Financial and Quantitative Analysis* 36, 523--543.

Becker, K.G., Finnerty, J.E. and Kopecky, K.J. 1996. Macroeconomic news and the efficiency of international bond futures markets, *Journal of Futures Markets* 16, 131--145.

Bollerslev, T., Cai, J. and Song, F.M. 2000. Intraday periodicity, long memory volatility, and macroeconomic announcement effects in the U.S. Treasury bond market, *Journal of Empirical Finance* 7, 37--55.

Brooks, R.D., Berman, G., Davidson, D. and Tan, T.Y. 1999. Announcements and revisions of Australian macroeconomic data and their news content for Australian financial markets, *Journal of International Financial Markets, Institutions and Money* 9, 195--215.

Christie--David, R. and Chaudhry, M. 2000. Currency futures, news releases, and uncertainty resolution, Global Finance Journal 11, 109--127.

Christie--David, R., Chaudhry, M. and Khan, W. 2002. News releases, market integration, and market leadership, Journal of Financial Research 25, 223--245.

DeGennaro, R.P. and R.E. Shreives, 1997, Public Information Releases, Private Information Arrival and Volatility in the Foreign Exchange Market, Journal of Empirical Finance 4, 295 – 315.

DeGoeij, P. and Marquering, W. 2002. Do macroeconomic announcements cause asymmetric volatility? Working paper, Erasmus Research Institute of Management, Rotterdam, The Netherlands.

Deravi, K., Gregorowicz, P. and Hegji, C.E. 1988. Balance of trade announcements and movements in exchange rates, *Southern Economic Journal* 55, 279--287.

Ederington, L.H. and Lee, J.H. 1993. How markets process information: news releases and volatility, *Journal of Finance* 48, 1161--1191.

Ederington, L.H. and Lee, J.H. 1994. The response of the Dollar/Yen exchange rate to economic announcements, *Financial Engineering and the Japanese Markets* 1, 111--128.

Engle, R.F. and Ng, V.K. 1993. Measuring and testing the impact of news on volatility, *Journal of Finance* 48, 1749--1778.

Evans, M. D. and Lyons R. K. 2003. How is macro news transmitted to exchange rates? NBER Working paper 9433.

Flannery, M.J. and Protopapadakis, A.A. 2002. Macroeconomic factors *do* influence aggregate stock returns, *Review of Financial Studies* 15, 751--782.

Fleming, M.J. and Remolona, E.M. 1999. Price formation and liquidity in the U.S. Treasury market: the response to public information, *Journal of Finance* 54, 1901--1915.

French, K.R. and R. Roll, 1986, Stock Return Variances: The Arrival of Information and the Reaction of Traders, Journal of Financial Economics 17, 5 – 26.

Frino, A. and Hill, A. 2001. Intraday futures market behaviour around major scheduled macroeconomic announcements: Australian evidence, *Journal of Banking and Finance* 25, 1319--1337.

Hansen, P.R. and Lunde, A. 2001. A forecast comparison of volatility models: does anything beat a GARCH1,1)? Working paper, Brown University.

Hardouvelis, G.A. 1988. Economic news, exchange rates and interest rates, *Journal of International Money and Finance* 7, 23--35.

Hoffman, D.L. and Schlagenhauf, D.E. 1985. The impact of news and alternative theories of exchange rate determination, *Journal of Money, Credit and Banking* 17, 328--346.

Hogan, K., Melvin, M. and Roberts, D.J. 1991. Trade balance news and exchange rates: is there a policy signal? *Journal of International Money and Finance* 10, S90--S99.

Irwin, D.A. 1989. Trade deficit announcements, intervention, and the dollar, *Economics Letters* 31, 257--262.

Ito, T. and V.V. Roley, 1987, News from the U.S. and Japan: Which Moves the Yen/Dollar Exchange Rate?, Journal of Monetary Economics 19, 255 – 77.

