The Relative Size of New Zealand Exchange Rate and Interest Rate Responses to News

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Abstract

This paper examines the relative size of the effects of New Zealand monetary policy and macroeconomic data surprises on the spot exchange rate, 2 and 5 year swap rate differentials, and the synthetic forward exchange rate schedule. We find that the spot exchange rate and 5 year swap rates respond by a similar magnitude to monetary surprises, implying there is little response of the forward exchange rate to this type of news. In contrast, the spot exchange rate responds by nearly three times as much as 5 year interest rates to CPI and GDP surprises, implying that forward rates appreciate to higher than expected CPI or GDP news. This is in contrast to standard theoretical models and US evidence. Lastly, we show that exchange rates but not interest rates respond to current account news. The implications of these results for monetary policy are considered.

*This paper was written when the authors were employed by the Reserve Bank of New Zealand. The views expressed in this paper are those of the authors and do not necessarily represent those of the Reserve Bank of New Zealand, the Bank of England, or Motu Economic and Public Policy Research. We thank David Drage, Aaron Drew and Arthur Grimes for comments. Corresponding author: Andrew Coleman, Motu Economic and Public Policy Research, 97 Cuba Street, Wellington, New Zealand. Phone: +64 4 939 4250, Email: andrew.coleman@motu.org.nz

1 Introduction

In recent years, a large literature has examined how exchange rates and interest rates respond to macroeconomic news. This literature has typically shown that interest rates increase and exchange rates appreciate in response to unexpected monetary policy tightenings, stronger-than-expected news about the real economy, or positive inflation surprises. Yet, with the exception of Faust et al (2007), the relative size of the response of interest rates and exchange rates to news has only rarely been examined. This is surprising, not just because the relative sensitivity of different asset prices to news is informative about the strength of different monetary policy channels, but because the comparison can be interpreted as the response of the forward exchange rate to news.

In this paper we develop a framework to examine the relative responsiveness of exchange rates and interest rates to different types of news announcements. We show that the correlation between the change in the spot exchange rate and the change in different maturity interest rates is closely related to the way the whole spot-forward exchange rate schedule responds to news. In general, changes in the spot-forward exchange rate schedule can be characterized as having a shift component, measuring the change in the long term forward exchange rate, and a twist component, measuring the extent to which short term forward rates twist around the long term forward exchange rate because of changes in the term structure of interest rates.

This framework is used to examine how New Zealand's exchange rates and interest rates responded to four different types of macroeconomic news between 2000 and 2007. We find that the correlation patterns between the spot exchange rate and different maturity interest rates were different for different types of news, or, equivalently, that each type of news had a characteristic effect on the spot-forward exchange rate schedule. For example, we find that the exchange rate and long term (five year) interest rates changed by similar amounts in response to monetary policy announcements, or, equivalently, that the spot exchange rate twisted around an unchanging long term forward exchange rate pivot. In contrast, the spot exchange rate responded to current account announcements while interest rates did not, resulting in vertical shifts of the whole spot-forward exchange rate schedule. Most curiously, we find that the spot exchange rate responded by nearly three times as much as five year interest rates to news about the inflation rate or real GDP. This means that higher than expected inflation and activity levels resulted in an appreciation of the five year forward exchange rate plus an additional upward twist of the spot exchange rate. The inflation result is in contrast to standard economic models, in which long term forward exchange rates depreciate in response to higher than expected inflation, and is different than Faust et al's finding that the U.S. forward exchange rates depreciate in response to positive inflation news.

The paper introduces a small methodological twist to the literature. In the standard approach, which we largely follow, the change in an asset price during a small time period starting immediately before and ending soon after a news announcement is regressed against a numerical measure of the surprise in the announcement:

$$\Delta P_t^i = \alpha_0^{i,j} + \alpha_1^{i,j} W_t^j + u_t^{i,j} \tag{1}$$

where ΔP_t^i is the change in the i^{th} asset and W_t^j is the measure of the j^{th} surprise. The residual $u_t^{i,j}$ is the extent to which the price reaction differs from what can normally be expected given the surprise. The residual could be non-zero for various reasons. Of particular note, however, is the possibility that the markets respond to more detailed information than that which is observed by the econometrician and summarised in the numerical measure W_t^j. In this case we would expect the residual terms $u_t^{i,j}$ and $u_t^{k,j}$ for two different assets i and k to be correlated as the residuals reflect the response to the detailed information. In this paper we test for and exploit the correlation between these residual terms to refine tests of the hypothesis that the exchange rate and interest rate respond by the same amount to news. For each type of news we find that the slope coefficient between the two residual series has the same sign as the ratio $\alpha_1^{i,j}/\alpha_1^{k,j}$ and is similar in magnitude. Thus if interest rates respond by less than the econometrician expects in response to a surprise, the spot rate also responds by less than expected.

The paper is organised as follows. In section 2 there is a review of previous literature that has jointly estimated the response of exchange rates and interest rates to news, and the development of an alternative estimation strategy. In section 3 we describe the data we use, and in section 4 we present the results. Section 5 offers a discussion of the results and section 6 concludes.

