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EFFECTS OF JAPANESE MACROECONOMIC ANNOUNCEMENTS ON THE DOLLAR/YEN EXCHANGE RATE:
HIGH-RESOLUTION PICTURE

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Effects of Japanese Macroeconomic Announcements on the Dollar/Yen Exchange Rate:

High-Resolution Picture

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ABSTRACT

Market impacts of Japanese macroeconomic announcements within minutes on the dollar/yen foreign exchange are analyzed. High-frequency data collected from the actual trading platform, EBS, are used. First, impacts on returns are analyzed. Macroeconomic statistics releases that consistently had significant effects on exchange rate returns include Tankan survey (a short-term business survey conducted by Bank of Japan), GDP, industrial production (preliminary), PPI, CPI (Tokyo area), the unemployment rate and Balance of Payment statistics. Macroeconomic statistics releases that did not have impacts on returns include Trade Balance, Retail Sales and Housing start indicators. Second, for most of macroeconomic news items whose surprise components have return impacts also have impacts on deals and volatility. The announcement itself, in addition to the magnitude of surprise, is found to increase the deals and price volatility in the immediately after the announcement. In addition, some other items have no return impacts but deals and volatility impacts. These facts are consistent with a view that market participants have heterogeneous information, so that even without any price change, trades take place. Price discovery process may require some transactions with price fluctuations around new price level consistent with statistical announcement

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1. Introduction

The exchange rate is a variable that market participants, economists, and sometimes policymakers are very much interested in. Its dynamic behavior is hard to explain, not to mention hard to predict. Exchange rates are influenced by many news and events—not only economic but political—that become available every minute, if not second. Some news causes a sudden jump in the exchange rate level. These price changes could be temporary (noises) or persistent (jump to a new equilibrium). In either case, movements in prices tend to be, but not always, associated with increased transactions. What triggers the price change and a surge in transaction activities? The usual suspects of the important variables that would cause jumps and volatility in prices and increases in transactions are disclosure of changes in the economic fundamentals. Any unexpected component, that is a “surprise,” of economic announcements, either unscheduled or regularly scheduled, has been examined in many papers in the literature of the macro announcement impact on the exchange rate.

Another strand of literature has examined why a particular time of the day tends to be characterized by a surge (or a drop) in transactions and volatility) compared to other times of the day. One of the reasons for a surge of transactions is a concentration of new information arrivals that tends to occur at the beginning of the business hours of major markets. A possible existence of private information may cause a different trading responses by dealers, some of them informed and some uninformed, at the arrival of new information. Then the trading may be intensified between these two types of dealers. Easley and O’Hara (1992) incorporated private information into a model. Another reason is the arrival of private information, such as large order flows from retail customers, which are modeled in Lyons’ (1997) hot potato hypothesis. A transmission of orders by large retail customers to a bank would generate multiplied transactions in the inter-bank market through a price discovery process in transactions.

A distinct intra-day transactions pattern has been shown in the literature on high frequency data of foreign exchange markets. Transaction volumes and price volatility depend on the time of the day. This intra-daily patterns of foreign exchange markets have been investigated and established by Ito and Hashimoto (2004, 2006) using the EBS data.

Our paper examines the behavior of dollar/yen exchange rates in reaction to releases of major macroeconomic statistics in Japan. This paper uses high-frequency (one-second-slice) EBS trade-

platform data from 2001 to 2005. The EBS represents the majority of interbank market of spot dollar/yen exchange rate. In particular, this paper examines how the dollar/yen exchange rate market digests information contained in the various macroeconomic statistics releases—to what extent transactions and prices react to the macroeconomic statistics news, how long the news effect lasts, which news has the most/least impact on the exchange rate, and whether there has been a shift in the types of news statistics that affect the exchange rate. In the analysis, the unexpected component of macroeconomic announcements, a “surprise,” is defined by the difference between the actual indicator announcement and the average of predicted indicators by the market.

Two key contributions of our paper can be summarized as follows. First, since the data are from the actual trading platform, they are quite reliable even during the very volatile period. This advantage of the EBS data is well-known and exploited by Chaboud et al. (2004), Berger et al. (2005), Ito and Hashimoto (2006, 2007). The data used in our analysis include both transactable quotes and transaction (deal) prices at every second. Second, to our best knowledge, this is the first paper that analyzes effects of the Japanese macroeconomic announcements on the yen/dollar exchange rate with high frequency trading-platform exchange rate data.

Our findings are as follows. First, surprise components of several Japanese macro statistics announcements are found to have particularly large impacts, whereas others do not, on the dollar/yen movements. Large impacts on dollar/yen returns were found in surprise components of Tankan (Bank of Japan, business survey), production indices (GDP advance, industrial production), unemployment, PPI, CPI (Tokyo area), and Balance of Payment announcements. On the other hand, CPI, trade balance, Diffusion (Keiki) indices, Retail Sales, Housing construction, and Money supply indicators are found to have almost no impact on the exchange rate. Nonfarm Payrolls had mixed results. Only a few macroeconomic announcements had significant effects—this result is a contrast to findings in the literature that examines the US news releases effects on exchange rates. However, this result parallels with Ehrmann and Fratzscher (2004) in that they find the US macroeconomics statistical releases have relatively greater impacts on exchange rates than the German news announcements.¹

Large impacts from GDP and Tankan announcements are easy to understand from theoretical point of view and found in the existing studies in different markets. Price variables such as PPI and CPI

¹ They infer the results partly due to the news release time; most of the US news announcements are released earlier in a month than the German/Euro Area news announcements.

(Tokyo area) are also consistent with international finance theory. In contrast, CPI (national) did not have impacts. This is likely due to the fact that most of information was extracted by CPI (Tokyo area), which is disclosed one month earlier than CPI (national). Money supply statistics also did not affect returns. The reason that money supply news announcement turned out to be almost irrelevant may come from the particular monetary policy in Japan—zero interest rate policy with quantitative easing—which was practiced during the sample years. Current accounts (balance of payments) are found to have significant impact on returns, while trade balance did not, because financial flows are more related to current accounts that include interest income and received dividend.

The rest of the paper is organized as follows. Section 2 gives a brief literature review. Section 3 describes the Japanese macroeconomic news announcements used in this paper. Section 4 shows the news surprise impact on returns. Section 5 summarizes estimation results of surprises on volatility. Section 6 shows the surprise impact on the number of transactions and reveals differences of intraday patterns of transaction volume between on news-announcement days and on no-news days. Section 7 concludes the paper.

2. Literature review

Intraday activities such as the number of deals and transaction volume in foreign exchange markets are examined by Chaboud et al. (2004), Berger et al. (2005), and Ito and Hashimoto (2005).² Baillie and Bollerslev (1990) and Andersen and Bollerslev (1997, 1998), for example, show the patterns of intraday price volatility using indicative quotes. Admati and Pfleiderer (1988), Brock and Kleidon (1992), and Hsieh and Kleidon (1996) provided theoretical and empirical background of intraday patterns of the bid-ask spread and volatility.

An examination of news impacts on exchange rates has traced a history of the development of data availability. Ito and Roley (1987) were the first to examine an effect of surprise components of

² Based on a more recent high frequency data, several stylized facts have been established on intradaily patterns of exchange rates. First, the intra-day seasonality is quite obvious in the number of deals, the number of quote revisions, and bid-ask spread. For example, three peaks in a day are consistently observed for the number of deals and quote revisions: Tokyo opening hours, London opening hours, and New York opening hours. Second, order flows—measured by the number of deals initiated by either buyers or sellers—have significant impacts on the exchange rate. More buyer-initiated deals in a fixed time window—say, one minute—tend to push up the currency in the following several minutes at least, and more seller-initiated deals tend to depreciate the currency. See Chaboud et al. (2004) and Ito and Hashimoto (2004, 2006, 2007).

Japanese macroeconomic announcements on the intraday movement of the dollar/yen exchange rate. However, the availability of high-frequency exchange rate data was severely limited at the time, and intraday observations meant five times per day. Once an electrically-recorded exchange rate database became available, many studies have exploited the data. Goodhart and Payne (1996) and Goodhart, Ito and Payne (1996) were among the first to use the Reuter trading platform data (D3000). Anersen and Bollerslev (1998) and Andersen, Bollerslev, Diebold, and Vega (2003) examined the effect of macroeconomic announcements on intradaily exchange markets using the Reuter indicative quote data. Evans and Lyons (2002) and Love and Payne (2003) considered the daily net order flows in foreign exchange markets and studied the relationship between exchange rate of returns and order flows using the Reuters data.

In recent years, the EBS has provided researchers with data which recorded the actual trading platform. Chaboud et al. (2004) examined US macro announcement impacts on the euro-dollar and dollar-yen exchange rates. Their findings are consistent with those in recent literature in that the conditional mean of exchange rates responds very quickly to the unexpected component of news releases. As for the trading volume, they found that news releases increase the volume of transactions. However, they also find a surge in trading volume even if the released news indicators are entirely in line with expectations.

Most of the previous literature that examines news effects on financial markets looked at the US and European news announcements. To list a few among many, Fleming and Remolona (1999) looked at the US news announcement effects on the Treasury market; Andersen, Bollerslev, Chaboud et al. (2004), Diebold and Vega (2003, 2005), and Faust et al. (2003) studied US news release and its impact on foreign exchange markets; Ehrmann and Fratzscher (2004) examined U.S. and Germany news releases on the foreign exchange markets. The empirical findings by these studies confirm that U.S. and European news releases have significant effects on pricing of the financial markets.

Analysis of Japanese news announcements on foreign exchange markets, however, needs to date back to Ito and Roley (1987) who used five observations in a day, so that each time window to capture the announcement impacts extended several hours. Since then, several papers have discussed the effects of Japanese economic announcements on foreign exchange markets. Our paper is in line with the previous literature in that we analyze the effects of unexpected news components on prices and trading volume in exchange rate markets; furthermore, we focus on the Japanese macroeconomic news indicators.

3. Japanese macroeconomic announcements

In contrast to U.S. macroeconomic announcements, most of which occur at 8:30am (EST), the release time of Japanese news announcements varies from news to news. As summarized in Table 1, some of the macroeconomic announcements are released in the afternoon. Most of the major macroeconomic statistics come out either 8:30am, 8:50am, 10:30am, 2:00pm, or 2:30pm.

The Japanese macroeconomic announcement time has become almost fixed after 2001. Until 2000, a lot of news was released 1 hour earlier than the current release time. Some news release time was, however, fixed later or went back and forth even after 2001. For example, it was 2002 when the current CPI release time was set. Release time of three news announcements (Balance of Payments, Trade Balance, and Retail sales) changed once in early 2000 and moved back to the original time about six months later.

The list of macroeconomic announcements, as shown in Table 1, includes many variables that have been studied in the literature of news effects on foreign exchange markets. For example, Chaboud et al. (2004) used the following US macro variables: Payroll, GDP advanced, PPI, Retail sales, Trade Balance, and Fed Funds Rate (Target). Andersen et al. (2003) used GDP (advance, preliminary, final), Nonfarm Payroll, Retail Sales, Industrial Production, Capacity Utilization, Personal Income, Consumer Credit, Personal Consumption Expenditure, New Home Sales, Durable Goods Orders, Construction Spending, Factory Orders, Business Inventories, Government Budget Deficit, Trade Balance, PPI, CPI, Consumer Confidence Index, NAPM Index, Housing Starts, Index of Leading Indicators, Target Federal Funds Rate, and Money supply. In the European perspectives, Ehrmann and Fratzscher (2004) used GDP, Ifo Business Climate Index, Business confidence balance, PPI, CPI, Retail sales, Trade Balance, M3, Unemployment, Industrial production, and Manufacturing orders as for Germany news releases.³ Our list mostly covers the same or comparable variables in the Japanese context.

Table 1

³ The Ifo Business Climate Index is a closely watched indicator of German business conditions, based on a monthly survey of about 7,000 companies. It is widely seen as a barometer for economic conditions of the Eurozone. A parallel in Japan is the Bank of Japan survey of *Tankan*.

Table 1 also shows the sample mean, sample standard deviation, surprise mean, and surprise standard deviation. All the sample means are near zero and less than respective sample standard deviations, we can safely conclude that traders' expectations are unbiased.

4. Impact of surprises on returns

In this section, we examine to what extent the dollar/yen return is impacted by an unexpected component (surprise) of macroeconomic news announcements. When an announcement of macro fundamental variable has non-zero unexpected content, the announcement should be followed by a change in the exchange rate, because investors and market participants should react to the surprise by rebalancing their portfolio positions, moving the exchange rate to a new equilibrium. If there is no surprise (expected=actual statistics announcements), it is expected that a surprise has no impact on returns.

Theory predicts that a release of macroeconomic announcements, if it contains a surprise component, may likely be followed by a change in the level of the exchange rate. The selected variables are often suspected to be a determinant of the exchange rate, so that new information may affect the level of the exchange rate immediately. The expected part has been already discounted in the exchange rate. Market participants react to this unexpected content by rebalancing their positions; that is, the surprise component would prompt more sell or buy orders—changes in the net order flow—in the market, and move the exchange rate.

We estimate the following regression to analyze impacts on returns from a surprise content of macro economic news:⁴

$$(1) \Delta s(t, u) = \sum_{i(u)=1}^{n(u)} \alpha_{i(u)} N_{i(u)}(t, u) + \varepsilon(t, u)$$

$$(2) \Delta s(t, u) = \sum_{i(u)=1}^{n(u)} \alpha_{i(u)} N_{i(u)}(t, u) + \delta \Delta s(t, u - k) + \theta ND(t, u - k) + \varepsilon(t, u),$$

⁴ In Chaboud et al. (2004), the estimation model takes the form of $r = b*s + e$, where r is the return from the one minute before the announcement release to h minutes after the release and s is the unexpected surprise component. The model is estimated only days when there is a news release, not for the whole sample period.

where $\Delta s(t, u)$ is the exchange rate return, measured by log-difference, from time u to $u+k$ on day t , k is the number of minutes, and u is the announcement time of the day for news $N_{i(u)}$. $N_{i(u)}(t, u)$ is a surprise of i -th macroeconomic news statistics in time window of u and measured as the difference between actual (announced) values and the market-consensus forecast of macroeconomic statistics releases. That is, $N_{i(u)}(t, u)$ is defined as “actual” minus “expected” of a macroeconomics statistics release. In the time window u , there are $n(u)$ variables that are scheduled to be announced.

In the estimation below, we primarily use standardized surprise measures, that is, a difference scaled by a standard deviation. The scaling is adopted to make the impacts of various economic variables comparable, and this is a standard practice in the literature. The coefficient of $N_{i(u)}(t, u)$, $\alpha_{i(u)}$, is interpreted as the effect of a one-standard-deviation surprise on the exchange rate return in time window from u to $u+1$. $ND(t, u-k)$ is the *net order flow*, defined as the difference between the numbers of ask-side deals and bid-side deals in the time window from time $u-k$ to u on day t . This term is included in order to control for a possible momentum movement of the exchange rate. Regressions are conducted over 1-, 5-, 15-, and 30-minute windows, that is, $k=1, 5, 15,$ and 30 , separately. The sample period is from January 2001 to December 2005. For the dependent variable of the percentage change in exchange rates, we consider three types of prices: “deal price on the ask side”, “deal price on the bid side”, and “the middle price of the bid-and ask-quote prices”.

Regressions use all business days ($t=1, 2, 3, \dots$) in the sample. Some days, typically once a month, N is non-zero. Regressions are run separately for separate time window u and time aggregation k .

Interpretations of coefficients on news surprises are as follows. As for the sign of $\alpha_{i(u)}$, it is expected to be “negative” for the fundamentals that show the strength of the economy: A surprise of better fundamentals ($N>0$) would cause appreciation of the yen ($\Delta s<0$). That is, any better-than-expected news in production indicators (Tankan, GDPP, GDPF, Industrial production, Diffusion indices), larger-than-expected surpluses in trade or current account (TB, BOP), and stronger-than-expected economic data (Retail sales, Payroll, Housing start, etc.) should produce an appreciation of the yen (negative Δs). This is because a positive surprise means the stronger Japanese economy, which may directly, a sheer optimism, or indirectly, cause capital inflows to Japan through expected monetary tightening (higher interest rate). Coefficients of unemployment rate announcements should be positive because higher-than-expected unemployment rate means weakening Japanese economy, which may prompt monetary easing. On the other hand, the sign of coefficients associated with

surprise inflation in price indices (PPI, CPI) could be either positive or negative. An unexpected inflation could produce depreciation if traders believe that the exchange rate follows purchasing power parity. However, surprise inflation may prompt a reaction in monetary policy to tighten, that is to raise the interest rate. Hence, traders react to surprise inflation by appreciating the currency.⁵ It will be shown later that estimation results are consistent with the theoretical predictions for all news indicators whose surprise component has statistically significantly estimates, and for inflation measure, the monetary tightening expectation is confirmed.

The OLS estimates of α_i are summarized in Tables 2.⁶ The estimates reveal that not all variables had statistically significant impacts on the exchange rate, but when they do, the impacts had theoretically predicted signs. Overall, macro variables whose surprises have significant effects on returns include Tankan (Survey on large manufacture firms), GDPP and GDPF, industrial production (preliminary), PPI, CPI (Tokyo area), unemployment and BOP. On the other hand, macro variables whose surprises have almost no impact on returns include Retail, Trade Balance, CPI (national), Payroll, households' expenditure, Housing start, Money supply, DIP, and DIF.

Tables 2

The reactions of the exchange rate to surprises are immediate. The fact that the estimated coefficient, α_i , is more or less similar for 1-, 5-, 15-, and 30-minute windows suggests that the most of the return reaction occurs within a minute and this new level continues for at least 30 minutes. Therefore, this reaction is a one-time sudden jump to a new equilibrium. This is consistent with what has been established in the literature on the US macro announcements effect on returns.

The magnitude of impacts is relatively small. Take the variable with largest impact, GDPP that is announced at 8:50 (Table 2-2). A one-standard deviation positive surprise of GDPP typically causes 0.0127 percent appreciation of the yen. That is, if the level of the yen/dollar rate is 100.00, then the

⁵ The latter reasoning is still relevant in the period of deflation in Japan. Any sign of surprise inflation may be a welcome sign that the Japanese economy would regain normality, ending the quantitative easing sooner than later, resulting in a hike of the policy interest rate from zero.

⁶ In this paper, we report estimation results of a surprise normalized by a standard deviation. Results with a surprise of level differences are not reported here in order to save spaces, but they are similar to those with normalized surprises.

new rate would be 100.0127 in one minute and 100.0192 in thirty minutes. The impact of Tankan-Manufacturing is about half of the GDPP impact. Others are smaller than GDPP and Tankan-M.

