The Effects of Monetary Policy Shocks on New Zealand's Exchange Rate

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Abstract

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This thesis examines the impact of monetary policy shock on the exchange rate in New Zealand. Monetary policy shock is the unexpected change in monetary policy that is determined by the Reserve Bank of New Zealand (RBNZ). Since March 1999, RBNZ has adopted Official Cash Rate (OCR) to be the monetary policy instrument. An increasing on OCR indicates monetary policy contraction from RBNZ. The empirical analyses are conducted using the models due to Zettelmeyer (2004) and Kearns & Manners (2006) that can be estimated by OLS. Monetary policy shocks are identified by the reactions of both 30-day and 90-day interest rates to OCR announcements. The sample period is from 1999 through 2010. The result indicates that there is no exchange rate puzzle in New Zealand. In addition, the monetary policy shocks have no significant impact on New Zealand's exchange rate.

Key words: Monetary Policy Shocks, Exchange Rate Puzzle, OCR, OLS.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Introduction

New Zealand is a small, open economy with a significant tradable sector. Consequently, fluctuations in the exchange rate can have large macroeconomic impacts. The exchange rate in this thesis refers to the amount of foreign currency that is required to purchase one unit of domestic currency. For example, if the current exchange rate between New Zealand Dollar (NZD) and United State Dollar (USD) is listed as 0.7124, this means that 71 cents of USD are needed to exchange for one NZD.

Figure 1 shows New Zealand's exchange rate with the United States Dollar in nominal terms (that is, not adjusting for inflation differences between the two countries) between 1990 and 2010. This shows that the exchange rate can fluctuate over a wide range. The most notable period is from 2004 to 2008, during which the exchange rate stayed relative high, hovering between 0.6 and 0.83, compared with the preceding 5-year period when it had stayed below 0.5. During periods of high exchange rates, exporters and manufacturers competing against imports often complain that the Reserve Bank's monetary policy is unnecessarily contributing to the high value.

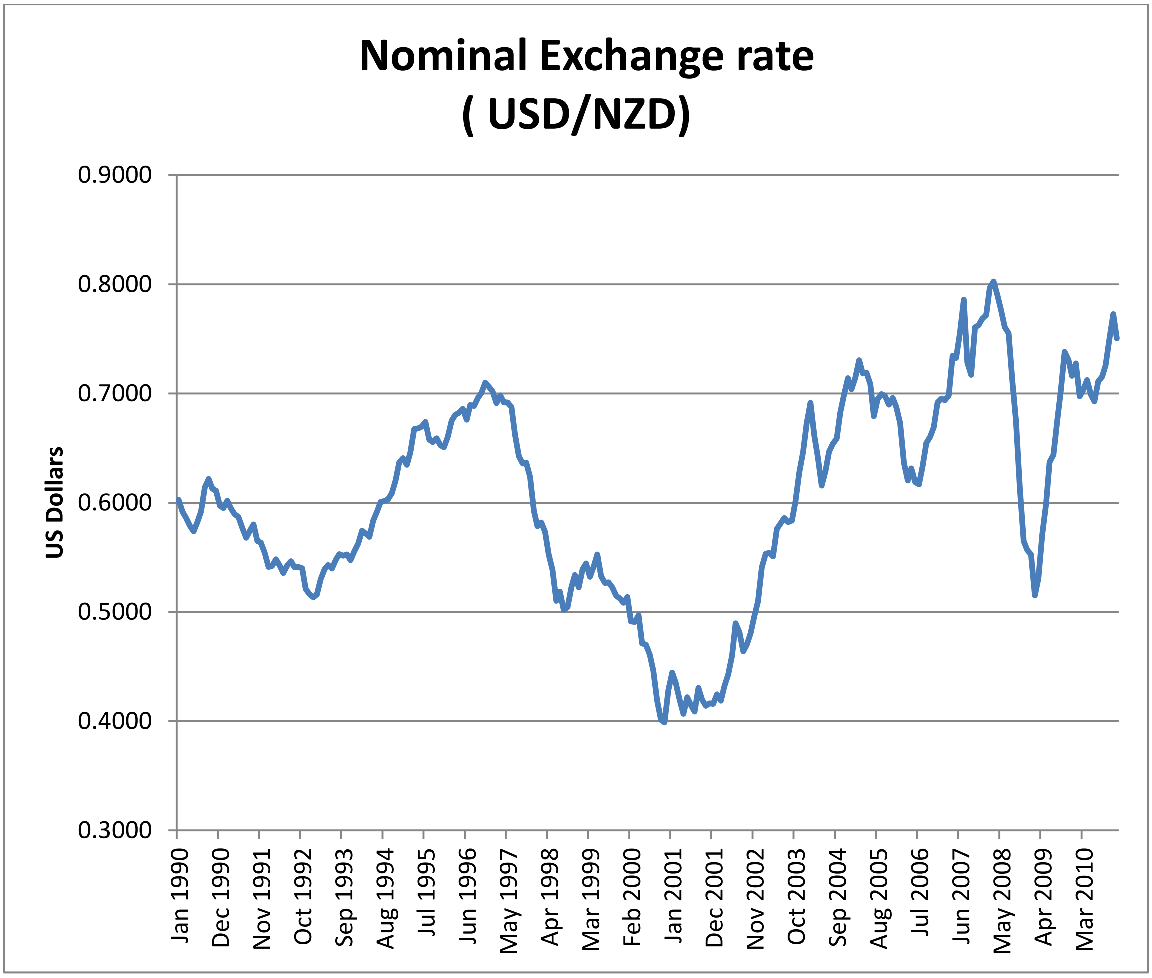

Figure 1: The New Zealand Nominal Exchange Rate, 1990-2010

This thesis will explain the impact of monetary policy shocks on the New Zealand exchange rate. It focuses on a particular question; sometimes termed the exchange rate puzzle. An exchange rate puzzle is said to exist while increased money supply causes a domestic currency to appreciate. Sims (1992) found conflicting results regarding monetary policy shocks and exchange rates. Although applying the same methodology, his results indicated the existence of exchange rate puzzles in both France and Germany, while there was no evidence of an exchange rate puzzle in Japan, United Kingdom, and the USA. The possible existence of exchange rate puzzles has made the effect of monetary policy shocks on exchange rates ambiguous and intriguing. Eichenbaum and

Evans (1995), Cushman and Zha (1997), Bonser-Neal, Roley, and Gordon (1998), and Kim and Roubini (2000), among others, have also examined the relationship between monetary policy shocks and exchange rate movements in different countries, applying different methodologies. This thesis will therefore study the effects of monetary policy shocks on the New Zealand exchange rate and test whether an exchange rate puzzle exists in New Zealand. The rest of this chapter will provide some context for this study, introduce the study's major research questions, and outline the structure of the thesis.

Among the existing literature, the effects of monetary policy shocks on exchange rate have been varied. The results are even conflicting in some cases. In general, there are two possible directions that the effects could be in: one as predicted by the standard theory and the other the opposite, namely, a puzzle. According to standard theory, monetary expansion will increase money supply to the market. The expansionary monetary policy is normally implemented by increasing the base money, reducing the central bank's interest rate or raising the level of non-borrowed reserves. As money supply increases, the exchange rate with other currencies should decrease: as supply increases, price reduces. However, the real world has no shortage of evidence pointing to the existence of a contrary. For example, the existence of exchange rate puzzles.

While there are many studies on the effect of monetary policy shocks on exchange rate, the effects have been found to vary from country to country and from time to time. The results also seem to depend on the methodology used. Research on whether the exchange rate puzzle exists in New Zealand has received very limited attention since New Zealand adopted the Official Cash Rate (OCR) as the new monetary policy instrument in March 1999. According to Mabin (2010), New Zealand exchange rate fluctuations have been significantly influenced by the expected return on New Zealand dollar, and the interest rate is one of the most important factors that directly control the return on holding New Zealand dollars in the banks. Thus a close relationship is expected between the market interest rates and the exchange rates in New Zealand. Adjustments to the OCR can lead to changes in retail interest rates and so affect the New Zealand exchange rate. This thesis will focus on the immediate effects of monetary policy shocks on exchange rates in New Zealand during the past decade. The immediateness aims to exclude or minimise other factors that are also likely to affect the exchange rate.

1.2 Background

New Zealand is a developed country with a small open economy. According to Evans *et al*. (1996), the economic reforms from 1984 to 1996 have had a significant influence on New Zealand's current economy. The reforms included a series of changes in the taxation system, the labour market, trade liberalization, monetary policy, and fiscal policy. Through these changes, New Zealand now has an enhanced business environment and a deregulated open market economy. With its small open market economy and floating exchange rate system, the exchange rate can have a large impact on New Zealand's economy and international trade. At the same time, it is important for the monetary authorities to control inflation within a desired range to maintain stable economic growth. To focus on the effects of monetary policy shocks on the exchange rate in New Zealand, it is therefore important to clarify these three sectors first: The Reserve Bank of New Zealand, the Official Cash Rate and the exchange rate.

1.2.1 The Reserve Bank, Official Cash Rate, and Exchange Rate

The Reserve Bank of New Zealand (RBNZ) is the central bank of New Zealand, established in 1934and completely owned by New Zealand government since 1936. Since the major reforms in 1989, the primary responsibility of the RBNZ is to implement monetary policy to maintain the stability of the general price level. Other major functions of the RBNZ include supporting a healthy financial system, monitoring and regulating the commercial banks, and supplying New Zealand currency to the public. Monetary policy is the key instrument by which the RBNZ maintains a stable price level. Currently, New Zealand's monetary policy is aimed at maintaining an inflation rate in the consumer price index of 1% to 3%, on average, during the medium term. This is required by the Policy Targets Agreement (PTA) to define their standard of price stability, which has to be approved by both the Minister of Finance and the Governor of the RBNZ (Reserve Bank of New Zealand website, 2010).