2 The estimation of the joint response of exchange rates and interest rates to news

2.1 Previous literature

Faust et al invoke the theory of uncovered interest parity to motivate their comparison of the way that exchange rates and interest rates respond to economic news. They note that to equalise returns on domestic and foreign interest earning assets, the expected exchange rate change over an n year period must equal the n-year interest rate differential, adjusted for a risk premium:

$$Es_{t+n} - s_t = n(r_t^{f,n} - r_t^n) + n\rho_t^n \tag{2}$$

where $s_t = ln(S_t)$, S_t is the spot exchange rate (foreign currency price of domestic currency), r_t^n and $r_t^{f,n}$ are domestic and foreign n-year interest rates, and ρ_n^n is the risk premium.[1] It follows that in a short interval surrounding the release

[1] Note we have changed their nomenclature to be consistent with New Zealand usage as New Zealand traditionally quotes exchange rates as the foreign price of the local currency. In

of some economic news,

$$\Delta s_t = n(\Delta r_t^n - \Delta r_t^{f,n}) + \Delta E s_{t+n} - n\Delta\rho_t^n. \quad (3)$$

Faust et al use this equation to analyse the behaviour of $\Delta E s_{t+n}$ in response to news under the assumption that $\Delta\rho_{t,n} = 0$, and to analyse the behaviour of $\Delta\rho_{t,n}$ in response to news under the assumption $\Delta E s_{t+n}$ follows a random walk.

As the synthetic n-year forward rate F_t^n is defined as

$$F_t^n = S_t \left(\frac{1 + r_t^{n,f}}{1 + r_t^n} \right)^n \quad (4)$$

with

$$\Delta f_t^n \simeq \Delta s_t + n(\Delta r_t^{n,f} - \Delta r_t^n) \quad (5)$$

where $f_t^n = ln(F_t^n)$, the analysis of $\Delta E s_{t+n}$ under the assumption that $\Delta\rho_{t,n} = 0$ is the same as the analysis of Δf_t^n. From equation 5 it is apparent that the extent that the spot exchange rate responds to news more than the n-year interest rate differential is identical to the response of the n-year forward rate to news. By examining the response of the whole spot-forward exchange rate schedule to news, the relative size of spot exchange rate changes and different maturity interest rate changes can be readily ascertained.

In general, changes in the spot-forward exchange rate schedule can be characterized as having a shift component, measuring the change in the long term forward exchange rate, and a twist component, measuring the extent to which short term forward rates twist around the long term forward exchange rate because of changes in the term structure of interest rates. This can be seen by rearranging equation 5 as a function of the interest rate differential and the longest maturity forward exchange rate, f_t^L:

$$\Delta f_t^n \simeq \Delta f_t^L + (L\Delta r_t^L - n\Delta r_t^n) - (L\Delta r_t^{L,f} - n\Delta r_t^{n,f}) \quad (6)$$

The second term on the right hand side captures the extent that the total return on a long maturity bond increases in response to news by more than the total return on a short dated (n-year) bond. If this term is positive, it means that short term interest rates are expected to increase between periods n and L. Consequently, the extent to which short term forward exchange rates increase with respect to the long term forward rate reflects both the size of the change in short term interest rates and the total length of time that the news is expected to affect short term interest rates in the future.[2]

countries such as the United States where exchange rates are quoted as the local price as the foreign currency, equation 1 is expressed as $Es_{t+n} - s_t = n(r_t^n - r_t^{f,n}) + n\rho_t^n$.

[2] An example makes this clear. Suppose in response to news the one year interest rate was expected to increase by 1 percent for three years, but there was no change to the one year rate thereafter. The total return to a one year bond would increase by 1 percent, the total

Equation 6 can be used to interpret recent work by Clarida and Waldman (2007), who developed a simple rational expectations model to investigate their empirical finding that spot exchange rates often appreciate in response to higher than expected inflation news. Their argument is that the spot exchange rate should appreciate if the central bank is expected to increase interest rates to offset inflationary pressure, even though in the long run the exchange rate should depreciate to ensure purchasing power parity holds. In the language we use, their model posits that there should be an appreciation of the spot rate but a depreciation of the long term forward rate. Equivalently, by equation 6, their theory predicts that the spot exchange rate rate appreciates in response to positive inflation surprises, but it does so by less than the increase in the total return to a long term bond. Clarida and Waldman examine the behaviour of spot exchange rates but do not test their implicit hypothesis about the behaviour of the long term forward rate. Below we show that spot and forward exchange rates both appreciate in response to positive inflation surprises in New Zealand, in contrast to their hypothesis.

2.2 Estimation strategy

In this paper we focus on the joint response of the spot exchange rate and the five year swap rate differential to news, although we also examine shorter horizons. We assume the relationships between the spot exchange rate, interest rate differentials, and news announcements can be described by the following three equations:

$$\begin{aligned}
\Delta s_t &= \alpha_0^{s,j} + \alpha_1^{s,j} W_t^j + u_t^{s,j} && (7)\\
n(\Delta r_t^n - \Delta r_t^{n,f}) &= \alpha_0^{rn,j} + \alpha_1^{rn,j} W_t^j + u_t^{rn,j} && (8)\\
u_t^{s,j} &= \delta^{n,j} u_t^{rn,j} + \eta_t^n && (9)
\end{aligned}$$

The covariance matrix is

$$\Sigma^{nj} = \begin{pmatrix} \sigma_{sj}^2 & \sigma_{srnj} \\ \sigma_{srnj} & \sigma_{rnj}^2 \end{pmatrix}$$

and $\delta^{n,j} = \sigma_{srnj}/\sigma_{rnj}^2$.