These findings shed some light on the Japanese news announcement effects on the dollar/yen returns. First, some macroeconomic statistics announcements are found to be relevant in the dollar/yen exchange rate returns. Surprise components of announcement of several macroeconomic variables have statistically significant effects on the dollar/yen exchange rate, as theory predicts. Surprise components related to production (Tankan, GDPP, GDPF), prices (PPI and CPI (Tokyo are)), and the current account have significant impact on returns. However, we fail to detect any consistently significant impact from other news releases such as Retail sales, TB, and business cycle indicators (DIP and DIF). These results mostly agree with findings of the US macro announcements and the dollar/yen exchange rate by Chaboud et al. (2004). Second, the Japanese news impacts on returns, when they exist, are long-lived. The significance lasts at least 15 minutes for most of the cases. These findings are similar to Chaboud et al. (2004) where a movement in returns triggered by the unexpected component of the US macroeconomic announcements is found to be generally completed within a few minutes. The long-lived effects confirm Ito and Hashimoto (2007) in that the price impact on returns remains about 10-15 minutes on average. Third, the magnitude of the impact is much smaller than the US macro variable announcements that were found in Chaboud et al. (2004). Our results are similar to Ehrmann and Fratzscher (2004) that found that US macro variables had larger impacts on the euro than the German macro announcements.

5. Impacts on Volatility and Volume

5.1. Theoretical Predictions

Theory predicts that only surprise components of the news release affect the returns, and news without a surprise should not significantly change returns. However, with regard to volatility and the number of deals, impacts from a surprise may be quite different.

If a surprise in some news has significant impacts on the return, it should significantly affect volatility as well, since volatility is the sum of the accumulated absolute changes. The size of volatility is determined by how the exchange rate moves to a new level, within one big jump or with many small changes, and with monotonous changes or with some reverse movements on the way to a new level.

Even when the return reaction is not significantly different from zero, volatility and volume of transactions may rise at the time of news release. The release of news announcement itself, with or without a surprise, may have significant impacts. Suppose “no surprise”, that is, the actual announcement of macroeconomics statistics is exactly the same as the average of market expectations. Theory suggests that there should be no positive or negative returns. However, even if the “average” expectation is confirmed by the actual announcement, an individual investor with his “subjective” expectation above the “average” expectation may find it necessary to trade with another individual investor with her subjective expectation “below” the average expectation. These trades may not change the price level. Therefore, it is natural to think that deal activities will surge following an announcement. Similarly, those deal activities—some selling and some buying—may affect the prices to move up or down following announcements, without resulting in a price change. Price volatility, which comes from the exchange rate going up and down within a narrow band, may increase while a total return being zero.

Table 3 summarizes the above discussion. When relevant news is released, which means non-zero returns, the number of deals could be zero (to be precise, not significantly different from zero) among investors with homogeneous subjective expectations. And the number of deals could be non-zero among investors with heterogeneous subjective expectations, and then, volatility has to be positive.

Table 3

When the released news is non relevant, which means zero returns, there are three possibilities. Deals and volatility may be both zero, if investors’ subjective expectations are homogeneous. If investors’ subjective expectations are heterogeneous, transactions among these people may or may not change the price level, but volatility becomes larger reflecting these transactions.

5.2. Volatility

We now examine to what extent the news release and its surprises will affect the exchange rate price volatility. The price volatility here is defined as a sum of squared 1-minute returns over the window of 1, 5, 15 or 30 minutes: it is called a realized volatility. The impact of news release on volatility is estimated in a regression with the following specification.

$$(3) V(t, u) = \alpha_0 + \alpha_1 V(t, u-1) + \sum_{i(u)=1}^{n(u)} \beta_{i(u)} |N_{i(u)}(t, u)| + \sum_{i=1}^{n(u)} \gamma_{i(u)} DUMN_{i(u)}(t, u) + \varepsilon(t, u),$$

where the volatility (V) of time window u on day t is explained by one-lagged volatility ($V(t, u-1)$), the absolute value of surprise components of macroeconomic announcements ($|N|$), and the dummy variable of macroeconomic news release ($DUMN$).⁷ The lagged volatility is included in order to capture the volatility clustering and a general condition of the market of the day. The dummy variable is 1 on the day of news releases, and zero otherwise. The reason that the dummy variable is included in this specification is to pick up the possible surge in price volatility in the price discovery process, independent of the size of surprises. Even if the return (level change) after k -minutes may not be affected when there is no surprise, activities and price volatility during k -minutes may become higher. The dummy variable captures that news announcement itself has an increasing effect on volatility.

Table 4 summarizes the news effects on realized volatilities of midprice (surprises are normalized by standard deviations). The set of news announcements that have significant impacts on volatility is not the same as that found in the return estimations. In the volatility regressions, news announcements such as Unemployment, CPI, TankanM (manufacturing), GDPP, GDPF are found to significantly increase volatility of exchange rates, and Housing Start is also found to have some impacts on volatility.

Table 4

News surprises of the morning announcements significantly increase volatility as they did for returns regressions. As for 8:30 news releases, surprises in CPI and unemployment are found to increase 1-minute volatility. News announcement of unemployment itself (dummy variable) is also found to have some impact on volatility, but its impact is weak and short-lived. As for 8:50 macroeconomic statistics announcements, the absolute value of news surprises in TankanM, GDPP, GDPF, PPI(only 1min volatility) and IPP are found to increase volatilities for at least 30 minutes after news releases.

⁷ Other specification we estimated (results are not reported here in order to save spaces) includes a squared surprise (N^2) in the regression: $V(t) = \alpha_0 + \alpha_1 V(t-1) + \beta_1 |N(t)| + \beta_2 \{N(t)\}^2 + \beta_3 DUMN(t) + \varepsilon(t)$.

Each of the news releases of TankanM, GDP, GDPF, Money supply, TB and BOP itself (dummy variable) is found to have some impact on volatilities.

Some of the news releases after 10:30am are found to have significant impacts on volatility whereas most of these news releases do not significantly affect returns. For example, a surprise in Nonfarm Payroll announcement at 10:30am significantly increases volatility about 30 minutes after the news releases. In the case of Nonfarm payroll announcement, the surprise part, B_1 , is negative and has a decreasing impact on volatility, whereas the news announcement itself, B_2 , is significant positive and has a larger impact on volatility. News announcements at 14:00, all of which do not affect returns, also have significant impact on volatility: Housing Start and household expenditures (only for 30min) of 14:00 announcements are also found to significant increase volatility.

5.3. Number of Deals

As mentioned in the preceding sub-sections, the total amount of deals may increase at the time of macroeconomic announcement, with or without a surprise and regardless of its size. Even with no surprise in an announcement, the announcement itself could have a positive impact on deal activities, because market participants who may have expectations that are different from “the average” may have to trade in order to square the positions. Unless market participants are homogeneous in subjective expectations on the news—which is very unlikely—some deals are bound to occur right after the announcement. When there is a surprise component in the news, additional deal activities will take place. Here, we examine the news announcement effects on the number of deals in the following regressions.

$$(4) TD(t, u) = \alpha_0 + \alpha_1 TD(t, u - k) + \sum_{i(u)=1}^{n(u)} \beta_{i(u)} |N_{i(u)}(t, u)| + \sum_{i(u)=1}^{n(u)} \gamma_{i(u)} DUMN_{i(u)}(t, u) + \varepsilon(t, u),$$

where $TD(t, u)$ is the total number of deals in the time window from announcement time u to $u+k$ minute, where $k=1, 5, 15,$ and 30 minutes on day t .⁸ $N_{i(u)}(t, u)$ and $n(u)$ are the same as regressions in

⁸ To be precise, “deal counts” in this paper means the number of seconds that included at least one deal activity within k minutes. For example, if the time window is one-minute, maximum of the deal count (on either side of bid and ask) is 60. This is the limitation of the data set, which we purchased from EBS for this time period. Still, having deals data is a huge advantage over conventional data set, such as Olsen and any others that based on Reuter FAFX screen used by many researchers including Andersen et al. (1997) and Ehrmann and Fratzscher (2004).

(1) and (2). $DUMN_{i(u)}(t,u)$ is a dummy variable of new announcement days, taking value 1 if that is the announcement day and 0 if that is not the announcement day of variable $i(u)$.

Here the $TD(t, u-k)$ is included in order to control for activities due to factors other than macroeconomic statistical announcements. Some days are busy days, due to various political and economic factors, and some are not. The one-lagged time window just before the time u is to control for such exogenous factors, because once deal activities are hiked, it lasts for some periods of time. A surprise is incorporated into the regression as an absolute value, because both a positive and negative surprise will stimulate the deal activity. This specification assumes that the effects are symmetric in the positive and negative direction. The dummy variable $DUMN$ captures the noise trading that is prompted by the announcement itself, independent of the size of a surprise.

An effect of a surprise on the total number of deals is reflected in the statistical significance of coefficients. If $\beta_{i(u)}$ is significantly larger than zero, then a magnitude (as measured by an absolute value) of a surprise component stimulates transactions. In addition, the bigger the surprise (the gap between the actual and predicted indicators), the more the number of deals. On the other hand, the number of deals is not affected by surprise components if $\beta_{i(u)}$ is not significantly different from zero.

The results are summarized in Table 5.⁹ News indicators that are found to have significant impacts on total deals are almost identical to those in Table 4, implying that the price discovery process produces both price volatility and deals (actual transactions), and market participants do have heterogeneous subjective expectations (recall Table 3). On the other hand, news indicators are mostly similar but not identical to that of returns (Table 2). For example, Tankan (both manufacturing and non-manufacturing), GDPP, IPP, unemployment, PPI, and trade balance are found to have significant impact on the number of deals, whereas money supply, Payroll, BOP, IPF, DIs, households' expenditure, housing start, retail sales, CPI and CPI of Tokyo area do not affect the total number of deals. The results are similar to that of returns with a few exceptions: trade balance announcement does not significantly change the returns whereas it does increase the number of deals. Similarly, BOP does move the exchange rate whereas it does not significantly affect the number of deals. Also, Tankan (non-manufacturing) was not significantly observed in the return estimation, but it is found out as one of the transaction accelerator.

⁹ Again, we report estimation results based on a surprise normalized by a standard deviation. Estimation results based on level difference surprises are not reported here to save spaces.

Table 5

Coefficients of most of the news announcements whose surprise components are significantly estimated become larger for longer time-windows. For example, coefficients of γ of TankanM are 23.22 for 1min window (which means that the deal activities increase by 23 transactions out of possible 120 transactions within a minute¹⁰), 108 for 5min, 215 for 15min, and 277 for 30min. This means that the number of transactions jumps following the Tankan (manufacturing) announcements, regardless of the size of surprise, and continues to increase up to 30 minutes. Similarly, the impact of GDPP has a large γ , suggesting that the announcement itself stimulates deal activities. The fact that both Tankan and GDPP have large impacts on transactions means that interpretations of these announcements are heterogeneous among investors, so that trades occur among these investors.

In sum, the surprise components of some news announcements have significant impacts on the total number of deals; there are strong impacts from announcement itself of Tankan and GDPP, and much lesser extent of IPP. On the other hand, Money supply, housing start, payroll and others did not produce large impacts on deal activities, suggesting that interpretation of these variables is relatively homogeneous among traders.

5.4. Graphical check

Finally, in order to check intuitively the effect of unexpected content of macroeconomic news releases on market activities, the number of deals on news-release days is compared to that on no-news days in Figure 1 (aggregate). Lines in the figure are period average of 2001-2005 (for CPI, period average of April 2002- December 2005) at 15-minute window. The top panel of the figure plots the difference between the number of deals on news-announcement days and non-announcement days. Two lines in the bottom panel show the number of deals on news-announcement days and non-announcement days, respectively. That is, the line in the top panels is the difference between two lines in the bottom panel.

¹⁰ Here the total number of deals is counted, so that both bid-side deals and ask-side deals are counted. As explained in an earlier footnote, the number is the number of seconds in which at least one transaction take place. Therefore, the maximum number within a minute is 120 (=60x2). Since even without announcement some transactions take place (that is $\alpha 0$ and $\alpha 1*TD(t-1)$), so that the increment of 23 is very large.

Figure 1

As is clear from the Figure 1, transactions on news announcement days tend to become larger at three peaks in a day.¹¹ The difference of the number of transactions between news-announcement days and non-announcement days is remarkable between 9 and 10 am (JST). This time period, the first peak of a transaction pattern in a day, is just after many macro statistics are announced at either 8:30am or 8:50am; therefore, this surge of activities may likely reflect the news releases impact as well as the overnight pent-up demands from retail customers.¹²

In order to examine impacts from each of the news announcements, we compare the transaction on both news-announcement days and non-announcement days for each of the news indicator release. Figures 2.1-2.11 show the period average of number of deals of news-release days and non-announcement days for each of the news release (either at 8:30am or at 8:50am). Each figure plots the period average of 2001-2005 (for CPI, period average of April 2002-2005) at a 15-minute window from 6am to 12 noon. Figures 2.12-2.17 show the 2001-2005 period averaged number of deals with news releases at either 10:30am, 2:00pm, or 2:30pm, at a 15-minute window. In each figure, the red line shows the benchmark that there was no macro announcement, and the black line shows the deal activities of announcement days (when at least one macro announcement took place.) Again, the top panel shows the difference of number of deals between news-announcement days and non-announcement days, and the bottom panel shows the number of deals of both news-release days and non-announcement days.

A look at each graph reveals that responses of the number of deals to news announcements differ from news to news. News releases such as Tankan, GDPP, and GDPF result in the huge increase in the number of deals around the news announcement time. For example, the number of deals jumps

¹¹ Ito and Hashimoto (2006b) show that there are three peaks in a day: about 9-10am (JST), 4-6pm (JST), and 10pm-midnight (JST). They clearly correspond to the Tokyo opening, London opening, and New York opening times, respectively. The last peak corresponds to hours when London and New York business hours overlap. Each of the three troughs, between 2am and 8am (JST), about 12am-1pm (JST), and 8pm (JST), correspond to New York market close, Tokyo lunch time, and London Lunch time, respectively.

¹² Figure 1 compares the number of deals on days with at least one announcement release with the number of deals on days without any announcement. Hence, the average of deals on announcement days of, say, 14:00 announcement may contain non-announcement days of, say, 8:30 announcement. Therefore, the contrast between these two days seems not so sharp.

more than 3 times when Tankan indicator is released; the number of deals at the time of GDPP releases is about 2.5 times higher than that of no-news days. On average, the number of deals at 15-minute windows doubles on announcement days, and this hike continues about 3 hours. On the other hand, the number of deals on other news releases such as CPI, PPI, Money Supply, TB, and BOP does not seem to be different from that on days when there is no news release.

Figures 2.1 - 2.11

As for the macroeconomics statistics releases after 10:30am, the impact of news announcements is not striking compared to that by the early morning (before 9:00am) news releases such as Tankan, GDPP, and GDPF. In the case of Nonfarm Payroll (10:30am) and Retail Sales (14:30) announcements, deals were not stimulated by these news releases at all. The total number of deals did not show a surge at the time of, or after the announcement. As for DIP and DIF (diffusion indices), the total number of deals became, on average, larger than that on non-announcement day from two hours before the news release until one hour after the announcements—but the difference was very small.

Figures 2.12 - 2.17

Figures 3.1-3.3 show effects of Monetary Policy Board Meeting (MPM) on the number of deals. The line shows averaged difference between the total number of deals on MPM days and non-MPM days. Because the closing time of board meetings varies from a meeting to next, time “0” is set as the closing time of each of the MPM meetings and is regarded as the approximate news release time.¹³ Figure 3.1 shows transactions associated with MPM closing by noon, figure 3.2 shows MPM closing between 12:00pm and 2:30pm, and figure 3.3 shows MPM closing after 2:30pm. Transactions on days when MPM finished before noon did not show any hike at the closing time or about one hour after the meeting. In contrast, as seen in figures 3.2 and 3.3, the total number of deals became significantly larger on MPM days at the closing time in the afternoon, and it continues about one or two hours after the meeting. In particular, the magnitude of an increase in transaction on days when MPM closed after 2:30pm is remarkably large.

¹³ The MPM closing time is recorded in the “Minutes”.

Figures 3.1 - 3.3

In summary, the surge in deals around 9:00am (JST) is partly caused by macroeconomics statistics announcements of Tankan, GDPP, and GDFP. To our surprise, most of the news releases do not significantly increase the transaction volumes. This finding is contrast to the US news impact on FX market where the news releases significantly stimulate the transaction. As for the MPM, the board meeting closing in the afternoon had some impact on transaction. This may be due to the fact that London and New York markets as well as Japanese markets have a chance to respond to the result of board meetings. Alternatively, a longer MPM meeting may tend to include more surprises than a shorter one.

6. Conclusion

In this paper, reactions of the dollar-yen exchange rate, deal activities, and realized volatility following the macroeconomic news announcement were examined. Returns, transactions, and volatility around the statistics announcement time were regressed with daily data with the announcement time only. In case of returns, the returns were regressed on the surprise component of the macro announcement. In case of deal activities, the deals are regressed on the absolute value of news surprise and the announcement dummy (zero-one). In case of volatility, volatility was also regressed on the absolute value of news surprise and the announcement dummy.

It was found that many variables, including GDP, Tokyo CPI, Tankan-M, were found to have impacts on returns, although the magnitude of the impacts are rather small—many smaller than the bid-ask spread. An impact on returns are immediate—mostly in one minute, and persistent. Stronger-than-expected announcement of these variables typically appreciated the yen. We fail to detect a significant impact on returns from Trade balance statistics or Diffusion indices.

As for the effects on the amount of transactions, GDPP and GDFP, Tankan, IP, and CPI, are found to have particularly significant effects on deals and price volatility. Among others, the Tankan-M is the variable that causes strong return reactions with big surges in volume of transactions (i.e., deal counts) and volatility. Many other variables have significant volatility and deals effects, suggesting the existence of heterogeneous subjective expectations and a relatively long price discovery process with trading activities. Traders disagree in interpretation of macroeconomic news, and they will trade.