Jones, C.M., Lamont, O. and Lumsdaine, R.L. 1998. Macroeconomic news and bond market volatility, *Journal of Financial Economics* 47, 315--337.

Kim, S.J. 1998. Do Australian and the U.S. macroeconomic news announcements affect the USD/AUD exchange rate? Some evidence from E--GARCH estimations, *Journal of Multinational Financial Management* 8, 233--248.

Kim, S.J. 2003. The spillover effects of U.S. and Japanese public information news in advanced Asia--Pacific stock markets, *Pacific--Basin Finance Journal* 11, 611--630.

Kim, S.J. and Sheen, J. 2000. International linkages and macroeconomic news effects on interest rate volatility – Australia and the U.S., *Pacific--Basin Finance Journal* 8, 85--113.

Lyons, R. K. 2001. The microstructure approach to exchange rates, MIT press, Cambridge, Massachusetts.

McQueen, G. and Roley, V.V. 1993. Stock prices, news, and business conditions, *Review of Financial Studies* 6, 683--707.

Pearce, D.K. and Roley, V. V. 1985. Stock prices and economic news, *Journal of Business* 58, 49--67.

Roley, V.V. 1982. Weekly money supply announcements and the volatility of short--term interest rates, Federal Reserve Bank of Kansas City, *Economic Review* 67, 3--15.

Sun, Q. and W. Tong, 2000, The Effect of U.S. Trade Deficit Announcements on the Stock Prices of U.S. and Japanese Automakers, Journal of Financial Research 23, 15 – 43.

Urich, T. and Wachtel, P. 1984. The effects of inflation and money supply announcements on interest rates, *Journal of Finance* 39, 1177--1188.

Figure 1: Japanese macroeconomic announcement times and market trading hours

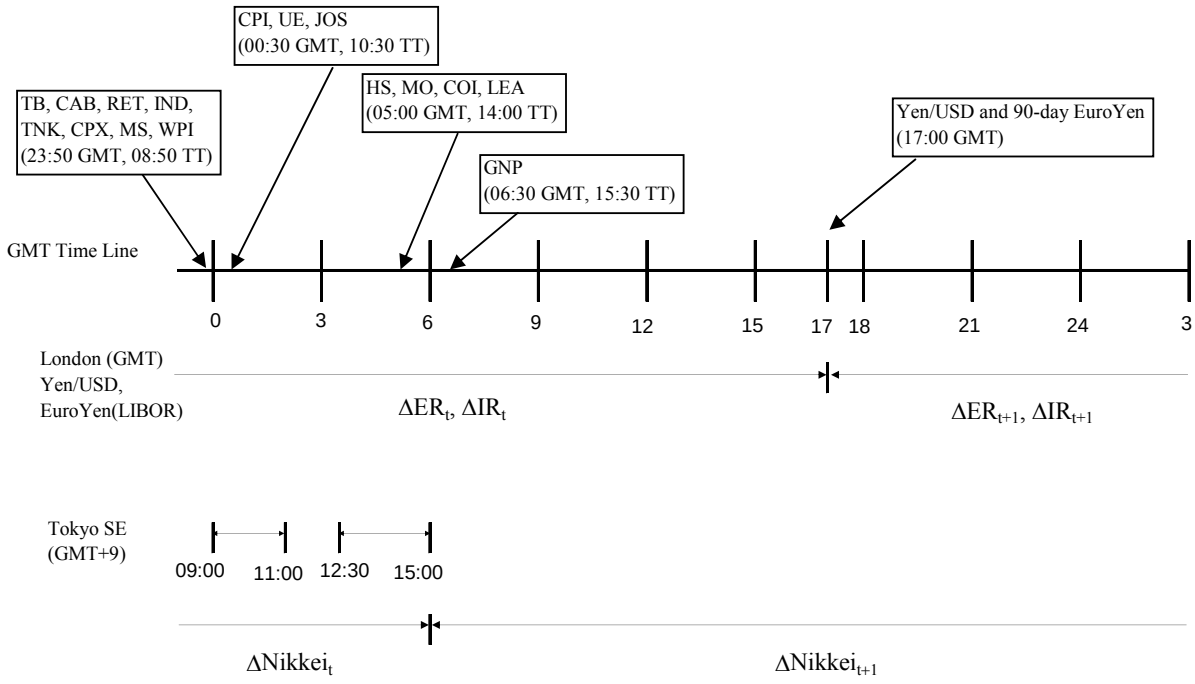

Table 1
Japanese Macroeconomic Announcements and Survey Data
(Source: MMS International)