To simplify the following exposition, we drop the superscripts or subscripts j and n, rename $\Delta R_t = n(\Delta r_t - \Delta r_t^f)$, ignore the constant terms and write the system in matrix form:

$$\Delta s = W\alpha^s + u^s \qquad (10)$$

return to a two year bond would increase by 2 percent, and the total return to all bonds with maturities of three years or more would increase by 3 percent. Thus the spot rate would appreciate 3 percent with respect to the long forward rate, the 1 year forward rate would appreciate by 2 percent with respect to the long forward rate, but there would be no change in the relative value of the 3 year forward rate with respect to the long forward rate.

$$\Delta R = W\alpha^r + u^r \quad (11)$$
$$u^s = u^r\delta + \eta \quad (12)$$

Although the coefficients α^s and α^r can be efficiently estimated using ordinary least squares, we use Zellner's feasible seemingly unrelated regressions estimator to exploit the correlation between u^s and u^r to refine the estimates of the standard errors. Let $\hat{\alpha}^s$ and $\hat{\alpha}^r$ be the OLS estimated coefficients of α^s and α^r in equations 10 and 11, $\hat{u}^s$ and $\hat{u}^r$ the corresponding residual estimates, $\hat{\Sigma}$ the estimate of the covariance matrix made using these residuals, and $\hat{\delta}$ the estimate of the coefficient δ in equation 12. In the tables presented below the estimated covariance matrix $\hat{\Sigma}$ is used in a two-step procedure to make the seemingly unrelated regression estimates of equations 10 and 11.

There are two ways to test whether the spot exchange rate and the interest rate differential respond to news by the same amount, or equivalently whether the forward rate responds to news. First, one can calculate the forward rate $\Delta f = \Delta s - \Delta R$, and estimate the equation

$$\Delta f = W\alpha_f + u_f \quad (13)$$

It follows from 10 and 11 that $\alpha_f = \alpha_s - \alpha_r$. A simple test of the hypothesis that $\alpha_s = \alpha_r$ is therefore to estimate 13 using OLS and test whether $\alpha_f = 0$. Note that the variance of u_f is $\sigma_f^2 = \sigma_s^2 + \sigma_r^2 - 2\sigma_{sr}$, the variance of the OLS estimator of α_f is $\sigma^2_{\hat{\alpha}_f} = \sigma_f^2(W'W)^{-1}$and the OLS estimate of α_f is $\hat{\alpha}_f = \hat{\alpha}^s - \hat{\alpha}^r$.

The second approach is to decompose the change in the interest rate differential ΔR into a predictable component $\Delta R^* = W\alpha_r$ and an unpredictable component u_r, and then to regress the spot rate against both:

$$\Delta s = \Delta R^*\gamma_0 + u_r\gamma_1 + \nu \quad (14)$$

From 10, 11, and 12,

$$\Delta s = \Delta R^*\frac{\alpha_s}{\alpha_r} + u_r\delta + \eta \quad (15)$$
$$\Delta f = \Delta R^*(\frac{\alpha_s}{\alpha_r} - 1) + u_r(\delta - 1) + \eta \quad (16)$$

Thus equation 13 is a version of equation 16 with δ restricted to equal 1.

If we knew the true values of ΔR^* and u_r, we could estimate equation 14 directly and test the hypothesis $\alpha_s = \alpha_r$ by testing whether $\gamma_0 = 1$. The advantage of this approach over the first approach is that the standard error of the coefficient γ_0 is smaller than the standard error of α_f unless $\delta = 1$: this is because $\sigma_\eta^2 \leq \sigma_f^2$.[3]

[3] $\sigma_f^2 = \sigma_s^2 + \sigma_r^2 - 2\sigma_{sr}$. $\sigma_\eta^2 = \sigma_s^2 + \delta^2\sigma_r^2 - 2\delta\sigma_{sr}$. Hence $\sigma_f^2 - \sigma_\eta^2 = \sigma_r^2(1-\delta)^2 \geq 0$

In practice, of course, we do not know ΔR^* and u_r. Rather, we use the OLS estimates of equation 11 to generate estimates $\Delta\hat{R}^*$ and $\hat{u}_r$, and we estimate the generated regression

