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Monetary Policy News and Exchange Rate Responses: Do Only Surprises Matter?

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Abstract: This paper shows that exchange rates respond to *only* the surprise component of an actual US monetary policy change and that failure to disentangle the surprise component from the actual monetary policy change can lead to an underestimation of the impact of monetary policy, or even to a false acceptance of the hypothesis that monetary policy has no impact on exchange rates. This finding implies that there is a need for reexamining the empirical analyses of asset price responses to macro news that do not isolate the unexpected component of news from the expected element. In addition, we add to the debate on how quickly exchange rates respond to news by showing that the exchange rates under study absorb monetary policy surprises within the same day as the news are announced.

Key words: Expectations, Monetary Policy, Federal Funds Futures, Exchange Rates.

JEL Classifications: E52, F31, G14.

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1. Introduction

This paper investigates whether exchange rates respond to *only* the surprise component of actual monetary policy changes and whether failure to disentangle the surprise component from the monetary policy news announcement leads to an underestimation of the impact of the news, or even to a false acceptance of the hypothesis that the news has no impact on exchange rates. In addition, we examine whether the exchange rate price adjustment associated with the monetary policy change is instantaneous or delayed.

Recent empirical contributions by Andersen, Bollerslev, Diebold and Vega (2003), Faust, Rogers, Swanson and Wright (2003), Evans and Lyons (2005) and Simpson, Ramchander and Chaudry (2005) find that exchange rates react to monetary policy surprises, i.e. to the unexpected component of a change in the monetary policy stance.[1] This finding is in line with the predictions of the standard asset pricing models of exchange rate determination where exchange rates are viewed as forward-looking asset-prices.[2]

A common characteristic of all these studies, however, is that they focus their analysis of news effects on only one type of variable, namely the surprise component of a news announcement.[3] Rather than focusing on only the surprise component of news which, by construction, is a simple linear function of the actual announcement and the expected component, our analysis makes use of the three variables (the surprise component, the expected component, and the actual announcement) separately.[4]

In doing so we are able to address not only whether exchange rates respond to the surprise component of news but also, at the same time, whether exchange rates respond to the expected component

[1] These papers as well as ours are related to an older literature on the effectiveness of anticipated versus unanticipated monetary policy on output and unemployment. While the recent literature employs survey data or market-based measures of expectations for distinguishing between anticipated and unanticipated monetary policy innovations, the older literature relies on output from econometric models of these policy innovations. Important older contributions include Barro (1977), Barro and Hercowitz (1980) and Mishkin (1982).

[2] Engel and West (2005) revisit the "asset-market" approach to exchange rate determination and conclude that "exchange rates and fundamentals are linked in a way that is broadly consistent with asset pricing models of the exchange rate".

[3] Recent papers by Bernanke and Kuttner (2004), Craine and Martin (2003) and Flannery and Protopapadakis (2002) follow the same approach in regards to using only the surprise element (the difference between announcement and expectation) of news as the explanatory variable when measuring the response of the stock market to monetary policy changes and other macroeconomic news.

[4] We are only investigating the impact of US monetary policy news and, therefore, we do not rescale our news variables by their respective standard deviations.

of news. In other words, unlike the aforementioned studies we are able to address whether exchange rates respond to *only* the surprise component of news. In addition, the inclusion of all three news variables in our analysis makes it possible to assess the importance of focusing on the surprise component of news by comparing the exchange rate response to news when news are measured properly (i.e. when separating the surprise component from the actual announcement) to the exchange rate response to news when news are measured improperly (i.e. when measuring news as simply the news announcement itself). This facilitates a comparison of our findings to the findings of studies that do not distinguish between announcement and surprise component.

Both the predictions of standard asset pricing theory and the survey responses from currency traders reported in Cheung and Chinn (2001) suggest that the effects from macro news announcements are quickly absorbed in prices. Nevertheless, there is no consensus in the empirical literature on exchange rates and macro news in regards to how fast the absorption process really is. For example, Andersen, Bollerslev, Diebold and Vega (2003) find that exchange rates generally respond within five minutes of the news announcement (characterized by a jump immediately following the announcement and little movement thereafter) while Faust and Rogers (2003) and Faust, Rogers, Swanson and Wright (2003) in the context of identified (recursively or not) VAR models show confidence intervals consistent with exchange rate responses occurring anywhere from instantaneously to five years after the news announcement. Similarly, Evans and Lyons (2005) find delayed exchange rate responses several days after the news occurred while Simpson, Ramchander and Chaudry (2005) show that exchange rates respond to news within the same day as the news are announced. Our analysis also adds to the literature on how quickly exchange rates respond to monetary policy news.

We focus our investigation on the 42 US monetary policy changes that occurred during the 1989 to 2000 time-period and we follow Kuttner (2001) and Faust, Rogers, Swanson and Wright (2003) and use data on Fed funds futures for isolating the surprise component of each of these actual policy

changes.[5, 6] In particular, we use the decomposition of the actual change into an expected and a surprise (unexpected) component, as displayed in Kuttner (2001, p. 532). Furthermore, we use an event study approach and incorporate several control variables that capture the surprise element of US macroeconomic news and policy developments. The period under study is characterized as a floating exchange rate regime, thus there is no reason to believe that the Fed changes US monetary policy in response to same-day or short-term exchange rate movements. Based on this institutional factor, it seems reasonable to assume that exchange rates are reacting to monetary policy changes, rather than the reverse.

Consistent with standard asset pricing theory applied to exchange rates we find that the expected component of a monetary policy change has no impact on the exchange rate while the unexpected component of a tightening (loosening) of US monetary policy is associated with a same-day appreciation (depreciation) of the USD. By comparing the exchange rate response to news with news decomposed into a surprise and an expected component, to the exchange rate response to news with news measured simply by the actual announcement itself (which is the sum of the surprise and the expected component) we show how failure to disentangle the surprise component from the actual monetary policy change can lead to an underestimation of the impact of monetary policy or even to a false acceptance of the hypothesis that monetary policy has no impact on exchange rates.