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Figure 1: Number of deals on Announcement days/Non-announcement days

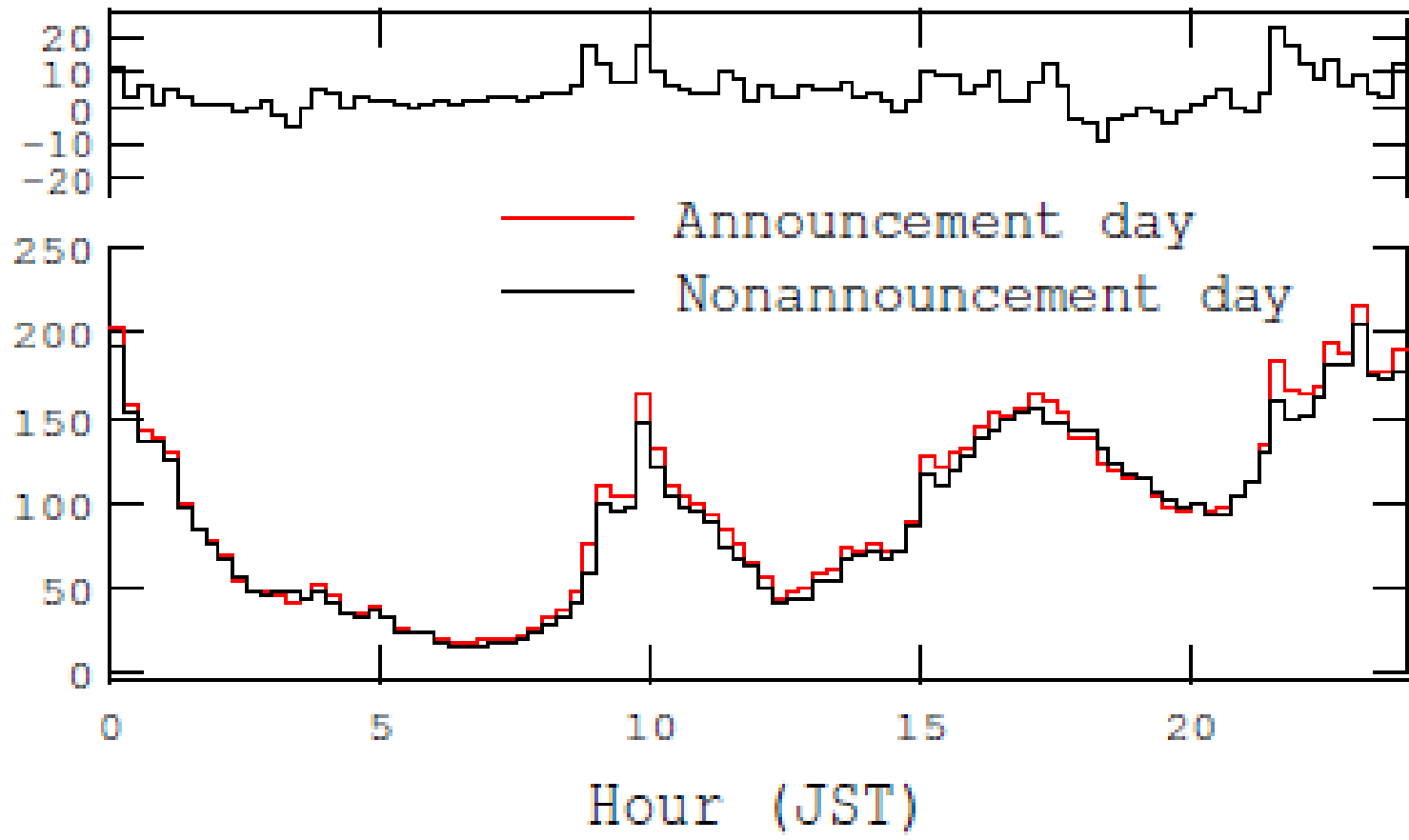
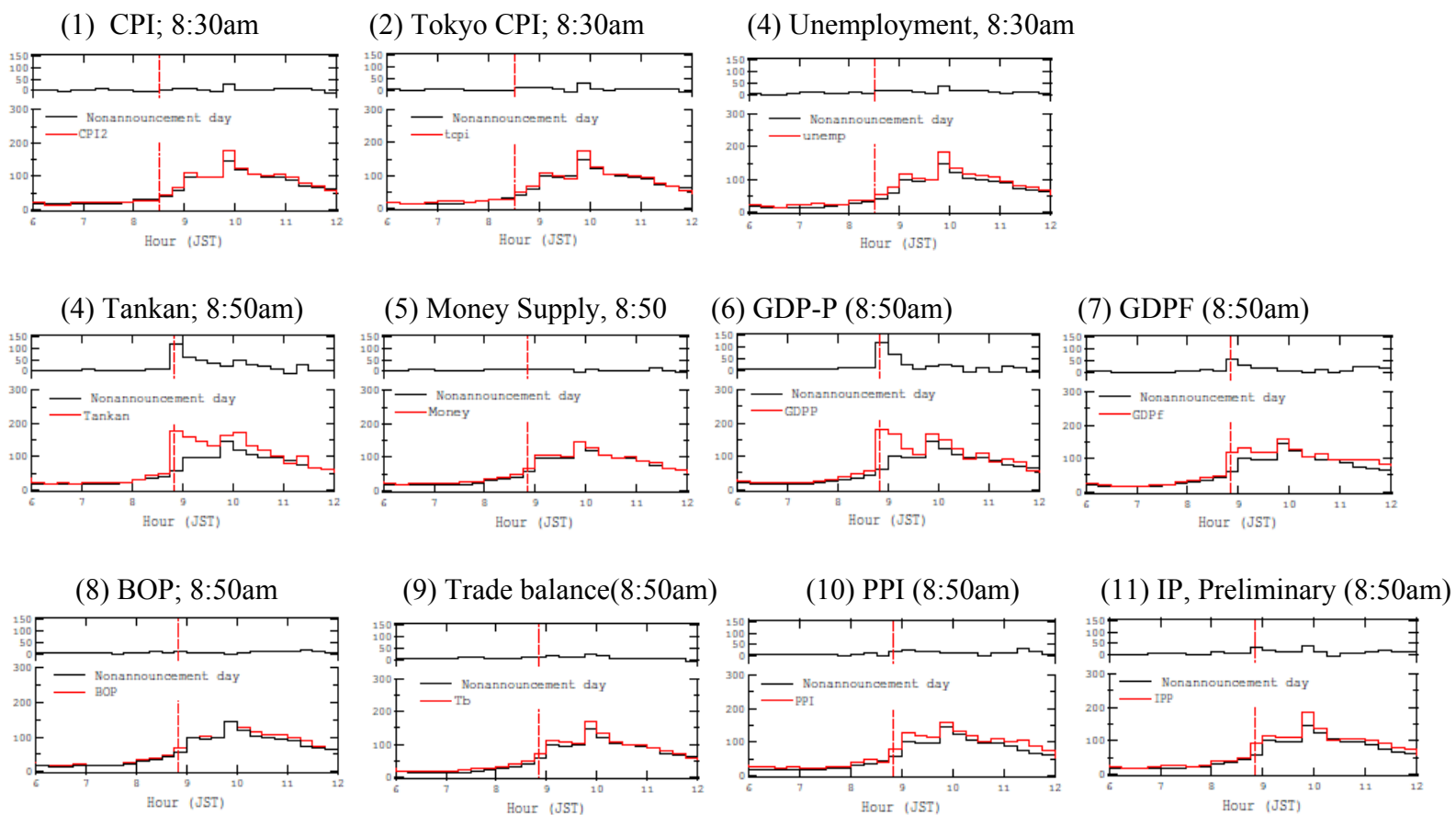
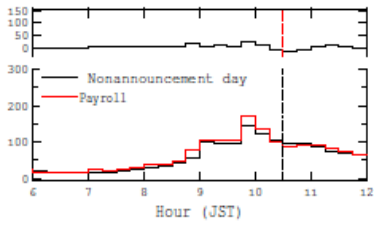


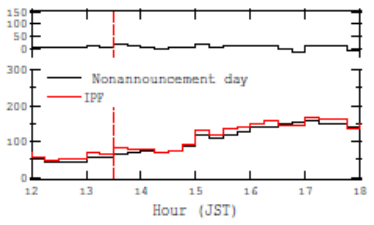
Figure 2: Transaction and News Release



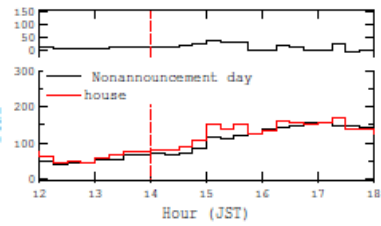
(12) Nonfarm Payroll; (10:30am),



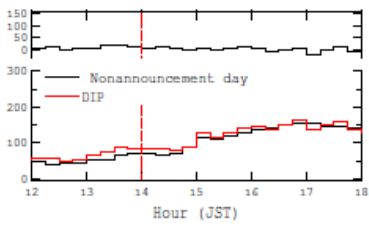
(13) Industrial Production Final, 13:30



(14) Housing Start, (14:00)



(15) Diffusion Index, prelim (14:00) (16) DI Final (14:00)



(17) Retail Sales (14:00)

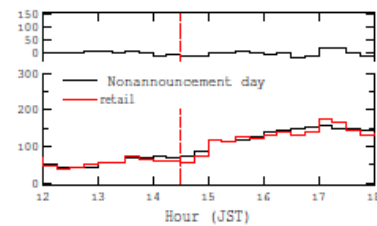


Figure 3.1 Transaction and MPM closing (by noon)

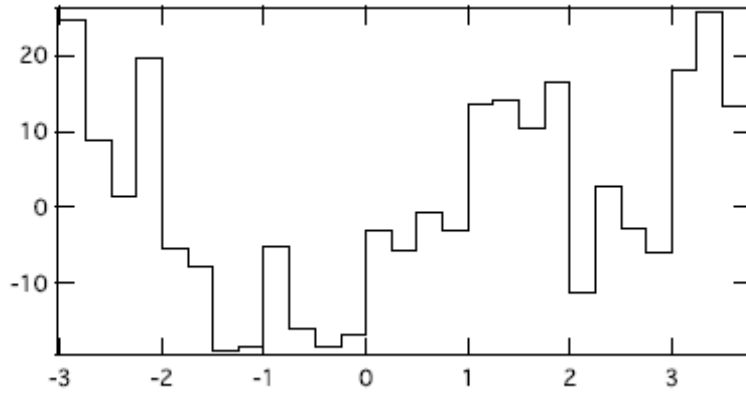


Figure 3.2 Transaction and MPM closing (between 12:00pm and 2:30pm)

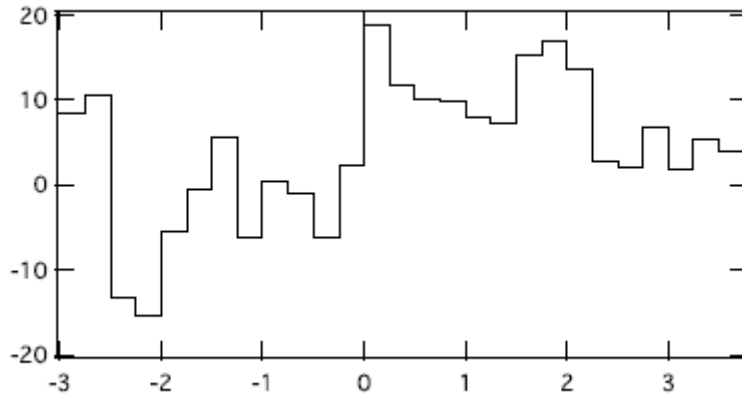


Figure 3.3 Transaction and MPM closing (after 2:30pm)

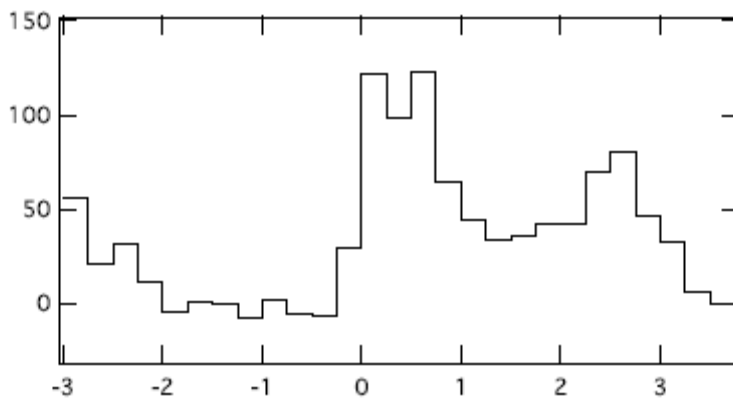


Table 1: Japanese Macroeconomic News Releases

| | Macroeconomic news releases | Unit | Definition | Frequency and announcement date | Mean | STD | Surprise Mean | Surprise STD |
|-------|------------------------------------|--------------------------------|--|--|--------|---------|---------------|--------------|
| 8:30 | TokyoCPI | % month-to-month change | Consumer Price Index in Tokyo region (all items excluding fresh food, seasonally) | Monthly, last week of the month | 0.000 | 0.016 | -0.000939 | 0.022 |
| | CPI | % month-to-month change | Consumer Price Index (all items excluding fresh food, nationwide, seasonally adjusted) | Monthly, Last week of the following month | -0.001 | 0.017 | 0.0002347 | 0.018 |
| | Unemployment | Rate (%) | | Monthly, last week of the following month | 0.178 | 0.928 | -0.000704 | 0.029 |
| 8:50 | Tankan (Large Manufacturing) | Index | BOJ short-term business survey of enterprises, Large Manufacturing Index level | Quarterly, The first week of the month following the quarter (July for Q2), (except mid-December for Q4) | -0.030 | 2.618 | 0.014085 | 0.520 |
| | Tankan (Large Non Manufacturing) | Index | BOJ short-term business survey of enterprises, Large Non-Manufacturing Index level | Quarterly, The first week of the month following the quarter (July for Q2), (except mid-December for Q4) | -0.020 | 1.570 | 0.0031397 | 0.231 |
| | Money supply (M2+CD) | % change from 12 month earlier | Money supply, M2+CD (average balance) | Monthly, 6th business day of the following month*1 | 0.114 | 0.536 | -0.000626 | 0.046 |
| | GDP Preliminary | % quarter-to-quarter change | Real GDP First Preliminary | Quarterly, Mid-month, two months after the last quarter month | 0.017 | 0.242 | 0.0031299 | 0.156 |
| | GDP Final | % quarter-to-quarter change | | Quarterly, Mid-month, three months after the last quarter month | 0.025 | 0.353 | -0.001878 | 0.104 |
| | BOP | Billions of yen | Current Account Surplus, Balance of Payments | Monthly, Mid-month, two month later (mid-March for January figure) | 58.309 | 269.907 | 1.89789 | 41.703 |
| | TB | Billions of yen | Trade balance (customs data) | Monthly, mid of the following month | 36.834 | 173.515 | -0.5259 | 32.604 |
| | PPI | % change from 12 month earlier | Producer Price Index (Wholesale Price Index until Dec 2002) | Monthly, Mid-month of the following month | 0.001 | 0.022 | 0.001252 | 0.027 |
| | Industrial Production, Preliminary | % month-to-month change | | Monthly, mid of month, two months later | 0.025 | 0.310 | -0.019327 | 0.187 |
| 10:30 | Nonfarm Payroll | % change from 12 month earlier | | Monthly, 1st wk of the two months later | -0.005 | 0.134 | -0.000783 | 0.191 |
| 13:30 | Industrial Production, Final | % month-to-month change | | Monthly, mid of month, two months later | 0.001 | 0.278 | 0.0020619 | 0.055 |
| 14:00 | Difusion Index, Preliminary | Index | Index of Business Conditions (Leading index), Preliminary | Monthly, early of the following month | 2.140 | 11.342 | 0.033099 | 0.826 |
| | Difusion Index, Final | Index | Index of Business Conditions (Leading index), Final | Monthly, mid-late of the following month | 1.984 | 10.778 | 0.11793 | 2.618 |
| | Households' expenditure | % change from 12 month earlier | Households' consumption expenditure | Monthly, early-month, two months later | -0.012 | 0.423 | -0.003061 | 0.221 |
| | Housing start | % change from 12 month earlier | | Monthly, last week of the month | -0.042 | 0.856 | 0.061268 | 1.058 |
| 14:30 | Retail Sales | % month-to-month change | | Monthly, last week of the following month | -0.074 | 0.580 | 0.0004695 | 0.604 |

Table 2 News Surprise Impact on Returns (surprises normalized by STD)

2-1. Announcement at 8:30(JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|--------------|-------------------------|-------------------------|------------------------|------------------------|--------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TokyoCPI | -6.10E-06 ** (0.000) | -1.81E-05 ** (0.000) | -7.20E-07 (0.000) | -3.40E-05 * (0.000) | -6.34E-06 ** (0.000) | -1.84E-05 *** (0.000) | -7.68E-07 (0.000) | -3.48E-05 * (0.000) |
| Unemployment | 1.50E-05 *** (0.000) | 2.79E-05 *** (0.000) | 2.91E-05 ** (0.000) | 5.07E-05 ** (0.000) | 1.53E-05 *** (0.000) | 2.74E-05 *** (0.000) | 2.91E-05 ** (0.000) | 4.99E-05 ** (0.000) |
| CPI | -1.97E-06 (0.000) | -4.01E-06 (0.000) | -1.75E-05 (0.000) | -9.89E-06 (0.000) | -1.93E-06 (0.000) | -3.88E-06 (0.000) | -1.75E-05 (0.000) | -1.02E-05 (0.000) |
| Return(-1) | | | | | -1.24E-01 *** (0.036) | -4.43E-02 (0.036) | -8.55E-03 (0.042) | -1.84E-02 (0.047) |
| Orderflow | | | | | 2.59E-06 (0.000) | 2.11E-06 (0.000) | -6.14E-08 (0.000) | -1.98E-06 (0.000) |
| R-squared | 1.35E-02 | 1.19E-02 | 4.25E-03 | 4.31E-03 | 2.26E-02 | 1.33E-02 | 4.34E-03 | 6.41E-03 |
| Nob | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 |

2-2. Announcement at 8:50(JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TankanM | -5.23E-05 *** (0.000) | -9.54E-05 *** (0.000) | -9.64E-05 *** (0.000) | -9.58E-05 *** (0.000) | -5.36E-05 *** (0.000) | -9.46E-05 *** (0.000) | -9.67E-05 *** (0.000) | -9.40E-05 *** (0.000) |
| TankanN | 7.41E-07 (0.000) | 3.36E-07 (0.000) | 8.84E-06 (0.000) | 1.49E-07 (0.000) | 9.95E-07 (0.000) | 2.16E-06 (0.000) | 9.00E-06 (0.000) | 1.07E-07 (0.000) |
| Money | 2.34E-06 (0.000) | -5.42E-07 (0.000) | -1.53E-05 (0.000) | -4.50E-05 * (0.000) | 2.08E-06 (0.000) | -3.50E-07 (0.000) | -1.51E-05 (0.000) | -4.54E-05 * (0.000) |
| GDP | -1.27E-04 *** (0.000) | -1.45E-04 *** (0.000) | -2.13E-04 *** (0.000) | -1.92E-04 *** (0.000) | -1.26E-04 *** (0.000) | -1.46E-04 *** (0.000) | -2.14E-04 *** (0.000) | -1.91E-04 *** (0.000) |
| GDPF | -8.28E-05 *** (0.000) | -6.60E-05 *** (0.000) | -6.93E-05 *** (0.000) | -5.78E-05 ** (0.000) | -8.31E-05 *** (0.000) | -6.75E-05 *** (0.000) | -7.15E-05 *** (0.000) | -5.86E-05 ** (0.000) |
| BOP | -9.45E-06 * (0.000) | -2.44E-05 ** (0.000) | -5.75E-05 *** (0.000) | -4.92E-05 ** (0.000) | -8.54E-06 * (0.000) | -2.28E-05 ** (0.000) | -5.79E-05 *** (0.000) | -5.02E-05 ** (0.000) |
| TB | 3.03E-06 (0.000) | -1.23E-06 (0.000) | 2.46E-05 (0.000) | 2.20E-05 (0.000) | 2.42E-06 (0.000) | -2.41E-06 (0.000) | 2.40E-05 (0.000) | 2.19E-05 (0.000) |
| PPI | -4.00E-06 (0.000) | -2.09E-05 ** (0.000) | -3.79E-05 ** (0.000) | -5.11E-05 ** (0.000) | -4.16E-06 (0.000) | -2.10E-05 ** (0.000) | -3.78E-05 ** (0.000) | -4.95E-05 ** (0.000) |
| IPP | -5.07E-05 *** (0.000) | -4.98E-05 *** (0.000) | -6.08E-05 *** (0.000) | -7.31E-05 *** (0.000) | -5.02E-05 *** (0.000) | -4.87E-05 *** (0.000) | -5.87E-05 *** (0.000) | -7.08E-05 *** (0.000) |
| Return(-1) | | | | | -0.185 *** (0.055) | -0.168 *** (0.052) | -0.076 * (0.057) | -0.075 * (0.057) |
| Orderflow | | | | | 4.69E-06 * (0.000) | 5.79E-06 *** (0.000) | 1.84E-06 (0.000) | -3.43E-09 (0.000) |
| R-squared | 0.341 | 0.181 | 0.113 | 0.056 | 0.347 | 0.188 | 0.115 | 0.059 |
| Nob | 1274 | 1274 | 1274 | 1274 | 1274 | 1274 | 1274 | 1274 |

