High frequency exchange rate behaviour of the NZD/USD exchange rate in response to macroeconomic announcements

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Abstract

This paper uses high frequency data to examine the price reaction of the NZD/USD exchange rate to surprise information emanating from announcements of the New Zealand and the United States GDP and CPI and US nonfarm payrolls. For NZ macroeconomic announcements we find that the NZD/USD appreciates (depreciates) in value to higher (lower) that expected NZ GDP and NZ CPI announcements. In contrast, the NZD/USD depreciates (appreciates) in value to higher (lower) that expected US GDP, US CPI and US nonfarm payroll announcements.

We also find the NZD / USD exchange rate reacts more quickly to negative news and price reaction to macroeconomic news announcements is faster in the post-2005 period. Overall the evidence suggests that the foreign exchange market is efficient. However, there may be potential trading profits for traders if they can interpret and analyse information more rapidly than other market participants.

Key words: NZD / USD exchange rate, macroeconomic announcements, CPI, GDP

JEL Classification: G14, G15

1. Introduction

This paper examines the price reaction of the New Zealand dollar / United States dollar (NZD/USD) exchange rate to unexpected or surprise information emanating from macroeconomic announcements for New Zealand (NZ) and the United States (US) gross domestic product (GDP), consumer price index (CPI) and US nonfarm payrolls. The foreign exchange (FX) market is by far, the largest financial market in the world. The average global FX trading activity is well in excess of $4 trillion a day (Bech, 2012). The Bank for International Settlements (2013) triennial survey also reports a significant pickup in global FX market activity to $5.3 trillion per day in 2013.Using high frequency data, with exchange rate returns sampled at a one second frequency, we are able to identify how quickly public news is incorporated into the NZD/USD exchange rate[3] and the termination times of any price reaction to these macroeconomic announcements.

The motivation for our study is as follows. First, while effects of economic announcements on foreign exchange trading have been studied widely (e.g., Almedia et al, 1998; Edison, 1996), there is little research regarding the impact of macroeconomic announcements on the New Zealand dollar (NZD). New Zealand is a small global economy compared to most developed countries. However, among the most actively traded advanced economy currencies in the Bank for International Settlements (2013) survey, the New Zealand dollar has continued to increase its share in global FX trading with a ranking of 10th among the participating countries, equal to 2% of the average daily global FX turnover.

Second, research using very high frequency exchange rate data, where tick-to-tick data is examined on a second by second basis, is limited. For example, Aggarwal and Schirm (1992) examines the informational impact of US trade balance announcements on asset prices including equities, currencies and debt instruments using daily data. They find that in the early 1980s announcements only influenced interest rates, but in the late 1980s such announcements also influenced stock prices and currency values. Edison (1996) examines the response of US interest rates and FX rates to economic news and find effects for US money supply changes and nonfarm payroll announcements, but no impact from other macroeconomic news such as inflation announcements. (Almeida, Goodhart, & Payne, 1998)find evidence that macroeconomic announcements influence exchange rates and other asset classes significantly, but this influence is evident only with intraday data sampled at high

[3] In this paper the NZD / USD exchange rate is expressed with the unit currency being New Zealand dollars and the quoted currency being Unites States dollars. For example 1 NZD = 0.8100 USD.

frequencies.[4] The use of high frequency data reduces the likelihood that other confounding events may distort any price reaction to the macroeconomic announcements that we examine. This enables us to more accurately analyse to what extent movements in the foreign exchange rate can be attributed to the arrival of new information and how quickly the market incorporates new information into the NZD/USD foreign exchange rate.

Third, we examine the impact of macroeconomic announcements on the NZD /USD exchange rate over the period between 1996 and 2013. This is a much longer time period than used in most prior studies and spans a number of economic cycles where there was both unexpected good and bad macroeconomic news. Fourth, we analyse if the magnitude and speed of any price reaction in the NZD/USD value differs in response to good or bad economic news. Prior research by Anderson et al. (2002) and Almedia at al. (1998) find that, in general, exchange rates react more markedly to negative than to positive news. Lastly, we examine if the price reaction to macroeconomic foreign exchange changes over time as the foreign exchange markets continue to evolve. With the introduction of more sophisticated electronic trading we expect liquidity in the foreign exchange market to increase over time and the speed to any price reaction to new information to also increase.

Overall our findings have implications for market microstructure and should be of interest to traders and other market participants in the NZD/USD foreign exchange market. Macroeconomic data releases are key indicators that foreign exchange traders closely follow. The indicators are used to monitor the current state of the economy. Surveys of economists' forecasts for these announcements are also published prior to the announcement, thereby establishing an expectation for the announcement. If the actual published values of macroeconomic announcements differ from expectations, there is a surprise factor entering the market and exchange rates may move as a consequence.

The results of our analysis are summarised as follows. Our results show that the NZD/USD appreciates (depreciates) in value to higher (lower) that expected NZ GDP and CPI announcements. For US macroeconomic announcements, the NZD/USD depreciates (appreciates) in value to higher (lower) that expected US GDP, US CPI and US nonfarm payroll announcements. The findings are consistent with announcements of unexpected economic news signalling changes in future interest rates. In particular, the market views unexpected inflationary pressure and higher than expected economic growth as indicative of interest rate tightening by the NZ or US Reserve Bank, which will increase the value of the currency. We find that the speed of the price reaction to the announcements of

[4] The consumer price index (CPI) is found to have an impact on interest rates in Hardouvelis (1988), but not in Dwyer and Hafer (1989) and McQueen and Roley (1993).

the NZ GDP, NZ CPI and US CPI economic indicators is swift and occurs within 10 seconds of the announcement. The evidence is generally consistent with semi-strong market efficiency, whereby the prices react to new publicly available information in an unbiased manner. However, the reaction times for exchange rate changes to US GDP and US nonfarm payroll announcements are slower at between 45 and approximately 470 seconds after the announcement. This may reflect the impact of other economic information announced at the same time as the US GDP and nonfarm payroll announcements and participants in the foreign exchange market requiring more time to analyse the economic impact of the announcements. We also find evidence that the NZD / USD exchange rate reacts more quickly to negative news, but there is no difference in the magnitude of the price reaction between positive and negative news. Lastly, price reaction of the NZD/USD exchange rate to macroeconomic news announcements is faster in the post-2005 period, when the number of contributors to the NZD/USD quotes increased.

Our results confirm that the NZD/USD exchange rate reacts to unexpected positive and negative macroeconomic announcements. While, overall the evidence suggests that the foreign exchange market is efficient, there may be potential trading profits for traders if they can interpret and analyse information more rapidly than other foreign exchange market participants.

The remainder of this paper is organised as follows. Section 2 describes the data. Section 3 outlines the hypotheses. Section 4 describes the methodology. Section 5 presents the results. Section 6 concludes.

2. Data, market expectations and the announcements procedure for economic indicators

2.1 *Economic Indicator Announcements*

This study examines the impact of macroeconomic news announcements of the NZ and US GDP and CPI and US nonfarm payrolls on the NZD / USD exchange rate. The time period of our study spans the years between 1996 and 2013. Data relating to each of the economic indicator announcements is sourced from Bloomberg Financial (Bloomberg), which provides a comprehensive calendar for each country's economic indicator announcements. The calendar provides details on the exact date and time of the announcement, as well as the market expectation for the announcement and the actual announcement value. Information relating to New Zealand and United States macroeconomic variables is released to the market by various agencies throughout the year.

NZ Economic indicators

The quarterly New Zealand gross domestic product (NZ GDP) is released by Statistics New Zealand who publishes both production and expenditure based GDP series. In this study we use the production-based measure, given that the expenditure-based series has historically shown more quarterly volatility and are more likely to be subject to timing and valuation problems. The real NZ GDP measure is expressed in 1995/96 prices and is released with a one quarter lag.

Announcements relating to New Zealand's consumer price index (NZ CPI) are compiled by Statistics New Zealand and are released quarterly with a one quarter lag. The NZ CPI measures the rate of price change of goods and services purchased by households. The series uses June 2006 as the base quarter which equals 1000 (Bloomberg, 2013).

US Economic indicators

Announcements relating to US gross domestic product (US GDP) are released monthly by the US Department of Commerce, Bureau of Economic Analysis. The monthly US consumer price index (US CPI) is released by the US Department of Labour, Bureau of Labour Statistics. The CPI represents changes in prices of all goods and services purchased for consumption by urban households. The series uses a base year of 1982-84 which equals 100 (Bloomberg, 2013).

The US Department of Labour, US Bureau of Labour Statistics unit collects data each month from the payroll records of a sample of non-agricultural business establishments. The information is used to calculate the net change in US employees on nonfarm payrolls (US nonfarm payroll). The sample includes around 140,000 businesses and government agencies representing approximately 440,000 worksites and is drawn from a sample of circa nine million unemployment tax insurance accounts. The US nonfarm payroll announcement is considered an important measure in identifying the rate of US economic growth. If the nonfarm payroll is expanding it is an indication that the economy is growing and vice versa (Bloomberg, 2013).

2.2 *Market Expectations*

Bloomberg undertakes a survey where expectations from various economists are collected and published prior to the announcement. The median from this survey is published and acts as the markets'

expectation for the announcement. Within several seconds of the announcement, Bloomberg publishes the announced figure.

The unexpected component of an announcement is calculated by taking the difference between the actual macroeconomic index announcement and the most recent survey median reported by Bloomberg. That is:

Unexpected component = Actual announcement value – Expected announcement value

2.3 *Exchange rate data*

The exchange rate data was obtained from the Thomson Reuters Tick History database and represents data of actual trades executed through the Thomson Reuters dealing system. The closing bid and ask of the NZD/USD cross rate was obtained in one second intervals. The average of the bid and ask quotations is taken as the quotation variable for each one second interval.

2.4 *Procedures for the announcement of the Economic Indicators*

Ederington and Lee (1993) describe the release procedures for US announcements by the various federal agencies. The announcements are released to reporters 30 minutes prior to the scheduled release time behind locked doors. During this time reporters may type their reports, but they are not allowed to leave or use the phone. One minute prior to the scheduled release time, the reporters are allowed to plug in their modems and/or pick up the phones, but these lines only become live at the scheduled release time. At the scheduled release time, the information is rapidly transmitted to the market exchanges within a few seconds.

In the authors' discussions with Statistics New Zealand about their release procedures for NZ GDP and NZ CPI announcements, a similar announcement procedure is used in New Zealand. Statistics New Zealand also release announcements behind locked doors prior to the scheduled time and electronic devices are only allowed to be turned on at the scheduled time of the announcement. Additionally, information is posted onto their website at the scheduled time of the announcement.

3. Hypotheses

We expect that the market expectation of an economic announcement (as indicated by the Bloomberg survey median) to already be priced into the market as this is publicly available information. Consequently, any movement in the exchange rate following the release of the NZ and US GDP and CPI and nonfarm payroll announcements should be due to the unexpected component of that announcement (calculated as the difference between the actual announcement and the survey median). As the unexpected component of an announcement is new unpredictable information, we anticipate that in a semi-strong form efficient market the news will be rapidly incorporated into the exchange rate once the information is made publicly available.

3.1 *Impact of the inflation announcements on the NZD/USD Exchange rate*

The effects of inflation announcements (i.e. NZ CPI and US CPI) can be ambiguous. Inflationary pressure effects on the exchange rate centres around price levels relative to trading partners. If domestic price levels increase relative to trading partners, domestic goods will become more expensive to foreigners and domestic citizens will find foreign goods to be relatively cheaper. Trade following these patterns will result in a depreciation of the domestic currency. In contrast, the effects can operate largely through interest rates, where unexpected good news signals higher inflationary pressure and the Reserve Bank will be more likely to increase interest rates. Previous literature by Fleming and Remolona (1999) and Andersen, Bollerslev, Diebold, and Vega (2007) has shown that interest rates rise in response to news of higher inflation. This is because greater inflation pressure will drive prices higher, which will prompt central banks to pursue tighter than anticipated monetary policy measures.