This is an important result as it implies the need for reexamining past empirical work of asset price responses to macro news whenever such work merely equate macro announcement with macro innovation without explicitly taking into account the importance of expectations. Specifically, this result may suggest a possible explanation for why our findings appear at odds with the findings presented in two well-known studies by, respectively, Eichenbaum and Evans (1995) and Lewis (1995). These studies do

[5] Since the market for Fed funds futures opened in 1988, empirical studies have found the Fed funds futures contract an extremely useful proxy for market expectations of future monetary policy (see Carlson, McIntire and Thomson, 1995, and Krueger and Kuttner, 1996, for early contributions, as well as Sack, 2002, and Sack, Swanson and Gurkaynak, 2002 and others).

[6] The contributions by Andersen, Bollerslev, Diebold and Vega (2003), Evans and Lyons (2005) and Simpson, Ramchander and Chaudry (2005) use survey data instead of market based measures for capturing expectations and, in turn, extracting the surprise component of news.

not distinguish between news announcement and surprise component and they do not find evidence in support of an immediate exchange rate response to monetary policy changes.

Adding to the debate on how quickly exchange rates respond to news, we find an absence of delayed effects which strongly suggests that the exchange rates under study absorb monetary policy surprises quickly and within the same day as the news are announced. Although our study employs separate measures of the surprise, the expected component, and the news announcement itself and, furthermore, we use a market based measure of expectations and thus avoid relying on survey data, our findings in regards to the speed of the absorption of news are, nevertheless, consistent with the findings presented in Andersen, Bollerslev, Diebold and Vega (2003) and Simpson, Ramchander and Chaudry (2005). However, our evidence in favor of a quick absorption process is at odds with the findings of Evans and Lyons (2005).

The rest of the paper is organized as follows. Section 2 briefly discusses the data and the Fed funds futures market. Section 3 presents the empirical analysis and results as well as several robustness checks. Section 4 further discusses our results in light of other contributions and concludes.

2. Data

We focus our analysis on the 42 US monetary policy changes that occurred during the 1989 to 2000 time-period and use Kuttner's decomposition (Kuttner 2001) to isolate the surprise component of each of these actual policy changes. Kuttner (2001) measures surprises associated with an actual monetary policy (i.e. Fed funds target rate) change as the difference between the actual announcement and expectations, the latter extracted from Fed funds futures data. Specifically, he uses daily spot-month Fed funds futures market data for disentangling expected from unexpected changes. He argues that his method for extracting the unexpected element of a target rate change generally "delivers a nearly pure measure of the one-day surprise target change" (Kuttner, 2001, p. 529).

Fed funds futures have been trading at the Chicago Board of Trade (CBOT) since October 1988. Futures contracts with maturities of one through 24 months are listed, along with a current-month (spot-

month) contract. By construction of the contracts, Fed funds futures rates implicitly embody predictions of the monthly average of the daily Fed funds rate for a future calendar month. For example, when the price of the one-month ahead contract changes on any given day in, say, January, this implies that market expectations of the average price of the Fed funds rate over the month of February has changed. Early studies by Carlson, McIntire and Thomson (1995) and Krueger and Kuttner (1996) show that Fed funds futures rates provide efficient and unbiased predictors of future funds rate movements at short horizons. Recent papers by Chernenko, Schwartz and Wright (2004) and Piazzesi and Swanson (2004) find a 3 basis point premium at one month horizons and a 6 basis point premium at two month horizons, illustrating that the longer the horizon the less useful a predictor is the Fed funds futures contract.

As pointed out by Kuttner (2001), there are two technical issues involved in using the Fed funds futures data for measuring expectations of future monetary policy. First, the Fed funds futures settlement price is calculated as an average of the relevant month's Fed funds rate. Second, the Fed funds future is not based on the actual policy instrument, the targeted Fed funds rate, but on the effective market rate. Kuttner (2001) carefully addresses these issues and computes a policy surprise measure based on the one-day change in the spot-month future rate, utilizing the fact that the day-t futures rate embodies the expected change on (or after) date t+1. If the target rate change occurs as expected, the spot rate will remain unchanged, while a deviation from the expected rate will cause the futures rate to change (in proportion to the remaining number of days affected by the unexpected change). For all but the first day of the month, he computes the one-day surprise for date t as $\frac{m}{m-t}(f_{s,t} - f_{s,t-1})$, where m is the number of days in the month and $f_{s,t}$ is the spot-month futures rate on day t of month s. For the first day of the month, the one-month futures rate from the last day of the previous month replaces the term $f_{s,t-1}$.

The 42 monetary policy change events and the decomposition of the actual change into the respective expected and unexpected components, respectively, are displayed in Kuttner (2001, p. 532).

The exact timing of the US monetary policy changes is an important issue. Until 1994, the Fed did not announce but signaled its decision to change the target rate through open market operations undertaken before noon (from 11.30 to 11.35 am) Eastern time. Starting in 1994, the Fed adopted a routine of announcing target rate changes and from 1995 onwards it did so at 2.15 pm Eastern time.[7] Since the announcement routine has changed during our sample period, no exchange rate quote time-stamp is ideal for the entire period under study. Our baseline analysis reports the results from models using noon Eastern time exchange rate quotes while the robustness analysis described in section 3.6 uses 3 pm Eastern time quotes as well as a mix of quotes. Accordingly, our analysis incorporates two separate foreign exchange market data-sets. The first consists of daily spot prices for the DEM/USD, JPY/USD and GBP/USD exchange rates obtained from the Pacific Exchange Rate Service and recorded at noon Pacific time (3 pm Eastern time). The second consists of daily spot prices for the same three exchange rates obtained from the Board of Governors of the Federal Reserve and recorded at noon Eastern time.

