A BRIDGE TOO FAR?
RBNZ COMMUNINCATION AND
THE FORWARD INTEREST RATE TRACK*

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ABSTRACT

We conduct a high frequency event study to estimate the impact of monetary policy surprises, data surprises, and central bank written statements on the New Zealand-US dollar and the New Zealand-Australian dollar exchange rates. Of particular interest is the measurement of the impact of the published forward interest rate track on the exchange rate. We find that it can account for only a modest amount of exchange rate changes. Hence, the release of this information does not represent transparency gone too far. However, other data surprises and monetary policy surprises are found to have significant effects on exchange rate movements. In general, it does appear that 'bad news' about inflation translates into 'good news' for the exchange rate.

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1. Introduction

The Reserve Bank of New Zealand (RBNZ) began relying on an overnight lending rate as the instrument of monetary policy in March 1999. Moreover, until 2007, the RBNZ had not intervened in foreign exchange markets since 1985.[1] As shown in Figure 1, there have been large movements in USD-NZD and AUD-NZD foreign exchange rate levels, measured either in terms of the U.S. (USD-NZD) or Australian (AUD-NZD) dollars, since 1999. Changes in the official cash rate (OCR), the formal name given to the RBNZ's instrument of monetary policy, represent one of several means the central bank has at its disposal to inform markets about the current and possible future stance of monetary policy. Indeed, the RBNZ is arguably not only the most transparent central bank in the world but it has become even more so in recent years (e.g., see Dincer and Eichengreen 2007).

Presumably, these developments serve to reduce, but not necessarily eliminate, the surprise element of monetary policy. The objective of this paper is to estimate the size of the exchange rate response to the surprise component of New Zealand monetary policy. Why might different forms of central bank communication influence exchange rate movements beyond any surprise element, if any, in the change in the instrument of monetary policy? Consider the following illustration. On July 26, 2007 the RBNZ increased the OCR by 25 basis points, a move that was believed to have been broadly anticipated by financial markets. Nevertheless, by the end of the day, the New Zealand dollar depreciated by just under a half a percent against the Australian and US dollars. Was there anything possibly newsworthy in the RBNZ's

[1] On June 11, 2007 the RBNZ finally did intervene to put downward pressure on a rapidly appreciating NZD. The NZD would continue to appreciate and would reach a post 1985 peak against the USD, but not the AUD, on July 26th.

announcement? The RBNZ's statement explaining its decision stated "…we think the four successive OCR increases we have delivered will be sufficient to contain inflation." Hence, even if the OCR move was widely expected, the forward looking sentiment in the wording of the RBNZ's statement may have independently influenced market expectations.

Ours is not, of course, the first study to quantify how the surprise component of monetary policy affects the exchange rate, although much of the literature has focused on the US experience. Nevertheless, as explained below, we have constructed a dataset with several unique characteristics. The New Zealand experience holds particular interest since it is one of the few central banks in the world to provide quantitative guidance about the interest rate track.[2] In addition, the RBNZ's Monetary Policy Statement (MPS) represents the focal point of the central bank's communications strategy because the publication aims to inform the public about its views concerning the current and anticipated future state of the economy and the external factors that might influence them. Hence, we attempt to quantify the impact of any surprises this document might contain, especially as successive MPS reflect revisions in the RBNZ's stance about the appropriate direction of future monetary policy. There are potentially other sources of surprises that may influence exchange rate movements. Some have a direct connection to monetary policy but others stem from announcements related to domestic economic activity as well as, and possibly more importantly, announcements from abroad with a potential impact of exchange rate movements around the time monetary policy decisions are made.

[2] The Norges Bank, the Bank of England, and the Riksbank now also provide this kind of market guidance but they have only done so fairly recently and it is too early to estimate their impact on asset price movements.

All of these types of surprises need to be taken into account. Kearns and Manners' (2006) estimates of the surprise element of monetary policy on exchange rates in four countries, including New Zealand, comes closest to our study. There are, however, a number of differences between their study and ours. Their data is coarser, and they do not estimate the separate impact on exchange rates from all sources of news. Since there is considerable discussion about the advisability of releasing a forward interest rate track (e.g., see Woodford 2005), separately estimating the potential effect of this kind of information should be of interest. In particular, we are also interested in the question whether 'bad news' for inflation is 'good news' for the exchange rate, or vice-versa. Clarida and Waldman (2007),[3] for example, report that a 1% inflation surprise in New Zealand increases the USD-NZD exchange rate by 0.7% in a 10 minute window around data announcements (i.e., 5 minutes before or after the announcement).[4] Our estimates are not only considerably larger but we also find that how the RBNZ communicates information to markets moves the NZD. Equally important is our finding that the release of a forward interest rate track adds only a modest amount to the surprise component of monetary policy. Fears expressed by some (e.g., see Blinder et. al. 2007 for a discussion of the issues) that releasing this type of information is tantamount to transparency gone too far, are overblown.

The rest of the paper is organized as follows. The next section briefly reviews the relevant literature on the connection between surprises and exchange rate movements. Section 3 describes the various channels used by the RBNZ to communicate monetary policy with special emphasis on the role of the forward interest rate track and the MPS. Section 4 describes the data and the principal results

[3] We became aware of their paper after the present study was first prepared.
[4] A rise in the exchange rate is interpreted here as an appreciation of the currency.

of the paper are also presented. Section 5 concludes.

2. Central Bank Communication, News, and Asset Prices

There exists an extensive literature dealing with the impact of surprises on asset prices. What follows then is a selective survey.[5] The early literature in this field focused primarily on the effects of news releases, typically originating from financial markets, on stock returns. More recently, attention has turned to estimating the effects from these sources on other asset prices, such as exchange rates and interest rates.

Lately, there has been considerably more interest shown in exploring how asset prices react to announcements and other forms of communication emanating from the monetary authorities. What explains this development? First, many central banks now rely on an overnight interest rate, or a similar instrument, to guide the general level of interest rates. Furthermore, interest rate announcement dates are scheduled well in advance and, unless there is an emergency or crisis of some kind (e.g., as in the events of 9/11), central banks do not deviate from the pre-announced schedule. Naturally, this prompts financial markets participants to form their expectations at known intervals of time. Second, central banks in several countries are now more formally independent, transparent, and accountable to their governments.[6] Third, there is a possibility that, at times, the words of central banks can substitute for direct action (Gürkaynak, Sack and Swanson 2005a, 2005b). Bernanke (2004) argues that the central bank can use this device to influence the likely future path of short

[5] Andersen, Bollerslev, Diebold, and Vega (2005), and Faust, Rogers, Wang, and Wright (2007) also provide a comprehensive bibliography of the relevant literature.

[6] There is an extensive literature on the sources and state of transparency among central banks worldwide. Siklos (2002) is one survey, while more recent surveys, together with empirical evidence, can be found in Dincer and Eichengreen (2007), and van der Cruijsen and Eijffinger (2008).

rates as well as long rates. Indeed, central banks have generally become more talkative. As a result, there is recognition that the monetary authority can influence markets on a daily basis.

Since financial market participants are also forward-looking, any monetary policy surprise can potentially have a deleterious impact on asset price movements. Yet, monetary policy transparency is precisely about minimizing such occurrences, unless the objectives of monetary policy are jeopardized as a result.[7] Indeed, in an attempt to provide even more guidance about the current and future stance of monetary policy some central banks, notably the RBNZ, began to publish a forward track for short-term interest rates. In addition, the RBNZ publishes interest rate projections based on different scenarios about inflation pressure, and it is the first central bank to have done so.[8] In the case of the US and the euro area, where there is arguably less central bank transparency according to some metrics (e.g., Dincer and Eichengreen 2007, Eijffinger and Geraats 2006), recent studies use interest rate futures, or forward exchange rates, to proxy future sentiment in financial markets (e.g., Connolly and Kohler 2004, Rigobon and Sack 2004, Kearns and Manner 2006, Brand, Buncic, and Turunen 2006). Whether it is possible to be too transparent is up for discussion but is not the focus of this paper (see, however, Mishkin 2004, and Cukierman 2008).

