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Asymmetries and state dependence: The impact of macro surprises on intraday exchange rates

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ABSTRACT

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This paper investigates the possible asymmetric response of 5-min intraday JPY/USD exchange rates to macroeconomic news announcements during 1999–2006 when the Japanese money market interest rate was effectively zero. This period provides a unique institutional setting when interest rates may rise but not decline, thereby constraining both endogenous policy reactions to news and private market expectations. Asymmetric responses to news, to the extent that they are important in exchange rate markets as they are in equity markets, would seem particularly likely to be evident during this period. We consider several ways asymmetric responses may be manifested and linked to macroeconomic news during this unusual period. We assess whether the intraday exchange rate responds differently depending on whether the news is emanating from Japan or the US; we consider the state of the business cycle; and we distinguish between "good" and "bad" news. *J. Japanese Int. Economies* **26** (4) (2012) 542–560. School of Business, University of Alberta, Edmonton, Canada T6G 2R6; Department of Economics, University of California, Santa Cruz, CA 95064, USA.

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1. Introduction

Recent research on the influence of US macroeconomic news surprises on the dynamics of intraday exchange rates offers important insights regarding how quickly exchange rate markets react to macro news and which macro news are essential for explaining exchange rate movements (see, for example, Andersen et al., 2003, 2007; Chaboud et al., 2004; Dominguez and Panthaki, 2006; Faust et al., 2005). Generally, these intraday exchange rate studies suggest that stronger than expected US economic activity and higher than expected inflation tends to appreciate the USD, and, furthermore, that US news produces conditional mean jumps in the exchange rate.

The impact of news surprises on exchange rates depends in principle upon a number of factors including the state of the economy, institutional setting and nature of the expected policy response, e.g. Clarida and Waldman (2007) and Engel et al. (2007).[1] These characteristics may lead to state-contingent asymmetric responses of exchange rates to news. Policy and private sector responses may be complicated and vary depending on factors such as the state of the business cycle, the nature of the macroeconomic news (e.g. "good" or "bad" news), and the (country) source of the news. Asymmetric responses might occur in particular institutional settings such as an environment with effectively zero short-term interest rates. Lower interest rates (below zero) are not feasible during this circumstance, hence monetary policy is not able to endogenously absorb shocks to certain news announcements by traditional means, thereby limiting private sector expectations of policy reactions.[2] Given the close linkages between interest rates and exchanges rates, such constraints, in turn, could make the response to news in the foreign exchange market state contingent.

Studies that focus on the intraday influence of Japanese macroeconomic news on the JPY/USD show that several Japanese news significantly influence exchange rate returns within 30 min after the news announcement (Hashimoto and Ito, 2010). A study that considers the EUR/JPY exchange rate response to several international macroeconomic news announcements suggests that US macroeconomic news announcements are of particular importance (Evans and Speight, 2010). In the context of equity markets and news, McQueen and Roley (1993) have shown that the effect of news is asymmetric in that it varies with the stages of the business cycle and that the equity price response may depend on whether a given news variable is conveying "good" or "bad" news about the state of the economy.[3] These results for equity returns are confirmed and extended in Flannery and Protopapadakis (2002). Basistha and Kurov (2008) find that the response of US equity returns to monetary news surprises is much stronger during recessions and tight credit conditions.[4]

We investigate the possible asymmetric response of intraday exchange rates (5-min intraday JPY/USD) to macroeconomic news announcements during a very unusual period – Japan during 1999–2006 when the money market interest rate was effectively zero (Fig. 1). Asymmetric responses to news, to the extent that they are important in exchange rate markets as they are in equity markets,

[1] These authors emphasize how expectations regarding central bank policy responses to inflation are formed in the context of exchange rate models.

[2] Although interest rates cannot be lowered in response to weaker than expected macro news in the zero-interest rate environment, we cannot a priori dismiss the possibility of a monetary policy response to weaker than expected macro news in the form of further quantitative easing. While there is no consensus regarding the effects of quantitative easing, or the effects of anticipation of such, it is possible that weaker than expected macro news increase the expectation of further quantitative easing which, in turn, may influence the exchange rate. As a result, there is a theoretical possibility that even in the zero-interest rate environment macro news can have symmetric exchange rate effects. See Oda and Ueda (2007) for a discussion of the market perception of Bank of Japan's willingness to continue its zero-interest rate policy.

[3] Using daily data, McQueen and Roley, 1993 show that news regarding unexpectedly strong economic activity in the US has a positive effect on the S&P 500 index when business conditions are weak, but a negative effect when business conditions are strong. They attribute this asymmetry to differences in the response of discount rates relative to expected cash flows given different states of the economy. They argue that studies not accounting for differences in the business cycle may lead to an underestimation of the effects of announcement surprises. Andersen et al. (2007) consider the possible asymmetric effects of US news surprises across different stages of the US business cycle. They note that the effects of US macroeconomic news on equities and bonds react differently depending on the state of the US business cycle and, therefore, correlations averaged over the business cycle are typically low. They do not make this observation for exchange rates and they do not consider Japanese macroeconomic news.

[4] Other empirical studies of asymmetric asset price responses to news include Bae and Andrew Karolyi (1994), DeGennaro and Shrieves (1997), Frömmel et al. (2008), Kaneko and Lee (1995), and Kim et al. (2004).

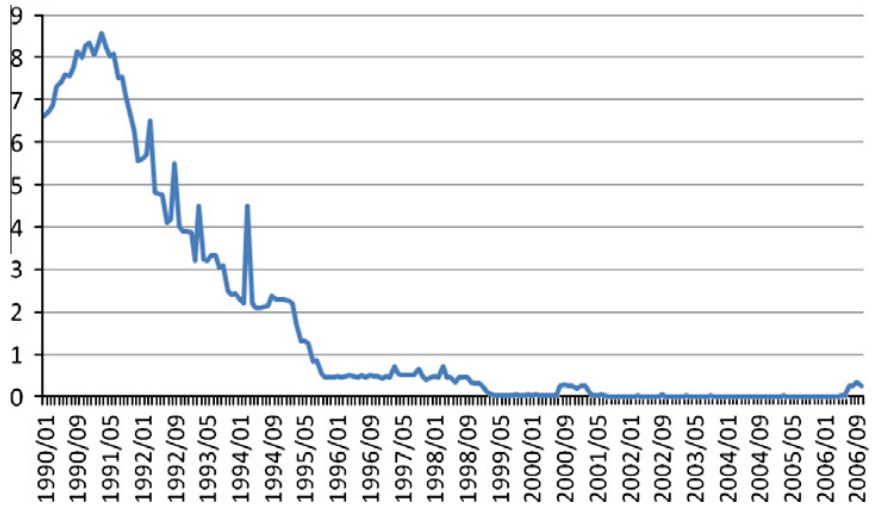

Fig. 1. Money market rate in Japan. *Note*: Call rate, uncollateralized overnight rate, end of month. *Source*: Bank of Japan.

would seem particularly likely to be evident during this period where the institutional setting is such that interest rates may rise but not decline, thereby limiting the policy response to news announcements and, as a result, limiting private market expectations of endogenous policy actions. In such an institutional setting, the exchange rate would seem more likely to exhibit asymmetric responses to news compared to the environments that Andersen et al. (2007) consider, in which they do *not* find state contingent impacts of news on exchange rates.[5]

How might these state dependencies be distinguished? We consider three ways that state dependencies and asymmetric responses of intraday exchange rates may be manifested and linked to macroeconomic news: (1) whether the news emanates from Japan or the US; (2) the state of the business cycle; and (3) differences between "good" and "bad" news. Accordingly, our first research question pertains to whether both US and Japanese macro news surprises influence the JPY/USD exchange rate, i.e. whether Japanese news matter and, if so, which Japanese news are important and how do their relative influence compare to the relative influence of US news.[6] The second research question pertains to whether news has asymmetric exchange rate effects across different stages of the business cycle. Since our data set of macro news surprises for both the US and Japan spans different combinations of US and Japan business cycle upturns and downturns, we are able to assess if business cycle asymmetries are present in our exchange rate context. We also test for business cycle asymmetries by introducing a continuous measure of the state of the business cycle in Japan – deviations from the average level of industrial production – and enter this as an interactive term with the macro news announcements. These tests of business cycle asymmetries are novel contributions to the empirical exchange rate literature. Finally, our third research question is whether "good" and "bad" (positive and negative) news exert asymmetric intraday effects on the exchange rate, e.g. is the absolute magnitude of the exchange rate movement attributed to a positive (i.e. better than expected) Japanese GDP surprise different than the absolute magnitude of the movement associated with a negative (i.e. worse than expected) Japanese GDP surprise.

We shed light on these possible asymmetries by analyzing the real-time (intraday) effects of both US and Japanese macroeconomic news surprises on the JPY/USD exchange rate over the 1 January 1999–31 October 2006 time-period. News data consisting of a large number of time-stamped US

[5] While we also obtained time-stamped data on macroeconomic news covering the 1991–1998 period, the quality of this data does not compare to the quality of the more recent news data under study. Consequently, our paper does not include a comparison analysis of asymmetric JPY/USD rate responses to macro news prior to 1999.