We control for macroeconomic news surprises coinciding with US monetary policy changes. We measure surprises as the difference between official announcements regarding CPI, PPI, industrial production, the unemployment rate and the trade balance, and results of surveys of expectations of these announcements conducted by Money Market Services and Bloomberg during the days preceding the announcements. The official value of these news variables is announced once a month, or at a lower frequency. Our news variables capture the associated surprise element on announcement dates, thus these variables are non-zero only on announcement dates and only when the announcement differs from market expectations.

Official foreign exchange intervention data and foreign interest rate data are obtained directly from the central banks relevant for this study. Table 1 provides descriptive statistics for all the variables.

[7] For additional details on the timing of Fed announcements, see Kuttner (2001) and Andersen, Bollerslev, Diebold and Vega (2003).

3. Exchange Rate Responses to Actual Monetary Policy Changes

When focusing on exchange rate responses to actual monetary policy changes, the asset-pricing approach to exchange rate determination suggests that an exchange rate should react to only the surprise component of such monetary policy news and it should do so "instantaneously".[8]

We formally test whether only the surprise element of a monetary policy change is systematically associated with exchange rate responses by incorporating the Kuttner-decomposition of actual monetary policy changes into an expected and an unexpected (surprise) component. Using an event study approach in the tradition of Cook and Hahn (1989), we regress the change in the (log of the) spot exchange rate on the expected and the unexpected component of the target rate change:

$$(1) \qquad \Delta s_t = \alpha + \beta_1 \tilde{r}_t^e + \beta_2 \tilde{r}_t^u + CZ_t + \varepsilon_t$$

where Δs_t is the first-difference in the log of the daily spot exchange rate and $\tilde{r}_t^e$ ($\tilde{r}_t^u$) is the expected (unexpected) target rate change in percentage points, and C is the coefficient vector associated with the control variables contained in Z_t.

The control variable matrix Z_t contains the unexpected component of macroeconomic news on days when an official macroeconomic announcement coincides with a monetary policy change. Specifically, we control for the types of macroeconomic news that Bonser-Neal and Tanner (1996) and, more recently, Galati, Melick and Micu (2005) have found to impact exchange rates. We do so by incorporating several variables that capture the surprise element of US macroeconomic news and policy developments regarding CPI (CPI-UNEXP), PPI (PPI-UNEXP), industrial production (IP-UNEXP), the unemployment rate (UNEM-UNEXP) and the trade balance (TRDE-UNEXP).[9]

[8] See Engel and West (2005) for a recent discussion of the asset-market approach to exchange rate determination.

[9] Since central bank foreign exchange intervention conducted by central banks may impact day-to-day changes in the spot exchange rates as well, we also control for the effects of such actions by either the Fed or the foreign central bank. Similarly, we control for actual monetary policy changes by foreign central banks. However, while we are able to capture the surprise element of the control variables contained in Z_t we do not have corresponding measures

Clearly, if the Fed had been following a fixed or managed float exchange rate policy from 1989 onwards, US monetary policy changes could have been systematically affected by same-day exchange rate changes. However, as pointed out by Eichenbaum and Evans (1995) and Kim and Roubini (2000), the period under study is characterized as a floating exchange rate regime, thus there is no reason to believe that the Fed changes US monetary policy in response to same-day or short-term exchange rate movements. Based on this institutional factor, therefore, simultaneous equation bias (endogeneity) should not be present in our regression models.[10]

In order to assess the importance of disentangling the surprise component from the actual monetary policy change we estimate a regression model of the exchange rate response to the monetary policy change without using the Kuttner-decomposition:

$$(2) \qquad \Delta s_t = \alpha + \beta_1(\tilde{r}_t^a) + CZ_t + \varepsilon_t$$

where $\tilde{r}_t^a$ (= $\tilde{r}_t^e$ + $\tilde{r}_t^u$) is the actual monetary policy change in percentage points. Consistent with Cook and Hahn (1989) and Kuttner (2001) we estimate the regression models described by equations 1) and 2) using standard OLS estimation techniques.

In order to test whether exchange rate markets absorb monetary policy news quickly or whether the absorption process stretches over or takes place after several days we estimate regression models characterized by the following equation:

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of the surprise element of central bank intervention or foreign monetary policy changes. Therefore, we address the issue of interventions and foreign monetary policy changes in the robustness section while our baseline models described in this section incorporate only the control variables that are based on expectations and capture surprises.

[10] In the context of a time-series analysis of exchange rate responses to day-to-day changes in monetary policy expectations in-between actual monetary policy changes, Fatum and Scholnick (forthcoming) formally test for simultaneity bias by conducting a standard Hausman test for endogeneity of regressors (see Hausmann 1978 and 1983). They strongly accept the null hypothesis of no simultaneity bias for the DEM/USD, the JPY/USD and the GBP/USD exchange rates. Although the focus and the context of their analysis are very different from what we investigate in this paper, their acceptance of the no simultaneity bias hypothesis also implies that the estimations presented in this paper are free of simultaneity bias.

(3) $\Delta s_{t+k} = a + b_1 \tilde{r}_t^e + b_2 \tilde{r}_t^u + CZ_{t+k} + \varepsilon_t$, k=0,…60.

where Δs_{t+k} is the first-difference in the log of the spot exchange rate k-periods ahead and Z_{t+k} contains the control variables k-periods ahead. Since our analysis uses an event study approach instead of time-series techniques, testing for delayed effects by lagging the exogenous monetary policy variable is not meaningful. Therefore, leads of the independent variable and the associated news control variables rather than lags of the monetary policy variables are used for capturing any delayed exchange rate responses to the monetary policy changes.

We estimate the regression models described by equation 3) using standard OLS with Newey-West covariances (see Newey and West, 1987) in order to take into account the possibility of autocorrelation in the control variables.

The estimations cover up to 60 leads of the independent variable (12 business weeks, ensuring that we capture any delayed effects in-between FOMC dates). For the sake of exposition, we only display a summary of each of the estimations using 0 through 15 leads (three business weeks), respectively, for each of the three exchange rate variables.