A frequently used measure of 'news', or surprise, is given by the following expression:

[7] Blinder, Goodhart, Hildebrand, Lipton, and Wyplosz (2001) find that the 'quality' of inflation reports can lead to smaller reactions to monetary policy actions.
[8] As previously noted, there is an ongoing debate about the benefits and risks from this kind of transparency. See, for example, Woodford (2005), and Blinder et. al. (2007).

$$s_{i,t} = \frac{A_{i,t} - E[A_{i,t}]}{\sigma_{i,t}} \qquad (1)$$

where $s_{i,t}$ is the surprise component of for announcement *i*, at time *t*, and is defined as the difference between the announced value of some economic indicator, A, and its median expected value based on a forecast or a survey, given by $E[A_{i,t}]$. Equation (1) is divided by the sample standard error, $\sigma_{i,t}$, to standardize the measure of surprise rendering them comparable across different types of announcements. Once the surprise indicator is evaluated it enters a regression as a determinant of some return. Denoting *q* as the (log) level value for a particular financial asset (in the present study an exchange rate), a simple test of the impact of surprises consists in estimating the following regression

$$\Delta q_t = \alpha + \beta \Delta MP_t^i + \varepsilon_t \qquad (2)$$

where Δq_t is the return on the asset in question, here the rate of appreciation or depreciation in the nominal exchange rate, ΔMP_t^i is a proxy for unexpected monetary policy with the superscript highlighting the fact that such surprises may originate from several sources, while ε_t is the error term.

In any given week, various private and public sector institutions release announcements that compare actual and projected values for a large number of economic variables. In the US alone, the number of such announcements is large with perhaps as many as 83 data related announcements (e.g, see Siklos and Bohl 2008). With so many announcements, researchers typically have either arbitrarily chosen a subset of them, because the extant empirical literature suggests them to be statistically important, or they rely on a systematic technique such as principal components analysis to reduce the number of statistically meaningful announcements. In the case of New Zealand, there are comparatively fewer data releases. However, an important consideration for a small open economy, under-appreciated in the literature, is that both domestic and foreign surprises (viz., from the US and Australia) are likely to be potentially relevant sources of shocks that can impact domestic asset price movements.

Consistent with the increased emphasis on estimating the impact of central bank policies on asset prices, researchers have also quantified statements, press releases, speeches, and other announcements emanating from the monetary authorities. Whether it is possible to objectively quantify the words of central bankers remains in question (Sebestyen 2005, Andersson 2007). Nevertheless, there have been promising efforts so far, with many studies suggesting that 'verbal interventions' do move markets (e.g., Ehrmann and Fratzscher 2003). However, a difficulty with the interpretations of verbal announcements is that statements by central bankers may obscure the monetary authority's likely course of action, or mask the inherent uncertainty about the future course of monetary policy.[9] Yet, there is also widespread acceptance of the notion that what the central bank communicates, and how, influences financial markets. This is especially true of inflation targeting central banks whose credibility depends on meeting statutory inflation objectives. Moreover, since most central banks conduct policy in small open economies, there is added emphasis on communicating anticipated economic outcomes that are partly dependent on the current stance of monetary policy.

One of the biggest challenges is identifying asset price reactions to market news

[9] This is the principle of 'constructive ambiguity' associated with Alan Greenspan's strategy of communicating US monetary policy in public.

from central bank announcements. For example, Gürkaynak, Sack, and Swanson (2005a) investigate whether the impact of monetary policy announcements on asset prices is adequately characterized by a single factor, the surprise component of the change in the current policy rate setting, a hypothesis that is rejected by the data. As a result, their study calls into question many single factor studies such as Cook and Hahn (1989), Kuttner (2001), Cochrane and Piazzesi (2002), Rigobon and Sack (2003), Ellingsen and Söderstrom (2003), and Bernanke and Kuttner (2005). Gürkaynak et.al. (2005a, 2005b, 2007) argue that central bank communication can account for more than three-fourths of the variation in the movements of 5 and 10 year Treasury yields, around FOMC meeting days. Indeed, there is another factor to consider when investigating asset price movements, namely what the Fed might do in future. In the case of ECB's monetary policy a third factor is also present given the short time delay that exists between the ECB interest rate announcement and the ECB President's news conference (see Brand, Buncic, and Turunen 2006).

Given the multiplicity of factors stemming from monetary policy announcements it is not surprising that a crucial issue is the sampling frequency. Some researchers have reported that news events dissipate within a matter of hours (Goodhart et.al. 1993, Andersen et.al. 2005). Therefore, using daily data may underestimate the short-run effects of unexpected events on asset prices whose impact may peak within minutes of the arrival of new information, only to be reversed later the same day. Ehrmann and Fratzscher (2004, 2007) counter that intra-daily data capture market overreactions, and they defend the use of daily data. Not all market participants necessarily react within a few hours. There is also a presumption that markets react to the same news at the same time. The news transmitted to different markets may be met with delays. Moreover, with intra-daily data, one needs to define a window, and the results may be sensitive to the chosen discrete time interval.

Because there may be both transitory and permanent effects as a result of central bank interest rate announcements, advocates of intra-daily data have devised new strategies to overcome some of the criticisms levelled at their estimation strategy. On balance, however, it would seem that to adequately estimate the impact of the release of information by a central bank around the time of a monetary policy announcement, the event study approach is perhaps the most fruitful way to proceed under the circumstances. Indeed, as we shall see, the available data permits us to isolate the effects we are seeking to identify with a fair amount of precision.

3. Proxying Monetary Policy Surprises in New Zealand

The RBNZ communicates with the public through a variety of avenues. These include: Monetary Policy Statements (MPS) and Interim OCR Reviews, speeches by the Governor and the senior management, Finance and Expenditure Select Committee testimonies, and press releases.

By far the most important means of communication about monetary policy decisions in New Zealand is the MPS. The other forms of communication listed above are likely to have played a lesser role simply because the precision and quantity of information provided by the MPS, as well as advance knowledge of the timing of the release of the MPS are known in advance. There are eight official cash rate (OCR) reviews a year: four are accompanied by an MPS which represents a detailed discussion and assessment of the state of the New Zealand economy and is accompanied by a short statement that provides a general overview of its contents, ordinarily one page in length. The MPS is published at 9:00am New Zealand time (3:00pm, the previous day in the Eastern US time zone). The dates when these statements are released can be found at http://www.rbnz.gov.nz/statements/0090630.html. Each MPS also contains forecasts for a wide variety of economic time series. While considerable attention is devoted to inflation, exchange rate, and economic growth forecasts, there has been considerable publicity given to the RBNZ's publication of alternative scenarios for 90-day bank bills, conditional on different hypothesized future paths for inflation. The result is published as the forward track for short term interest rates. The publication of the MPS is also accompanied by the data set used in its preparation. All of these documents can be readily downloaded from the RBNZ's website.