	Economic Variable	Ann. Frequency	Unit of Measurement[a]	Ann. Time: Tokyo (GMT+9)	Starting Period[b]	Total No. of Ann.[c]	Unbiased Results[d]	Unbiased[e]
1	Trade Balance (TB)	Monthly	$ US billion	8:50am	June '88	129	0.9179 {0.0000}	Yes
2	Current Account Balance (CAB)	Monthly	$ US billion	8:50am	November '93	54	0.9169 {0.0001}	Yes
3	Gross National Product (GNP)	Quarterly	% change in GNP	3:30pm	June '88	41	0.0957 {0.0000}	No
4	Unemployment Rate (UE)	Monthly	Unemployment Rate %	9:30am	May '94	58	1.0144 {0.0411}	Yes
5	Job Offer / Seeker Ratio (JOS)	Monthly	Ratio of job offers to job seekers	9:30am	May '94	58	0.9927 {0.2620}	Yes
6	Retail Sales (RET)	Monthly	% change in large-scaled retail sales	8:50am	June '88	129	0.6082 {0.0142}	No
7	Industrial Production (IND)	Monthly	% change in industrial production index	8:50am	June '88	129	- 0.2085 {0.0000}	No
8	Housing Starts (HS)	Monthly	% change in number of houses built	2:00pm	June '88	125	0.9869 {0.8131}	Yes
9	Machinery Orders (MO)	Monthly	% change in machinery orders	2:00pm	April '93	71	0.8656 {0.0720}	Yes
10	Tankan DI (TNK)	Quarterly	Tankan Diffusion Index (manufacturing)[f]	8:50am	March '93	24	0.9660 {0.5130}	Yes
11	Capex DI (CPX)	Quarterly	% change in Tankan capital spending	8:50am	September '93	22	0.8028 {0.0251}	No
12	Coincident Index (COI)[g]	Monthly	EPA Coincident Index	2:00pm	May '94	59	N/A	N/A
13	Leading Index (LEA)[g]	Monthly	EPA Leading Index	2:00pm	May '94	59	N/A	N/A
14	Wholesale Price Index (WPI)	Monthly	% change in WPI	8:50am	July '88	128	0.9853 {0.2420}	Yes
15	Consumer Price Index (CPI)	Monthly	% change in CPI for the Tokyo area[h]	9:30am	April '89	119	0.9696 {0.3964}	Yes
16	Money Supply (MS)	Monthly	% change in M3	8:50am	June '88	129	0.9878 {0.6319}	Yes

Notes:

MMS surveys are conducted every Friday, with the results being released to subscribers. The survey involves approximately 20 to 25 economists from major financial institutions and securities firms in Japan. Market expectations are proxied by the median response in the last survey *prior to* the announcement of the relevant economic variable.

[a] All % changes are relative to the previous period (month or quarter).

[b] Note that these are the first *announcement* dates, with the figures actually related to the previous period's state of affairs. The final announcements (due to data availability) are in March '99, with the exception of CAB, TNK and CPX (December '98).

[c] Announcements were omitted from the analysis if either the actual or expected values, or the dates of the announcement, were missing (as all three pieces of information are crucial to our study). It may be interesting to note that all median expectations data was missing from August 1994.