A quick absorption process would be consistent with monetary policy surprises being systematically related to same-day changes in exchange rates (i.e. b_1 should be significant only when k=0) while the "current" monetary policy surprises should be orthogonal to "future" exchange rates (i.e. b_1 for $k = 1,...,60$ should all be insignificant).

3.2 The DEM/USD Exchange Rate

The first two columns of Table 2 show the estimation results from regressing same-day changes in the DEM/USD exchange rate on the expected and the unexpected components of the Fed funds target rate changes, as described in equation (1). The first column shows the results when including all the news control variables while the second column shows the results when including only the significant news

control variables. For both models the b_1 coefficient is insignificant while the b_2 coefficient is positive and significant at the 99 percent level, suggesting that the expected component of a monetary policy change has no impact on the exchange rate while the unexpected component of a tightening (loosening) of US monetary policy is associated with an immediate appreciation (depreciation) of the USD vis-à-vis the DEM. The coefficient estimates imply that an unexpected one percentage point (one hundred basis points) change in the target rate is associated with a 2.7 percent same-day change in the exchange rate. Or, equivalently, an unexpected 25 basis point change in the target rate is associated with a 0.675 percent same-day change in the exchange rate.

The last two columns of Table 2 show the estimation results from regressing same-day changes in the DEM/USD exchange rate on the actual change in the Fed funds target rate (i.e. the sum of the expected and the unexpected components), as described in equation (2). Again, the first of these two columns shows the results when including all the news control variables while the second column shows the results without any news control variables included as none of these appear to be significant.

None of the two models show any significant effects of a monetary policy change when the Kuttner-decomposition is not used, i.e. when the unexpected component is "hidden" in the actual change.

This finding shows that assessing the impact of monetary policy changes on exchange rates without taking into account expectations in order to isolate the surprise component would lead to a wrong conclusion, namely that monetary policy changes do not matter for exchange rates. We see this as an important result because it highlights the necessity of focusing on the surprise component of news rather than on the actual news (i.e. the sum of the surprise and the expected component) itself.

Turning to the delayed effects and the issue of how quickly the exchange rate absorbs monetary policy news, Table 3 shows the coefficient estimate associated with the unexpected component of the Fed funds target rate changes for each of the first 15 lead-models described in equation (3) and, in order to facilitate an easy comparison between same-day and delayed effects, repeats the same-day coefficient also shown in the second column of Table 2. In other words, each row of Table 3 is associated with a separate

regression model, and each row shows the coefficient estimate (and standard error) for only the surprise component of an actual monetary policy change regardless of whether or not any of the news control variables are significant and included in the regression.[11]

Whereas the same-day effect is highly significant, as previously discussed, the table shows that none of the lead models are associated with significant effects of the unexpected component of a monetary policy change. This complete absence of delayed effects implies that the DEM/USD response to a monetary policy surprise takes place on the same day as the monetary policy change occurs and, therefore, strongly suggests that the DEM/USD exchange rate market absorbs news quickly.

3.3 The JPY/USD Exchange Rate

The results from regressing same-day changes in the JPY/USD exchange rate on the expected and the unexpected components of the Fed funds target rate changes are displayed in the first two columns of Table 4. The last two columns of Table 4 show the results from the regression models using the actual change in the Federal Funds target rate as the focal explanatory variable. The results are very similar to those based on the DEM/USD exchange rate.

Focusing on the model using the Kuttner-decomposition and only including significant news control variables, the results (displayed in the second column of Table 4) show an insignificant estimate of the b_1 coefficient and a positive and (this time only marginally) significant b_2 coefficient, thus once again indicating that an unexpected tightening (loosening) of US monetary policy is associated with a same-day depreciation (appreciation) of the foreign currency. The magnitude of the estimated b_2 coefficient suggests that a one percentage point (one hundred basis points) change in the target rate triggers a 1.26 percent same-day change in the exchange rate.

[11] A high R^2 statistic and a highly significant F-statistic are, in the absence of a significant coefficient associated with the surprise component of the monetary policy change, due to the inclusion of one or more significant news control variables.

As before, none of the regression models using the sum of the expected and the unexpected components as a single explanatory variable display any significant effects of a monetary policy change. Again, this illustrates the importance of extracting the unexpected component from the actual change in order to avoid arriving at wrong conclusions.

The relevant lead model results for the JPY/USD are summarized in Table 5. With the exception of a marginally significant coefficient estimate for the k=14 lead model, the table shows that none of the lead models are associated with significant effects of the unexpected component of a monetary policy change. The analysis, therefore, suggests that the JPY/USD exchange rate market absorbs news quickly.

3.4 The GBP/USD Exchange Rate

The results of the analysis of the GBP/USD exchange rate responses are very similar to those based on the other two exchange rates in our sample and the key findings are repeated. Tables 6 and 7 display these findings.

The first two columns of Table 6 show that for both model specifications the b_1 coefficient is insignificant while the b_2 coefficient is again positive and significant (at the 95 percent level). The coefficient estimates imply that an unexpected one percentage point (one hundred basis points) change in the target rate is associated with a 2.0 – 2.18 percent same-day change in the exchange rate (or an unexpected 25 basis point change in the target rate is associated with a 0.5 percent same-day change in the exchange rate).

The last two columns show, interestingly, that even without isolating the unexpected component from the actual monetary policy change the regression analysis suggests that monetary policy changes trigger a same-day exchange rate response. More interesting, however, is it to compare the magnitude of the coefficient estimates associated with the actual change to the magnitude of the coefficient estimates associated with the unexpected or surprise component of the change. The coefficient estimates stemming from the model focusing on the announced policy change without isolating the surprise would imply that

a one percentage point (one hundred basis points) change in the target rate is associated with a 0.82 – 0.95 percent same-day change in the exchange rate. This is less than half of the magnitude suggested by the regressions using the Kuttner-decomposition and the isolated surprise component of the policy change. In other words, our findings illustrate that using the actual change as a measure of the impact of a monetary policy change will underestimate the importance of monetary policy (in the case of the GBP/USD exchange rate) or even wrongfully reject any effects of monetary policy (in the case of the DEM/USD and the JPY/USD exchange rates).