The surprise element of monetary policy in New Zealand can be estimated from a few sources. One can simply look at the change in 90 day interest rates around policy announcements, as did Gürkaynak et al (2005a, 2005b). A surprise can also be derived from the change in futures contracts prices relative to the day prior to the policy action. Kuttner (2001) proposes the use of the futures market data to gauge the unanticipated component of monetary policy, and this approach has been typically followed in the subsequent literature. For US data, fed funds futures have been found to have good predictive content for the realized fed funds rate (Krueger and Kuttner 1996, Gürkaynak 2005, and Hamilton 2007). In the case of New Zealand, a proxy is futures on 90 day bank bills (also see Kearns and Manners 2006), or Overnight Index Swaps (OIS; Choy 2003, Gordon and Krippner 2001).[10]

[10] Bank bills are bills of exchange issued or accepted by banks. OIS were introduced in 2003 and represent exchanges of obligations for short periods. They have proved useful to the RBNZ as a means of deriving market expectations about the OCR. See Choy (2003).

Bank bills futures are not directly comparable to fed funds, since the 90 day bank bills rate is not the actual policy rate. However, it is widely agreed that bank bills represent the instrument which the OCR aims to influence. First, second, third, and fourth contracts for the 90 day bank bills futures can be used to calculate different components of a monetary policy surprise in a manner described in Gürkaynak (2005; also see below). Finally, Reuters surveys market participants about the probability they attach to likely policy outcomes. A week or so before the Monetary Policy Committee of the RBNZ meets, the weighted median market expectation of the OCR is provided to the committee. This survey may or may not influence the Governor's OCR decision.[11] In any event, the survey provides yet another source of monetary policy surprises.

Table 1 summarizes the surprise measures employed in this study while Table 2 provides descriptive statistics for the three different monetary policy surprise measures defined above. Depending on the definition of the monetary policy surprise proxy, our sample begins in 2000, 2001, or 2002 and always ends in 2007. The summary statistics are comparable. Nevertheless, the correlation coefficients between types of monetary policy surprises, while high, vary from a low of 0.72 to a high of 0.87. An additional feature of the data is also worthy of some additional comment. There is the possibility of a term premium. As suggested in the extant literature (Kuttner 2001, Bernanke and Kuttner 2005, Gürkaynak et.al. 2005a, 2005b, Gürkaynak 2005), while the term premium exists and could be time varying, the resort to high frequency data, namely a window of 30 minutes around policy announcements, should result in very small variations of the term premium. Piazzesi

[11] The Governor is the only person statutorily responsible for the OCR decision.

and Swanson (2008), for example, show that one day changes in the fed funds rate futures around FOMC announcements are very small. As a result, defining a relatively narrow window around such announcements likely represents the 'cleanest' way to calculate surprises, as term premia that are primarily influenced by lower business cycle frequency movements are effectively removed (also, see Gürkaynak 2005). Note also that during the first two thirds of the period covered in this study there was a worldwide decline in long rates. This too can be problematic since it is unclear whether differencing of interest rates would be sensible under the circumstances. However, in an event study, this stylized feature of the data is less likely to pose a problem. We believe it is fairly safe to assume that, at the intra-daily frequency, the impact of these kinds of trends would be negligible.

Figure 2 plots the three proxies for monetary policy surprises in a 30 minute window, together with a 95% confidence ellipse. In general, surprises are positively related to interest rate movements. A positive surprise implies an expectation that future interest rates will also rise, and by an almost equivalent amount.[12]

The literature has adopted several approaches to extracting information contained in monetary policy announcements. Gürkaynak et al (2005), and Brand, Buncic, and Turumen (2006) employ a recursive type approach to estimating the size of the reaction to news announcements. Assume that the relevant time window is 10 minutes (denoted Δf_t^{10}). This refers to the length of time over which the implied forward implied rate is evaluated, and define the reaction of the market to a central bank interest rate setting decision as taking place over a 30 minute period (denoted

[12] A simple regression of the change in the interest rate against the three surprises yields slope coefficients of 0.85 (MP^1), 0.92 (MP^2), and 0.89 (MP^3). These are close to one but the null that the slope is equal to one can be rejected at the 5% level.

Δf_t^{30}). We can write the relationship between these two measures as follows:

$$\Delta f_t^{10} = \lambda_0 + \lambda_1 \Delta f_t^{30} + resid_t \qquad (3)$$

Equation (3) hypothesizes that the size of the reaction to the setting of the interest rate is given by λ_1 and is referred to as the 'jump' factor. The residuals in the regression (*resid*) represent changes in the market's expectations about the future path of interest rates referred to as the 'path' factor.[13] In a second stage, equation (3) is re-estimated by adding a second factor derived from the first stage regression. Setting aside the generated regressor problem, restrictions need to be imposed to identify the sources of the shocks to interest rates not only to facilitate comparisons with the existing literature but, as pointed out in Gürkaynak (2005), because this approach also permits us to use a unique dataset from New Zealand permitting the decomposition of the sources of surprises to the NZ dollar exchange rate.

4. The Impact of Monetary Policy Surprises on the NZ Dollar

4.1 *The Response to Monetary Policy Surprises*

We begin with the following regression similar to the one used in Kuttner (2001), Bernanke and Kuttner (2005), and Gürkaynak et al (2005a, 2005b):

$$\Delta q_t = \alpha + \beta MP_t^u + \varepsilon_t \qquad (4)$$

where Δq_t is the rate of change in the nominal exchange rate of the NZD, expressed in foreign currency units (i.e., either in USD or AUD terms), collected at various intervals. Consequently, a negative value represents a depreciation of the NZD currency. The variable MP_t^u represents monetary policy surprises previously defined. The proxy can either be a single variable or a vector of proxies for the unexpected

[13] In the case of the ECB considered by Brand, Buncic, and Turumen (2006) there is a third factor, called the timing factor, previously described.

component of monetary policy decisions. It is important to recognize the possibility that the NZD currency will also be influenced by announcements abroad, especially from the US and Australia.

Most of the major US macroeconomic data announcements are released at 8:30am Eastern time in the US (viz., the Consumer Price Index, Gross Domestic Product, Housing starts, Jobless claims, non-farm payrolls, etc…). Other announcements (e.g., Industrial production) are released at 9:15am Eastern time. All US data announcements correspond to early morning in New Zealand, the following day. Hence, by the time an OCR announcement is made, it is unlikely that this type of news would further impact the NZD exchange rate. The FOMC releases its announcements at 2:15pm Eastern time and, depending on the time of year, this corresponds either to 6:15am, 7:15am, or 8:15am the next day local New Zealand time. New Zealand markets open at 8:00am local time, and RBNZ announcements are made at 9:00am local time. Since our window calculations begin at 8:50am New Zealand time, we can safely assume that markets react to US news within 35 to 50 minutes from the releases, and between 35 to 50 minutes for FOMC announcements, depending on the time of year. As a result, we must also control for US monetary policy surprises that take place on the following days: 24-25 October 2006, 27-28 January 2004, 13 August 2002, 19 March 2002, 2 October 2001, 15 May 2001, 18 April 2001, 3 October 2000, 16 May 2000, 16 November 1999, and 18 May 1999. FOMC announcements on these days are temporally close to RBNZ OCR announcements. We use the Bernanke and Kuttner (2005) measure of the FOMC surprises to control for the unexpected portion of FOMC decisions.[14]

New Zealand data also pose problems on five other occasions because monthly releases of Trade Balance figures were announced on the same day as an OCR decision, namely 27 April 2006, 28 April 2005, 28 October 2004, 29 April 2004, and 29 January 2004. Trade balance data are announced at 10:45am local time in New Zealand. Hence, they do not coincide with the 30 and 60 minutes window employed in our regressions. Nevertheless, the mere anticipation of the release of an important piece of New Zealand economic news may well have a separate influence on exchange rate movements.