We hypothesise:

H1: A positive (negative) unexpected component associated with a NZ CPI announcement will cause the NZD/USD exchange rate to rise (fall).

H2: A positive (negative) unexpected component associated with a US CPI announcement will cause the NZD/USD exchange rate to fall (rise).

3.2 *Impact of the growth indicator announcements on the NZD/USD Exchange rate*

We predict that stronger than expected economic growth will drive domestic prices higher and result in tightening of monetary policy by central banks, which will cause the domestic currency to

appreciate. Almeida et al. (1998) find empirical evidence of announcements indicating higher than expected economic growth leading to a currency appreciation. Again this is consistent with the view that high unexpected inflation and economic growth signals likely interest rate tightening by central banks and leads to an increase in the local currency value.

We hypothesise:

H3: A positive (negative) unexpected component associated with a NZ GDP announcement will cause the NZD/USD exchange rate to rise (fall).

H4: A positive (negative) unexpected component associated with a US GDP announcement will cause the NZD/USD exchange rate to fall (rise).

H5: A positive (negative) unexpected component associated with an US nonfarm payroll announcement will cause the NZD/USD exchange rate to fall (rise).

Prior research has also found that exchange rates respond in an asymmetric fashion to news according to the nature of the news (i.e. positive vs. negative news). In general exchange rates tend to respond more markedly to negative news than to positive news (Andersen, Bollerslev, Diebold, and Vega (2002), Almeida et al. (1998), Galati and Ho (2003)). We investigate whether similar results hold true for announcements on the NZD /USD exchange rate and hypothesise that:

H6: There is asymmetry in the effect in relation to the initiation and termination times of the price reaction to the NZ and US GDP and CPI and nonfarm payroll announcements; and

H7: The magnitude of a price reaction for negative news will be greater than the impact of positive news on the exchange rate

Finally, we also investigate the stability of the effects of announcements on exchange rates over the sample period. Almeida et al. (1998) investigate whether price reaction of the DEM/USD exchange rate to macroeconomic announcements is invariant over time. They find some evidence that announcements have greater impacts in 1992 relative to 1994, which is possibly due to foreign exchange markets being more turbulent in 1992.[5]

Figure 1 illustrates the number of trades that were closed through the Thomson Reuters Dealing system on an annual basis. This dramatic spike in trades that is observed in 2005 onwards is posited to

[5] The existing literature also examines how new information from announcements affects exchange rate volatility. Traders have different motives, different strategies and different abilities to forecast and analyse the impact of new information on the value of exchange rates. Generally, this body of research shows that new information increases exchange rate volatility (Chang and Taylor (2003); Laakkonen (2004)).Furthermore, Laakkonen (2004) finds that negative news has a greater impact on volatility than positive news.

be due to two factors. First, in 2005 the market experienced an increase in the number of contributors pricing the NZD. Second, liquidity in the market has increased over time, which is indicated from a significantly larger number of quotes for the NZD/USD cross rate on the exchange. We hypothesise:

H8: The announcement impact of the economic indicators on the NZD / USD exchange rate will be greater in the post-2005 period.

4 Methodology

The following section explains the methodology used to evaluate the magnitude and speed with which the NZD/USD exchange rate reacts to economic announcements. We use multivariate analysis to determine the direction, magnitude and the speed of the reaction to the announcement of macroeconomic indicators. The speed of a reaction is distinguished using two components, namely, how long the reaction takes to commence and the length of time it lasts for. Empirical tests are undertaken via both 'forward' and 'backward' regressions in order to determine the initiation and termination times (in seconds) of announcement reactions. The forward regression is a methodology used by Almeida et al. (1998) to test for the magnitude and persistence of an announcement, whereas the backward regression is a methodology used by Balduzzi, Elton, and Green (2001) to determine how long it takes for a reaction to reach completion. Together, the forward and backward regressions, along with high frequency data allow us to map out the path of reactions accurately. These tests are further explained below.

Let:

q_t	One second quotation series for the NZD/USD cross rate at time t
x_{it}	Actual announced value for series i at time t
x_{it}^e	Corresponding expected value from Bloomberg (survey median)
$x_{it}^u = x_{it} - x_{it}^e$	The unexpected component of the announcement
$\lvert x_{it}^u \rvert = \lvert x_{it} - x_{it}^e \rvert$	The absolute value of the unexpected component of the announcement
u_{it}	Error term

4.1 Forward Regressions

The forward regression is:

$$r_{i,0+k} = \alpha + \beta_1 x_{it}^u + \beta_2 x_{it}^e + u_{it} \quad (1)$$

Where: $r_{i,0+k} = \frac{q_{0+k}}{q_0} - 1$ (the exchange rate return k seconds following the announcement).[6]

Equation 1 relates to the change in NZD/USD exchange rate in the k seconds immediately following an announcement to the portions of the unexpected (x_{it}^u) and expected(x_{it}^e) component of the announcement. If the foreign exchange market is efficient, we expect x_{it}^e to have no impact on the NZD / USD exchange rate as this expectation should already be priced into the market. Hence, β_2 should not be significantly different from zero. On the other hand, x_{it}^u (unexpected component) is expected to have an impact if there is new information or a surprise factor to the announcement. Hence, β_1 should be significantly different from zero once the reaction begins. The rate of return is calculated by maintaining a start point of the announcement time (time zero), while the horizon (time k) begins at time zero and is increased by 1 second increments.

The forward regressions enable us to determine how long it takes for any price reaction in the NZD/USD to commence. Assume that there is a time window between the announcement (time zero) and the time in which the reaction begins (time x). In this instance, β_1 will be insignificant within this time interval and therefore time x is defined as the time where β_1 becomes significant.

4.2 Backward Regressions

The backward regression is:

$$r_{i,t+k} = \alpha + \beta_1 x_{it}^u + \beta_2 x_{it}^e + u_{it} \qquad (2)$$

Where: $r_{i,t+k} = \frac{q_z}{q_{0+k}} - 1$

Equation 2 is used to investigate how long it takes for the exchange rate to react to the announcement. In this instance, the endpoint of the horizon (k) used to calculate rates of return is kept constant at five minutes (z = 300 seconds), while the beginning of the horizon (t) is changed from zero,

[6] In respect of changes in the NZD/USD exchange rate we do not adjust these returns for market movements not associated with the announcement. There are three reasons for this. Firstly, prior literature in this area does not make such adjustments. Secondly, an appropriate index or other series relating to market NZD/USD exchange rate movements cannot be identified. Finally, we expect market effects on the currency at high frequency around an announcement to be zero; hence we adopt the assumption that any movements are completely due to the announcement.

the time of the announcement, to 300 seconds post the announcement with increments of one second. An end point of five minutes is used based on the findings of prior literature in this area, which shows that reactions tend to be over within this timeframe (Ederington and Lee (1995); Almeida et al. (1998)). However, for the US nonfarm payroll announcement, z is set at 30 minutes (1800 seconds)[7]. As already noted, the backward regression allows us to determine how long it takes for the reaction to terminate. Assuming that there is a time window between when the reaction begins (time x) and when the reaction terminates (time y), then the backward regression will allow us to determine time y.

4.3 Is the reaction to positive news and negative news symmetric?

To examine whether the price reaction of the NZD / USD exchange rate to differs between positive and negative news, the announcements are first separated into two categories, namely, where the unexpected component is 'positive' ($x_{it}^{upositive}$)and where the component is 'negative' ($x_{it}^{unegative}$). We define positive (negative) news as the occurrence of a positive (negative) surprise. For each announcement we run the following regressions:

$$r_{i,o+k} = \alpha + \beta_1 |x_{it}^{upositive}| + \beta_2 |x_{it}^{unegative}| + \beta_3 x_{it}^{e} + u_{it} \qquad (3)$$

Where $r_{i,0+k} = \frac{q_{0+k}}{q_0} - 1$

$$r_{i,t+k} = \alpha + \beta_1 |x_{it}^{upositive}| + \beta_2 |x_{it}^{unegative}| + \beta_3 x_{it}^{e} + u_{it} \qquad (4)$$

Where $r_{i,t+k} = \frac{q_z}{q_0+k} - 1$

Equations 3 and 4 represent the forward and backward equations respectively, but with the unexpected component broken down into positive and negative news. Again, for the backward regression z is set at five minutes (z = 300) except for US nonfarm payroll announcements where z is set at 30 minutes (z = 1800). The output from equations 3 and 4 allows us to determine the initiation and termination times for the price reactions of the NZD /USD exchange rate to positive and negative news respectively.

[7] An initial end point of 300 seconds was used, but it was later found that US nonfarm payroll announcements last beyond five minutes. Hence the end point was extended out to 30 minutes.

We also determine whether or not there is any asymmetry in terms of the dynamics of the reaction. If $\beta_1 = -\beta_2$ then it will be evidence that the reaction to positive news and negative news is symmetric. To test if $\beta_1 = -\beta_2$ we employ the methodology proposed by Paternoster, Brame, Mazerolle, and Piquero (1998) as follows:

$$z = \frac{\beta 1 + \beta 2}{\sqrt{SEb_1^2 + SEb_2^2}}$$

4.4 *Do the effects of announcements change overtime?*

To test if the response of the NZD /USD exchange rate to macroeconomic news is invariant over time, we split the sample into two groups: 'pre-2005' which includes announcements prior to and within 2004 and 'post-2005' which includes announcements in 2005 and onwards. We then undertake the following regressions with pre- and post-2005 period dummies.

$$r_{i,0+k} = \alpha + \beta_1 x_{it}^{u} pre2005 + \beta_2 x_{it}^{e} pre2005 + \beta_3 x_{it}^{u} post2005 + \beta_4 x_{it}^{e} post2005 + u_{it} \quad (5)$$

Where $r_{i,0+k} = \frac{q_{0+k}}{q_0} - 1$

$$r_{i,t+k} = \alpha + \beta_1 x_{it}^{u} pre2005 + \beta_2 x_{it}^{e} pre2005 + \beta_3 x_{it}^{u} post2005 + \beta_4 x_{it}^{e} post2005 + u_{it} \quad (6)$$

Where $r_{i,t+k} = \frac{q_t}{q_{0+k}} - 1$

Equations 5 and 6 allow the analysis to be undertaken using the two sample groups. Material differences in the initiation and termination times as well as reaction paths for the pre-2005 and post-2005 subgroups from this analysis will indicate that the exchange rate response dynamics to news is not invariant across the sample.

5 Results

5.1 Descriptive Statistics

Table 1 provides summary descriptive statistics for the unexpected component of each macroeconomic announcement. The descriptive statistics for the unexpected component of the GDP

and CPI announcements are measured as a percentage change over a specified period. The total sample mean unexpected component for NZ GDP announcements was 0.06%. This mean indicates that on average announcements are associated with a surprise factor which is 0.06% above expectation. NZ CPI announcements have an unexpected component that on average is 0.06% below expectation. Interestingly, the average US GDP and US CPI announcements are in line with expectation. US nonfarm payroll announcements are measured as a net change in US employees on nonfarm payrolls. Thus, the total sample mean unexpected component for US nonfarm payroll announcements of -16,000 means that on average the net change of US employees on nonfarm payrolls is -16,000 below expectation. The number of unexpected positive and negative news announcements is fairly evenly distributed for the NZ GDP, US GDP and US CPI macroeconomic announcements. US nonfarm payroll and NZ CPI announcements are, however, associated with a higher portion of negative announcements.

Figures 2-6 illustrate the distribution of the unexpected component for each announcement. For the US CPI, NZ GDP and NZ CPI announcements, the distribution of the unexpected component is relatively close to zero, which is an indication that market expectations are relatively accurate. This is particularly the case for the US CPI, with 35% of the announcements converging with expectations (i.e. unexpected component = 0) and the presence of a small range around zero. However, US nonfarm payroll and US GDP announcements are associated with distributions that cover a wider range.