[d] Reported are the coefficient β_1, and the p-value of the joint test of $\beta_0 = 0$ and $\beta_1 = 1$, from the equation:

$$Actual_t = \beta_0 + \beta_1 Expected_t + \varepsilon_t$$

[e] Unbiasedness was determined on the basis of the joint test of $\beta_0 = 0$ and $\beta_1 = 1$, as well as examination of the slope coefficient alone i.e. if β_1 was sufficiently close to one.

[f] Data for the *non-manufacturing* Tankan DI was also available. However, the manufacturing Tankan DI was selected for our analysis because it covers 17 industries, while non-manufacturing covers only 10.

[g] Both the COI and LEA series appeared to contain errors, as announced and expected values were identical for most dates. Both have still been included in our dummy variable analyses, since the dates are still accurate. However, an analysis of news variables for these two series would prove fruitless (and hence the unbiasedness test is not applicable).

[h] Data was also available for *national* CPI, as well as CPI *excluding perishables* (both Tokyo and National). However, National CPI failed to pass the unbiasedness test, while Tokyo CPI excluding perishables contained nine fewer observations than the regular Tokyo CPI. Thus, CPI for the Tokyo area was selected for our analysis.

Table 2
Statistical Properties
of the Japanese Financial Markets Returns

	Yen/USD Exchange Rate	3-mth Euroyen Interest Rate	Nikkei 225 Stock Index
	Summary statistics		
Mean	– 0.0005	– 0.0014	– 0.0086
Variance	0.518	0.0089	1.9302
Skewness	– 0.5284	– 0.2648	0.3416
Excess kurtosis	5.1189	20.7795	5.1695
	Tests of white noise[(a)]		
Q(20): $\chi^2(20)$	37.5476**	510.5173***	51.8869***
	{0.0101}	{0.0000}	{0.0001}
$Q^2(20)$: $\chi^2(20)$	491.1669***	2368.286***	644.7643***
	{0.0000}	{0.0000}	{0.0000}
E-N Joint test: $\chi^2(3)$	111.0090***	490.0200***	125.0948***
	{0.0000}	{0.0000}	{0.0000}
	Augmented Dickey-Fuller unit root test[(b)]		
Trend and constant	– 25.017***	– 31.859***	– 25.165***
Lags	4	4	4

Notes:

*, ** and *** indicate significance at the 10, 5 and 1% levels, respectively. Numbers in {…} are asymptotic *p*-values.

[(a)] Q(20) and $Q^2(20)$ are Ljung-Box Q-tests of serial correlation of returns and squared returns, up to the 20th order.

E-N is the Engle-Ng's joint test of asymmetric volatility response. The test statistic is the joint significance of the regression of z_t^2 on S_{t-1}^-, $S_{t-1}^- \cdot z_{t-1}$, and $S_{t-1}^+ \cdot z_{t-1}$, where

S_{t-1}^- takes the value of one when $z_{t-1} < 0$, and zero otherwise. S_{t-1}^+ takes the value of one when $z_{t-1} > 0$, and zero otherwise.

In this case, $z_t = (R_t - \mu)/\sigma$, where μ and σ^2 are the unconditional mean and variance of the returns.

[(b)] The Augmented Dickey-Fuller test statistic is for H_0: $\beta = 0$ in the equation:

$$\Delta y_t = \alpha + \gamma t + \beta y_{t-1} + \sum_{i=1}^{Lags} \delta_i \Delta y_{t-1} + u_t$$

Lags of the tests were determined by the number of lagged dependent variables needed to yield white noise residuals at the 5%

level (using the Ljung-Box Q-test).

The Mackinnon (1991) critical value at the 1% level of significance is –3.9856.