[6] Other studies that take into account Japanese macro news when analyzing the intraday JPY/USD exchange rate include Cai et al. (2001), Clarida and Waldman (2007), Ito and Roley (1987), and Melvin and Yin (2000). See Almeida et al. (1998), Andersen et al. (2003), and Bauwens et al. (2005) for studies that consider the intraday exchange rate response to both US and European macroeconomic news.

and Japanese macroeconomic announcements and preceding survey expectations obtained from Bloomberg News Service, along with indicative 5-min spot JPY/USD exchange rate quotes, facilitate our investigation. Both US and Japanese news surprises are measured as the difference between the macroeconomic announcement and the median value of the immediately preceding Bloomberg News Service survey of market expectations regarding the given announcement.[7]

For our baseline estimations, we estimate the exchange rate response to news surprises using only observations within 10-min before and 90-min after each announcement. To accommodate the long memory and the intraday periodicity that characterize our intraday JPY/USD exchange rate data, we estimate our baseline models using heteroskedasticity and serial-correlation robust (HAC) standard errors. To ensure the robustness of our results we also carry out estimations that include all the observations in our sample and, furthermore, we re-estimate the baseline model using the two-step weighted least squares (2WLS) estimation procedure.[8]

The following two sections discuss our data and our econometric methodology, respectively. Section 4 presents the baseline results, the methodological robustness checks, and assessment of asymmetries. Section 5 summarizes our results and concludes.

2. Data

The intraday JPY/USD exchange rate data is provided by Olsen and Associates, collected from commercial banks by Tenfore and Oanda, and covers the 1 January 1999 to 31 October 2006 time-period. The data consists of the bid and the offer spot exchange rate at the end of every 5-min interval over every 24-h period. The quotes are indicative quotes, i.e. not necessarily traded quotes. We filter the data for anomalies and bad quotes following the procedure of Dacorogna et al. (1993).Our midpoint (log) exchange rate price at each 5-min point is constructed by linearly interpolating the average of the preceding and immediately following (log) bid and offer quotes. The continuously compounded 5-min returns (R_t) are calculated as the change in the 5-min midpoint prices.[9] Consistent with the existing intraday literature on widely traded currency pairs we define a trading day to start at 21.05 GMT the night before and end at 21.00 GMT on the evening of the trading day in question (see Bollerslev and Domowitz, 1993) and, furthermore, we define a weekend to start at 21.05 GMT Friday and finish at 21.00 GMT Sunday.

Our news data consists of a large number of time-stamped (real-time) Japanese and US macroeconomic announcements and preceding survey expectations obtained from Bloomberg News Service.[10] We include in our analysis Japanese news variables that are largely comparable to the US news variables that are significant in either the time-series analysis or the event study analysis of Andersen et al. (2003) in their investigation of the JPY/USD exchange rate. In addition, we consider surprises regarding Japanese news of particular interest, e.g. surprises regarding the Bank of Japan's TANKAN survey variables.[11] We include US news variables that Andersen et al. (2003) find to significantly influence the JPY/USD exchange rate, and we also take into account additional "usual suspects" variables such as surprises regarding US consumer and producer price indices. Consequently, our data includes announcements and survey expectations regarding 16 types of Japanese macro news and 19 types of US macro news. The Japanese news variables are GDP (quarterly), GDP (annual), Industrial Production, Capacity Utilization, Construction Orders, Overall Spending, Large Retail Sales, Trade Balance, Current Account, Retail Trade, Consumer

[7] Fatum and Scholnick (2008) show that failure to disentangle the expected component of news may lead to an underestimation of the impact of news.

[8] Our baseline estimations follow Andersen et al. (2007). The 2WLS estimation procedure is described in Andersen and Bollerslev (1998).

[9] Indicative quotes are not necessarily traded ("firm") quotes and, therefore, indicative quotes are not binding commitments to trade. Moreover, indicative quotes may reflect dealer-specific inventories or beliefs. Despite these potential shortcomings of our exchange rate data, the statistical properties of exchange rate return series derived from indicative quotes at the 5-min sampling frequency are very similar to those of firm quotes (see Danielsson and Payne, 2002).

[10] Japanese macro announcements are available from Bloomberg News Service as well as from the data banks of the Bank of Japan and the Japanese Cabinet Office.

[11] The Bank of Japan website at http://www.boj.or.jp/en/theme/research/stat/tk/index.htm provides details (in English) regarding the TANKAN survey variables.

Table 1
Japanese macro surprises.

Announcement	Non-zero announcement surprises	Starting date	Announcement frequency	Announcement time (Tokyo time)
GDP				
GDP quarterly	39	03/12/99	Quarterly	Irregular
GDP annually	25	09/17/03	Quarterly	8.50 AM
Real activity				
Large retail sales	78	12/15/99	Monthly	8.50 AM
Industrial production	116	05/17/00	Monthly	Irregular
Capacity utilization	53	03/15/02	Monthly	1.30 PM
Consumption				
Overall spending	7	03/31/06	Monthly	8.50 AM
Investment				
Construction orders	75	03/01/00	Monthly	2.00 PM
Net exports				
Trade balance	34	09/12/02	Monthly	8.50 AM
Current account	79	01/18/99	Monthly	8.50 AM
Retail trade	60	02/26/01	Monthly	Irregular
Prices				
Consumer price index	37	09/28/01	Monthly	Irregular
Forward looking				
Leading economic index	73	12/06/99	Monthly	2.00 PM
Consumer confidence index	42	03/23/02	Monthly	Irregular
TANKAN large manufacturing	17	12/12/01	Quarterly	8.50 AM
TANKAN non-manufacturing	14	04/01/02	Quarterly	Irregular
Monetary policy				
Monetary base	45	10/02/02	Monthly	8.50 AM

Notes: (a) *Data sources*: Bank of Japan, Japanese Cabinet Office, and Bloomberg News Service. (b) *Sample period*: 1 January 1999–31 October 2006. (c) While our sample period starts 1 January 1999, some of the announcement series under study are not tracked by Bloomberg News Service and/or data on surveys of market expectations are not available until later in the sample. The starting date denotes when the first announcement and associated survey are available for a given announcement series. (d) The announcement time is denoted irregular if the announcement time has changed during the sample period.

Price Index, Consumer Confidence Index, TANKAN Large Manufacturing Index, TANKAN Non-Manufacturing Index, Leading Economic Index, and Monetary Base. The US news variables are GDP, Non-Farm Payroll Employment, Industrial Production, Capacity Utilization, Personal Income, Consumer Credit, Consumer Spending, New Home Sales, Durable Good Orders, Factory Orders, Business Inventories, Trade Balance, Producer Price Index, Consumer Price Index, Consumer Confidence Index, NAPM Index, Housing Starts, Index of Leading Indicators, and Target Federal Funds Rate.

Consistent with the recent literature on exchange rates and news, for each of the macroeconomic announcements in our data we define a news surprise as the difference between the macroeconomic announcement and the preceding survey expectation of that announcement. Subsequently, we standardize each news surprise series in order to allow for a comparison of the relative influences of different types of news.[12]

[12] A standardized news surprise is given by the unexpected component of the macroeconomic announcement divided by the associated sample standard deviation. Let $A_{q,t}$ denote the value of a given macroeconomic fundamental q, announced at time (min) t. Let $E_{q,t}$ refer to the median value of the preceding market expectations for the given fundamental at announcement time t, and let $\hat{\sigma}_q$ denote the sample standard deviation of all the surprise components associated with fundamental q. The standardized surprise of macroeconomic fundamental q announced at time t is then defined as $S_{q,t} = (A_{q,t} - E_{q,t})/\hat{\sigma}_q$.

Table 2
US and Japanese business cycle combinations.

Japanese business cycle	US business cycle	Dates
Upturn	Upturn	January 1999–December 2000
Upturn	Upturn	February 2002–October 2006
Upturn	Downturn	No observations
Downturn	Upturn	January 2001–March 2001
Downturn	Upturn	December 2001–January 2002
Downturn	Downturn	April 2001–November 2001

Notes: (a) US business cycle definitions in accordance with the Business Cycle Dating Committee of the National Bureau of Economic Research. (b) Japanese business cycle definitions based on the Japanese industrial production index and the Composite Coincident Business Cycle Index of the Government of Japan Cabinet Office.

Table 1 displays details regarding the Japanese news surprises.[13] The table shows the number of non-zero news surprises, the announcement frequency, and the start date of each of the Japanese news variable series.[14]

The timing of economic upturns and downturns for the US follows the Business Cycle Dating Committee of the National Bureau of Economic Research. Business cycle dating for Japan is set in accordance with peaks and troughs of the Japanese industrial production index. Peaks (troughs) are identified as the highest (lowest) level of industrial production during an economic expansion (contraction).[15] Table 2 shows the dates for various US and Japan business cycle combinations. As the table shows, there is no part of our sample which encompasses a Japanese upturn coincident with a US downturn, i.e. our sample period encompasses only three business cycle combinations.