Tick-by-tick data are available from April 2001. Prior to that date, however, data at 10 minute intervals past every hour are available. In other to ascertain the sensitivity of our results to the choice of window size we also present results for a 60 minutes window. The results for the 30 minutes window are based on an interval timed to begin at 8:10am (instead of 8:50am) and 9:10 am (instead of 9:20am). All times are local. For the 60 minutes window, we define the window to begin at 8:10am (instead of 8:50am) to 10:10am (instead of 9:50am), again New Zealand time. In the results reported below the impact of adding these results is negligible, in part because the net effect is to add only 5 additional observations. Finally, on one occasion (March 2002), Statistics New Zealand published the GDP release on its website well before the normal announcement time of 10:45am local time.[15] We also exclude from our data the OCR announcement following the September 11,

[14] We are grateful to Ken Kuttner for providing us with the US fed funds surprise data. For details on the construction of the series, see Bernanke and Kuttner (2005).

[15] The early release concerned the December 2001 GDP figure released in early 2002. See Statistics New Zealand "GDP Inadvertently Released Before Embargo Time", http://www.stats.gov.nz/, March 2002 Quarterly Report.

2001 terrorist attacks on the US, as this was obviously not a scheduled announcement by the RBNZ.

Table 3 shows the results from estimating equation (4), relying on the three different proxies for MP_t^u, for both the NZD-USD and NZD-AUD exchange rates. To conserve space, estimates of the constant term are omitted but they are all statistically insignificant and economically uninteresting. These results should be taken as the benchmark against which all subsequent results should be compared with. Slope coefficients are highly significant and positive for bank bills futures (MP_t^1) and the OIS based surprise (MP_t^3) measures. Therefore, the NZD appreciates in the face of a positive monetary policy surprise. If the latter is interpreted as 'bad news' about inflation, this translates into 'good news' for nominal exchange rate movements. For example, a 100 basis point unanticipated monetary policy results in an 3.3% appreciation of the NZD-AUD exchange rates for the 30 minutes window. A similar sized surprise produces an even larger effect on the US dollar, at 4.1%. Differences in the USD and AUD reactions are not, however, statistically significant. It is notable that the Reuters based surprise measure (MP_t^2) is not statistically significant in any of the NZD-AUD regressions and is only significant at either the 5 and 10 percent levels in only a few of the NZD-USD regressions at the 60 minutes and 1 day windows. Since Reuters in New Zealand does not survey market participants on a regular basis, the lag between a particular survey and the actual RBNZ decision can, at times, stretch up to two weeks. Alternatively, it may be that the resort to a weighted estimate of the expectation of future OCR changes may be misleading if the weights do not properly reflect the relative accuracy or knowledge of the survey participants. Finally, also note that monetary policy surprises remain largely unchanged as the window is widened from 30 minutes to a full day. Therefore, the results in Table 3 highlight two other important implications. First, monetary policy surprises have large effects on the exchange rate. Second, more precise estimates of the impact of these surprises are indeed obtained from reliance on intra-day data. Notice that the standard errors are roughly 40% larger when equation (4) is estimated using daily data and this, of course, is also reflected in the R^2 estimates shown in Table 3 which tend to fall as the window becomes wider.

4.2 *Decomposition of Surprises Into Level and Timing Effects*

The foregoing results assume that monetary policy surprises have a single dimension, following the traditional approach used the extant literature. However, since central banks are believed to act gradually, there is some uncertainty about whether the necessary easing or tightening will be carried out at once or over time. This implies that a surprise can carry over to more than one monetary policy decision date. In principle then, there is potentially a transitory and a permanent component to any monetary policy surprise. These effects have been labelled path and timing effects, respectively. For example, a surprise in the timing of a policy decision is one that leaves the expected OCR unchanged following a monetary policy announcement. In what follows, and for reasons discussed previously, we consider only surprises generated from bank bills and OIS data.[16]

To fix ideas, suppose that a futures contract expires around the time of the next monetary policy announcement date and that this yields surprise denoted by MP_t^l.

[16] We rely on the second contract for bank bills futures and the 3 month OIS, as these correspond to a three month horizon following an OCR decision. There is one decision during that period. Hence, there is the possibility that markets may expect a change in interest rates. Using the third contract for bank bills and the 90 day OIS yielded very similar results (not shown).

Assuming there are no further expectations of an OCR change, the impact of the surprise is a permanent one. Therefore, we can write:

$$MP_t^i = level_t \qquad (5)$$

Next, suppose that that current OCR announcement contains both a transitory and a permanent component. Assuming they are additive, we can treat the transitory portion as akin to an error term in a regression of the form:

$$MP_t^u = \theta\, level_t + timing_t \qquad (6)$$

where MP_t^u was previously defined. Substituting the right hand side of equation (6) into equation (4) we estimate the impact of a monetary policy surprise on the exchange rate as follows:[17]

$$\Delta q_t = \beta_0 + \beta_1\, level_t + \beta_2\, timing_t + \varepsilon_t \qquad (7)$$

In equation (7), the regressors are separately estimated leading to a generated regressor problem to which we return below when we discuss the possibility of bias in the coefficients. Results from the estimation of equation (6) are given in Table 4.

The coefficient on the level variable is not statistically significantly different from unity, implying a parallel shift in short-term interest rates. Moreover, the level effect explains between 69 and 80% of the variation in surprises. Therefore, the level effect represents a much smaller fraction of New Zealand surprises than for the US (see Gürkaynak 2005). This finding is noteworthy as the RBNZ has routinely tried to de-emphasize the importance of the surprise element of monetary policy announcements. It would seem that this effort has been successful.

Table 5 presents the results of the response of exchange rate changes to both

[17] Gürkaynak (2005) also introduces the notion of a 'slope' effect to account for the pace of interest rat changes. We examine below the significance of this effect in the New Zealand context when we estimate the impact of the release of the forward track for the interest rate.

the level and timing of surprises (equation (7)). The results clearly show that level effects dominate. Since timing effects appear inconsequential, this suggests that the RBNZ has successfully mitigated the transitory effects from monetary policy surprises. This result contrasts with the US evidence where timing effects are found to be significant for both interest rate and stock returns (e.g., see Gürkaynak 2005). An obvious problem with the foregoing estimation approach is that market prices may incorporate some idiosyncratic noise. In essence this is akin to an 'errors in variables' problem. If the errors are of the classical variety, they can bias coefficient estimates toward zero. This is known as the attenuation bias problem.[18] An appendix (not shown) demonstrates that this type of bias is a problem for survey-based measures rather than for the other proxies considered in the results just presented.

4.3 *The Impact of the Forward Interest Rate Track*

Since 1994, the RBNZ has published interest rate forecasts. The forecasting process has since gone through various changes (e.g., see McCaw and Ranchhod 2002, Ranchhod 2003). For example, until 1997, interest rate forecasts were presented without taking into account the effects of changing future interest rates on key macroeconomic aggregates. During the 1997-1999 period, when the monetary conditions index (MCI) became an instrument of policy, the RBNZ began to forecast future interest rates conditional on the impact of these rates on key variables such as inflation. The resulting interest rate forecasts came to be called endogenous policy forecast interest rate tracks. The practice continues since the OCR became the instrument of monetary policy beginning in June 1999. Interest rates are forecast

[18] This is a somewhat neglected issue in the literature. The errors may, or may not, be random, and since we look at asset prices, these may also be correlated with the right hand side errors. Typically, however, the measurement error problem focuses on the independent variable(s) in a regression.

generated following several iterations or calibrations of the RBNZ's formal economic model called the FPS (Forecasting and Policy System; see http://www.rbnz.gov.nz/research/fps/). Perhaps most germane to this study, assumptions about the exchange rate, as well as external forecasts of the foreign economic environment, represent significant inputs in the process (see McCaw and Ranchhod 2002, Figure 2). The RBNZ publishes an endogenous interest rate track four times a year. Therefore, since our earlier proxies for MP_t^u assume eight events per year, consistent with the total number of monetary policy announcements in a year, the series of interest rate track surprises contains missing values for every second observation. As a result, the sample employed here consists only of data published in successive MPS since August 2000.[19] We calculate the implied 90 day interest rates at 9 and 12 month horizons before the release of an MPS and take the difference between them and the RBNZ's published 90 day interest rates at the same horizons. We denote the relevant series *fs9m* and *fsm12m*, respectively.