5.2 Evidence of a price reaction to the announcements of economic indicators

Tables 2 and 3 present the forward and backward regressions respectively for the total sample of positive and negative news over the pre- and post-2005 periods. Only the coefficients and p values for the β_1 coefficients in equations (1) and (2) are reported. For all five macroeconomic announcements, the β_1 coefficients have the predicted signs consistent with hypotheses H1 to H5. For the NZ GDP and CPI announcements, the β_1 coefficients are positive and the NZD/USD exchange rate appreciates (depreciates) with positive (negative) surprises in NZGDP and NZCPI announcements. The β_1 coefficients are negative for the US GDP, CPI and nonfarm payroll announcements meaning the NZD / USD exchange rate depreciates (appreciates) with positive (negative) surprises in these announcements. The findings are consistent with those of Almeida et al. (1998) and are evidence that announcement effects operate through interest rate changes, where the market views unexpected inflationary pressure and economic growth as indicative of interest rate tightening.

Insert Tables 2 and 3 about here

5.3 Initiation time of any price reaction

The results in Table 2 also provide the initiation time for any price change in the NZD/USD exchange rate to the announcement. For the NZ GDP, NZ CPI, and US CPI announcements, a price change in the NZD / USD exchange rate begins within 10 seconds of the announcement, with the coefficient on β_1 being significant at the 0.05 level or better. Slower initiation times for the price reaction in the NZD/USD exchange rate, before the coefficient on β_1 becomes significant, are observed for the US GDP and US nonfarm payrolls, with price reaction initiation times of circa 45 and 480 seconds respectively.

Overall, the evidence presented suggests that markets are efficient in incorporating the new information and do so relatively quickly. Apart from the US nonfarm payroll announcements, there is only a short lag between scheduled release times and reaction initiations. The time lag before any price reaction commences may represent the time it takes for the information to dissipate and be analysed by market participants following the "unlocking of doors" and "reconnections of communication lines" within the data announcement room.

5.4 ***Termination time of any price reaction***

The results of the backward regressions in Table 3 indicate the termination time to the announcement of any price change in the NZD/USD exchange rate. The termination time for NZ CPI announcement reactions is just over 30 seconds, after which the coefficient on β_1 is no longer significant. For the NZ GDP announcement the termination time is around 100 seconds. For US CPI announcements, there is evidence that the price reaction lasts longer with the termination time around 2.5 minutes. For US GDP announcements, the NZD/USD price reaction terminates around 45 seconds. Lastly, US nonfarm payroll announcements are associated with a NZD/USD price reaction that takes a much longer time period to end (over 600 seconds).

Ederington and Lee (1995) outline two reasons why prices adjust slowly. A slow price reaction may be that the information flow to the market may be slow. Alternatively a slow price reaction may be due to time taken to interpret and analyse the impact of the new information. In respect of US nonfarm payroll announcements, the US Bureau of Labour Statistics also releases a comprehensive report which usually contains additional economic information other than just the nonfarm payroll headline number. The report can be lengthy and contain data on employment, unemployment and hours worked within a

sector breakdown. To fully analyse all this data and the implications of this report for the US economy may take time.

Overall the results indicate that the NZD/USD foreign exchange market does not fully react instantaneously to macroeconomic announcements and, in particular in respect of the US nonfarm payroll announcement it may take some time for the NZD / USD exchange rate price reaction to reach termination. The evidence suggests that if currency traders can obtain and interpret the information from announcements faster than other market participants (i.e. before initiation or before termination), a potential trading profit could be made. [8]

5.5 Asymmetry of reactions to positive and negative news

Tables 4 and 5 present the β_1 (positive news) and β_2 (negative news) coefficients, the expected signs of these coefficients and associated p-values of the forward and backward regressions for equations 4 and 5 respectively.

Interestingly, the NZD/USD exchange rate reaction dynamics to positive and negative news appears to be asymmetric for all five announcements. For both NZ CPI and US GDP announcements reactions to negative news both initiate and terminate more rapidly in comparison to the respective positive news announcements. On the other hand, NZ GDP negative announcements appear to initiate faster, but terminate slower when compared to the associated positive news announcements. Additionally, US CPI negative announcements appear to have slower initiation and faster termination times when compared to US CPI positive announcements. However, in respect of the US nonfarm payroll, there is no strong evidence of any asymmetric price reaction paths between positive and negative announcements albeit there is some evidence of negative price reactions terminating early.

Of note is that for both the positive and negative announcements for NZ GDP, NZ CPI, US GDP and US CPI all price reactions commence within the first minute following the scheduled announcement times, but the termination times vary much more substantially between positive and

[8] A further reason for delayed reaction may be that expectations are not fully priced into the market. As already noted, we expect the NZD/USD exchange rate to react only to the unexpected component $\left(x_{it}^{u}\right)$ of the announcement. That is, the survey component $\left(x_{it}^{e}\right)$ is expected to have no impact on any price change in the NZD/USD exchange rate to the macroeconomic announcement. In the interest of space constraints, the coefficients and p-values for β_2 have not been presented. However the results show that β_2 is consistently insignificant for the NZ and US GDP and CPI announcements. Interestingly, however, β_2 displays periods of significance for the US nonfarm payroll announcements suggesting that the market may not have fully priced in expectations into the exchange rate. The survey component represents the median expectation of the economists' surveyed. It could be that the distribution of expectations around this median is wide and therefore the market may have conflicting views of the announcements expectation.

negative announcements. Overall it appears that the reaction duration (i.e. the time between initiation and termination) for positive and negative announcements differ for all announcement types. The results of the z-test to determine whether the magnitude of positive news impacts differs to that of negative news present unexpected results. The z-scores show that the coefficients on β_1 and β_2 are not significantly different, which suggests that there is no difference in the magnitude of the exchange rate reaction to positive and negative macroeconomic news announcements.

In summary, other than in respect of the US nonfarm payroll announcements, the evidence supports hypothesis H6 that the price reactions of the NZD / USD exchange rates to positive and negative announcements are not symmetric. The results do not, however, support hypothesis H7 that the magnitude of a price reaction for negative news is greater than the impact of positive news on the exchange rate.

Insert Tables 4 and 5 about here

5.6 Pre-2005 vs. Post-2005 reactions

We next split the sample into two groups, namely, pre-2005 and post-2005. Tables 6 and 7 present the β_1 (pre 2005) and β_3 (post 2005) coefficients and associated p-values of the forward and backward regressions respectively. The evidence shows mixed and somewhat surprising results.

In respect of the forward regressions (Table 6) the NZ GDP and CPI and the US CPI announcements have no significant impact on the NZD / USD exchange rate in the pre-2005 period. However, there is some evidence in the pre-2005 period the NZD / USD exchange rate depreciated in response to unexpected increases in the US GDP and US nonfarm payroll announcements, with the price reaction occurring within 60 and 120 seconds respectively.

In contrast, in the post-2005 period there is evidence that the NZ GDP and CPI and the US CPI announcements all impacted on the NZD/USD exchange rate with the price changes all in the predicted direction. Price reaction to the NZ GDP and CPI and the US CPI announcements is also swift and occurring within 5, 2 and 5 second respectively. Interestingly in the post-2005 period there is no strong evidence from the forward regressions that the NZD/USD exchange rate reacted to unexpected US GDP announcements. Contrary to expectations, in the post-2005 period an unexpected increase in the US nonfarm payroll announcement is associated with an increase in the value of the NZD, albeit the coefficients on β_3 are only significant in the first 30 second period post the announcement.

In the backward regressions the results in Table 7 show that in the pre-2005 period, the NZ GDP and the NZ and US CPI economic announcements have little or no significant impact on the value of the NZD/USD exchange rate. In the post-2005 period there is evidence that any NZD/USD price reaction to the NZ GDP and CPI announcements terminates within approximately 120 and 40 seconds respectively. However, there is no evidence of any significant price reaction of the NZD/USD to the US CPI announcement in the post-2005 period. For the US GDP announcements in the pre-2005 and post-2005 periods the price reaction ends within circa 20 and 6-10 seconds respectively. For the US nonfarm payroll announcements the results in Table 7 suggest any price reaction takes longer than 30 minutes to terminate in the pre-2005 period. In contrast, there is no evidence of a significant price reaction to the US nonfarm payrolls in the post-2005 period.

Insert Tables 6 and 7 about here

6 Conclusion

This study uses very high frequency exchange rate data to investigate the impact of the NZ GDP and CPI announcements and the US GDP, CPI and US nonfarm payroll announcements on the NZD/USD exchange rate in the period between 1996 and 2013. The use of high frequency data on a second-by-second basis allows for more precise analysis of the exchange rate reaction dynamics. Our results have implications for market microstructure and should be of interest to traders and other market participants in the NZD/USD foreign exchange market. Macroeconomic data releases are key indicators that foreign exchange traders closely follow and are used to monitor the current state of the economy.

The empirical results suggest that macroeconomic announcements affect the NZD /USD exchange rate. We find evidence that the NZD/USD appreciates (depreciates) in value to higher (lower) that expected NZGDP and NZCPI announcements. In contrast, the NZD/USD depreciates (appreciates) in value to higher (lower) that expected USGDP, USCPI and US nonfarm payroll announcements. The findings are consistent with announcements of unexpected economic positive (negative) news signalling future interest rate increases (decreases). That is, the market views unexpected inflationary pressure and economic growth as indicative of interest rate tightening by the NZ or US Reserve Bank, which will increase the value of the domestic currency.

The speed of the price reaction to the announcements of economic indicators occurs within 10 seconds for the NZ GDP, NZ CPI and US CPI macroeconomic announcements. The evidence is

consistent with semi-strong market efficiency, whereby the prices react to new publicly available information in an unbiased manner. However, the reaction times for exchange rate changes to US GDP and US nonfarm payroll announcements are slower at between 45 and approximately 470 seconds after the announcement. We attribute this slower price reaction to additional economic information announced at the same time as the US economic headline GDP and nonfarm payroll announcements, and participants in the foreign exchange market requiring more time to analyse the economic impact of the announcement.

We also find some evidence that the NZD/USD exchange rate reaction is asymmetric with respect to the announcement of positive and negative news. For both NZ CPI and US GDP announcements, price reactions to negative news both initiate and terminate more rapidly in comparison to the respective positive news announcements. On the other hand, NZ GDP negative announcements appear to initiate faster, but terminate slower when compared to the associated positive news announcements. Finally, the evidence suggests reaction times of the NZD/USD exchange rate to announcements of economic indicators has a faster initiation time in the post 2005 period. This suggests that the market has become more efficient over time and is incorporating news into the exchange rate more rapidly.

In summary, the results suggest that unexpected macroeconomic announcements impact on the value of the NZD/USD dollar. However, despite overall evidence of market efficiency, exchange rates do not react instantaneously to announcements of significant economic indicators of the NZ and US economy. If currency traders can obtain and interpret the information from announcements faster than other market participants, a potential trading profit could be made. It would also be interesting to investigate the impact of economic announcements to changes in the value of NZD / USD trading volumes and whether currency reactions are more sensitive during expansionary or contraction phases of the business cycle. This would provide additional insights into how economic variables impact on the NZD/USD exchange rate. We leave this to future research.

