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Effectiveness of Foreign Exchange Interventions: Evidence from New Zealand

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Effectiveness of Foreign Exchange Interventions: Evidence from New Zealand

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Abstract: This paper examines the effectiveness of explicit and implicit foreign exchange (FX) interventions in New Zealand: one secret spot market intervention and two implicit interventions – a regular Monetary Policy Statement (MPS) and an unexpected oral intervention by the Reserve Bank of New Zealand (RBNZ) governor addressing the New Zealand Dollar (NZD). By applying a synthetic control methodology to a unique dataset of RBNZ interventions, we construct a counterfactual to estimate their effect. The results indicate that the actual intervention and the MPS release were ineffective in moving the NZD. However, the speech depreciated the NZD by 1.12%, although the effect was small and short lived. Our findings suggest that FX interventions, explicit or implicit, are a weak policy tool to affect the exchange rate in New Zealand.

Keywords: Foreign exchange intervention; Explicit intervention; Implicit intervention; Synthetic control; Effectiveness

JEL Classifications: C31; E58; F31

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1. Introduction

Foreign exchange (FX) interventions occurred on 19% of trading days between 1995 and 2011 across 33 central banks that provided data (Fratzscher et al., 2019). Many countries have become more active in FX markets since the Global Financial Crisis as countries have approached the zero lower bound and unconventional monetary policy discussions have returned to the spotlight. The Bank of Israel (2019) and the Reserve Bank of Australia (2019) have both mentioned the possibility of renewing interventions in their monetary policy meetings. Markets have also questioned whether the Swiss National Bank (Revill, 2019) and the US Treasury (Ahmann & Lawder, 2019) will begin to intervene again. In New Zealand, the Reserve Bank of New Zealand (RBNZ) has included the purchase of foreign currency to influence the exchange rate as one of its unconventional monetary policy options (Reserve Bank of New Zealand (RBNZ), 2020). FX interventions therefore remain an important policy tool for central banks internationally and in New Zealand.

Monetary authorities have implemented different approaches to intervene in the FX market and influence the exchange rate. Explicit interventions are the physical purchase or sale of currencies in the FX market. Implicit interventions involve communications by the Central Bank with the market that do not require the physical exchange of currencies. They are usually performed through a publication or oral speech by its governor or the chairman of the banking supervision agency addressing concerns about the foreign exchange positions. In the recent past, monetary authorities in the US and the euro area have abandoned explicit market interventions and primarily relied on oral interventions as a policy tool to affect exchange rates (Ehrmann & Fratzscher, 2007). Similarly, structured communications by the Bank of Chile coupled with an explicit statement of the resources available for intervention have been estimated to have led to appreciation of nearly 3% (De Gregorio & Tokman, 2005). Other banks, such as the Central Bank

of Brazil and the Bank of Japan, have mostly conducted actual interventions through substantial purchases or sales in foreign exchange markets, which have often been supported by an exchange rate communication (Chamon et al., 2017; Fratzscher, 2006). Are explicit or implicit interventions effective policy tools, however? Which methods should central banks choose to maximise the effectiveness of interventions? This paper attempts to answer these questions in the New Zealand context. Three RBNZ interventions are examined to assess their effectiveness: one large explicit spot market intervention and two implicit interventions – a Monetary Policy Statement (MPS) release by the RBNZ that indicated the overvaluation of the NZD and a speech by the RBNZ governor addressing the unsustainability of the exchange rate.

The primary reason for central banks to intervene in the FX market is to 'lean against the wind' by counteracting the prevailing trend in the exchange rate level or to tame FX volatility (Adler & Tovar, 2011; Chutasripanich & Yetman, 2015).[1] They also intervene to correct misalignments when an exchange rate deviates from its fundamental value.[2] The most important influence on the exchange rate potentially occurs through the 'monetary policy channel' by influencing the home interest rates. However, the focus of the literature has mostly been on sterilised intervention. Sarno and Taylor (2001) provided an excellent discussion of the channels through which sterilised FX interventions might work. Sterilised interventions might influence the exchange rate through the 'portfolio balance channel' by changing the relative supplies of foreign and domestic assets and adjusting the relative risks of the two types of assets. Interventions could also have an impact through the 'signalling or expectations channel'. Since central banks often have a greater level of information about exchange rate fundamentals than the average market

[1] However, in the past, the Bank of Japan has followed the approach of 'leaning with the wind' and a similar perspective has also been contemplated by the Reserve Bank of New Zealand (De Gregorio & Tokman, 2005).
[2] Other pragmatic reasons for intervention include building up foreign reserves and maintaining market liquidity or even profitability (Cassino & Lewis, 2012; Neely, 2001).

participant, they could prompt traders to change their outlook by conveying some of this 'insider' information around the value of the foreign exchange rate. Moreover, if the market believes that the central bank has credible knowledge about the 'true' value of the exchange rate, then interventions could use the 'coordination channel' and induce the market to sell off an overvalued currency and vice versa. Similarly, if irrational market participants have driven the exchange rate from its fundamental value, authorities can intervene in such a way that makes these traders alter their positions in the direction of the intervention.

In the empirical literature, the effectiveness of FX interventions, both actual and oral, is contentious. Studies across a broad range of time horizons, currency pairs, and countries have produced differing conclusions. Explicit FX interventions by the Bundesbank and the Federal Reserve have been found to affect the exchange rate for short periods (Fatum & Hutchison, 2003). Similar research reviewing the Riksbank (Aguilar & Nydahl, 2000) and the Bank of Japan (Cheng et al., 2015; Galati et al., 2005) has found little or no effect of explicit interventions. Recent studies using multi-country panel approaches have shown more positive results. Fratzscher et al. (2019) concluded that FX interventions could be an effective tool, with an 80% success rate under certain conditions. A panel IV regression determined that an intervention of 1% of the GDP would move the exchange rate just under 2% in the respective direction on average (Adler et al., 2019). Fratzscher (2005) concluded that oral interventions in the United States, Japan, and the euro area may have had a permanent effect on exchange rates. On the contrary, Jansen and de Haan (2005, 2007) argued that the efforts to support the euro had been unsuccessful. Others considered oral interventions in conjunction with actual interventions to determine whether there was any interaction in the pairing (Beine et al., 2009). They found that a combination of interventions was more effective than individual actual interventions.

While the results of interventions' impact vary, the successful ones show some reoccurring themes. For explicit interventions, intervening with the wind (Fratzscher, 2005; Mark & Mershon, 2018), intervening when the currency had substantially deviated from its fundamental value (Beine et al., 2009; Fratzscher, 2005), and aligning the intervention with monetary policy (Fatum & Pedersen, 2009) all increased an intervention's probability of success. The size of interventions has also been heavily discussed, although with mixed conclusions. Beine et al. (2009) questioned whether larger interventions are more successful, their rationalization being that market participants are not aware of the size of the intervention when implemented. However, other authors have supported the idea that the size of the intervention matters (Fatum & Yamamoto, 2014; Mark & Mershon, 2018). Another factor noted for a successful intervention is secrecy. Keeping an intervention covert limits the channels that it works through, potentially lowering its chance of success (Neely, 2001; Sarno & Taylor, 2001). For oral interventions, the likelihood of success increases the more widely a statement is reported in the news (Jansen & de Haan, 2007) and if the communication is used in conjunction with an actual intervention (Kim & Le, 2010).

This paper is motivated by two apparent gaps in the existing research on FX interventions. First, as far as we are aware, this is the first paper to focus on the effectiveness of both actual and oral interventions by the RBNZ in the FX market. The effectiveness of FX intervention in New Zealand is an important policy question; however, the lack of public availability of data on RBNZ's interventions has made it difficult for researchers to assess these interventions.[3] The research has

[3] Data on the RBNZ's interventions are not publicly available, leaving an absence of research on this topic. There are, however, three related papers. Karagedikli and Siklos (2008) investigated how monetary policy, especially surprise announcements, affected the NZD, finding that monetary policy surprises typically had a permanent impact on the exchange rate. The second study, by Cassino and Lewis (2012), considered the profitability of the RBNZ's FX interventions, discovering that they can be profitable, although most of this profit is driven by building up FX reserves. The final relevant New Zealand paper examined the effect of statements from the RBNZ on the interest rate (Guthrie & Wright, 2000). It concluded these statements had led to significant changes in New Zealand interest rates that could not be attributed to open market operations.

relevance for small open economies that practice inflation targeting. FX interventions are an extra tool to isolate open economies from the additional international financial shocks to which they are susceptible. Furthermore, the effectiveness of interventions is likely to be heterogeneous across countries due to differing intervention objectives (Fratzcher et al., 2019). New Zealand, for example, is unusual in terms of its foreign exchange market. It has one of the largest turnovers of its currency relative to its GDP in the world. The daily FX turnover based on a 2019 Bank of International Settlements (BIS) survey is over 55% of New Zealand's annual GDP. This is substantial when compared with Switzerland, another small open economy with a heavily traded currency, the turnover to GDP of which is only 35%. Thus, the NZD reaction to interventions may be different from that of other currencies since there is an enormous amount of NZD liquidity.

The second motivation stems from the methodology. To control for the endogeneity present in FX interventions, we use a synthetic control methodology (Abadie et al., 2010) to create a 'counterfactual NZD'. This counterfactual is achieved by weighting a basket of other currencies in such a way that the weighted average mimics the NZD's evolution before the intervention. These weights are assumed to be constant over time and used to estimate the NZD path if no intervention had taken place. The intervention's effect can thus be estimated as the difference in the evolution of the counterfactual and the actual NZD post-intervention. This technique has rarely been applied in the FX intervention literature. Chamon et al. (2017) used this methodology to explore the impact that an announcement of an FX intervention programme and the subsequent actual interventions had on the Brazilian real, finding it to be successful. Similarly, Mark and Mershon (2018) studied exchange rate expectations and risk premia using a panel of nine countries and concluded that interventions can move expectations and risk premia. Other papers in international finance that have used this methodology include those by Jinjarak et al. (2013), who investigated the impact of capital controls in Brazil, and Billmeier and Nannicini (2013), who

studied the impact of economic liberalisation on the real GDP per capita. This paper adds to the literature by adopting a synthetic control methodology to examine the effect of both explicit and implicit FX interventions independently.