$$\Delta s = \Delta\hat{R}^*\theta_0 + \hat{u_r}\theta_1 + \xi \tag{17}$$

This is an example of a type of equation examined by Pagan (1984). The OLS estimates are $\hat{\theta_0} = \hat{\alpha_s}/\hat{\alpha_r}$, $\hat{\theta_1} = \hat{\delta}$, and $\hat{\xi} = \hat{\eta}$. Hence equation 17 can be used to test the hypothesis that $\alpha_r = \alpha_s$ by testing the hypothesis $\theta_0 = 1$. Note, however, that it is no longer the case that equation 17 automatically produces a better test of the hypothesis than equation 13. Pagan showed the variance of the OLS estimate of θ_0 is $\sigma^2_{\hat{\theta_0}} = (\sigma^2_\eta + \sigma^2_r(\theta_0 - \theta_1)^2)(W'W)^{-1}$.[4] This is smaller than the variance of the OLS estimate of α_f if $\sigma^2_r(\theta_0 - \theta_1)^2 + \sigma^2_\eta \leq \sigma^2_f$: since $\sigma^2_f = \sigma^2_\eta + \sigma^2_r(1-\delta)^2$, this condition is equivalent to $(\theta_0 - \theta_1)^2 \leq (1-\delta)^2$. Thus if δ is closer to the ratio α_s/α_r than to 1, equation 17 is likely to produce a more accurate test of the hypothesis that $\alpha_r = \alpha_s$ than equation 13. As we show below, this condition is likely to be satisfied for the CPI and GDP surprises, where we estimate both the ratio α_r/α_s and the coefficient δ to be greater than 2. In contrast, because current account news has very little effect on long term interest rates, the estimates of α_r and δ for the current account surprises are very near zero and equation 13 provides a much better test of the hypothesis than equation 17. For monetary policy surprises we estimate that δ is very close to 1 and thus equation 13 provides an efficient method of testing the hypothesis.

The above analysis emphasises the role the parameter δ plays in the efficiency of tests that examine how exchange rates and interest rate differentials respond to news. We think there are good grounds to believe that this parameter will be neither 0 nor 1 in general. One reason is that residual terms u_s and u_r in equations 10 and 11 may contain the response of market participants to detailed information that is not captured by the summary measure W. A 0.2 percent higher than expected increase in the CPI that is attributed to rising oil prices may elicit a very different financial market response than a similar sized increase in the CPI that is associated with an across the board rise in non-tradeable prices, for example, and the response is likely to be correlated across different financial markets. If this is the main reason why u_s and u_r are correlated, and if market participants respond to the detailed information in the same way that they respond to the summary information W, the coefficient δ will tend to the ratio α_s/α_r.

Lastly we estimate the correlation between the spot exchange rate changes and the interest rate differential changes over the news announcement periods:

$$\Delta s = \Delta R\beta + \varepsilon \tag{18}$$

[4] He further showed that the OLS estimate of $\sigma^2_{\hat{\theta_0}}$ is inconsistent. Corrected estimates are presented in the table below.

This equation is a version of equation 13 with the coefficients γ_0 and γ_1 restricted to be equal.

3 Data

In section 4 we estimate how the interest rate, spot exchange rate and forward exchange rates respond to new information in data and monetary policy announcements. The exchange rate response is measured as the change in the logarithm of the exchange rate over a period starting immediately before the announcement and ending shortly after the announcement. The implicit forward rates were calculated from the spot exchange rate and the 2 and 5 year interest swap rates of the New Zealand dollar and the U.S. dollar. Drew and Karagedikli (2007) show that swap rates with horizons longer than five years behave in almost exactly the same manner as five year swap rates so we limit our analysis to these maturities. The intra-day swap and spot exchange rates were obtained from the Marketwatch Databank of the Reserve Bank of New Zealand. We have data on 2 and 5 year interest rate swaps at 10 minutes past every hour. The spot exchange rate data are collected at the same time.[5]

We use the market-based measure of monetary surprises used in Drew and Karagedikli (2007) and Karagedikli and Siklos (2007). The basic measure of a monetary surprise is the change in the first contract of the 90-day bank bill future over the period immediately surrounding the policy change announcement. Thus if the 90-day bill rate fell from 8.40 to 8.25 percent after the Governor announced there would be no change in the overnight cash rate, we would measure the surprise as -0.15 percent.[6] This measure of monetary surprises is commonly used in the literature: for example, Kuttner (2001) and Bernanke and Kuttner (2005) calculate a measure of U.S. monetary surprises from the Fed funds futures rates. In addition to monetary surprises, we analyse the effect of three data announcements: Gross Domestic Product (GDP), the Consumer Price Index (CPI) and the Current Account (CA). The surprise components of these data announcements is measured as the difference between the median market expectations surveyed by Bloomberg and the actual out-turns. This measure of a surprise is now standard and believed to capture changes in expectations quite accurately (see Engel 2007).

We considered using data windows of three different lengths: one hour (the tight window), two hours (the wide window) and one day (the daily window).

[5] Tick by tick data are available for all major New Zealand variables but not for foreign swap rates. Consequently, we opted for hourly data.

[6] See Drew and Karagedikli (2007) and Karagedikli and Siklos (2008) for more details. Our results are similar to the spot exchange rate results of the former and the interest rate results of the latter, with some minor differences arising from the different data windows. Drew and Karagedikli (2007) and Karagedikli and Siklos (2008) also use two other measures of monetary surprises in their papers, finding results that are very similar to those based on the market-based measure.