Table 7 shows the coefficient estimate associated with the unexpected component of the Fed funds target rate changes for each of the first 15 GBP/USD exchange rate lead-models described in equation (3). These results mimic the results for the DEM/USD exchange rate as none of the GBP/USD lead models are associated with significant effects of the unexpected component of a monetary policy change. This complete absence of delayed effects implies that the GBP/USD exchange rate market absorbs news quickly.

3.5 Macroeconomic News

Consistent with Bonser-Neal and Tanner (1996), Galati, Melick and Micu (2005) and others, we find evidence that surprises regarding macroeconomic news affect exchange rate fluctuations across all three exchange rates in our sample. However, since we are using an event study approach in order to focus on the impact of monetary policy changes (and not a time-series analysis), our regression models described by equations 1) and 2) only incorporate the announcement surprises on days coinciding with the 42 monetary policy changes in our sample while our regression models described by equation 3) only incorporate the announcement surprises coinciding with the same 42 days leaded one day at a time (as k goes from 1 to 60). Therefore, our analysis, by construction, does not facilitate strong conclusions regarding the exchange rate responses associated with these announcement surprises.

3.6 Additional Robustness Checks

In order to test the robustness of our results, we also carry out the analysis using different exchange rate quotes time-stamps, redo the estimations on various sub-samples, and address issues pertaining to the possibility of asymmetric effects and slow absorption processes of the announcement surprises contained in the news control variables.

First, as noted earlier, the announcement routine of the Fed has changed during the sample period and, therefore, no exchange rate quotes time-stamp is ideal for the entire period under study. We test the robustness of our baseline results (employing only noon Eastern exchange rate quotes) by redoing all the estimations using instead exchange rates recorded at 3 pm Eastern time (ideal for the target rate changes that occurred during the last part of the sample). In addition, we use a mix of exchange rate quotes (exchange rates recorded at noon Eastern time for the 24 target rate changes that occurred prior to 1994 and exchange rates recorded at 3 pm Eastern time for the target rate changes that occurred after 1994). Our baseline results are not affected by using these alternative exchange rate quotes.[12]

Second, we redo the estimations using only US target rate change events that do not coincide with interest rate changes conducted by the relevant foreign central bank. This is done to ensure that the estimated exchange rate responses to US monetary policy surprises are not partly driven by simultaneous monetary policy changes carried out by foreign central banks. The results are identical to those based on the full sample. [13]

[12] Another way of addressing the timing issue would be to split up the sample into two sub-samples, conduct the event study analysis on these sub-samples separately, and use exchange rates with a noon Eastern time-stamp for the 1989-1994 sample and exchange rates with a 3 pm Eastern time-stamp for the second part of the sample. However, this is unappealing due to the relatively few events in the full sample (42 for the JPY/USD and GBP/USD exchange rates and 38 for the DEM/USD exchange rate).

[13] Fed funds target rate change events coinciding with changes in the German Discount and Lombard rates, the Japanese Discount Rate of Commercial Bills and the British Minimum Lending Rate and Repo Rate are excluded. This leads to exclusion of two events from the DEM/USD sample and one event from the GBP/USD sample.

Third, we redo the estimations using only events that do not coincide with intervention operations conducted (unilaterally as well as coordinated) by the Fed, the Bundesbank and the Bank of Japan. [14] Again, the results are unchanged.

Fourth, we expand equation (1) to incorporate various dummies in order to test for asymmetric exchange rate responses to the unexpected component of a monetary policy change. In particular, we separate monetary tightening from monetary loosening. We find, however, no evidence of asymmetries.

Fifth, in order to allow for the possibility of a slow absorption process in regards to other macro news announcements the lead-models are also estimated including all leads of the news control variables ranging from 1 to 60 (as opposed to the baseline approach where each lead model includes only the associated lead of the news control variables). This alteration has no impact on the delayed effect results.

4. Conclusion

We investigate whether exchange rates respond to only the surprise component of actual monetary policy changes and we assess the importance of isolating the surprise component from the actual news announcement. Furthermore, we investigate whether the exchange rate adjustment associated with monetary policy surprises is instantaneous or delayed. We focus our investigation on the 42 US monetary policy changes that occurred during the 1989 to 2000 time-period and we follow Kuttner (2001) in using Fed funds futures data in order to isolate the surprise component of each of these actual policy changes. In addition, we incorporate several control variables that capture the surprise element of US macroeconomic news and policy developments.

Our main findings are the following: First, we show that the expected component of a monetary policy change has no impact on the exchange rate while the unexpected component of a tightening (loosening) of US monetary policy is associated with a same-day appreciation (depreciation) of the USD and, importantly, that failure to disentangle the surprise component from the actual monetary policy

[14] This leads to exclusion of one event from the DEM/USD sample and one event from the JPY/USD sample. Due to unavailability of Bank of England intervention data, we are not able to control for intervention in the GBP/USD exchange rate.

change can lead to an underestimation of the impact of monetary policy or even to a false acceptance of the hypothesis that monetary policy has no impact on exchange rates. Second, we show that for all the 45 displayed lead-models (15 leads estimated separately for each of the three exchange rates in our sample), no coefficient estimate associated with the surprise component of monetary policy changes appears significant at the 95% significance level or higher and only one instance of significance at the 90% level occurs. This absence of delayed effects strongly suggests that the exchange rates under study absorb monetary policy surprises within the same day as the news are announced.

