Currency Jumps, Cojumps and the Role of Macro News

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ABSTRACT

This study investigates the impact of macro news on currency jumps and cojumps. The analysis uses intraday data, sampled at 5-minute frequency, for four currencies for the period 2005-2010. Results indicate that currency jumps are a good proxy for news arrival. We find 9-15% of currency jumps can be directly linked to U.S. announcements. Notably, news can explain 22-56% of the 5-minute jump returns, and there is evidence that better-than-expected news about the U.S. economy has a negative impact on currency jumps. Cojump statistics suggest close dependencies among European currencies, especially between the euro and the Swiss franc. We also provide evidence on the uncertainty resolution to news.

JEL Classification: G13; G14

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I. Introduction

This paper identifies severe and discontinuous movements (or "jumps") in exchange rates and examines their relationship with various macroeconomic news announcements across Europe, Japan, and the U.S. The study is important for two reasons. First, the response of prices to new information provides insights into price determination, price discovery, and the microstructure behavior of markets. In this regard researchers often characterize the price series as some continuous-time diffusive process. More recently, however, this characterization has come under heightened scrutiny as empirical observations point to the pervasiveness of severe movements in prices that seemingly violate Gaussian distribution. Such empirical evidence in the currency market would carry important implications for hedging, portfolio allocation and the pricing of derivative securities.

Second, the justification for studying macro news effects is that such events provide a unique window to examine how asset prices are connected to the broader economy. In general, empirical evidence supports the strong role of economic fundamentals in influencing bond and equity prices; however, fundamentals are found to carry far less explanatory power in explaining exchange rate movements. In citing previous research in the currency literature, Evan and Lyons (2008) term this phenomenon as the "news puzzle", and argue that directional effects are harder to detect in exchange rates since they are likely to be swamped by other factors. Adding to this literature is the long-held view that the model of exchange rate determination that performs best is one in which currency movements are considered random (see, Meese and Rogoff (1983); Adler and Lehmann (1983); Cumby and Obstfeld (1984); Froot and Thaler (1990); Alexander and Thomas (1987); Gandolfo et al., (1990); and Saratis and Stewart (1995). The failure of

fundamental models to explain the behavior of exchange rates led Frankel and Rose (1994) to conclude that: "The case for macroeconomic determinants of exchange rates is in a sorry state ... results indicate that no model based on such standard fundamentals like money supplies, real income, interest rates, inflation rates, or current account balances will ever succeed in explaining or predicting a high percentage of the variation in the exchange rate, at least at short-or-medium-term frequencies".

Given this backdrop the central questions we seek to answer in our study are as follows: if economic fundamentals are not very helpful in explaining currency price movements, can they at least be used to explain dramatic price fluctuations? To what extent do currency jumps and cojumps correspond with macro news and what is the direction of this relationship? Are some types of macro news more influential than others? Finally, what is the speed of market response and jump resolution to news releases?[1] These questions are examined using intraday U.S. dollar exchange rates for the British pound, euro, Japanese yen and the Swiss franc for the period 2005 to 2010. In the first step, the study applies the jump detection technique recently proposed by Andersen et al. (2010) to extract jumps in the exchange rates and simultaneous jumps across currencies (also known as "cojumps"). Second, once the precise timing of intraday currency jumps is identified, cross-tabulation and regression analyses are employed to examine the extent to which these jumps and cojumps can be related to a comprehensive set of U.S. and foreign macro news surprises. Finally, the paper examines the speed of currency market response and

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[1] Although there may be other factors, such as currency interventions, that may also impact exchange rates our focus on pre-scheduled macro news releases stems from a couple of reasons. First, studies find that macro announcements may be responsible for most of the observed time-of-day and day-of-the-week volatility patterns in forex markets (see for example, Ederington and Lee (1993), p. 1161). Second, to maintain empirical tractability, the reliance on scheduled news announcements as opposed to random news arrival provides a natural and controlled experiment to be able to systematically relate jumps with macro news.

resolution to news releases. The persistence in the price response function would be construed as evidence against the efficiency of currency markets.

The remainder of the paper is as follows. Section 2 surveys the relevant literature and further distinguishes the current study. Section 3 introduces the jump identification methodology. The data used in the study is described in Section 4. The empirical findings are discussed in Section 5. Section 6 concludes.

II. Literature Review

Several studies examine jump diffusion processes in asset prices. Anderson and Bollerslev (1998), Andersen et al. (2001a), Andersen et al. (2001b) and Barndorff-Nielsen and Shephard (2002) provide a framework for the identification of jumps based on examining spikes in realized volatility. Barndorff-Nielsen and Shephard (2004, 2006) extend jump detection by incorporating elements from realized bi-power variation. More recently, Andersen et al. (2010) propose a technique that is useful in identifying the precise timing of intraday jumps.

In analyzing the role of monetary and macro news on currency markets most of the earlier studies rely on low-frequency monthly or daily data. For instance, Hardouvelis (1988) use daily data to document the importance of trade deficit, inflation, and business cycle news. In a related paper, Klein et al. (1991) provide contingent support on the influence of news about trade balance on currencies. In summarizing the literature, Evans and Lyon (2008) note that even the most comprehensive study of news effects accounts for less than 10% of the total price variation in exchange rates.

More recent research employs high frequency data to examine intraday adjustment of exchange rates. Andersen et al. (2003) use 5-minute interval data for the period 1992-1998 to study the impact of German and U.S. announcement surprises on the conditional means and

volatilities of currencies. They document that although exchange rates react quickly to macro news surprises, the response of conditional variance is found to be relatively slow. They characterize the nature of the price response to be asymmetric where adverse news is found to have a larger impact. Lahaye et al. (2011) identify jumps and cojumps for various types of assets including exchange rates and relate them to macro news. Using data for the period 1987 to 2004 they find that the likelihood that news releases causes a jump in exchange rate is between 1% and 2%, compared to bonds and stocks which are in the range of 3% to 4%. In addition, the proportion of currency jumps that are associated with a particular type of news is only about 3% to 4%. The authors attribute the weak power of fundamentals in explaining currency jumps partly to the fact that they consider only U.S. macroeconomic news and ignore the impact that domestic (or local) news may have on currency markets. In summary, while high-frequency studies is able to better capture the immediate price response of news, macroeconomic news appears to account for a very small portion of the variation in currency values.

We distinguish our investigation from prior work in the following ways. First, we provide a more complete articulation of jumps and cojumps in currency markets by using U.S. news announcements along with macro news from Germany, Japan, the U.K., European Union (EU), and Switzerland. Thus we are able to establish the relative importance of U.S. and non-U.S. news in exchange rate dynamics. Second, we consider a more recent time period – January 2005 through December 2010, a period that witnessed considerable volatility in financial markets. Third, we provide a test of the speed of news absorption by comparing the immediate price response on news days with a time-matched benchmark sample of days without news and jumps.

III. Jump Identification Methodology

The evolution of asset prices in jump-diffusion models is represented as a sum of a continuous sample path process and occasional discontinuous jumps with the following stochastic differential equation form:

$$dp_t = \mu_t dt + \sigma(t)dw_t + \kappa_t dq_t, \quad t \geq 0, \tag{1}$$

where p_t denotes the continuous-time log-price process, the instantaneous drift process μ_t is continuous and locally bounded, the instantaneous volatility process σ_t is càdlàg, w_t is a standard Brownian motion independent of the drift, and q_t refers to a normalized counting process such that $dq_t = 1$ indicates a jump at time t, and $dq_t = 0$ otherwise, with the κ_t process describing the logarithmic size of the jump if a jump actually occurs at time t.

The continuous-time expression in equation (2) is convenient for theoretical pricing arguments. However, since empirical studies rely on discretely sampled prices, the implied discrete-time returns are:

$$r_t = p_t - p_{t-1}, \quad t = 1,2,\dots \tag{2}$$

where the unit time interval is usually referred to as a "day." With $M + 1$ observations per day of high-frequency data, the continuously compounded M intra-daily returns for day t are similarly denoted by,

$$r_{t,j} = p_{t,j} - p_{t,j-1}, \quad t = 1,2,\dots,T, \tag{3}$$

where, $p_{t,j}$ is the jth intra-day log-price for day t and T is the total number of days in the sample.

Following Andersen and Bollerslev (1998) and Barndroff-Nielsen and Shephard (2002), realized volatility (RV) for day t is given by

$$RV_t = \sum_{j=1}^{M} r_{t,j}^2, \quad t = 1,\dots,T \tag{4}$$

From the theory of quadratic variation, RV_t provides a consistent estimator of the daily increment to the quadratic variation for the underlying log-price process in equation (2). That is, for $M \to \infty$,

$$RV_t \to_p \int_{t-1}^{t} \sigma_s^2 ds + \sum_{s=q_{t-1}}^{q_t} \kappa_s^2, \quad t = 1, \dots, T. \tag{5}$$

Note that the realized volatility measure includes the contributions of both integrated volatility (the first term) and total variation stemming from the squared jumps.

On the other hand, the bi-power variation (BV) introduced by Barndorff-Nielsen and Shephard (2004) is given by

$$BV_t \equiv \mu_1^{-2} \sum_{j=2}^{M} |r_{t,j}||r_{t,j-1}|, \quad t = 1, \dots, T, \tag{6}$$

where μ_1 is the mean of the absolute value of the standard normally distributed random variable, $\mu_1 = \sqrt{2/\pi}$. It has been shown that, even in the presence of jumps, for $M \to \infty$,

$$BV_t \to_p \int_{t-1}^{t} \sigma_s^2 ds, \quad t = 1, \dots, T. \tag{7}$$

Combining equations (6) and (8), for $M \to \infty$,

$$RV_t - BV_t \to \sum_{s=q_{t-1}}^{q_t} \kappa_s^2, \quad t = 1, \dots, T. \tag{8}$$

The difference between RV_t and BV_t would then provide a consistent estimate of the contribution of the jump component to the total variation.