The RBNZ historically has implemented 20 distinct actual interventions.[4] These amounted to just under $7b from June 2007 to September 2015, a period that captures all the interventions to date. A further 18 oral interventions have taken place in the form of statements addressing the NZD's over- or undervaluation, 13 of these occurring in every MPS that ran from October 2013 to June 2015. From a confidential dataset that includes all the RBNZ interventions to date, we selected three interventions in the period of August to September 2014. These interventions were chosen since there was one large actual intervention, two oral interventions, and no other macroeconomic surprises during this time. This makes the chosen period an excellent event study to apply the synthetic control methodology.

The first intervention was an explicit intervention that was implemented secretly. In August 2014, a total of NZD$530m was sold over three days. The NZD was extremely high compared with historical levels at that moment, and many felt that the high exchange rate was negatively affecting the competitiveness of New Zealand. Weeks after this first intervention, an MPS was released (Reserve Bank of New Zealand (RBNZ), 2014f). This MPS did not coincide with an interest rate change, but the policy assessment called the NZD 'unsustainably high'.

Two weeks after the MPS release, the RBNZ made an oral intervention when Governor Graeme Wheeler reiterated, in a public speech, the sentiment from the MPS and said: 'Unjustified and unsustainable are important considerations in assessing whether exchange rate intervention is feasible' (Wheeler, 2014). This statement was unexpected and could be perceived by the market

[4] An intervention might occur as a separate event or as an intervention cluster when the RBNZ intervened on consecutive days.

as an implicit threat of future FX interventions since previous governors had never addressed the movement of the NZD as unsustainable in a speech.

The main findings of our paper are as follows. First, we find that the actual intervention did not have any measurable impact on the NZD, which implies that keeping interventions secret is an ineffective strategy. We also find that the MPS did not move the exchange rate. The statement in the MPS could have been anticipated by the market as previous MPSs had contained similar statements. Unlike the first two interventions, the Governor's speech did have some effect on the NZD movement. Some of this success is probably attributable to the unexpectedness of speech and the new information that it provided to the market. However, while the speech did produce an unusual movement of the NZD, the size of the movement was small and short lived.

The remainder of the paper is as follows. Section two discusses the dataset, while the methodology is explained in section three. The results from the three events studied are presented in section four. Finally, section five contains the conclusions.

2. Data and variables

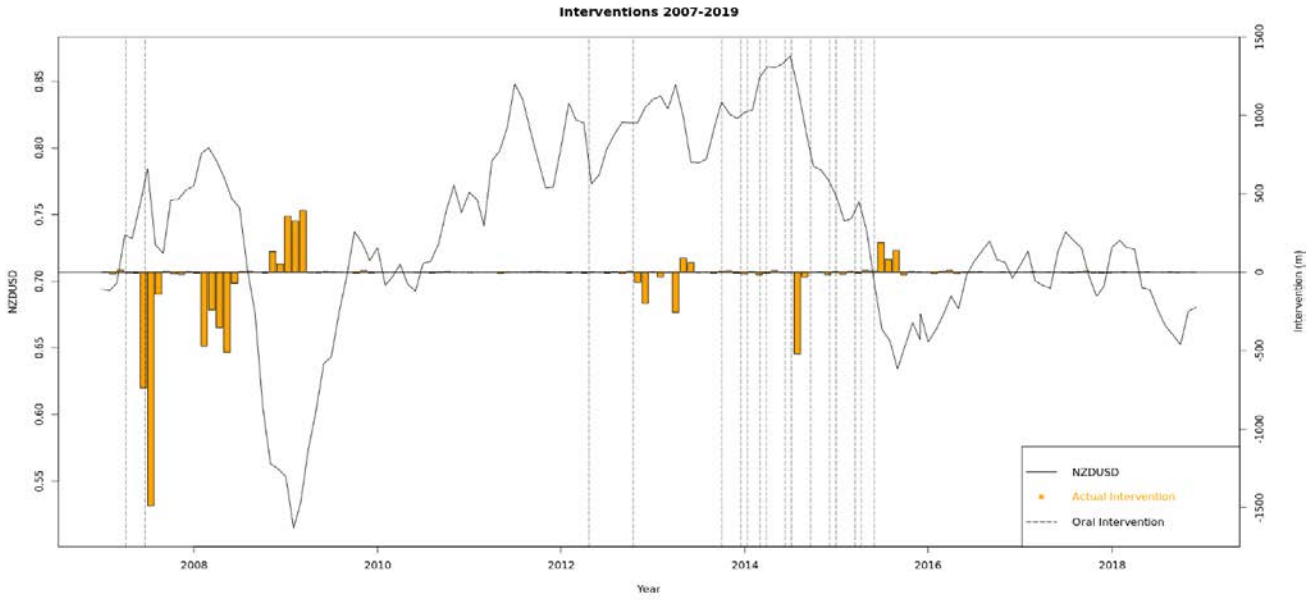
The dataset for this paper consists of the intervention data from the RBNZ paired with exchange rate data and a set of macroeconomic controls. All the series are daily, structured with no weekends, and set up in a panel formation with N currency pairs (or countries) and T days.

2.1 FX interventions

The confidential dataset provided by the RBNZ includes daily intervention data. The daily intervention series provided spans from June 2007 to September 2015. Within this period, there are around 20 distinct intervention clusters, 13 of which occurred during the Global Financial Crisis (GFC) and were potentially directed at avoiding a market breakdown. The remainder can be categorised as minimising the extremes of the exchange rate cycle. The combined purchase or

sale of the NZD amounted to around $7b over the 8 years. Interventions occurred at times when the exchange rate was extremely high or low relative to previous levels; see **Figure 1**.

Figure 1: Interventions in the period 2007-2019



Source: RBNZ, Bloomberg.

Over the same 8-year period, there were also 18 oral interventions, the majority of which occurred between late 2013 and 2015. With two exceptions, these interventions were made public in MPS releases, which contained a statement referring to the NZD as overvalued. While this is not an explicit threat of future interventions, it is an attempt to talk down the currency as market participants know that the RBNZ has the power to intervene in these circumstances. The two exceptions were the speech by the RBNZ governor examined in this paper and one explicit intervention that the RBNZ confirmed with a statement later in the day (RBNZ, 2007).

From this confidential dataset, we selected the interventions from August to September 2014 as the period for our analysis.[5] While there were multiple actual interventions across the dataset, -

[5] Note that we cannot disclose the exact date of the first intervention when the NZD was sold by the RB.

we chose this period as it was a time during which no major macroeconomic events took place that were likely to have affected the NZD exchange rate. This is crucial for the identification of the impact of the intervention. While other interventions had been larger, those interventions occurred simultaneously with other events (like the GFC), making it impossible to attribute changes in the NZD exchange rate to the interventions. To verify this lack of conflict, news that appeared on Bloomberg in the two weeks either side of every intervention was checked for any event that might cause a conflict, which led to the selection of interventions in August and September 2014, the 'cleanest' period available.[6] Alongside the actual intervention, this period also included an oral intervention, allowing the effect of an actual and an oral intervention to be contrasted.

2.2 Exchange rates

The RBNZ interventions occurred against the USD, so the exchange rate of the NZD–USD currency pair was utilised. Throughout this analysis, when the NZD is mentioned, it refers to this pair. Each observation is the end-of-day value. Alongside the NZD, 35 additional currency pairs' exchange rates were pulled from Bloomberg. These were all set against the USD and necessary to construct the synthetic control. This set covers all the OECD nations and New Zealand's top trading partners. Strongly correlated currencies strengthen the estimation of the synthetic control, so the chosen basket of currencies only includes ones that could reasonably be related to the NZD.[7] Both the level of the exchange rate and the return, calculated as the log difference of each day, were used throughout the analysis.

[6] There are three events worth commenting on during this period. On 4 September, the European Central Bank unexpectedly cut rates by 10 basis points (European Central Bank, 2014; Udland, 2014), the Bank of England held the bank rate at 0.5% (Bank of England, 2014), and the Bank of Japan (Bank of Japan, 2014) held rates. An election was held in New Zealand on 20 September. Finally, the RBNZ released the foreign currency assets and liabilities on 29 September. The net NZD sales would have indicated that the RBNZ had intervened in August, although the market would not have known the exact date. We examined the NZD around each of these other events and found little reaction.

[7] The Hong Kong dollar was eliminated since it operates a currency board (International Monetary Fund, 2018).

2.3 Macroeconomic controls

Additionally, country-specific stock indices and bond returns for each nation were exported from Bloomberg. The stock indices' returns were calculated like the exchange rate returns. Where possible, 3-month yields were used for the bond returns. When these were not available, the next closest yield was substituted instead. The control data required the removal of three currency pairs due to the lack of data or problems with the data quality, reducing the 34 currencies to 31 with the removal of Argentina, Iran, and Nigeria.

2.4 Timeline of events

The period of August to September 2014 is nicely structured with gaps between the events of interest, allowing for the application of a synthetic control to multiple cases. First, an actual intervention in August totalling $530m was implemented by the RBNZ across three days, the largest proportion of this, $200m, occurring on the first day. This was the RBNZ's first FX intervention for over a year. The intervention occurred covertly, and any commentary from the market would have only been speculation.