Table 3
The Impact of Public Information Releases on the Yen/USD Exchange Rate

	Model 1 All Announcements		Model 2 Growth & Inflation		Model 3 Individual Dummies[a]		Model 4 News Variables[b]	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Panel A: Conditional Mean Equations								
α_c	0.0106	{0.1933}	0.0298***	{0.0000}	0.0185	{0.1355}	0.0129	{0.4079}
α_{HOL}	− 0.0021	{0.8181}	− 0.0114**	{0.0162}	− 0.0078	{0.2890}	− 0.0038	{0.7189}
α_{ALL}	− 0.0232	{0.5146}						
α_{GROW}			0.0252	{0.1854}				
α_{INFL}			− 0.0988***	{0.0000}				
α_{TB}					− 0.0121	{0.8344}	− 0.0008	{0.1637}
α_{CAB}					− 0.0047	{0.9492}	0.0044***	{0.0032}
α_{GNP}					0.0521	{0.5347}		
α_{UE}					0.3052***	{0.0000}	− 0.0853	{0.7427}
α_{JOS}							0.8742	{0.7260}
α_{RET}					0.0316	{0.5316}		
α_{IND}					0.0503	{0.3925}		
α_{HS}					− 0.0401	{0.4018}	0.0065	{0.4663}
α_{MO}					0.0306	{0.7905}	0.0083	{0.3444}
α_{TNK}					0.052	{0.6861}	− 0.0283	{0.1040}
α_{LEA}					0.0283	{0.7195}		
α_{WPI}					− 0.1803***	{0.0001}	0.0264	{0.8191}
α_{CPI}					− 0.1353**	{0.0133}	− 0.1652*	{0.0729}
α_{MS}					− 0.0157	{0.7799}	− 0.0522	{0.5782}
Panel B: Conditional Variance Equations								
β_c	− 0.3379***	{0.0000}	− 0.3623***	{0.0000}	− 0.3437***	{0.0000}	− 0.2410***	{0.0000}
$\beta_{\varepsilon 1}$	− 0.0049	{0.6847}	− 0.0051	{0.6870}	− 0.0084	{0.4447}	− 0.0018	{0.7284}
$\beta_{\varepsilon 2}$	0.1313***	{0.0000}	0.1405***	{0.0000}	0.1415***	{0.0000}	0.1118***	{0.0000}
β_h	0.9774***	{0.0000}	0.9763***	{0.0000}	0.9766***	{0.0000}	0.9772***	{0.0000}
β_{HOL}	0.2205***	{0.0000}	0.2374***	{0.0000}	0.2319***	{0.0000}	0.1509***	{0.0000}
β_{ALL}	0.0467***	{0.0000}						
β_{GROW}			0.0276***	{0.0000}				
β_{INFL}			0.0600***	{0.0000}				
β_{TB}					− 0.2168***	{0.0000}	− 0.0007	{0.2178}
β_{CAB}					0.0406	{0.2820}	− 0.0026***	{0.0046}
β_{GNP}					0.0583	{0.2812}		
β_{UE}					0.6189***	{0.0000}	0.2358	{0.2553}
β_{JOS}							3.1784	{0.2507}
β_{RET}					− 0.2645***	{0.0000}		
β_{IND}					0.2346***	{0.0000}		
β_{HS}					− 0.1654***	{0.0000}	0.0249***	{0.0000}
β_{MO}					− 0.1544***	{0.0000}	0.0071	{0.1384}
β_{TNK}					− 0.0434	{0.6842}	0.0247**	{0.0280}
β_{LEA}					− 0.2755***	{0.0000}		
β_{WPI}					0.1610***	{0.0000}	0.3295***	{0.0000}
β_{CPI}					0.0275	{0.3619}	0.0528	{0.4210}
β_{MS}					0.1748***	{0.0000}	0.0819	{0.1392}

Table 3 (continued)