Following Huang and Tauchen (2005), we define the jump ratio statistic as

$$RJ_t = \frac{RV_t - BV_t}{RV_t}, \tag{9}$$

which converges to a standard normal distribution when scaled by its asymptotic variance. That is,

$$ZJ_t = \frac{RJ_t}{\sqrt{\left[\left(\frac{\pi}{2}\right)^2 + \pi - 5\right]\frac{1}{M}max\left(1, \frac{TP_t}{BV_t^2}\right)}} \xrightarrow{d} N(0,1), \tag{10}$$

where TP_t is the Tri-Power Quarticity, shown to be robust to jumps by Barndorff-Nielsen and Shephard (2004), that is defined as:

$$TP_t \equiv M\mu_{\frac{4}{3}}^{-3}\frac{M}{M-2}\sum_{j=3}^{M}\left|r_{t,j}\right|^{\frac{4}{3}}\left|r_{t,j-1}\right|^{\frac{4}{3}}\left|r_{t,j-2}\right|^{\frac{4}{3}}, \quad t=1,\dots,T, \qquad (11)$$

and $\mu_{4/3} = 2^{\frac{2}{3}}\Gamma(\frac{7}{6})/\Gamma(\frac{1}{2})$, with $\Gamma(\cdot)$ denoting the Gamma function. Therefore, with a significant level of α, day t is a jump day if $ZJ_t > \Phi_\alpha^{-1}$ with Φ denoting the cumulative distribution function of standard normal distribution.[2] Whereas equation (11) provides a tractable means for determining days with jumps it does not aid in the identification of the individual jumps themselves. This study uses the Andersen et al. (2010) algorithm for identifying intraday jumps and the exact timing and size of the jumps.

IV. Data Description

The study employs intraday data for the dollar exchange rates for the British pound (UKP), euro (EUR), Japanese yen (JPY) and Swiss franc (SF), and macroeconomic news announcements for the U.S., U.K., Germany, EU, Japan, and Switzerland. The sample period spans January 2005 through December 2010.

The exchange rate data relate to the intraday prices established in currency futures contracts traded on the *Chicago Mercantile Exchange* (CME), which offers both open outcry (pit) and electronic (Globex) trading. Open outcry trading occurs Monday through Friday from 8:20 am – 3:00 pm (U.S. Eastern Standard Time). Trading is also offered simultaneously on the Globex electronic trading platform Sunday through Friday, from 6:00 pm to 5:15 pm next day

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[2] However, based on the evidence provided by Huang and Tauchen (2005, equation 7, p. 463), we choose the (non-logarithmic) relative jump measure test statistic to measure the significance of the jump component. The relative jump measure statistic is equivalent to the negative of the ratio statistic proposed by Barndorff-Nielsen and Shepard (2006) with the additional maximum adjustment. Huang and Tauchen (2005) and Tauchen and Zhou (2011) evaluate several test statistics, including the logarithmic test statistic, and show that the relative jump statistic has one of the best overall size and power properties and is robust in the presence of microstructure noise.

(U.S. EST). The raw tick-by-tick data specifies the time, to the nearest second, and the rate pertaining to each transaction. We construct continuous exchange rate series from the front month contract, rolling over to the next contract when the daily transactions of the first back-month contract exceed the daily transactions of the current front month contract. This procedure avoids stale prices from the front-month contract that typically occur in the four weeks prior to expiration. The CME data are obtained from TickData Inc.

Table 1 reports summary statistics for the raw returns series for the four currencies sampled at daily (Panel A) and 5-minute (Panel B) frequency. Examining Panel A, with the exception of JPY, all currencies yielded negative daily returns, with standard deviations ranging from 0.63% to 0.68%. Furthermore, each currency exhibits negative skewness and relatively high kurtosis, leading to the rejection of the null hypothesis of normally distributed daily returns. Panel B provides similar evidence using returns measured at 5-minute frequency. The 5-minute sampling frequency results in approximately 386000, 412000, 405000 and 365000 observations for the UKP, EUR, JPY and SF, respectively. The mean of the 5-minute return series is close to zero for all currencies. Only the mean of the yen return series is positive. The standard deviation for all currencies is close to 0.04%, and displays excess kurtosis ranging from 16 for EUR to 47 for JPY.

Scheduled releases of announcements offer a controlled setting to study the impact of public information or news arrival on asset prices. This study obtains data on foreign and U.S. macro news releases from *Bloomberg*. The announcements are released by various government agencies on a pre-arranged schedule and disseminated immediately on newswires and other data providers. For each announcement, we collect both the realized value and the median consensus forecast.

In order to compare the estimated news impact across news variables that have different units of measurement, we follow prior research in deploying a measure of standardized news surprises (see Balduzzi, Elton, and Green, 2001; Simpson, Ramchander, and Chaudhry, 2005). Specifically, the unanticipated- or surprise component of an announcement that is given by the difference between the actual value and the consensus forecast is normalized by its standard deviation. Let $A_{i,t}$ denote the realized value of an announcement of type i at time t, and $E_{i,t}$ denote the consensus forecast. The standardized surprise of the announcement is given by

$$SA_{i,t} = \frac{A_{i,t} - E_{i,t}}{\sigma_i}, \tag{12}$$

where σ_i is the sample standard deviation of the surprise component of the type i announcement, $A_{i,t} - E_{i,t}$. As σ_i is constant for each announcement, the standardization procedure does not affect the statistical significance of the estimated response coefficients and fit of the regression model.

We consider 60 different types of macro announcements which are divided into fourteen categories based on the time stamp (all of them are measured in U.S. EST) of each news release. Table 2 lists the various macroeconomic announcements as well as their announcement time, origin, number of observations, and the means and standard deviations of the surprises. The U.S. accounts for 22 announcements, followed by Germany with 11, UK with 11, Japan with 8, Switzerland with 5 and the EU region with 3. The news announcements span a variety of real economic activity variables including labor (e.g., nonfarm payroll, unemployment rate), housing (e.g., housing starts, new home sales), consumption (e.g., retail sales, personal income), production (e.g., ISM manufacturing survey, durable goods orders), and inflation (e.g., producers price index, consumer price index). We also consider U.S. monetary policy and fiscal balance surprises in the analysis.

There are a total of 4018 announcements during the six year sample period. The distribution of macro news indicates that announcements are fairly evenly spread across Monday through Friday with a few isolated news releases on Sunday. A large majority of the observations occur at 8:30 a.m. U.S. EST which corresponds to the time when most U.S. macro announcements are released, followed by U.K. announcements at 4:30 a.m. U.S. EST. The U.S. has the largest number of news releases at 1562, accounting for about 39% of the total announcements in this study. There are 764 macro announcements from Germany, and 718, 496, 263, and 215 announcements for the U.K., Japan, Switzerland, and the EU, respectively.

V. Empirical Results

Currency Jump Analysis

Table 3 reports the statistical properties of jumps measured at the 5-minute frequency. The number of days with at least one significant jump ranges from 553 days for EUR to 723 days for SF. This translates into jump percentages, as indicated by the P(jump day), of 37% to 49% for the EUR and SF, respectively. The UKP and JPY each has jump percentages of 39% and 41%.

An examination of the E(#jump|jumpday) statistic indicates that SF has the highest jump frequency per *jump day* at about 1.40 jumps each jump day. This higher market sensitivity of the Swiss franc may be due to its perception as a safe haven currency. The table also shows the average absolute jump size for each currency and associated standard deviations. All currencies have jump sizes in the range of 0.20% to 0.22%, whereas the means of the absolute returns for all the four currencies are all close to 0.03%. In other words, the magnitudes of the jumps are between 6 and 7 times the averages of the absolute returns. Finally, the results indicate that there are slightly more negative jumps (U.S. dollar appreciation) than positive jumps (U.S. dollar depreciation) during the sample period. This phenomenon is most pronounced for EUR with

about 54% of the jumps being negative. The negative jumps in EUR may be a phenomenon associated with the sample period which witnessed significant turmoil in financial markets. Specifically, the global financial crisis resulted in a worldwide flight to safety and a corresponding increase in the demand for Swiss franc and U.S. dollar based instruments.

Figure I provides a visual representation of currency jumps. The spikes in the graphs show that significant jumps occur at 4:35 am (only for UKP), 8:35 am, 10:05 am, and finally at 6:05 pm when currency trading in the futures market resumes after a break. With the exception of these dramatic spikes, the majority of the remaining jumps appear to be evenly distributed across the trading day. Notably, the exhibit displays the correspondence of jumps with the release of major U.K and U.S. scheduled macro news releases. For instance, there are a total of 713 jumps identified for UKP, averaging about 2.6 jumps over each five minute interval. However, we find a total of 79, 59, and 22 jumps in UKP jumps at 4:35 am, 8:35 am, and 10:05 am, respectively. Similarly, the largest jumps for EUR, JPY and SF are observed following the 8:30 am U.S. macro news announcements. Overall, there are strong indications that the currency jumps are related to economic fundamentals, especially those associated with the U.S. and U.K. announcements.