2-3. Announcement at 10:30(JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|------------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Payroll | -4.27E-06 (0.000) | -2.44E-05 * (0.000) | -2.44E-05 * (0.000) | -3.04E-05 * (0.000) | -4.15E-06 (0.000) | -6.09E-06 (0.000) | -2.43E-05 * (0.000) | -2.95E-05 (0.000) |
| Return(-1) | | | | | -1.03E-01 ** (0.050) | -1.49E-01 *** (0.058) | 5.03E-03 (0.046) | 2.63E-02 (0.045) |
| Orderflow | | | | | 6.84E-06 *** (0.000) | 3.37E-06 * (0.000) | 1.72E-06 (0.000) | 5.31E-07 (0.000) |
| R-squared | 0.002 | 0.001 | 0.005 | 0.003 | 0.015 | 0.013 | 0.009 | 0.005 |
| Nob | 576 | 576 | 576 | 576 | 576 | 576 | 576 | 576 |

2-4. Announcement at 13:30 (JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|----------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| IPF | -3.87E-06 (0.000) | -2.25E-07 (0.000) | -9.20E-07 (0.000) | -2.73E-06 (0.000) | -4.17E-06 (0.000) | -1.06E-06 (0.000) | -1.17E-06 (0.000) | -3.18E-06 (0.000) |
| Return(-1) | | | | | 0.161 *** (0.038) | -0.081 *** (0.027) | -0.060 ** (0.033) | -0.034 (0.034) |
| Orderflow | | | | | -1.24E-06 (0.000) | 5.92E-06 *** (0.000) | 1.98E-07 (0.000) | 1.53E-06 (0.000) |
| R-squared | 0.0007 | 8.90E-07 | 1.55E-06 | 1.80E-05 | 0.0162 | 0.0147 | 0.0036 | 0.0010 |
| Nob | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 |

2-5. Announcement at 14:00 (JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|-------------|-----------------------|----------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| DIP | -6.14E-07 (0.000) | -2.18E-06 (0.000) | -8.11E-06 (0.000) | -1.96E-05 (0.000) | -3.74E-07 (0.000) | -1.77E-06 (0.000) | -7.53E-06 (0.000) | -2.03E-05 (0.000) |
| DIF | -8.84E-07 (0.000) | -1.21E-06 (0.000) | -2.16E-05 * (0.000) | -7.16E-06 (0.000) | -1.36E-06 (0.000) | -1.51E-06 (0.000) | -2.15E-05 * (0.000) | -6.50E-06 (0.000) |
| Expenditure | 5.78E-07 (0.000) | 4.78E-06 (0.000) | 1.24E-05 (0.000) | 3.77E-05 ** (0.000) | 6.67E-07 (0.000) | 5.12E-06 (0.000) | 1.24E-05 (0.000) | 3.79E-05 ** (0.000) |
| House | 7.48E-06 * (0.000) | -6.87E-06 (0.000) | -1.23E-06 (0.000) | -9.10E-06 (0.000) | 7.76E-06 ** (0.000) | -7.89E-06 (0.000) | -4.46E-07 (0.000) | -9.85E-06 (0.000) |
| Return(-1) | | | | | 1.20E-01 *** (0.044) | -1.51E-01 *** (0.029) | -5.24E-02 * (0.032) | 5.57E-02 ** (0.033) |
| Orderflow | | | | | -6.46E-08 (0.000) | 4.94E-06 *** (0.000) | -8.43E-09 (0.000) | -5.97E-07 (0.000) |
| R-squared | 0.002 | 0.001 | 0.003 | 0.004 | 0.011 | 0.023 | 0.006 | 0.006 |
| Nob | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |

2-6. Announcement at 14:30(JST), Midprice

| | Equation (1) | | | | Equation (2) | | | |
|--------------|----------------------|----------------------|----------------------|----------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Retail Sales | -2.02E-06 (0.000) | -2.35E-06 (0.000) | -7.21E-06 (0.000) | -1.07E-06 (0.000) | -1.77E-06 (0.000) | -2.70E-06 (0.000) | -6.26E-06 (0.000) | -2.14E-06 (0.000) |
| Return(-1) | | | | | -8.61E-02 ** (0.038) | -1.35E-01 *** (0.028) | -9.17E-02 *** (0.031) | -1.80E-01 *** (0.033) |
| Orderflow | | | | | 3.33E-06 ** (0.000) | 4.70E-06 *** (0.000) | -2.50E-07 (0.000) | 3.60E-06 *** (0.000) |
| R-squared | 2.41E-04 | 6.95E-05 | 1.64E-04 | 1.97E-06 | 0.005 | 0.023 | 0.009 | 0.024 |
| Nob | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 |

Table 3: Theoretical Predictions

| | | | Returns | Deals | Volatility |
|-------------------|---------------------------------------|---|----------|-------|------------|
| Relevant news | Homogeneous Subjective Expectations | One big price jump | non-zero | 0 | + |
| | Heterogeneous Subjective Expectations | Price discovery process immediate; one big jump | non-zero | + | + |
| | Heterogeneous Subjective Expectations | Price discovery process takes time | non-zero | + | ++ |
| Non-relevant news | Homogeneous Subjective Expectations | No price change | 0 | 0 | 0 |
| | Heterogeneous Subjective Expectations | Price discovery immediate | 0 | + | 0 |
| | Heterogeneous Subjective Expectations | Price discovery process takes time | 0 | + | + |

Table 4. News release impacts on Realized Volatility (Midprice, surprises normalized by STD)

4-1. Announcement at 8:30

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 2.41E-08 *** | (6.6E-09) | 1.66E-07 *** | (3.1E-08) | 4.47E-07 *** | (4.8E-08) | 1.06E-06 *** | (8.8E-08) |
| Volatility(-1) | 6.45E-01 *** | (2.9E-02) | 1.02E-01 *** | (2.2E-02) | 2.01E-01 *** | (2.4E-02) | 2.48E-01 *** | (2.7E-02) |
| TotalDeals(-1) | -8.64E-10 | (1.7E-09) | 7.14E-09 *** | (1.8E-09) | 4.92E-09 *** | (1.2E-09) | 4.98E-09 *** | (1.2E-09) |
| ABSTCPI | -3.67E-09 | (7.6E-09) | 9.32E-09 | (3.2E-08) | 1.60E-08 | (4.5E-08) | -6.37E-08 | (7.8E-08) |
| ABSUNEMP | 1.23E-08 * | (7.8E-09) | 2.37E-08 | (3.2E-08) | 2.48E-08 | (4.6E-08) | -1.29E-07 * | (8.0E-08) |
| ABSCPI | -1.17E-08 ** | (7.0E-09) | -1.46E-08 | (2.9E-08) | -2.80E-10 | (4.2E-08) | -8.00E-08 | (7.2E-08) |
| TCPIDUM | 6.88E-08 | (7.0E-08) | 2.21E-07 | (2.9E-07) | 4.16E-07 | (4.1E-07) | 6.45E-07 | (7.2E-07) |
| UNEMPDUM | -6.98E-08 * | (5.3E-08) | -1.77E-07 | (2.2E-07) | -2.85E-07 | (3.1E-07) | 4.68E-07 | (5.4E-07) |
| CPIDUM | 5.35E-08 | (6.3E-08) | -1.11E-07 | (2.6E-07) | -1.68E-07 | (3.7E-07) | 3.16E-07 | (6.5E-07) |
| R-squared | 0.304505 | | 0.040612 | | 0.107887 | | 0.128432 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

4-2. Announcement at 8:50

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 4.82E-08 *** | (1.7E-08) | 1.87E-07 *** | (2.8E-08) | 6.81E-07 *** | (6.0E-08) | 1.32E-06 *** | (1.3E-07) |
| Volatility(-1) | 0.963905 *** | (8.8E-02) | 0.285302 *** | (3.4E-02) | 0.415316 *** | (4.1E-02) | 0.278654 *** | (3.9E-02) |
| TotalDeals(-1) | -6.3E-09 ** | (3.2E-09) | 1.26E-09 | (1.2E-09) | 7.56E-10 | (1.1E-09) | 3.2E-09 ** | (1.4E-09) |
| ABSTANKANM | 8.58E-08 *** | (2.3E-08) | -8E-08 *** | (3.4E-08) | -1.1E-07 ** | (6.5E-08) | -1.5E-07 | (1.3E-07) |
| ABSTANKANN | 5.2E-09 | (2.0E-08) | -3.2E-08 | (3.0E-08) | -6.1E-08 | (5.7E-08) | -6E-08 | (1.2E-07) |
| ABSMONEY | 3.81E-09 | (1.8E-08) | -2.2E-08 | (2.6E-08) | -6.4E-08 | (5.1E-08) | -8.1E-08 | (1.0E-07) |
| ABSGDPP | 1.14E-07 *** | (1.8E-08) | 2.09E-07 *** | (2.7E-08) | 2.74E-07 *** | (5.2E-08) | 2.85E-07 *** | (1.1E-07) |
| ABSGDPF | 1.91E-07 *** | (1.8E-08) | 2.54E-07 *** | (2.7E-08) | 2.47E-07 *** | (5.2E-08) | 3.19E-07 *** | (1.1E-07) |
| ABSBOP | 2.3E-08 | (2.0E-08) | 5.46E-09 | (2.9E-08) | 9.07E-09 | (5.6E-08) | 3.28E-08 | (1.2E-07) |
| ABSTB | -4.9E-09 | (2.1E-08) | -6.9E-09 | (3.2E-08) | 4.14E-08 | (6.2E-08) | 1.03E-07 | (1.3E-07) |
| ABSPPI | 2.54E-08 * | (1.9E-08) | 1.41E-08 | (2.8E-08) | -2.3E-08 | (5.4E-08) | -4.8E-08 | (1.1E-07) |
| ABSIPP | 4.42E-08 ** | (2.1E-08) | 9.62E-08 *** | (3.1E-08) | 1.16E-07 ** | (6.0E-08) | 1.2E-07 | (1.2E-07) |
| TANKANMDUM | 9.68E-07 *** | (2.1E-07) | 3.81E-06 *** | (3.2E-07) | 5.65E-06 *** | (6.1E-07) | 6.26E-06 *** | (1.2E-06) |
| MONEYDUM | -1.4E-08 | (8.3E-08) | 2.5E-07 ** | (1.2E-07) | 2.91E-07 | (2.4E-07) | 4.48E-07 | (4.9E-07) |
| GDPPDUM | 2.98E-07 ** | (1.5E-07) | 4.63E-07 ** | (2.3E-07) | 6.91E-07 * | (4.4E-07) | 1.22E-06 * | (9.0E-07) |
| GDPFDUM | -5.1E-07 *** | (1.5E-07) | -4.2E-07 ** | (2.2E-07) | -2.4E-07 | (4.2E-07) | -1E-06 | (8.7E-07) |
| BOPDUM | -1.4E-07 * | (9.3E-08) | 3.45E-08 | (1.4E-07) | 4.96E-09 | (2.7E-07) | -1.5E-07 | (5.5E-07) |
| TBDUM | 6.29E-08 | (1.0E-07) | 1.94E-07 * | (1.5E-07) | -7.7E-08 | (2.9E-07) | -2.1E-07 | (6.0E-07) |
| PPIDUM | -1E-07 | (1.2E-07) | -1.4E-07 | (1.8E-07) | 9.99E-08 | (3.5E-07) | 9.16E-08 | (7.1E-07) |
| IPPDUM | 2.01E-08 | (1.1E-07) | -4.8E-08 | (1.6E-07) | -1.1E-07 | (3.0E-07) | -2.1E-07 | (6.2E-07) |
| R-squared | 0.358573 | | 0.419834 | | 0.308547 | | 0.150188 | |
| NOB | 1274 | | 1274 | | 1274 | | 1274 | |

4-3. Announcement at 10:30

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.79E-08 *** | (2.8E-09) | 5.15E-08 *** | (1.7E-08) | 2.13E-07 *** | (3.3E-08) | 3.00E-07 *** | (1.0E-07) |
| Volatility(-1) | 6.19E-02 ** | (3.1E-02) | 5.15E-01 *** | (6.2E-02) | 2.37E-01 *** | (2.4E-02) | 4.12E-01 *** | (4.8E-02) |
| TotalDeals(-1) | 2.79E-09 *** | (3.6E-10) | 1.55E-09 *** | (5.4E-10) | 2.01E-09 *** | (3.1E-10) | 1.24E-09 *** | (4.9E-10) |
| ABSPAYROLL | -2.03E-09 | (2.1E-09) | -1.09E-08 | (1.1E-08) | 3.18E-09 | (2.0E-08) | -7.57E-08 * | (5.1E-08) |
| PAYROLLDUM | 2.15E-08 * | (1.5E-08) | 6.96E-08 | (7.9E-08) | -7.89E-08 | (1.4E-07) | 9.31E-07 *** | (3.6E-07) |
| R-squared | 0.178486 | | 0.271338 | | 0.36524 | | 0.244617 | |
| NOB | 576 | | 576 | | 576 | | 576 | |

4-4. Announcement at 13:30

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | -1.08E-09 | (3.0E-09) | 2.84E-08 ** | (1.3E-08) | 1.54E-07 *** | (2.9E-08) | 3.15E-07 *** | (6.5E-08) |
| Volatility(-1) | 3.73E-01 *** | (2.7E-02) | 6.13E-01 *** | (3.9E-02) | 3.95E-01 *** | (3.0E-02) | 6.20E-01 *** | (5.0E-02) |
| TotalDeal(-1) | 5.09E-09 *** | (5.6E-10) | 2.69E-09 *** | (6.4E-10) | 3.33E-09 *** | (5.2E-10) | 1.72E-09 *** | (6.8E-10) |
| ABSIIPF | -6.78E-10 | (3.8E-09) | -1.77E-08 | (1.4E-08) | -9.60E-09 | (2.8E-08) | -2.36E-08 | (6.0E-08) |
| IIPFDUM | 1.80E-08 | (2.1E-08) | 4.53E-08 | (7.7E-08) | 6.67E-08 | (1.6E-07) | 7.43E-08 | (3.3E-07) |
| R-squared | 0.346858 | | 0.346086 | | 0.335231 | | 0.265788 | |
| NOB | 1261 | | 1261 | | 1261 | | 1261 | |

4-5. Announcement at 14:00

| | 1min | | 5min | | 15min | | 30min | |
|----------------|----------------|-----------|----------------|-----------|----------------|-----------|----------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.5002E-08 *** | (6.4E-09) | 5.3656E-08 *** | (1.4E-08) | 1.6848E-07 *** | (2.5E-08) | 3.6102E-07 *** | (5.8E-08) |
| Volatility(-1) | 0.231179 *** | (5.9E-02) | 0.147603 *** | (1.5E-02) | 0.410793 *** | (1.8E-02) | 0.383734 *** | (2.9E-02) |
| TotalDeals(-1) | 5.8181E-09 *** | (9.8E-10) | 4.5849E-09 *** | (4.8E-10) | 1.7067E-09 *** | (3.2E-10) | 1.4935E-09 *** | (4.3E-10) |
| ABSNEWSDIP | 1.2485E-09 | (5.2E-09) | 2.9623E-09 | (1.0E-08) | 2.2649E-09 | (1.8E-08) | -5.912E-08 * | (3.7E-08) |
| ABSNEWSDIF | 2.6167E-09 | (5.9E-09) | 2.3421E-09 | (1.2E-08) | 1.0958E-08 | (2.0E-08) | 3.8773E-09 | (4.1E-08) |
| ABSNEWSEXPEND | -1.558E-09 | (7.7E-09) | -3.042E-09 | (1.5E-08) | -3.8E-09 | (2.6E-08) | -1.708E-07 *** | (5.4E-08) |
| ABSNEWSHOUSE | -7.62E-09 | (8.1E-09) | -2.168E-08 * | (1.6E-08) | -5.166E-08 ** | (2.7E-08) | -6.957E-08 | (5.7E-08) |
| DIPDUM | -1.778E-08 | (2.9E-08) | -6.104E-08 | (5.8E-08) | -7.297E-08 | (9.8E-08) | 2.9565E-07 * | (2.1E-07) |
| DIFDUM | -2.58E-08 | (3.1E-08) | -5.105E-08 | (6.1E-08) | -6.087E-08 | (1.0E-07) | -2.068E-07 | (2.2E-07) |
| EXPENDDUM | 3.446E-10 | (4.1E-08) | -1.858E-08 | (8.0E-08) | -3.552E-08 | (1.4E-07) | 9.6684E-07 *** | (2.8E-07) |
| HOUSEDUM | 3.5996E-08 | (3.9E-08) | 2.0847E-07 *** | (7.7E-08) | 4.2534E-07 *** | (1.3E-07) | 5.0912E-07 ** | (2.7E-07) |
| R-squared | 0.081615 | | 0.256044 | | 0.450222 | | 0.279119 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

4-6. Announcement at 14:30

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.30E-08 *** | (2.2E-09) | 5.90E-08 *** | (8.9E-09) | 2.14E-07 *** | (5.0E-08) | 4.84E-07 *** | (7.5E-08) |
| Volatility(-1) | 2.12E-01 *** | (1.2E-02) | 9.68E-02 *** | (1.1E-02) | 1.67E-01 *** | (4.1E-02) | 4.50E-01 *** | (4.3E-02) |
| TotalDeals(-1) | 2.50E-09 *** | (3.5E-10) | 3.44E-09 *** | (3.3E-10) | 2.84E-09 *** | (7.2E-10) | 8.85E-10 * | (5.9E-10) |
| ABSRETAIL | 7.79E-10 | (2.7E-09) | -4.76E-09 | (9.9E-09) | -3.69E-08 | (5.0E-08) | -4.26E-08 | (7.1E-08) |
| RETAILDUM | -7.72E-09 | (1.3E-08) | 4.66E-08 | (4.9E-08) | 1.64E-07 | (2.5E-07) | 1.36E-07 | (3.5E-07) |
| R-squared | 0.300373 | | 0.26505 | | 0.063935 | | 0.174903 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Table 5. News release impact on total deals (surprises normalized by STD)