3. Econometric methodology

We model the response of the 5-min JPY/USD exchange rate return, R_t, as a linear function of J lagged values of the return itself and K lags of each of the Q news variables, $S_{q,t}$:

$$R_t = \beta_0 + \sum_{j=1}^{J} \beta_j R_{t-j} + \sum_{q=1}^{Q} \sum_{k=0}^{K} \gamma_{q,k} S_{q,t-k} + \varepsilon_t, t = 1, \ldots, T \quad (1)$$

where T = 611,239, Q = 35 (19 US and 16 Japanese news), and J and K are chosen according to the Schwarz Bayesian Information Criteria (SBIC).

We estimate Eq. (1) using three different methodologies. For our baseline estimations, we only include observations within 10-min before and 90-min after each announcement. We estimate our baseline models using HAC standard errors, thus accommodating the long memory and the intraday periodicity that characterize our intraday JPY/USD exchange rate series.[16]

The second methodology that we employ to estimate Eq. (1) includes all observations in our sample. The objective is to ensure that limiting the sample to include only the 100-min windows around the macro announcements does not affect the results. Finally, we employ the two-step weighted least squares (2WLS) estimation procedure. This approach enables us to directly estimate the volatility

[13] The Bank of Japan website at www.boj.or.jp/en/theme/stat/index.htm and the Japanese Cabinet Office website at www.cao.go.jp/index-e.html provide additional details (in English) regarding the Japanese macro announcements. For additional details on the timing of announcements see Hashimoto and Ito (2010, Table 1). Details regarding the US news surprises are described in Andersen et al. (2003, p. 43) and not shown here for brevity.

[14] Table 1 shows considerable variation in start dates across the Japanese news variables. A similar variation is found in the start dates across the US news variables analyzed in Andersen et al. (2003, p. 43).

[15] We also considered using the official Cabinet Office dating of business cycles in Japan. However, the Cabinet Office dating shows one long continuous upturn during a major part of our sample, February 2002 and onwards, while the industrial production dating scheme clearly shows an upturn (July 2002–July 2004), followed by a short downturn (August 2004–July 2005) and recovery. Using the Cabinet Office measure would therefore disregard one cycle that seems evident in the data. Other than that this one cycle, our business cycle dating matches the Cabinet Office quite closely.

[16] We also estimate Eq. (1) with day-of-the-week dummies included. Inclusion of these dummies does not influence our findings thus, for brevity, we do not report these additional estimations.

pattern of our data. More specifically, in our 2WLS methodology, we first estimate Eq. (1) by OLS and obtain the estimated residuals $\hat{\varepsilon}_t$. The next step is to model the volatility pattern using the absolute value of the estimated residuals of Eq. (1). We follow Andersen et al. (2007) and use the following parameterization:

$$|\hat{\varepsilon}_t| = \sum_{i=1}^{I'} \beta_i |\hat{\varepsilon}_{t-i}| + \sum_{d=1}^{D} \gamma_d D_d + \sum_{q=1}^{Q} \sum_{j'=0}^{J'} \gamma_{q,j'} D_{q,t-j'} + u_t \tag{2}$$

where $I' = 9$ lags of the absolute value of the estimated residuals (accounting for serial correlation, or ARCH effects), $D = 38$ dummies capturing the well-documented intraday volatility pattern, and the last summation reflects dummy variables for each of the announcement surprises up to a lag length of $J' = 14$. In the last step, we use the fitted residuals from Eq. (2) to perform a WLS estimation of Eq. (1).

Comparing the WLS results to the results of our HAC baseline estimations ensures that there is no substantial precision lost in the coefficient estimates stemming from the baseline estimation procedure.

In order to analyze whether macro surprises have asymmetric effects across different stages of the business cycle, we let t_i for i = UP, DOWN denote whether the Japanese business cycle is in upturn or downturn. We then estimate the following equation separately across the two Japanese business cycle possibilities:

$$R_t = \beta_0 + \sum_{j=1}^{J} \beta_j R_{t-j} + \sum_{q=1}^{Q} \sum_{k=0}^{K} \gamma_{q,k} S_{q,t-k} + \varepsilon_t, \quad \text{for} \quad t \in t_i \text{ and } i = \text{UP, DOWN} \tag{3}$$

We also consider a continuous measure of the state of the Japanese business cycle and test for asymmetric effects of the business cycle. In particular, we consider deviations of industrial production from the sample average as a measure of the state of the business cycle. We interact the continuous business cycle measure with the macro news announcements and test for explanatory power. The equation estimated is:

$$R_t = \beta_0 + \sum_{j=1}^{J} \beta_j R_{t-j} + \sum_{q=1}^{Q} \sum_{k=0}^{K} (\gamma_{q,k}^0 + \gamma_{q,k}^1 \ln(IP_t/\overline{IP}) S_{q,t-k} + \varepsilon_t \tag{4}$$

where IP_t is the monthly Japanese industrial production index and $\overline{IP}$ is the average of the monthly Japanese industrial production index in Japan between January 1999 and December 2006.

Finally, we extend our analysis to allow for the possibility that positive surprises (i.e. better than expected economic news) have a different impact than negative surprises (i.e. worse than expected economic news). We test whether this is the case by first defining $S_{q,t}^{Pos} = S_{q,t}$ if $S_{q,t} \geqslant 0$ (and 0 otherwise), and $S_{q,t}^{Neg} = S_{q,t}$ if $S_{q,t} < 0$ (and 0 otherwise) and, in turn, estimating the following equation:

$$R_t = \beta_0 + \sum_{j=1}^{J} \beta_j R_{t-j} + \sum_{q=1}^{Q} \sum_{k=0}^{K} \gamma_{q,k}^{Pos} S_{q,t-k}^{Pos} + \sum_{q=1}^{Q} \sum_{k=0}^{K} \gamma_{q,k}^{Neg} S_{q,t-k}^{Neg} + \varepsilon_t \tag{5}$$

where the superscripts Pos and Neg denote positive and negative surprises, respectively.

4. Results

4.1. Country of origin asymmetries

We first investigate whether similar US and Japanese macro news influences the exchange rate differently. The first column of Table 3 displays the results of our preliminary regression model described in Eq. (1), including only observations within the 10-min "windows" before and the 90-min "windows" after each of the announcements and using HAC standard errors. We set $J = 2$ and $K = 0$ according to SBIC, i.e. we include as explanatory variables two lags of the exchange rate return and only the contemporaneous value of each of the 35 (19 US and 16 Japanese) standardized news variables.

For the US news variables our results show that 12 of the 19 variables are significant and of the correct sign. The magnitudes of the coefficient estimates suggest that news surprises regarding non-farm

Table 3
Preliminary regression with three different methodologies.

Sample	Baseline Methodology 100-min Windows		Methodology Check 1 All sample		Methodology Check 2 100-min Windows	
Estimation procedure	OLS with HACS.E.		OLS with HACS.E.		WLS	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
US announcements						
GDP	0.0410***	(0.0056)	0.0415***	(0.0055)	0.0397***	(0.0037)
Nonfarm payroll employment	0.1172***	(0.0207)	0.1179***	(0.0207)	0.1193***	(0.0043)
Industrial production	0.0066	(0.0052)	0.0071	(0.0051)	0.0077	(0.0054)
Capacity utilization	0.0122**	(0.0057)	0.0121**	(0.0057)	0.0121*	(0.0069)
Personal income	0.0034	(0.0034)	0.0033	(0.0034)	0.0030	(0.0035)
Consumer credit	−0.0029	(0.0018)	−0.0028	(0.0018)	−0.0024	(0.0036)
Consumer spending	0.0122***	(0.0041)	0.0122***	(0.0041)	0.0117***	(0.0037)
New home sales	0.0103*	(0.0053)	0.0103**	(0.0052)	0.0097***	(0.0036)
Durable goods orders	0.0235***	(0.0064)	0.0241***	(0.0065)	0.0237***	(0.0038)
Factory orders	0.0036	(0.0056)	0.0043	(0.0056)	0.0039	(0.0038)
Business inventories	−0.0046	(0.0039)	−0.0042	(0.0039)	−0.0043	(0.0037)
Trade balance	0.0739***	(0.0109)	0.0741***	(0.0107)	0.0716***	(0.0045)
Producer price index	0.0094**	(0.0046)	0.0091*	(0.0046)	0.0097***	(0.0037)
Consumer price index	0.0042	(0.0067)	0.0043	(0.0067)	0.0045	(0.0037)
Consumer confidence index	0.0363***	(0.0049)	0.0369***	(0.0050)	0.0366***	(0.0038)
NAPM index	0.0329***	(0.0050)	0.0327***	(0.0050)	0.0332***	(0.0036)
Housing starts	0.0083**	(0.0039)	0.0080**	(0.0039)	0.0094**	(0.0037)
Index of leading indicators	0.0090**	(0.0037)	0.0089**	(0.0036)	0.0093**	(0.0037)
Target federal funds rate	−0.0009***	(0.0001)	−0.0016***	(0.0000)	−0.0009	(0.0067)
Japanese announcements						
Trade balance	−0.0053	(0.0038)	−0.0056	(0.0038)	−0.0052	(0.0065)
Current account	−0.0047	(0.0037)	−0.0049	(0.0037)	−0.0048	(0.0042)
Leading economic index	0.0016	(0.0045)	0.0014	(0.0043)	0.0000	(0.0036)
Consumer confidence index	0.0038	(0.0037)	0.0035	(0.0036)	0.0028	(0.0056)
TANKAN large manufacturing index	−0.0611***	(0.0176)	−0.0618***	(0.0175)	−0.0576***	(0.0077)
TANKAN non-manufacturing index	−0.0083	(0.0131)	−0.0085	(0.0131)	−0.0063	(0.0079)
Monetary base	−0.0047	(0.0040)	−0.0043	(0.0038)	−0.0044	(0.0053)
Capacity utilization	−0.0070	(0.0116)	−0.0065	(0.0112)	−0.0038	(0.0135)
GDP (quarterly)	−0.0239***	(0.0067)	−0.0235***	(0.0065)	−0.0231***	(0.0078)
GDP (annual)	−0.0635***	(0.0189)	−0.0647***	(0.0187)	−0.0639***	(0.0105)
Large retail sales	0.0013	(0.0039)	0.0013	(0.0038)	0.0009	(0.0043)
Construction orders	−0.0019	(0.0042)	−0.0019	(0.0040)	−0.0014	(0.0073)
Industrial production	−0.0191***	(0.0033)	−0.0186***	(0.0032)	−0.0178***	(0.0030)
Retail trade	−0.0108	(0.0066)	−0.0099	(0.0064)	−0.0077	(0.0055)
Consumer price index	−0.0087***	(0.0029)	−0.0084***	(0.0029)	−0.0091**	(0.0044)
Overall spending	−0.0077***	(0.0028)	−0.0069**	(0.0029)	−0.0078	(0.0117)
R-squared	11.19%		3.80%		10.48%	
Number of observations	33,466		611,237		33,466	