Table 4 further explores the jump-news relationship by providing two related statistics. The first statistic is p(J|N), reported in Panel A, indicates the percentage of news release that are matched with jumps five minutes after the news release. Second, the proportion of daily jumps that are associated with at least one generic macroeconomic news release, denoted as p(N|J), is presented in Panel B. Examining Panel A, we notice that announcements from the EU, Germany, Japan and Switzerland do not correspond to significant jumps in any currency. For example, of the 215 EU announcements, only one announcement matches a jump in the euro 5-minute

returns. Given the important role of Germany in the EU, one would expect to find a close connection between Germany's macroeconomic news and the euro. However, only 3 out of the total 764 German announcements result in EUR jumps. Furthermore, only 11 out of the 496 Japanese announcements and 4 out of the 496 Swiss announcements can be matched with jumps in JPY and SF, respectively. On the other hand, 104 out of the 718 announcements (about 15%) match five minute jump returns in UKP, suggesting a close relationship between U.K. news and currency jumps. Finally, overall, we find that a much higher proportion of U.S. macroeconomic announcements result in jumps across all four currencies. Out of the total 1562 U.S. announcements, 102 (6.47%), 136 (8.71%), 167 (10.69%) and 130 (8.32%) can be matched with jumps in UKP, EUR, JPY and SF, respectively.

The dominance of U.S. announcements is further supported when examining p(N|J) in Panel B. For instance, out of the 713 jumps that were identified for UKP, 70 of those jumps, or roughly 10%, occurred within five minutes of at least one scheduled U.S. macro news announcement. The corresponding percentages for EUR, JPY and SF are 15.04%, 13.61%, and 9.43%, respectively. Furthermore, with the exception of UKP, the evidence seems to reject the importance of local news in favor of U.S. news in influencing currency jumps. In the case of UKP, 9.42% (67) of the identified jumps occurred in the immediate 5-minute aftermath of the U.K. news releases. Thus, evidence relating to the importance of local economic news on jumps is supported only for UKP.

Panel C provides a more granular perspective of p(N|J) by relating jumps with the precise timing of the news release. We notice that a large majority of jumps at 4:35 am (for UKP), 8:35 am, 10:05 am and 2:15 pm can be matched with U.K or U.S. news. For instance, in the case of UKP, 67 out of the 79 jumps at 4:35 am occur within five minutes of at least one major U.K.

announcement, 48 out of the 59 jumps at 8:35 transpire immediately after at least one major 8:30 U.S. news announcement, and all of the jumps at 2:15 is attributable to the U.S. FOMC announcement. In general, about 81%, 80%, 89% and 78% of the 8:35 jumps in UKP, EUR, JPY and SF occur after at least one U.S. news release at 8:30 am.

Table 5 provides evidence on currency jumps that are matched with individual news releases. The results show that the 8:30 am, 10:00 am, and 2:15 pm set of U.S. announcements are significantly associated with jumps. In particular, the U.S. employment situation or job report released at 8:30 am, which includes nonfarm payroll information and the unemployment rate statistic, is found to be among the most important news variables. Between 22% and 36% of the releases of payroll and unemployment rate can be matched with jumps at 8:35 am across the four currencies. This primacy of the employment report in influencing asset prices has been documented by other studies (see, for example, Andersen and Bollerslev, 1998). In addition, the 8:30 am information about U.S. real economic activity as conveyed by advanced retail sales, GDP, and trade balance also carry significant weight on exchange rate jumps. In terms of ranking the various announcements, following the employment report the next most important variable pertains to the U.S. FOMC's target federal funds rate. For instance, 10%, 24%, 12% and 16% of the U.S. fed fund news announcements releasing at 2:15 pm match jumps at 2:20 pm, respectively, in UKP, EUR, JPY and SF.   The results in Table 5 further indicate that the jumps in the British pound may be attributed to both local and U.S. macroeconomic news.   A substantial proportion of U.K. news releases of economic growth (specifically, retail sales) and price level (specifically, CPI, RPI and PPI) variables can be matched to jumps in UKP at 4:35 am.

In order to draw additional inferences on the jumps-news relationship, we identify the top 20 jumps for each currency (based on the absolute values of the returns) at 8:35 am. For the sake of brevity we provide only a summary discussion of these results. We find that with the exception of one jump in EUR (on 08/01/2009) all top 20 currency jumps at 8:35 am across all four currencies can be related with U.S. macro news at 8:30 am. For instance, in the case of UKP, 9 of the top 20 jumps are associated with the release of the employment report, 4 to trade balance (TBGS), 3 jointly to GDP and personal consumption (PC), 2 to advanced retail sales (ARS), 1 to CPI, and 1 to PPI. Overall, the analysis of the top 20 jumps confirms that the employment report, containing nonfarm payroll and unemployment rate, is the most influential among all U.S. announcements.[3]

In order to estimate the marginal impact of each time-stamped news surprise on jump returns, for each currency we fit a multivariate regression model of the form:

$$jp_{t_{j+1}} = c + \sum_{i=1}^{n} c_i SA_{i,t_j} + \varepsilon_{t_j}, \tag{13}$$

where the variable $jp_{t_{j+1}}$ is a jump occurring at time t_{j+1}, five minutes after one (or more) macroeconomic news release and SA_{i,t_j} is the standardized surprise of the ith news announcement.

In the framework of (13) we run two sets of regressions. In the first, we estimate reduced form stepwise regressions identifying a restricted set of regressors that represent that most influential factors. This seems to be reasonable since Table 4 suggests that there are only a limited number of jump-news matched observations. The second set of stepwise regressions

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[3] There are a total of 4 currency intervention related news items during our sample period - 1 from Japan (9/15/2010) and 3 from Switzerland (3/12/2009; 6/18/2009; 9/25/2009) - with only two of these announcements definitively related to intervention activity. There is some evidence to suggest that interventions may underlie a select number of currency jumps identified in this paper. However, since none of these events coincide with regular macro news releases, they do not carry any implications on the central thesis of our research linking macro news to jumps.

provides results that correspond to 4:35 am (UKP only), 8:35 am, and 10:05 am groups of jumps – time periods associated with major spikes in the jump distribution, as reported in Figure 1.

Table 6 presents the results from the first set of regressions. Several important results are evident. First, the deployment of the stepwise regression models reduces the number of independent variables significantly. For instance, while there are 34 announcements that are matched with at least one jump in the UKP return series, the stepwise regression results suggest that only 15 of them have significant explanatory power. Similarly, the stepwise regressions for the EUR, JPY and SF identify only 6, 8, and 5 significant independent variables out of the 31, 30, and 30 types of macro announcements that match with at least one corresponding jump. Second, the explanatory power of the regression model, as observed from adjusted R-squares, is highest for UKP and lowest for EUR. Specifically, 56%, 22%, 42%, and 29% of the 5-minute jump returns can be explained by standardized surprises in macro news announcements. Importantly, the U.S. nonfarm payroll, GDP, trade balance and unemployment have a negative and significant impact on jump returns of all four currencies. For instance, a positive one standard deviation surprise of the U.S. change in nonfarm payroll at 8:30 am results in -0.27%, -0.25%, -0.35%, and -0.33% changes in the 5-minute jump returns for UKP, EUR, JPY and SF, respectively. Third, there is strong evidence that better-than-expected news about the U.S. economy has a negative impact on the jump returns value of the foreign currency. It would be relevant to note that the change in the unemployment rate is a countercyclical economic indicator, and thus is expected to carry the positive and significant coefficient value. This evidence is consistent with Simpson et al. (2005) who use a similar set of macro news announcements for the U.S. and document a negative relationship between economic variables and foreign currency values. Fourth, although not reported, we find surprises in fed funds interest rate do not have any impact on any of the

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four currencies at the 10% significance level. Finally, contrary to the purchasing power parity (PPP) hypothesis, we find that U.S. CPI announcements are negatively associated with foreign currency jumps. Plausible explanations include uncertainty resolution and the possible countervailing short-term capital flows arising from higher U.S. economic growth that sometimes often accompanies inflation.

Table 7 reports results from stepwise estimations (13) for the intervals 4:35 am, 8:35 am, and 10:05 am models. The results indicate that the 4:30 am surprises of six U.K. announcements explain about 58% of the jump returns measured at 4:35 am. Similarly, according to the model results, the 8:35 am and 10:05 jumps can be explained by major U.S. macro announcements at 8:30 am and 10:00 am. A simple comparison of the 8:30 model across the four currencies indicate that the standardized surprises of the U.S news have more explanatory power for jumps in UKP and JPY (61% and 53%, respectively) than for jumps in EUR and SF (35% and 32%, respectively).

The stepwise regression models identify the influential news variables that explain currency jumps. In order to ascertain the probability of news releases that result in jumps we run Probit regressions of the following form:

$$\begin{cases} Pr(NJump|News) = \Phi(c^- + b^- SA), \\ Pr(PJump|News) = \Phi(c^+ + b^+ SA), \end{cases}$$

where, $Pr(NJump|News)$, and $Pr(PJump|News)$ denote the probabilities of a negative and a positive jump given a U.S. (U.K.) macro news release, SA refers to the standardized surprises all U.S. macro announcements, Φ is the cumulative distribution function of a standard normal distribution, and c^-, c^+, b^-, and b^+ are coefficients to be estimated.[4]

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[4] We also estimate a simpler Probit regression model of the form: $Pr(Jump|News) = \Phi(c + b|SA|)$. Results suggest that the simple model masks important asymmetry that is found in the relationship between news and jumps.