5-1. Announcement at 8:30

| | 1min | | 5min | | 15min | | 30min | |
|---------------|-------------|--------|-------------|--------|-------------|---------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 1.32 *** | (0.11) | 6.21 *** | (0.42) | 23.43 *** | (1.26) | 64.83 *** | (3.05) |
| TotalDeal(-1) | 0.52 *** | (0.03) | 0.58 *** | (0.02) | 0.59 *** | (0.03) | 0.68 *** | (0.04) |
| ABSNEWSTCPI | -0.08 | (0.13) | 0.25 | (0.43) | -0.31 | (1.17) | -2.57 | (2.70) |
| ABSNEWSUNEMP | 0.40 *** | (0.13) | 1.45 *** | (0.44) | 1.87 * | (1.20) | -2.08 | (2.76) |
| ABSNEWS CPI | -0.20 ** | (0.12) | -0.25 | (0.40) | 0.49 | (1.08) | 0.08 | (2.49) |
| TCPIDUM | 0.39 | (1.18) | 8.45 ** | (3.94) | 20.78 ** | (10.73) | 10.41 | (24.69) |
| UNEMP DUM | 1.02 | (0.89) | -3.39 | (2.97) | -0.57 | (8.10) | 26.88 * | (18.65) |
| CPI DUM | -0.20 | (1.07) | -5.48 * | (3.57) | -17.18 ** | (9.74) | -0.92 | (22.41) |
| R-squared | 0.23 | | 0.34 | | 0.27 | | 0.22 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

5-2. Announcement at 8:50

| | 1min | | 5min | | 15min | | 30min | |
|----------------|-------------|--------|-------------|--------|-------------|---------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 2.13 *** | (0.20) | 9.36 *** | (0.79) | 42.68 *** | (2.05) | 111.03 *** | (4.30) |
| TotalDeal(-1) | 0.54 *** | (0.03) | 0.61 *** | (0.03) | 0.68 *** | (0.03) | 0.76 *** | (0.04) |
| ABSNEWSTANKANM | 0.32 | (0.27) | -1.20 * | (0.94) | -6.29 *** | (2.20) | -7.53 ** | (4.34) |
| ABSNEWSTANKANN | -0.63 *** | (0.23) | -3.94 *** | (0.82) | -4.09 ** | (1.92) | -4.28 | (3.79) |
| ABSNEWSMONEY | 0.13 | (0.21) | -0.08 | (0.73) | -0.62 | (1.71) | 0.60 | (3.39) |
| ABSNEWSGDPP | 1.73 *** | (0.21) | 7.91 *** | (0.74) | 14.56 *** | (1.74) | 20.68 *** | (3.44) |
| ABSNEWSGDPF | 1.87 *** | (0.21) | 5.14 *** | (0.74) | 9.01 *** | (1.74) | 13.23 *** | (3.43) |
| ABSNEWSBOP | 0.11 | (0.23) | 1.66 ** | (0.81) | 1.48 | (1.90) | 1.25 | (3.76) |
| ABSNEWSTB | 0.13 | (0.25) | 0.01 | (0.89) | 0.94 | (2.09) | 4.37 | (4.13) |
| ABSNEWSPI | 0.21 | (0.22) | 0.70 | (0.77) | 0.63 | (1.82) | -0.26 | (3.59) |
| ABSNEWSIPP | 0.71 *** | (0.25) | 2.25 *** | (0.86) | 3.62 ** | (2.03) | 5.40 * | (4.01) |
| TANKANDUM | 23.22 *** | (2.50) | 107.65 *** | (8.75) | 214.52 *** | (20.53) | 276.96 *** | (40.54) |
| MONEYDUM | 0.02 | (0.98) | 0.80 | (3.43) | 1.05 | (8.05) | 1.59 | (15.91) |
| GDPDUM | 10.98 *** | (1.81) | 21.29 *** | (6.31) | 42.67 *** | (14.82) | 38.16 * | (29.27) |
| GDPFDUM | 0.28 | (1.74) | 5.66 | (6.10) | -5.08 | (14.32) | -10.65 | (28.28) |
| BOPDUM | 0.04 | (1.10) | -2.09 | (3.85) | -1.59 | (9.04) | -14.30 | (17.85) |
| TBDUM | 1.45 | (1.21) | 4.57 | (4.22) | 2.67 | (9.90) | -3.17 | (19.55) |
| PPIDUM | -0.93 | (1.43) | -5.43 | (5.00) | 6.59 | (11.74) | 29.41 | (23.18) |
| SERVICEDUM | -0.36 | (0.70) | 0.73 | (2.46) | 0.34 | (5.78) | -2.97 | (11.42) |
| IPPIDUM | 3.97 *** | (1.25) | 11.62 *** | (4.38) | 20.07 ** | (10.27) | 22.92 | (20.29) |
| R-squared | 0.50 | | 0.52 | | 0.46 | | 0.35 | |
| NOB | 1274 | | 1274 | | 1274 | | 1274 | |

5-3. Announcement at 10:30

| | 1min | | 5min | | 15min | | 30min | |
|----------------|-------------|--------|-------------|--------|-------------|---------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 2.43 *** | (0.32) | 12.00 *** | (1.37) | 39.67 *** | (3.72) | 66.39 *** | (8.13) |
| TotalDeal(-1) | 0.67 *** | (0.03) | 0.68 *** | (0.03) | 0.56 *** | (0.03) | 0.55 *** | (0.03) |
| ABSNEWSPAYROLL | -0.04 | (0.25) | -0.85 | (0.93) | 0.47 | (2.24) | 0.49 | (4.17) |
| PAYROLLDUM | 0.90 | (1.71) | 2.40 | (6.44) | -11.81 | (15.56) | -19.39 | (28.88) |
| R-squared | 0.42 | | 0.44 | | 0.39 | | 0.36 | |
| NOB | 576.00 | | 576.00 | | 576.00 | | 576 | |

5-4. Announcement at 13:30

| | 1min | | 5min | | 15min | | 30min | |
|---------------|-------------|--------|-------------|--------|-------------|---------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 1.60 *** | (0.15) | 6.90 *** | (0.65) | 27.10 *** | (1.86) | 59.26 *** | (4.01) |
| TotalDeal(-1) | 0.63 *** | (0.02) | 0.77 *** | (0.02) | 0.74 *** | (0.03) | 0.72 *** | (0.03) |
| ABSIIPF | -0.20 | (0.18) | -1.23 ** | (0.72) | -1.81 | (1.89) | -3.97 | (3.74) |
| IIPFDUM | 2.68 *** | (1.01) | 7.51 ** | (3.96) | 17.45 ** | (10.41) | 28.05 * | (20.66) |
| R-squared | 0.41 | | 0.46 | | 0.41 | | 0.33 | |
| NOB | 1261 | | 12961 | | 1261 | | 1261 | |

5-5. Announcement at 14:00

| | 1min | | 5min | | 15min | | 30min | |
|----------------|-------------|--------|-------------|--------|-------------|---------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 2.15 *** | (0.21) | 10.18 *** | (0.77) | 28.89 *** | (2.02) | 58.89 *** | (3.90) |
| TotalDeal(-1) | 0.72 *** | (0.03) | 0.68 *** | (0.02) | 0.63 *** | (0.02) | 0.60 *** | (0.02) |
| ABSNEWSDIP | 0.24 * | (0.17) | 0.08 | (0.58) | -0.39 | (1.43) | -3.53 * | (2.53) |
| ABSNEWSDIF | 0.35 ** | (0.19) | 0.03 | (0.65) | -0.15 | (1.60) | -0.85 | (2.84) |
| ABSNEWSEXPEND | -0.10 | (0.25) | -0.83 | (0.86) | -3.13 * | (2.11) | -6.53 ** | (3.73) |
| ABSNEWSHOUSE | -0.30 | (0.26) | -0.65 | (0.90) | -2.98 * | (2.21) | -2.10 | (3.92) |
| DIPDUM | -1.27 * | (0.95) | -2.12 | (3.24) | 2.31 | (7.96) | 15.11 | (14.11) |
| DIFDUM | -1.29 | (1.01) | -2.46 | (3.44) | 0.72 | (8.48) | 0.66 | (15.01) |
| EXPENDITUREDUM | 0.37 | (1.32) | 2.34 | (4.49) | 11.27 | (11.05) | 25.43 * | (19.56) |
| HOUSEDUM | 1.87 * | (1.27) | 5.78 * | (4.33) | 15.84 * | (10.67) | 20.54 | (18.89) |
| R-squared | 0.37 | | 0.42 | | 0.41 | | 0.37 | |
| NOB | 1273 | | 1273 | | 1273 | | 1273 | |

5-6. Announcement at 14:30

| | 1min | | 5min | | 15min | | 30min | |
|---------------|-------------|--------|-------------|--------|-------------|--------|-------------|---------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| Const | 1.65 *** | (0.15) | 8.18 *** | (0.61) | 25.18 *** | (1.93) | 73.65 *** | (3.99) |
| TotalDeal(-1) | 0.68 *** | (0.02) | 0.68 *** | (0.02) | 0.68 *** | (0.02) | 0.60 *** | (0.02) |
| ABSNEWSRETAIL | 0.32 * | (0.20) | -0.02 | (0.71) | -1.69 | (1.99) | -2.18 | (3.89) |
| RETAILDUM | -1.48 * | (0.96) | -2.76 | (3.50) | -3.31 | (9.73) | -6.01 | (19.06) |
| R-squared | 0.41 | | 0.50 | | 0.43 | | 0.36 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Appendix Table 1. News surprise impact on returns (surprises normalized by STD)
A1-1. Announcement at 8:30 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|--------------|-------------------------|-------------------------|------------------------|------------------------|-------------------------|--------------------------|-------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TokyoCPI | -4.03E-06 (0.000) | -1.95E-05 ** (0.000) | -2.19E-07 (0.000) | -3.70E-05 * (0.000) | -3.13E-06 (0.000) | -2.01E-05 *** (0.000) | -4.55E-07 (0.000) | -3.73E-05 * (0.000) |
| Unemployment | 1.51E-05 *** (0.000) | 2.55E-05 *** (0.000) | 2.84E-05 ** (0.000) | 5.06E-05 ** (0.000) | 1.48E-05 *** (0.000) | 2.33E-05 *** (0.000) | 2.79E-05 ** (0.000) | 5.04E-05 ** (0.000) |
| CPI | 3.94E-06 (0.000) | -4.33E-06 (0.000) | -1.58E-05 (0.000) | -1.47E-05 (0.000) | 4.24E-06 (0.000) | -2.83E-06 (0.000) | -1.55E-05 (0.000) | -1.50E-05 (0.000) |
| Return(-1) | | | | | -6.36E-02 ** (0.032) | -1.53E-01 *** (0.036) | -8.73E-02 ** (0.041) | -8.35E-02 (0.067) |
| Orderflow | | | | | 8.08E-06 *** (0.000) | 8.68E-06 *** (0.000) | 3.35E-06 ** (0.000) | 5.47E-07 (0.000) |
| R-squared | 1.34E-02 | 9.26E-03 | 3.58E-03 | 4.56E-03 | 2.40E-02 | 2.58E-02 | 6.77E-03 | 6.40E-03 |
| Nob | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|--------------|--------------------------|--------------------------|------------------------|-------------------------|-------------------------|--------------------------|-------------------------|-------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TokyoCPI | -9.15E-06 *** (0.000) | -2.64E-05 *** (0.000) | -6.39E-06 (0.000) | -4.05E-05 ** (0.000) | -7.82E-06 ** (0.000) | -2.67E-05 *** (0.000) | -6.17E-06 (0.000) | -4.10E-05 ** (0.000) |
| Unemployment | 1.37E-05 *** (0.000) | 2.56E-05 *** (0.000) | 2.81E-05 ** (0.000) | 4.68E-05 ** (0.000) | 1.33E-05 *** (0.000) | 2.50E-05 *** (0.000) | 2.74E-05 ** (0.000) | 4.51E-05 ** (0.000) |
| CPI | -8.68E-07 (0.000) | -5.66E-06 (0.000) | -1.95E-05 * (0.000) | -8.73E-06 (0.000) | -7.14E-07 (0.000) | -5.24E-06 (0.000) | -1.95E-05 * (0.000) | -8.82E-06 (0.000) |
| Return(-1) | | | | | -6.07E-02 ** (0.031) | -1.04E-01 *** (0.034) | -9.20E-02 ** (0.040) | -3.99E-02 (0.045) |
| Orderflow | | | | | 1.15E-05 *** (0.000) | 7.24E-06 *** (0.000) | 2.82E-06 * (0.000) | -1.31E-06 (0.000) |
| R-squared | 1.33E-02 | 1.31E-02 | 3.98E-03 | 4.35E-03 | 3.86E-02 | 2.48E-02 | 7.97E-03 | 6.89E-03 |
| Nob | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|--------------|-------------------------|-------------------------|------------------------|------------------------|--------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TokyoCPI | -6.10E-06 ** (0.000) | -1.81E-05 ** (0.000) | -7.20E-07 (0.000) | -3.40E-05 * (0.000) | -6.34E-06 ** (0.000) | -1.84E-05 *** (0.000) | -7.68E-07 (0.000) | -3.48E-05 * (0.000) |
| Unemployment | 1.50E-05 *** (0.000) | 2.79E-05 *** (0.000) | 2.91E-05 ** (0.000) | 5.07E-05 ** (0.000) | 1.53E-05 *** (0.000) | 2.74E-05 *** (0.000) | 2.91E-05 ** (0.000) | 4.99E-05 ** (0.000) |
| CPI | -1.97E-06 (0.000) | -4.01E-06 (0.000) | -1.75E-05 (0.000) | -9.89E-06 (0.000) | -1.93E-06 (0.000) | -3.88E-06 (0.000) | -1.75E-05 (0.000) | -1.02E-05 (0.000) |
| Return(-1) | | | | | -1.24E-01 *** (0.036) | -4.43E-02 (0.036) | -8.55E-03 (0.042) | -1.84E-02 (0.047) |
| Orderflow | | | | | 2.59E-06 (0.000) | 2.11E-06 (0.000) | -6.14E-08 (0.000) | -1.98E-06 (0.000) |
| R-squared | 1.35E-02 | 1.19E-02 | 4.25E-03 | 4.31E-03 | 2.26E-02 | 1.33E-02 | 4.34E-03 | 6.41E-03 |
| Nob | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 | 1278 |