Statistics associated with the constant and the first two lags of the dependent variable are omitted for space considerations and are available upon request. Standard errors are given in parenthesis.
* The individual coefficient is significant at the 10% level.
** The individual coefficient is significant at the 5% level.
*** The individual coefficient is significant at the 1% level.

payroll employment and trade balance are the two most influential types of US macro surprises. This is consistent with existing studies of US macro surprises and the JPY/USD exchange rate. Furthermore, we find that a news surprise regarding GDP is the third most influential type of US macro news.[17]

[17] This is in contrast to Andersen et al. (2003) who detect no impact of US GDP surprises on the JPY/USD exchange rate. However, given that our sample starts after theirs ends, it is not surprising to find some variation in the set of influential US and Japanese macro news. See Faust et al. (2005) for a discussion of the time-dependence of macro news.

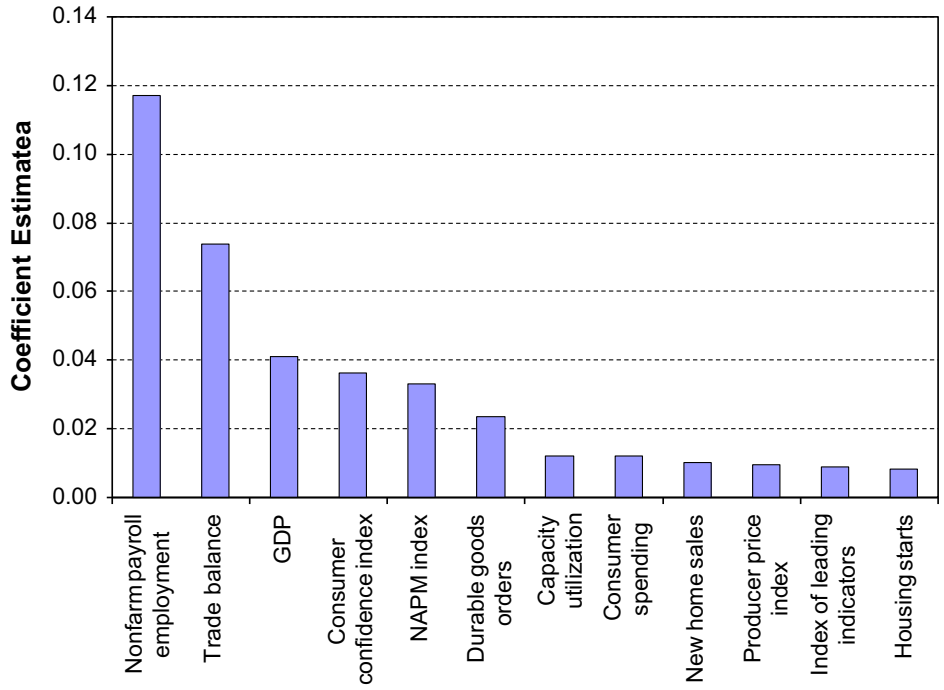

Fig. 2. Standardized US macro surprises. *Notes*: The figure displays the significant coefficient estimates of the standardized US macro surprises reported in the first column of Table 3.

Turning to the Japanese macro news estimates from our baseline model, Table 3 shows that six of the 16 Japanese macro news variables are significant and of the correct sign. The two most influential Japanese news surprises are news regarding Japanese GDP (annualized) and the TANKAN large manufacturing index. According to the magnitude of the estimated coefficients, these two types of Japanese news appear less influential than news surprises regarding the two most influential types of US news, but more influential than any other type of US news, including news regarding US GDP.[18]

Figs. 2 and 3 display the coefficient estimates from the significant news variables for the US and Japan, respectively.[19]

To get a sense of the relative influence of broad categories of US and Japanese news, we group our news variables into seven categories and investigate the relative magnitude of the effects: GDP, real activity (RA), consumption (CONS), investment (INV), net exports (NETEX), prices (P), forward looking (FL), and monetary news (M).[20] Fig. 4 shows the average news effect for each category. The average news effect is the simple average of the significant coefficient estimates within each news category. While US and Japanese GDP news, consumption news (CONS) and price news (PA) have very similar average impacts on the exchange rate, the exchange rate clearly responds respond asymmetrically

[18] Andersen et al. (2003) conjecture that their generally insignificant results regarding the influence of German news surprises on the intraday DEM/USD exchange rate may be attributable to the "uncertain", i.e. not pre-scheduled, release time of German macro announcements. By contrast, the exact timing of Japanese announcements is mostly predictable. Consequently, our significant results regarding the influence of Japanese news surprises lend some credibility to this conjecture.

[19] To ease the comparison of the effects of US and Japanese news surprises, the coefficient estimates associated with the Japanese news in Fig. 3 are multiplied by negative one.

[20] The groupings are as follows. GDP consists, obviously, of news regarding GDP for both the US and Japan. RA consists of nonfarm payroll, industrial production, capacity utilization, personal income, and consumer credit for the US, and large retail sales, industrial production and capacity utilization for Japan. CONS consists of consumer spending and new home sales for the US, and overall spending for Japan. INV consists of durable goods orders, factory orders, and business inventories for the US, and construction orders for Japan. NETEX consists of trade balance for the US, and trade balance, current account and retail trade for Japan. P consists of producer price index and consumer price index for the US, and consumer price index for Japan. FL consists of consumer confidence index, NAPM index, housing starts, and index of leading indicators for the US, and leading economic index, consumer confidence, TANKAN large manufacturing index, and TANKAN non-manufacturing index for Japan. M consists of target federal funds rate for the US, and monetary base for Japan.

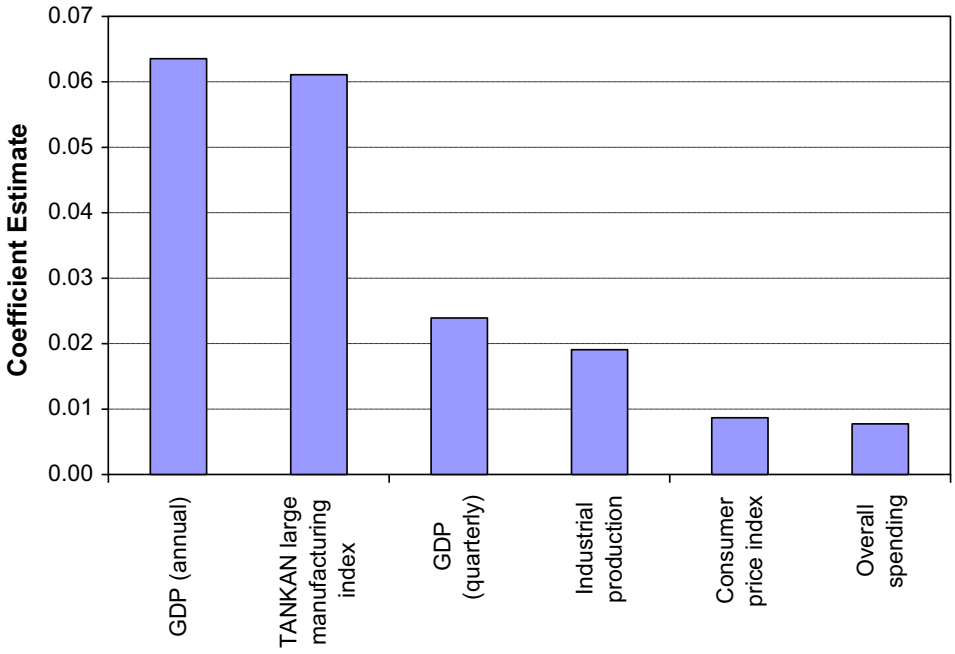

Fig. 3. Standardized Japanese macro surprises. *Notes*: (a) The figure displays the significant coefficient estimates of the standardized Japanese macro surprises reported in the first column of Table 3. (b) To ease the comparison of the effects of US and Japanese news surprises, the coefficient estimates associated with the Japanese news displayed in Fig. 2 are multiplied by negative one.

depending on country of origin in regards real activity news (RA), investment news (INV), net export news (NETEX), and forward looking news (FL).