Comparing our findings to other studies, our findings appear at odds with two related and well-known studies (neither of which focuses on expectations) of exchange rate responses to actual monetary policy innovations. Using three measures of monetary policy and a VAR approach for analyzing monthly data, Eichenbaum and Evans (1995) find that initial USD appreciation in response to a US monetary contraction is small in comparison with subsequent USD appreciation and for the GBP/USD and the JPY/USD exchange rates the initial response is insignificant. Similarly, Lewis (1995) uses a VAR approach and biweekly data and finds no significant immediate reaction to (again, three measures of) monetary policy for either the DEM/USD or the JPY/USD exchange rate. As shown in section 3 of our study, it is necessary to disentangle the surprise component from the actual monetary policy change in order to avoid arriving at incorrect conclusions regarding exchange rate responses to monetary policy. It is indeed possible that both Eichenbaum and Evans (1995) and Lewis (1995) underestimate the initial impact of monetary policy due to their focus on actual monetary policy changes rather than on monetary policy surprises.

Furthermore, our findings appear at odds with Evans and Lyons (2005). Investigating daily aggregates from an end-user microstructure data-set and employing VAR estimation techniques, they find that news such as monetary policy surprises induce changes in end-user trading and that these changes remain significant for several days. In other words, their findings imply that surprises matter but exchange rates do not absorb news instantaneously. Evans and Lyons (2005) suggest that a possible explanation for their finding of delayed effects is that in the case of non-financial corporations the “ultimate decision

makers" are not the people who are in charge of continuous monitoring of markets. Therefore, argues Evans and Lyons (2005), these corporations will not respond to news until the time of their, say, weekly "currency strategy meeting" when the ultimate decision makers are present. If this description of an important institutional aspect of decision making structures is accurate, it would indeed induce response lags to news. However, delayed responses to news are costly and the argument offered by Evans and Lyons (2005) does not explain why corporations with less frequent strategy meetings are not over time driven out of the market by corporations with more frequent strategy meetings.

Our findings appear in line with Bonser-Neal, Roley and Sellon, Jr. (1998). They use an event study approach and the Fed funds target rate as a measure of monetary policy actions and show that exchange rates generally respond immediately to changes in US monetary policy. Their work, however, does not focus on expectations. As such, their findings may have some resemblance to ours when we analyze the GBP/USD exchange rate. Even without isolating the monetary policy surprise component we show that monetary policy changes are associated with same-day GBP/USD exchange rate changes. However, we also show that without disentangling the surprise from the actual change it is possible that the impact of a monetary policy change is underestimated.

Despite our study being different due to, in particular, our use of separate measures of the surprise component, the expected component, and the news announcement itself and, furthermore, our use of a market based measure of expectations, our findings seem consistent with the high-frequency analysis by Andersen, Bollerslev, Diebold and Vega (2003) and the daily data analysis by Simpson, Ramchander and Chaudry (2005). Both of these papers focus on the exchange rate responses to only the surprise component of news and both use survey data for measuring expectations. In the context of a two-stage weighted least squares time-series analysis and, subsequently, an event study analysis, Andersen, Bollerslev, Diebold and Vega (2003) show that exchange rates generally respond instantaneously (characterized by a jump immediately following the announcement and little movement thereafter) to news such as Fed fund target rate changes. Simpson, Ramchander and Chaudry (2005) use a VECM

framework and show that, in particular, a loosening of US monetary policy is associated with a same-day depreciation of the USD.

Two insights that follow from our work are that only the surprise component of an actual monetary policy change has an impact on exchange rates and that the associated exchange rate response occurs within the same day of the policy change. The most important insight, however, is that failure to disentangle the surprise component from the actual monetary policy change can lead to an underestimation of the impact of monetary policy or even to a false acceptance of the hypothesis that monetary policy has no impact on exchange rates. This has general implications for the empirical literature on asset price responses to macro news. It suggests that there is a need for reexamining the results from empirical analyses that do not isolate the unexpected component of news from the expected element.

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TABLE 1: **Summary Statistics**

	Mean	**Std. Dev.**	**Max**	**Min**	**Non-Zero Observations**
Federal Funds Target Rate Change Unexpected (pct. points)	0.0757	0.1327	0.14	-0.36	42
Federal Funds Target Rate Change Expected (pct. points)	-0.0195	0.2296	0.61	-0.29	42
Federal Funds Target Rate Change Actual (pct. points)	-0.0952	0.3072	0.75	-0.50	42
DEM/USD Daily Spot Rate	1.6372	0.1386	2.0295	1.356	2434
GBP/USD Daily Spot Rate	0.6190	0.0435	0.7144	0.499	2989
JPY/USD Daily Spot Rate	119.3039	16.1690	159.91	81.071	2989
US CPI Unexpected	-0.0006	0.0246	0.3	-0.3	94
US Industrial Production Unexpected	0.0013	0.0527	0.9	-0.7	121
US PPI Unexpected	-0.0028	0.0561	0.6	-0.8	120
US Trade Balance Unexpected	-0.0111	0.3246	2.75	-3.8	141
US Unemployment Rate Unexpected	-0.0015	0.0311	0.4	-0.4	97
Bundesbank Intervention (binary)	0.0514	0.2208	1	0	125
Bundesbank Interest Rate (binary)	0.0070	0.0835	1	0	21
Bank of England Interest Rate (binary)	0.0144	0.1191	1	0	43
Bank of Japan Interest Rate (binary)	0.0054	0.0730	1	0	16
Bank of Japan Intervention (binary)	0.0646	0.2458	1	0	193

NOTES:

a) All data series run from March 27, 1989 to February 2, 2002, with the exception of the DEM/USD exchange rate which ends on December 31, 1998. All data are five days a week (Monday to Friday).
b) Mean and std. dev. for the Federal Funds Target Rate variables are calculated using only non-zero observations.

Data Sources:
Federal Funds Target Rate Data: From Kuttner (2001).
Exchange Rate Data: Board of Governors of the Federal Reserve (Noon Eastern Time).
Bundesbank, Bank of England and Bank of Japan Data: From official central bank sources.
U.S. Macroeconomic Surprise Data: From Money Market Services and Bloomberg (the surprise is measures as the difference between actual announcement and median survey value).