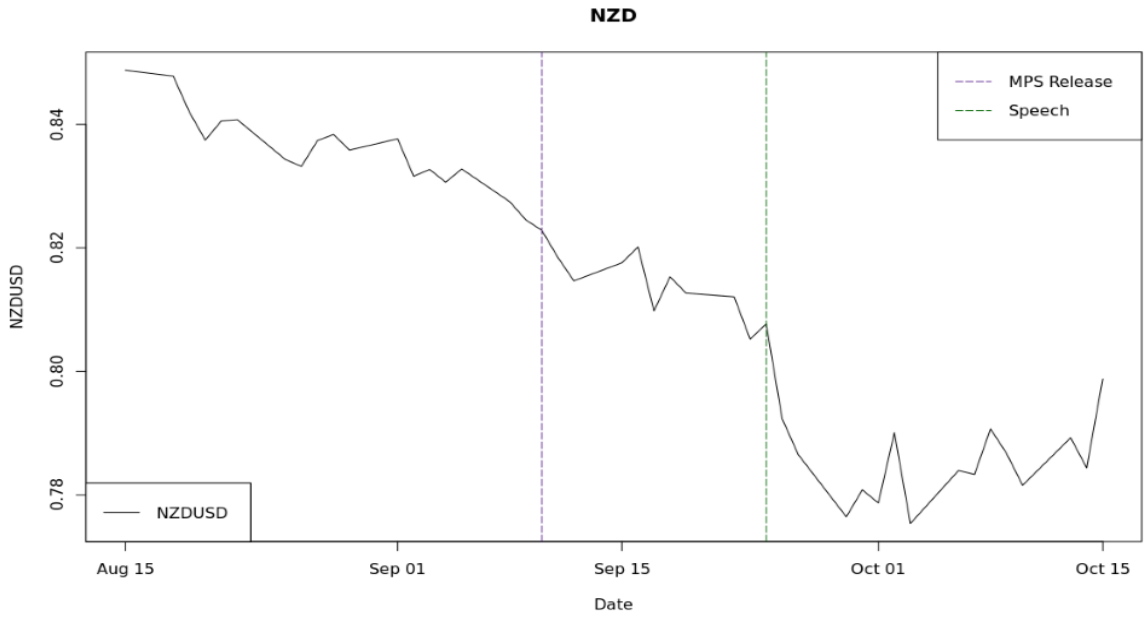
Subsequently, on 11 September, the RBNZ released its regular MPS. The policy statement commented, '[The exchange rate's] current level remains unjustified and unsustainable' (RBNZ, 2014f); however, there was no outright mention of FX intervention. This statement should not have been unexpected, since every MPS since October 2013 had featured a similar version (RBNZ, 2013a, 2013b, 2014a, 2014b, 2014c, 2014d, 2014e). The challenge for the RBNZ in mid-2014, however, was that it was in the middle of a tightening cycle, and the OCR was raised by 25 basis points in both June and July. Trying to talk down the exchange rate would be difficult since it was arguably out of line with the monetary policy.

After the MPS, the RBNZ apparently still did not deem the NZD level to be appropriate because, on 25 September, Governor Graeme Wheeler addressed it in a speech. The speech,

entitled ‘New Zealand’s exchange rate: Why the Reserve Bank believes its level is unjustified and unsustainable’ (Wheeler, 2014), discussed the rationale for the claimed overvaluation of the NZD. It followed this with a discussion of why this was unjustified, hinting that intervention was a possibility: ‘Unjustified and unsustainable are important considerations in assessing whether exchange rate intervention is feasible’ (Wheeler, 2014). This speech was quite a significant event; no past governor had specifically addressed the exchange rate in a one-off speech. The strength and level of detail of the statement probably took the market by surprise. While it did not explicitly state that the RBNZ had already intervened, or whether it would again, it gave a strong indication to the market of its willingness to do so.

Below, the trend of the exchange rate is graphed with the timing of the MPS and the speech. The interventions appeared in the weeks before those two events. Before this period, the NZD exchange rate had already fallen from its high of over 0.88; hence, each of these intervention events occurred when the exchange rate was already declining.

Figure 1: The evolution of the NZD around the interventions



Source: RBNZ, Bloomberg.

3. Methodology

3.1 Synthetic control methodology

The methodology that we use in this paper was proposed by Abadie et al. (2010). The discussion below follows their paper. If $J + 1$ exchange rates exist and only one exchange rate is exposed to the treatment, the FX intervention, it leaves J exchange rates untreated and potential controls. Y_{it}^{N} represents the pretreatment exchange rate of currency i in period t for currencies $i = 1, \dots, J + 1$ and time $t = 1, \dots, T$. Similarly, Y_{it}^{I} represents any given exchange rate after the intervention. Supposing that the intervention occurred in country $i = 1$, Y_{1t}^{N} represents the NZD before the intervention. Assuming that there is no effect of the intervention prior to the event, then $Y_{it}^{I} = Y_{it}^{N}$ for $t < T_0$, T_0 being the intervention period. This presumes that no information is leaked to the market and there are no other events that may lead to speculation by traders before the intervention occurs. Abnormal moves in the exchange rate pre-intervention have been noted by some studies

(Dominguez, 2006; Sager & Taylor, 2004). After the intervention, in periods T_0 to T, the effect of the intervention can be estimated as $\alpha_{it} = Y_{it}^{I} - Y_{it}^{N}$. Next, Y_{it}^{N} is taken to follow a factor model given by:

$$Y_{it}^{N} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \quad (1)$$

δ_t is a time trend, θ_t is a vector of parameters, Z_i is the set of untreated currency pairs, λ_t is a vector of unknown parameters, μ_i is country fixed effects, and, finally, ε_{it} is a mean zero iid shock. This equation is just a generalised version of a difference-in-differences model. Should λ_t be constant for all t, it would be exactly the traditional model of difference-in-differences seen in many empirical studies.

We take a vector of weights $W = (w_2, \dots, w_{J+1})$, where $w_j \geq 0$ for $j = 2, \dots, J+1$ and $w_2 + \cdots + w_{j+1} = 1$. The assumption that the weights must be positive and sum to one prevents extrapolation. Each of these weights is applied to the basket of untreated currencies; hence, currencies $i = 2, \dots, J+1$. Collectively, the weighted average of these currencies forms the synthetic control. The weights are applied to the factor model:

$$\sum_{j=2}^{J+1} w_j Y_{jt} = \delta_t + \theta_t \sum_{j=2}^{J+1} w_j Z_i + \lambda_t \sum_{j=2}^{J+1} w_j \mu_i + \sum_{j=2}^{J+1} w_j \varepsilon_{it} \quad (2)$$

The method is implemented by estimating the weights through the minimisation of the mean squared prediction error (MSPE):

$$\sqrt{(X_1 - X_0\widehat{W})'V(X_1 - X_o\widehat{W})} \quad (3)$$

where X_1 represents a vector of the NZD exchange rate including any additional controls, such as the stock and bond indices' pre-treatment. Similarly, X_0 is identical except that it contains the data for the non-treated currencies. V is a symmetric and positive semi-definite matrix and is chosen to minimise the MPSE.

A strong synthetic control should have a low MSPE pre-intervention since it will match the actual currency movement closely. In a significant intervention event, the actual NZD should deviate from the synthetic control substantially; hence, the MSPE experiences a large increase in the following days.

Finally, once the weights have been estimated, they are assumed to be constant over time and used to estimate the NZD counterfactual after the intervention.

3.2 Estimation

The 'Synth' package in R is used to estimate the synthetic control. Two different dependent variables are used throughout the analysis, the quoted NZD spot rate and the daily returns from the exchange rate taken as a log difference of the NZD level series. For the methodology, the series should be stationary; for this reason, the exchange rate return results are more robust and the discussion predominantly focuses on these results. Optimisation of the synthetic control occurs over the 20 days prior to each event. While the choice of the control period is largely arbitrary, a robustness check demonstrates that the results are consistent using different length periods. As in Abadie et al. (2010), the mean of the synthetic control and the NZD are set to match in the first

and last observations of the control period. This creates the effect seen in the results graphs, in which the synthetic control and the actual NZD converge at the time of the intervention event. Stock and bond indices are included as additional controls to ensure that currencies that are structurally similar to the NZD are weighted more heavily.

3.3 Inference with synthetic control

This paper uses three ways to infer significance with the synthetic control, and these are based on Abadie et al. (2010). The first two are placebo studies and the third is essentially a different way to present the placebo results through an MSPE ratio.

The intuition of a placebo is that, if the intervention caused an effect, there should be nothing else that could have caused it. Hence, any effect seen should be unique to the NZD and at the time when the intervention occurred. If another currency or period is chosen at random, identified as treated, and the synthetic control is applied, no effect should be visible for these. Abadie et al. (2015) described two forms of these placebos: 'in-space placebos' and 'in-time placebos'. In-space placebos note that the treatment only occurs to the NZD, not to any of the controls. If the move in the NZD is driven by some common macroeconomic shock, other currencies will probably deviate from their synthetic controls too.

Plotting the gap from the synthetic controls of other currencies alongside the NZD helps to infer whether the intervention was the cause of an NZD move. Producing an in-space placebo plot involves performing the regular synthetic control iteratively for each of the 32 control currencies in total. The day of intervention is held constant, so it considers each currency as being treated on the same day as the NZD intervention occurs. The presentation of these graphs is improved by eliminating some of the placebos.[8] Cleaning up the plots makes them clearer, inferring any

[8] A placebo that deviates before the intervention cannot be a result of it. These placebos add no value to the inference of success and are removed. A systematic rule is used to remove the 'bad' placebos. The MSPE for each placebo is

significance of an intervention. The in-time placebos compare the NZD across treated and untreated periods. A treatment effect should not be seen in 'normal' times. By selecting a series of untreated days around the treated period, it creates a range of NZD moves that occurred naturally. These 'normal' moves provide a baseline for comparison with the three events studied. A significant actual or oral intervention should move the NZD substantially further than a typical day.

The MSPE ratio plot is the last means of inference. A successful intervention should cause the MSPE to spike from its low pre-intervention value. Conversely, an untreated control currency's MSPE should remain roughly constant throughout the period. The post-intervention MSPE is divided by the pre-intervention MSPE to create a ratio. The ratio is calculated for both the NZD and the control currencies in the placebo. A significant NZD intervention will show up as a ratio much greater than one and larger than the ratios of the placebos because of the post-intervention spike in the MSPE. The strength of the synthetic control rests on a stable relationship before the intervention but also the relationship holding post-intervention. The relationship between the NZD and the controls, however, is likely to break down as time passes. Hence, inference for a long time horizon should not be made since it is unreasonable to assume that the synthetic control will permanently represent the counterfactual of the NZD. For this reason, conclusions around the long-term performance of the intervention are difficult to make.