In the paper, we report and refer to a single window.[7] Our preference is to use a short period window, for the standard errors of the coefficients in longer period windows are larger as there is more scope for the exchange rate and interest rate to change in response to other factors. For the data surprises we use the tight window as our main window. The GDP, CPI and current account data are announced quarterly at 10.45 am. The tight window is defined as the log difference in the market rates between 10.10 am and 11.10 am, and thus measures the market reaction after 25 minutes. We believe this is an adequate period. The wide and daily windows are the log differences of the market rates between 12.10 pm and 10.10 am, and 17.10 pm and 10.10 am respectively. For monetary surprises we use the wide window as our primary window. Monetary policy announcements are made at 9.00 am by the Reserve Bank of New Zealand. Our tight window is the log difference of the rate between 9.10 am and 8.10 am, our wide window is the log difference of the rate between 10.10 am and 8.10 am and our daily window is the log difference of the rate between 17.10 pm and 8.10 am. The wide window is used as the tight window only measures the market reaction ten minutes after the announcement.

4 Results

Tables 2 - 5 show the results of the estimation of equations 10 - 18 using the four different sets of macroeconomic surprises. The top half of each table displays the results using two year interest rate swap rates and forward rates, while the bottom half displays the results using five year rates. The first row of each table shows the *total* response of the two year interest rate differential to a surprise, $\Delta R_2 = 2(\Delta r^{2,NZ} - \Delta r^{2,US})$. This can be interpreted as the additional return over the life of the swap contract that is earned following a surprise, and thus can be directly compared to the percentage change in the spot exchange rate. We focus on the five year results on a priori grounds as the two year forward rate is unlikely to be a good proxy for the long term forward rate.

The results in table 2 show that a 1 percentage point surprise increase in the OCR leads to a 2.4 percentage point increase in the total earnings of a five year bond.[8] The exchange rate appreciates by 3.6 percent, or by 1.2 percentage points more than the increase that might be expected given the total increase in the return from a five year bond. Equivalently, this means the five year forward rate appreciates by 1.2 percent in response to a 1 percentage point OCR surprise. The difference is not statistically significant at the 5 percent level, however, indicating that the spot exchange rate responds in a similar fashion to OCR news as five year bonds. Put differently, the spot exchange rate largely twists around the forward pivot in response to news about monetary policy,

[7] A summary of the other results is in the appendix. All results are available upon request.

[8] Drew and Karagedikli indicate that the total earnings increase in longer maturity bonds is similar i.e. it is also 2.4 percentage points.

although there is a modest (and statistically insignificant) shift of the long forward rate to this news.

The response of interest rates and exchange rates to CPI and GDP news is quite different. In each case, the spot exchange rate is nearly three times as responsive to news than the five year swap rate differentials. For example, total earnings on a five year swap rate contract increase by 0.32 percentage points in response to a l percentage point surprise increase in the CPI, whereas the exchange rate appreciates by 0.87 percent.[9] The differences between the exchange rate and interest rate differential response to CPI and GDP surprises are quite accurately measured and are statistically significant at the five percent significance level. Thus it can be concluded that in response to higher than expected CPI and GDP news there is an upward shift of the forward rate and a further upward twist of the spot rates that reflects higher local interest rates.

Although the spot exchange rate responds more than the interest rate differential to GDP and CPI news, the size of the exchange rate response is not very large. A one percentage point increase in GDP or the inflation rate is associated with a 0.64 or 0.87 percent appreciation of the spot exchange rate respectively. These movements , while non-trivial, suggest that the normal variation in GDP and the inflation rate is only responsible for a small amount of the variation in the currency.

These results confirm the finding by Clarida and Waldman (2007) that bad news about the inflation rate is good news about the spot exchange rate. In their theoretical model, however, they imply that the long term forward rate should depreciate in response to higher than expected CPI news, rather than appreciate. Faust et al (2007) also find that US forward rates with respect to the Euro and sterling depreciate in response to stronger than expected CPI news. Consequently, the evidence presented here that the New Zealand long term forward exchange rate appreciates in response to CPI surprises – that the spot rate responds much more than swap rates to CPI news – is unusual. It is possibly related to the evidence presented by Clarida and Waldman that the New Zealand dollar spot exchange rate is much more responsive to CPI news than any other developed country currency other than the Norwegian krone.

In each of these three cases, the two year bond rate changes less in response to news than the five year bond rate. This implies that news is expected to have an effect on short term interest rates between two and five years into the future, a finding consistent with the evidence presented in Drew and Karagedikli (2007). As a result, the two year forward exchange rate appreciates in response to positive economic news by more than the five year forward exchange rate, but by less than the spot exchange rate. It appears, therefore, that positive economic news causes an upward twist of the spot-forward exchange rate schedule around

[9] Note the typical surprise in the CPI is only 0.125 percent.

the long term forward rate.

The response of interest rates and exchange rates to current account news is different again. Table 5 shows that interest rates are unaffected by current account news – the coefficients on the interest rate terms are small and statistically insignificant – whereas the spot rate appreciates in response to a positive current account news. As a consequence, spot and forward exchange rates increase by the same amount in response to macroeconomic news.