TABLE 2 **DEM/USD: Exchange Rate Responses to Changes in The Federal Funds Target Rate**				
Daily Data: 27 March 1989 to 31 December 1998				
	Model 1A	Model 1B	Model 2A	Model 2B
C	-0.0007 (0.0014)	-0.0005 (0.00112)	-0.0015 (0.0014)	-0.0015 (0.0012)
FFT-EXPECTED	-0.0019 (0.0061)	-0.0016 (0.0050)		
FFT-UNEXPECTED	0.0269*** (0.0097)	0.0267*** (0.0087)		
FFT-ACTUAL			0.0076 (0.0046)	0.0061 (0.0037)
CPI-UNEXP	-0.0223 (0.0640)		-0.0412 (0.0673)	
IP-UNEXP	0.0061 (0.0390)		-0.0057 (0.0410)	
PPI-UNEXP	-0.0007 (0.0222)		-0.0127 (0.0229)	
TRDE-UNEXP	-0.0002 (0.0043)		0.0023 (0.0044)	
UNEM-UNEXP	0.0327** (0.0159)	0.0322** (0.0148)	0.0218 (0.0160)	
Observations	38	38	38	38
R-squared	0.26	0.26	0.14	0.07
S.E. of regression	0.0066	0.0063	0.0070	0.0068
F-statistic	1.5246	3.8885**	0.8572	2.7106

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equations (1) and (2) in the text.
(d) The dependent variable is the first difference of the log of the daily DEM/USD spot exchange rate.
(e) The independent variables FFT-EXPECTED and FFT-UNEXPECTED measure the expected and the unexpected element, respectively, of the Federal Funds Target rate change on FOMC dates. Both variables are taken from Kuttner (2001). The independent variable FFT-ACTUAL is the actual Federal Funds Target rate change on FOMC dates.
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).

TABLE 3 **DEM/USD: Summary of Same-Day and Delayed Exchange Rate Responses to the Unexpected Change in The Federal Funds Target Rate**

Daily Data: 27 March 1989 to 31 December 1998

Each row below is associated with a separate regression model. Only the point estimate and the associated standard error for the independent variable FFT-UNEXPECTED are shown, regardless of whether or not the control variables are significant.

	FFT-UNEXPECTED	R-squared	F-statistic
DLNDEM(0)	0.0267*** (0.0087)	0.26	3.8885**
DLNDEM(1)	-0.0040 (0.0094)	0.16	0.9382
DLNDEM(2)	-0.0190 (0.0112)	0.12	0.6902
DLNDEM(3)	-0.0024 (0.0095)	0.22	1.3385
DLNDEM(4)	-0.0052 (0.0080)	0.14	0.9297
DLNDEM(5)	-0.0090 (0.0106)	0.12	0.6581
DLNDEM(6)	-0.0179 (0.0108)	0.30	2.1190*
DLNDEM(7)	-0.0023 (0.0093)	0.12	0.6273
DLNDEM(8)	-0.0019 (0.0135)	0.19	0.8494
DLNDEM(9)	-0.0071 (0.0151)	0.20	1.0569
DLNDEM(10)	-0.0147 (0.0095)	0.14	1.4092
DLNDEM(11)	0.0207 (0.0157)	0.27	2.6181**
DLNDEM(12)	-0.0073 (0.0110)	0.10	0.5304
DLNDEM(13)	-0.0124 (0.0104)	0.34	1.8802
DLNDEM(14)	-0.0064 (0.0085)	0.38	2.6277**
DLNDEM(15)	0.0056 (0.0116)	0.09	0.6330

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equation (3) in the text.
(d) The dependent variable is lead one through fifteen of the first difference of the log of the daily DEM/USD spot exchange rate.
(e) The independent variable FFT-UNEXPECTED measures the unexpected element of the Federal Funds Target rate change on FOMC dates. This variable is taken from Kuttner (2001).
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).

TABLE 4 **JPY/USD: Exchange Rate Responses to Changes in The Federal Funds Target Rate**				
Daily Data: 27 March 1989 to 4 April 2001				
	Model 1A	Model 1B	Model 2A	Model 2B
C	-0.0000 (0.0011)	-0.0004 (0.0010)	-0.0005 (0.0010)	-0.0000 (0.0009)
FFT-EXPECTED	0.0001 (0.0045)	0.0014 (0.0042)		
FFT-UNEXPECTED	0.0135 (0.0084)	0.0126* (0.0073)		
FFT-ACTUAL			0.0039 (0.0033)	0.0048 (0.0029)
CPI-UNEXP	-0.0098 (0.0553)		-0.0178 (0.0553)	
IP-UNEXP	0.0157 (0.0141)		-0.0167 (0.0142)	
PPI-UNEXP	-0.0367* (0.0192)	-0.0389** (0.0185)	-0.0422** (0.0188)	-0.0430** (0.0182)
TRDE-UNEXP	-0.0004 (0.0037)		0.0007 (0.0036)	
UNEM-UNEXP	0.0110 (0.0137)		0.0057 (0.0131)	
Observations	42	42	42	42
R-squared	0.26	0.22	0.23	0.19
S.E. of regression	0.0011	0.0012	0.0012	0.0012
F-statistic	1.7470	3.5780**	1.7569	4.6799**

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equations (1) and (2) in the text.
(d) The dependent variable is the first difference of the log of the daily JPY/USD spot exchange rate.
(e) The independent variables FFT-EXPECTED and FFT-UNEXPECTED measure the expected and the unexpected element, respectively, of the Federal Funds Target rate change on FOMC dates. Both variables are taken from Kuttner (2001). The independent variable FFT-ACTUAL is the actual Federal Funds Target rate change on FOMC dates.
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).

TABLE 5 **JPY/USD: Summary of Same-Day and Delayed Exchange Rate Responses to the Unexpected Change in The Federal Funds Target Rate**

Daily Data: 27 March 1989 to 4 April 2001

Each row below is associated with a separate regression model. Only the point estimate and the associated standard error for the independent variable FFT-UNEXPECTED are shown, regardless of whether or not the control variables are significant.