	Model 1 All Announcements	Model 2 Growth & Inflation	Model 3 Individual Dummies	Model 4 News Variables
Panel C: Diagnostics				
Log-L	– 274.6	– 271.0	– 242.7	– 265.4
q	1	1	1	0
	Tests of white noise for z_t [(c)]			
Q(20)	26.7832	25.8128	26.6078	27.6307
	{0.1415}	{0.1721}	{0.1467}	{0.1184}
$Q^2(20)$	16.9864	16.8438	19.5367	18.823
	{0.6536}	{0.6631}	{0.4872}	{0.5333}
Joint test: E-N	3.713	4.0873	2.3348	2.636
	{0.2942}	{0.2522}	{0.5059}	{0.4512}
	Joint tests of significance [(d)]			
H_0: $\alpha_j = 0$	0.4247	21.8272***	49.1912***	41.6121***
	{0.5146}	{0.0000}	{0.0000}	{0.0000}
H_0: $\beta_j = 0$	183.7106***	39.4582***	15452.64***	286.7108***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}
H_0: $\alpha_j = \beta_j = 0$	197.9519***	52.5575***	18447.14***	328.8059***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}

[(a)]Since TNK & CPX are announced on the same days, one dummy has been dropped.
Similarly, COI & LEA are announced on the same days, as are UE and JOS.

[(b)]Only the announcement series with unbiased expectations are included in this regression.

*, ** and *** indicate significance at the 10, 5 and 1% levels respectively.

q is the number of MA lags required to remove serial correlations and sign bias of z_t.

[(c)]Q(20) and $Q^2(20)$ are Q-tests of serial correlations of z_t and z_t^2 respectively.
E-N is Engle-Ng's joint test of asymmetry volatility.

[(d)]Hypothesis testings include joint significance tests of news effects on the mean, conditional variance, and on both mean and variance.

Table 4
The Impact of Public Information Releases on the 3-mth Euroyen Interest Rate

	Model 1 All Announcements		Model 2 Growth & Inflation		Model 3 Individual Dummies[a]		Model 4 News Variables[b]	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Panel A: Conditional Mean Equations								
α_c	0.0027***	{0.0000}	– 0.0013***	{0.0007}	0.0039***	{0.0000}	0.0021***	{0.0000}
α_{HOL}	– 0.0025***	{0.0000}	0.0006**	{0.0294}	– 0.0017***	{0.0000}	– 0.0019***	{0.0000}
α_{ALL}	– 0.0041***	{0.0000}						
α_{GROW}			– 0.0021	{0.2043}				
α_{INFL}			– 0.0082***	{0.0001}				
α_{TB}					0.0112***	{0.0028}	0.0000	{0.4772}
α_{CAB}					– 0.0316***	{0.0000}	– 0.0007***	{0.0000}
α_{GNP}					0.0021	{0.7448}		
α_{UE}					0.0272***	{0.0000}	– 0.0121	{0.6892}
α_{JOS}							– 0.7647***	{0.0082}
α_{RET}					– 0.0012	{0.6404}		
α_{IND}					0.0039	{0.1310}		
α_{HS}					– 0.0206***	{0.0000}	0.0021***	{0.0001}
α_{MO}					– 0.0165***	{0.0015}	– 0.0006**	{0.0302}
α_{TNK}					– 0.0119	{0.1904}	– 0.0002	{0.8513}
α_{LEA}					– 0.0013	{0.8177}		
α_{WPI}					– 0.0003	{0.9326}	– 0.0113	{0.1758}
α_{CPI}					– 0.0141***	{0.0000}	0.0286***	{0.0000}
α_{MS}					– 0.0086**	{0.0244}	– 0.0108	{0.1667}
Panel B: Conditional Variance Equations								
β_c	– 0.2823***	{0.0000}	– 0.2556***	{0.0000}	– 0.3752***	{0.0000}	– 0.5214***	{0.0000}
$\beta_{\varepsilon 1}$	0.0306***	{0.0002}	0.0409***	{0.0077}	0.0588***	{0.0004}	0.0600***	{0.0069}
$\beta_{\varepsilon 2}$	0.2128***	{0.0000}	0.1971***	{0.0000}	0.3080***	{0.0000}	0.2887***	{0.0000}
β_h	0.9573***	{0.0000}	0.9666***	{0.0000}	0.9490***	{0.0000}	0.9408***	{0.0000}
β_{HOL}	0.0317***	{0.0000}	0.0833***	{0.0000}	0.0838***	{0.0000}	0.1587***	{0.0000}
β_{ALL}	0.1561***	{0.0000}						
β_{GROW}			0.0241***	{0.0000}				
β_{INFL}			– 0.0896***	{0.0000}				
β_{TB}					0.2948***	{0.0000}	– 0.0004	{0.4793}
β_{CAB}					0.4134***	{0.0072}	0.0110***	{0.0000}
β_{GNP}					– 0.1208*	{0.0898}		
β_{UE}					– 0.2308***	{0.0000}	– 2.0734***	{0.0000}
β_{JOS}							5.9966***	{0.0021}
β_{RET}					0.3738***	{0.0000}		
β_{IND}					0.3001***	{0.0000}		
β_{HS}					– 0.4255***	{0.0000}	– 0.0294***	{0.0000}
β_{MO}					– 0.0774*	{0.0951}	– 0.0174***	{0.0027}
β_{TNK}					– 0.4950**	{0.0183}	– 0.0278*	{0.0741}
β_{LEA}					0.0977***	{0.0019}		
β_{WPI}					– 0.0894***	{0.0002}	0.4208***	{0.0000}
β_{CPI}					0.1673***	{0.0000}	0.5496***	{0.0000}
β_{MS}					0.1367***	{0.0000}	0.5522***	{0.0000}