4. Results

This section discusses the empirical findings. The synthetic control method is applied to the actual intervention, the regular MPS release, and the speech independently, and the discussion of the results is separated into three parts.

calculated for the three days before the intervention. A 'good' placebo will have a small MSPE for this period. If the MSPE from a placebo is larger than the 99th percentile of the MSPEs produced from all the placebos, it is dropped.

4.1 Outputs

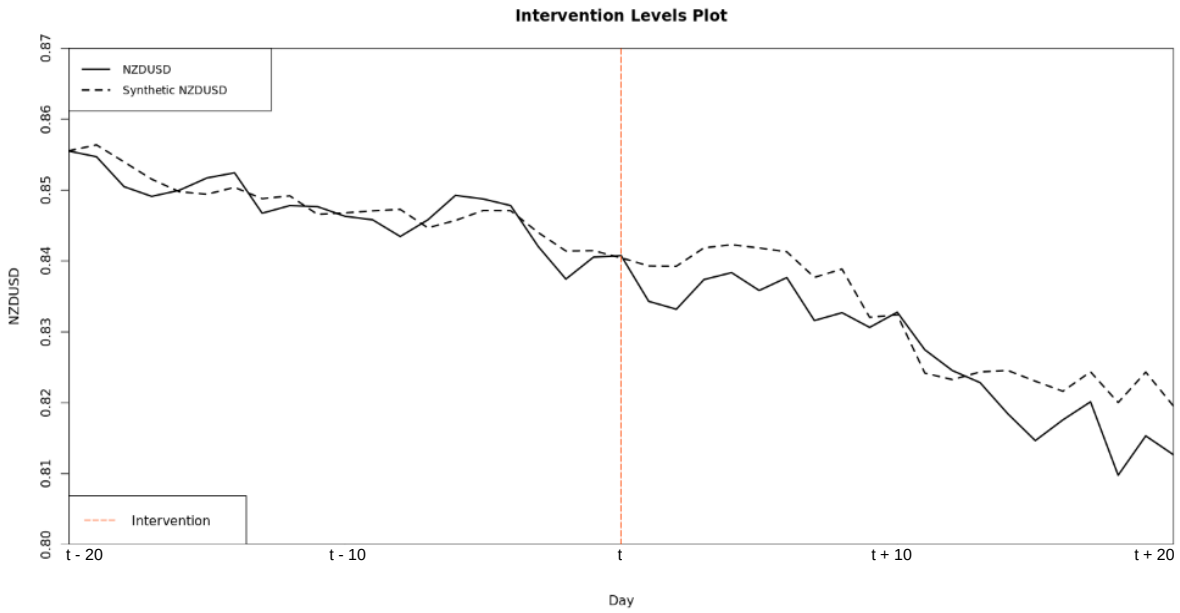
Two dependent variables are used in the synthetic control, the level of the NZD and its return. The results are shown in a series of three graphs. First, the levels plot graphs the actual NZD exchange rate as a series alongside the estimated synthetic control. This illustrates the prevailing trend in the exchange rate and shows how well the synthetic control fits before the intervention. The plot using the level series shows the impact of the intervention in NZD terms. The exchange rate returns data are used for the remaining results. To illustrate the ongoing impact of an intervention, the difference in daily returns between the actual NZD and the synthetic control is accumulated forward from the day of the intervention. This captures the unexpected compounded percentage change in the NZD attributable to the intervention. In the same way, the gaps are accumulated backwards from the intervention to confirm that there is no systematic deviation of the synthetic control away from the NZD pre-intervention. These results are shown in the intervention cumulative returns plots, and the process is also applied to the in-space placebos of the returns series.

For each in-space placebo graph, there is an associated MSPE ratio plot. The ratio is calculated for the first three days after the intervention to capture the strongest effect. A large ratio for the NZD both in absolute terms and relative to the other currency ratios shows a significant event. Additionally, there is one in-time placebo plot. In total, six placebo periods are stacked on a graph so that the real and placebo intervention dates line up, allowing the NZD after an intervention to be compared with the NZD on a ‘normal’ day. A successful intervention will produce an abnormally large move in the NZD. Significance is inferred if three criteria are met. The NZD must deviate from its expected path, this deviation must be abnormal, and it must be in the direction intended by the RBNZ.

4.2 Actual intervention

The actual intervention in August, when the RBNZ intervened by selling NZD and purchasing USD, is considered first. A comparison of the synthetic control with the NZD can be seen below:

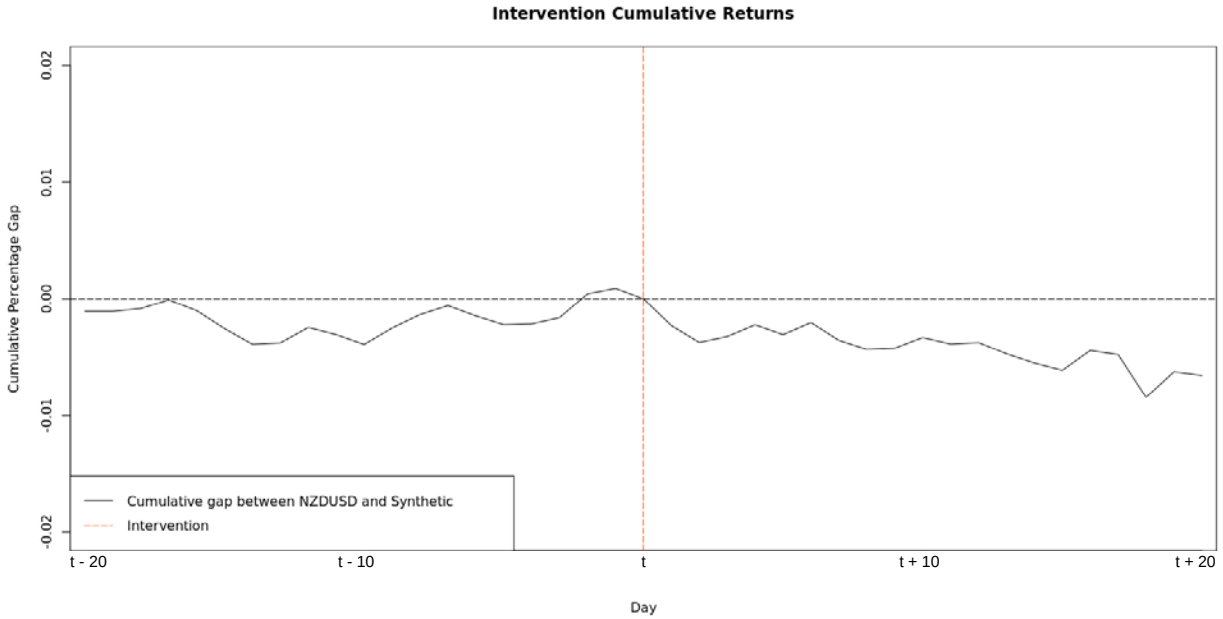
Figure 2: The evolution of NZD and synthetic NZD around the actual intervention



The vertical line indicates the timing of the first intervention, with the solid black line representing the NZD and the dashed line the synthetic control. The intervention occurred at a time when the NZD had begun to depreciate; hence, the RBNZ was intervening in the trend. There is a slight deviation away from the synthetic control at the time of the intervention.

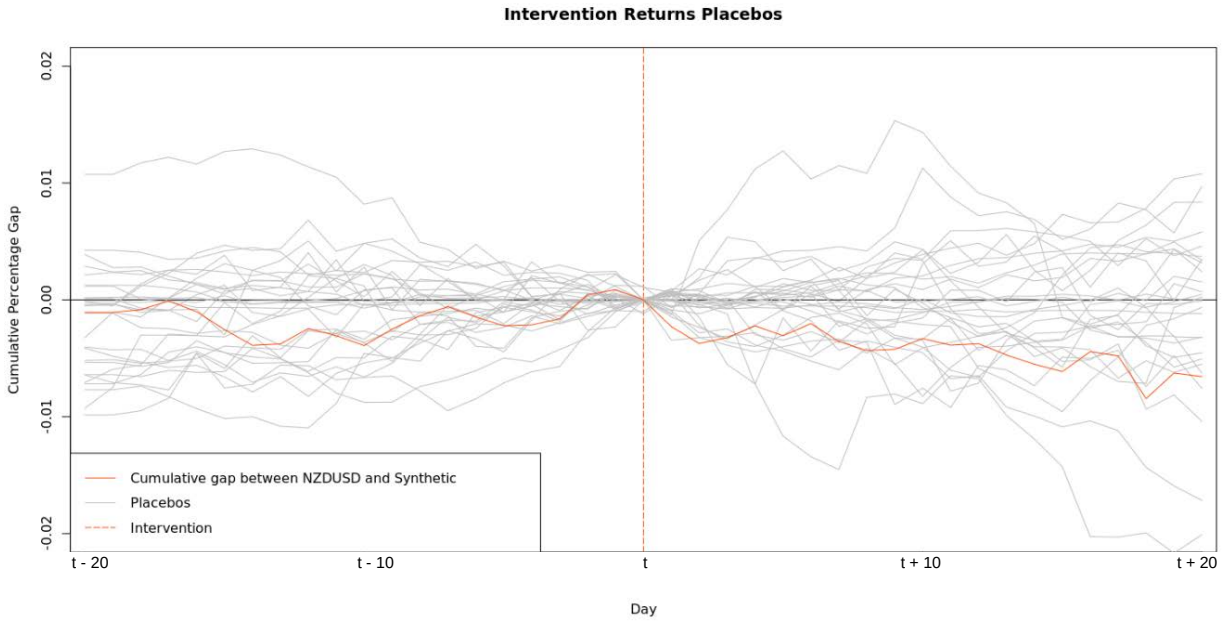
The remainder of the results for the first intervention uses the NZD returns as the dependent variable. The compounded percentage change in the NZD that was unexpected based on the synthetic control is expressed in the cumulative return gap graph below:

Figure 3: Cumulative gaps between NZD and synthetic NZD around the actual intervention



The black line plots the cumulative gaps between the synthetic and the actual NZD. A slightly persistent negative gap after the intervention shows that the NZD depreciated for a few days. While the gap is in the desired direction of the RBNZ, the magnitude is small at 0.35%. The in-space placebos also suggest that the effect is not unique.