The regressions reveal that the residuals u_r and u_s are strongly positively correlated in the equations for monetary policy, CPI and GDP surprises, with the spot estimates of the coefficients δ_5 equal to 1.06, 2.41 and 2.35 respectively. (Since there is no relationship between current account surprises and interest rates, the correlation coefficient is insignificantly different to zero.) In each case the coefficients are of similar magnitude to the ratio α_s/α_r. These results are consistent with the idea that the markets respond to a more detailed level of information than that represented by the headline figure, and that the response to this detailed information is consistent with the response to the headline figure. Consequently, an econometrican can predict how the exchange rate responds to news much better if he or she knows both the headline news announcement and the response of interest rates to this news rather than just the headline announcement. Incorporating the interest rate variable as well as the news variable into the spot equation regression increased the R^2 term from 0.22 to 0.35 for OCR surprises, 0.37 to 0.57 for CPI surprises, and 0.34 to 0.63 for GDP surprises.

In section 2, it was demonstrated that the correlation between u_r and u_s could potentially be used to improve the efficiency of the test $\alpha_s = \alpha_r$. In practice, the improvements proved to be minor, presumably because the small size of the sample we use means that the coefficients δ and the ratio α_s/α_r could not be estimated with sufficient accuracy. According to the theory, in the limit equation 17 would have better efficiency than equation 13 so long as δ is closer to α_s/α_r than 1. For monetary policy surprises, $\hat{\delta} = 1.06$ so this is unlikely to be the case. For CPI and GDP surprises, $(\hat{\delta}, \hat{\alpha_s}/\hat{\alpha_r}) = (2.41, 2.71)$ and (2.35, 2.89) respectively, so some improvement is likely. For current account surprises, equation 17 has very poor properties because when interest rates are uncorrelated with news the ratio $\alpha_s/\alpha_r \to \infty$. The results of the two t-tests of the hypothesis $\alpha_s = \alpha_r$ were similar for the OCR, CPI, and GDP surprises, but not for current account surprises. In the latter case, the test associated with equation 13 decisively rejected the hypothesis although the test associated with equation 17 did not.[10]

[10] Since the test associated with equation 17 has very poor properties, as $\hat{\alpha_s}/\hat{\alpha_r} > 5000$, we ignore it.

5 Discussion

Central banks around the world routinely focus on spot exchange rates rather than forward exchange rates. The usual reason for the neglect of forward exchange rates is that they tend to be residually calculated from spot exchange rates and bond rates and thus contain little independent information. Obviously it is true that a forward exchange rate can be calculated from a spot exchange rate and a local-foreign interest rate differential. Nonetheless, it does not mean that changes in the forward rate are devoid of informational content, for they provide information about the correlation of movements in the spot exchange rate and the interest rate differential. This correlation can be calculated and presented directly, or it can presented in the guise of the way the forward exchange rate behaves. Sometimes it may be more informative to present in terms of the co-movements of spot exchange rates and interest rates. On other occasions, it may be useful to analyse the forward rate directly.

In the short period we studied there were three interesting results. First, the spot exchange rate and the five year swap rate differential have a similar response to monetary policy surprises. This means the medium and long term forward rates change little in response to monetary policy surprises. Put differently, it means that the spot exchange rate largely twists around an unchanged forward rate in response to monetary shocks. When a similar effect is observed in commodity markets – for example, when temporary supply shocks increase spot but not forward prices – the usual interpretation is that the shock is only expected to have a temporary effect on prices (Williams 1986). If this interpretation is applied to the exchange rate market, it means that monetary policy shocks are only expected to have temporary effects on the exchange rate. This need not be the case; for example, according to conventional theory, a monetary loosening that was expected to lead to a long term increase in the inflation rate might be expected to lead to a decline in future spot rates and a decline in forward rates. This evidence that monetary surprises do not affect the long term forward exchange rate is consistent with other evidence that New Zealand financial markets believe the Bank's long term inflation goals will be achieved.

The second result concerns the effect of CPI and GDP surprises on financial market prices. In both cases, the paper shows that the spot exchange rate changes by nearly three times as much as five year swap rates in response to news, appreciating when the CPI or GDP is higher than expected. Consequently, the change in the spot-forward exchange rate schedule is dominated by the shift in the long term forward rate rather than the twist in the schedule. Drawing a parallel with commodity markets again, it seems that CPI and GDP news largely have permanent rather than temporary effects on exchange rates.

The third result just concerns the effect of CPI surprises on financial market prices. As stated above, the paper shows that the spot exchange rate changes by nearly three times as much as five year swap rates in response to CPI news, appreciating when the CPI is higher than expected. It is difficult to make sense of this result in terms of traditional monetary models of the exchange rate. It means that New Zealand's forward exchange rates as well as the spot rate appreciate in response to bad news about inflation, a result that is not consistent with conventional economic models. This evidence is also in contrast with that of Faust et al for the U.S. economy, where forward rates depreciate in response to bad news about inflation. Moreover, this evidence sits oddly with evidence from the monetary surprises regression that monetary policy largely has a temporary effect on the exchange rate.

One interpretation of this finding is that the spot exchange rate is excessively sensitive to CPI news, in the sense that it responds by much more than the response in interest rates. An alternative interpretation is based on the assumption that CPI news provides a signal of the strength of the underlying economy as well as a signal of the future direction of monetary policy. The exchange rate schedule largely shifts rather than twists in response to CPI news. This is similar to the response to GDP news, but in marked contrast to the response to monetary policy news. As such, it would appear that the exchange rate mainly responds to the GDP signal rather than to the monetary policy signal in CPI news. If this interpretation is correct, bad news about inflation is good news for the exchange rate not because of an anticipated monetary tightening but because the bad news about inflation reflects good news about the economy.