Figure 3a plots the size of monetary policy surprises estimated from the forward interest rate track. The surprises, measured in basis points, can be quite large. However, what is especially noteworthy is that, during the second half of the sample, markets consistently over-estimated the direction of future interest rates. Figure 3b highlights the fact that positive monetary policy surprises, namely interest rates that exceed even the RBNZ's forward interest rate track, result in a small appreciation of the NZD vis-á-vis the USD.[20] Nevertheless, the confidence ellipse suggests a small likelihood that the relationship will be statistically significant. We now turn to a more

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[19] In principle, we could go back to 1997 when interest rate forecasts first appeared in the MPS. However, we then encounter the problem of some missing intra-daily data, as previously discussed.

[20] The results are the same for the AUD-NZD case.

formal examination of the role of these surprises.

Tables 6a and 6b report the regression results.[21] The surprise variable, MP_t^1, is statistically significant in every regression. However, *fs9m* and *fs12m* are statistically significant at least at the 5% levels for the 30 minutes window and only for the Reuters based surprise measure (MP_t^2) earlier deemed problematic. The variable *fs12m* is statistically significant, again for the 30 minutes window, but only for the OIS based monetary surprise proxy (MP_t^3). This means that the additional information content in the forward track dissipates fairly quickly. Nevertheless, during that interval of time, there is a further appreciation in the nominal exchange rate over an above the one due to the surprise element in monetary policy. Notice that for the 60 minutes window the results differ as between the USD-NZD and AUD-NZD reactions to the interest rate track announcement. Hence, distinguishing between the two currencies can impact the interpretation of results.

In general, the size of the effect stemming from the forward track suggests that its impact is modest to insignificant. It should be emphasized, however, that the significance of the forward track is a function of how the monetary surprise variable is proxied. Indeed, interest rate forecasts affect the exchange rate only when the survey based measure is used. Since it was suggested earlier that this measure was problematic for a variety of reasons this suggests that a forward interest rate track does no independent harm to the exchange rate. Of course, it is not at all straightforward to separately identify the contribution of the forward track from other information contained in the monetary policy surprise variable due to the fact

[21] We also generated series for the 3 and 6 months ahead horizons implied 90 day interest rates. The results were statistically and economically comparable to the results shown in Table 6.

that the forecasts are contained in the MPS which itself contains potentially many sources of surprise. In any event, the notion that releasing such information represents too much transparency – a bridge too far so to speak – is not borne out in the data.

4.4 *Other Surprises, Monetary or Otherwise*

Next, we wish to determine whether the existing specifications may have omitted other types of surprises. Here we consider an additional source, namely a quantification of the *language* used by the RBNZ to communicate its views through the MPS. To do so we interpret the commentary in the MPS according to whether the discussion focuses on output, interest rate, inflation, or exchange rate developments, as well as developments from abroad which may be seen as having a potential impact on domestic monetary policy. For example, when the outlook for each one of these variables is favourable, according to the RBNZ, we assign a +1 in the event of a positive commentary and -1 if the sentiment for any one of these variables is negative. We also attempt to assign a value according to whether there is a *bias* of some kind in the statement. That is, we separately identify commentary that specifically indicates that, as a result of the outlook for a particular series, whether monetary policy is likely to tighten, in which case we assign a +1 to the resulting dummy variable or -1 in the event that a loosening of policy is anticipated. Otherwise, that is, when the statement is deemed neutral, the dummy is assigned a zero. Hence, equation (4) is modified as follows:

$$\Delta q_t = \alpha + \beta MP_t^u + \gamma_i comm_t^i + \phi bias_t + \sigma reversal_t + \varepsilon_t \tag{8}$$

where all variables, except *comm, bias* and *reversal*, were previously defined. *Comm* and *bias* are dummy variables taking on the values described above, while *i* refers to whether the commentary specifically deals with output (y), interest rates (rs), inflation (p), exchange rate (q), or international developments (int). *Reversal* is a 0-1 dummy that captures whether there is a change in the bias over time, as in whether a change in the RBNZ's sentiment about the appropriate stance of monetary policy shifts from one release of the MPS to the next. The results previously discussed are unchanged. Hence, to conserve space they are not discussed.[22] However, it is worthwhile noting that the *reversal* variable is statistically significant when either the Reuters survey or OIS are used to construct the proxy for MP_t^u. Therefore, there is a little bit of evidence that the foreign exchange market pays attention to the changing views of the RBNZ.

Exchange rates can, of course, also be influenced by surprises contained in regular macroeconomic announcements that appear within any of the windows defined above. Figure 4 plots surprises from 4 of the 6 available surprises constructed from New Zealand macroeconomic data releases against interest rate changes across different windows. In general, positive surprises in inflation, GDP growth, and the Trade Balance, lead as expected, to positive interest rate changes. The opposite, again as one would expect, holds for a surprise unemployment rate release. Comparing actual data on these announcements against surveys from Reuters and Bloomberg we obtain an estimate of the surprise based on the median expectation. It should be noted that expectations are based on a sample of anywhere from 9 to 15 individuals surveyed, with a mean of around 13 people surveyed. We are able to construct the resulting surprise variable for the full sample of OCR announcements.

Finally, Table 7 presents the results of equation (4) augmented with the

[22] They are, however, available on request.

additional macroeconomic announcement surprises, omitting the coefficient estimates for the constant and MP_t^u terms to conserve space. As shown, the estimates of β are unchanged relative to the earlier evidence discussed. Notice, however, that the explanatory power of the regressions is improved considerably suggesting that such announcements have a sizeable impact on exchange rate movements. In particular, as in Clarida and Waldman (2007), bad news stemming from CPI announcements, that is a negative surprise, represents good news for the exchange rate, a reflection of the credibility of the central bank.

5. Conclusions

This paper estimates the impact of monetary surprises on the behaviour of the USD-NZD and AUD-NZD exchange rates since the Official Cash Rate (OCR) became the instrument of monetary policy in New Zealand. More importantly, we were interested in separately estimating the impact from the release of an endogenously determined forward interest rate track by the Reserve Bank of New Zealand (RBNZ). Although some view the release of this kind of information as an illustration of a central bank taking transparency too far, the results of this paper suggest otherwise. The forward interest rate track, a device now published by a few inflation targeting central banks, does not represent a bridge too far. It is likely that this information is digested simultaneously together with other pieces of information emanating from the central bank. In fact, other forms of information contained in the RBNZ's Monetary Policy Statement (MPS), as well as general macroeconomic data releases contain quantitatively more significant information that affects the exchange rate. Our results are also consistent with Clarida and Waldman's (2007) finding that bad news for inflation is good news for the exchange rate. In spite of the fact that the

RBNZ appears to have done a reasonably good job at minimizing monetary policy surprises they appear to have largely permanent effects on the rate of change of the exchange rate. Clearly, the fact that we rely on an event study approach raises some problems. It is conceivable that a time series approach might yield additional insights into the high frequency determinants of the exchange rate. We leave this extension for future research.