Considering the limited ability of the Bank of Japan to endogenously adjust interest rates in response to news, it is interesting to notice that forward looking news matters more when emanating from Japan. Normally, forward looking news variables are particularly likely to elicit an endogenous policy response (since monetary policy is in itself forward looking), thereby partially off-setting the exchange rate response to such news. However, as our results suggest, when the monetary authority is restricted in the extent to which it can respond to news, the exchange rate response to forward looking news is more pronounced.

These results corroborate earlier findings in the literature regarding the importance of forward-looking variables. For example, Chaboud et al. (2004) find that US non-farm payroll employment, and Hashimoto and Ito (2010) find that the TANKAN large manufacturing index are among the most important news variables influencing exchange rate changes. More generally, our results largely confirm the findings of Hashimoto and Ito (2010) for Japan—they also find statistical significance for TANKAN, GDP, and industrial production, and insignificance of national CPI in their regressions.[21]

The second and third columns of Table 3 display the results of our methodology robustness checks. The second column pertains to the alternative model that includes all the available data of the sample (as opposed to the baseline model which utilizes only the 100-min windows around the announcements). The third column pertains to the WLS estimation procedure described in the previous section. Comparing the coefficient estimates across the three columns, it is evident that the results obtained using the three different methodologies are practically identical. In other words, our methodology is proven to be very robust.

In order to get a sense of the overall explanatory power of the Japanese news surprises relative to the US news surprises, we estimate Eq. (1) separately with only US news variables included and separately with only Japanese news variables included as explanatory variables. Table 4 presents the results. For the model including only the US variables, the same 12 news variables as before are significant and of the correct sign. For the model including only the Japanese variables, the same

[21] Hashimoto and Ito (2010) report that, unlike national CPI, CPI for the Tokyo region is significant.

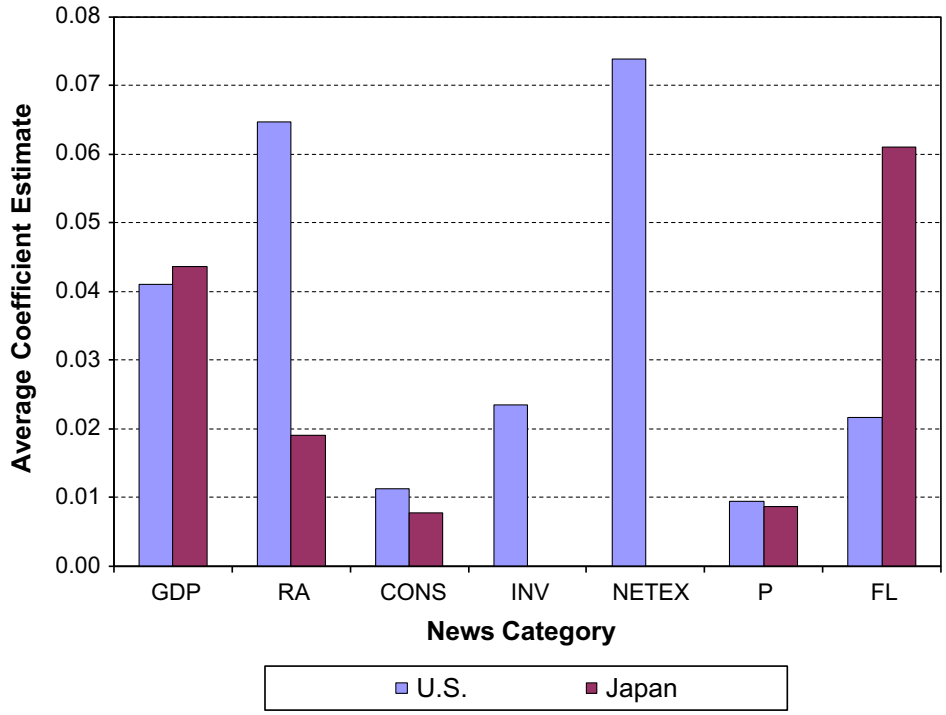

Fig. 4. Average effect of macro surprises by category. *Notes*: (a) The average news effect is defined as the simple average of the significant coefficient estimates within each news category. (b) Section 4 provides details on the news categories. (c) To ease the comparison of the effects of US and Japanese news surprises, the coefficient estimates associated with the Japanese news displayed in Fig. 3 are multiplied by negative one.

six news variables as before are significant and of the correct sign. In addition, the Japanese news variable Retail Trade is now marginally significant and of the correct sign.[22] More importantly, the R^2 of the model incorporating only US news variables is 11.05% while the R^2 of the model incorporating only Japanese news variables is practically the same at 11.97%.[23] This suggests that, overall, the Japanese macro news are as important as the US macro news.

This is an interesting finding. On the one hand, our results show that focusing on only US news when modeling the JPY/USD exchange rate literally misses half the story. On the other hand, our results also suggest that Japanese and US news are sufficiently uncorrelated that disregarding the former does not invalidate the estimated effects of the latter, thereby confirming the results and the credibility of studies focusing on only US news.

We also extend our analysis to address whether there is a different exchange rate response to macro news when interest rates are above the lower bound. We do so by dividing our sample into two parts: September 2000–March 2001—when the Bank of Japan raised the interbank interest rate above zero temporarily—and the remainder of the sample (January 1999–August 2000 and April 2001–December 2006) as the zero-interest rate period observations. The results of estimating our baseline model separately across the two samples are shown in Table 5. The last column of the table shows the results of the coefficient tests. These tests indicate that six macro variables are significantly different across the two samples, three of which are stronger when interest rates are above zero (US Industrial Production; US Personal Income; US New Home Sales) and three of which are stronger when interest rates are zero (US GDP; US Nonfarm Payroll Employment; JP GDP quarterly). These results thus do not show a clear pattern in regards to whether the exchange rate response to news are

[22] Since Japanese and US (New York) business hours are completely different such that when Japanese news surprises are occurring, no US surprises occur, and vice versa, it is reassuring that Tables 3 and 4 are almost identical in regards to which macro news matter for the JPY/USD rate.

[23] In order to make the R^2 comparison meaningful, the results displayed in Table 4 are based on time-series estimations that include all sample observations rather than the "windows" approach used for the baseline model estimations displayed in Table 3.

Table 4
US macro surprises only and Japanese macro surprises only regressions.

Sample	US Only 100-min Windows		Japanese Only 100-min Windows	
Estimation procedure	OLS with HACS.E.		OLS with HACS.E.	
	Coef.	S.E.	Coef.	S.E.
US announcements				
GDP	0.0411***	(0.0056)	–	–
Nonfarm payroll employment	0.1171***	(0.0207)	–	–
Industrial production	0.0066	(0.0052)	–	–
Capacity utilization	0.0122**	(0.0057)	–	–
Personal income	0.0035	(0.0034)	–	–
Consumer credit	−0.0029	(0.0018)	–	–
Consumer spending	0.0122***	(0.0041)	–	–
New home sales	0.0104**	(0.0053)	–	–
Durable goods orders	0.0235***	(0.0064)	–	–
Factory orders	0.0037	(0.0056)	–	–
Business inventories	−0.0046	(0.0039)	–	–
Trade balance	0.0739***	(0.0109)	–	–
Producer price index	0.0094**	(0.0046)	–	–
Consumer price index	0.0042	(0.0067)	–	–
Consumer confidence index	0.0363***	(0.0049)	–	–
NAPM index	0.0329***	(0.0050)	–	–
Housing starts	0.0083**	(0.0039)	–	–
Index of leading indicators	0.0090**	(0.0037)	–	–
Target federal funds rate	−0.0010***	(0.0001)	–	–
Japanese announcements				
Trade balance	–	–	−0.0052	(0.0038)
Current account	–	–	−0.0049	(0.0037)
Leading economic index	–	–	0.0016	(0.0045)
Consumer confidence index	–	–	0.0039	(0.0037)
TAN KAN large manufacturing index	–	–	−0.0611***	(0.0175)
TAN KAN non-manufacturing index	–	–	−0.0084	(0.0131)
Monetary base	–	–	−0.0046	(0.0041)
Capacity utilization	–	–	−0.0071	(0.0119)
GDP (quarterly)	–	–	−0.0243***	(0.0067)
GDP (annual)	–	–	−0.0630***	(0.0188)
Large retail sales	–	–	0.0013	(0.0040)
Construction orders	–	–	−0.0017	(0.0043)
Industrial production	–	–	−0.0189***	(0.0034)
Retail trade	–	–	−0.0111*	(0.0066)
Consumer price index	–	–	−0.0089***	(0.0029)
Overall spending	–	–	−0.0075***	(0.0028)
R-squared	11.05%		11.97%	
Number of observations	24,918		8548	