6 Conclusion

This paper has extended the New Zealand "event analysis" literature by comparing the relative size of the exchange rate and interest rate response to macroeconomic news. It has shown that spot exchange rates and five year swap rate differentials respond by a similar amount in response to monetary policy surprises, but that the spot exchange rate changes by nearly three times as much as swap rates in response to CPI and GDP news. The CPI result in particular is intriguing, as it means that medium term forward rates as well as the spot rate appreciate in response to bad news about inflation. This evidence is not consistent with conventional economic models or empirical evidence about the relative size of exchange rate and interest rate differential response to CPI news in the United States. It may suggest that the New Zealand spot exchange rate is excessively responsive to CPI news, or that CPI news largely provides a signal about the underlying strength of the economy. Discovering why New Zealand's spot exchange rate is so sensitive to CPI news would appear to warrant further research.

The paper has also suggested a new way of testing whether the spot exchange rate and the interest rate differential respond by the same amount to news. The alternative test takes advantage of potential information that may be observed by market participants but not observed by the econometrican. This information is likely to induce a correlation between the residuals of standard event analysis equations estimated separately, correlation that can be exploited to improve the efficiency of the tests in certain circumstances. The alternative test is simple to apply, although the improvements in efficiency in this sample appear to have been modest.

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Appendix: Regression results with different period windows

As discussed in section 3, we calculate the response of interest rate and exchange rate changes to news announcements over three different periods: the one hour tight window, the two hour wide window, and the one day daily window. Our preference is to use the tight window data, although we use the wide window data for the monetary policy surprises as the tight window ends only 10 minutes after the announcement. We prefer the short windows because there is less scope for the exchange rates or interest rates to change in response to other factors during short periods of time, and the variance of the term $u_t^{i,j}$ in the regression

$$\Delta P_t^i = \alpha_0^{i,j} + \alpha_1^{i,j} W_t^j + u_t^{i,j}$$

should be smaller.

Table 6 shows the results of the main equations presented in tables 2 - 5 estimated using different length windows. In general, the coefficients estimates for each equation are similar for the different windows, but the t-test of the hypothesis that $\alpha_s = \alpha_r$ get smaller as the window period is increased. In particular, using the tight window it is possible to reject the hypothesis that $\alpha_s = \alpha_r$ for the CPI and GDP data; using the daily window it is not.

The main case where there is a change in the coefficient estimates as the period of the window increases concerns the estimate of θ_1 in equation 17 for CPI surprises:

$$\Delta s = \Delta \hat{R}^* \theta_0 + \hat{u_r} \theta_1 + \xi$$

This coefficient is estimated to be 2.41 (s.e=0.78) in the tight window, but 0.57 in the wide window and 0.17 in the daily window. This coefficient is the same as the coefficient δ in equation 12:

$$\hat{u_s} = \delta \hat{u_r} + \eta$$

and thus measures the correlation between the residual terms in the basic event analysis regressions. Further analysis of this equation shows there is very high correlation between the residuals $\hat{u_s}$ and $\hat{u_r}$ in the first 25 minutes after the news announcement, but that in the next hour the innovations to interest rates and the spot exchange rate were uncorrelated. In addition, there was weak evidence of negative serial correlation between the change in the exchange rate in the first 25 minutes and the change in the exchange rate in the subsequent hour, although this effect was not large. It would appear, therefore that by moving from a tight window to a wide window there is considerable dilution of the underlying correlation between the residuals that is directly related to the announcement effect.

Table 1 Data Windows

Window	Monetary Surprise	Data Surprise
Announcement	9.00 am	10.45 am
Tight Window	9.10 am - 8.10 am	11.10 am - 10.10 am
Wide Window	10.10 am - 8.10 am	12.10 pm - 10.10 am
Daily Window	17.10 pm - 8.10 am	17.10 pm - 10.10 am

Table 2. NZ-US dollar response to OCR surprises

Dependent variable	W	$\hat{u}_r$	$\Delta\hat{R}$	ΔR	Obs	R^2	t-test $\alpha_s = \alpha_r$
	2 year rates						
ΔR_2	0.013** (0.0019)				55	0.48	
Δs	0.036** (0.0081)				55	0.22	
Δf_2	0.0226* (0.0087)				55	0.22	2.60*
$\hat{u}_S$		1.81** (0.63)			55	0.14	
Δs		1.81** (0.63)	2.70** (0.66)		55	0.33	2.57*
Δs				2.24** (0.45)	55	0.32	
	5 year rates						
ΔR_5	0.024** (0.0035)				55	0.46	
Δs	0.036** (0.0091)				55	0.22	
Δf_5	0.012 (0.0084)				55	0.038	1.44
$\hat{u}_S$		1.06** (0.33)			55	0.16	
Δs		1.06** (0.33)	1.51** (0.36)		55	0.35	1.41
Δs				1.27** (0.24)	55	0.34	