Since March 1999, the Official Cash Rate (OCR) has been the instrument by which RBNZ implements its monetary policy. In general, RBNZ reviews the OCR eight times each year, and makes adjustments respectively. To move against inflation, contractionary monetary policy can be applied by increasing the OCR which feeds through to higher retail interest rates, thus increasing saving and reducing spending. Consequently, demand will decrease and the inflationary pressure will be expected to drop. On the other hand, under expansionary monetary policy the RBNZ will reduce the OCR to increase spending and reduce saving, commonly used during recessionary periods with no inflationary pressure. The increase on demand will encourage economic activity, but may also generate inflationary pressure if the demand is pushed beyond the economy's supply-side capacity.

It is generally accepted that a change in monetary policy also affects the exchange rate. A tight monetary policy is accompanied by a high base interest rate. A higher interest rate indicates a higher return on domestic assets than foreign assets, which attracts investors and increases the demand for domestic currency. As demand increases, the value of the domestic currency increases as well, hence, the exchange rate should increase in response to a tight monetary policy. Conversely, the exchange rate will reduce if an expansionary monetary policy is implemented.

1.2.2 Global Financial Crisis

The current global financial crisis started in 2007 due to the burst of the housing bubble in America; when many financial institutions were bankrupted or bailed out by their government. There is general agreement that deregulation in the United States lending system, supported by the US government, a policy of low interest rates, and speculation in the housing market were major contributors to this bubble. It has been described as the worst financial crisis since the 1930s' Great Depression, and like the Great Depression, has a large impact on the global economy. According to the RBNZ, the New Zealand economy has been affected by the crisis since June 2008, while diffidence about investment and declines in exports have also damaged the New Zealand economy.

In order to maintain a stable economy, RBNZ lowered the OCR and has kept it at a low level. This can be seen in Figure 2, which shows the movements of the New Zealand OCR since the 17th of March 1999. According to the *Monetary Policy Statement* of June 2008, the economy at that time was weak but with high inflation in energy and food products. The international credit crisis would slow down New Zealand's economic growth and weaker domestic economic activities could reduce New Zealand's GDP in

2008,hence the RBNZ decided to reduce the OCR from 8.25 percent to 8.0 percent on the 24th of July 2008, which was the first OCR cut in five years. In September 2008, the RBNZ reduced the OCR further down to 7.5 percent as, with the problems of higher cost and lower demand, the RBNZ was expecting weaker business activities in the future.

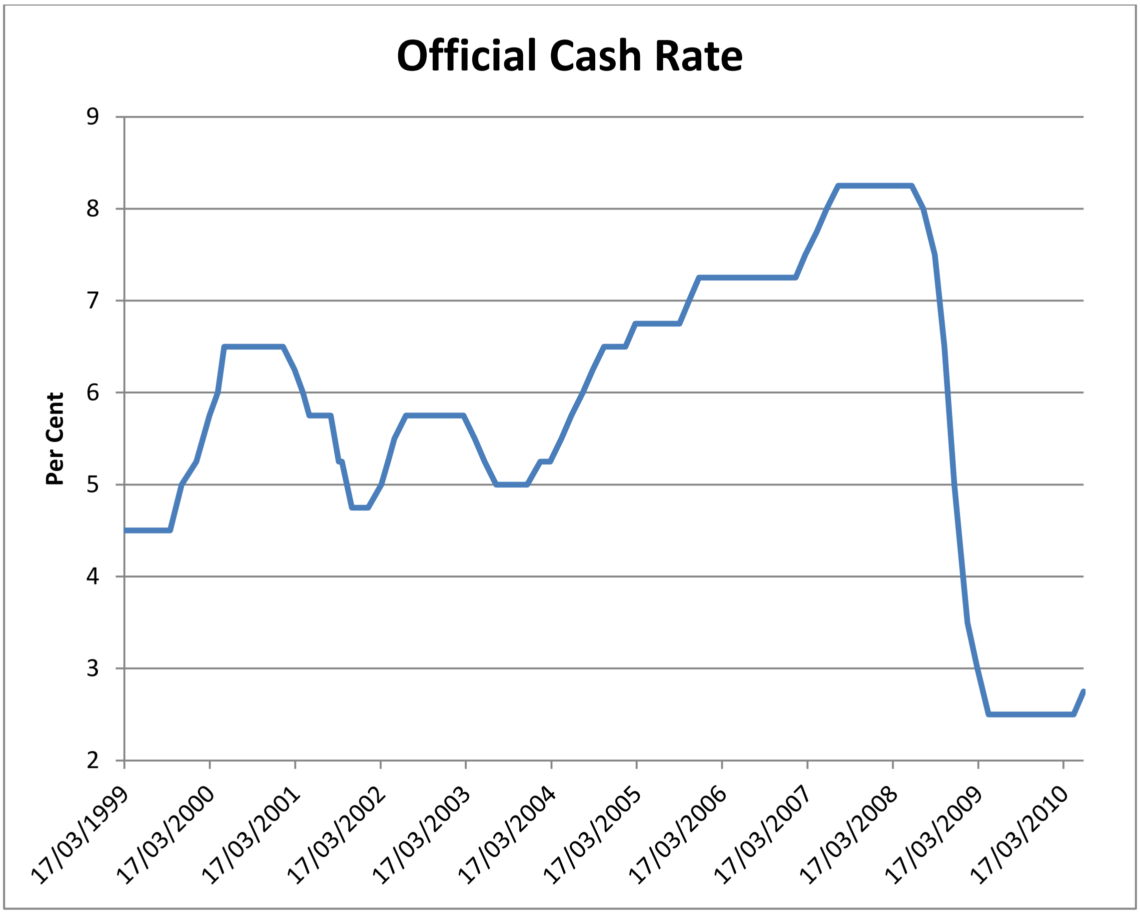

Figure 2: The Official Cash Rate in New Zealand, 1999-2010

By December 2008, the OCR had been reduced to 5.0 percent and by March 2009, to 3.0 percent. Thus, from June 2008 to March 2009, New Zealand's OCR had been reduced from a high of 8.25 percent down to only 3.0 percent. In other words, over a space of nine months, RBNZ had reduced the OCR by 525 basis points in total. This dramatic reduction clearly indicated that the RBNZ was implementing an expansionary monetary policy in order to avoid significant economic harm from the impacts of the global financial crisis.

The damaged international financial markets reduced total demand and economic activities all around the world, and any decrease in world demand has the potential to harm New Zealand's export sector. A reduction in export revenue directly slowed New Zealand's GDP and domestic economy, so, in order to boost the economy, the RBNZ directly employed expansionary monetary policy to depreciate the New Zealand currency. This expansionary policy should have reduced the exchange rate and boosted the domestic economy. However, the result has not been achieved, partly due to the sheer scale of the financial tsunami. This particular background has added to the significance of the thesis in that one can examine the effect of monetary policy shocks on the exchange rate with and without the presence of the global financial crisis.

1.3 Current Issues and Research Questions

Obben et al. (2006) pointed out that the New Zealand export sectors have been hurt by the high exchange rate. In addition, Cline and Williamson (2010) also noted that the New Zealand exchange rate is very high and the New Zealand dollar is overvalued. Based on these findings, some New Zealand exporters are complaining that the monetary policy, despite the sharp fall in the OCR, is still keeping the exchange rate too high and the RBNZ should lower it quickly. Others are arguing that the RBNZ should not shoulder all the responsibility, since other economic and financial factors may also be at play. This debate provides the main context for this thesis, which focuses on the immediate effects of monetary policy shocks on the exchange rate in New Zealand. In order to address this problem, there are three research questions to be answered.

1. Does the exchange rate puzzle exist in the New Zealand market?

According to Zettelmeyer (2004), Kearns and Manners (2006), and Karim *et al*. (2007), there is no evidence of an exchange rate puzzle in New Zealand. In general, a contraction in monetary policy will raise the value of New Zealand's currency, while, conversely, an expansion of monetary policy will depreciate the value of the New Zealand dollar. Based on this, standard theory, RBNZ should be able to reduce the exchange rate by implementing expansionary monetary policy. However, Wilkinson et al. (2001) noted that the fluctuation of New Zealand's exchange rate does not consistently follow the theory, and their results suggested that a tightening of monetary policy could reduce the value of New Zealand currency. This conclusion contradicts those of the other authors mentioned above, indicating that the exchange rate puzzle does exist in New Zealand.

Given this conflict, changing monetary policy in one direction could have two opposite impacts on exchange rate movements, based on previous evidence in New Zealand. A positive monetary policy shock could lead the exchange rate to increase, which shows no evidence of an exchange rate puzzle, or it could cause the New Zealand dollar to depreciate, which lends support to the exchange rate puzzle theory. Knowledge of whether the exchange rate puzzle exists in New Zealand is therefore essential to the study of the effect of monetary policy shocks on the New Zealand exchange rates; hence, the first objective is to find out whether an exchange rate puzzle exists in New Zealand.

2. How much could RBNZ immediately influence the exchange rate through monetary policy?

In order to examine the effects of monetary policy shocks on the exchange rate, it is also important to find out how much and how quickly the RBNZ could influence the exchange rate through changes in its monetary policy instrument. In New Zealand, the RBNZ has the independent authority to regulate monetary policy through OCR announcements, and has a responsibility to maintain a stable inflation rate, within a certain range, when applying the policy. It is also important for RBNZ to monitor and maintain a sound and efficient financial system in New Zealand. International trade is crucial to New Zealand's economic development and financial system, and, since there is a close relationship between international trade and the exchange rate, fluctuations in the exchange rate have a significant influence on New Zealand's economy. Therefore, the second objective is to find out how much the RBNZ could immediately influence the exchange rate through monetary policy. The result could disclose the capability and authority of the RBNZ to influence the value of New Zealand currency through monetary policy shocks (although it should be recognised that its statutory objective is to maintain general price stability, not maintain a target exchange rate).