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Table 1
Descriptive statistics
Summary of the NZ and US macroeconomic announcement data and the associated news component

Announcement	New Zealand Gross Domestic Product (NZGDP)	New Zealand Consumer Price Index (NZCPI)	United States Gross Domestic Product (USGDP)	United States Consumer Price Index (USCPI)	United States Nonfarm Payrolls (USNonfarm)
Panel A: features of macroeconomic announcements					
Frequency of announcements	Quarterly	Quarterly	Monthly	Monthly	Monthly
Unit of measurement	Quarter on quarter percentage change	Quarter on quarter percentage change	Quarter on quarter percentage change	Month on month percentage change	Total month on month net change (000's)
Total number of announcements	55	63	196	200	200
Range of years covered	1999 - 2013	1997 - 2013	1997 - 2013	1996 - 2013	1997 - 2013
Total sample statistics:					
Mean unexpected component	0.06%	-0.06%	0.00%	0.00%	-16000
Median unexpected component	0.00%	0.00%	0.00%	0.00%	-8500
Maximum unexpected component	1.70%	0.50%	0.02%	0.40%	246000
Minimum unexpected component	-0.70%	-0.70%	-0.02%	-0.40%	-318000
Standard deviation of unexpected component	0.39%	0.20%	0.49%	0.13%	88500
Positive unexpected component statistics:					
Mean positive unexpected component	0.38%	0.19%	0.43%	0.14%	60000
Median positive unexpected component	0.25%	0.20%	0.30%	0.10%	46000
Maximum positive unexpected component	1.70%	0.50%	1.70%	0.40%	246000
Minimum positive unexpected component	0.10%	0.10%	0.10%	0.10%	1000
Standard deviation of positive unexpected component	0.35%	0.11%	0.37%	0.08%	52000
Negative unexpected component statistics:					
Mean Negative unexpected component	-0.27%	-0.19%	-0.39%	-0.14%	-75600
Median Negative unexpected component	-0.20%	-0.10%	-0.30%	-0.10%	-63500
Maximum Negative unexpected component	-0.10%	-0.10%	-0.10%	-0.10%	-1000
Minimum Negative unexpected component	-0.70%	-0.70%	-0.02%	-0.40%	-318000
Standard deviation of Negative unexpected component	0.17%	0.13%	0.32%	0.07%	61900
Number (% of total) of positive (>0) news observations	24 (44%)	16 (25%)	83 (42%)	60 (30%)	87 (44%)
Number (% of total) of negative (<0) news observations	22 (40%)	36 (57%)	85 (43%)	70 (35%)	112 (56%)
Number (% of total) of no surprise (=0) news observations	9 (16%)	11 (17%)	28 (14%)	70 (35%)	1 (1%)

Table 2
Forward Regression

For each announcement we run the following regression:

$$r_{i,0+k} = \alpha + \beta_1 x_{it}^u + \beta_2 x_{it}^e + u_{it}$$

Where $r_{i,0+k}$ is the exchange rate return k seconds after announcement, x^u_{it} is the unexpected component of the announcement and x^e_{it} is the expected component of the announcement. Time horizons k are increased in one second intervals to measure returns, with the start point of each price change being fixed at time 0 (the announcement time). The table reports the coefficient β_1, for each time horizon for all announcements. Under each coefficient is the p-value. *, **, and *** indicate significance at the 0.05, 0.01 and 0.001 percent levels, respectively

Time interval		NZGDP	NZCPI	USGDP	USCPI	USNonfarm Payroll
Expected coefficient sign		+	+	-	-	-
0 - 1s	β	0.001	0.011	0.003	-0.015	0.0000002
	p-value	0.901	0.131	0.319	0.140	0.415
0 - 2s	β	0.004	0.027*	0	-0.007	0.0000003
	p-value	0.584	0.017	0.905	0.618	0.342
0 - 3s	β	0.013	0.07***	0.006	-0.014	-0.0000003
	p-value	0.442	0.000	0.098	0.350	0.499
0 - 4s	β	0.011	0.08**	0.006	-0.017	0.0000001
	p-value	0.450	0.010	0.103	0.245	0.890
0 - 5s	β	0.016	0.082**	0.006	-0.037*	-0.0000001
	p-value	0.223	0.007	0.131	0.021	0.868
0 - 6s	β	0.03	0.089**	0.003	-0.031	-0.0000001
	p-value	0.077	0.003	0.461	0.077	0.889
0 - 7s	β	0.024	0.112**	0	-0.052**	-0.0000003
	p-value	0.097	0.001	0.914	0.006	0.613
0 - 8s	β	0.049	0.171**	0.001	-0.072***	-0.0000001
	p-value	0.065	0.002	0.913	0.000	0.855
0 - 9s	β	0.071*	0.219***	-0.002	-0.06**	-0.0000009
	p-value	0.029	0.000	0.711	0.006	0.187
0 - 10s	β	0.093*	0.273***	0.001	-0.075***	-0.0000004
	p-value	0.028	0.000	0.828	0.001	0.557
0 - 15s	β	0.183**	0.419***	-0.004	-0.086***	-0.0000001
	p-value	0.005	0.000	0.458	0.001	0.922
0 - 30s	β	0.321***	0.512***	-0.013	-0.096**	-0.0000001
	p-value	0.000	0.000	0.119	0.003	0.916
0 - 45s	β	0.379***	0.607***	-0.023*	-0.135***	-0.0000009
	p-value	0.000	0.000	0.028	0.000	0.535
0 - 60s	β	0.372***	0.571***	-0.039***	-0.16***	-0.0000016
	p-value	0.000	0.000	0.000	0.000	0.340
0 - 120s	β	0.43***	0.613***	-0.059***	-0.201***	-0.0000021
	p-value	0.000	0.000	0.000	0.000	0.253
0 - 180s	β	0.486***	0.636***	-0.058***	-0.149*	-0.0000035
	p-value	0.000	0.000	0.000	0.019	0.053
0 - 240s	β	0.494***	0.703***	-0.057***	-0.094	-0.0000027
	p-value	0.000	0.000	0.000	0.135	0.148
0 - 300s	β	0.487***	0.724***	-0.047**	-0.1	-0.0000038
	p-value	0.000	0.000	0.002	0.123	0.063
0 - 360s	β	0.481***	0.708***	-0.058***	-0.109	-0.0000034
	p-value	0.000	0.000	0.000	0.139	0.117
0 - 420s	β	0.474***	0.699***	-0.064***	-0.097	-0.0000035
	p-value	0.000	0.000	0.000	0.237	0.116
0 - 480s	β	0.515***	0.703***	-0.066***	-0.102	-0.0000048*
	p-value	0.000	0.000	0.000	0.218	0.034
0 - 540s	β	0.52***	0.691***	-0.071***	-0.129	-0.0000056*
	p-value	0.000	0.000	0.000	0.122	0.016
0 - 600s	β	0.532***	0.676***	-0.064***	-0.138	-0.0000057*
	p-value	0.000	0.000	0.001	0.115	0.012
0 - 660s	β	0.535***	0.699***	-0.058**	-0.159	-0.0000082***
	p-value	0.000	0.000	0.004	0.085	0.001
0 - 720s	β	0.527***	0.69***	-0.064**	-0.151	-0.0000088***
	p-value	0.000	0.000	0.001	0.123	0.000
0 - 780s	β	0.56***	0.692***	-0.07***	-0.115	-0.0000097***
	p-value	0.000	0.000	0.001	0.207	0.000
0 - 840s	β	0.568***	0.685***	-0.061**	-0.113	-0.0000096***
	p-value	0.000	0.000	0.006	0.205	0.000
0 - 900s	β	0.566***	0.964	-0.059**	-0.137	-0.0000091***
	p-value	0.000	0.279	0.009	0.123	0.000
R^2 before initiation		0.04	0.08	0.01	0.01	0.02
R^2 during reaction		0.26	0.34	0.01	0.04	0.03

Table 3
Backward Regression

For each announcement we run the following regression:

$$r_{i,t+k} = \alpha + \beta_1 x_{it}^u + \beta_2 x_{it}^e + u_{it}$$

Where $r_{i,t+k}$ is the exchange rate return between 300 seconds and t seconds after announcement (where t<300). In this instance, the endpoint of the horizon (k) used to calculate rates of return is kept constant at five minutes (300 seconds), while the beginning of the horizon (t) is changed from zero (time of the announcement) to 300 seconds post the announcement with increments of one second. For the US Nonfarm payroll announcement k is set at 30 minutes (1800 seconds). x^u_{it} is the unexpected component of the announcement and x^e_{it} is the expected component of the announcement. The table reports the coefficient β_1, for each time horizon for all announcements. Under each coefficient is the p-value. *, **, and *** indicate significance at the 0.05, 0.01 and 0.001 percent levels respectively.

Time interval		NZGDP	NZCPI	USGDP	USCPI	USNonfarm Time interval	USNonfarm Payroll
Expected coefficient		+	+	-	-		-
300 - 1s	β	0.486***	0.713***	-0.05**	-0.085	1800 - 1s	-0.0000112***
	p-value	0.000	0.000	0.001	0.190		0.000
300 - 5s	β	0.471***	0.642***	-0.053***	-0.063	1800 - 5s	-0.0000109***
	p-value	0.000	0.000	0.000	0.316		0.000
300 - 10s	β	0.394***	0.451***	-0.048***	-0.024	1800 - 10s	-0.0000106***
	p-value	0.000	0.001	0.001	0.690		0.001
300 - 15s	β	0.304***	0.305**	-0.043**	-0.014	1800 - 15s	-0.0000109***
	p-value	0.000	0.008	0.003	0.812		0.000
300 - 30s	β	0.166***	0.212**	-0.033**	-0.004	1800 - 30s	-0.0000108***
	p-value	0.000	0.007	0.008	0.943		0.000
300 - 45s	β	0.108**	0.118	-0.024*	0.035	1800 - 45s	-0.00001***
	p-value	0.007	0.119	0.041	0.533		0.001
300 - 60s	β	0.115**	0.153*	-0.008	0.06	1800 - 60s	-0.0000094***
	p-value	0.003	0.020	0.484	0.277		0.001
300 - 75s	β	0.088**	0.08	-0.003	0.033	1800 - 75s	-0.0000089**
	p-value	0.009	0.192	0.766	0.515		0.002
300 - 90s	β	0.082*	0.081	-0.01	0.07	1800 - 90s	-0.0000088**
	p-value	0.013	0.197	0.356	0.160		0.002
300 - 105s	β	0.072*	0.08	0	0.073	1800 - 105s	-0.0000087**
	p-value	0.026	0.175	0.981	0.122		0.002
300 - 150s	β	0.03	0.124*	0.008	0.098*	1800 - 150s	-0.000008**
	p-value	0.322	0.019	0.426	0.012		0.002
						1800 - 299s	-0.000007**
							0.006
						1800 - 600s	-0.0000053*
							0.013
						1800 - 900s	-0.0000019
							0.242
						1800 - 1200s	-0.0000023
							0.099
						1800 - 1320s	-0.0000018
							0.115
						1800 - 1620s	-0.0000016*
							0.034
						1800 - 1740s	-0.0000006
							0.153
Average R^2 till termination		0.157	0.113	0.035	0.002		0.066

Table 4
Positive news vs Negative news Forward Regression

For each announcement we run the following regression:

$$r_{i,o+k} = \alpha + \beta_1 |x_{it}^{upositive}| + \beta_2 |x_{it}^{unegative}| + \beta_3 x_{it}^{e} + u_{it}$$

Where $r_{i,0+k}$ is the exchange rate return k seconds after announcement, $x^{upositive}_{it}$ and $x^{unegative}_{it}$ are the positive and negative unexpected components of the announcement respectively and x^{e}_{it} is the expected component of the announcement. Positive (negative) news is defined as the occurrence of a positive (negative) surprise. Time horizons k are increased in one second intervals to measure returns, with the start point of each price change being fixed at time 0 (the announcement time). The table reports the coefficient β_1 for positve announcements and β_2 for negative announcements, for each time horizon for all announcements.Under each coefficient is the p-value and z-score. *, **, and *** indicate significance at the 0.05, 0.01and 0.001 percent levels, respectively