Table 4 (continued)

	Model 1 All Announcements	Model 2 Growth & Inflation	Model 3 Individual Dummies	Model 4 News Variables
Panel C: Diagnostics				
Log-L	6514.9	6513.9	6591.8	6565.3
q	12	7	12	12
	Tests of white noise for z_t [(c)]			
Q(20)	22.004	27.7347	22.2216	20.3172
	{0.3403}	{0.1158}	{0.3286}	{0.4383}
$Q^2(20)$	13.4697	12.7848	11.3434	7.7029
	{0.8563}	{0.8864}	{0.9368}	{0.9937}
E-N Joint test	1.8785	1.1366	0.8366	1.4613
	{0.5980}	{0.7683}	{0.8407}	{0.6912}
	Joint tests of significance [(d)]			
$H_0: \alpha_j = 0$	79.7252***	23.7164***	713.0709***	474.8213***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}
$H_0: \beta_j = 0$	6223.436***	197.0840***	9908.239***	4755.427***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}
$H_0: \alpha_j = \beta_j = 0$	11666.58***	3177.308***	13292.62***	6439.793***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}

(a), (b), (c), (d): See the notes in Table 3.

Table 5
The Impact of Public Information Releases on the Nikkei 225 Index

	Model 1 All Announcements		Model 2 Growth & Inflation		Model 3 Individual Dummies[(a)]		Model 4 News Variables[(b)]	
	Coeff	p-value	Coeff	p-value	Coeff	p-value	Coeff	p-value
Panel A: Conditional Mean Equations								
α_c	0.0457***	{0.0005}	0.0980***	{0.0000}	0.0702***	{0.0053}	0.0764***	{0.0000}
α_{HOL}	– 0.0266***	{0.0002}	– 0.0554***	{0.0000}	– 0.0439***	{0.0008}	– 0.0447***	{0.0002}
α_{ALL}	– 0.0007	{0.9825}						
α_{GROW}			0.0234	{0.4592}				
α_{INFL}			– 0.0264	{0.7750}				
α_{TB}					– 0.0564	{0.3780}	– 0.0025**	{0.0131}
α_{CAB}					0.0255	{0.8599}	– 0.0017	{0.4475}
α_{GNP}					– 0.0136	{0.8795}		
α_{UE}					– 0.1888	{0.2019}	– 0.0835	{0.9071}
α_{JOS}							5.1723	{0.1883}
α_{RET}					0.1792**	{0.0254}		
α_{IND}					– 0.0828	{0.2422}		
α_{HS}					0.1717***	{0.0007}	0.0032	{0.8454}
α_{MO}					– 0.0273	{0.7927}	0.0074	{0.6955}
α_{TNK}					0.2239	{0.3698}	0.0084	{0.7264}
α_{LEA}					– 0.1203	{0.3315}		
α_{WPI}					0.0917*	{0.0521}	0.0823	{0.6553}
α_{CPI}					– 0.0893	{0.3450}	0.0822	{0.6537}
α_{MS}					– 0.0674	{0.2509}	0.0009	{0.9942}