3. Have the effects of monetary policy shocks on exchange rate been influenced by the current financial tsunami?

After the global financial tsunami hit the New Zealand market, on the 24th of July 2008, the OCR was lowered for the first time in five years. Although the RBNZ has implemented expansionary monetary policy to fight against the recession, New Zealand producers have been significantly hurt. The current global financial crisis had a large impact on New Zealand's economic activities and forced the RBNZ to reduce the OCR by 525 basis points in nine months. All of the evidence indicates that monetary policy from the middle of 2008 has been influenced by the financial crisis. Since its influence has been visible in New Zealand markets, it is important to analyse the impact of the current global financial crisis. The results could help monetary authorities to perform better when facing the next financial shock and could provide investors with better information for the future. Therefore, the third research objective is to find out whether the effects of monetary policy shocks on exchange rate have been influenced by the global financial crisis.

1.4 Outline of the Thesis

Chapter 2 will present the literature review on the relationship between monetary policy shocks and exchange rate movements. How to identify monetary policy shocks will be explained and evidence of exchange rate puzzles will also be discussed, including the two main methods of this research. In addition, some arguments about applying these two methods will be reviewed.

Chapter 3 will present the methodology that is used in this thesis. The regression models, the selected variables, and the data will be explained.

Chapter 4 will analyse the modelling results based on the chosen methodology. The results will then be compared with previous studies and used to answer the three research questions.

Chapter 5 will summarize the findings produced through this research and discuss their implications for the research problem addressed in this thesis. The importance and limitations of this thesis will also be given.

Chapter 2: Literature Review

2.1 Introduction

Based on the standard theory, a contractionary monetary policy reduces money supply which increases the domestic exchange rate. However, some evidence has shown the opposite impact on the exchange rate. This special case is called the exchange rate puzzle. There have been a large number of papers studying the relationship between monetary policy and the exchange rate. To summarize how the monetary policy shock is identified, there are two main lines of research. First, the Vector Autoregression (VAR) approach, which includes the Structure Vector Autoregression model (SVAR) and the Vector Error Correlation Model (VECM) under specified restrictions, commonly used to examine the long run dynamic effect between monetary policy and the exchange rate. Secondly, event-study approaches, which are normally carried out with a single equation model, usually estimated by the Ordinary Least Squares (OLS) method, and typically used to examine the short run effect or same day effect of monetary policy changes and movements in the exchange rate.

2.2 Identifying Monetary Policy Shocks

Before studying the effect of monetary policy on exchange rates, it is important to identify monetary policy shocks first. A monetary policy *shock* is an *unexpected* (as perceived by the market) change in monetary conditions introduced by the monetary authorities. In general terms, monetary policy can be implemented by changes in three monetary policy instruments: the Base Money (M1), the Base Interest Rate, and the level of Non-Borrowed Reserves. The base money contains coins, paper money, and any assets that can quickly be converted into currency, which represents the amount of liquid money supply in the economy. The base interest rate is the target price of borrowing money from the central bank, such as the OCR in New Zealand and the Federal Funds Rate in America. Non-borrowed reserves act like base money and indicate the surplus of reserves in the banking system, which influences the amount that bank has available to lend to clients. A central bank can use one or more of these three instruments to control the amount of money supply in order to stabilize the country's economy. For example, if the country is experiencing high inflation in the market, the central bank can implement a contractionary monetary policy to reduce inflation by reducing the base money, increasing the base interest rate, or reducing non-borrowed reserves.

There are many studies in the literature relating to different measures of monetary policy shocks. Cushman and Zha (1997) and Wilkinson *et al*, (2001) employed changes in base money (M1) to measure monetary policy shocks. Changes in non-borrowed reserves as another monetary policy shock indicator have been used by Koray and McMillin (1999), Kim (2001), and Faust and Rogers (2003). The most popular indicator of monetary policy shocks, however, is changes in the relative short term interest rate which are very strongly influenced by the central bank's base interest rate (the OCR in New Zealand).

According to Bernanke and Blinder (1992), for example, changes in short term interest rates are dominated by monetary policy shocks, but are not as sensitive to other influences. Therefore, the relative short term interest rate is more reliable in indicating monetary policy shocks compared with other indicators. In addition, the market interest rate is the Reserve Bank's interest rate plus a measurement value (risk premium) from the market. According to Piazzesi and Swanson (2004), the risk premium remains stable during short term periods. Thus, differences in the short term interest rate are a reasonable proxy for monetary policy shocks due to changes in the OCR after the risk premium is cancelled during the process. In this research, monetary policy shocks will be identified by the immediate reaction of either the 30-day interest rate or the 90-day interest rate to OCR announcements in New Zealand.

With the understanding that the OCR is the indicator of New Zealand monetary policy, it is important to find out how to identify monetary policy shocks in different models. There are three types of model commonly used to study the relationship between monetary policy shocks and the exchange rate. In the VAR model, the monetary policy shock is identified by the disturbance term to the short term interest rate (ε_t^{IR}). Under the SVAR model, the monetary policy shock is identified by the structural disturbance to the short term interest rate ($B^0\varepsilon_t^{IR}$) whereby the identification of the B^0 is conducted with a method such as the Choleski decomposition method. Under the Event Study model, the monetary policy shock is identified by the difference in the short term interest rate within an event window (ΔIR_t).

In New Zealand, the RBNZ has independent authority to adjust the OCR in order to keep inflation within the target range. The dates for possible changes are announced in advance (typically every eight weeks), so that financial markets can anticipate the direction and level of any change with whatever public knowledge is available at the time, including the possibility of an announcement that of no change. Even if the public makes the right prediction on the direction of monetary policy movement, they may not be able to estimate the exact amount of changes on the OCR; therefore, each OCR announcement is unpredictable. The unexpected changes in the Official Cash Rate represent monetary policy shocks in New Zealand, which will be reflected in changes to retail interest rates after each announcement.

2.3 Earlier Evidence on Exchange Rate Puzzle

This section presents some earlier evidence of the exchange rate puzzle. Dornbusch (1976) was the first to explain volatile exchange rates through the overshooting model, which argued that a change in the exchange rate has a faster effect on the asset markets than on the goods markets. In the short run, therefore, the exchange rate will depreciate after a positive monetary policy shock in the asset market, but by more than it should since the goods' prices are relatively sticky in the goods markets. During the adjustment of exchange rate fluctuation, in the long run, the exchange rate moves back to its equilibrium at a higher value than in the short run, thus the exchange rate is highly fluctuating over time, and the changes could be volatile.

In another early study, Urich and Wachtel (1981) examined how money supply announcements could affect the interest rate. Their result indicates that if there is an unexpected money supply increase the interest rate is likely to rise, due to speculators' intervention in the market. Following this research, Cornell (1982) examined the relationship between money supply announcements, the interest rate and the exchange rate by testing joint hypotheses. The result indicated that an unanticipated increase in the money supply could raise the interest rate and exchange rate if the investors believe that the current monetary expansion would soon lead to a monetary contraction in order to balance the current oversupply of money. Speculators increase the demand for the currency and expect to make a profit when the tightening monetary policy is implemented. This speculation pushes the interest rate to rise, but in response to the anticipated monetary contraction in the future rather than to the current monetary expansion. The increase in demand for the currency also raises the exchange rate, for the same reason.

Batten and Thornton (1984) noted that there are two possible and opposite effects on the exchange rate movement following a monetary policy shock. If there is a negative shock on money supply, the public may believe that the central bank is trying to tighten monetary conditions to lower inflation. In this case, the exchange rate will increase following a negative monetary policy shock, consistent with the standard theory. On the other hand, the negative monetary shock could lead the exchange rate to decrease if the public believes that the unanticipated contraction will lead to expansion in money supply in the future. With this expectation of future expansion, investors lose confidence on the currency and the exchange rate will decrease. This result indicates an exchange rate puzzle.

2.4 Vector Auto-regressive Model (VAR)

VAR is capable of capturing the evolution of and the interdependencies between multiple time series. Model (1) represents a basic VAR regression with one dependent variable. Model (2) represents a VAR regression with two dependent variables.

$$y_t = c + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_p y_{t-p} + \varepsilon_t \tag{1}$$

$$\begin{cases} y_{1,t} = c_1 + \beta_{1,1} y_{1,t-1} + \beta_{1,2} y_{2,t-1} + \varepsilon_{1,t} \\ y_{2,t} = c_2 + \beta_{2,1} y_{1,t-1} + \beta_{2,2} y_{2,t-1} + \varepsilon_{2,t} \end{cases} \quad (2)$$

The equations in the VAR model explain each variable's evolution based on its own lags and the lags of all the other variables in the model. The right hand side of the equation only contains the past value of the variables. If $y_{2,t}$ symbolizes the indicator of monetary policy, then $\varepsilon_{2,t}$ will indicate the monetary policy shocks.

Since Sims (1980) introduced the VAR model, the methodology has been extensively used for dynamic macroeconomics analyses. Although VAR has gained credibility in examining changes in multivariate time series, there are many arguments against using a VAR to study the effects of monetary policy shocks on exchange rates. According to Fung and Kasumovich (1998), one of the problems regards the recursive-causal structure, which could cause puzzles when using the VAR method to analyse the effects of monetary shocks. Lately, Bjornland (2008) noted that simultaneity is another issue when estimating the relationship between monetary policy and exchange rate using a VAR model. In order to solve this problem, the restricted recursive VAR model was commonly used to remove the simultaneous effects in previous research, although the consequence could cause biased estimation.

2.4.1 VAR in Research on Exchange Rate Puzzle

Sims (1992) used a VAR model to study the relationship between monetary policy shocks and exchange rate variations, using monthly data from the 1950s to the 1990s, with variables including interest rate, base money, consumer price index, production, and exchange rate. The result showed a significant and continual negative relationship between interest rates and exchange rates in France and Germany, where contractionary monetary policy shocks reduced the value of domestic currency in both countries. Evidence of an exchange rate puzzle was clearly identified in this study, and Sims noted that this exchange rate puzzle could be caused by inflationary pressure.