Time interval		NZGDP		NZCPI		USGDP		USCPI		USNonfarm Payroll	
		Positive News	Bad News	Positive News	Bad News	Positive News	Bad News	Positive News	Bad News	Positive News	Bad News
Expected coefficient sign		+	-	+	-	-	+	-	+	-	+
0 - 1s	β	0	-0.001	0.019	-0.006	0.001	-0.005	-0.044**	-0.014	0.0000004	0
	p-value	0.965	0.916	0.202	0.610	0.823	0.348	0.008	0.394	0.385	0.950
	z-score	-0.069		0.739		-0.551		-2.491		0.654	
0 - 2s	β	0	-0.012	0.04	-0.019	-0.003	-0.005	-0.014	0.001	0.0000006	-0.0000001
	p-value	0.987	0.488	0.089	0.271	0.536	0.427	0.580	0.963	0.333	0.910
	z-score	-0.594		0.742		-1.007		-0.360		0.702	
0 - 3s	β	0.004	-0.031	0.027	-0.097**	-0.002	-0.015*	-0.026	0.002	-0.0000013	-0.0000005
	p-value	0.859	0.437	0.490	0.001	0.681	0.017	0.295	0.939	0.118	0.482
	z-score	-0.584		-1.467		-2.067		-0.690		-1.676	
0 - 4s	β	0	-0.034	0.034	-0.108*	0	-0.013	-0.043	-0.008	-0.0000018	-0.0000014
	p-value	0.987	0.334	0.590	0.021	0.980	0.051	0.085	0.749	0.069	0.077
	z-score	-0.832		-0.958		-1.478		-1.452		-2.535	
0 - 5s	β	0.007	-0.036	0.042	-0.108*	0.003	-0.01	-0.066*	0.008	-0.0000017	-0.000001
	p-value	0.708	0.264	0.503	0.021	0.685	0.175	0.012	0.774	0.084	0.169
	z-score	-0.784		-0.849		-0.742		-1.587		-2.219	
0 - 6s	β	0.007	-0.081*	0.062	-0.106*	0.003	-0.002	-0.054	0.007	-0.0000018	-0.0000011
	p-value	0.776	0.048	0.319	0.022	0.607	0.745	0.060	0.804	0.127	0.222
	z-score	-1.605		-0.580		0.101		-1.167		-1.960	
0 - 7s	β	-0.002	-0.081*	0.054	-0.149**	0.003	0.002	-0.069*	0.035	-0.0000021	-0.000001
	p-value	0.904	0.019	0.440	0.004	0.696	0.775	0.028	0.257	0.062	0.250
	z-score	-2.157		-1.120		0.474		-0.769		-2.192	
0 - 8s	β	0.002	-0.153*	0.059	-0.242**	0	-0.001	-0.115***	0.03	-0.0000021	-0.0000013
	p-value	0.964	0.017	0.586	0.003	0.973	0.926	0.000	0.338	0.082	0.171
	z-score	-2.113		-1.369		-0.047		-1.898		-2.221	
0 - 9s	β	0	-0.226**	0.056	-0.322***	0.005	0.01	-0.07	0.05	-0.0000028*	-0.0000005
	p-value	0.995	0.004	0.619	0.000	0.590	0.315	0.056	0.167	0.046	0.668
	z-score	-2.632		-1.898		1.110		-0.385		-1.860	
0 - 10s	β	-0.012	-0.321**	0.1	-0.382***	0.006	0.004	-0.102**	0.049	-0.0000035*	-0.0000017
	p-value	0.829	0.001	0.462	0.000	0.558	0.717	0.005	0.177	0.018	0.131
	z-score	-3.054		-1.688		0.662		-1.046		-2.813	
0 - 15s	β	0.053	-0.466**	0.609**	-0.299*	0.006	0.017	-0.124**	0.048	-0.0000022	-0.0000013
	p-value	0.539	0.002	0.002	0.029	0.507	0.115	0.003	0.248	0.293	0.401
	z-score	-2.439		1.365		1.623		-1.286		-1.348	
0 - 30s	β	0.182	-0.624**	0.711**	-0.387*	0.003	0.033*	-0.132*	0.06	0.0000006	0.0000007
	p-value	0.134	0.003	0.001	0.015	0.839	0.040	0.014	0.258	0.847	0.778
	z-score	-1.881		1.236		1.678		-0.960		0.325	
0 - 45s	β	0.305**	-0.541**	0.887***	-0.431*	-0.023	0.022	-0.129*	0.142*	-0.0000005	0.0000013
	p-value	0.008	0.006	0.001	0.017	0.168	0.251	0.026	0.014	0.883	0.612
	z-score	-1.078		1.529		-0.066		0.161		0.191	
0 - 60s	β	0.287*	-0.558**	0.795**	-0.431*	-0.032	0.047*	-0.13*	0.19**	-0.0000026	0.0000008
	p-value	0.017	0.007	0.001	0.014	0.079	0.020	0.040	0.003	0.453	0.756
	z-score	-1.188		1.268		0.575		0.685		-0.409	
0 - 120s	β	0.359**	-0.584**	0.956***	-0.398*	-0.043*	0.079***	-0.122	0.279**	-0.0000052	-0.0000001
	p-value	0.003	0.004	0.000	0.022	0.037	0.001	0.155	0.001	0.181	0.986
	z-score	-0.990		1.938		1.191		1.306		-1.077	
0 - 180s	β	0.393**	-0.69**	1.023***	-0.392*	-0.051*	0.065*	-0.01	0.286**	-0.000005	0.0000024
	p-value	0.003	0.002	0.000	0.022	0.033	0.016	0.925	0.007	0.193	0.407
	z-score	-1.188		2.235		0.371		1.867		-0.535	
0 - 240s	β	0.391**	-0.717**	1.029***	-0.498*	-0.045	0.071*	0.032	0.217*	-0.0000016	0.0000035
	p-value	0.004	0.002	0.000	0.011	0.076	0.012	0.762	0.036	0.691	0.257
	z-score	-1.276		1.661		0.706		1.703		0.373	
0 - 300s	β	0.345*	-0.796***	1.014***	-0.542**	-0.046	0.048	0.067	0.265*	-0.0000054	0.0000028
	p-value	0.010	0.001	0.000	0.007	0.064	0.087	0.528	0.013	0.219	0.413
	z-score	-1.758		1.419		0.038		2.211		-0.483	
0 - 360s	β	0.345*	-0.776**	0.956**	-0.553*	-0.075**	0.038	0.038	0.254*	-0.0000051	0.0000023
	p-value	0.011	0.001	0.001	0.010	0.005	0.204	0.754	0.037	0.278	0.518
	z-score	-1.658		1.140		-0.937		1.705		-0.472	
0 - 420s	β	0.346*	-0.751**	0.889**	-0.579**	-0.062*	0.066*	0.11	0.302*	-0.0000054	0.0000022
	p-value	0.011	0.001	0.003	0.007	0.034	0.044	0.417	0.026	0.252	0.550
	z-score	-1.569		0.883		0.088		2.158		-0.550	
0 - 480s	β	0.43**	-0.701**	0.782**	-0.653**	-0.068*	0.064	0.042	0.246	-0.0000066	0.0000035
	p-value	0.001	0.002	0.007	0.002	0.022	0.052	0.759	0.075	0.168	0.338
	z-score	-1.074		0.376		-0.091		1.479		-0.518	
0 - 540s	β	0.462***	-0.646**	0.738*	-0.662**	-0.074*	0.068*	-0.01	0.248	-0.0000095	0.0000029
	p-value	0.001	0.005	0.011	0.002	0.016	0.048	0.945	0.074	0.054	0.442
	z-score	-0.723		0.217		-0.140		1.218		-1.076	
0 - 600s	β	0.48***	-0.645**	0.7*	-0.661**	-0.06	0.07	0.03	0.304*	-0.0000086	0.0000038
	p-value	0.001	0.006	0.017	0.002	0.062	0.050	0.836	0.036	0.076	0.306
	z-score	-0.637		0.111		0.218		1.635		-0.797	
0 - 660s	β	0.493***	-0.628**	0.778*	-0.65**	-0.049	0.068	-0.009	0.308*	-0.0000071	0.0000089*
	p-value	0.000	0.007	0.012	0.004	0.134	0.064	0.955	0.045	0.166	0.023
	z-score	-0.520		0.345		0.380		1.384		0.279	
0 - 720s	β	0.473**	-0.645**	0.882**	-0.569*	-0.052	0.078*	0.022	0.321*	-0.0000085	0.0000091*
	p-value	0.001	0.008	0.005	0.013	0.111	0.032	0.892	0.047	0.102	0.022
	z-score	-0.639		0.826		0.538		1.505		0.097	
0 - 780s	β	0.489**	-0.713**	0.812**	-0.61**	-0.048	0.092*	0.101	0.35*	-0.000009	0.0000095*
	p-value	0.002	0.006	0.009	0.008	0.151	0.014	0.503	0.020	0.086	0.018
	z-score	-0.775		0.540		0.885		2.127		0.078	
0 - 1020s	β	0.565***	-0.733**	-0.777	-2.033	-0.024	0.083	0.194	0.531**	-0.000012*	0.0000081
	p-value	0.001	0.009	0.676	0.138	0.560	0.066	0.240	0.001	0.034	0.059
	z-score	-0.536		-1.226		0.987		3.130		-0.547	
0 - 1260s	β	0.563**	-0.851**	-0.819	-2.096	-0.022	0.067	0.245	0.495**	-0.0000092	0.0000072
	p-value	0.001	0.004	0.660	0.126	0.615	0.165	0.155	0.004	0.121	0.114
	z-score	-0.875		-1.273		0.701		3.060		-0.277	
0 - 960s	β	0.542**	-0.843**	-0.871	-2.278	-0.051	0.077	0.389	0.456	-0.0000125	0.0000099*
	p-value	0.002	0.005	0.641	0.098	0.277	0.142	0.302	0.223	0.053	0.045
	z-score	-0.912		-1.371		0.370		1.595		-0.319	
Average R^2		0.31		0.38		0.06		0.03		0.04	

Table 5

Positive News vs Negative News Backward Regression

For each announcement we run the following regression:

$$r_{i,t+k} = \alpha + \beta_1 |x_{it}^{upositive}| + \beta_2 |x_{it}^{unegative}| + \beta_3 x_{it}^{e} + u_{it}$$

Where $r_{i,t+k}$ is the exchange rate return between 300 seconds and t seconds after announcement (where t<300). In this instance, the endpoint of the horizon (k) used to calculate rates of return is kept constant at five minutes (300 seconds), while the beginning of the horizon (t) is changed from zero (time of the announcement) to 300 seconds post the announcement with increments of one second. For the US Nonfarm payroll announcement k is set at 30 minutes (1800 seconds). , $x^{upositive}_{it}$ and $x^{unegative}_{it}$ are the positive and negative unexpected components of the announcement respectively and x^{e}_{it} is the expected component of the announcement. Positive(negative) news is defined as the occurrence of a positive (negative) surprise. The table reports the coefficient β_1 for positive announcements and β_2 for negative announcements, for each time horizon for all announcements. Under each coefficient is the p-value. *, **, and *** indicate significance at the 0.05, 0.01and 0.001 percent levels, respectively