Panel B: Conditional Variance Equations								
β_c	– 0.4345***	{0.0000}	– 0.3750***	{0.0000}	– 0.3814***	{0.0000}	– 0.3276***	{0.0000}
$\beta_{\varepsilon 1}$	– 0.1035***	{0.0000}	– 0.1016***	{0.0000}	– 0.1026***	{0.0000}	– 0.1055***	{0.0000}
$\beta_{\varepsilon 2}$	0.1818***	{0.0000}	0.1724***	{0.0000}	0.1693***	{0.0000}	0.1811***	{0.0000}
β_h	0.9773***	{0.0000}	0.9788***	{0.0000}	0.9804***	{0.0000}	0.9797***	{0.0000}
β_{HOL}	0.2890***	{0.0000}	0.2511***	{0.0000}	0.2576***	{0.0000}	0.2348***	{0.0000}
β_{ALL}	0.0953***	{0.0000}						
β_{GROW}			0.0752***	{0.0000}				
β_{INFL}			0.0467***	{0.0000}				
β_{TB}					0.1921***	{0.0007}	– 0.0005	{0.3127}
β_{CAB}					0.1714**	{0.0305}	0.0009	{0.6165}
β_{GNP}					0.1848*	{0.0629}		
β_{UE}					0.0886	{0.2729}	0.1819	{0.5680}
β_{JOS}							1.488	{0.1368}
β_{RET}					0.1300*	{0.0567}		
β_{IND}					– 0.2037***	{0.0090}		
β_{HS}					0.1451	{0.1180}	0.0067	{0.3455}
β_{MO}					– 0.1916**	{0.0321}	– 0.0039	{0.6068}
β_{TNK}					0.4396***	{0.0000}	0.0215*	{0.0900}
β_{LEA}					– 0.0051	{0.9337}		
β_{WPI}					0.1583**	{0.0169}	– 0.0459	{0.5021}
β_{CPI}					– 0.1207***	{0.0064}	– 0.3112***	{0.0000}
β_{MS}					– 0.0175	{0.8297}	0.1224**	{0.0193}

Table 5 (continued)

	Model 1 All Announcements	Model 2 Growth & Inflation	Model 3 Individual Dummies	Model 4 News Variables
Panel C: Diagnostics				
Log-L	– 1897.9	– 1898.2	– 1880.3	– 1895.8
q	0	0	0	0
	Tests of white noise for z_t [(c)]			
Q(20)	26.0112	25.1978	23.9944	25.5792
	{0.1654}	{0.1940}	{0.2426}	{0.1802}
$Q^2(20)$	21.1284	19.5123	16.334	24.5485
	{0.3896}	{0.4888}	{0.6957}	{0.2193}
E-N Joint test	0.7771	0.3755	0.9135	0.2989
	{0.8549}	{0.9453}	{0.8222}	{0.9602}
	Joint tests of significance [(e)]			
$H_0: \alpha_j = 0$	0.0005	0.6572	24.8374**	8.5613
	{0.9825}	{0.7199}	{0.0242}	{0.5742}
$H_0: \beta_j = 0$	307.7772***	496.5329***	194.8375***	43.9140***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}
$H_0: \alpha_j = \beta_j = 0$	391.1375***	538.7857***	276.1845***	58.6294***
	{0.0000}	{0.0000}	{0.0000}	{0.0000}

(a), (b), (c), (d): See the notes in Table 3.