However, a later study by Eichenbaum and Evans (1995) did not find any exchange rate puzzle in the USA. Their research investigated the impact of Federal Reserve monetary policy shocks on the exchange rate from January 1974 to May 1990, measured by innovations in the Federal Funds rate, non-borrowed reserves, and the Romer and Romer index of monetary policy in different VAR models. The results indicated that tightening monetary policy caused the US interest rate to rise first, followed by US Dollar appreciation. In addition, the results also reported that monetary policy shocks did not have a major impact on the exchange rate in the USA.

In the same year, Grilli and Roubini (1995) also applied the VAR approach to study the effects of monetary policy shocks on exchange rates in the G-7 countries. Like Eichenbaum and Evans (1995), they also found no evidence of an exchange rate puzzle in the USA; however, the results indicated that all other G-7 countries experienced negative impacts on their currency values after contractionary monetary policy shocks. One of the reasons given was unexpected shocks on inflation. This exchange rate puzzle is consistent with the one in Sims (1992), with inflationary pressure emerging as the key to explaining the exchange rate puzzle in the VAR approach.

Another problem that often appears when using the VAR analyses is the liquidity puzzle. According to Leeper and Gordon (1992), the liquidity puzzle could arise when the monetary policy shock is caused, in the short run, by changes in the monetary aggregates, such as the base money (M1). Sims (1992) also indicated that, when facing unexpected changes in money demand, the monetary policy shocks cannot be well explained by the changes in monetary aggregates.

Fung and Kasumovich (1998) also noted that using the VAR method to analyse the relationship between monetary shocks and exchange rate could frequently cause two puzzles. One is the liquidity puzzle, where the interest rate decreases immediately following a monetary contraction. The other one is the price puzzle, where, when facing a negative monetary shock, the price level increases instantly instead of decreasing. Using the appropriate monetary policy instrument (such as short term interest rate) that is only directly effected by the central bank could avoid the first puzzle. However, the solution for the first puzzle could lead to the second puzzle, which is the price puzzle and often occurs while facing pressures from inflation.

Facing the above problems, some researchers have found that applying an appropriate identification scheme in the VAR model is the key to solving the various puzzles. Therefore, structural VAR with non-recursive simultaneous restrictions has become the standard method for analyzing the effect of monetary policy shocks on the exchange rates.

2.4.2 SVAR in Research on the Exchange Rate Puzzle

Cushman and Zha (1997) argued that inadequate monetary shock identification schemes are the basic problem causing puzzles in previous research on the effects of monetary policy shocks. Therefore, they examined the impacts of monetary policy shocks on the exchange rate in Canada using a Structural Vector Auto-regressive (SVAR) method. This research also noted that shocks in foreign economies have immediate effects on a small open economy; therefore it is necessary to eliminate the exogeneity to provide more reliable results. Both Canadian base money and the 90-day Treasury bill rate were used to identify monetary policy shocks. The findings were that a contractionary monetary policy shock (such as reducing the money base or increasing the interest rate) raises the exchange rate and increases the value of Canadian dollar. That result therefore did not show any evidence of an exchange rate puzzle.

Kim and Roubini (2000) introduced a structural VAR approach to studying the relationship between monetary policy shocks and exchange rate's movement. They applied non-recursive simultaneous restrictions to identify monetary policy shocks and with an identification scheme that allowed the monetary policy shocks and exchange rate shocks to react simultaneously, both the liquidity puzzle and the price puzzle were solved. Their result showed that there was no evidence of an exchange rate puzzle in the non-US G-7 countries over the sampled time period.

It has also been noted that a floating exchange rate can have significant effects on the domestic price level (inflation rate) (Bjornland, 2008). Furthermore, inflation has effects on monetary policy and monetary policy has effects on the floating exchange rate. Thus, in a small open economy, the exchange rate and monetary policy have a close interactive relationship, especially if monetary policy is targeting the domestic inflation rate. It is therefore not appropriate to apply contemporaneous restrictions in VAR for a small open economy with an inflation target. Hence, a structural VAR model was used in the research, allowing simultaneous interactions between monetary policy and other variables, but restricting the long-run effects on the real exchange rate. Quarterly data between the first quarter of 1993 and the third quarter of 2004 were used in the updated SVAR model to measure the impacts of monetary policy on the exchange rate in Norway and no evidence of an exchange rate puzzle was found.

In order to support the VAR result, Bjornland (2008) also used OLS in an event study approach to examine the immediate effect of monetary policy announcements on the exchange rate. Both approaches indicated the same result: that loosening monetary policy causes the exchange rate to depreciate. Moreover, a one percentage point rise in the 90-day interest rate was estimated to increase the value of Norwegian Krone by approximately two percent confirming the event study approach as another important method to analyse the effect of monetary policy shocks on exchange rates.

2.5 Event Study

Event studies typically use ordinary least squares (OLS) to estimate the impact of monetary shocks on the exchange rate. The general form of the regression is shown in equation 3.

$$y_t = c + \beta x_t + \varepsilon_t \qquad (3)$$

For a single equation event study on the monetary-exchange rate nexus, OLS can be used to estimate the effect of monetary policy shocks on the country's exchange rate, namely, the β. On the left hand side of model (3), differences in the exchange rate is the dependent variable, on the right hand side is the independent variable which indicates the monetary policy shocks, such as differences in the short term interest rate. An event window is applied to each variable in order to measure the changes before and after the monetary policy announcement, with the coefficient of the independent variable indicating the relationship between monetary policy shocks and exchange rate movements.

Hardouvelis (1988) used such an event study to analyse the impact of monetary policy shocks on the exchange rate in America. The sample period was October 1979 to August 1984 and the result was consistent with standard economic theory. Increases in the interest rate led the American currency to appreciate, thus, no exchange rate puzzle was found in this research.

Similarly, Lewis (1995) examined the effect of monetary policy shocks on America's foreign exchange rates. Base money, non-borrowed reserves, and the Federal Funds rate were used as indicators over a sample period from 1985 to 1990. Again, no exchange rate puzzle was found, supporting the standard theory that contractionary monetary policy lead to an appreciation of the US dollar.

More recently, Bonser-Neal et al. (1998) used the event study approach to examine the relationship between monetary policy and the exchange rate in America. The time periods were from September 1974 to September 1979 and from October 1987 to December 1994 when the Federal Reserve was using the Federal Funds rate as its monetary policy instrument. The results showed that for both the spot and forward exchange rates, a tightening of monetary policy led to the US dollar appreciating in all periods.

2.6 Exchange Rate Puzzle in New Zealand

Regarding the New Zealand market, Wilkinson *et al.* (2001) argued that there was evidence of the exchange rate puzzle in New Zealand, studying monthly data from March 1985 to March 1998 for both New Zealand and Australia. Short-term interest rates, foreign-domestic interest rate differentials, and base money were separately used to indicate monetary policy shocks in three different VAR models for comparison. The results showed some evidence against the standard theory, as an increase in the New Zealand base money would lead to an initial appreciation of the NZ Dollar against the Japanese Yen, British Pound, and US Dollar in all three models. In addition, an increase in the short-term interest rate depreciated the NZ Dollar against the Australian Dollar by a small amount, but appreciated the NZ Dollar against all of the other three currencies studied. However, there is no exchange rate puzzle when the monetary policy shocks were measured by the interest rate differentials for all four currencies. Overall, the research concluded that the New Zealand exchange rate was mainly explained by its past values, and although monetary policy shocks did have impacts on the exchange rates, their contributions were weaker than the effects from CPI and production. The results also reported little evidence of the overshooting hypothesis in New Zealand. For Australia, the results were more consistent with the standard theory and previous studies.

When Zettelmeyer (2004) used OLS to estimate the monetary policy shock's effects on exchange rates in Australia, Canada, and New Zealand, an instrumental variable was introduced to solve the endogeneity problem between the exchange rate and the interest rate. In addition, each news broadcast on the announcement day was classified from 1 to 3: Class "1" indicated no significant influence on the announcement; Class "2" represented that the news could have some influence on the monetary policy, however, such evidence is not traceable to any document; Class “3” meant the impact of the public news was significant and the relative data needed to be removed. By eliminating the endogeneity, the results proved consistent with the standard economic theory. As monetary policy was identified by changes in the 90-day interest rate, the results further indicated that the exchange rate increased by two to three percent when the 90-day interest rate rose by one percentage point.

Kearns and Manners (2006) also examined the impact of monetary policy on the exchange rate using the event study approach with intraday data in Australia, New Zealand, Canada, and United Kingdom. Since the monetary policy change had been determined before the announcement was made to the public, the influence from other news on the announcement day could be ignored. In addition, the effect of the endogenity problem on the interest rate and exchange rate was minimised by using intraday data. In order to reduce the public news effects on the exchange rate, they applied a 70-minute event window to the dependent variable. The results indicated a positive relationship between interest rates and exchange rates in all four countries, where tightening monetary policy leads the exchange rate to appreciate, consistent with the standard theory. Moreover, an unexpected rise in the interest rate by 100-basis-points led the exchange rate to increase by approximately 1.5 per cent.

In another study, Karim *et al*. (2007) examined the effects of monetary policy shocks on the exchange rate with a SVAR model by addressing different variable groups from four research areas: international economy, terms of trade, domestic economy and climate. The result did not show any evidence of an exchange rate puzzle in New Zealand, and, in addition, showed that monetary policy shocks have a smaller effect on the exchange rate compared with changes in other economic activities. In fact, the New Zealand monetary policy shock only indicated a one percent variation in the NZD/UDS exchange rate, and less than one percent variation in the NZD/GBP rate.

2.7 Comparison of VAR and Event Study Approaches

Even though the VAR model is commonly used to examine the relationship between monetary policy and the exchange rate, there are many researchers who have expressed dissatisfaction with this model. Engel and Frankel (1984), Hardouvelis (1984), Hakkio and Pearce (1985), and Ito and Roley (1987) noted that, in comparison with the VAR approach, an event study has better outcomes in isolating the economic news' effects from the effects of monetary policy shocks on the exchange rate.