Time interval		NZGDP		NZCPI		USGDP		USCPI		USNonfarm Time interval	USNonfarm Payroll	
		Good News	Bad News	Good News	Bad News	Good News	Bad News	Good News	Bad News		Good News	Bad News
Expected coefficent sign		+	-	+	-	-	+	-	+		-	+
300 - 1s	β	0.345*	-0.794***	0.994***	-0.537**	-0.047	0.052	0.111	0.279**	1800 - 1s	-0.000013*	0.00001*
	p-value	0.010	0.001	0.000	0.008	0.062	0.063	0.298	0.009		0.045	0.044
300 - 2s	β	0.345*	-0.784***	0.974***	-0.524**	-0.043	0.052	0.081	0.264*	1800 - 2s	-0.0000131*	0.00001*
	p-value	0.010	0.001	0.001	0.009	0.094	0.067	0.444	0.013		0.042	0.042
300 - 3s	β	0.341*	-0.765***	0.987***	-0.446*	-0.044	0.062*	0.094	0.263*	1800 - 3s	-0.0000112	0.0000104*
	p-value	0.011	0.001	0.001	0.027	0.075	0.023	0.375	0.013		0.084	0.036
300 - 4s	β	0.345**	-0.762**	0.979***	-0.435*	-0.046	0.06*	0.111	0.273**	1800 - 4s	-0.0000107	0.0000113*
	p-value	0.010	0.001	0.001	0.030	0.063	0.029	0.285	0.008		0.098	0.022
300 - 5s	β	0.338*	-0.76**	0.971***	-0.435*	-0.049*	0.057*	0.134	0.258*	1800 - 5s	-0.0000109	0.0000109*
	p-value	0.011	0.001	0.001	0.028	0.048	0.037	0.197	0.013		0.093	0.027
300 - 6s	β	0.338*	-0.714**	0.952***	-0.437*	-0.05*	0.05	0.122	0.258*	1800 - 6s	-0.0000107	0.000011*
	p-value	0.011	0.002	0.001	0.025	0.041	0.065	0.252	0.015		0.097	0.025
300 - 7s	β	0.348**	-0.715**	0.96***	-0.394*	-0.049*	0.045	0.136	0.23*	1800 - 7s	-0.0000104	0.0000109*
	p-value	0.009	0.002	0.000	0.041	0.043	0.095	0.189	0.027		0.108	0.027
300 - 8s	β	0.344**	-0.643**	0.954***	-0.301	-0.046	0.048	0.183	0.235*	1800 - 8s	-0.0000104	0.0000112*
	p-value	0.009	0.004	0.001	0.118	0.054	0.072	0.080	0.024		0.109	0.023
300 - 9s	β	0.345**	-0.57*	0.957***	-0.221	-0.051*	0.037	0.137	0.215*	1800 - 9s	-0.0000097	0.0000104*
	p-value	0.009	0.011	0.000	0.229	0.036	0.167	0.184	0.037		0.141	0.039
300 - 10s	β	0.357**	-0.476*	0.913***	-0.16	-0.052*	0.043	0.17	0.216*	1800 - 10s	-0.000009	0.0000116*
	p-value	0.006	0.029	0.001	0.392	0.024	0.091	0.093	0.032		0.163	0.019
300 - 15s	β	0.292**	-0.33*	0.403	-0.244	-0.052*	0.031	0.191*	0.217*	1800 - 15s	-0.0000103	0.0000113*
	p-value	0.001	0.028	0.093	0.163	0.029	0.244	0.047	0.024		0.104	0.021
300 - 20s	β	0.251**	-0.21	0.405	-0.207	-0.056*	0.013	0.202*	0.247*	1800 - 20s	-0.0000126*	0.0000096*
	p-value	0.001	0.102	0.067	0.196	0.011	0.594	0.044	0.013		0.046	0.047
300 - 25s	β	0.221**	-0.235*	0.259	-0.252	-0.044*	0.015	0.162	0.25*	1800 - 25s	-0.0000121	0.0000095*
	p-value	0.001	0.038	0.154	0.059	0.038	0.530	0.107	0.012		0.055	0.048
300 - 30s	β	0.164**	-0.172	0.302	-0.156	-0.049*	0.015	0.199*	0.205*	1800 - 30s	-0.0000131*	0.0000093
	p-value	0.005	0.076	0.063	0.186	0.018	0.519	0.039	0.032		0.038	0.054
300 - 35s	β	0.165**	-0.198*	0.229	-0.137	-0.033	0.01	0.208*	0.148	1800 - 35s	-0.0000101	0.0000105*
	p-value	0.006	0.048	0.167	0.257	0.093	0.638	0.031	0.120		0.106	0.028
300 - 40s	β	0.047	-0.281**	0.206	-0.153	-0.039*	0.004	0.193*	0.149	1800 - 40s	-0.000011	0.0000098*
	p-value	0.428	0.007	0.184	0.178	0.048	0.860	0.043	0.115		0.081	0.043
300 - 45s	β	0.04	-0.255**	0.126	-0.112	-0.023	0.026	0.196*	0.124	1800 - 45s	-0.000012	0.0000087
	p-value	0.453	0.007	0.424	0.331	0.244	0.235	0.037	0.183		0.059	0.074
300 - 50s	β	0.047	-0.255**	0.177	-0.09	-0.02	-0.007	0.221*	0.148	1800 - 50s	-0.0000126*	0.0000087
	p-value	0.394	0.008	0.232	0.402	0.315	0.767	0.020	0.115		0.038	0.060
300 - 55s	β	0.052	-0.248*	0.208	-0.076	-0.016	0.002	0.205*	0.076	1800 - 55s	-0.0000126*	0.0000083
	p-value	0.360	0.013	0.227	0.546	0.427	0.925	0.028	0.411		0.043	0.082
300 - 60s	β	0.059	-0.238*	0.218	-0.112	-0.015	0.001	0.197*	0.075	1800 - 60s	-0.0000099	0.0000091*
	p-value	0.269	0.010	0.112	0.259	0.449	0.979	0.033	0.414		0.102	0.049
300 - 120s	β	-0.014	-0.213**	0.057	-0.144	-0.004	-0.031	0.189**	-0.014	1800 - 120s	-0.0000073	0.00001*
	p-value	0.738	0.004	0.647	0.117	0.832	0.101	0.007	0.841		0.202	0.023
300 - 180s	β	-0.047	-0.106	-0.01	-0.15*	0.005	-0.017	0.077	-0.021	1800 - 180s	-0.0000075	0.0000075
	p-value	0.206	0.098	0.910	0.023	0.725	0.310	0.182	0.711		0.176	0.077
300 - 240s	β	-0.046	-0.079	-0.016	-0.045	-0.001	-0.024*	0.036	0.048	1800 - 240s	-0.0000109*	0.0000065
	p-value	0.082	0.076	0.765	0.262	0.895	0.032	0.420	0.280		0.042	0.113
Average R2		0.089		0.034		0.002		0.007			0.020	

Table 6
Forward regression - pre 2005 and post 2005 periods

For each announcement we run the following regression:

$$r_{i,0+k} = \alpha + \beta_1 x^u_{it} pre2005 + \beta_2 x^e_{it} pre2005 + \beta_3 x^u_{it} post2005 + \beta_4 x^e_{it} post2005$$

Where $r_{i,0+k}$ is the exchange rate return k seconds after announcement, x^u_{it}pre2005 and x^e_{it}post2005 are the pre 2005 and post2005 unexpected components of the announcement respectively and x^e_{it} is the expected component of the announcement. Time horizons k are increased in one second intervals to measure returns, with the start point of each price change being fixed at time 0 (the announcement time). Pre 2005 includes announcements prior to and within 2004 and post 2005 includes announcements in 2005 and onwards. The table reports the coefficient β_1 for pre2005 and β3 for post 2005, for each time horizon for all announcements. Under each coefficient is the p-value. *, **, and *** indicate significance at the 0.05, 0.01 and 0.001 percent levels, respectively

Time interval		NZGDP		NZCPI		USGDP		USCPI		USNonfarm Payroll	
		Pre 2005	Post 2005	Pre 2005	Post 2005	Pre 2005	Post 2005	Pre 2005	Post 2005	Pre 2005	Post 2005
Expected coefficent sign		+	+	+	+	-	-	-	-	-	-
0 - 1s	β	-0.001	0.005	0.003	0.015	0	0.006	0.001	-0.029*	0	0.0000008
	p-value	0.907	0.586	0.758	0.095	0.898	0.215	0.955	0.029	0.856	0.060
0 - 2s	β	0	0.02	0.008	0.037**	0.001	0	0.006	-0.02	0	0.0000011*
	p-value	0.999	0.096	0.634	0.007	0.831	0.925	0.767	0.303	0.904	0.044
0 - 3s	β	0.002	0.047	0.013	0.102***	0	0.015**	0.006	-0.03	-0.0000009*	0.0000017*
	p-value	0.920	0.096	0.630	0.000	0.915	0.006	0.792	0.133	0.038	0.024
0 - 4s	β	0.002	0.04	0.011	0.117**	-0.001	0.016**	0.004	-0.034	-0.0000009	0.0000028**
	p-value	0.915	0.111	0.807	0.002	0.872	0.006	0.868	0.091	0.108	0.002
0 - 5s	β	0.002	0.059**	0.005	0.125***	-0.001	0.016*	0.003	-0.071***	-0.0000009	0.0000024**
	p-value	0.915	0.009	0.904	0.001	0.874	0.011	0.896	0.001	0.079	0.005
0 - 6s	β	0.002	0.099***	0.008	0.133***	-0.003	0.014*	0.009	-0.065**	-0.000001	0.0000027*
	p-value	0.930	0.001	0.853	0.000	0.556	0.033	0.725	0.004	0.114	0.011
0 - 7s	β	0.002	0.074**	0.002	0.175***	-0.003	0.009	0.003	-0.098***	-0.000001	0.0000019
	p-value	0.915	0.002	0.974	0.000	0.637	0.214	0.904	0.000	0.114	0.065
0 - 8s	β	0	0.151***	-0.002	0.268***	-0.003	0.009	0.008	-0.14***	-0.000001	0.0000026*
	p-value	0.996	0.001	0.980	0.000	0.670	0.287	0.770	0.000	0.133	0.019
0 - 9s	β	0.002	0.216***	-0.003	0.345***	-0.008	0.007	0.01	-0.116***	-0.0000013	0.0000004
	p-value	0.953	0.000	0.967	0.000	0.283	0.450	0.751	0.000	0.100	0.748
0 - 10s	β	-0.004	0.3***	-0.007	0.434***	-0.007	0.015	0.008	-0.144***	-0.0000008	0.0000011
	p-value	0.927	0.000	0.934	0.000	0.379	0.126	0.786	0.000	0.290	0.425
0 - 15s	β	-0.017	0.557***	-0.053	0.692***	-0.012	0.009	0.008	-0.162***	-0.0000015	0.0000041*
	p-value	0.800	0.000	0.637	0.000	0.098	0.343	0.819	0.000	0.174	0.028
0 - 30s	β	-0.02	0.96***	-0.055	0.837***	-0.024*	0	0.012	-0.183***	-0.0000022	0.0000054*
	p-value	0.791	0.000	0.653	0.000	0.038	0.999	0.798	0.000	0.168	0.047
0 - 60s	β	0.088	0.885***	-0.047	0.923***	-0.054***	-0.015	0.02	-0.31***	-0.0000035	0.0000035
	p-value	0.283	0.000	0.724	0.000	0.000	0.383	0.705	0.000	0.060	0.270
0 - 120s	β	0.148	0.916***	0.063	0.926***	-0.05**	-0.069***	-0.079	-0.309***	-0.0000045*	0.0000047
	p-value	0.071	0.000	0.667	0.000	0.003	0.001	0.287	0.000	0.029	0.180
0 - 180s	β	0.196*	1.005***	0.096	0.943***	-0.058**	-0.048*	0.006	-0.28***	-0.0000058**	0.0000027
	p-value	0.040	0.000	0.514	0.000	0.003	0.039	0.947	0.001	0.005	0.429
0 - 240s	β	0.182	1.052***	0.129	1.03***	-0.052**	-0.055*	-0.007	-0.162	-0.0000054*	0.0000043
	p-value	0.054	0.000	0.441	0.000	0.010	0.025	0.937	0.052	0.011	0.227
0 - 300s	β	0.146	1.089***	0.083	1.087***	-0.049*	-0.033	-0.016	-0.167	-0.000007**	0.0000044
	p-value	0.108	0.000	0.614	0.000	0.013	0.172	0.866	0.052	0.003	0.265
0 - 600s	β	0.203*	1.078***	0.067	1.019***	-0.066*	-0.053	0.011	-0.259*	-0.0000092***	0.0000035
	p-value	0.029	0.000	0.708	0.000	0.010	0.084	0.934	0.026	0.000	0.411
0 - 900s	β	0.161	1.26***	0.591	1.093	-0.07*	-0.033	0.079	-0.317**	-0.0000138***	0.0000038
	p-value	0.143	0.000	0.670	0.321	0.018	0.351	0.540	0.007	0.000	0.428
0 - 1200s	β	0.222	1.325***	0.587	1.088	-0.077*	-0.014	0.187	-0.395**	-0.0000142***	0.0000066
	p-value	0.054	0.000	0.671	0.322	0.024	0.732	0.211	0.004	0.000	0.196
0 - 1500s	β	0.27*	1.305***	0.577	1.139	-0.1**	-0.037	0.188	-0.39**	-0.0000154***	0.0000026
	p-value	0.031	0.000	0.678	0.301	0.005	0.386	0.251	0.009	0.000	0.631
0 - 1800s	β	0.253*	1.265***	0.613	1.233	-0.086*	-0.023	0.178	-0.233	-0.0000156***	0.0000011
	p-value	0.042	0.000	0.659	0.265	0.023	0.608	0.594	0.438	0.000	0.843
Average R^2		0.55		0.56		0.06		0.06		0.08	