A1-2. Announcement at 8:50 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TankanM | -6.13E-05 *** (0.000) | -8.70E-05 *** (0.000) | -9.86E-05 *** (0.000) | -1.01E-04 *** (0.000) | -6.25E-05 *** (0.000) | -8.55E-05 *** (0.000) | -9.97E-05 *** (0.000) | -9.85E-05 *** (0.000) |
| TankanN | 1.30E-05 ** (0.000) | 2.47E-06 (0.000) | 1.48E-05 (0.000) | 1.12E-05 (0.000) | 1.24E-05 ** (0.000) | 1.11E-06 (0.000) | 1.37E-05 (0.000) | 1.12E-05 (0.000) |
| Money | -3.89E-07 (0.000) | -2.06E-06 (0.000) | -1.48E-05 (0.000) | -4.23E-05 * (0.000) | -1.08E-06 (0.000) | -2.68E-06 (0.000) | -1.58E-05 (0.000) | -4.29E-05 * (0.000) |
| GDP | -1.37E-04 *** (0.000) | -1.43E-04 *** (0.000) | -2.18E-04 *** (0.000) | -1.93E-04 *** (0.000) | -1.35E-04 *** (0.000) | -1.43E-04 *** (0.000) | -2.17E-04 *** (0.000) | -1.93E-04 *** (0.000) |
| GDPF | -8.03E-05 *** (0.000) | -6.44E-05 *** (0.000) | -7.17E-05 *** (0.000) | -6.04E-05 ** (0.000) | -8.07E-05 *** (0.000) | -6.78E-05 *** (0.000) | -7.55E-05 *** (0.000) | -6.15E-05 ** (0.000) |
| BOP | -1.21E-05 ** (0.000) | -2.33E-05 ** (0.000) | -5.57E-05 *** (0.000) | -4.83E-05 *** (0.000) | -1.16E-05 ** (0.000) | -2.18E-05 ** (0.000) | -5.57E-05 *** (0.000) | -4.94E-05 ** (0.000) |
| TB | -1.28E-08 (0.000) | -3.47E-06 (0.000) | 2.17E-05 (0.000) | 1.38E-05 (0.000) | -4.08E-07 (0.000) | -3.16E-06 (0.000) | 2.12E-05 (0.000) | 1.45E-05 (0.000) |
| PPI | -4.61E-06 (0.000) | -2.40E-05 ** (0.000) | -3.74E-05 ** (0.000) | -5.32E-05 ** (0.000) | -5.49E-06 (0.000) | -2.38E-05 ** (0.000) | -3.63E-05 ** (0.000) | -5.07E-05 ** (0.000) |
| IPP | -4.89E-05 *** (0.000) | -4.82E-05 *** (0.000) | -6.12E-05 *** (0.000) | -7.28E-05 *** (0.000) | -4.77E-05 *** (0.000) | -4.70E-05 *** (0.000) | -5.65E-05 *** (0.000) | -7.02E-05 *** (0.000) |
| Return(-1) | | | | | -1.49E-01 *** (0.047) | -2.69E-01 *** (0.050) | -1.53E-01 *** (0.053) | -8.82E-02 * (0.055) |
| Orderflow | | | | | 1.14E-05 *** (0.000) | 1.07E-05 *** (0.000) | 4.52E-06 ** (0.000) | 8.33E-07 (0.000) |
| R-squared Nob | 3.56E-01 1274 | 1.56E-01 1274 | 1.18E-01 1274 | 5.71E-02 1274 | 0.364701 1274 | 0.177322 1274 | 1.25E-01 1274 | 5.99E-02 1274 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TankanM | -6.91E-05 *** (0.000) | -9.89E-05 *** (0.000) | -1.06E-04 *** (0.000) | -1.04E-04 *** (0.000) | -6.93E-05 *** (0.000) | -9.68E-05 *** (0.000) | -1.06E-04 *** (0.000) | -1.01E-04 *** (0.000) |
| TankanN | 1.00E-05 * (0.000) | 7.57E-06 (0.000) | 1.46E-05 (0.000) | 2.40E-06 (0.000) | 9.55E-06 * (0.000) | 6.95E-06 (0.000) | 1.38E-05 (0.000) | 2.27E-06 (0.000) |
| Money | -2.45E-06 (0.000) | 2.01E-06 (0.000) | -2.09E-05 (0.000) | -4.84E-05 ** (0.000) | -2.48E-06 (0.000) | 1.76E-06 (0.000) | -2.05E-05 (0.000) | -4.86E-05 ** (0.000) |
| GDP | -1.31E-04 *** (0.000) | -1.51E-04 *** (0.000) | -2.23E-04 *** (0.000) | -2.01E-04 *** (0.000) | -1.28E-04 *** (0.000) | -1.49E-04 *** (0.000) | -2.21E-04 *** (0.000) | -2.00E-04 *** (0.000) |
| GDPF | -8.55E-05 *** (0.000) | -6.75E-05 *** (0.000) | -7.19E-05 *** (0.000) | -6.14E-05 ** (0.000) | -8.49E-05 *** (0.000) | -7.13E-05 *** (0.000) | -7.69E-05 *** (0.000) | -6.33E-05 ** (0.000) |
| BOP | -8.29E-06 (0.000) | -2.16E-05 ** (0.000) | -5.24E-05 *** (0.000) | -4.68E-05 * (0.000) | -7.64E-06 (0.000) | -2.12E-05 ** (0.000) | -5.34E-05 *** (0.000) | -4.89E-05 ** (0.000) |
| TB | 3.24E-06 (0.000) | -7.58E-06 (0.000) | 2.59E-05 (0.000) | 1.84E-05 (0.000) | 2.44E-06 (0.000) | -8.70E-06 (0.000) | 2.57E-05 (0.000) | 1.94E-05 (0.000) |
| PPI | -7.13E-06 (0.000) | -2.27E-05 ** (0.000) | -3.83E-05 ** (0.000) | -5.47E-05 ** (0.000) | -7.46E-06 (0.000) | -2.14E-05 ** (0.000) | -3.70E-05 ** (0.000) | -5.18E-05 ** (0.000) |
| IPP | -4.85E-05 *** (0.000) | -5.98E-05 *** (0.000) | -6.02E-05 *** (0.000) | -7.89E-05 *** (0.000) | -4.63E-05 *** (0.000) | -5.64E-05 *** (0.000) | -5.42E-05 *** (0.000) | -7.40E-05 *** (0.000) |
| Return(-1) | | | | | -0.193 *** (0.058) | -0.303 *** (0.047) | -0.185 *** (0.052) | -0.124 ** (0.055) |
| Orderflow | | | | | 1.11E-05 *** (0.000) | 1.11E-05 *** (0.000) | 5.33E-06 ** (0.000) | 1.08E-06 (0.000) |
| R-squared Nob | 0.321 1274 | 0.176 1274 | 0.121 1274 | 0.060 1274 | 0.329 1274 | 0.205 1274 | 0.132 1274 | 0.066 1274 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|---------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| TankanM | -5.23E-05 *** (0.000) | -9.54E-05 *** (0.000) | -9.64E-05 *** (0.000) | -9.58E-05 *** (0.000) | -5.36E-05 *** (0.000) | -9.46E-05 *** (0.000) | -9.67E-05 *** (0.000) | -9.40E-05 *** (0.000) |
| TankanN | 7.41E-07 (0.000) | 3.36E-07 (0.000) | 8.84E-06 (0.000) | 1.49E-07 (0.000) | 9.95E-07 (0.000) | 2.16E-06 (0.000) | 9.00E-06 (0.000) | 1.07E-07 (0.000) |
| Money | 2.34E-06 (0.000) | -5.42E-07 (0.000) | -1.53E-05 (0.000) | -4.50E-05 * (0.000) | 2.08E-06 (0.000) | -3.50E-07 (0.000) | -1.51E-05 (0.000) | -4.54E-05 * (0.000) |
| GDP | -1.27E-04 *** (0.000) | -1.45E-04 *** (0.000) | -2.13E-04 *** (0.000) | -1.92E-04 *** (0.000) | -1.26E-04 *** (0.000) | -1.46E-04 *** (0.000) | -2.14E-04 *** (0.000) | -1.91E-04 *** (0.000) |
| GDPF | -8.28E-05 *** (0.000) | -6.60E-05 *** (0.000) | -6.93E-05 *** (0.000) | -5.78E-05 ** (0.000) | -8.31E-05 *** (0.000) | -6.75E-05 *** (0.000) | -7.15E-05 *** (0.000) | -5.86E-05 ** (0.000) |
| BOP | -9.45E-06 * (0.000) | -2.44E-05 ** (0.000) | -5.75E-05 *** (0.000) | -4.92E-05 ** (0.000) | -8.54E-06 * (0.000) | -2.28E-05 ** (0.000) | -5.79E-05 *** (0.000) | -5.02E-05 ** (0.000) |
| TB | 3.03E-06 (0.000) | -1.23E-06 (0.000) | 2.46E-05 (0.000) | 2.20E-05 (0.000) | 2.42E-06 (0.000) | -2.41E-06 (0.000) | 2.40E-05 (0.000) | 2.19E-05 (0.000) |
| PPI | -4.00E-06 (0.000) | -2.09E-05 ** (0.000) | -3.79E-05 ** (0.000) | -5.11E-05 ** (0.000) | -4.16E-06 (0.000) | -2.10E-05 ** (0.000) | -3.78E-05 ** (0.000) | -4.95E-05 ** (0.000) |

A1-3. Announcement at 10:30 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|-------------------------|----------------------|-------------------------|----------------------|--------------------------|--------------------------|-------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Payroll | -8.49E-06 ** (0.000) | -1.12E-05 (0.000) | -2.73E-05 ** (0.000) | -2.92E-05 (0.000) | -7.29E-06 * (0.000) | -1.06E-05 (0.000) | -2.73E-05 ** (0.000) | -2.83E-05 (0.000) |
| Return(-1) | | | | | -1.95E-01 *** (0.050) | -1.53E-01 *** (0.054) | 1.53E-05 (0.045) | 2.27E-02 (0.045) |
| Orderflow | | | | | 1.53E-05 *** (0.000) | 5.01E-06 ** (0.000) | 2.23E-06 (0.000) | 7.75E-07 (0.000) |
| R-squared | 0.006 | 0.002 | 0.006 | 0.003 | 0.065 | 0.016 | 0.012 | 0.004 |
| Nob | 576 | 576 | 576 | 576 | 576 | 576 | 576 | 576 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|------------------------|----------------------|-------------------------|----------------------|--------------------------|--------------------------|-------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Payroll | -6.87E-06 * (0.000) | -1.01E-05 (0.000) | -2.77E-05 ** (0.000) | -2.67E-05 (0.000) | -5.89E-06 * (0.000) | -8.59E-06 (0.000) | -2.80E-05 ** (0.000) | -2.60E-05 (0.000) |
| Return(-1) | | | | | -1.58E-01 *** (0.048) | -1.71E-01 *** (0.056) | -1.16E-02 (0.045) | 1.60E-02 (0.045) |
| Orderflow | | | | | 1.34E-05 *** (0.000) | 4.54E-06 ** (0.000) | 2.09E-06 (0.000) | 7.95E-07 (0.000) |
| R-squared | 0.004 | 0.002 | 0.006 | 0.002 | 0.050 | 0.018 | 0.011 | 0.004 |
| Nob | 576 | 576 | 576 | 576 | 576 | 576 | 576 | 576 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|------------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Payroll | -4.27E-06 (0.000) | -2.44E-05 * (0.000) | -2.44E-05 * (0.000) | -3.04E-05 * (0.000) | -4.15E-06 (0.000) | -6.09E-06 (0.000) | -2.43E-05 * (0.000) | -2.95E-05 (0.000) |
| Return(-1) | | | | | -1.03E-01 ** (0.050) | -1.49E-01 *** (0.058) | 5.03E-03 (0.046) | 2.63E-02 (0.045) |
| Orderflow | | | | | 6.84E-06 *** (0.000) | 3.37E-06 * (0.000) | 1.72E-06 (0.000) | 5.31E-07 (0.000) |
| R-squared | 0.002 | 0.001 | 0.005 | 0.003 | 0.015 | 0.013 | 0.009 | 0.005 |
| Nob | 576 | 576 | 576 | 576 | 576 | 576 | 576 | 576 |

A1-4. Announcement at 13:30 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|---------------------|---------------------|----------------------|-------------------------|--------------------------|--------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| IPF | -3.23E-05 (0.000) | 5.77E-05 (0.000) | 8.40E-05 (0.000) | -5.79E-06 (0.000) | -4.19E-05 (0.000) | 2.87E-05 (0.000) | 6.98E-05 (0.000) | -1.78E-05 (0.000) |
| Return(-1) | | | | | 1.19E-02 (0.040) | -1.04E-01 *** (0.027) | -8.46E-02 *** (0.033) | -4.23E-02 (0.033) |
| Orderflow | | | | | 6.98E-06 *** (0.000) | 8.58E-06 *** (0.000) | 6.45E-07 (0.000) | 1.74E-06 (0.000) |
| R-squared | 1.13E-04 | 1.67E-04 | 9.41E-05 | 8.10E-07 | 0.014661 | 0.02695 | 6.48E-03 | 1.39E-03 |
| Nob | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|----------------------|---------------------|----------------------|-------------------------|--------------------------|-------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| IPF | -8.30E-05 (0.000) | -3.42E-05 (0.000) | 7.38E-05 (0.000) | -5.10E-05 (0.000) | -9.58E-05 * (0.000) | -5.60E-05 (0.000) | 6.64E-05 (0.000) | -5.88E-05 (0.000) |
| Return(-1) | | | | | 0.02548 (0.037) | -0.111515 *** (0.030) | -0.081529 ** (0.033) | -0.03518 (0.034) |
| Orderflow | | | | | 7.59E-06 *** (0.000) | 6.63E-06 *** (0.000) | 6.75E-07 (0.000) | 1.74E-06 (0.000) |
| R-squared | 9.61E-04 | 2.26E-05 | 7.54E-05 | 1.99E-05 | 0.021043 | 0.016296 | 6.15E-03 | 1.03E-03 |
| Nob | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|------------|----------------------|----------------------|----------------------|----------------------|-------------------------|--------------------------|-------------------------|----------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| IPF | -7.01E-05 (0.000) | -4.08E-06 (0.000) | -1.67E-05 (0.000) | -4.95E-05 (0.000) | -7.57E-05 (0.000) | -1.91E-05 (0.000) | -2.11E-05 (0.000) | -5.76E-05 (0.000) |
| Return(-1) | | | | | 0.160991 *** (0.038) | -0.081064 *** (0.027) | -0.060414 ** (0.033) | -0.0344 (0.034) |
| Orderflow | | | | | -1.24E-06 (0.000) | 5.92E-06 *** (0.000) | 1.98E-07 (0.000) | 1.53E-06 (0.000) |
| R-squared | 7.03E-04 | 8.90E-07 | 1.55E-06 | 1.80E-05 | 0.016225 | 0.014665 | 3.65E-03 | 9.77E-04 |
| Nob | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 | 1261 |

A1-5. Announcement at 14:00 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|-------------|----------------------|----------------------|-------------------------|------------------------|-------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| DIP | -2.37E-06 (0.000) | -4.94E-06 (0.000) | -8.11E-06 (0.000) | -1.97E-05 (0.000) | -1.78E-06 (0.000) | -4.74E-06 (0.000) | -7.66E-06 (0.000) | -2.04E-05 (0.000) |
| DIF | -1.37E-07 (0.000) | -1.44E-06 (0.000) | -2.28E-05 ** (0.000) | -9.12E-06 (0.000) | -2.65E-07 (0.000) | -1.76E-06 (0.000) | -2.26E-05 * (0.000) | -8.77E-06 (0.000) |
| Expenditure | -1.50E-06 (0.000) | 9.43E-06 (0.000) | 1.65E-05 (0.000) | 3.93E-05 ** (0.000) | -1.57E-06 (0.000) | 1.02E-05 (0.000) | 1.63E-05 (0.000) | 3.95E-05 ** (0.000) |
| House | 2.19E-06 (0.000) | -9.43E-06 (0.000) | -4.19E-07 (0.000) | -1.50E-05 (0.000) | 1.94E-06 (0.000) | -1.07E-05 * (0.000) | 3.80E-07 (0.000) | -1.58E-05 (0.000) |
| Return(-1) | | | | | 1.34E-02 (0.050) | -1.64E-01 *** (0.026) | -3.50E-02 (0.032) | 4.44E-02 * (0.034) |
| Orderflow | | | | | 8.89E-06 *** (0.000) | 5.95E-06 *** (0.000) | -3.81E-07 (0.000) | -4.87E-07 (0.000) |
| R-squared | 2.68E-04 | 2.22E-03 | 3.42E-03 | 3.97E-03 | 0.013 | 0.035 | 0.005 | 0.005 |
| Nob | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|-------------|----------------------|----------------------|-------------------------|------------------------|--------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| DIP | -1.41E-06 (0.000) | -1.40E-06 (0.000) | -5.64E-06 (0.000) | -1.96E-05 (0.000) | -1.54E-06 (0.000) | -9.07E-07 (0.000) | -5.00E-06 (0.000) | -1.95E-05 (0.000) |
| DIF | 1.22E-06 (0.000) | -5.13E-06 (0.000) | -2.22E-05 ** (0.000) | -8.05E-06 (0.000) | 2.92E-06 (0.000) | -6.47E-06 (0.000) | -2.21E-05 * (0.000) | -8.36E-06 (0.000) |
| Expenditure | 2.58E-06 (0.000) | 7.55E-06 (0.000) | 1.55E-05 (0.000) | 3.88E-05 ** (0.000) | 3.40E-06 (0.000) | 8.41E-06 (0.000) | 1.54E-05 (0.000) | 3.95E-05 ** (0.000) |
| House | 4.75E-06 (0.000) | -6.88E-06 (0.000) | -1.07E-06 (0.000) | -5.97E-06 (0.000) | 3.01E-06 (0.000) | -1.03E-05 (0.000) | -3.40E-07 (0.000) | -6.73E-06 (0.000) |
| Return(-1) | | | | | -5.83E-01 *** (0.029) | -3.19E-01 *** (0.028) | -4.93E-02 * (0.030) | -8.33E-03 (0.033) |
| Orderflow | | | | | 2.46E-05 *** (0.000) | 9.26E-06 *** (0.000) | 2.30E-07 (0.000) | 9.51E-07 (0.000) |
| R-squared | 6.69E-04 | 1.16E-03 | 3.03E-03 | 3.49E-03 | 0.249 | 0.096 | 0.006 | 0.004 |
| Nob | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|-------------|-----------------------|----------------------|------------------------|------------------------|-------------------------|--------------------------|------------------------|------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| DIP | -6.14E-07 (0.000) | -2.18E-06 (0.000) | -8.11E-06 (0.000) | -1.96E-05 (0.000) | -3.74E-07 (0.000) | -1.77E-06 (0.000) | -7.53E-06 (0.000) | -2.03E-05 (0.000) |
| DIF | -8.84E-07 (0.000) | -1.21E-06 (0.000) | -2.16E-05 * (0.000) | -7.16E-06 (0.000) | -1.36E-06 (0.000) | -1.51E-06 (0.000) | -2.15E-05 * (0.000) | -6.50E-06 (0.000) |
| Expenditure | 5.78E-07 (0.000) | 4.78E-06 (0.000) | 1.24E-05 (0.000) | 3.77E-05 ** (0.000) | 6.67E-07 (0.000) | 5.12E-06 (0.000) | 1.24E-05 (0.000) | 3.79E-05 ** (0.000) |
| House | 7.48E-06 * (0.000) | -6.87E-06 (0.000) | -1.23E-06 (0.000) | -9.10E-06 (0.000) | 7.76E-06 ** (0.000) | -7.89E-06 (0.000) | -4.46E-07 (0.000) | -9.85E-06 (0.000) |
| Return(-1) | | | | | 1.20E-01 *** (0.044) | -1.51E-01 *** (0.029) | -5.24E-02 * (0.032) | 5.57E-02 ** (0.033) |
| Orderflow | | | | | -6.46E-08 (0.000) | 4.94E-06 *** (0.000) | -8.43E-09 (0.000) | -5.97E-07 (0.000) |
| R-squared | 0.002 | 0.001 | 0.003 | 0.004 | 0.011 | 0.023 | 0.006 | 0.006 |
| Nob | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |

A1-6. Announcement at 14:30 (JST)

Deal Bid Return

| | Equation (1) | | | | Equation (2) | | | |
|------------------|----------------------|---------------------|----------------------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Retail Sales | -1.44E-07 (0.000) | 1.23E-06 (0.000) | -7.44E-06 (0.000) | -1.37E-06 (0.000) | 1.22E-07 (0.000) | 1.16E-06 (0.000) | -6.56E-06 (0.000) | -2.53E-06 (0.000) |
| Return(-1) | | | | | -7.85E-02 *** (0.022) | -1.59E-01 *** (0.030) | -8.45E-02 *** (0.030) | -2.16E-01 *** (0.032) |
| Orderflow | | | | | 7.32E-06 *** (0.000) | 6.35E-06 *** (0.000) | -1.76E-07 (0.000) | 4.06E-06 *** (0.000) |
| R-squared Nob | 1.24E-06 1278 | 1.55E-05 1278 | 1.83E-04 1278 | 3.15E-06 1278 | 0.023 1278 | 0.030 1278 | 0.008 1278 | 0.036 1278 |

Deal Ask Return

| | Equation (1) | | | | Equation (2) | | | |
|------------------|---------------------|----------------------|----------------------|---------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Retail Sales | 2.73E-07 (0.000) | -8.35E-07 (0.000) | -4.86E-06 (0.000) | 1.88E-06 (0.000) | 6.51E-07 (0.000) | -1.44E-06 (0.000) | -3.80E-06 (0.000) | 7.79E-07 (0.000) |
| Return(-1) | | | | | -8.87E-02 ** (0.044) | -1.48E-01 *** (0.028) | -1.57E-01 *** (0.030) | -1.82E-01 *** (0.032) |
| Orderflow | | | | | 7.57E-06 *** (0.000) | 5.50E-06 *** (0.000) | 8.42E-07 (0.000) | 3.69E-06 *** (0.000) |
| R-squared Nob | 2.18E-06 1278 | 8.22E-06 1278 | 7.33E-05 1278 | 6.27E-06 1278 | 0.009 1278 | 0.029 1278 | 0.023 1278 | 0.026 1278 |

Midprice Return

| | Equation (1) | | | | Equation (2) | | | |
|------------------|----------------------|----------------------|----------------------|----------------------|-------------------------|--------------------------|--------------------------|--------------------------|
| | 1min | 5min | 15min | 30min | 1min | 5min | 15min | 30min |
| Retail Sales | -2.02E-06 (0.000) | -2.35E-06 (0.000) | -7.21E-06 (0.000) | -1.07E-06 (0.000) | -1.77E-06 (0.000) | -2.70E-06 (0.000) | -6.26E-06 (0.000) | -2.14E-06 (0.000) |
| Return(-1) | | | | | -8.61E-02 ** (0.038) | -1.35E-01 *** (0.028) | -9.17E-02 *** (0.031) | -1.80E-01 *** (0.033) |
| Orderflow | | | | | 3.33E-06 ** (0.000) | 4.70E-06 *** (0.000) | -2.50E-07 (0.000) | 3.60E-06 *** (0.000) |
| R-squared Nob | 2.41E-04 1278 | 6.95E-05 1278 | 1.64E-04 1278 | 1.97E-06 1278 | 0.005 1278 | 0.023 1278 | 0.009 1278 | 0.024 1278 |