Furthermore, according to Rudebusch (1998), VAR models do not make sense for measuring monetary policy shocks in the context of the USA for two reasons, closely related to two important characteristics of the VAR model. The first is related to the monetary policy equation or monetary reaction equation in the VAR system, which models the endogenous part of the monetary policy, and which Rudebusch found unable to estimate the reaction of Federal Reserve correctly, due to four major shortcomings inherent in the standard VAR approach.

First, while economic structure and monetary policy reactions have been changing over time, the VAR kept using a simple constant linear structure for estimating the monetary policy reactions and shocks. As the Federal Reserve has to react differently in a changing environment, time-invariant linear monetary VARs could be prone to misspecifications. In fact, a Chow test and Andrews' (1993) maximum F test pointed to structural changes which refuted the time-invariant structure assumed by the VAR model. To provide economic evidence for the instability of the structure governing the reaction process, Rudebusch contrasted the VAR reaction function with the Taylor rule, which is widely acknowledged to be a good approximation of how the Federal Reserve set policy under Chairman Alan Greenspan and, hence, is used as the benchmark. The results showed a stark difference in terms of to what and how the Federal Reserve would react. This point is reinforced by the large differences between the two kinds of reaction functions, in terms of how the Federal Reserve responded to exogenous shocks to the other variables as well as its own policy.

Secondly, the information set, or the right-hand-side variables, in the monetary VAR were not broad enough. Christiano (1996) claimed that commodity prices, as an important factor in monetary policy, will only be meaningful if the VAR is accurately identified. However, inclusion of extra variables in the VAR would worsen the possible multicollinearity problem, evidenced by the statistical insignificance of most regressors.

Thirdly, the monetary VARs used final and revised data to model policy reactions while, in the real world, policy makers had to react to initial releases of data. For example, the final data of one variable ending in March may not be available for release before May. By using the revised data, the error term of the VAR regression could be correlated with one of the variables, thus, the relative coefficient that is used to explain the relationship between the independent and dependent variables could be biased.

Fourthly, and finally, the VARs had a long distributed lag structure in which about half of the variables that were lagged 4 or more periods were significant. This suggested that the authority reacted systematically to old information, that is, for example, the authority reacted to 4-month old information whenever it reacted. Given that a large literature base points to the fact that there is no information in the term structure for predicting interest rates, it is unlikely that the Federal Reserve would react to old information systematically, hence, the significance of the coefficients is most certainly spurious, resulting from in-sample data fitting.

Rudebusch's second criticism is related to the measurement of the monetary policy shock, which is considered the exogenous part of the monetary policy. Since a monetary policy shock was measured as the regression residual in the VAR, the measurement would be incorrect if the reaction function was estimated incorrectly, which appeared to be the case from the above discussions. He suggested a better source for constructing monetary policy shocks was needed, for example, utilising rates from the federal funds futures contracts. This avoided the problem of interest rate residuals from the VAR being uncorrelated with financial market shocks as, in financial markets, shocks in futures markets may differ from the VAR interest rate residuals. This conjecture was supported by the lack of fit of the shocks estimated from the VAR to the ones based on the federal funds futures contracts. What is more disappointing is that even the VARs that Rudebusch examined could not agree with each other on the size of the monetary policy shocks.

Later, Brunner (2000) also critiqued the reliability of VAR approaches in determining monetary policy shocks. In a VAR estimation, all economic data from the previous periods are assumed to be available for all researchers at the beginning of the examining period; however, this is hardly possible in reality. In fact, many of the economic data in period t-1 may not even be accessible to the public in period t+1. This is particularly obvious when analysing monetary policy shocks.

On the other hand, an event study approach is much easier to handle and the result is more reliable overall than the VAR method as its approach eliminates the problems of exogeneity. In addition, the impacts of monetary policy shocks are difficult to e measure completely and accurately by VAR, especially in a small open economy, whereas the event study offers a natural definition of a policy shock. Since this thesis measures monetary policy shocks as the *immediate* changes in market interest rate, the event study approach is preferred to the VAR approach and is therefore adopted.

2.8 Conclusion

If changes in monetary policy could be anticipated accurately by all the public, then there would be no monetary policy shocks to the market and no consequent changes in the exchange rate. However, due to limited information and resources available to the public, the decision on whether to change the Official Cash Rate (and by how much) cannot be estimated precisely. Each OCR announcement is therefore a potential monetary policy shock that is not fully anticipated, consequently, the exchange rate can change after each OCR announcement removes the uncertainty leading up to the announcement. This feature is what allows an event study to explore the relationship between monetary policy shocks and their impact on exchange rate movements.

Although there have been many studies regarding the impact of monetary policy shocks on the exchange rate, there is very limited research focusing on the New Zealand market, especially after the RBNZ employed the OCR as its instrument of monetary policy from 1999 and more especially after the recent global financial crisis. Previous studies have produced mixed evidence for the existence of the exchange rate puzzle in New Zealand. Monetary policy has targeted price stability since a floating exchange rate was adopted in March 1985 and, as a small open economy, New Zealand's exchange rate is relatively volatile. It is therefore important to find out whether the RBNZ's monetary policy does have the standard impact on the exchange rate and to measure the size of that impact if it does (including after the global financial crisis). These questions are addressed in the remainder of this thesis.

Chapter 3: Methodology, Variables, and Data

3.1 Introduction

The research for this study applied the event study method, estimated by an OLS regression, using New Zealand data. The daily nominal exchange rate was used to calculate the dependent variable. Both the 30-day and 90-day interest rates were separately used as the independent variable. A dummy variable was used to distinguish the impact of the global financial crisis on the effect of monetary policy shocks on New Zealand's exchange rate during the sample period between 17th of March 1999 and the 10th of June 2010. In total, there were 90 observations available, including the only unscheduled OCR announcement during the period (which was shortly after the September 11th terrorism attack in the United States).

3.2 Methodology

This research focuses on how the RBNZ influences the exchange rate through monetary policy shocks during the period, since March 1999, when the RBNZ has been utilising the OCR as its monetary policy instrument. The RBNZ reviews the OCR eight times a year on scheduled dates, and, since each OCR is scheduled and announced to the public on a specific day, changes in retail interest rates and in the country's exchange rate on that day are key events suitable for this study. Since the OCR is not updated every day, any data regarding short term interest rate movements between two OCR announcements should contain influences from the public. Therefore, the VAR method is not appropriate for this study.

The sample period is from the 27th of March 1999 to 10th of June 2010, with 92 observations available in total providing adequate observations for the event study approach. With a prescheduled OCR announcement date, what happens on the announcement day does not feed back to the OCR decision-making process and hence the endogeneity problem is solved and, with a 24-hour event window, the impacts from other public news should be eliminated. The empirical analyses are conducted using the event study models due to Zettelmeyer (2004) and Kearns and Manners (2006) that can be estimated by OLS, however, the methods used by these previous authors need closer examination.

Zettelmeyer (2004) applied his event study method to the relationship between monetary policy shocks and the exchange rate from 1990 to 2000 in New Zealand. During that period the RBNZ mainly focused on the "cash target" as its monetary policy instrument prior to 1999. With a daily target "open mouth" operation system, news regarding the interest rate and exchange rate could influence the daily warnings from RBNZ. In order to get an unbiased estimation of the impact, Zettelmeyer argued that any other news which affected the relative interest rates and exchange rate on the announcement day had to be eliminated. As mentioned earlier, each news item on the announcement day was classified from 1 to 3. If the announcement day contained class "3" news, then this observation was removed from the sample.

He also noted the endogeneity problem between interest rate and exchange rate. Under the daily target "open mouth" operation system, the changes in the interest rate could influence the movements of the exchange rate, while the interest rate could also be influenced by the changes on the exchange rate. This interrelationship violated the OLS assumption that the dependent variable cannot correlate with the independent variable. In order to solve this problem, a two-stage least squares approach was introduced by Zettelmeyer, with the idea of eliminating the interrelationship between the interest rate and exchange rate. An instrumental variable was introduced to generate the uncorrelated interest rate in the first stage, which only responded to the changes in monetary policy, but not to changes in the exchange rate. The second stage was to analyse the effect of monetary policy shocks on the exchange rate, using the percentage change in the nominal exchange rate as the dependent variable on the left hand side of the regression and the percentage change on the generated interest rate as the independent variable on the right hand side of the regression. Changes in the generated interest rate indicated monetary policy shocks, and its coefficient measures the marginal impact of monetary policy shocks on the exchange rate. According to Zettelmeyer (2004), there was no exchange rate puzzle in New Zealand and a 100-basis-point surprise tightening of monetary policy could raise the exchange rate by 2.72%.

Kearns and Manners (2006) also employed an event study method to analyse the impact of monetary policy shocks on exchange rate in New Zealand over the period from March 1999 to June 2004, with 42 observations in total. During this period, each Official Cash Rate was decided before the announcement day via a Board meeting of the RBNZ, therefore any change in the exchange rate on the announcement day could not influence the decision on the predetermined OCR. Although the market interest rate may be influenced by other events, the impact is minimal since the monetary policy announcement is the most important shock to the interest rate on the OCR announcement day. With a short event window, the correlation problem between interest rate and exchange rate was eliminated; consequently, any public news on the OCR announcement day could not affect the already determined OCR. Since interest rate data were available only on a daily basis, they utilised a 24-hour event window for the short term interest rates and applied a seventy-minute event window to the exchange rate to minimise influence from other factors.

3.2.1 Comparison of the Methodologies

Based on the two studies just described, this paper examines the immediate effects of monetary policy announcements on New Zealand's exchange rate during the period between March 1999 and June 2010. In New Zealand, decisions on monetary policy are determined by a Board meeting before the announcement day; therefore, other news on announcement day does not influence the decision as it was made before the news occurred. In addition, movements in the exchange rate upon the announcement will not influence the OCR for the same reason. Consequently, neither the news classification nor the instrument variable components of the study by Zettelmeyer (2004) are required for this research. This is consistent with the study by Kearns and Manners (2006).