The results from Probit regressions, reported in Table 8, indicate that the coefficients are found to be statistically significant at the 1% level. For instance, from the estimated models for UKPs, we observe that c^-, c^+, b^-, and b^+ equal -1.96, 0.19, -1.79 and -0.17, respectively. In other words, when the standardized surprise is zero, the probability of observing a negative and positive jump in UKP five minute returns immediately after the announcement is $\Phi(-1.96) \cong$ 2.50%, and $\Phi(-1.79) \cong 3.67\%$, respectively; if we observe a surprise of positive one standard deviation, then the corresponding probability of observing a negative and positive jump are $\Phi(-1.96 + 0.19) \cong 3.84$ (a 53.47% increase in probability), and $\Phi(-1.79 - 0.17) \cong 2.50\%$ (a 31.94% decrease in probability), respectively. Similarly, following a surprise of negative one standard deviation, the probability of observing a negative and positive jump in UKP returns are $\Phi(-1.96 - 0.19) \cong 1.58$ (a 36.88% decrease in probability), and $\Phi(-1.79 + 0.17) \cong 5.26\%$ (a 43.26% increase in probability), respectively.

The Probit regressions reveal that negative standardized surprises are more likely to result in positive jumps and positive standard surprises are more likely to cause negative jumps. This is consistent with the results of the stepwise regression models discussed earlier. The Probit regression models of UKP currency jumps against the U.K announcements also suggest that positive standardized surprises of the U.K. announcements are more likely to cause positive jumps (appreciation of UKP) and negative surprises are more likely to cause negative jumps (depreciation of UKP).

Cojumps

We have demonstrated that currency jumps are significantly associated with U.S. announcements, and in the special case of UKP the currency's jumps can also be related with

U.K. announcements at 4:30 am. Next, we examine cojump properties and evaluate their correspondence with macro news announcements. Cojumps are defined as simultaneous jumps between two or more prices. Given our consideration of four currencies, simultaneous price movements may take the form of bivariate, trivariate, or quadruple cojumps.

The plots in Figure II provide a visual representation of various currency cojumps combinations. The distributions of the cojumps show significant spikes at 8:35 am and 10:05 am, i.e., within 5-minutes of the U.S. news released at 8:30 and 10:00 am. Most other co-jumps are equally distributed across the trading day. For instance, we find 44 cojumps between UKP and EUR at 8:35 am compared to 8 cojumps between the two currencies at 10:05 am.

The detailed statistical properties of cojumps are presented in Table 9. Several noteworthy results are evident. First, confirming the visual evidence, we find that cojumping is most pronounced between EUR and SF (probability of cojump is 0.078%). Furthermore, the bivariate cojump between UKP and EUR and between UKP and SF are approximately the same (0.034%, and 0.037%, respectively). Second, the P(coj|jump) statistic indicates that the highest significant jump dependence is between EUR and SF. Specifically, if a jump occurs in EUR, the probability that a jump will also occur in SF is about 44%. We also observe that about 18% of all UKP jumps are also cojumps with EUR, and about 20% of all jumps in EUR are cojumps with UKP. The overall evidence affirms the close-knit nature of linkages among the European currencies. Third, as documented by the final four columns of the table, there is an obvious relationship between cojumps and macroeconomic news. We note that between 23% and 44% of bivariate cojumps, and about 25% to 52% of trivariate cojumps may be attributed to macroeconomic news, particularly those related to the U.S., as shown in the last two columns of the table. The evidence supports the dominant role of U.S. macro fundamentals on cojumps.

Additional investigation using 8:30 am news announcements reveals that the number of cojumps peaked in 2006 prior to the onset of the global financial crisis.[5] There are a total of 31 cojumps found in 2006 compared to only 11 co-jumps at the height of the financial crisis in 2008. However, the average jump sizes are found to be much larger in 2008 – specifically, jumps in JPY and SF are on average about 80% larger in 2008 compared to 2006 (0.53% vs. 0.30% for JPY and 0.52% vs. 0.31% for SF).

To further examine the connections between cojumps and standardized surprises of U.S. macro news, we run the following Probit regressions on various cojump pairs:

$$\begin{cases} Pr(NCoJump|News) = \Phi(c^- + b^-SA), \\ Pr(PCoJump|News) = \Phi(c^+ + b^+SA), \end{cases}$$

where, $Pr(NCoJump|News)$ and $Pr(PCoJump|News)$ denote probabilities of a negative and a positive cojump given a U.S. (or U.K.) macro news release, and all other variables have been defined earlier. A negative (positive) cojump is defined as both the two currencies have a negative (positive) significant jump at the same time. The results are presented in Table 10. As indicated by the results, all regression coefficients except b^+ in the UKP-SF currency pair cojump regression model are significant at the 10% level. Similar to the jump Probit regressions, the cojump regression models results imply that a positive surprise of a U.S macroeconomic announcement increases the probability of observing negative cojumps in all the six currency pairs, whereas a negative surprise of a U.S announcement increases the probability of positive cojumps occurrences in all currency pairs.

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[5] These results are available upon request.

Persistence of Jumps

Thus far, our analysis shows that currency jumps and cojumps are a reasonably good proxy for information-arrival in the futures market. We now extend these findings to examine the speed of news absorption; i.e., how quickly macroeconomic news is incorporated into prices such that profit opportunities from trading-on-the-news are precluded. In other words, we seek to determine whether returns following news-related jumps are predictable. We examine this issue by comparing jump returns with a time-matched benchmark return sample on days without news and without jumps.

To examine the persistence of jumps we compute the average returns for four 5-minute intervals surrounding 4:30 am, 8:30 am and 10:00 am which are scheduled release times for the U.K. and U.S. macro news. We separate the news days into positive and negative jumps. This is shown in Figure III. The results indicate that news-related price jumps do not exhibit persistence – i.e., jumps tend to be isolated episodic events that are found to dissipate quickly. The graphs show that with the exception of the immediate 5-minute window following the release of the macro news the average five minute returns for all other intervals for news days with a positive/negative jump are very close to zero, and are indistinguishable from the benchmark returns. For instance, looking at the results for EUR we find that on days with news and positive jumps at 8:35 am, the average five minute returns at 8:35 am is about 0.31%; whereas, the average five minute returns at 8:35 am on days without news is close to 0%. In comparison, the average five minute returns at 8:40 am on days with news and positive jumps converges to the 8:40 am returns on days without news. In summary, evidence shows that the impact of macro news is fully impounded into currency prices within five minutes of the news release.

VI. Concluding Remarks

The asset market view of exchange rate determination posits that currency values are forward looking asset prices that react to changes in market's expectations of future fundamentals. However, in conflict with this viewpoint, empirical models have not been very successful in relating exchange rate movements to economic fundamentals. Various efforts have been undertaken to resolve this apparent contradiction; one approach is to use intraday exchange rates that allows the researcher to narrow the analysis window in order to examine the micro effects of macro news. The present study extends the microstructure analysis by focusing on intraday jump distributions of currency returns. Specifically, the study examines jump and cojumps in four currencies – British pound, the euro, Japanese yen and Swiss franc – and examines the role of macro news in explaining dramatic price changes. The empirical analysis benefits from: (a) utilizing high frequency currency futures data for 2005 to 2010, a period that includes the recent financial market crisis; (b) accounting for several different types of U.S. and local macro news releases; and (c) using a methodology that identifies the precise timing and size of intra-day jumps.

Several important results emerge. First, the proportion of days containing at least one significant jump in the sample period ranges from 37% for EUR to 49% for SF, with jump magnitudes ranging between 6 and 7 times of the average absolute returns. Second, compared to foreign news releases, a disproportionate number of jumps are associated with U.S. announcements. Specifically, about 10%, 15%, 14% and 9% of daily jumps in UKP, EUR, JPY and SF coincide with U.S. news announcements. Third, since our jump extraction method identifies the precise timing of each jump and cojump we are able to relate intraday jumps and cojumps with the announcement-time with greater precision. We find U.S. macro

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announcements released at 8:30 am to be the most influential. Regression results of the marginal impact of macro news on the post-announcement 5-minute jump returns indicate that nonfarm payroll, unemployment report, GDP and trade balance are among the most important U.S. news variables. Notably, we find that unexpected positive news about the U.S. economy is negatively related to jump returns of the foreign currency. Fourth, Probit regression results reveal an asymmetry in the relationship between jumps and announcements. Specifically, given the overall negative relationship between U.S. news and foreign currency jump returns, there is a greater likelihood that positive economic shocks in the U.S. result in negative foreign currency jump. Fifth, evidence from cojumps suggests a close relationship among European currencies, with the highest degree of jump dependence between EUR and SF. The cojump attribution analysis finds that the jump sizes are much larger in 2008, at the height of the financial crisis, and also corroborates the dominant role of U.S. announcements on the joint distribution of jump returns.

On a broad front our study shows that: (a) jumps are a good proxy for news arrival in currency markets; (b) there is a systematic reaction of currency prices to economic surprises; and (c) prices respond quickly within 5-minutes of the news release. In order to provide additional insights the current empirical design may be extended in several ways. For example, it would be interesting to examine currency jumps in the context of a broader definition of news that, in addition to scheduled macro news, incorporates elements of non-fundamental and non-scheduled news releases. Moreover, the interplay between information about order flow and state of the economy would enrich inferences drawn on currency price discontinuities. These issues are left for future research.