Appendix Table 2. News surprises on Realized Volatility (surprises normalized by STD)

A2-1. Announcement at 8:30

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 9.29E-09 *** | (1.8E-09) | 3.84E-08 *** | (6.6E-09) | 1.28E-07 *** | (1.4E-08) | 3.79E-07 *** | (3.4E-08) |
| Volatility(-1) | 1.19E-02 | (3.3E-02) | 1.81E-01 *** | (3.8E-02) | 1.64E-01 *** | (3.8E-02) | 2.34E-01 *** | (4.6E-02) |
| TotalDeals(-1) | 2.60E-09 *** | (4.8E-10) | 2.74E-09 *** | (4.8E-10) | 2.77E-09 *** | (4.3E-10) | 2.48E-09 *** | (5.7E-10) |
| ABSTCPI | -4.86E-10 | (2.0E-09) | 2.06E-09 | (6.8E-09) | 3.06E-09 | (1.3E-08) | -1.52E-08 | (3.0E-08) |
| ABSUNEMP | 5.61E-09 *** | (2.1E-09) | 1.58E-08 ** | (7.0E-09) | 6.49E-09 | (1.4E-08) | -4.43E-08 * | (3.1E-08) |
| ABSCPI | -3.42E-09 ** | (1.9E-09) | 2.87E-09 | (6.3E-09) | 3.82E-09 | (1.2E-08) | -6.75E-09 | (2.8E-08) |
| TCPIDUM | 2.30E-08 | (1.9E-08) | 1.30E-07 ** | (6.2E-08) | 2.49E-07 ** | (1.2E-07) | 2.56E-07 | (2.7E-07) |
| UNEMPDUM | -1.86E-08 * | (1.4E-08) | -5.92E-08 | (4.7E-08) | -1.88E-08 | (9.2E-08) | 2.87E-07 * | (2.1E-07) |
| CPIDUM | 3.65E-09 | (1.7E-08) | -9.28E-08 * | (5.6E-08) | -1.49E-07 * | (1.1E-07) | -3.98E-09 | (2.5E-07) |
| R-squared | 0.040021 | | 0.118483 | | 0.135512 | | 0.112546 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 7.67E-09 *** | (1.5E-09) | 3.08E-08 *** | (5.3E-09) | 1.27E-07 *** | (1.3E-08) | 4.07E-07 *** | (4.9E-08) |
| Volatility(-1) | -3.60E-02 * | (2.8E-02) | 1.67E-01 *** | (3.8E-02) | 2.85E-01 *** | (3.5E-02) | 1.55E-01 ** | (6.7E-02) |
| TotalDeals(-1) | 2.86E-09 *** | (4.0E-10) | 2.97E-09 *** | (3.8E-10) | 1.81E-09 *** | (3.8E-10) | 2.96E-09 *** | (8.2E-10) |
| ABSTCPI | 6.50E-10 | (1.7E-09) | 7.28E-09 * | (5.4E-09) | 9.83E-09 | (1.2E-08) | 3.62E-09 | (4.3E-08) |
| ABSUNEMP | 9.04E-09 *** | (1.8E-09) | 1.46E-08 *** | (5.6E-09) | 1.67E-08 * | (1.2E-08) | -3.91E-08 | (4.4E-08) |
| ABSCPI | -2.61E-09 * | (1.6E-09) | -6.57E-09 * | (5.0E-09) | 6.00E-09 | (1.1E-08) | -4.73E-09 | (3.9E-08) |
| TCPIDUM | -7.28E-09 | (1.6E-08) | 1.15E-07 ** | (5.0E-08) | 1.42E-07 * | (1.1E-07) | 1.45E-07 | (3.9E-07) |
| UNEMPDUM | 2.58E-09 | (1.2E-08) | -5.21E-08 * | (3.8E-08) | -7.56E-08 | (8.2E-08) | 2.46E-07 | (2.9E-07) |
| CPIDUM | 7.52E-09 | (1.4E-08) | -6.41E-08 * | (4.5E-08) | -7.79E-08 | (9.9E-08) | -4.56E-08 | (3.5E-07) |
| R-squared | 0.080881 | | 0.155639 | | 0.180739 | | 0.047986 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 2.41E-08 *** | (6.6E-09) | 1.66E-07 *** | (3.1E-08) | 4.47E-07 *** | (4.8E-08) | 1.06E-06 *** | (8.8E-08) |
| Volatility(-1) | 6.45E-01 *** | (2.9E-02) | 1.02E-01 *** | (2.2E-02) | 2.01E-01 *** | (2.4E-02) | 2.48E-01 *** | (2.7E-02) |
| TotalDeals(-1) | -8.64E-10 | (1.7E-09) | 7.14E-09 *** | (1.8E-09) | 4.92E-09 *** | (1.2E-09) | 4.98E-09 *** | (1.2E-09) |
| ABSTCPI | -3.67E-09 | (7.6E-09) | 9.32E-09 | (3.2E-08) | 1.60E-08 | (4.5E-08) | -6.37E-08 | (7.8E-08) |
| ABSUNEMP | 1.23E-08 * | (7.8E-09) | 2.37E-08 | (3.2E-08) | 2.48E-08 | (4.6E-08) | -1.29E-07 * | (8.0E-08) |
| ABSCPI | -1.17E-08 ** | (7.0E-09) | -1.46E-08 | (2.9E-08) | -2.80E-10 | (4.2E-08) | -8.00E-08 | (7.2E-08) |
| TCPIDUM | 6.88E-08 | (7.0E-08) | 2.21E-07 | (2.9E-07) | 4.16E-07 | (4.1E-07) | 6.45E-07 | (7.2E-07) |
| UNEMPDUM | -6.98E-08 * | (5.3E-08) | -1.77E-07 | (2.2E-07) | -2.85E-07 | (3.1E-07) | 4.68E-07 | (5.4E-07) |
| CPIDUM | 5.35E-08 | (6.3E-08) | -1.11E-07 | (2.6E-07) | -1.68E-07 | (3.7E-07) | 3.16E-07 | (6.5E-07) |
| R-squared | 0.304505 | | 0.040612 | | 0.107887 | | 0.128432 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

A2-2 Announcement at 8:50

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 2.45E-08 *** | (9.3E-09) | 6.14E-08 *** | (1.4E-08) | 2.52E-07 *** | (2.8E-08) | 6.74E-07 *** | (2.0E-07) |
| Volatility(-1) | -0.10328 | (1.2E-01) | 0.212441 *** | (8.6E-02) | 0.34754 *** | (7.3E-02) | 0.327647 | (2.8E-01) |
| TotalDeals(-1) | 2.04E-09 | (1.8E-09) | 1.57E-09 ** | (7.2E-10) | 1.27E-09 ** | (6.1E-10) | 1.4E-09 | (2.6E-09) |
| ABSTANKANM | 4.44E-08 *** | (1.2E-08) | 1.75E-08 | (1.7E-08) | -4.2E-08 * | (3.1E-08) | -8.1E-08 | (2.0E-07) |
| ABSTANKANN | -2.5E-08 *** | (1.1E-08) | -4.3E-08 *** | (1.5E-08) | -6.1E-08 ** | (2.7E-08) | -5.4E-08 | (1.8E-07) |
| ABSMONEY | 1.2E-09 | (9.6E-09) | -9.7E-09 | (1.3E-08) | -2.3E-08 | (2.4E-08) | -2.2E-08 | (1.6E-07) |
| ABSGDPP | 1.04E-07 *** | (9.8E-09) | 1.67E-07 *** | (1.3E-08) | 2.01E-07 *** | (2.4E-08) | 2.09E-07 * | (1.6E-07) |
| ABSGDPF | 1.53E-07 *** | (9.8E-09) | 1.91E-07 *** | (1.3E-08) | 2.1E-07 *** | (2.4E-08) | 2.25E-07 * | (1.6E-07) |
| ABSBOP | 1.03E-08 | (1.1E-08) | 8.44E-09 | (1.4E-08) | 6.04E-09 | (2.7E-08) | -7E-10 | (1.7E-07) |
| ABSTB | -3.1E-09 | (1.2E-08) | -6.8E-09 | (1.6E-08) | -1.4E-08 | (2.9E-08) | 4.17E-09 | (1.9E-07) |
| ABSPPI | 2.13E-08 ** | (1.0E-08) | 2.77E-08 ** | (1.4E-08) | 2.99E-08 | (2.5E-08) | 2.7E-08 | (1.7E-07) |
| ABSIPP | 1.88E-08 ** | (1.1E-08) | 3.96E-08 *** | (1.5E-08) | 5.05E-08 ** | (2.8E-08) | 6.56E-08 | (1.9E-07) |
| TANKANMDUM | 7.1E-07 *** | (1.2E-07) | 1.62E-06 *** | (1.6E-07) | 2.88E-06 *** | (2.9E-07) | 3.42E-06 ** | (1.9E-06) |
| MONEYDUM | -1E-08 | (4.5E-08) | 5.73E-08 | (6.1E-08) | 6.14E-08 | (1.1E-07) | -2.9E-09 | (7.4E-07) |
| GDPPDUM | 7.5E-08 | (8.4E-08) | 1.04E-07 | (1.1E-07) | 3.48E-07 ** | (2.1E-07) | 5.49E-07 | (1.4E-06) |
| GDPFDUM | -3.2E-07 *** | (8.1E-08) | -3.2E-07 *** | (1.1E-07) | -3.2E-07 * | (2.0E-07) | -4.5E-07 | (1.3E-06) |
| BOPDUM | -1.1E-07 ** | (5.1E-08) | -9.8E-08 * | (6.9E-08) | -1.2E-07 | (1.3E-07) | -2.8E-07 | (8.3E-07) |
| TBDUM | 3.24E-08 | (5.5E-08) | 8.53E-08 | (7.4E-08) | 9.87E-08 | (1.4E-07) | -8.7E-08 | (9.0E-07) |
| PPIDUM | -8.7E-08 * | (6.6E-08) | -1.5E-07 ** | (8.9E-08) | -1.6E-07 | (1.6E-07) | -2.4E-07 | (1.1E-06) |
| IPPDUM | 6.67E-08 | (5.8E-08) | 3.82E-08 | (7.8E-08) | 2.18E-08 | (1.4E-07) | -1.6E-07 | (9.4E-07) |
| R-squared | 0.409057 | | 0.475588 | | 0.345437 | | 0.017784 | |
| NOB | 1274 | | 1274 | | 1274 | | 1274 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 3.62E-08 ** | (1.6E-08) | 7.39E-08 *** | (1.5E-08) | 2.58E-07 *** | (2.8E-08) | 5.4E-07 *** | (4.1E-08) |
| Volatility(-1) | 0.265666 | (2.1E-01) | 0.918133 *** | (2.7E-02) | 0.789577 *** | (3.9E-02) | 0.683248 *** | (4.4E-02) |
| TotalDeals(-1) | -2.1E-09 | (3.2E-09) | -2.4E-09 *** | (6.3E-10) | -1.2E-09 *** | (5.0E-10) | -5.8E-10 | (4.8E-10) |
| ABSTANKANM | 9.3E-08 *** | (2.1E-08) | 3.13E-08 ** | (1.8E-08) | -8.3E-10 | (3.0E-08) | -1.8E-08 | (4.2E-08) |
| ABSTANKANN | -4.8E-08 *** | (1.9E-08) | -5.4E-08 *** | (1.6E-08) | -1E-07 *** | (2.6E-08) | -9.7E-08 *** | (3.7E-08) |
| ABSMONEY | 2.79E-10 | (1.7E-08) | 6.7E-10 | (1.4E-08) | -1.5E-08 | (2.3E-08) | -2.6E-08 | (3.3E-08) |
| ABSGDPP | 9.43E-08 *** | (1.7E-08) | 1.6E-07 *** | (1.4E-08) | 1.94E-07 *** | (2.4E-08) | 1.98E-07 *** | (3.3E-08) |
| ABSGDPF | 1.21E-07 *** | (1.7E-08) | 1.89E-07 *** | (1.4E-08) | 2.05E-07 *** | (2.4E-08) | 2.17E-07 *** | (3.3E-08) |
| ABSBOP | 7.46E-09 | (1.8E-08) | 1.6E-08 | (1.6E-08) | 1.57E-08 | (2.6E-08) | 1.66E-08 | (3.6E-08) |
| ABSTB | -1.4E-09 | (2.0E-08) | 4.62E-09 | (1.7E-08) | 6.29E-09 | (2.9E-08) | 3.44E-08 | (4.0E-08) |
| ABSPPI | -9.6E-08 *** | (1.8E-08) | 1.73E-08 | (1.5E-08) | -2.3E-08 | (2.5E-08) | -6.3E-08 ** | (3.5E-08) |
| ABSIPP | 2.75E-08 * | (2.0E-08) | 4.33E-08 *** | (1.7E-08) | 5.16E-08 ** | (2.8E-08) | 4.07E-08 | (3.9E-08) |
| TANKANMDUM | 6.61E-07 *** | (2.0E-07) | 1.87E-06 *** | (1.7E-07) | 3.22E-06 *** | (2.8E-07) | 3.62E-06 *** | (3.9E-07) |
| MONEYDUM | 1.33E-08 | (7.8E-08) | 1.62E-08 | (6.6E-08) | 5.75E-08 | (1.1E-07) | 1.53E-07 | (1.5E-07) |
| GDPPDUM | 1.19E-07 | (1.4E-07) | 2.22E-07 ** | (1.2E-07) | 5.5E-07 *** | (2.0E-07) | 8.66E-07 *** | (2.8E-07) |
| GDPFDUM | -3.3E-07 *** | (1.4E-07) | -3.6E-07 *** | (1.2E-07) | -3.3E-07 ** | (2.0E-07) | -3.9E-07 * | (2.7E-07) |
| BOPDUM | -1.9E-07 ** | (8.8E-08) | -9.1E-08 | (7.4E-08) | -1.1E-07 | (1.2E-07) | -2.4E-07 * | (1.7E-07) |
| TBDUM | 1.89E-08 | (9.5E-08) | 2.61E-08 | (8.0E-08) | -2.9E-08 | (1.3E-07) | -1.1E-07 | (1.9E-07) |
| PPIDUM | 9.11E-07 *** | (1.1E-07) | -5.6E-08 | (1.0E-07) | 2.24E-07 * | (1.6E-07) | 5.54E-07 *** | (2.3E-07) |
| IPPDUM | 4.88E-08 | (1.0E-07) | 4.21E-08 | (8.4E-08) | 3.71E-08 | (1.4E-07) | 6.46E-08 | (2.0E-07) |
| R-squared | 0.236016 | | 0.651287 | | 0.490104 | | 0.397333 | |
| NOB | 1274 | | 1274 | | 1274 | | 1274 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 4.82E-08 *** | (1.7E-08) | 1.87E-07 *** | (2.8E-08) | 6.81E-07 *** | (6.0E-08) | 1.32E-06 *** | (1.3E-07) |
| Volatility(-1) | 0.963905 *** | (8.8E-02) | 0.285302 *** | (3.4E-02) | 0.415316 *** | (4.1E-02) | 0.278654 *** | (3.9E-02) |
| TotalDeals(-1) | -6.3E-09 ** | (3.2E-09) | 1.26E-09 | (1.2E-09) | 7.56E-10 | (1.1E-09) | 3.2E-09 ** | (1.4E-09) |
| ABSTANKANM | 8.58E-08 *** | (2.3E-08) | -8E-08 *** | (3.4E-08) | -1.1E-07 ** | (6.5E-08) | -1.5E-07 | (1.3E-07) |
| ABSTANKANN | 5.2E-09 | (2.0E-08) | -3.2E-08 | (3.0E-08) | -6.1E-08 | (5.7E-08) | -6E-08 | (1.2E-07) |
| ABSMONEY | 3.81E-09 | (1.8E-08) | -2.2E-08 | (2.6E-08) | -6.4E-08 | (5.1E-08) | -8.1E-08 | (1.0E-07) |
| ABSGDPP | 1.14E-07 *** | (1.8E-08) | 2.09E-07 *** | (2.7E-08) | 2.74E-07 *** | (5.2E-08) | 2.85E-07 *** | (1.1E-07) |
| ABSGDPF | 1.91E-07 *** | (1.8E-08) | 2.54E-07 *** | (2.7E-08) | 2.47E-07 *** | (5.2E-08) | 3.19E-07 *** | (1.1E-07) |
| ABSBOP | 2.3E-08 | (2.0E-08) | 5.46E-09 | (2.9E-08) | 9.07E-09 | (5.6E-08) | 3.28E-08 | (1.2E-07) |
| ABSTB | -4.9E-09 | (2.1E-08) | -6.9E-09 | (3.2E-08) | 4.14E-08 | (6.2E-08) | 1.03E-07 | (1.3E-07) |
| ABSPP | 2.54E-08 * | (1.9E-08) | 1.41E-08 | (2.8E-08) | -2.3E-08 | (5.4E-08) | -4.8E-08 | (1.1E-07) |
| ABSIPP | 4.42E-08 ** | (2.1E-08) | 9.62E-08 *** | (3.1E-08) | 1.16E-07 ** | (6.0E-08) | 1.2E-07 | (1.2E-07) |
| TANKANMDUM | 9.68E-07 *** | (2.1E-07) | 3.81E-06 *** | (3.2E-07) | 5.65E-06 *** | (6.1E-07) | 6.26E-06 *** | (1.2E-06) |
| MONEYDUM | -1.4E-08 | (8.3E-08) | 2.5E-07 ** | (1.2E-07) | 2.91E-07 | (2.4E-07) | 4.48E-07 | (4.9E-07) |
| GDPDUM | 2.98E-07 ** | (1.5E-07) | 4.63E-07 ** | (2.3E-07) | 6.91E-07 * | (4.4E-07) | 1.22E-06 * | (9.0E-07) |
| GDPFDUM | -5.1E-07 *** | (1.5E-07) | -4.2E-07 ** | (2.2E-07) | -2.4E-07 | (4.2E-07) | -1E-06 | (8.7E-07) |
| BOPDUM | -1.4E-07 * | (9.3E-08) | 3.45E-08 | (1.4E-07) | 4.96E-09 | (2.7E-07) | -1.5E-07 | (5.5E-07) |
| TBDUM | 6.29E-08 | (1.0E-07) | 1.94E-07 * | (1.5E-07) | -7.7E-08 | (2.9E-07) | -2.1E-07 | (6.0E-07) |
| PPIDUM | -1E-07 | (1.2E-07) | -1.4E-07 | (1.8E-07) | 9.99E-08 | (3.5E-07) | 9.16E-08 | (7.1E-07) |
| IPPDUM | 2.01E-08 | (1.1E-07) | -4.8E-08 | (1.6E-07) | -1.1E-07 | (3.0E-07) | -2.1E-07 | (6.2E-07) |
| R-squared | 0.358573 | | 0.419834 | | 0.308547 | | 0.150188 | |
| NOB | 1274 | | 1274 | | 1274 | | 1274 | |