Moreover, according to Kearns and Manners (2006), shorter intraday data could more precisely control for endogentity and external factors that might influence both the exchange rate and the interest rate and therefore applied a seventy-minute event window to the changes in exchange rate. They still used the 24-hour event window for changes in the short term interest rate however, since they did not have access to data for a seventy-minute event window for this rate. In this case, the monetary policy shock was measured within a 24-hour time period but the effect on exchange rate was measured within a seventy-minute time period. This "two time period" approach was not consistent and may cause bias in the results. For that reason, this study differs from Kearns and Manners

(2006), and applies a 24-hour event window for both changes on nominal exchange rate and short term interest rate, consistent with the study by Zettelmeyer (2004). In addition, this study covers the period from the 17th of March 1999 to the 10th of June 2010 with 90 observations available, more than double the observations available to Kearns and Manners (2006). Consequently, the result should be more reliable and accurate. Last but not least, in order to find out the impact of the global financial crisis, this study introduces a dummy variable to distinguish the effects of monetary policy shocks on the exchange rate after the onset of the crisis. Table 1 summarises comparisons of the three studies.

3.2.2 The Exchange Rate Model

Adopting the event study method, the impact of monetary policy shocks on the exchange rate can be specified by the following regression:

$$\Delta e_t = \alpha + \beta \Delta i_t + \varepsilon_t \qquad (4)$$

Note:

Δe_t is the percentage change in the nominal exchange rates before and after the OCR announcement, with the time interval between t and t-1 equal to 24 hours.

β is the coefficient of the changes in short term interest rate.

Δi_t is the change of percentage points in the short term interest rates before and after the OCR announcement, with the time interval between t and t-1 equal to 24 hours.

ε_t is the error term.

Table 1: Comparison of the Three Methodologies

	Zettelmeyer (2004)	Kearns and Manners (2006)	This Research
Method	Two-stage least squares	Ordinary least squares	Ordinary least squares
Event window	24 hour event window on both interest rate and exchange rate	70 minute event window on exchange rate, but 24 hour event window on interest rate.	24 hour event window on both interest rate and exchange rate
Instrument Variable	Direction (-1, 0, 1) is used to indicate the future condition of monetary policy.	N/A	N/A
Dummy variable	N/A	N/A	Used to distinguish between pre- and post- global financial crisis.
Data series	90-day interest rate Directions on monetary policy News classification Nominal exchange rate	30-day interest rate 90-day interest rate Nominal exchange rate	30-day interest rate 90-day interest rate Nominal exchange rate Dummy variable
Sample period	08/01/90 ~ 01/19/00	17/03/99 ~ 10/06/04	21/04/99 ~ 10/06/10
Observations	35	42	90

3.3 Selected Variables

Many studies that focus on long run dynamic analysis have used either the real exchange rate or the nominal exchange rate separately as the dependent variable in their model. This study focuses on the immediate effects of monetary policy announcements on the exchange rate, which are measured within a 24-hour period. During this short event window, the price level does not change significantly and so the differences between the real exchange rate and nominal exchange rate are negligible. Therefore, only the nominal exchange rate is adopted in this event study approach, consistent with both Zettelmeyer (2004) and Kearns and Manners (2006). The impact on exchange rate can be observed through the difference in the nominal exchange rates within a 24-hour period before and after the OCR announcement.

After identifying how to measure the impacts of changes on the exchange rate, it is also important to determine the variable that can be used to represent the monetary policy *shock* that occurs at each of the monetary policy announcements. In general, there are three important monetary instruments which are interest rate, base money, and the non-borrowed reserves. New Zealand has adopted the OCR to indicate monetary policy changes since 1999. OCR is the interest rate set by the reserve bank to influence the cost of borrowing money for the retail banks in New Zealand; therefore the market retail interest rate has a close relationship with the OCR. As the OCR increases, retail interest rates should increase as well.

If there is no change in the short-term retail interest rate after an OCR announcement, this means the level of the OCR after the announcement was fully anticipated by the markets and, in this rare case, there is no policy shock. Typically, however, there is some uncertainty about the size of change to the OCR (even when the direction of change seems certain), and so the retail interest rate changes once that uncertainty is resolved by the policy announcement. Consequently, change in the short term retail interest rate is the best indicator of a policy shock during the event (announcement day).

Consistent with this approach, Piazzesi and Swanson (2004) noted that the market interest rate is the base interest rate plus a risk premium and that the risk premium remains stable during short term periods. In this study, the base interest rate is the OCR, thus the difference in the 30-day market interest rate is a reasonable measure of the difference in OCR after the risk premium is cancelled. Consequently, changes in the 30-day interest rate are appropriated to identify the monetary policy shocks.

Bjornland (2008) also noted that the 90-day interest rate is a good indicator when measuring monetary policy shocks. In New Zealand, the OCR announcements are scheduled eight times a year, which means that there are one and half months between consecutive announcements. The 90-day interest rate is not only short enough to reflect the changes in monetary policy announcement, but also sufficiently long to cover unanticipated changes facing two announcements. Since the exchange rate is focusing on long term fluctuation, the 90-day interest rates have sufficient effects on the exchange rate movements for the purposes of this study; therefore, the difference in 90-day interest rates before and after the OCR announcement can also be used to identify monetary policy shocks. In this research, both the 30-day and 90-day interest rates were separately used as the independent variable in individual OLS regressions.

In order to ascertain the impact of the global financial crisis, a dummy variable was introduced to distinguish the periods before and after the recent financial tsunami influencing the New Zealand market. According to the OCR announcement from RBNZ, although the finance tsunami started in late 2007 the New Zealand money market continued to be strong until the second quarter of 2008. The OCR announcement on the 5th of June 2008 is the first OCR announcement which clearly indicated significant influence from the financial tsunami on New Zealand's money market. In addition, the OCR experienced its first drop in five years on the 5th of June 2008; therefore, this study regards the observations from the 5th of June 2008 as having been affected by the financial tsunami.

3.4 Data Collection

In order to produce reliable results, daily data were collected from the 17th of March 1999 to the 10th of June 2010. From this period, daily data for the nominal exchange rate, the 30-day interest rate and the 90-day interest rate on each OCR announcement day and the day before the OCR announcement day were selected. The percentage changes in the daily nominal exchange rates of the day before and the announcement day were calculated as the dependent variable. The independent variables are the changes in the 30-day interest rate and the 90-day interest rate, measured by the differences in percentage points the day before and on the OCR announcement day.

The Official Cash Rate was first introduced to New Zealand on the 17th of March 1999. The RBNZ reviews the OCR eight times in a full year, except in 2001 when there were nine reviews, making a total of 92 OCR announcements available during the study period.

Since this event study is based on a 24-hour event window before and after the OCR announcement, the number of observations had to be reduced from 92 to 90, by removing the announcements on the 17th of March 1999 and the 26th of April 2007, for the following reasons Since the OCR was introduced on the 17th of March 1999, the difference in the initial data was not available, thus the initial announcement is removed. Additionally, ANZAC Day is celebrated on the 25th of April, which was the day before one of the scheduled OCR announcements in 2007. Since it was a public holiday, there was no data available for the 25th ,consequently, the OCR announcement on the 26th of April 2007 was also isolated, since there is no data available based on the 24-hour event window.

The nominal exchange rate, 30-day interest rate, and 90-day interest rate data were all obtained from the Reserve Bank of New Zealand website. All data were collected on a daily basis at 11:10am. The percentage change in the daily exchange rate was calculated using the 11:10am exchange rate on the OCR announcement day minus the 11:10am exchange rate on the day before the announcement divided by the 11:10am exchange rate on the day before the announcement, then multiplied by 100. The percentage point change in the short term interest rate was calculated using the 11:10am 30-day interest rate (90-day interest rate) on the OCR announcement day minus the 11:10am 30-day interest rate (90-day interest rate) on the day before the announcement. A dummy variable was applied to distinguish the influence before and after the financial crisis with “0” indicating observations from the 21st of April 1999 to the 24th of April 2008 and “1” indicating observations from the 5th of June 2008 to the 10th of June 2010. Detailed figures are listed in Table A, presented in the appendix to this thesis.

Finally, it is important to explain that there was one unscheduled OCR announcement during the study period. Following the September 11th 2001 terrorist attacks, RBNZ made the only unscheduled OCR announcement to date on the 19th of September 2001. In order to test whether the unscheduled announcement should be included in the sample, a dummy variable "d_{sep}" was introduced into the analysis, with "d_{sep}" set equal to "1" if the observation includes the unscheduled observation on the 19th of Sep 2001 and "d_{sep}" set equal to "0" if it does not. The regression involving the dummy variable was carried out as follows in equation 5:

$$\Delta e_t = \alpha + \beta_1 \Delta i_t + \beta_2 d_{sep} + \mathcal{E}_t \qquad (5)$$

The results of this test are presented in Table 2, showing two regressions, depending on which short-term interest rate is used as the independent variable. In both models, the F-test points to a joint significance, but the t-test suggests that the "9.11" dummy variable is very insignificant. Since there is a lack of any economic theory supporting the dummy variable, the t-test is preferred to the F-test in this case. Based on the results of the t-test, the dummy variable is not significant in either regression. The results indicate that the unscheduled announcement did not significantly change the exchange rate movement, therefore the observation on the 19th of September 2001 should not be treated differently and the sample should include all 90 observations in this research. The Durbin-Watson (DW) test statistics, which are shown in the last row of the table, are larger than the upper-bound of 1.703 (for three regression coefficients and a sample size of 90), which indicate that both regressions were free of autocorrelation.