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TABLE 1

SUMMARY STATISTICS OF CURRENCY RETURNS

Panel A: Returns sampled at daily intervals

Statistics	Returns (%)			
	British Pound	Euro	Japanese Yen	Swiss Franc
Mean	-0.0138	-0.0119	0.0026	-0.0124
Std. Deviation	0.6339	0.6369	0.6833	0.6572
Min	-0.4476	0.1634	0.0405	0.2678
Max	2.9424	2.1162	4.8645	2.9042
Skewness	-3.8926	-2.5896	-5.4186	-3.1829
Kurtosis	2.7852	3.5700	3.7239	4.4652
Count	1,598	1,603	1,599	1,595

Panel B: Return sampled at 5-minute intervals

Statistics	Returns (%)			
	British Pound	Euro	Japanese Yen	Swiss Franc
Mean	-7.5E-05	-7.2E-05	1.1E-05	-6.0E-05
Std. Deviation	0.0444	0.0406	0.0462	0.0446
Min	-1.1926	-0.6650	-2.1437	-1.9552
Max	1.0671	1.1449	1.6050	1.0658
Skewness	-0.2366	0.0636	0.2524	-0.1924
Kurtosis	21.1208	16.1905	46.9153	27.0097
Count	386,442	411,995	404,919	365,320

TABLE 2

MACROECONOMIC NEWS ANNOUNCEMENTS BY REGION AND TIME

Region	Time (U.S. EST)	News	Obs.	Mean	Std. Dev.
EU	5:00	Gross Domestic Product (GDP)	71	0.0000	0.0012
		Producer Price Index (PPI)	72	-0.0003	0.0018
		Unemployment Rate (UR)	72	0.0000	0.0011
Germany	2:00	Current Account Balance (CA)	72	0.4264	3.4926
		Consumer Price Index (CPI)	71	0.0000	0.0010
		EXPORT	72	0.0022	0.0272
		Gross Domestic Product (GDP)	48	0.0002	0.0027
		IMPORT	72	0.0052	0.0376
		Producer Price Index (PPI)	72	0.0005	0.0043
		Retail Sales (RS)	70	-0.0072	0.0134
		Trade Balance (TB)	72	0.1625	2.6037
	3:55	Unemployment Rate (UR)	72	-0.0004	0.0011
	6:00	Industrial Production (IP)	72	-0.0021	0.0155
		Manufacturing Orders (MO)	71	0.0006	0.0286
Japan[a]	0:00	Manufacturing Orders (MO)	72	0.0044	0.0635
	18:50	Current Account Balance (BOP)	72	21.0694	178.7927
		Domestic Consumer Price Index (CPI)	72	0.0004	0.0028
		Gross Domestic Product (GDP)	48	0.0004	0.0026
		Industrial Production (IP)	72	-0.0024	0.0089
		Retail Sales (RS)	72	0.0012	0.0103
		Bank of Japan Survey (TANKAN)	24	0.0036	0.0198
		Trade Balance (TB)	64	-7.6828	48.0083
Switzerland	1:45	Consumer Price Index (CPI[b])	71	-0.0004	0.0019
		Gross Domestic Product (GDP)	24	0.0011	0.0030
		Unemployment Rate (UR)	72	0.0000	0.0006
	3:15	Industrial Production (IP)	24	0.0023	0.0263
		Producer Price Index (PPI)	72	-0.0005	0.0033
U.K.[c]	4:30	Current Account Balance (CA)	24	0.0167	3.8464
		Consumer Price Index (CPI)	72	0.0005	0.0018
		Gross Domestic Product (GDP)	72	-0.0002	0.0016
		Industrial Production (IP)	72	-0.0023	0.0062
		Money Supply (M4)	68	0.0011	0.0063
		Manufacturing Production (MP)	72	-0.0017	0.0066
		Producer Price Index (PPI)	72	0.0005	0.0032
		Retail Price Index (RPI)	71	0.0007	0.0019
		Retail Sales (RS)	72	0.0014	0.0083
		Trade Balance (TB)	51	-100.9608	573.2732
		Unemployment Rate (UR)	72	-1.7472	13.5404

TABLE 2

MACROECONOMIC NEWS ANNOUNCEMENTS BY REGION AND TIME (CONTINUED)

Region	Time (U.S. EST)	News	Obs.	Mean	Std. Dev.
U.S.	8:30	Advanced Retail Sales (ARS)	72	0.0001	0.0060
		Change in Nonfarm Payrolls (CNP)	72	-13.6667	66.6115
		Consumer Price Index (CPI)	72	0.0000	0.0015
		Durable Goods Orders (DGO)	72	-0.0017	0.0249
		Gross Domestic Product (GDP)	72	-0.0004	0.0046
		Housing Starts (HS)	72	1.4167	88.0807
		Personal Consumption (PC)	72	-0.0002	0.0036
		Personal Income (PI)	72	0.0007	0.0035
		Producer Price Index (PPI)	72	0.0005	0.0056
		Trade Balance Goods and Services (TBGS)	72	0.3125	3.5466
		Unemployment Rate (UR)	72	0.0000	0.0015
	9:15	Capacity Utilization (CU)	72	-0.0005	0.0037
		Industrial Production (IP)	72	-0.0006	0.0044
	10:00	Business Inventories (BI[d])	72	-0.0001	0.0023
		Consumer Confidence (CC)	72	-0.1417	4.9822
		Construction Spending (CS)	72	0.0013	0.0077
		Factory Orders (FO)	72	0.0001	0.0076
		Leading Indicators (LI)	72	0.0000	0.0020
		Institute of Supply Management-Manufacturing Survey (ISM-M)	72	0.2708	2.1053
		New Home Sales (NHS)	72	-1.2361	68.2882
	14:00	Treasure Budget Statement (BST)	72	-0.2403	11.0579
	14:15	Federal Open Market Committee (FOMC)	50	-0.0001	0.0005

Notes:
  a. Japanese news releases are one hour later during Daylight Savings Time (DST).
  b. 3:15 am from January 2009.
  c. Due to the DST starting date difference, few announcements are at 5:30 am.
  d. 8:30 am for some days in 2005.

TABLE 3

DESCRIPTIVE PROPERTIES OF SIGNIFICANT CURRENCY JUMPS SAMPLED AT 5-MINUTE FREQUENCY

	British Pound	Euro	Japanese Yen	Swiss Franc
Observations	382,623	409,448	401,498	361,950
E(|abs(return)|)	0.03	0.03	0.03	0.03
Days	1,491	1,514	1,498	1,484
Jump Days	580	553	615	723
P(Jumpday) (%)	38.90	36.53	41.05	48.72
E(#Jump|Jump Day)	1.23	1.17	1.34	1.39
Jumps	713	645	823	1,007
P(jump) (%)	0.19	0.16	0.20	0.28
E(|jumpsize||jump)	0.20	0.20	0.22	0.20
Std(|jumpsize||jump) (%)	0.23	0.24	0.28	0.24
Positive Jumps	348	298	402	493
P(jump>0) (%)	0.09	0.07	0.10	0.14
E(jumpsize|jump>0)	0.19	0.21	0.22	0.20
Std(jumpsize|jump>0) (%)	0.12	0.14	0.18	0.13
Negative Jumps	365	347	421	514
P(jump<0) (%)	0.10	0.08	0.10	0.14
E(jumpsize|jump<0)	-0.20	-0.20	-0.21	-0.20
Std(jumpsize|jump<0) (%)	0.14	0.10	0.18	0.14
% of Negative Jumps	51.19	53.80	51.15	51.04

TABLE 4

RELATIONSHIP BETWEEN INDIVIDUAL CURRENCY JUMPS AND AGGREGATE MACROECONOMIC NEWS

Panel A: News matched with jumps, p(J|N)

Region	British Pound Obs	p(J|N)(%)	Euro Obs	p(J|N)(%)	Japanese Yen Obs	p(J|N)(%)	Swiss Franc Obs	p(J|N)(%)
EU	1	0.47	1	0.47	0	0.00	1	0.47
Germany	1	0.13	3	0.39	2	0.26	2	0.26
Japan	0	0.00	2	0.40	11	2.22	1	0.20
Switzerland	1	0.38	0	0.00	0	0.00	4	1.52
U.K.	104	14.48	0	0.00	1	0.14	3	0.42
U.S.	101	6.47	136	8.71	167	10.69	130	8.32
Total	208	8.47	142	5.78	181	7.37	141	5.74

Panel B: Jumps matched with news, p(N|J)

Region	British Pound Jumps	p(N|J)(%)	Euro Jumps	p(N|J)(%)	Japanese Yen Jumps	p(N|J)(%)	Swiss Franc Jumps	p(N|J)(%)
EU	1	0.14	1	0.16	0	0.00	1	0.10
Germany	1	0.14	3	0.47	2	0.24	2	0.20
Japan	0	0.00	2	0.31	10	1.22	1	0.10
Switzerland	1	0.14	0	0.00	0	0.00	4	0.40
U.K.	67	9.40	2	0.31	1	0.12	2	0.20
U.S.	70	9.82	97	15.04	112	13.61	95	9.43
Total	140	19.64	105	16.28	125	15.19	105	10.43

Panel C: Jump match news disaggregated by Time

Region	Time	British Pound Jumps	Match	p(M)	Euro Jumps	Match	p(M)	Japanese Yen Jumps	Match	p(M)	Swiss Franc Jumps	Match	p(M)
U.K.	4:30	79	67	84.81	1	1	100.00	4	1	25.00	6	2	33.33
	8:30	59	48	81.36	76	62	80.26	87	77	88.51	81	63	77.78
U.S.	10:00	22	13	59.09	36	20	55.56	40	26	65.00	44	23	52.27
	14:15	5	5	100.00	12	12	100.00	7	6	85.71	12	8	66.67

Note: p(J|N), p(N|J), and p(M) refer to the percentage of news matched jumps, jumps matched news and the percentage of jumps matched news at time of news release, respectively.