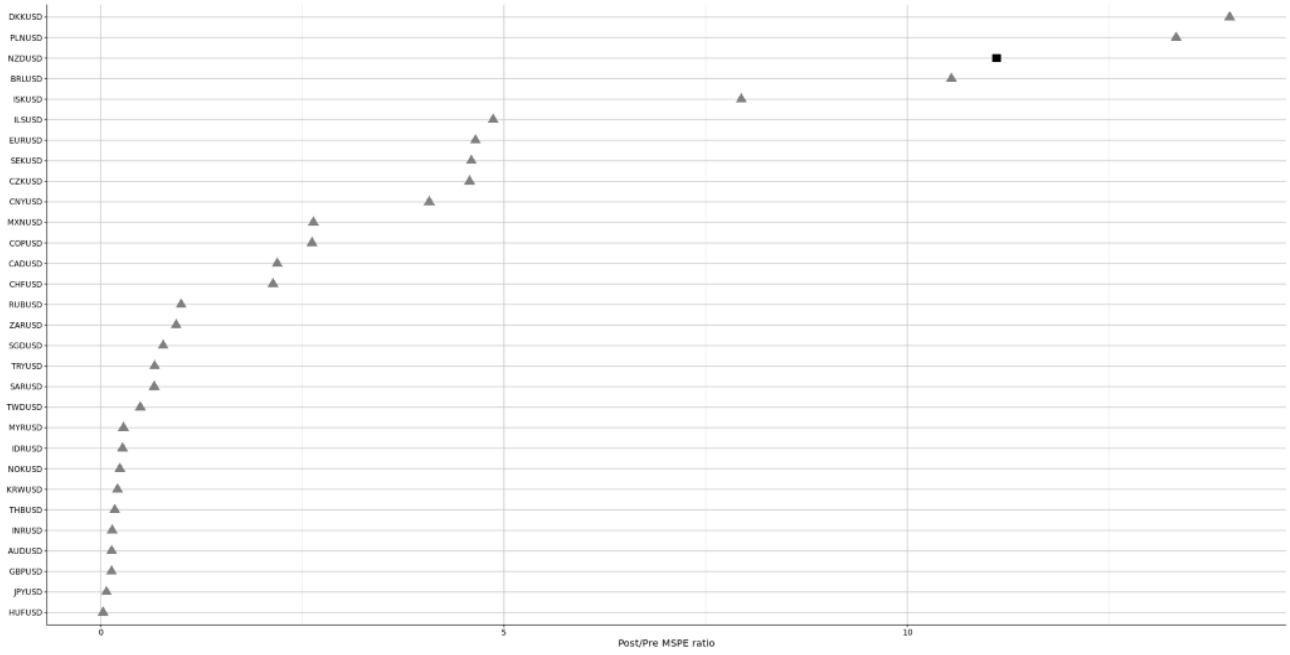
Figure 4: Placebo analysis for the actual intervention



The grey lines are the placebos created from the control currencies. The drop in the NZD away from the synthetic control, as represented by the coloured line, is larger than most controls but not exceptionally so.

The MSPE ratio plots demonstrate that, while the cumulative depreciation of the NZD is larger than that of many other currencies, it is hardly an outlier.

Figure 5: Comparing the MSPE for the actual intervention



In summary, the move of the NZD post-intervention is small in magnitude and not unlike the moves of other currencies that did not experience an intervention, suggesting that the actual intervention implemented by the RBNZ had at best a limited impact.

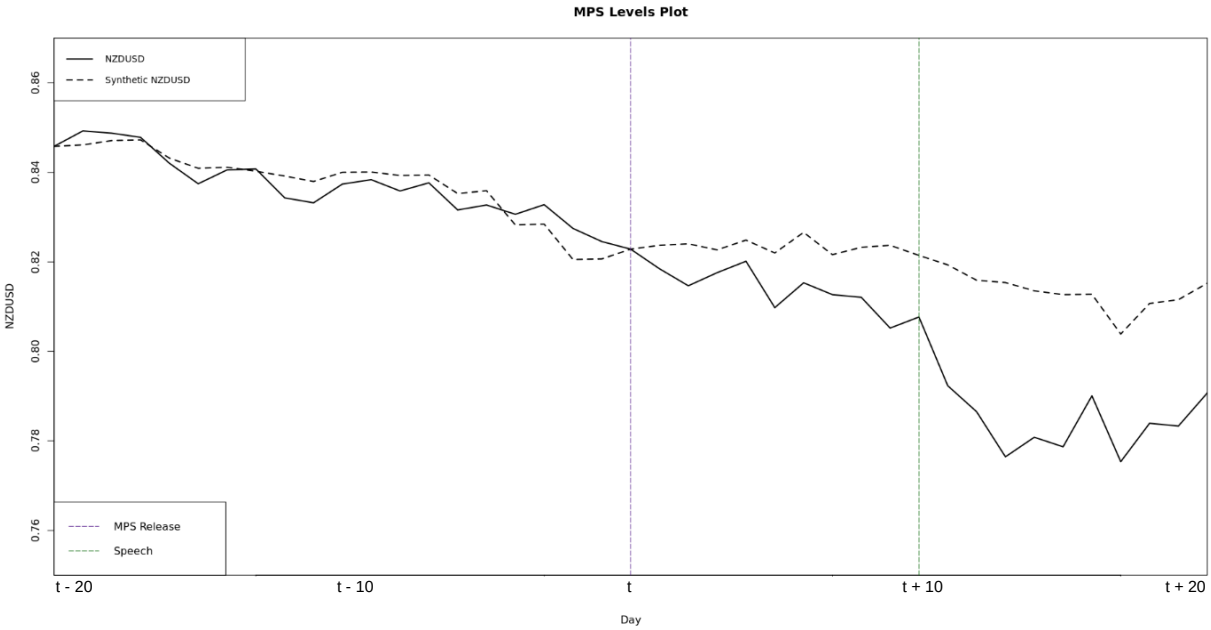
Two potential reasons mentioned in the literature could account for its failure. The first regards the size of the intervention. The initial $200m sold is about 0.2% of the international daily turnover of the NZD (Bank of International Settlements, 2019) and 0.1% of the GDP. Intervening during New Zealand's market hours, when many other markets are closed, would maximise the impact of the intervention, but even then it is likely to be small compared with the NZD turnover.

Secondly, the intervention was kept secret, mitigating the strength of the signalling channel. Despite the secrecy puzzle (why keep interventions secret if communication can increase their effectiveness) being well known (Kim & Le, 2010; Neely, 2001; Sarno & Taylor, 2001), the RBNZ has kept all its actual interventions secret except one. Credibility and surprise are two possible motivations for secrecy. If a central bank is concerned that an actual intervention will not work, keeping the intervention a secret will be less detrimental to its credibility. In the same vein, the intervention to depreciate the NZD was at the end of a tightening cycle of monetary policy. Publicly intervening in monetary policy may have eroded the RBNZ's credibility (as in Kim & Le, 2010). The surprise rationale, on the other hand, follows the noise trading channel (Hung, 1997). By intervening in secret, a central bank might hope that unexpected change in the currency will incentivise other traders to take similar positions and build momentum in that direction.

4.3 Oral intervention – MPS release

The second event considered is the MPS release. Here, the RBNZ moved from an actual intervention to an oral intervention. The effect from the statement that the NZD was overvalued is shown with the same series of graphs as before. The level of the NZD graphed against the synthetic control is given in **Figure 7**:

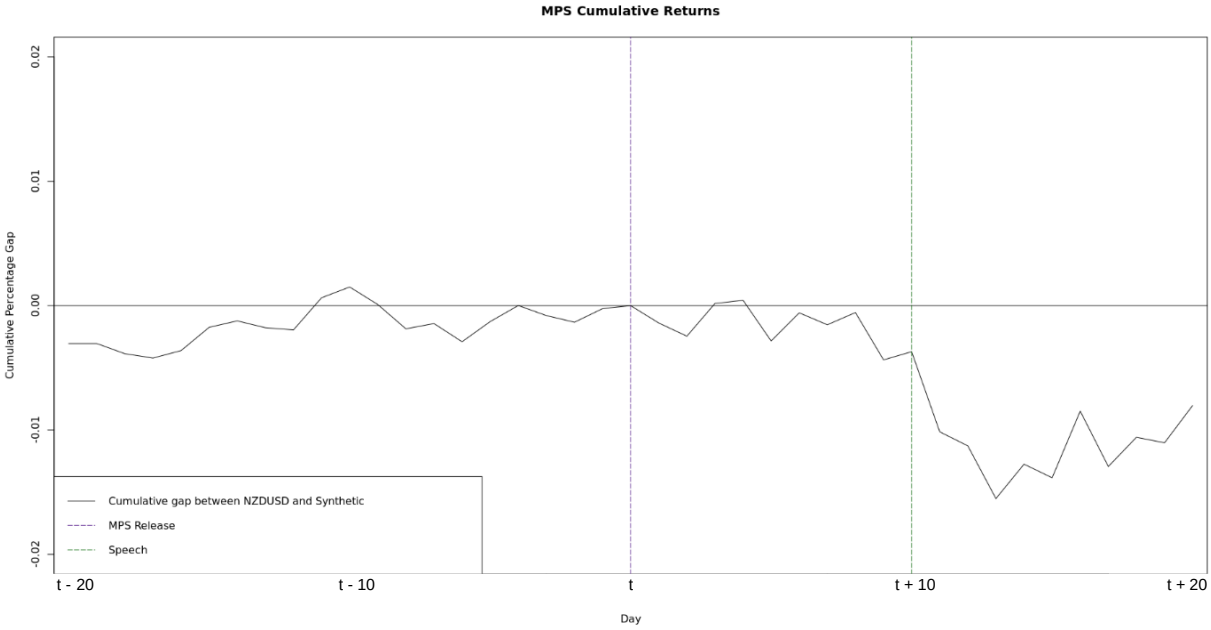
Figure 6: The evolution of the NZD and the synthetic NZD around the MPS



Before the intervention, there is no obvious systematic error in the synthetic control; it follows the NZD movements well. The gradual downward trend in the exchange rate seen around the actual intervention continues. Just like after the actual intervention, there is a small drop in the NZD following the MPS release. However, the gap in the subsequent two days is just short of 1 cent against the USD, so it is not large.