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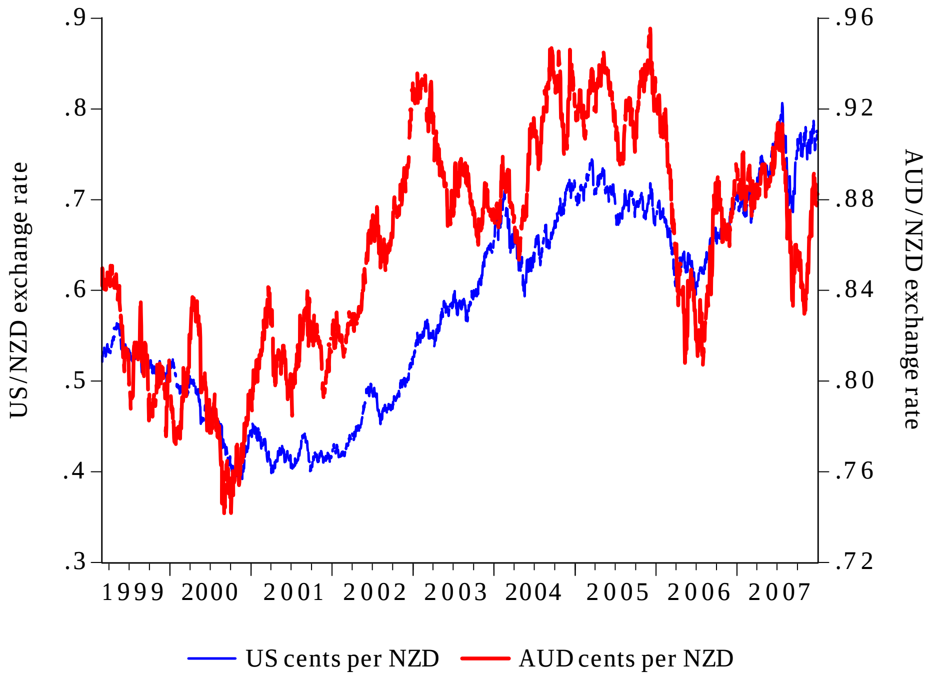
Figure 1 USD-NZD and AUD-NZD Nominal Exchange Rates



Source: Reserve Bank of New Zealand. Data are at the daily frequency (7 days a week).

Figure 2 Monetary Policy Surprises and Interest Rate Changes

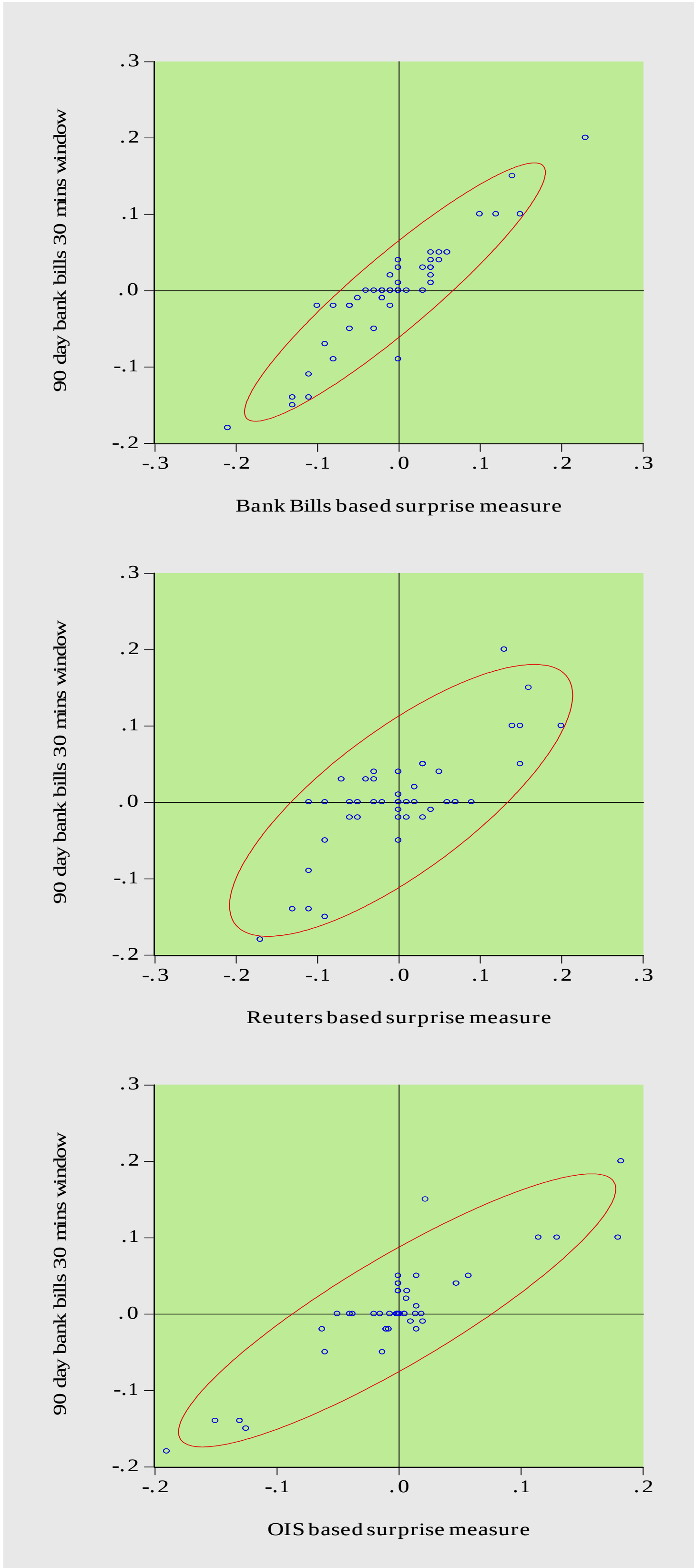
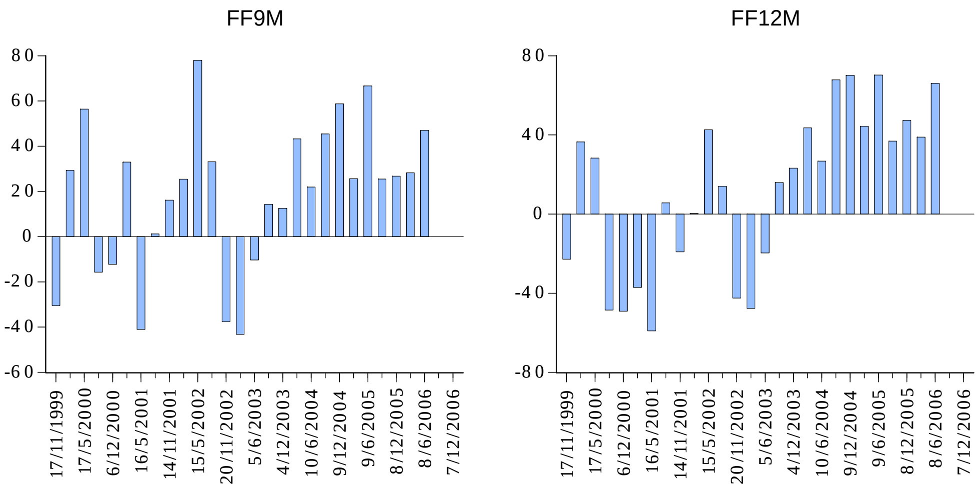
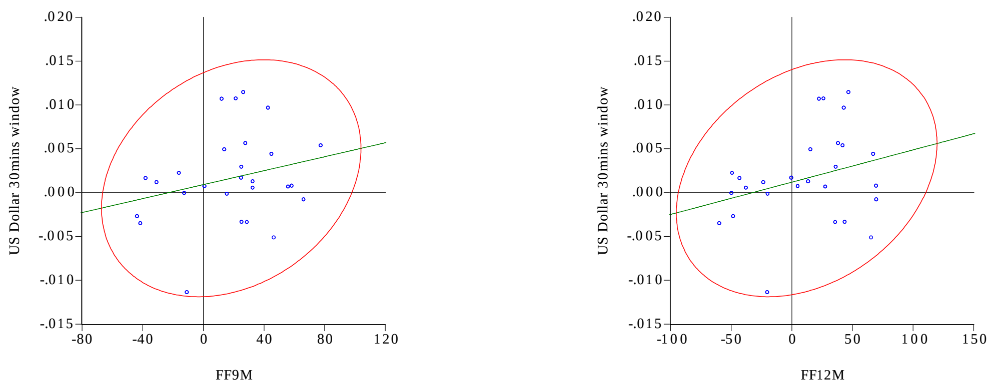