Table 7
Backward regressions- pre 2005 and post 2005 periods

For each announcement we run the following regression:

$$r_{i,t+k} = \alpha + \beta_1 x^u_{it} pre2005 + \beta_2 x^e_{it} pre2005 + \beta_3 x^u_{it} post2005 + \beta_4 x^e_{it} post2005$$

Where $r_{i,t+k}$ is the exchange rate return between 300 seconds and t seconds after announcement (where t<300). In this instance, the endpoint of the horizon (k) used to calculate rates of return is kept constant at five minutes (300 seconds), while the beginning of the horizon (t) is changed from zero (time of the announcement) to 300 seconds post the announcement with increments of one second. For the US Nonfarm payroll announcement k is set at 30 minutes (1800 seconds), x^u_{it} pre2005 and x^u_{it}post2005 are the pre 2005 and post 2005 unexpected components of the announcement respectively and x^e_{it} is the expected component of the announcement. Pre 2005 includes announcements prior to and within 2004 and post 2005 includes announcements in 2005 and onwards. The table reports the coefficient β_1 for pre2005 and β3 for post 2005, for each time horizon for all announcements. Under each coefficient is the p-value. *, **, and *** indicate significance at the 0.05, 0.01 and 0.001 percent levels, respectively

Time interval		NZGDP		NZCPI		USGDP		USCPI		USNonfarm Time interval	USNonfarm Payroll	
		Pre 2005	Post 2005	Pre 2005	Post 2005	Pre 2005	Post 2005	Pre 2005	Post 2005		Pre 2005	Post 2005
Expected coefficient sign		+	+	+	+	-	-	-	-		-	-
300 - 1s	β	0.146	1.083***	0.08	1.073***	-0.05*	-0.038	-0.017	-0.138	1800 - 1s	-0.0000156***	0.0000003
	p-value	0.105	0.000	0.631	0.000	0.014	0.116	0.860	0.109		0.000	0.958
300 - 2s	β	0.146	1.068***	0.075	1.051***	-0.05*	-0.032	-0.022	-0.147	1800 - 2s	-0.0000156***	0.0000001
	p-value	0.111	0.000	0.649	0.000	0.014	0.190	0.812	0.085		0.000	0.991
300 - 3s	β	0.143	1.041***	0.07	0.985***	-0.049*	-0.047*	-0.022	-0.137	1800 - 3s	-0.0000147***	-0.0000006
	p-value	0.115	0.000	0.688	0.000	0.013	0.046	0.817	0.109		0.000	0.921
300 - 4s	β	0.144	1.048***	0.072	0.97***	-0.048*	-0.048*	-0.02	-0.133	1800 - 4s	-0.0000147***	-0.0000017
	p-value	0.111	0.000	0.679	0.000	0.014	0.042	0.831	0.110		0.000	0.769
300 - 5s	β	0.144	1.03***	0.078	0.963***	-0.048*	-0.049*	-0.019	-0.096	1800 - 5s	-0.0000147***	-0.0000013
	p-value	0.114	0.000	0.653	0.000	0.014	0.040	0.837	0.250		0.000	0.824
300 - 6s	β	0.144	0.99***	0.075	0.954***	-0.046*	-0.046*	-0.025	-0.102	1800 - 6s	-0.0000146***	-0.0000016
	p-value	0.123	0.000	0.658	0.000	0.018	0.047	0.794	0.232		0.000	0.786
300 - 7s	β	0.144	1.014***	0.082	0.913***	-0.046*	-0.042	-0.019	-0.07	1800 - 7s	-0.0000146***	-0.0000008
	p-value	0.117	0.000	0.635	0.000	0.017	0.076	0.836	0.407		0.000	0.894
300 - 8s	β	0.145	0.938***	0.085	0.819***	-0.046*	-0.042	-0.024	-0.028	1800 - 8s	-0.0000146***	-0.0000015
	p-value	0.123	0.000	0.638	0.000	0.017	0.072	0.797	0.742		0.000	0.800
300 - 9s	β	0.143	0.873***	0.086	0.743***	-0.041*	-0.039	-0.026	-0.051	1800 - 9s	-0.0000143***	0.0000007
	p-value	0.141	0.000	0.627	0.000	0.032	0.094	0.778	0.537		0.000	0.901
300 - 10s	β	0.15	0.789***	0.091	0.653***	-0.042*	-0.048*	-0.024	-0.023	1800 - 10s	-0.0000148***	0.0000001
	p-value	0.125	0.000	0.626	0.000	0.022	0.031	0.787	0.776		0.000	0.990
300 - 15s	β	0.162*	0.532***	0.136	0.396**	-0.037	-0.041	-0.024	-0.006	1800 - 15s	-0.0000141***	-0.0000029
	p-value	0.024	0.000	0.436	0.005	0.053	0.073	0.779	0.941		0.000	0.605
300 - 20s	β	0.166*	0.361***	0.121	0.371**	-0.035*	-0.028	-0.042	-0.009	1800 - 20s	-0.0000138***	-0.0000031
	p-value	0.013	0.000	0.451	0.005	0.046	0.178	0.642	0.912		0.000	0.580
300 - 25s	β	0.164**	0.33***	0.135	0.318**	-0.033	-0.018	-0.041	-0.049	1800 - 25s	-0.0000137***	-0.0000026
	p-value	0.005	0.000	0.309	0.003	0.053	0.381	0.644	0.546		0.000	0.650
300 - 30s	β	0.165**	0.129	0.138	0.25**	-0.026	-0.032	-0.028	0.015	1800 - 30s	-0.0000134***	-0.0000042
	p-value	0.001	0.059	0.246	0.010	0.118	0.100	0.747	0.843		0.000	0.455
300 - 35s	β	0.166**	0.152*	0.15	0.181	-0.019	-0.02	-0.026	0.076	1800 - 35s	-0.0000131***	-0.0000032
	p-value	0.002	0.032	0.226	0.066	0.234	0.287	0.766	0.327		0.000	0.569
300 - 40s	β	0.049	0.228**	0.124	0.196*	-0.018	-0.021	-0.018	0.056	1800 - 40s	-0.0000132***	-0.0000029
	p-value	0.345	0.002	0.279	0.033	0.243	0.269	0.828	0.463		0.000	0.611
300 - 45s	β	0.049	0.19**	0.131	0.102	-0.015	-0.029	-0.018	0.081	1800 - 45s	-0.0000127***	-0.0000031
	p-value	0.301	0.005	0.266	0.270	0.339	0.116	0.831	0.280		0.000	0.594
300 - 50s	β	0.05	0.202**	0.105	0.129	-0.002	-0.007	-0.025	0.086	1800 - 50s	-0.000013***	-0.000003
	p-value	0.297	0.003	0.340	0.139	0.876	0.729	0.766	0.261		0.000	0.583
300 - 55s	β	0.05	0.215**	0.09	0.143	-0.005	-0.008	-0.027	0.142	1800 - 55s	-0.0000126***	-0.0000029
	p-value	0.319	0.003	0.480	0.161	0.762	0.692	0.746	0.057		0.000	0.605
300 - 60s	β	0.058	0.204**	0.131	0.164*	0.005	-0.017	-0.036	0.143	1800 - 60s	-0.0000121***	-0.0000023
	p-value	0.218	0.002	0.202	0.045	0.727	0.340	0.659	0.054		0.000	0.672
300 - 120s	β	-0.003	0.173**	0.02	0.162*	0.001	0.036*	0.063	0.142*	1800 - 120s	-0.0000111***	-0.0000035
	p-value	0.939	0.001	0.827	0.030	0.966	0.027	0.298	0.010		0.000	0.498
300 - 180s	β	-0.05	0.084	-0.012	0.144**	0.009	0.016	-0.022	0.113*	1800 - 180s	-0.0000098**	-0.0000016
	p-value	0.122	0.063	0.848	0.006	0.452	0.289	0.661	0.014		0.001	0.754
										1800 - 360s	0***	-0.000006
											0.000	0.202
										1800 - 720s	0***	-0.0000018
											0.000	0.604
										1800 - 960s	0***	-0.0000023
											0.000	0.464
										1800 - 1200s	0***	-0.0000055*
											0.000	0.047
										1800 - 1440s	0***	-0.0000004
											0.000	0.833
										1800 - 1680s	0***	-0.0000029**
											0.000	0.008
Average R^2		0.120		0.069		0.006		0.003			0.024	

Figure 1

The number of trades that were transacted through the Thomson Reuters Dealing system on an annual basis

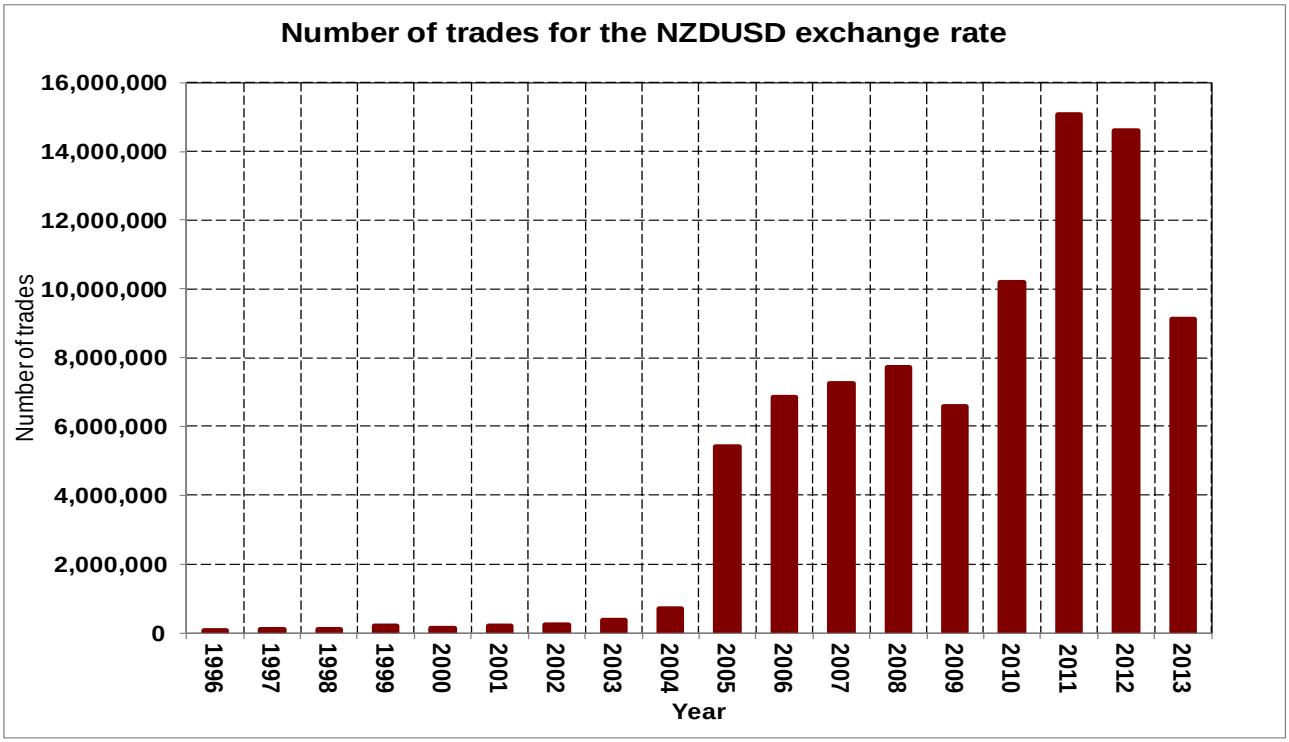

Figure 2

Figure 2 shows the distribution of the unexpected components for the 55 NZ GDP announcements that occur between 1999 and 2013. The unexpected component is calculated as the difference between the actual announcement value and the expected value as given by Bloomberg's survey median value.