A2-3. Announcement at 10:30

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 8.05E-09 *** | (2.1E-09) | 2.47E-08 *** | (9.3E-09) | 5.59E-08 *** | (2.3E-08) | 1.35E-07 * | (8.3E-08) |
| Volatility(-1) | 3.85E-02 | (4.6E-02) | 2.47E-01 *** | (5.2E-02) | 1.37E-01 *** | (3.0E-02) | 4.16E-01 *** | (7.0E-02) |
| TotalDeals(-1) | 1.77E-09 *** | (2.7E-10) | 1.71E-09 *** | (3.0E-10) | 1.80E-09 *** | (2.4E-10) | 5.83E-10 * | (4.4E-10) |
| ABSPAYROLL | 1.57E-09 | (1.6E-09) | -5.89E-10 | (6.2E-09) | 1.04E-08 | (1.4E-08) | -5.91E-08 * | (4.1E-08) |
| PAYROLLDUM | 8.17E-09 | (1.1E-08) | 6.12E-09 | (4.3E-08) | -6.65E-08 | (9.4E-08) | 9.14E-07 *** | (2.9E-07) |
| R-squared | 0.128992 | | 0.246517 | | 0.290204 | | 0.165405 | |
| NOB | 576 | | 576 | | 576 | | 576 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 8.91E-09 *** | (1.8E-09) | 2.41E-08 *** | (8.7E-09) | 1.02E-07 *** | (2.0E-08) | 1.28E-07 * | (9.0E-08) |
| Volatility(-1) | 2.09E-03 | (4.6E-02) | 3.46E-01 *** | (5.4E-02) | 3.67E-01 *** | (3.8E-02) | 5.14E-01 *** | (9.9E-02) |
| TotalDeals(-1) | 1.74E-09 *** | (2.4E-10) | 1.44E-09 *** | (2.9E-10) | 6.72E-10 *** | (2.3E-10) | 4.18E-10 | (5.2E-10) |
| ABSPAYROLL | 6.59E-10 | (1.4E-09) | -5.64E-09 | (5.9E-09) | -6.76E-09 | (1.2E-08) | -8.37E-08 ** | (4.5E-08) |
| PAYROLLDUM | -1.48E-09 | (9.5E-09) | 1.65E-08 | (4.0E-08) | -9.50E-09 | (8.2E-08) | 1.03E-06 *** | (3.1E-07) |
| R-squared | 0.134521 | | 0.29044 | | 0.361472 | | 0.142689 | |
| NOB | 576 | | 576 | | 576 | | 576 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.79E-08 *** | (2.8E-09) | 5.15E-08 *** | (1.7E-08) | 2.13E-07 *** | (3.3E-08) | 3.00E-07 *** | (1.0E-07) |
| Volatility(-1) | 6.19E-02 ** | (3.1E-02) | 5.15E-01 *** | (6.2E-02) | 2.37E-01 *** | (2.4E-02) | 4.12E-01 *** | (4.8E-02) |
| TotalDeals(-1) | 2.79E-09 *** | (3.6E-10) | 1.55E-09 *** | (5.4E-10) | 2.01E-09 *** | (3.1E-10) | 1.24E-09 *** | (4.9E-10) |
| ABSPAYROLL | -2.03E-09 | (2.1E-09) | -1.09E-08 | (1.1E-08) | 3.18E-09 | (2.0E-08) | -7.57E-08 * | (5.1E-08) |
| PAYROLLDUM | 2.15E-08 * | (1.5E-08) | 6.96E-08 | (7.9E-08) | -7.89E-08 | (1.4E-07) | 9.31E-07 *** | (3.6E-07) |
| R-squared | 0.178486 | | 0.271338 | | 0.36524 | | 0.244617 | |
| NOB | 576 | | 576 | | 576 | | 576 | |

A2-4. Announcement at 13:30

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|---------------|---------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | -8.46E-09 *** | (3.5E-09) | 1.60E-08 ** | (9.5E-09) | 8.32E-08 *** | (1.9E-08) | 1.22E-07 *** | (5.2E-08) |
| Volatility-1) | 6.33E-01 *** | (6.4E-02) | 9.82E-01 *** | (4.0E-02) | 6.27E-01 *** | (3.6E-02) | 4.10E-01 *** | (5.7E-02) |
| TotalDeal(-1) | 3.95E-09 *** | (6.6E-10) | 2.03E-10 | (4.4E-10) | 7.78E-10 ** | (3.5E-10) | 2.13E-09 *** | (5.1E-10) |
| ABSIIIPF | -4.59E-09 | (4.3E-09) | -1.99E-08 ** | (1.0E-08) | -1.22E-08 | (1.8E-08) | -1.39E-08 | (4.5E-08) |
| IIPFDUM | 3.97E-08 ** | (2.4E-08) | 5.93E-08 | (5.5E-08) | 7.41E-08 | (1.0E-07) | 4.64E-08 | (2.5E-07) |
| R-squared | 0.219591 | | 0.456263 | | 0.376367 | | 0.160099 | |
| NOB | 1261 | | 1261 | | 1261 | | 1261 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|---------------|---------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 7.78E-09 *** | (2.6E-09) | 2.85E-08 *** | (1.0E-08) | 1.25E-07 ** | (6.9E-08) | 2.03E-07 ** | (8.8E-08) |
| Volatility-1) | 9.96E-01 *** | (2.8E-02) | 9.32E-01 *** | (3.9E-02) | 6.03E-01 *** | (1.3E-01) | 7.27E-01 *** | (1.2E-01) |
| TotalDeal(-1) | -2.07E-09 *** | (4.7E-10) | -3.39E-10 | (4.7E-10) | 8.29E-10 | (1.3E-09) | 5.82E-10 | (9.2E-10) |
| ABSIIIPF | 7.92E-10 | (3.2E-09) | -1.39E-08 | (1.1E-08) | -1.17E-08 | (6.5E-08) | -2.19E-08 | (7.6E-08) |
| IIPFDUM | 5.77E-09 | (1.8E-08) | 3.83E-08 | (6.1E-08) | 3.97E-08 | (3.6E-07) | 4.04E-08 | (4.2E-07) |
| R-squared | 0.578819 | | 0.431524 | | 0.042431 | | 0.080781 | |
| NOB | 1261 | | 1261 | | 1261 | | 1261 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|---------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | -1.08E-09 | (3.0E-09) | 2.84E-08 ** | (1.3E-08) | 1.54E-07 *** | (2.9E-08) | 3.15E-07 *** | (6.5E-08) |
| Volatility-1) | 3.73E-01 *** | (2.7E-02) | 6.13E-01 *** | (3.9E-02) | 3.95E-01 *** | (3.0E-02) | 6.20E-01 *** | (5.0E-02) |
| TotalDeal(-1) | 5.09E-09 *** | (5.6E-10) | 2.69E-09 *** | (6.4E-10) | 3.33E-09 *** | (5.2E-10) | 1.72E-09 *** | (6.8E-10) |
| ABSIIIPF | -6.78E-10 | (3.8E-09) | -1.77E-08 | (1.4E-08) | -9.60E-09 | (2.8E-08) | -2.36E-08 | (6.0E-08) |
| IIPFDUM | 1.80E-08 | (2.1E-08) | 4.53E-08 | (7.7E-08) | 6.67E-08 | (1.6E-07) | 7.43E-08 | (3.3E-07) |
| R-squared | 0.346858 | | 0.346086 | | 0.335231 | | 0.265788 | |
| NOB | 1261 | | 1261 | | 1261 | | 1261 | |

A2-5. Announcement at 14:00

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|----------------|-----------|----------------|-----------|----------------|-----------|----------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 2.8658E-09 | (4.1E-09) | -8.873E-10 | (1.1E-08) | 7.4973E-08 *** | (1.7E-08) | 1.3836E-07 *** | (5.3E-08) |
| Volatility(-1) | 0.319246 *** | (4.6E-02) | 0.113255 *** | (1.1E-02) | 0.393573 *** | (1.4E-02) | 0.361189 *** | (3.5E-02) |
| TotalDeals(-1) | 4.0746E-09 *** | (6.1E-10) | 3.8389E-09 *** | (3.6E-10) | 1.1685E-09 *** | (2.0E-10) | 1.1178E-09 *** | (3.7E-10) |
| ABSNEWSDIP | 3.0393E-10 | (3.3E-09) | 1.8001E-09 | (8.0E-09) | 1.3493E-09 | (1.2E-08) | -7.766E-08 *** | (3.3E-08) |
| ABSNEWSDIF | -8.614E-11 | (3.7E-09) | 2.6619E-10 | (9.0E-09) | -1.826E-09 | (1.3E-08) | -3.702E-09 | (3.7E-08) |
| ABSNEWSEXPEND | -1.175E-09 | (4.9E-09) | -1.92E-09 | (1.2E-08) | -7.469E-09 | (1.7E-08) | -2.034E-07 *** | (4.9E-08) |
| ABSNEWSHOUSE | -8.989E-10 | (5.1E-09) | -1.105E-08 | (1.2E-08) | -3.044E-08 ** | (1.8E-08) | -5.388E-08 | (5.1E-08) |
| DIPDUM | -4.598E-09 | (1.8E-08) | -3.338E-08 | (4.5E-08) | -4.068E-08 | (6.5E-08) | 4.71E-07 *** | (1.9E-07) |
| DIFDUM | -1.693E-08 | (2.0E-08) | -3.199E-08 | (4.8E-08) | -4.381E-08 | (6.9E-08) | -1.99E-07 | (2.0E-07) |
| EXPENDDUM | 7.5559E-10 | (2.6E-08) | -8.002E-09 | (6.2E-08) | 7.4606E-09 | (9.0E-08) | 1.262E-06 *** | (2.6E-07) |
| HOUSEDUM | -1.8E-09 | (2.5E-08) | 1.5911E-07 *** | (6.0E-08) | 3.0525E-07 *** | (8.7E-08) | 4.8618E-07 ** | (2.5E-07) |
| R-squared | 0.137924 | | 0.268448 | | 0.515663 | | 0.1983 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|----------------|-----------|----------------|-----------|----------------|-----------|----------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 6.1534E-09 * | (3.9E-09) | 8.5795E-09 | (8.0E-09) | 7.8624E-08 *** | (1.5E-08) | 2.1452E-08 | (6.7E-08) |
| Volatility(-1) | 0.371739 *** | (7.4E-02) | 0.143531 *** | (8.2E-03) | 0.422809 *** | (1.3E-02) | 0.12927 *** | (2.4E-02) |
| TotalDeals(-1) | 3.0582E-09 *** | (6.5E-10) | 3.2399E-09 *** | (2.6E-10) | 9.9294E-10 *** | (1.8E-10) | 2.7518E-09 *** | (4.1E-10) |
| ABSNEWSDIP | -9.313E-10 | (3.1E-09) | -5.356E-10 | (5.8E-09) | 1.4663E-09 | (1.0E-08) | -1.086E-07 *** | (4.3E-08) |
| ABSNEWSDIF | 2.0846E-09 | (3.5E-09) | 1.8661E-09 | (6.5E-09) | -7.208E-10 | (1.2E-08) | -1.284E-08 | (4.8E-08) |
| ABSNEWSEXPEND | -8.097E-10 | (4.6E-09) | 5.2513E-10 | (8.5E-09) | -1.2E-08 | (1.5E-08) | -2.871E-07 *** | (6.3E-08) |
| ABSNEWSHOUSE | -2.836E-09 | (4.8E-09) | -9.607E-09 | (8.9E-09) | -3.036E-08 ** | (1.6E-08) | -4.649E-08 | (6.7E-08) |
| DIPDUM | 3.1982E-09 | (1.7E-08) | 1.3015E-08 | (3.2E-08) | -1.118E-08 | (5.8E-08) | 7.9793E-07 *** | (2.4E-07) |
| DIFDUM | -2.219E-08 | (1.8E-08) | -4.407E-08 * | (3.4E-08) | -4.319E-08 | (6.2E-08) | -2.378E-07 | (2.5E-07) |
| EXPENDDUM | -4.145E-09 | (2.4E-08) | -2.366E-08 | (4.4E-08) | 2.5305E-08 | (8.1E-08) | 1.7522E-06 *** | (3.3E-07) |
| HOUSEDUM | 1.9008E-08 | (2.3E-08) | 1.0808E-07 *** | (4.3E-08) | 2.6942E-07 *** | (7.8E-08) | 3.8805E-07 | (3.2E-07) |
| R-squared | 0.103576 | | 0.430143 | | 0.588954 | | 0.128059 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|----------------|-----------|----------------|-----------|----------------|-----------|----------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.5002E-08 *** | (6.4E-09) | 5.3656E-08 *** | (1.4E-08) | 1.6848E-07 *** | (2.5E-08) | 3.6102E-07 *** | (5.8E-08) |
| Volatility(-1) | 0.231179 *** | (5.9E-02) | 0.147603 *** | (1.5E-02) | 0.410793 *** | (1.8E-02) | 0.383734 *** | (2.9E-02) |
| TotalDeals(-1) | 5.8181E-09 *** | (9.8E-10) | 4.5849E-09 *** | (4.8E-10) | 1.7067E-09 *** | (3.2E-10) | 1.4935E-09 *** | (4.3E-10) |
| ABSNEWSDIP | 1.2485E-09 | (5.2E-09) | 2.9623E-09 | (1.0E-08) | 2.2649E-09 | (1.8E-08) | -5.912E-08 * | (3.7E-08) |
| ABSNEWSDIF | 2.6167E-09 | (5.9E-09) | 2.3421E-09 | (1.2E-08) | 1.0958E-08 | (2.0E-08) | 3.8773E-09 | (4.1E-08) |
| ABSNEWSEXPEND | -1.558E-09 | (7.7E-09) | -3.042E-09 | (1.5E-08) | -3.8E-09 | (2.6E-08) | -1.708E-07 *** | (5.4E-08) |
| ABSNEWSHOUSE | -7.62E-09 | (8.1E-09) | -2.168E-08 * | (1.6E-08) | -5.166E-08 ** | (2.7E-08) | -6.957E-08 | (5.7E-08) |
| DIPDUM | -1.778E-08 | (2.9E-08) | -6.104E-08 | (5.8E-08) | -7.297E-08 | (9.8E-08) | 2.9565E-07 * | (2.1E-07) |
| DIFDUM | -2.58E-08 | (3.1E-08) | -5.105E-08 | (6.1E-08) | -6.087E-08 | (1.0E-07) | -2.068E-07 | (2.2E-07) |
| EXPENDDUM | 3.446E-10 | (4.1E-08) | -1.858E-08 | (8.0E-08) | -3.552E-08 | (1.4E-07) | 9.6684E-07 *** | (2.8E-07) |
| HOUSEDUM | 3.5996E-08 | (3.9E-08) | 2.0847E-07 *** | (7.7E-08) | 4.2534E-07 *** | (1.3E-07) | 5.0912E-07 ** | (2.7E-07) |
| R-squared | 0.081615 | | 0.256044 | | 0.450222 | | 0.279119 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

A2-6. Announcement at 14:30

Volatility (Deal Bid)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 4.40E-09 | (8.4E-09) | 1.51E-08 * | (1.0E-08) | 7.50E-08 * | (4.8E-08) | 2.21E-07 *** | (6.9E-08) |
| Volatility(-1) | 4.28E-02 | (6.3E-02) | 8.34E-02 *** | (1.0E-02) | 9.91E-02 *** | (3.5E-02) | 3.55E-01 *** | (4.2E-02) |
| TotalDeals(-1) | 3.85E-09 *** | (1.3E-09) | 2.67E-09 *** | (3.7E-10) | 2.46E-09 *** | (6.2E-10) | 1.22E-09 *** | (4.9E-10) |
| ABSRETAIL | 2.12E-09 | (1.0E-08) | 1.17E-09 | (1.1E-08) | -1.12E-08 | (4.7E-08) | -1.73E-08 | (6.4E-08) |
| RETAILDUM | -2.15E-08 | (5.1E-08) | -2.87E-08 | (5.6E-08) | -1.81E-08 | (2.3E-07) | -1.60E-08 | (3.1E-07) |
| R-squared | 0.0099703 | | 0.173255 | | 0.039654 | | 0.125809 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Deal Ask)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 6.10E-09 *** | (1.6E-09) | 1.82E-08 *** | (6.9E-09) | 6.97E-08 * | (5.3E-08) | 2.33E-07 *** | (7.6E-08) |
| Volatility(-1) | 7.53E-02 *** | (7.3E-03) | 3.69E-02 *** | (4.8E-03) | 3.71E-02 * | (2.8E-02) | 3.35E-01 *** | (3.5E-02) |
| TotalDeals(-1) | 1.73E-09 *** | (2.5E-10) | 2.58E-09 *** | (2.4E-10) | 2.81E-09 *** | (6.7E-10) | 1.24E-09 *** | (5.0E-10) |
| ABSRETAIL | 7.72E-10 | (2.0E-09) | -3.24E-09 | (7.7E-09) | -1.93E-08 | (5.2E-08) | -1.75E-08 | (7.0E-08) |
| RETAILDUM | -8.32E-09 | (9.7E-09) | -1.23E-08 | (3.8E-08) | 2.04E-08 | (2.5E-07) | -2.85E-08 | (3.4E-07) |
| R-squared | 0.159742 | | 0.218367 | | 0.026286 | | 0.133005 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |

Volatility (Midprice)

| | 1min | | 5min | | 15min | | 30min | |
|----------------|--------------|-----------|--------------|-----------|--------------|-----------|--------------|-----------|
| | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. | Coefficient | s.e. |
| C | 1.30E-08 *** | (2.2E-09) | 5.90E-08 *** | (8.9E-09) | 2.14E-07 *** | (5.0E-08) | 4.84E-07 *** | (7.5E-08) |
| Volatility(-1) | 2.12E-01 *** | (1.2E-02) | 9.68E-02 *** | (1.1E-02) | 1.67E-01 *** | (4.1E-02) | 4.50E-01 *** | (4.3E-02) |
| TotalDeals(-1) | 2.50E-09 *** | (3.5E-10) | 3.44E-09 *** | (3.3E-10) | 2.84E-09 *** | (7.2E-10) | 8.85E-10 * | (5.9E-10) |
| ABSRETAIL | 7.79E-10 | (2.7E-09) | -4.76E-09 | (9.9E-09) | -3.69E-08 | (5.0E-08) | -4.26E-08 | (7.1E-08) |
| RETAILDUM | -7.72E-09 | (1.3E-08) | 4.66E-08 | (4.9E-08) | 1.64E-07 | (2.5E-07) | 1.36E-07 | (3.5E-07) |
| R-squared | 0.300373 | | 0.26505 | | 0.063935 | | 0.174903 | |
| NOB | 1278 | | 1278 | | 1278 | | 1278 | |