TABLE 5
CURRENCY JUMPS MATCHED WITH TYPE OF MACROECONOMIC NEWS RELEASE

Region	Time (U.S. EST)	News	UKP Obs	UKP Per	EUR obs	EUR Per	JPY obs	JPY Per	SF obs	SF Per
EU	5:00	GDP			1	1.41			1	1.41
		PPI								
		UR	1	1.39						
Germany	2:00	CA								
		CPI								
		EXPORT								
		GDP	1	2.08						
		IMPORT								
		PPI							1	1.39
		RS			2	2.86	1	1.43	1	1.43
		TB								
	3:55	UR								
	6:00	IP								
		MO			1	1.41	1	1.41		
Japan	0:00	MO			1	1.39	1	1.39	1	1.39
	18:50	BOP								
		DCPI								
		GDP					3	6.25		
		IP			1	1.39	3	4.17		
		RS					2	2.78		
		TANKAN					2	8.33		
		TB								
Switzerland	1:45	CPI							2	2.82
		GDP							1	4.17
		UR	1	1.39						
	3:15	IP								
		PPI							1	1.39
UK	4:30	CA	2	8.33					1	4.17
		CPI	13	18.06	1	1.39				
		GDP	9	12.5					1	1.39
		IP	8	11.11						
		M4	11	16.18						
		MP	8	11.11						
		PPI	7	9.72	1	1.39				
		RPI	13	18.31	1	1.41				
		RS	22	30.56			1	1.39	1	1.39
		TB	4	7.84	1	1.96				
		UR	7	9.72						

TABLE 5
CURRENCY JUMPS MATCHED WITH TYPE OF MACROECONOMIC NEWS RELEASE (CONTINUED)

Region	Time (U.S. EST)	News	UKP		EUR		JPY		SF	
			obs	Per	obs	Per	obs	Per	Obs	Per
US	8:30	ARS	6	8.33	9	12.5	13	18.06	11	15.28
		CNP	16	22.22	18	25	26	36.11	16	22.22
		CPI	3	4.17	5	6.94	4	5.56	6	8.33
		DGO	4	5.56	7	9.72	4	5.56	9	12.5
		GDP	6	8.33	7	9.72	11	15.28	4	5.56
		HS	1	1.39	3	4.17	4	5.56	4	5.56
		PC	6	8.33	7	9.72	11	15.28	4	5.56
		PI	4	5.56	3	4.17	3	4.17	3	4.17
		PPI	4	5.56	5	6.94	7	9.72	4	5.56
		TBGS	9	12.5	8	11.11	12	16.67	11	15.28
		UR	16	22.22	18	25	26	36.11	16	22.22
	9:15	CU	1	1.39	2	2.78	1	1.39	1	1.39
		IP	1	1.39	2	2.78	1	1.39	1	1.39
	10:00	BI	1	1.39	1	1.39	2	2.78	4	5.56
		CC	3	4.17	6	8.33	6	8.33	6	8.33
		CS	4	5.56	8	11.11	8	11.11	5	6.94
		FO	2	2.78	1	1.39	1	1.39	2	2.78
		LI			1	1.39	4	5.56	1	1.39
		ISM-M	5	6.94	8	11.11	8	11.11	5	6.94
		NHS	4	5.56	4	5.56	8	11.11	9	12.5
	14:00	BST			1	1.39	1	1.39		
	14:15	FOMC	5	10.00	12	24.00	6	12.00	8	16.00

TABLE 6

MARGINAL IMPACT OF MACROECONOMIC NEWS ON RETURN JUMPS ACROSS ALL ANNOUNCEMENTS

Variable			UKP		EUR		JPY		SF	
Country	Time (U.S. EST)	News	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
UK	4:30	CPI	0.21**	4.49						
		GDP	0.14**	4.32						
		MP	0.15**	2.89						
		PPI	0.09*	2.03						
		RS	0.15**	5.43						
		UR	-0.17**	-3.43						
US	8:30& 10:00	ARS	-0.14**	-2.54	-0.14$	-1.68	-0.18**	-2.88		
		CNP	-0.27**	-6.18	-0.25**	-3.53	-0.35**	-7.10	-0.33**	-4.44
		CPI	-0.41*	-2.29	-0.29$	-1.70				
		DGO	-0.13*	-2.20						
		GDP	-0.13**	-3.10	-0.11$	-1.66	-0.17$	-1.85	-0.28$	-1.76
		PC					-0.18*	-2.29		
		TBGS	-0.23**	-3.86	-0.30**	-2.97	-0.24**	-2.70	-0.26**	-2.78
		UR	0.14**	3.38	0.14$	1.84	0.20**	3.51	0.24**	2.97
		CC	-0.16*	-2.18						
		ISM-M	0.23**	2.48			-0.23*	-2.40		
		NHS					-0.10$	-1.92	-0.09$	-1.70
Model		Obs	140		105		125		105	
		Adj-R^2	0.56		0.22		0.42		0.29	
		F-Value	12.62		4.66		12.26		8.07	
		P-value	0.00		0.00		0.00		0.00	

Notes:

a. Superscripts "**", "*", and "$" represents significance at the 1%, 5% and 10% level, respectively.

b. This table reports the panel stepwise regression results of the following form: $jp_{t_j} = c + \sum_{i=1}^{n} c_i SA_{i,t_j} + \varepsilon_{t_j}$, across all four currencies. Specifically, jumps that match at least one news announcement are regressed against the standardized surprises of the news announcements five minutes before the jump.

TABLE 7

MARGINAL IMPACT OF MACROECONOMIC NEWS ON RETURN JUMPS BY ANNOUNCEMENT TIME

Variable		UKP		EUR		JPY		SF	
Country	News	Estimate	T-stat	Estimate	T-stat	Estimate	T-state	Estimate	T-stat
UK (4:30 am)	CPI	0.21^{**}	4.79						
	GDP	0.14^{**}	4.63						
	IP	0.15^{**}	2.85						
	PPI	0.11^{**}	2.64						
	RS	0.14^{*}	5.52						
	UR	$-0.15^{\$}$	-1.85						
Model	Obs	67							
	Adj-R^2	0.58							
	F-Value	15.21							
	P-value	0.00							
US (8:30 am)	ARS	-0.14^{*}	-2.35			-0.18^{**}	-2.89		
	CNP	-0.27^{**}	-5.89	-0.26^{**}	-3.98	-0.35^{**}	-7.26	-0.33^{**}	-4.22
	CPI	-0.41^{*}	-2.19	$-0.29^{\$}$	-1.81				
	DGO	-0.13^{*}	-2.14						
	GDP	-0.13^{*}	-2.93	-0.13^{*}	-2.07	$-0.17^{\$}$	-1.89		
	PC					-0.18^{*}	-2.35		
	TBGS	-0.23	-3.77	-0.29^{**}	-3.10	-0.24^{**}	-2.79	-0.26^{**}	-2.64
	UR	0.14	3.30	0.14^{*}	2.04	0.20^{**}	3.56	0.24^{**}	2.84
Model	Obs	48		62		77		63	
	Adj-R^2	0.61		0.35		0.53		0.32	
	F-Value	11.62		6.44		15.39		8.42	
	P-value	0.00		0.00		0.00		0.00	
US (10:00 am)	BI							$-0.35^{\$}$	-1.79
	CC	-0.16^{*}	-2.21	$-0.12^{\$}$	-1.75				
	CS							$0.15^{\$}$	1.88
	ISM-M	0.23^{**}	2.79	$-0.11^{\$}$	-2.09	-0.23^{**}	-3.41		
	NHS					$-0.07^{\$}$	-1.95	-0.08^{*}	-2.58
Model	Obs	13		20		26		23	
	Adj-R^2	0.45		0.42		0.45		0.32	
	F-Value	5.98		4.46		6.08		4.48	
	P-value	0.02		0.01		0.00		0.02	

Notes:

a. This table reports the stepwise regression results of the following form: $jp_{t_j} = c + \sum_{i=1}^{n} c_i SA_{i,t_j} + \varepsilon_{t_j}$, for each currency. The jumps that match at least one U.K. 4:30 am (UKP only) or U.S. 8:30 am or 10:00 am (all currencies) news announcement are regressed against the news announcements five minutes before the jump.

b. Regressions were also run at 14:20 (5 minutes after the FOMC), but none of the models report significant coefficients.

c. Superscripts "**", "*", and "$" represents significance at the 1%, 5% and 10% level, respectively.

TABLE 8
PROBIT REGRESSION MODELS FOR JUMPS

Panel A: Probit regression matching currency jumps with U.S. macroeconomic news.

Parameter	UKP		EUR		JPY		SF	
	Estimate	Chi-Square	Estimate	Chi-Square	Estimate	Chi-Square	Estimate	Chi-Square
c^-	-1.96**	763.33	-1.79**	827.85	-1.66**	813.58	-1.72**	863.23
b^-	0.19**	7.92	0.18**	8.61	0.28**	25.18	0.17**	9.06
c^+	-1.79**	852.19	-1.65**	874.34	-1.62**	839.34	-1.76**	848.36
b^+	-0.17**	8.43	-0.17**	9.68	-0.22**	16.84	-0.16**	7.32

Panel B: Probit regression matching British pound jumps with U.K. macroeconomic news.