Table 2: Testing of Unscheduled Announcement

	30-days interest rate	**90-days interest rate**
$\boldsymbol{\alpha}$	-0.16 (0.11)	-0.19 (0.049)
$\boldsymbol{\beta_1}$	3.48 (0.009)	4.19 (0.0002)
$\boldsymbol{\beta_2}$	1.27 (0.22)	1.35 (0.16)
$\boldsymbol{R^2}$	0.08	0.15
Prob (F-stat.)	0.03	0.001
DW stat.	1.79	1.72

Note: P-values are in parentheses.

3.5 Conclusion

Both VAR and Event Study methods are popular for analysing the relationship between monetary policy changes and exchange rate movements with VAR better for estimating frequent data series. In New Zealand, the Official Cash Rate is reviewed only eight times a year, therefore the Event Study approach is clearly better in this case than the VAR approach. The empirical analyses are based on the methodologies used by Zettelmeyer (2004) and Kearns and Manners (2006) which adopt OLS and the monetary policy shocks are identified by the changes in either the 30-day interest rate or the 90-day interest rate. The coefficient of the short term interest rate indicates the percentage changes in the exchange rate, based on every 100-basis point increase in the short term interest rate within a 24-hour event window. A dummy variable is introduced to analyse the impact of the global financial crisis. Overall, there are 90 observations in the sample, with all data collected from the RBNZ website.

The next chapter will discuss the empirical results of this study and address the three research questions set out in Chapter 1.

Chapter 4: Empirical Results

4.1 Introduction

As explained in the previous chapter, the methodology of this research is based on the studies of Zettelmeyer (2004) and Kearns and Manners (2006), and examines the immediate effects of monetary policy announcements on New Zealand's exchange rate. The immediate effect is analysed by collecting the data that was released about 2 hours after each OCR announcement. According to Kearns and Manners (2006), any potential reverse impact of the exchange rate on the interest rate can be set aside for two reasons. First, the event window is too narrow for other factors to exert a significant influence on the exchange rate, and, secondly, the policy decision is made ahead of the announcement. Consequently, this study is an event study approach based on a 24-hour event window. The results reported in this chapter are consistent with the previous studies in that there appears to be no exchange rate puzzle in the New Zealand market and the monetary policy shocks have no great impact on the exchange rate. Unfortunately, the influence of the global financial crisis is unable to be identified, due to the small number of observations during the post-financial crisis period.

4.2 Empirical Results

The major results of the analysis are presented in Table 3and reveal that the changes in the 30-day interest rate and in the 90-day interest rate are both significant at the 95% confidence level. It is notable that, in the equivalent regression, the coefficient of the 90-day interest rate changes is larger than that of the 30-day interest rate changes. This is reasonable since the expectation of the 90-day interest rate covers two monetary policy announcements, but the 30-day interest rate refers to only one announcement: the longer the maturity period is, the harder it is to predict. The small R^2 values are consistent with both Zettelmeyer (2004) and Kearns and Manners (2006).

Table 3: Estimation Results

	90 Observations	
	30-day Interest Rate	***90-day Interest Rate***
Regression	$\Delta e_t = \alpha + \beta \Delta i_{30d,t} + \varepsilon_t$	$\Delta e_t = \alpha + \beta \Delta i_{90d,t} + \varepsilon_t$
$\boldsymbol{\alpha}$	*-0.16* *(0.12)*	*-0.18* *(0.07)*
$\boldsymbol{\beta}$	*2.85* *(0.02)*	*3.71* *(0.00)*
$\boldsymbol{R^2}$	*0.06*	*0.13*
DW	*1.78*	*1.7*

Note: Percentage changes in the exchange rate are based on a 100-basis-point increase in the short term interest rate. P-values are in parentheses.

Exchange Rate Puzzle:

According to the results in Table 3, the coefficients of changes in both the 30-day and 90-day interest rate are greater than zero. Since the coefficient is positive, the exchange rate and interest rate move in the same direction, that is, an increase in the interest rate will appreciate the New Zealand dollar. This result is consistent with the standard theory, thus the exchange rate puzzle does not exist in the New Zealand market during the sample period. The finding is consistent with Zettelmeyer (2004) and Kearns and Manners (2006) during the previous sample periods in their researches. The DW test statistics, which are shown in the last row of the table, are larger than the upper-bound of 1.679 (for two regression coefficients and a sample size of 90), which indicate that both regressions were free of autocorrelation.

Influence of RBNZ:

The results in Table 3 also indicate that the effect of monetary policy shocks on the New Zealand exchange rate has larger impacts in this research compared with previous studies. According to Zettelmeyer (2004), every percentage point increase in the 90-day interest rate would lead the New Zealand exchange rate to rise by 2.72 percent, while Kearns and Manners (2006) found that for 1 percentage point rise in the 30-day and 90-day interest rates, the New Zealand dollar would appreciate by 1.83 percent and 1.97 percent respectively. Using the same event study approach, for the same increase in the 30-day interest rate and 90-day interest rates, this research has shown increases of 2.85 percent and 3.71 percent in the New Zealand exchange rate respectively. The sample period from Kearns and Manners (2006) is between the 17th of March 1999 and the 10th of June 2004 with 42 observations, but this research has extended the sample period to the 10th of June 2010, with 90 observations in total. The larger impact on New Zealand's exchange rate could therefore be due to the larger sample size and the influence of the current global financial crisis, which began after the Kearns and Manners study.

In general, the Reserve Bank adjusts the OCR by 25-basis-points whenever it makes a change. Based on the results, an unanticipated 25-basis-point increase in the 30-day interest rate would increase the exchange rate by about 0.7 percent, while an unanticipated 25-basis-point increase on the 90-day interest rate would increase the exchange rate by about 0.9 percent, so, overall, the monetary policy shocks have no major effects on the New Zealand exchange rate. This result is consistent with previous studies such as Eichenbaum and Evans (1995), who noted that monetary policy was important to maintaining a stable economic development, but the movements of exchange rate are not exclusively determined by monetary policy shocks. In addition, Dalziel (2002) and Karim, Lee and Gan (2007) also argued that monetary policy shocks only explain relatively small changes in exchange rate movements.

Influence of Financial Tsunami:

According to OCR announcements and *Monetary Policy Statements*, the Reserve Bank of New Zealand considers that the global financial crisis affected the New Zealand market from June 2008. The OCR announcement on the 5th of June 2008, for example, announced the first official cash rate reduction in five years. Based on this announcement, the dummy variable D_t was used to distinguish between pre- and post-financial crisis observations. D_t is set equal to zero in the pre-financial crisis period (that is, before June 2008) and equal to 1 in the post-financial crisis period (that is, starting from June 2008). D_t^s is the slope dummy which is measured by multiplying the dummy variable (D_t) and the independent variable (Δi_t).

The intercept dummy is included in equation (6):

$$\Delta e_t = \alpha + \beta_1 \Delta i_t + \beta_2 D_t + \mathcal{E}_t \qquad (6)$$

The slope dummy is included in equations (7):

$$\Delta e_t = \alpha + \beta_1 \Delta i_t + \beta_2 D_t^s + \mathcal{E}_t \qquad (7)$$

Δe_t is the percentage change in the nominal exchange rates before and after the OCR announcement, with the time interval between t and t-1 equal to 24 hours.

β_1 is the coefficient of the changes in the short term interest rate.

β_2 is the coefficient of the dummy variable.

Δi_t is the change of percentage points in the short term interest rates before and after the OCR announcement, with the time interval between t and t-1 equal to 24 hours.

D_t is the dummy variable that distinguishes the pre- and post-financial crisis.

D_t^s is the slope dummy that distinguishes the pre- and post-financial crisis.

$D_t^s = \Delta i_t * D_t$

$\mathcal{E}_t$ is the error term.

According to the results in Table 4 and Table 5, the p-values of coefficients on all dummy variables (β_2) are all greater than 0.1 indicating that they are all insignificant. Since there were only 17 observations available from the 5th of June 2008 to the 10th of June 2010, it is possible that there was not enough data available in the post-financial crisis period to produce a more significant result; therefore, any influence of the global financial crisis is not clearly demonstrated. The DW test statistics, reported in both tables 4 and 5, are larger than the upper-bound of 1.703 (for three regression coefficients and a sample size of 90), which indicate that both regressions were free of autocorrelation.

Table 4: Estimation Results: Intercept Dummy

	Intercept Dummy	
	30-day Interest Rate	**90-day Interest Rate**
Regression	$\Delta e_t = \alpha + \beta_1 \Delta i_{30d,t} + \beta_2 D_t + \varepsilon_t$	$\Delta e_t = \alpha + \beta_1 \Delta i_{90d,t} + \beta_2 D_t + \varepsilon_t$
α	*-0.13* *(0.2)*	*-0.14* *(0.2)*
β_1	*2.78* *(0.03)*	*3.72* *(0.0)*
β_2	*-0.13* *(0.6)*	*-0.21* *(0.39)*
R^2	*0.06*	*0.13*
DW stat.	*1.78*	*1.71*

Note: Percentage changes in the exchange rate are based on a 100-basis-point increase in the short term interest rate with an intercept dummy. P-values are in parentheses.

Table 5: Estimation Results: Slope Dummy

	Slope Dummy	
	30-day interest rate	**90-day interest rate**
Regression	$\Delta e_t = \alpha + \beta_1 \Delta i_{30d,t} + \beta_2 D_t^s + \varepsilon_t$	$\Delta e_t = \alpha + \beta_1 \Delta i_{90d,t} + \beta_2 D_t^s + \varepsilon_t$
α	*-0.15* *(0.14)*	*-0.18* *(0.06)*
β_1	*1.62* *(0.27)*	*2.91* *(0.03)*
β_2	*3.78* *(0.14)*	*2.05* *(0.34)*
R^2	*0.08*	*0.13*
DW stat.	*1.87*	*1.78*

Note: Percentage changes in the exchange rate are based on a 100-basis-point increase in the short term interest rate with a slope dummy. P-values are in parentheses.