Statistics associated with the constant and the first two lags of the dependent variable are omitted for space considerations and are available upon request. Standard errors are given in parenthesis.
* The individual coefficient is significant at the 10% level.
** The individual coefficient is significant at the 5% level.
*** The individual coefficient is significant at the 1% level.

stronger or weaker when interest rates are at the zero bound. This seems unsurprising considering that, as mentioned earlier, even when interest rates cannot be lowered, further quantitative easing can still be undertaken. Therefore, the exchange rate response to macro news need not be asymmetric during the zero-interest rate period and, consequently, the exchange rate response to news when interest rates are zero need not be systematically different from when interest rates and above zero.[24]

[24] The number of macro surprises in the September 2000–March 2001 sample is limited, and for several news variables no surprises occurred during this period. Our results comparing the exchange rate response to macro news across the two samples, therefore, should be interpreted with caution.

Table 5
Separating zero interest rate policy (ZIRP) and non-ZIRP sample.

Sample	ZIRP		Non-ZIRP		Ho: ZIRP coefficient = non-ZIRP coefficient
Estimation procedure	100-min Windows OLS with HACS.E.				
	Coef.	S.E.	Coef.	S.E.	*t*-Statistic
US announcements					
GDP	0.0427***	(0.0058)	0.0104	(0.0095)	−2.907***
Nonfarm payroll employment	0.1221***	(0.0220)	0.0344***	(0.0064)	−3.834***
Industrial production	0.0043	(0.0054)	0.0349***	(0.0088)	2.954***
Capacity utilization	0.0140**	(0.0058)	–	–	–
Personal income	0.0016	(0.0036)	0.0212**	(0.0098)	1.880*
Consumer credit	−0.0030	(0.0019)	−0.0024	(0.0024)	0.188
Consumer spending	0.0121***	(0.0044)	0.0126	(0.0087)	0.053
New home sales	0.0097*	(0.0053)	0.0513***	(0.0144)	2.712***
Durable goods orders	0.0236***	(0.0066)	0.0222	(0.0212)	−0.063
Factory orders	0.0029	(0.0057)	0.0391	(0.0238)	1.479
Business inventories	−0.0056	(0.0041)	0.0153	(0.0164)	1.239
Trade balance	0.0739***	(0.0109)	–	–	–
Producer price index	0.0102**	(0.0048)	0.0014	(0.0141)	−0.590
Consumer price index	0.0051	(0.0076)	−0.0067	(0.0048)	−1.313
Consumer confidence index	0.0353***	(0.0055)	0.0442***	(0.0073)	0.979
NAPM index	0.0323***	(0.0052)	0.0440***	(0.0165)	0.674
Housing starts	0.0089**	(0.0039)	−0.0134	(0.0222)	−0.988
Index of leading indicators	0.0104**	(0.0042)	−0.0008	(0.0075)	−1.295
Target federal funds rate	−0.0009***	(0.0001)	–	–	–
Japanese announcements					
Trade balance	−0.0053	(0.0038)	–	–	–
Current account	−0.0047	(0.0037)	–	–	–
Leading economic index	0.0016	(0.0045)	–	–	–
Consumer confidence index	0.0038	(0.0037)	–	–	–
TANKAN large manufactory index	−0.0611***	(0.0176)	–	–	–
TANKAN non-manufactory index	−0.0083	(0.0131)	–	–	–
Monetary base	−0.0047	(0.0040)	–	–	–
Capacity utilization	−0.0070	(0.0116)	–	–	–
GDP (quarterly)	−0.0240***	(0.0068)	−0.0113***	(0.0008)	1.862*
GDP (annual)	−0.0634***	(0.0189)	–	–	–
Large retailers sales	0.0023	(0.0041)	−0.0114	(0.0079)	−1.546
Construction orders	−0.0019	(0.0042)	–	–	–
Industrial production	−0.0191***	(0.0033)	–	–	–
Retail trade	−0.0109	(0.0066)	–	–	–
Consumer price index	−0.0087***	(0.0029)	–	–	–
Overall spending	−0.0077***	(0.0028)	–	–	–
R-squared		11.29%			
Number of observations		33,466			

Non-ZIRP sample defined from September 1999 to March 2001. Statistics associated with the constant and the first two lags of the dependent variable are omitted for space considerations and are available upon request. Standard errors are given in parenthesis.
* The individual coefficient or the *t*-statistic is significant at the 10% level.
** The individual coefficient or the *t*-statistic is significant at the 5% level.
*** The individual coefficient or the *t*-statistic is significant at the 1% level.

4.2. Business cycle state dependence

We concentrate our investigation of business cycle asymmetries on whether the Japanese economy is in upturn or downturn. Table 6 shows the results of estimating the model described by Eq. (3) over the two different Japanese business cycles. For the Japan upturn sub-sample the table shows that

Table 6
Japanese business cycle effects – upturn versus downturn.

Sample Estimation Procedure	Japan upturn 100-min Windows OLS with HACS.E.		Japan downturn 100-min Windows OLS with HACS.E.		Ho: Japan upturn = Japan downturn
	Coef.	S.E.	Coef.	S.E.	*t*-Statistic
US announcements					
GDP	0.0467*	(0.0070)	0.0293***	(0.0077)	1.678
Nonfarm payroll employment	0.1108*	(0.0278)	0.1263***	(0.0283)	−0.391
Industrial production	0.0082	(0.0061)	0.0045	(0.0095)	0.328
Capacity utilization	0.0094	(0.0073)	0.0165*	(0.0088)	−0.620
Personal income	0.0059*	(0.0032)	−0.0056	(0.0099)	1.098
Consumer credit	−0.0042*	(0.0024)	−0.0015	(0.0028)	−0.714
Consumer spending	0.0146*	(0.0055)	0.0067	(0.0058)	0.995
New home sales	0.0123*	(0.0074)	0.0061	(0.0061)	0.640
Durable goods orders	0.0269*	(0.0081)	0.0152*	(0.0081)	1.025
Factory orders	0.0020	(0.0077)	0.0074	(0.0060)	−0.556
Business inventories	−0.0062	(0.0051)	−0.0034	(0.0064)	−0.338
Trade balance	0.0621*	(0.0074)	0.0893***	(0.0218)	−1.180
Producer price index	0.0128**	(0.0054)	−0.0026	(0.0085)	1.522
Consumer price index	0.0008	(0.0079)	0.0110	(0.0113)	−0.740
Consumer confidence index	0.0404*	(0.0066)	0.0295***	(0.0078)	1.062
NAPM index	0.0359*	(0.0069)	0.0265***	(0.0059)	1.039
Housing starts	0.011	(0.0051)	0.0026	(0.0066)	1.064
Index of leading indicators	0.0061	(0.0052)	0.0132***	(0.0050)	−0.980
Target federal funds rate	−0.0008*	(0.0001)	–	–	–
Japanese announcements					
Trade balance	−0.0034	(0.0032)	−0.0162	(0.0110)	1.117
Current account	−0.0038	(0.0046)	−0.0075	(0.0059)	0.496
Leading economic index	−0.0032	(0.0023)	0.0072	(0.0053)	−1.797
Consumer confidence index	0.0015	(0.0045)	0.0069	(0.0055)	−0.752
TANKAN large manufactory index	−0.0981*	(0.0304)	−0.0501***	(0.0184)	−1.354
TANKAN non-manufactory index	−0.0338**	(0.0132)	0.0144	(0.0230)	−1.819
Monetary base	−0.0050	(0.0044)	−0.0027	(0.0094)	−0.222
Capacity utilization	−0.0068	(0.0048)	−0.0074	(0.0151)	0.037
GDP (quarterly)	−0.0211*	(0.0061)	−0.0325**	(0.0143)	0.739
GDP (annual)	−0.0426**	(0.0214)	−0.0731***	(0.0270)	0.886
Large retail sales	0.0034	(0.0060)	−0.0002	(0.0043)	0.488
Construction orders	−0.0102*	(0.0020)	0.0083**	(0.0039)	0.169**
Industrial production	−0.0180*	(0.0037)	−0.0217***	(0.0078)	0.421
Retail trade	−0.0163**	(0.0081)	0.0063	(0.0085)	−1.926*
Consumer price index	−0.0108*	(0.0035)	−0.0022	(0.0035)	−1.745
Overall spending	−0.0077*	(0.0028)	–	–	–
R-squared	11.29%		11.49%		
Number of observations	21,526		11,940		

Statistics associated with the constant and the first two lags of the dependent variable are omitted for space considerations and are available upon request. Standard errors are given in parenthesis.
* The individual coefficient or the *t*-statistic is significant at the 10% level.
** The individual coefficient or the *t*-statistic is significant at the 5% level.
*** The individual coefficient or the *t*-statistic is significant at the 1% level.

eleven of the US news variables and nine of the Japanese news variables are significant and of the correct sign. Again, the most influential news variables are US non-farm payroll employment, US trade balance, Japanese GDP, and Japanese TANKAN large manufacturing index. The Japan downturn subsample results show that only eight of the US news variables and only four of the Japanese news variables are significant and of the correct sign, i.e. it appears the exchange rate is responsive to a smaller set of news when the Japanese economy is in a downturn.