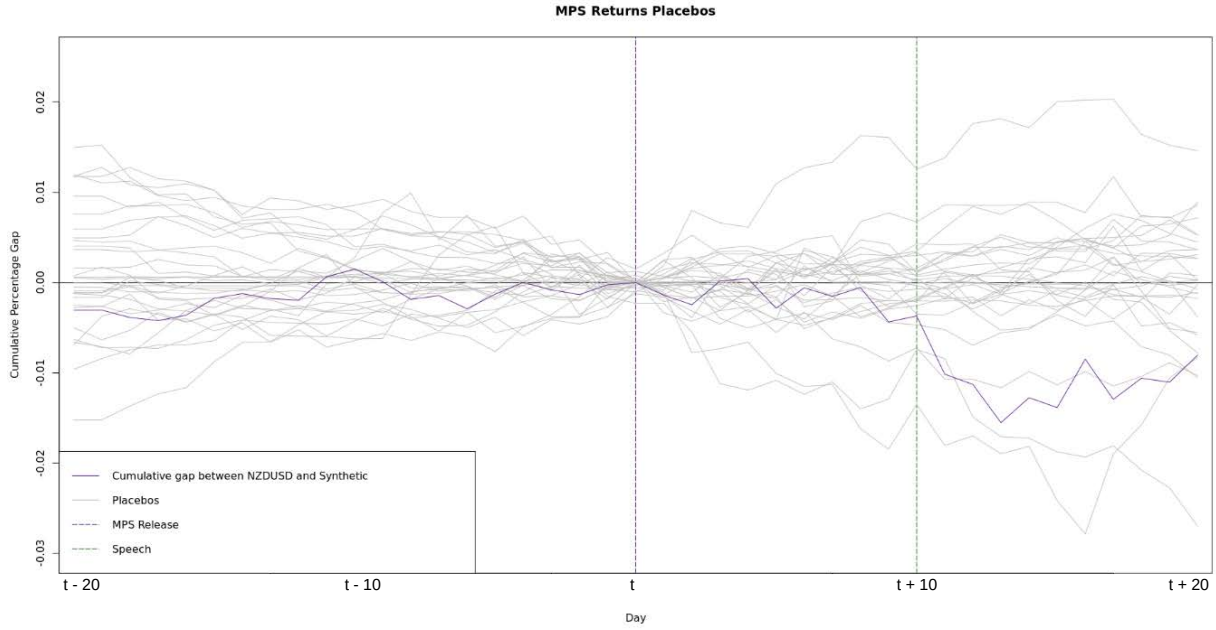
A substantial shock is visible a couple of weeks after the MPS, which coincides with the speech, suggesting that it could be an important event. The outputs from the synthetic control using exchange rate returns as the dependent variable corroborate the weak result indicated by the levels graph:

Figure 7: Cumulative gaps between NZD and synthetic NZD around the MPS



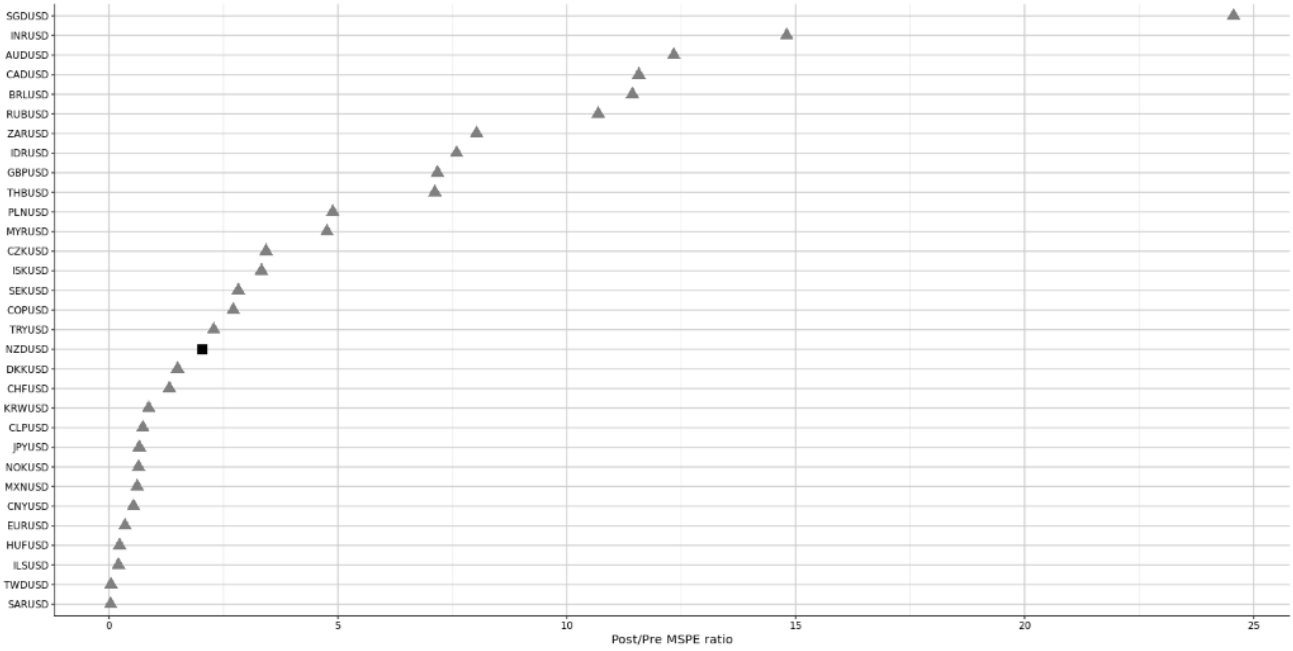
The noteworthy feature here is that, while there is slight depreciation of the NZD after the MPS release, the subsequent appreciation means that the compounded change in the NZD is around zero. The initial fall itself is almost non-existent, dropping 0.25%. The insignificant nature of the drop is further verified by the cumulative placebo plot:

Figure 8: Placebo analysis for the MPS



The coloured line once again represents the gap between the NZD and the estimated synthetic control. Relative to currencies that did not experience the oral intervention, the NZD dip is insignificant, indicating that the fall after the MPS could just be random.

Figure 9: Comparing the MSPE for the MPS



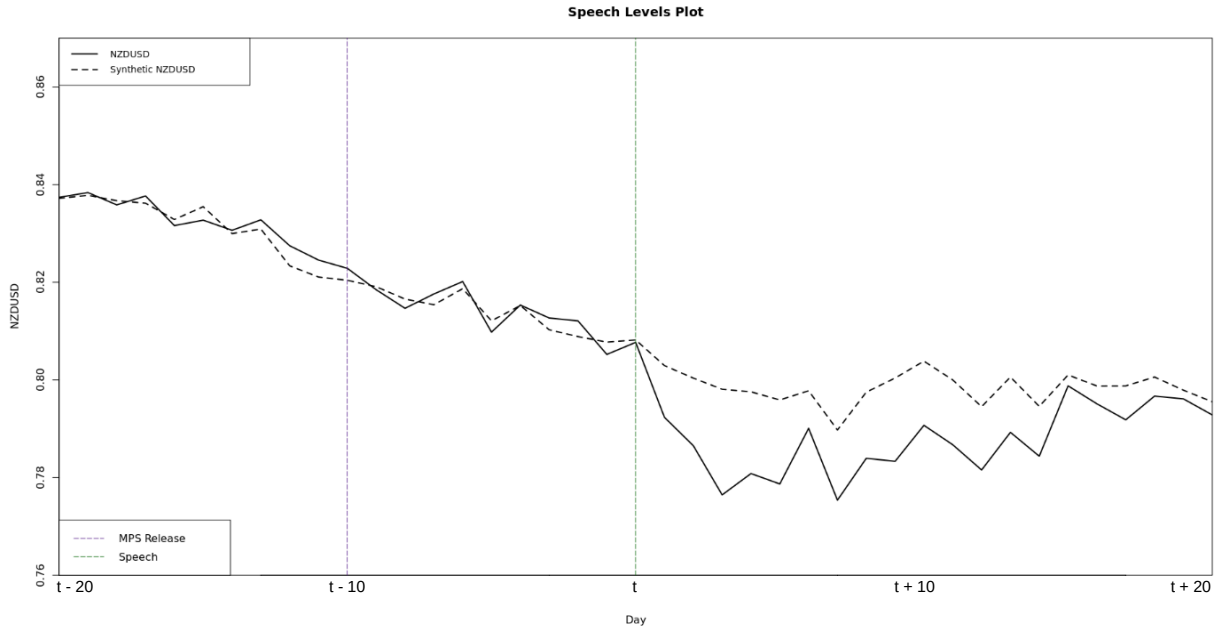
The evidence suggests that the MPS release did not have a material effect on the NZD exchange rate. Any depreciation during this period is just as likely to be a continuation of the NZD's downward trend that was present before the MPS release.

The insignificant effect of the MPS release cannot be explained with the same rationale as the speech since it could utilise the signalling channel. However, this channel requires the dissemination of new information. Repeating a statement that had been published in the previous seven OCR announcements did not add anything that the market otherwise did not know.