Parameter	UKP	
	Estimate	Chi-Square
c^-	-1.45**	360.08
b^-	-0.35**	23.82
c^+	-1.57**	363.56
b^+	0.29**	14.11

Notes:

a. The Probit regression has the following form:

$$\begin{cases} \Pr(\text{NegativeJump}|\text{News}) = \Phi(c^- + b^- SA) \\ \Pr(\text{Positive Jump}|\text{News}) = \Phi(c^+ + b^+ SA) \end{cases}$$

b. Superscripts "**", "*", and "$" represents significance at the 1%, 5% and 10% level, respectively.

TABLE 9

DESCRIPTIVE PROPERTIES OF SIGNIFICANT CURRENCY COJUMPS SAMPLED AT 5-MINUTE FREQUENCY

	#obs	#Coj	P(coj) (%)	P(coj|jump) (%)				#Coj Match News	P(news|coj) (%)	#Coj Match U.S. News	P(US news|coj match news)(%)
				UKP	EUR	JPY	SF				
UKP-EUR	381818	128	0.034	17.95	19.84			44	34.38	43	97.73
UKP-JPY	378229	73	0.019	10.24		8.87		27	36.99	27	100.00
UKP-SF	349852	129	0.037	18.09			12.81	44	34.11	43	97.73
EUR-JPY	400226	96	0.024		14.88	11.66		42	43.75	40	95.24
EUR-SF	361378	283	0.078		43.88		28.10	64	22.61	61	95.31
JPY-SF	359213	124	0.035			15.07	12.31	42	33.87	40	95.24
UKP-EUR-JPY	377646	45	0.012	6.31	6.98	5.47		22	48.89	22	100.00
UKP-EUR-SF	349500	89	0.025	12.48	13.80		8.84	22	24.72	22	100.00
UKP-JPY-SF	347954	47	0.014	6.59		5.71	4.67	22	46.81	22	100.00
EUR-JPY-SF	358756	68	0.019		10.54	8.26	6.75	35	51.47	35	100.00
UKP-EUR-JPY-SF	347637	40	0.012	5.61	6.20	4.86	3.97	20	50.00	20	100.00

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TABLE 10
PROBIT REGRESSION MODELS FOR COJUMPS

Parameter	UKP-EUR		UKP-JPY		UKP-SF	
	Estimate	Chi-Square	Estimate	Chi-Square	Estimate	Chi-Square
c^-	-2.33**	512.22	-2.32**	565.03	-2.30**	544.76
b^-	0.31**	12.84	0.18*	3.92	0.27**	9.90
c^+	-1.98**	774.58	-2.18**	665.54	-2.04**	769.01
b^+	-0.18**	7.62	-0.15$	3.55	-0.10	2.17

Parameter	EUR-JPY		EUR-SF		JPY-SF	
	Estimate	Chi-Square	Estimate	Chi-Square	Estimate	Chi-Square
c^-	-2.16**	638.73	-1.96**	758.16	-2.11**	654.52
b^-	0.24**	9.42	0.22**	11.01	0.27**	13.55
c^+	-2.05**	733.81	-1.95**	796.52	-2.12**	684.11
b^+	-0.17*	5.23	-0.13*	3.85	-0.19*	6.41

Note:

a. The probit regression has the following form:

$$\begin{cases} \Pr(\text{Negative CoJump}|\text{News}) = \Phi(c^- + b^- SA) \\ \Pr(\text{Positive CoJump}|\text{News}) = \Phi(c^+ + b^+ SA) \end{cases}.$$

b. Superscripts "**", "*", and "$" represents significance at the 1%, 5% and 10% level, respectively.

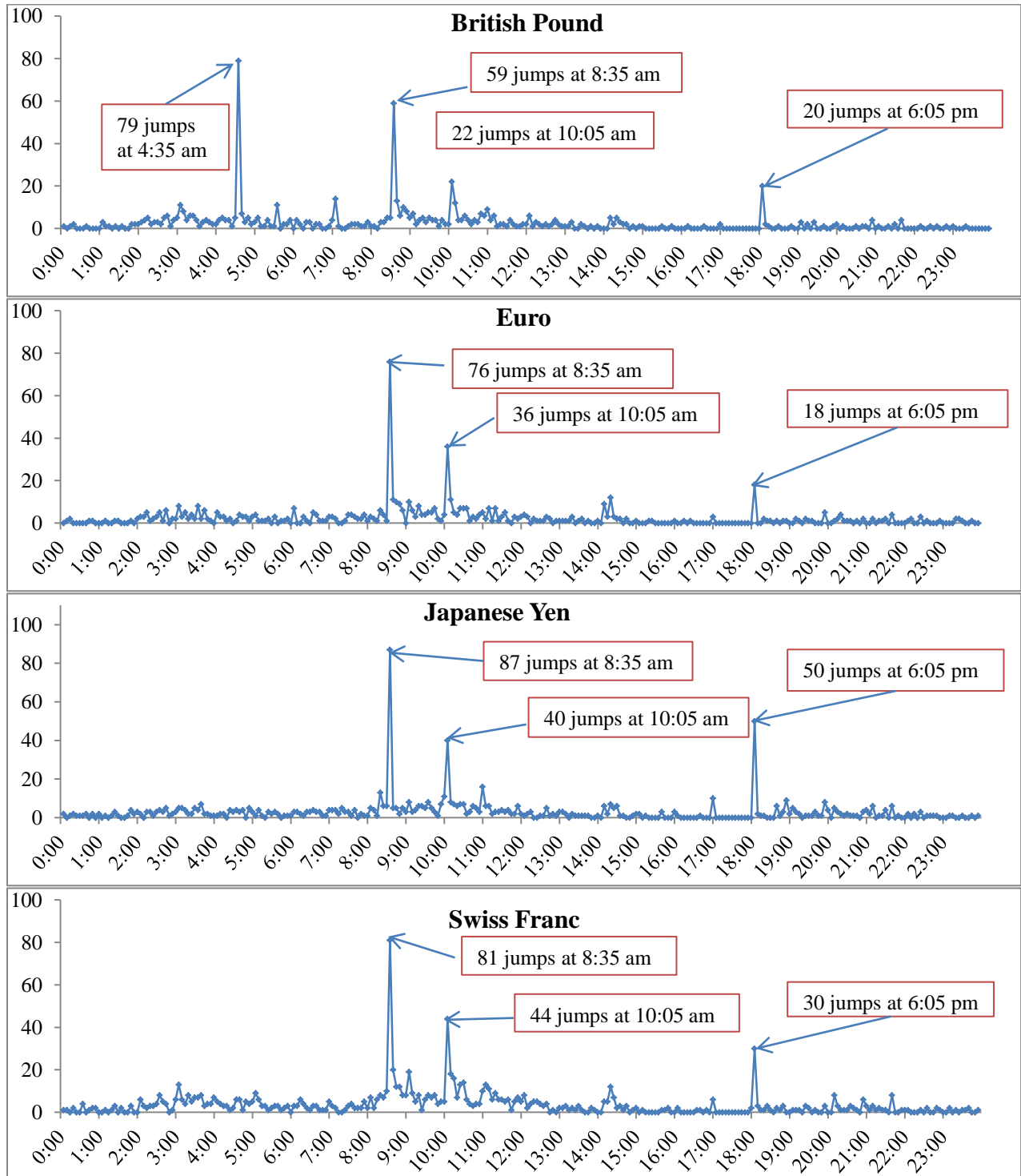FIGURE I. Jump Return Distribution Sampled at 5-Minute Frequency

FIGURE II. Cojump Return Distribution Sample at 5-Minute Frequency
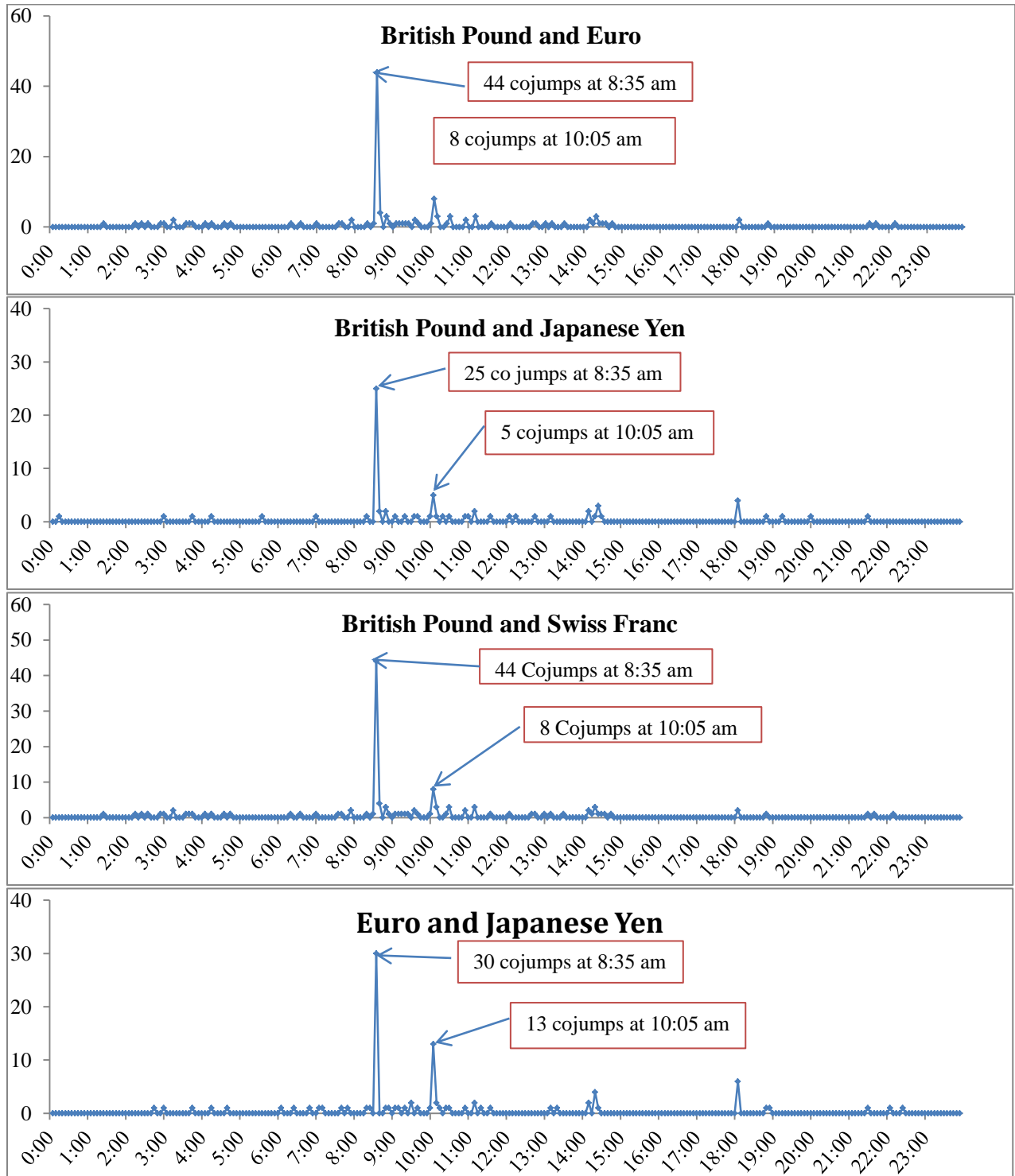