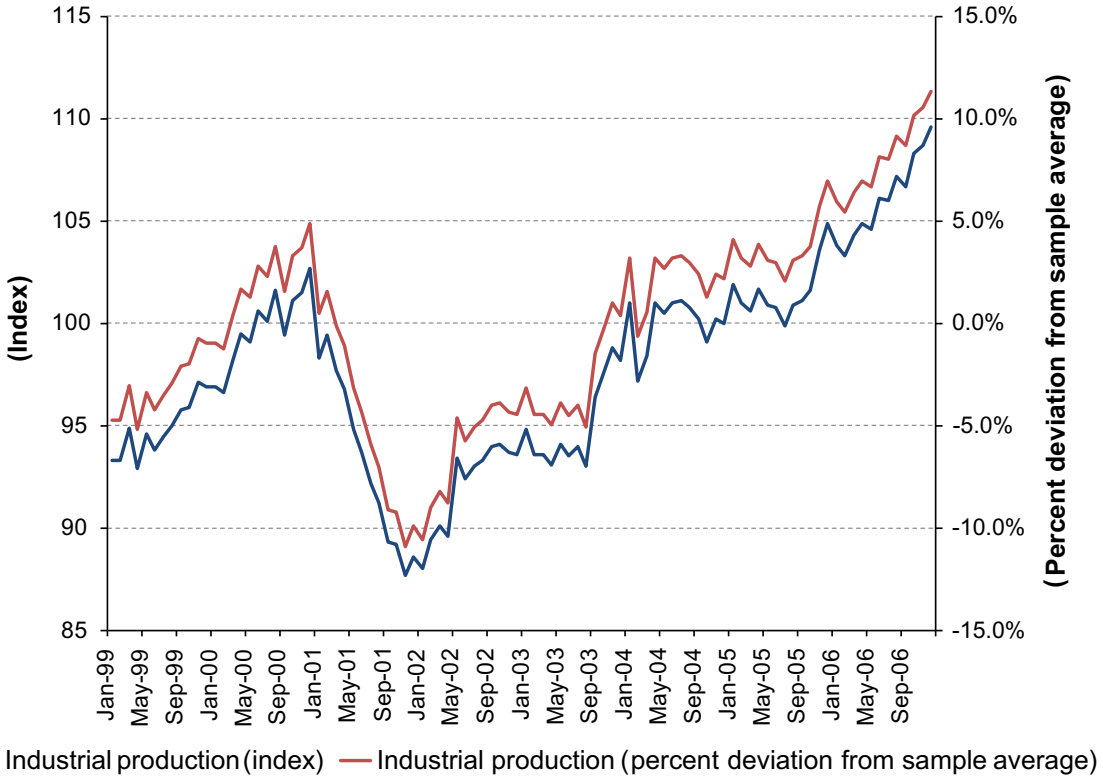

Fig. 5. Industrial production in Japan.

Formal tests (*t*-tests) of symmetry cannot reject that the influence of any given US news variable is the same across the two Japanese business cycles. By contrast, of the nine Japanese news variables that are significant in at least one of the two business cycles, two of those (Construction Orders and Retail Trade) are associated with significantly different coefficient estimates across the two Japanese business cycles, thereby further supporting that asymmetries in the exchange rate response to Japanese news across different Japanese business cycles are present in the data.[25]

The results of estimating Eq. (4), where the business cycle is measured by the continuous variable industrial production, are shown in Table 7. The results suggest that when the Japanese industrial production is above the sample average, the exchange rate response to both US and Japanese macro surprises is consistently stronger. The first column of Table 7 reports the linear term in the FX response, i.e. the average effect of standardized news announcements on exchange rates. The column shows that when the Japanese industrial production is relatively close to its sample average, eleven US and four Japanese news variables are significant and of the correct sign.[26] However, the most interesting result from Table 7 is that the estimated coefficients for the interactive terms suggest that five of the eleven US news variables and all three of the Japanese news variables which are significant on average are also larger in magnitude when the Japanese industrial production is above its sample average. In other words, asymmetries in the exchange rate response to both US and Japanese news arise across different states of the Japanese business cycles.

4.3. Asymmetric responses to positive and negative surprises

As noted earlier, other studies generally find some evidence of asymmetric responses to US news surprises. In particular, negative surprises about the US economy tend to have a greater impact than positive surprises. In this section we analyze whether the same result holds true for Japanese news

[25] The *t*-statistic for the null of symmetry across positive and negative S_q news is given by $\left(\gamma^A_{q,k} - \gamma^D_{q,k}\right)/sqrt\left[\left(\text{s.e.}\gamma^A_{q,k}\right)^2 + \left(\text{s.e.}\gamma^D_{q,k}\right)^2\right]$. For additional details see, for example, Anderson et al. (2010).

[26] A plot of the IP_t and $\ln(IP_t/\overline{IP})$ series is shown in Fig. 5.

Table 7
Response to macro surprise as a function of Japanese industrial production.

Sample	Linear term in FX response		Interactive term in FX response	
Estimation procedure	100-min Windows OLS with HACS.E.			
	Coef.	S.E.	Coef.	S.E.
US announcements				
GDP	0.0440 ***	(0.0062)	0.2810 ***	(0.0950)
Nonfarm payroll employment	0.1238 ***	(0.0147)	1.1656 ***	(0.3133)
Industrial production	0.0065	(0.0052)	0.0423	(0.0887)
Capacity utilization	0.0121 **	(0.0055)	−0.0266	(0.0793)
Personal income	0.0023	(0.0033)	0.0874	(0.0920)
Consumer credit	−0.0031 *	(0.0017)	−0.0173	(0.0288)
Consumer spending	0.0151 ***	(0.0040)	0.1417 *	(0.0851)
New home sales	0.0084	(0.0056)	0.1296	(0.1557)
Durable goods orders	0.0238 ***	(0.0064)	0.0389	(0.1115)
Factory orders	0.0034	(0.0055)	0.0372	(0.0742)
Business inventories	−0.0044	(0.0040)	0.0185	(0.0575)
Trade balance	0.0644 ***	(0.0094)	0.3904 ***	(0.1510)
Producer price index	0.0071	(0.0046)	0.1327*	(0.0778)
Consumer price index	0.0027	(0.0060)	0.1878*	(0.1089)
Consumer confidence index	0.0383 ***	(0.0054)	0.1326	(0.0982)
NAPM index	0.0354 ***	(0.0056)	0.1988 **	(0.0967)
Housing starts	0.0074 **	(0.0037)	0.0995	(0.0823)
Index of leading indicators	0.0087 **	(0.0036)	−0.0607	(0.0527)
Target federal funds rate	−0.0009 ***	(0.0001)	–	–
Japanese announcements				
Trade balance	−0.0149 *	(0.0086)	0.1934	(0.1474)
Current account	−0.0048	(0.0036)	−0.0588	(0.0493)
Leading economic index	0.0009	(0.0024)	−0.0708 **	(0.0328)
Consumer confidence index	0.0053	(0.0059)	−0.0544	(0.1228)
TANKAN large manufactory index	−0.0754 ***	(0.0181)	−0.8003 ***	(0.2615)
TANKAN non-manufactory index	−0.0089	(0.0129)	0.0176	(0.2805)
Monetary base	−0.0027	(0.0037)	−0.1129	(0.0913)
Capacity utilization	−0.0043	(0.0092)	0.0474	(0.1429)
GDP (quarterly)	−0.0351	(0.0232)	−0.2552	(0.4099)
GDP (annual)	−0.0289	(0.0330)	−0.5513	(0.8209)
Large retail sales	−0.0021	(0.0055)	−0.1100	(0.0705)
Construction orders	0.0008	(0.0058)	−0.0859	(0.0906)
Industrial production	−0.0190 ***	(0.0028)	−0.1939***	(0.0448)
Retail trade	−0.0047	(0.0057)	−0.2398 **	(0.1011)
Consumer price index	−0.0075 ***	(0.0026)	−0.1092 ***	(0.0411)
Overall spending	0.0266	(0.0592)	−0.4131	(0.6866)
R-squared		11.81%		
Number of observations		33,466		

Statistics associated with the constant and the first two lags of the dependent variable are omitted for space considerations and are available upon request. Standard errors are given in parenthesis.
* The individual coefficient or the *t*-statistic is significant at the 10% level.
** The individual coefficient or the *t*-statistic is significant at the 5% level.
*** The individual coefficient or the *t*-statistic is significant at the 1% level.

surprises during the zero interest rate period. In order to do so, we estimate Eq. (5), which, as previously noted, is an extension of our regression model that allows positive surprises to have a different coefficient estimate than negative surprises. We expect a greater impact when Japanese news is "bad" given the limited scope for conducting counter-cyclical actions to offset the news effect on the economy (and the exchange rate) during the zero-interest rate period. Table 8 presents the results.