	FFT-UNEXPECTED	R-squared	F-statistic
DLNJPY(0)	0.0126* (0.0073)	0.22	3.5780**
DLNJPY(1)	-0.0067 (0.0093)	0.33	2.7783**
DLNJPY(2)	-0.0090 (0.0095)	0.13	0.8254
DLNJPY(3)	-0.0051 (0.0088)	0.50	5.2350***
DLNJPY(4)	-0.0008 (0.0086)	0.19	1.4382
DLNJPY(5)	-0.0091 (0.0106)	0.14	0.8697
DLNJPY(6)	-0.0240 (0.0149)	0.14	1.1494
DLNJPY(7)	-0.0097 (0.0146)	0.04	0.1922
DLNJPY(8)	-0.0139 (0.0093)	0.36	2.7182**
DLNJPY(9)	-0.0046 (0.0083)	0.04	0.1676
DLNJPY(10)	-0.0016 (0.0070)	0.10	0.6760
DLNJPY(11)	0.0166 (0.0105)	0.28	3.2169
DLNJPY(12)	0.0093 (0.0138)	0.10	0.5030
DLNJPY(13)	-0.0044 (0.0123)	0.20	0.9787
DLNJPY(14)	-0.0285* (0.0137)	0.17	0.8130
DLNJPY(15)	0.0073 (0.0091)	0.31	3.0801

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equation (3) in the text.
(d) The dependent variable is lead one through fifteen of the first difference of the log of the daily JPY/USD spot exchange rate.
(e) The independent variable FFT-UNEXPECTED measures the unexpected element of the Federal Funds Target rate change on FOMC dates. This variable is taken from Kuttner (2001).
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).

TABLE 6 **GBP/USD: Exchange Rate Responses to Changes in The Federal Funds Target Rate**				
Daily Data: 27 March 1989 to 4 April 2001				
	Model 1A	Model 1B	Model 2A	Model 2B
C	-0.0007 (0.0011)	-0.0005 (0.0010)	-0.0014 (0.0010)	-0.0010 (0.0009)
FFT-EXPECTED	0.0045 (0.0045)	0.0046 (0.0042)		
FFT-UNEXPECTED	0.0218** (0.0085)	0.0200** (0.0076)		
FFT-ACTUAL			0.0095*** (0.0033)	0.0082*** (0.0029)
CPI-UNEXP	-0.0365 (0.0556)		-0.0470 (0.0564)	
IP-UNEXP	0.0017 (0.0142)		-0.0030 (0.0145)	
PPI-UNEXP	-0.0229 (0.0193)		-0.0158 (0.0192)	
TRDE-UNEXP	-0.0009 (0.0037)		0.0023 (0.0037)	
UNEM-UNEXP	0.0257* (0.0138)	0.0235* (0.0132)	0.0188 (0.0134)	
Observations	42	42	42	42
R-squared	0.29	0.25	0.23	0.16
S.E. of regression	0.0011	0.0012	0.0012	0.0013
F-statistic	1.9545	4.1793**	1.7831	7.8727***

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equations (1) and (2) in the text.
(d) The dependent variable is the first difference of the log of the daily GBP/USD spot exchange rate.
(e) The independent variables FFT-EXPECTED and FFT-UNEXPECTED measure the expected and the unexpected element, respectively, of the Federal Funds Target rate change on FOMC dates. Both variables are taken from Kuttner (2001). The independent variable FFT-ACTUAL is the actual Federal Funds Target rate change on FOMC dates.
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).

TABLE 7 **GBP/USD: Summary of Same-Day and Delayed Exchange Rate Responses to the Unexpected Change in The Federal Funds Target Rate**

Daily Data: 27 March 1989 to 4 April 2001

Each row below is associated with a separate regression model. Only the point estimate and the associated standard error for the independent variable FFT-UNEXPECTED are shown, regardless of whether or not the control variables are significant.

	FFT-UNEXPECTED	R-squared	F-statistic
DLNGBP(0)	0.0200** (0.0076)	0.25	4.1793**
DLNGBP(1)	-0.0042 (0.0074)	0.07	0.4017
DLNGBP(2)	-0.0119 (0.0084)	0.12	0.7524
DLNGBP(3)	0.0065 (0.0083)	0.20	1.3005
DLNGBP(4)	-0.0006 (0.0080)	0.09	0.6323
DLNGBP(5)	-0.0151 (0.0096)	0.18	1.2038
DLNGBP(6)	-0.0096 (0.0089)	0.17	1.7954
DLNGBP(7)	0.0002 (0.0098)	0.19	1.1565
DLNGBP(8)	-0.0086 (0.0128)	0.16	0.7382
DLNGBP(9)	-0.0028 (0.0098)	0.13	0.6897
DLNGBP(10)	-0.0115 (0.0105)	0.07	0.4292
DLNGBP(11)	0.0130 (0.0133)	0.28	2.5368**
DLNGBP(12)	0.0096 (0.0083)	0.11	0.5472
DLNGBP(13)	-0.0076 (0.0899)	0.27	1.4709
DLNGBP(14)	-0.0088 (0.0084)	0.39	2.5909**
DLNGBP(15)	0.0096 (0.0094)	0.13	1.0894

NOTES:
(a) * Denotes significance at 90%, ** Denotes significance at 95%, *** Denotes significance at 99%.
(b) Standard Errors in ( ) below the point estimates.
(c) Estimations are defined in Equation (3) in the text.
(d) The dependent variable is lead one through fifteen of the first difference of the log of the daily GBP/USD spot exchange rate.
(e) The independent variable FFT-UNEXPECTED measures the unexpected element of the Federal Funds Target rate change on FOMC dates. This variable is taken from Kuttner (2001).
(f) The control variables measure the surprise element of US macroeconomic announcements concerning CPI (CPI-UNEXP), Industrial Production (IP-UNEXP), PPI (PPI-UNEXP), Balance of Trade (TRADE-UNEXP) and Unemployment (UNEM-UNEXP).