Figure 3a
Market Versus RBNZ Forward Interest Rate Track Differential*



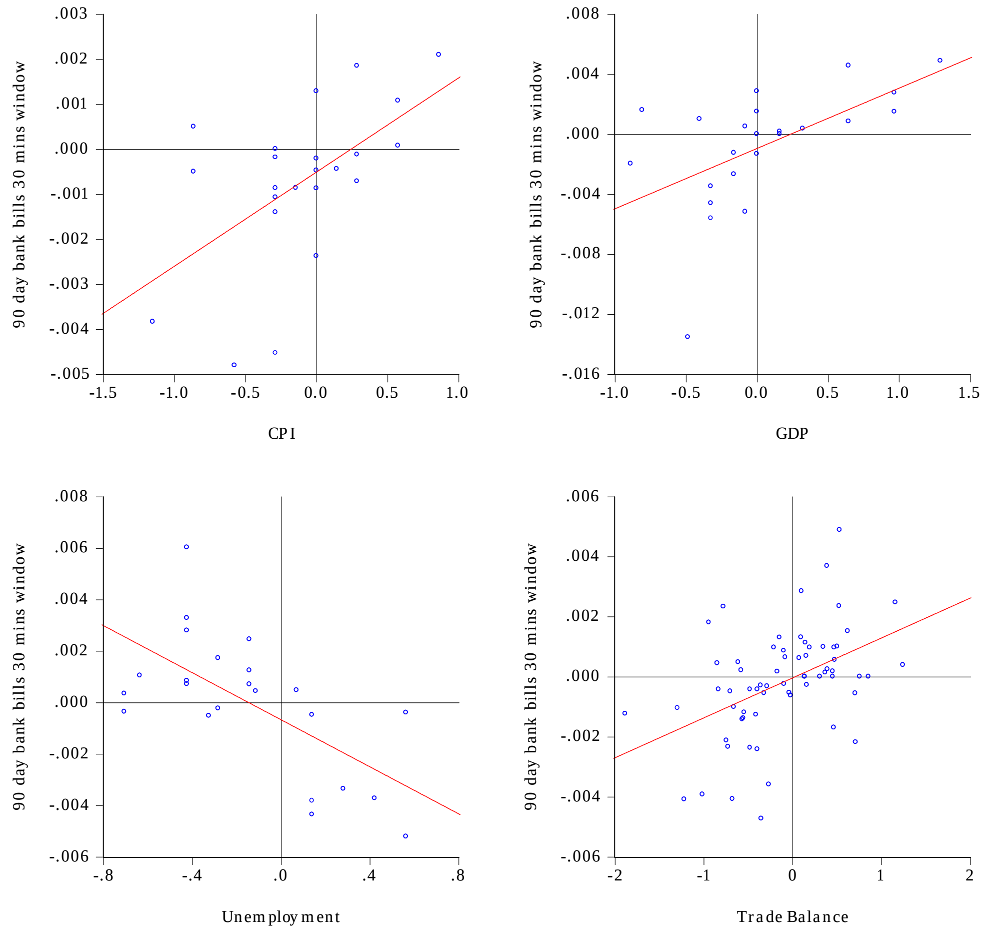
*Note: FF9M and FF12M defined in the text.
Day/Month/Year shown on the bottom axis refers to dates
when MPS statements and interest rate forward tracks were released.
Source: RBNZ and authors calculations.

Figure 3b
Market Versus the RBNZ Forward Interest Rate Track
and the NZD-USD Exchange Rate*



*Note: FF9M and FF12M are defined in the text. Source: RBNZ and authors' calculations.

Figure 4 Macro Announcement Surprises and Interest Rate Changes*



*Note: Surprises defined int the text. Source: RBNZ and authors' calculations.

Table 1 Policy Events and Measures of Monetary Policy Surprises

Basis of Surprise Measure	1st available Observation	No. of Observations*	Monetary Policy Surprise Label
Change in the 1st contract on 90 day bank bills futures (MP_t^1)	16 August 2000	55	MP_t^1
Weighted market expectations from Reuters (MP_t^2)	14 November 2001	48	MP_t^2
Change in Overnight Index Swaps (OIS); (MP_t^3)	20 March 2002	43	MP_t^3

* In all case the last observation is the MPS release of January 27, 2007.

Table 2 Summary Statistics for Monetary Policy Surprise Proxies

Summary Statistics	Proxy		
	MP_t^1	MP_t^2	MP_t^3
Mean	-0.005	0.003	-0.001
Maximum	0.23	0.20	0.19
Minimum	-0.21	-0.17	-0.19
Std. Deviation	0.073	0.08	0.072
Correlation Matrix	MP_t^1	MP_t^2	MP_t^3
MP_t^1	1		
MP_t^2	0.72	1	
MP_t^3	0.87	0.78	1
Observations	55	45	43

Table 3 Exchange Rate Responses to Monetary Policy Surprises: Benchmark Specification

	AUD-NZD			USD-NZD		
Coefficient	MP_t^1	MP_t^2	MP_t^3	MP_t^1	MP_t^2	MP_t^3
Window	30 minutes			30 minutes		
β	0.033*** (0.006)	0.013 (0.008)	0.032*** (0.009)	0.041*** (0.008)	0.021** (0.010)	0.039*** (0.010)
Obs.	55	45	43	55	45	43
R^2	0.37	0.06	0.25	0.42	0.13	0.30
	60 minutes			60 minutes		
β	0.036*** (0.008)	0.012 (0.009)	0.032*** (0.010)	0.044*** (0.010)	0.020* (0.011)	0.041*** (0.013)
Obs.	55	45	43	55	45	43
R^2	0.35	0.04	0.20	0.36	0.08	0.24
	1 day			1 day		
β	0.035*** (0.010)	0.013 (0.010)	0.035*** (0.013)	0.044*** (0.012)	0.021* (0.012)	0.043*** (0.015)
Obs.	55	45	43	55	45	43
R^2	0.23	0.04	0.17	0.19	0.07	0.19

Note: Estimates of β based on equation (4), using least squares with White corrected standard errors. *** signifies statistically significant at the 1% level, ** at the 5% level, *at the 10% level of significance. See Table 1 for the definition of monetary policy surprises.

Table 4 The Level or Permanent Effect of Monetary Policy Surprises on Exchange Rates

Monetary Policy Surprise	Constant	Level	R^2
MP_t^1	-0.002 (0.006)	0.828*** (0.076)	0.69
MP_t^3	-0.006 (0.005)	0.755*** (0.057)	0.80

Note: *** signifies statistically significant at the 1% level. Equation (6) estimated via least squares. Results are for the USD-NZD exchange rate. See Table 1 for the definition of monetary policy surprises.