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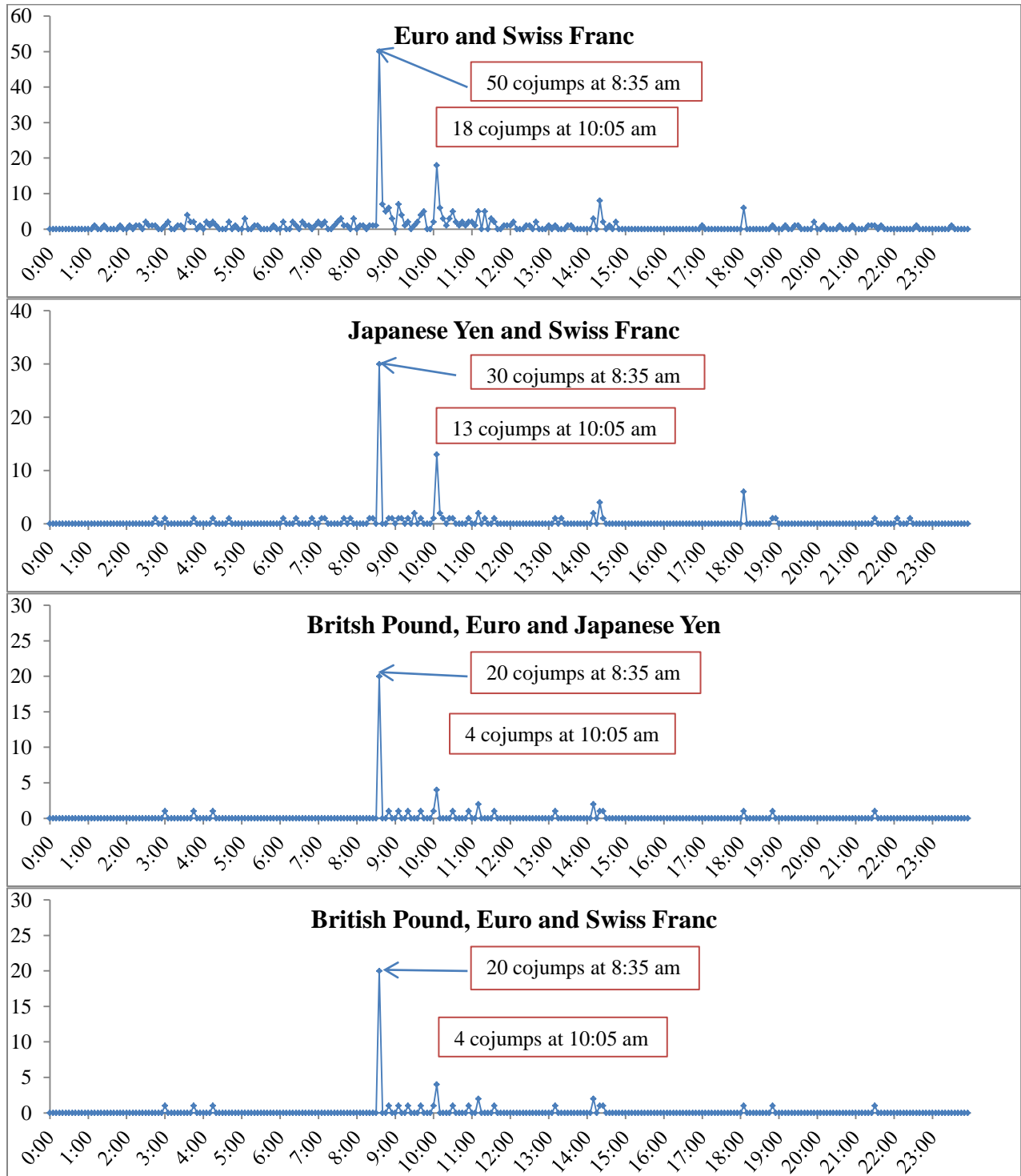FIGURE II. Cojump Return Distribution Sample at 5-Minute Frequency (continued)

Euro and Swiss Franc

50 cojumps at 8:35 am

18 cojumps at 10:05 am

Japanese Yen and Swiss Franc

30 cojumps at 8:35 am

13 cojumps at 10:05 am

Britsh Pound, Euro and Japanese Yen

20 cojumps at 8:35 am

4 cojumps at 10:05 am
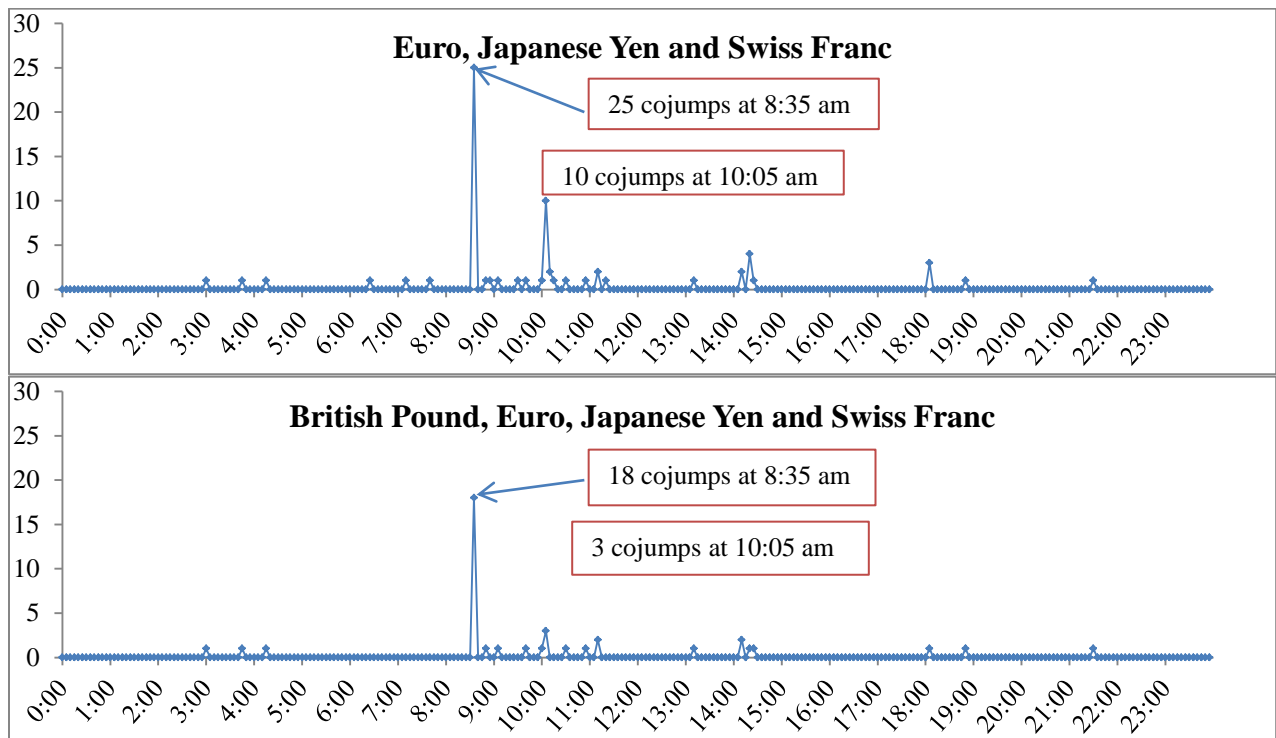
British Pound, Euro and Swiss Franc

20 cojumps at 8:35 am

4 cojumps at 10:05 am

FIGURE III. Persistence of Jumps

Jumps Around News: British Pound

- News & Negative Jumps
- News & Positive Jumps
- No News

Jumps Around News: Euro

- News & Negative Jumps
- News & Positive Jumps
- No News

Jumps Around News: Japanese Yen

- News & Negative Jumps
- News & Positive Jumps
- No News

Jumps Around News: Swiss Franc

- News & Negative Jumps
- News & Positive Jumps
- No News