4.4 Oral intervention – speech

A sizeable negative deviation is visible in the MPS release graphs, coinciding with the speech by Graham Wheeler, giving some indication that it might be a significant event. The examination of this speech is outlined below. First is the levels plot:

Figure 10: The evolution of the NZD and the synthetic NZD around the speech

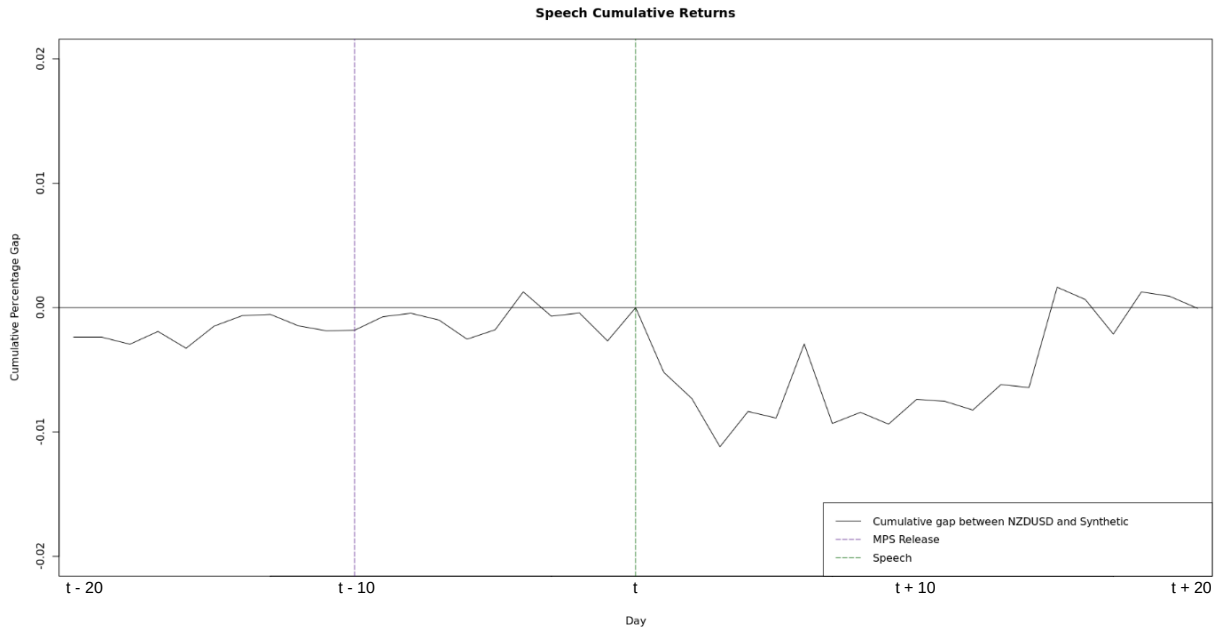


The synthetic control matches the NZD nicely and the drop in the NZD is noticeable after the intervention. It falls from 0.8077 to 0.7787, a change of about 0.03 NZD–USD in just three

days. However, since the NZD may have been depreciating anyway, it is the NZD's deviation from the synthetic control that is important.

Using the NZD returns as the dependent variable, the cumulative unexpected return still shows a sizeable impact from the speech:

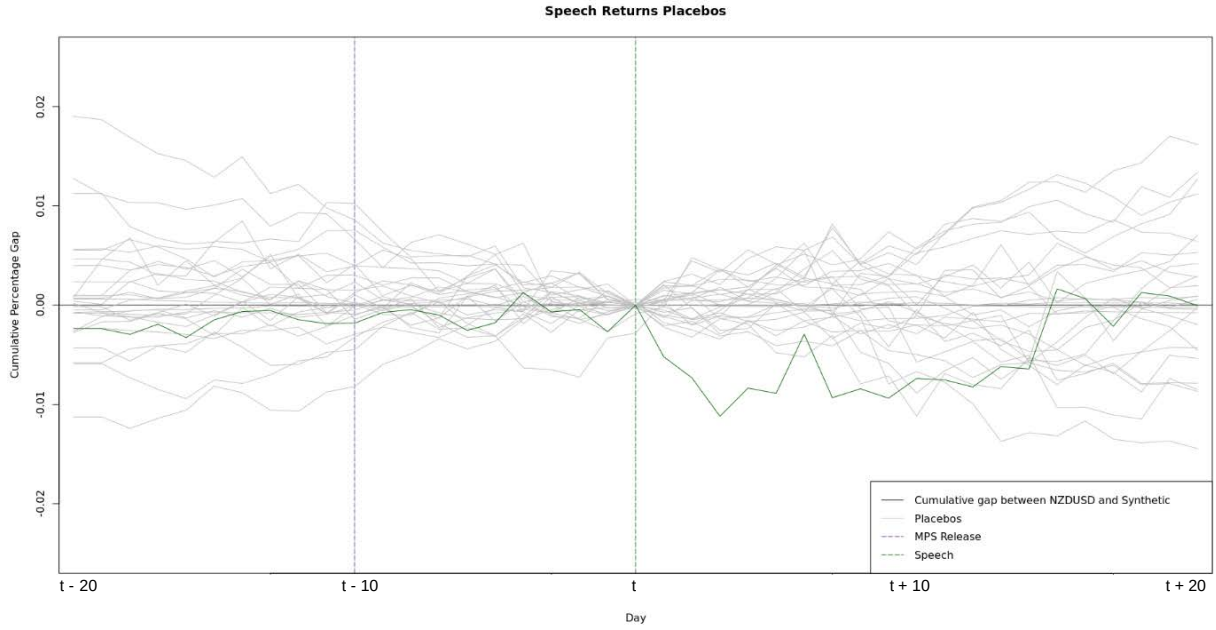
Figure 11: Cumulative gaps between NZD and synthetic NZD around the speech



In the space of three days, the cumulative fall in the NZD is 1.12%. The drop is over three times what was seen after the actual intervention or the MPS release, with drops of 0.35% and 0.25%, respectively. The gap is only somewhat persistent, lasting for two weeks after the speech before it closes towards zero again. The contemporaneous effect, however, is substantial compared with the actual intervention or the oral intervention in the MPS.

The initial drop is significant compared with the control currencies:

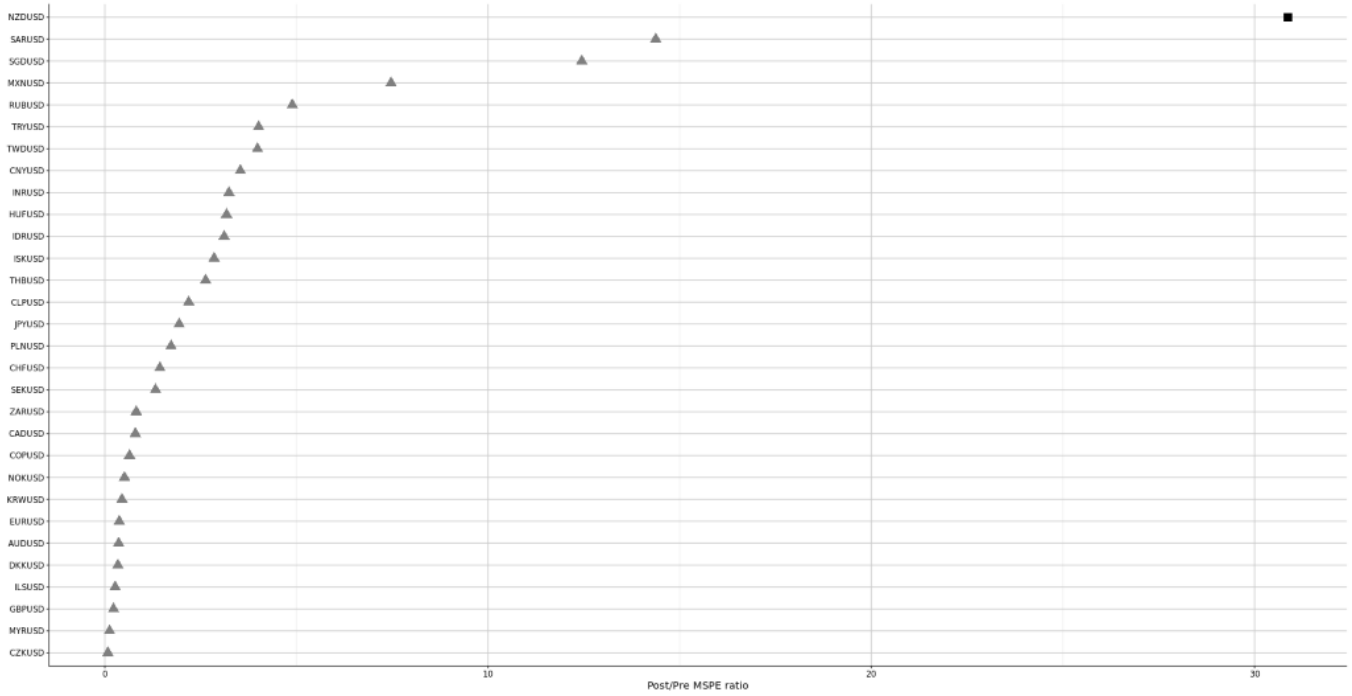
Figure 12: Placebo analysis for the speech



The size of the deviation away from the synthetic control plotted by the coloured line is immediately apparent. The main cluster of placebos has a random distribution after the speech. In contrast, there is a significant fall in the NZD. The size of the gap in the three days after the speech is substantially larger than the placebos, although, after a few days, it is back in the middle of the distribution of placebos.

The MSPE ratios show how extreme the initial NZD move was.