Table 5 Permanent and Transitory Effectst of Monetary Policy Surprises on Exchange rates

	AUD-NZD		USD-NZD	
Variable	MP_t^1	MP_t^3	MP_t^1	MP_t^3
Window:	30 minutes window			
Level	0.036*** (0.016)	0.035*** (0.029)	0.044*** (0.009)	0.043*** (0.011)
Timing	0.009 (0.007)	-0.029 (0.009)	0.014 (0.019)	-0.037 (0.031)
Obs.	55	55	43	43
R^2	0.46	0.47	0.50	0.52
F-Stat	21.81	22.67	17.21	18.22
Window:	60 minutes			
Level	0.040*** (0.016)	0.038*** (0.008)	0.049*** (0.010)	0.047*** (0.013)
Timing	0.008 (0.008)	-0.041 (0.010)	0.009 (0.019)	-0.048 (0.030)
Obs.	55	55	43	43
R^2	0.45	0.45	0.45	0.47
F-Stat	20.92	21.11	14.18	14.93
Window:	1 Day			
Level	0.045*** (0.011)	0.043*** (0.012)	0.047*** (0.012)	0.049*** (0.014)
Timing	-0.007 (0.011)	-0.056 (0.012)	0.009 (0.023)	-0.048 (0.041)
Obs.	55	55	43	43
R^2	0.37	0.43	0.31	0.36
F-Stat	9.99	12.58	7.54	9.74

Note: *** indicates statistically significant at the 1% level. Equation (7) estimated via least squares. Standard errors in parenthesis. Controls for FOMC announcements included but coefficient estimates not shown. Standard errors are bootstrapped as described in Gürkaynak (2005), based on a 1000 replications. Results are for the USD-NZD exchange rate. See Table 1 for the definition of monetary policy surprises.

Table 6a The Impact of the Forward Interest Rate Track on the AUD-NZD Exchange Rate

Variables	MP_t^1			MP_t^2			MP_t^3		
Window	30 minutes								
MP_t^u	0.034*** (0.010)	0.033*** (0.010)	0.032*** (0.010)	0.014 (0.013)	0.012 (0.012)	0.011 (0.012)	0.028* (0.018)	0.026* (0.015)	).027** (0.013)
fs9m		0.003 (0.002)			0.004** (0.002)			0.003 (0.002)	
fs12m			0.003 (0.002)			0.004** (0.002)			0.004** (0.002)
R^2	0.31	0.34	0.35	0.06	0.13	0.15	0.14	0.21	0.26
Window	60 minutes								
MP_t^u	0.040*** (0.009)	0.040*** (0.010)	0.039*** (0.013)	0.013 (0.013)	0.013 (0.012)	0.012 (0.012)	0.030* (0.017)	0.027** (0.013)	0.029*** (0.012)
fs9m		0.003 (0.002)			0.005 (0.002)			0.004 (0.002)	
fs12m			0.003 (0.002)			0.004 (0.002)			0.004 (0.002)
R^2	0.34	0.38	0.40	0.04	0.12	0.15	0.13	0.20	0.25
Window	1 day								
MP_t^u	0.025* (0.015)	0.031** (0.015)	0.029* (0.015)	0.009 (0.015)	0.014 (0.013)	0.014 (0.013)	0.023 (0.020)	0.021 (0.017)	0.022 (0.015)
fs9m		0.003 (0.003)						0.003 (0.003)	
fs12m			0.003 (0.0030		0.004 (0.003)	0.004 (0.003)			0.004 (0.003)
R^2	0.11	0.17	0.20	0.02	0.08	0.11	0.06	0.10	0.14

Note: MP is defined in Table 1. The estimates of the constant term are not shown to conserve space. The dependent variable is the rate of change in the nominal exchange rate. See Table 5 for explanation of symbols for significance levels.

Table 6b The Impact of the Forward Interest Rate Track on the USD-NZD Exchange Rate

Variables	MP_t^1			MP_t^2			MP_t^3		
Window	30 minutes								
MP_t^u	0.037*** (0.013)	0.036*** (0.015)	0.035*** (0.015)	0.014 (0.017)	0.012 (0.017)	0.011 (0.016)	0.028 (0.024)	0.026 (0.022)	0.027* (0.020)
fs9m		0.003 (0.003)			0.004** (0.002)			0.003 (0.003)	
fs12m			0.003* (0.002)			0.004** (0.002)			0.004** (0.002)
R^2	0.28	0.28	0.29	0.05	0.09	0.11	0.10	0.15	0.19
Window	60 minutes								
MP_t^u	0.045*** (0.014)	0.045*** (0.014)	0.044*** (0.015)	0.016 (0.018)	0.016 (0.017)	0.014 (0.016)	0.035* (0.025)	0.032* (0.020)	0.034** (0.019)
fs9m		0.005* (0.003)			0.006* (0.003)			0.005 (0.003)	
fs12m			0.004** (0.002)			0.005* (0.003)			0.005* (0.003)
R^2	0.27	0.33	0.33	0.04	0.13	0.14	0.12	0.19	0.22
Window	1 day								
MP_t^u	0.048*** (0.018)	0.051*** (0.020)	0.050** (0.020)	0.032** (0.019)	0.035* (0.021)	0.034* (0.020)	0.058** (0.026)	0.057** (0.026)	0.057*** (0.023)
fs9m		0.001 (0.004)			0.003 (0.004)			0.001 (0.004)	
fs12m			0.001 (0.003)			0.003 (0.003)			0.003 (0.003)
R^2	0.23	0.23	0.23	0.12	0.12	0.14	0.23	0.24	0.26

See note to Table 6a.

Table 7 Macro Announcement Surprises and the Exchange Rate

	30 minutes	R^2	60 minutes	R^2	1 day	R^2
Announcement	AUD-NZD					
CPI	0.0024*** (0.0007)	0.34	0.0029*** (0.0008)	0.42	0.0025*** (0.0011)	0.18
GDP	0.0027** (0.0010)	0.27	0.0036*** (0.0012)	0.34	0.0039*** (0.0016)	0.26
CA	0.0071*** (0.0015)	0.53	0.0074*** (0.0018)	0.54	0.0083*** (0.0028)	0.37
RS	0.0014*** (0.0003)	0.31	0.0016*** (0.0003)	0.31	0.0011** (0.0006)	0.09
TB	0.0012*** (0.0003)	0.20	0.0015*** (0.0004)	0.22	0.0014** (0.0006)	0.10
U	-0.0048*** (0.0010)	0.57	-0.0054*** 0.0011)	0.52	-0.0054 (0.0019)	0.30
	USD-NZD					
CPI	0.0021*** (0.0007)	0.32	0.0032*** (0.0009)	0.40	0.0039*** (0.0011)	0.27
GDP	0.0040*** (0.0013)	0.31	0.0052*** (0.0016)	0.35	0.0047 (0.0030)	0.17
CA	0.0080*** (0.0013)	0.58	0.0090*** (0.0015)	0.61	0.0078*** (0.0024)	0.22
RS	0.0015*** (0.0004)	0.27	0.0017*** (0.0004)	0.29	0.0014* (0.0007)	0.07
TB	0.0013*** (0.0003)	0.21	0.0016*** (0.0004)	0.18	0.0011 (0.0007)	0.04
U	-0.0046*** (0.0013)	.42	-0.0044** (0.0016)	0.29	-0.0055** (0.0025)	0.21

Notes: Equation (8) estimated via least squares. To conserve space coefficient estimates for MP_t^u not shown. The independent variables include a constant and MP_t^1 (see Table 1 for the definition) not shown to conserve space. CPI (Consumer Price Index), GDP (Gross Domestic Product), CA (Current Account), RS (Retail Sales), TB (Trade Balance), and U (unemployment rate) are surprise measures evaluated as defined in equation (1). All announcements are for New Zealand data. The timing of the announcements is explained in the paper. See Table 5 for explanation of symbols for significance levels.