** or * indicates statistical signicance at the 1% or 5% levels.

Table 3. NZ-US dollar response to CPI surprises

Dependent variable	W	$\hat{u}_r$	$\Delta\hat{R}$	ΔR	Obs	R^2	t-test $\alpha_s = \alpha_r$
	2 year rates						
ΔR_2	0.0024** (0.00057)				23	0.45	
Δs	0.0087** (0.0024)				23	0.37	
Δf_2	0.0063* (0.0024)				23	0.24	2.59*
$\hat{u}_S$		0.89 (0.94)			23	0.04	
Δs		0.89 (0.94)	3.65** (1.25)		23	0.40	2.12*
Δs				2.12** (0.74)	23	0.28	
	5 year rates						
ΔR_5	0.0032** (0.00057)				23	0.59	
Δs	0.0087** (0.0024)				23	0.37	
Δf_5	0.0055* (0.0022)				23	0.23	2.49*
$\hat{u}_S$		2.41** (0.78)			23	0.32	
Δs		2.41** (0.78)	2.71** (0.66)		23	0.57	2.61*
Δs				2.59** (0.49)	23	0.57	

** or * indicates statistical signicance at the 1% or 5% levels.

Table 4. NZ-US dollar response to GDP surprises

Dependent variable	W	$\hat{u}_r$	$\Delta\hat{R}$	ΔR	Obs	R^2	t-test $\alpha_s = \alpha_r$
	2 year rates						
ΔR_2	0.0016** (0.00047)				23	0.35	
Δs	0.0064** (0.0019)				23	0.34	
Δf_2	0.0048* (0.0019)				23	0.24	2.57*
$\hat{u}_S$		1.39 (0.86)			23	0.12	
Δs		1.39 (0.86)	3.93* (1.39)		23	0.41	2.10*
Δs				2.29** (0.72)	23	0.32	
	5 year rates						
ΔR_5	0.0022** (0.00054)				23	0.43	
Δs	0.0064** (0.0019)				23	0.34	
Δf_5	0.0042* (0.0016)				23	0.24	2.54*
$\hat{u}_S$		2.35** (0.59)			23	0.44	
Δs		2.35** (0.59)	2.89** (0.68)		23	0.63	2.73*
Δs				2.58** (0.44)	23	0.62	

** or * indicates statistical signicance at the 1% or 5% levels.

Table 5. NZ-US dollar response to Current Account surprises

Dependent variable	W	$\hat{u}_r$	$\Delta\hat{R}$	ΔR	Obs	R^2	t-test $\alpha_s = \alpha_r$
	2 year rates						
ΔR_2	-0.00017 (-0.0002)				22	0.04	
Δs	0.0044** (0.0007)				22	0.65	
Δf_2	0.0046** (0.0007)				22	0.68	6.20**
$\hat{u}_S$		0.95 (0.80)			22	0.07	
Δs		0.95 (0.80)	-25.6 (32.0)		22	0.67	0.83
Δs				0.10 (1.3)	22	0.00	
	5 year rates						
ΔR_5	0.000 (0.0003)				22	0.00	
Δs	0.0044** (0.0007)				22	0.65	
Δf_5	0.0044** (0.0081)				22	0.60	5.50**
$\hat{u}_S$		-0.22 (0.60)			22	0.01	
Δs		-0.22 (0.60)	5129 (1.6×10^6)		22	0.65	0.003
Δs				-0.22 (0.99)	22	0.00	

** or * indicates statistical signicance at the 1% or 5% levels.

Table 6. NZ-US dollar response to news

Dependent variable	window	W	$\hat{u}_r$	$\Delta\hat{R}$	Obs	R^2	t-test $\alpha_s = \alpha_r$
	5 year rate response to OCR surprises						
Δf_5	tight	0.0098 (0.011)			54	0.02	0.92
Δf_5	wide	0.012 (0.0084)			55	0.04	1.44
Δf_5	daily	0.011 (0.010)			55	0.02	1.05
Δs	tight		0.87** (0.30)	1.45** (0.50)	54	0.25	0.89
Δs	wide		1.06** (0.33)	1.51** (0.36)	55	0.35	1.41
Δs	daily		0.87** (0.30)	1.49** (0.48)	55	0.26	1.01
	5 year rate response to CPI surprises						
Δf_5	tight	0.0055* (0.0022)			23	0.23	2.49*
Δf_5	wide	0.049* (0.0020)			23	0.18	2.13*
Δf_5	daily	0.0063 (0.0043)			23	0.09	1.48
Δs	tight		2.41** (0.78)	2.71** (0.66)	23	0.57	2.61*
Δs	wide		0.57 (0.50)	2.27** (0.76)	23	0.44	1.68
Δs	daily		0.17 (0.53)	1.91* (0.74)	23	0.34	1.23
	5 year rate response to GDP surprises						
Δf_5	tight	0.0042* (0.0016)			23	0.24	2.54*
Δf_5	wide	0.040 (0.0021)			23	0.14	1.87
Δf_5	daily	0.0029 (0.0013)			23	0.04	0.88
Δs	tight		2.35** (0.59)	2.89** (0.68)	23	0.63	2.73*
Δs	wide		2.42** (0.48)	2.50** (0.69)	23	0.66	2.18*
Δs	daily		1.15 (0.71)	2.04 (1.26)	23	0.22	0.83

** or * indicates statistical signicance at the 1% or 5% levels.

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