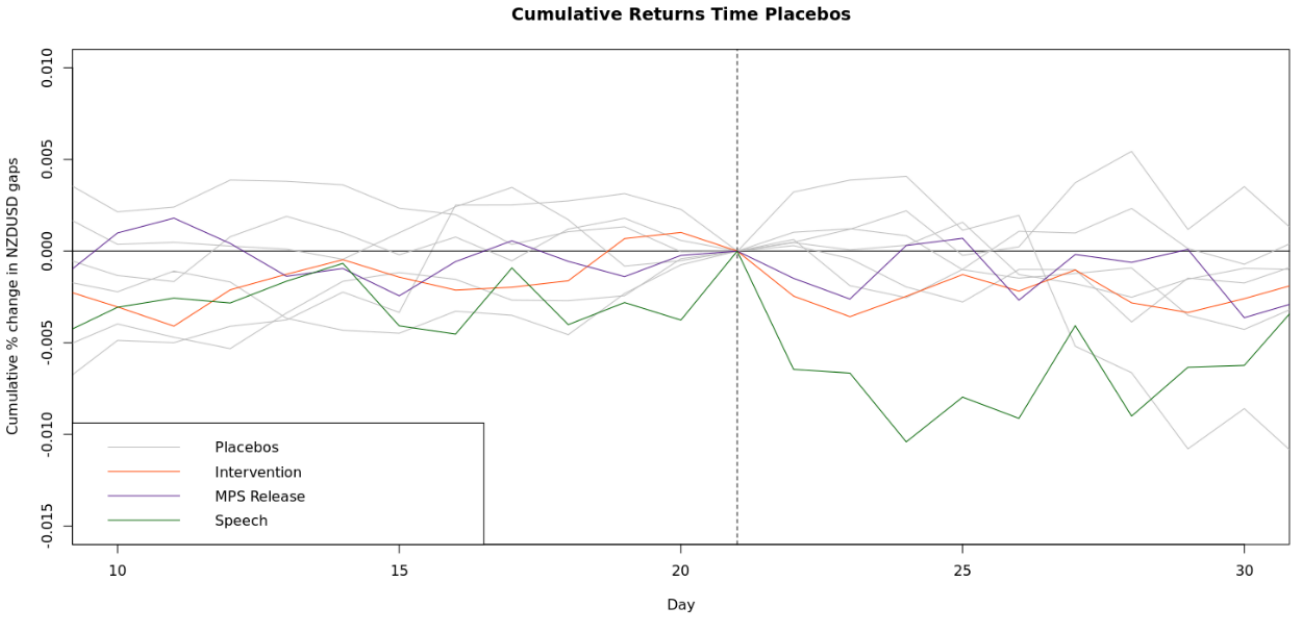
Figure 13 Comparing the MSPE for the speech



The size of the MSPE ratio for the speech is large itself and by far the largest of the currency pairs.

To solidify the significance of the speech effect beyond what has already been demonstrated, the in-time placebo of the returns data is plotted below. **Figure 15** plots six placebos with random days chosen to act as the treated day. This generates a comparison between the 'normal' days and the three coloured treated series plotted alongside them:

Figure 14: Comparing gaps across interventions



The first two events fall into a range similar to the usual pattern of the NZD. Conversely, the speech produces a much larger fall initially, well outside what could have been considered random.

The magnitude of the drop from the speech and its size relative to the control currencies, the MSPE ratios of the controls, and a normal NZD move make it a significant event. The speech differed from the prior interventions due to a few defining factors. Foremost is how unexpected the speech was. It was even kept secret within the RBNZ itself, and an RBNZ governor had never delivered a speech addressing the NZD historically. There are three plausible reasons for the unexpected nature of the speech being so successful. First, it probably widened the dissemination of information throughout the market. How widely publicised an intervention is can be a factor in its success (Jansen & de Haan, 2007). This speech received coverage from Bloomberg (Brockett, 2014), the Financial Times (Strauss, 2014), and the New Zealand media (Gray, 2014; Ruth, 2014). A statement being delivered outside an MPS would also have conveyed the RBNZ's concern about the NZD's overvaluation. If the RBNZ thought the overvaluation was serious enough to warrant a

one-off speech, the market would take more note. Lastly, the speech detailed the thinking of the RBNZ around why this was true, providing new information to the market. The success of an unexpected communication moving the exchange rate is in line with the research by Karagedikli and Siklos (2008), which showed a similar result from unexpected OCR changes.

A noticeable element of the speech is that its effect was short lived. There are four potential explanations for the effect. The first is that the market overreacted and took time to correct itself. This phenomenon has been observed in both the stock (Ma et al., 2005) and the FX market (Li et al., 2015; Manzan & Westerhoff, 2005). Nevertheless, given how far away from the fundamental value the NZD was according to the RBNZ, it seems difficult to consider a 1.12% drop in the NZD as an overreaction. Another possibility mentioned by Jansen and de Haan (2005, 2007) is that, as time passes, traders begin to make conflicting interpretations of the signal made. After the intervention, New Zealand traders may have begun to interpret the speech in differing ways, driving the NZD from the path intended by the RBNZ. The exchange rate is also constantly adjusting to new information entering the market. A two-week period after the intervention provides opportunities for other events to occur and reverse the trend in the NZD. Although the post-intervention period was checked to be free of reported political or macroeconomic events, only major events typically receive coverage. Finally, the synthetic control is only robust as long as the relationship between the NZD and the control currencies holds. It is difficult to determine whether the intervention deteriorated this relationship. If the relationship broke down, the gap from the synthetic control would no longer be representative of the intervention's effect, meaning that the synthetic control cannot be used to comment on the effect of an intervention beyond the short-run effect.

Throughout the discussion of the results, the classification of an intervention as successful depended on an abnormal move of the NZD in the direction that we assumed the RBNZ intended.

This definition of success does not necessarily line up with the RBNZ's real goals. While the intervention through the speech was effective, inducing the NZD to fall a little over 1%, the Monetary Policy Statements subsequent to September's continued to comment on the NZD's current level being unjustified and unsustainable (RBNZ, 2014g, 2015a). If the RBNZ indeed wanted to talk down the NZD after the speech, it might not have deemed the speech enough.

A key result then is that the FX interventions examined, whether actual or oral, were unsuccessful or only partially successful for the RBNZ in terms of its policy. Conversely, Karagedikli and Siklos (2008) showed how the monetary policy in New Zealand could permanently affect the exchange rate. If interest rates are potentially more effective than FX interventions as a tool to move the exchange rate, then the RBNZ may want to consider this when choosing its policy tools. The disadvantage of interest rate changes is that, unlike the narrower impact of an intervention, an interest rate change has large spillover effects on the broader economy. Therefore, central banks might face a trade-off between a tool with a narrow focus that will potentially fail and achieving success but with an impact beyond the exchange rate.[9]

The dataset and methodology, as mentioned, mean these results must only be interpreted in terms of New Zealand and short-run effects. There are some clear limitations in trying to extend these results. Only three intervention events were studied, making it challenging to generalise the conclusions to RBNZ interventions as a broader monetary policy tool. The interventions examined were attempts to depreciate the NZD, and there may be an asymmetric response if the RBNZ tries to appreciate the NZD. Furthermore, using speeches in the future as an oral intervention may not elicit the same response since some of the reaction this time was probably linked to how

[9] Two robustness checks were used to check the consistency of these results. The 20-day control period was lengthened to 30 days to verify that the shorter control was sufficient, and the speech remained the only significant event. An AR(1) model was used as an alternative to forecast a counterfactual during each of the three events. Just as with the synthetic control method, the effect of the speech was the most apparent.

unexpected it was. Finally, this analysis treated the three events as independent. It is not improbable that these events were dependent on each other, and the escalation across the three could have prompted the market to react. Although these are perceivable limitations, they relate more to the extension of the results rather than the accuracy of the results themselves.

5. Conclusion

As many world economies approach the zero lower bound of interest rates, alternative policy tools become more important. FX interventions are one tool to which central banks are giving more thought. The literature, however, is divided on the effectiveness of actual and oral interventions. This paper contributes to that debate by studying three interventions that were implemented by the RBNZ, using confidential RBNZ data and a methodology that has not been widely used in the FX intervention literature.

Our analysis leads to four main findings. The first is that actual interventions seem to be ineffective in New Zealand. The move in the NZD was less than 0.4% and within the range of usual moves of the NZD and the control currencies during this period. There are two plausible reasons for this failure. The actual intervention size was very small, accounting for about 0.2% of the typical NZD daily turnover or about 0.1% of the GDP, and the actual intervention was implemented in 'secret'. A secret intervention cannot work through the 'signalling channel' since it cannot provide the market with new information (Beine & Lecourt, 2004). Our analysis thus provides further evidence that keeping interventions a secret might reduce the chance of success for central banks. This is in line with many existing papers on secret interventions.

Second, 'expected' oral intervention also seems to be ineffective. The MPS statement around the NZD overvaluation had been published consistently for nearly a year. Hence, markets must have expected the sentiment to be reiterated in the MPS as the NZD had not otherwise depreciated. If oral interventions are to work through the 'signalling channel', they must provide new

information for the market to incorporate. This could explain the failure of the MPS to move the NZD.

Our key result is that 'unexpected' oral intervention can succeed in moving the NZD, as RBNZ Governor Wheeler's speech was followed by a fall in the NZD of over 3 cents, amounting to an unexpected change of 1.12%. The source of its success is likely to be threefold. The reach of the speech was much greater because it was unexpected by the market. This broadened the coverage that it received. Second, the fact that the RBNZ was worried enough about the NZD overvaluation to give a one-off speech probably meant that the market had a stronger reaction. Lastly, the speech conveyed the RBNZ's reasoning behind its belief that the NZD was overvalued. All of this introduced a huge amount of 'new' information to the market.

Finally, the last result of this paper is related to the use of FX interventions as a policy tool for the RBNZ. The speech might have moved the NZD beyond what could have been random, but it was only just over a 1% fall. Furthermore, the NZD had reverted to its pre-speech level within two weeks of the intervention. Subsequent MPS releases until June 2015 continued to assert that the NZD was overvalued. While the speech was effective in the sense that it moved the NZD, the outcome was not permanent, achieving a lasting devaluation of the NZD, leading the RBNZ to continue to comment on the NZD's overvaluation. The FX intervention studied here thus proved to be a weak instrument to affect the exchange rate. In contrast, Karagedikli and Siklos (2008) showed that unexpected monetary policy changes could exert a more permanent effect on the NZD. This suggests that interest rate changes might be a more effective policy tool than FX interventions and highlights a possible trade-off. Central banks are potentially faced with a decision between failing to move the exchange rate with FX interventions or succeeding in altering it but also affecting the rest of the economy by using monetary policy.

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