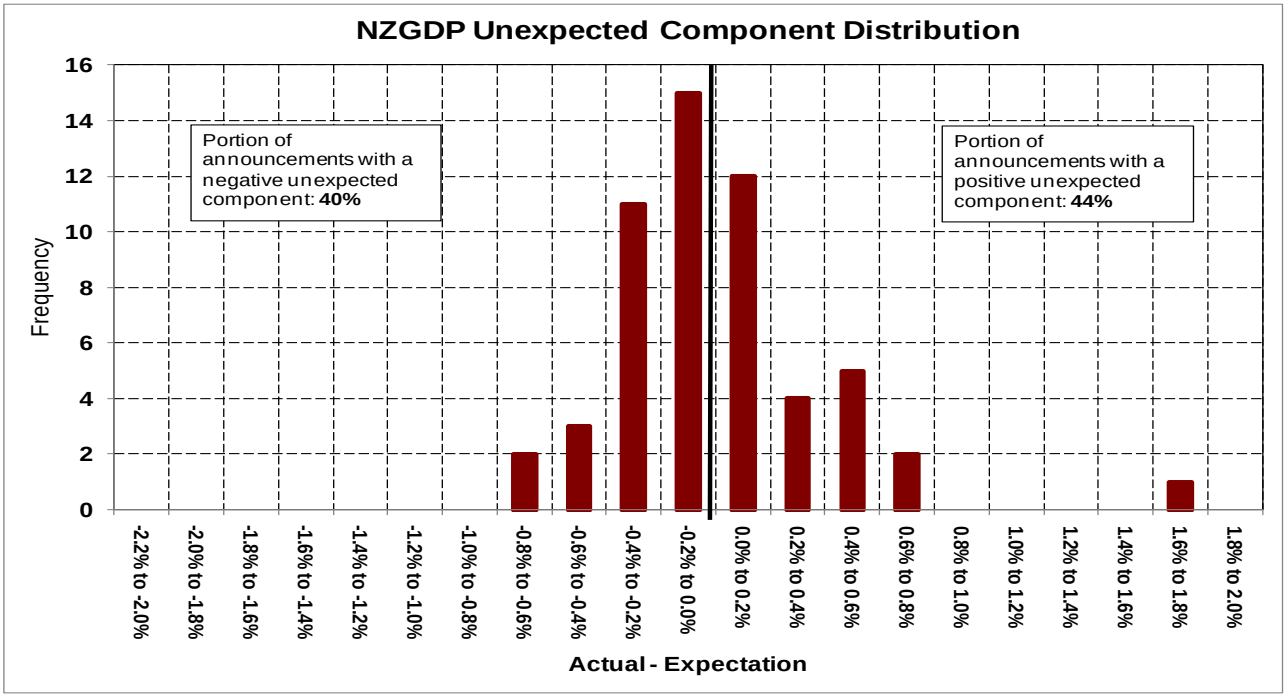

Figure 3

Figure 3 shows the distribution of the unexpected components for the 63 NZ CPI announcements that occur between 1997 and 2013. The unexpected component is calculated as the difference between the actual announcement value and the expected value as given by Bloomberg's survey median value.

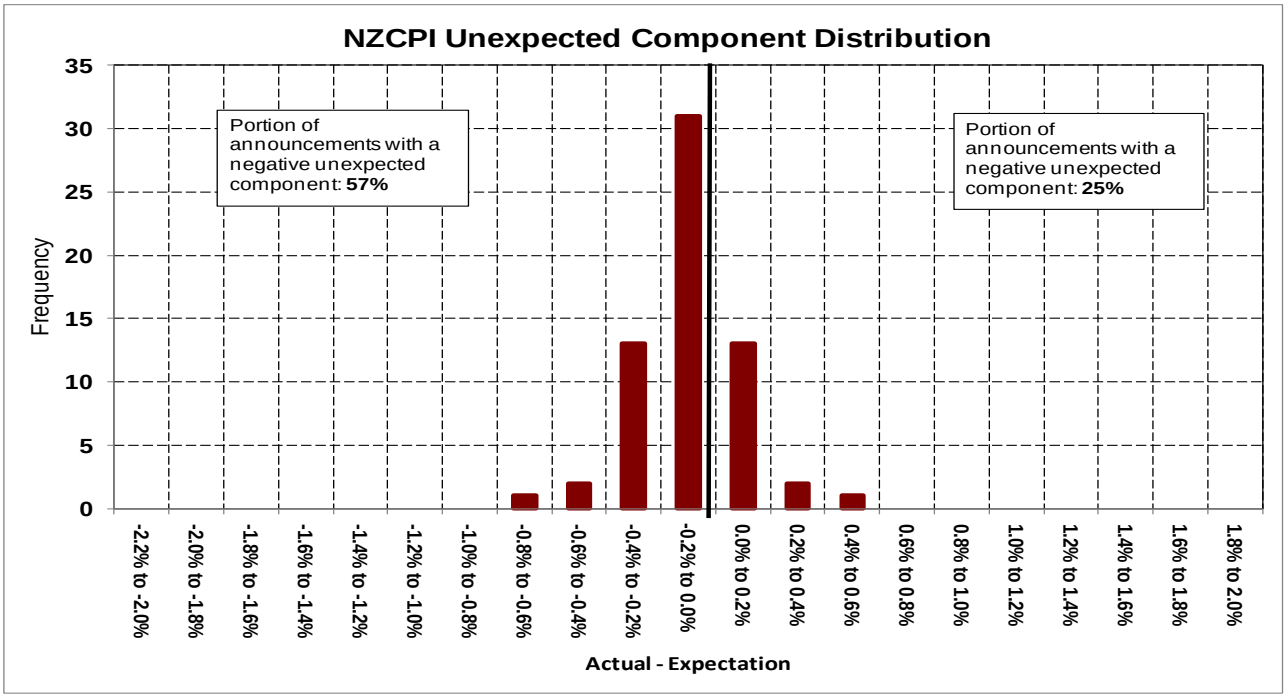

Figure 4

Figure 4 shows the distribution of the unexpected components for the 196 US GDP announcements that occur between 1997 and 2013. The unexpected component is calculated as the difference between the actual announcement value and the expected value as given by Bloomberg's survey median value.

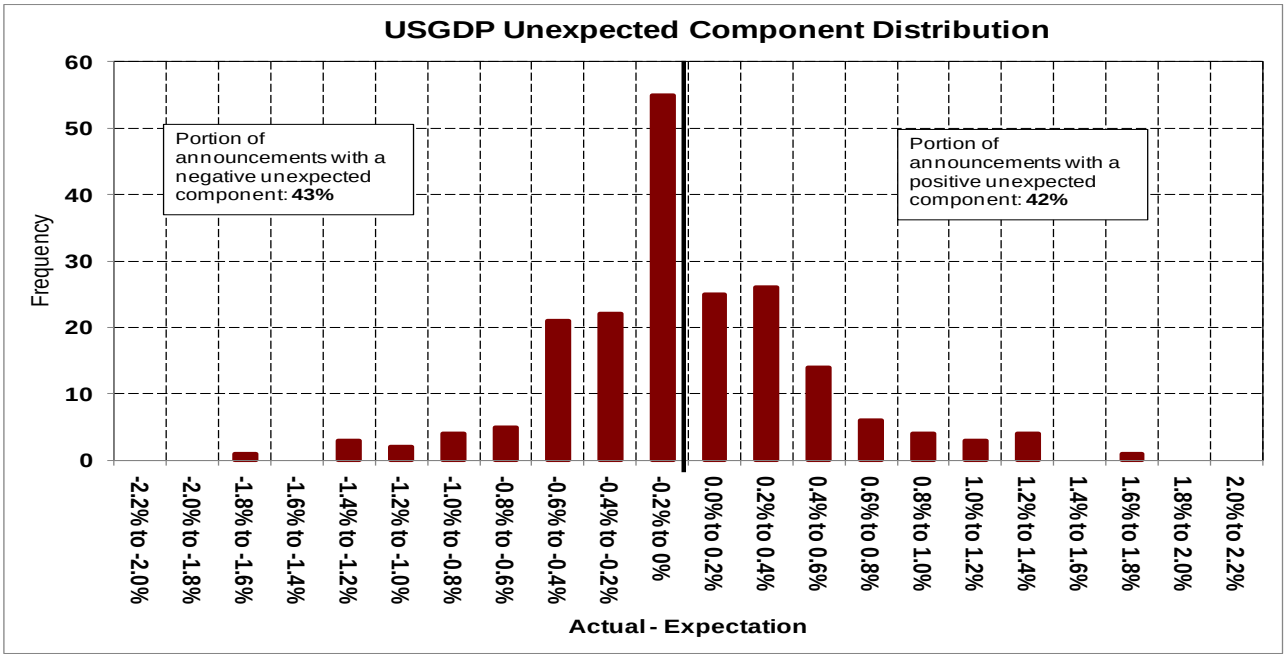

Figure 5

Figure 5 shows the distribution of the unexpected components for the 200 US CPI announcements that occur between 1996 and 2013. The unexpected component is calculated as the difference between the actual announcement value and the expected value as given by Bloomberg's survey median value.

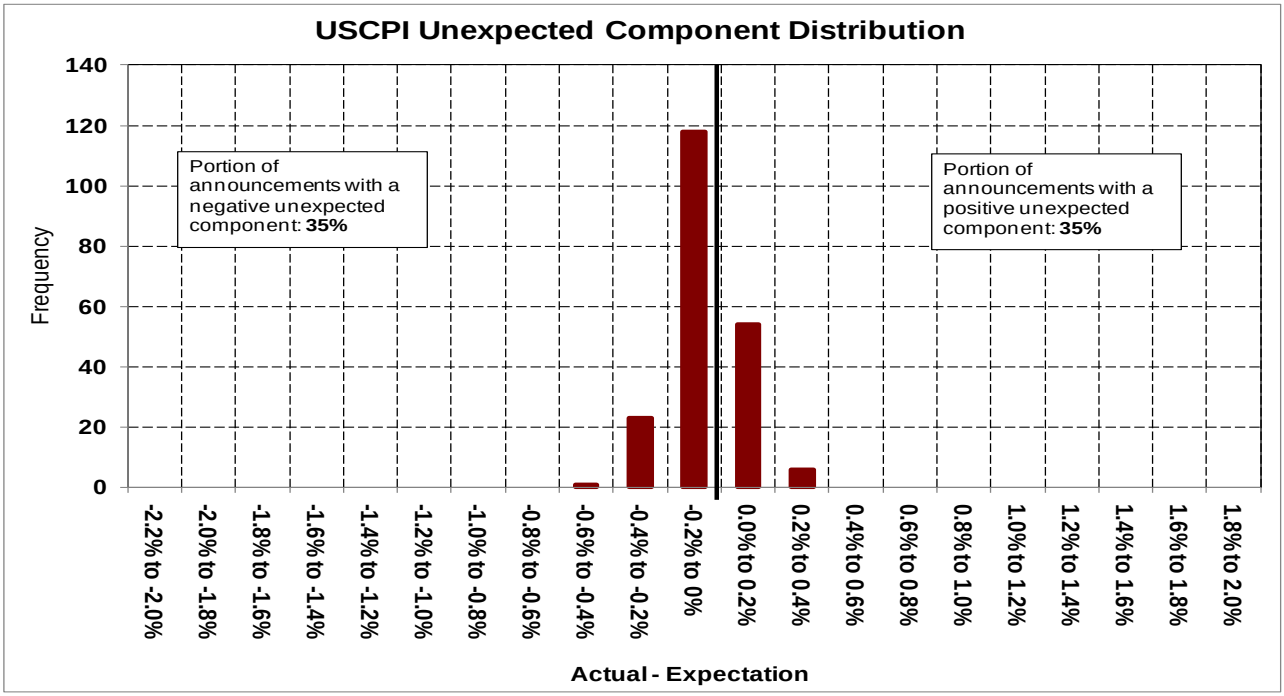

Figure 6

Figure 6 shows the distribution of the unexpected components for the 200 US nonfarm payroll announcements that occur between 1997 and 2013. The unexpected component is calculated as the difference between the actual announcement value and the expected value as given by Bloomberg's survey median value.