Contrary to our priors, the asymmetries across positive and negative Japanese news surprises appear very modest and unsystematic. We find an equal number of significant coefficients of the expected sign associated with negative and positive Japanese surprises (7 of each). The average absolute

Table 8
Positive and negative macro surprises.

Sample Estimation procedure	Positive surprises 100-min Windows OLS with HAC S.E.		Negative surprises		Ho: Positive surprises = negative surprises
	Coef.	S.E.	Coef.	S.E.	*t*-Statistic
US announcements					
GDP	0.0219***	(0.0049)	0.0612***	(0.0085)	−4.006 ***
Nonfarm payroll employment	0.1111***	(0.0209)	0.1193***	(0.0271)	−0.242
Industrial production	0.0122	(0.0076)	0.0017	(0.0077)	0.917
Capacity utilization	0.0093	(0.0086)	0.0154*	(0.0083)	−0.482
Personal income	0.0045*	(0.0025)	0.0008	(0.0107)	0.339
Consumer credit	−0.0007	(0.0018)	−0.0055*	(0.0031)	1.326
Consumer spending	0.0081	(0.0052)	0.0176**	(0.0073)	−1.002
New home sales	0.0080	(0.0056)	0.0147	(0.0111)	−0.538
Durable goods orders	0.0153*	(0.0090)	0.0337***	(0.0069)	−1.611
Factory orders	0.0129***	(0.0044)	−0.0063	(0.0101)	1.739*
Business inventories	−0.0105*	(0.0054)	0.0022	(0.0057)	−1.598
Trade balance	0.0633***	(0.0103)	0.0794***	(0.0153)	−0.874
Producer price index	0.0049	(0.0049)	0.0154*	(0.0081)	−1.102
Consumer price index	−0.0111	(0.0098)	0.0144*	(0.0078)	−1.999 **
Consumer confidence index	0.0377***	(0.0071)	0.0345***	(0.0068)	0.321
NAPM index	0.0326***	(0.0076)	0.0330***	(0.0073)	−0.035
Housing starts	0.0026	(0.0048)	0.0196***	(0.0054)	−2.327 **
Index of leading indicators	0.0083**	(0.0039)	0.0098	(0.0073)	−0.181
Target federal funds rate	−0.0009***	(0.0001)	−0.0009***	(0.0001)	–
Japanese announcements					
Trade balance	−0.0036	(0.0076)	−0.0056	(0.0042)	0.226
Current account	−0.0078	(0.0049)	0.0000	(0.0069)	−0.893
Leading economic index	0.0055	(0.0049)	−0.0039	(0.0031)	1.598
Consumer confidence index	0.0051	(0.0061)	0.0030	(0.0045)	0.275
TANKAN large manufactory index	−0.0591*	(0.0318)	−0.0694***	(0.0231)	0.235
TANKAN non-manufactory index	−0.0058	(0.0295)	−0.0117	(0.0157)	0.149
Monetary base	−0.0199***	(0.0074)	−0.0020	(0.0044)	−2.093**
Capacity utilization	−0.0196***	(0.0058)	0.0082	(0.0181)	−1.462
GDP (quarterly)	−0.0219***	(0.0059)	−0.0317*	(0.0180)	0.517
GDP (annual)	−0.0465**	(0.0182)	−0.0773***	(0.0283)	0.916
Large retailers sales	−0.0049	(0.0043)	0.0071	(0.0053)	−1.716 *
Construction orders	−0.0032	(0.0047)	−0.0014	(0.0054)	−0.260
Industrial production	−0.0182**	(0.0074)	−0.0195***	(0.0037)	0.164
Retail trade	0.0012	(0.0046)	−0.0398***	(0.0135)	2.855 ***
Consumer price index	−0.0062	(0.0038)	−0.0108**	(0.0046)	0.767
Overall spending	−0.0735***	(0.0197)	−0.0071**	(0.0028)	−3.346 ***
R-squared		11.40%			
Number of observations		33,466			

Both sets of coefficients are based on the same regression. Standard errors are given in parenthesis.
* The individual coefficient or the *t*-statistic is significant at the 10% level.
** The individual coefficient or the *t*-statistic is significant at the 5% level.
*** The individual coefficient or the *t*-statistic is significant at the 1% level.

economic impacts of negative and positive Japanese surprises are practically identical (0.0365 for negative Japanese surprises versus 0.0370 for positive ones). Three Japanese news variables (Monetary Base, Retail Trade, and Overall Spending) are associated with coefficient estimates where formal tests (*t*-tests) reject the null of symmetry across the positive versus negative news surprises.[27] However,

[27] Although the *t*-test also rejects the null of symmetry across the positive versus negative news surprises regarding Large Retailers Sales, note that individual positive and negative surprises do not have an impact on the exchange rate.

only in the case of Retail Trade news is the effect (in absolute terms) of negative news larger than that of positive news. Overall, these results do not support the idea that the exchange rate responds asymmetrically across "good" and "bad" Japanese news. One possible explanation for finding largely symmetric exchange rate responses across positive and negative Japanese macro news is, as noted earlier, that monetary policy can respond to negative unexpected macro news via further quantitative easing when interest rates are zero.

Consistent with other studies, however, we do find some evidence that negative surprises about the US economy tend to have larger effects than positive US surprises. There are slightly more significant coefficients of the expected sign associated with negative US surprises than with positive surprises (11 versus 9). The average absolute effect of a negative US surprise is 0.0403 compared to the average absolute effect of a positive surprise is 0.0342. Three US news variables (GDP, CPI, and Housing Starts) are associated with coefficient estimates where *t*-tests reject the null of smaller effect of positive relative to negative news surprises (in absolute terms).

5. Conclusion

Our investigation considers possible asymmetric responses of the intraday exchange rate to macroeconomic news announcements. We address this issue by jointly investigating the intraday JPY/USD exchange rate responses to US and Japanese macroeconomic news surprises over the 1 January 1999–31 October 2006 time-period. Asymmetric exchange rate responses to news seem particularly likely to appear in economic and institutional settings such as the zero interest rate environment of Japan. When lower interest rates (below zero) are not feasible, endogenous policy reactions to macroeconomic shocks are constrained. Given the close linkages between interest rates and exchange rates, these constraints, in turn, are likely to make the exchange rate response to news asymmetric.

We discuss several asymmetries that may occur during our sample period. First, we consider whether US and Japanese macro news influence the exchange rate differently. Our results show that for several types of news the exchange rate responds asymmetrically depending on country origin of news. Consistent with our priors, we find that forward-looking news is especially important when emanating from the country where the monetary authority is restricted in the extent to which it can respond to shocks. We also compare the overall influence of Japanese news to the overall influence of US news, and we show that Japanese macro news are as important as US macro news in influencing the JPY/USD exchange rate.

Second, we consider whether the exchange rate effects of news surprises vary with different stages of the business cycle. Our results provide some evidence of asymmetries in the exchange rate response to Japanese news across different Japanese business cycle stages, consistent with the idea that an institutional setting that limits the possibility of endogenous policy responses to news makes asymmetries more likely.

Third, we investigate whether "good" and "bad" news exert similar intraday effects (in absolute terms) on the exchange rate. We find no clear evidence of asymmetric effects across positive and negative Japanese news surprises. By contrast, we find some evidence of asymmetric effects across positive and negative US news surprises. This finding is not in itself surprising as it conforms with the existing literature on US news and exchange rates. However, in light of the previous finding – that positive–negative asymmetries are not present in the Japanese news even though such asymmetries would seem particularly likely during the zero interest rate period under study – this could indicate that asymmetries in regards to positive versus negative news particularly pertains to US news. Additional research investigating exchange rate responses to both positive and negative US and non-US news in other currency markets is warranted in order to address whether this is generally the case.

Overall our results illustrate the necessity of taking into account the country of origin of news, business cycle asymmetries, and the direction of news, in order to more accurately assess the intraday exchange rate responses to macroeconomic news surprises. This seems particularly important in contexts where institutional settings limit the endogenous policy response to news.

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