4.3 Conclusion

This chapter presents the empirical results of this study. Overall, the results are consistent with previous studies and indicate no exchange rate puzzle in New Zealand. The OLS regression test is statistically significant, indicating that monetary policy shocks have no major effects on New Zealand's exchange rate. However, the OLS regression with the crisis dummy variable is not statistically significant, so the impact of the global financial crisis is not identified.

The next, and final, chapter of this thesis will summarize the results of this research and discuss the contributions of this study. Limitations and suggestions for future study will also be given.

Chapter 5: Summary and Conclusion

5.1 Summary

This research has focused on the immediate effect of monetary policy shocks on the New Zealand exchange rate. The results indicate that there is no exchange rate puzzle in New Zealand during the sample period and the immediate effect of monetary policy shocks on New Zealand's exchange rate is minor. The results are consistent with the standard theory and previous studies by Zettelmeyer (2004) and Kearns and Manners (2006).

Although New Zealand markets have been reregulated and improved through economic reforms from1984 to 1994, there are still problems. In recent years, a constantly high exchange rate, particularly between 2004 and 2008, has created difficulties for New Zealand's export sectors and some commentators have put pressure on the Reserve Bank of New Zealand to lower the highly appreciated New Zealand dollar. Although there have been many previous studies examining the relationship between monetary policy shocks and exchange rate movements, there has not been enough research focusing on the immediate effect of current monetary policy shocks since the Reserve Bank of New Zealand adopted the Official Cash Rate as its monetary policy instrument in March 1999. This research is carried out to examine the relationship between the monetary policy shocks and New Zealand exchange rate movements since that date, including the first study of the period after the global financial crisis.

According to the literature, there have been two main methods adopted for the study of the effects of monetary policy shocks on the exchange rate. The VAR approach is normally used to inspect the long run dynamic effect between monetary policy and exchange rates, while the event study approach is usually used to examine the immediate effect between monetary policy and exchange rate. When examining the New Zealand money market after March 1999, the event study approach was selected as a more appropriate instrument as the OCR announcements are scheduled eight times a year, though it could be better to choose the VAR method if the base interest rate was, instead, based on a daily update. For the purposes of this study, the percentage difference in the daily nominal exchange rate was adopted as the dependent variable in order to indicate movements in New Zealand's exchange rate. The percentage point differences in both the 30-day interest rate and the 90-day interest rate were calculated separately and used as the independent variable in order to indicate the monetary policy shocks. From the 17th of March 1999 to the 10th of June 2010, there were 90 observations available, including the extraordinary observation on the 19th of September 2001, which is the only unscheduled OCR announcement to date (due to the September 11th terrorism attack in the USA). This observation was examined using a dummy variable test, which found that the parameter estimate was insignificant so, without further support for its isolation, it was retained in order to avoid unnecessary loss of information. In addition, a dummy variable representing the financial tsunami was used to distinguish the influence of monetary policy on the exchange rate before and after the crisis.

Based on the methodology used by Zettelmeyer (2004) and Kearns and Manners (2006), an event study approach with a 24-hour event window was chosen. The event in this research concerns the monetary policy announcement scheduled by the Reserve Bank of New Zealand, which included both changes and no change in the OCR. In fact there were 37 changes in the OCR, and 53 announcements of no change during the sample period.

Since the decision on each OCR announcement was made ahead of time, it was not affected by the exchange rate movement or public news on the announcement day, therefore, the instrument variable and news classification techniques adopted in Zettelmeyer (2004) were not required. Based on the study of Kearns and Manners (2006), changes in the short term interest rate were used to represent the effect of monetary policy shocks and, instead of using only the 90-day interest rate, as in Zettelmeyer (2004), this research adopted both the 30-day and the 90-day interest rates, separately, as independent variables, in the equation. Since the 30-day interest rate has a shorter maturity period and only responds to one OCR announcement, the 30-day interest rate is more precise for measuring the immediate impact of an unanticipated change in the Official Cash Rate. On the other hand, the 90-day interest rate is better related to the exchange rate, since the OCR announcement is scheduled eight times a year, and the maturity period of the 90-day interest rate may cover two OCR announcements. Since the exchange rate is based on long run expectations, the 90-day interest rate, with a longer forecasting period, should have a larger influence on the exchange rate movement. This is supported by the results showing the coefficient of the percentage point difference on the 90-day interest rate is larger than that of the 30-day interest rate. However, it would not be acceptable to employ an interest rate with a longer maturity period than 90 days as the longer the maturity period, the more external factors effect changes in the interest rate and the harder it is to estimate the effect of monetary policy shocks accurately.

According to the present research results, there is no evidence of an exchange rate puzzle in New Zealand during the selected sample period, which is consistent with previous research by Zettelmeyer (2004) and Kearns and Manners (2006). In addition, the monetary policy shocks are shown to have no great impact on the New Zealand's exchange rate. The results further indicate that every 100-basis-point increase in the 30-day interest rate lead the New Zealand dollar to appreciate by 2.85while the same increase in the 90-day interest rate raised the exchange rate by 3.71%. This is consistent with earlier studies which indicate that monetary policy shocks only explain a relatively small amount of actual exchange rate movements and supports previous assertions that, although monetary policy was important for maintaining inflation and stabilizing economic development, changes in the exchange rate are not exclusively determined by the monetary policy shocks. Due to the small number of observations in the post-financial crisis period, any influence of the global financial crisis could not be identified.

5.2 Contributions of This Study

The relationship between monetary policy and exchange rate is an important factor for countries with a small open economy, such as New Zealand. The monetary policy and exchange rate nexus has a direct influence on the import and export sectors which directly link to the country's Gross Domestic Production (GDP) and economic development. Since the notable economic reforms of the late 1980s, the Reserve Bank of New Zealand has adopted different instruments to implement their monetary policy, but from March 1999, the Official Cash Rate (OCR) has been officially adopted. The OCR has been a good instrument since it has been introduced, however, there has not been enough research focussing on the impact of monetary policy shocks on the New Zealand exchange rate during the last decade. Further, previous studies have come to conflicting conclusions regarding the existence of an exchange rate puzzle in New Zealand.

This study has covered the sample period from March 1999 to June 2010, and, by carrying out an Event Study concludes that there appears to be no exchange rate puzzle in New Zealand since the OCR was introduced. In addition, the results further indicate that the RBNZ has no power to significantly influence the exchange rate by implementing monetary policy shocks. Indeed the RBNZ is relatively powerless against the constantly high exchange rate; therefore the public should not blame RBNZ for the high valued New Zealand dollar. Last, but not least, the results also provide updated information regarding the effects of monetary policy shocks on exchange rates to the RBNZ while the public also gain better information on how to forecast exchange rate movements when facing monetary policy shocks in the future.

5.3 Limitations and Suggestions for Future Research

According to Kearns and Manners (2006), intraday data could more precisely control for endogeneity and external factors that may influence both the nominal exchange rate and the retail interest rate, however, data for short term interest rate movements is available only on a daily basis. If intraday data on the announcement day were available, the event window could be narrowed down further, and the result would be more accurate.

In addition, since the dummy variable for the financial crisis was found to be insignificant, it is not clear whether the current financial tsunami has affected the underlying relationship between monetary policy shocks and the exchange rate. This limitation was partly due to a relatively small sample size for the post-crisis period, with only 17 observations available after the financial crisis hit the New Zealand market. More reliable estimation results will no doubt be possible when more observations during the post-financial crisis period become available. This is clearly an opportunity for further study.

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Appendix

Table A: The Data for Analysis

No.	OCR Announcement Date	OCR	ΔOCR	Δe_t	$\Delta i_{30d,t}$	$\Delta i_{90d,t}$	D_t	D_t^s for 30-day IR	D_t^s for 90-day IR
1	21/04/1999	4.50	0	-0.40	0.01	0.01	0	0	0
2	19/05/1999	4.50	0	-0.79	-0.08	-0.08	0	0	0
3	30/06/1999	4.50	0	-0.94	0	-0.02	0	0	0
4	18/08/1999	4.50	0	0.47	0	0.03	0	0	0
5	29/09/1999	4.50	0	-0.12	-0.01	-0.01	0	0	0
6	17/11/1999	5.00	0.5	-1.09	0.02	-0.01	0	0	0
7	19/01/2000	5.25	0.25	-0.65	0.04	0.05	0	0	0
8	15/03/2000	5.75	0.5	-1.24	-0.08	-0.05	0	0	0
9	19/04/2000	6.00	0.25	0.00	0.05	0.05	0	0	0
10	17/05/2000	6.50	0.5	-0.28	0.02	0.05	0	0	0
11	05/07/2000	6.50	0	-0.43	-0.01	-0.01	0	0	0
12	16/08/2000	6.50	0	-0.69	-0.02	-0.05	0	0	0
13	04/10/2000	6.50	0	-0.32	0	0	0	0	0
14	06/12/2000	6.50	0	-0.73	0	0.04	0	0	0
15	24/01/2001	6.50	0	-0.47	0	0	0	0	0
16	14/03/2001	6.25	-0.25	-0.76	-0.11	-0.11	0	0	0
17	19/04/2001	6.00	-0.25	-0.07	-0.05	-0.14	0	0	0
18	16/05/2001	5.75	-0.25	-0.05	-0.04	-0.08	0	0	0
19	04/07/2001	5.75	0	0.25	0.01	0.02	0	0	0
20	15/08/2001	5.75	0	0.75	0	0.03	0	0	0
21	19/09/2001	5.25	-0.5	0.02	-0.31	-0.27	0	0	0
22	03/10/2001	5.25	0	-0.42	0	-0.01	0	0	0
23	14/11/2001	4.75	-0.5	-0.12	-0.09	-0.04	0	0	0
24	23/01/2002	4.75	0	0.00	0	0.01	0	0	0
25	20/03/2002	5.00	0.25	-0.57	0.19	0.14	0	0	0

26	17/04/2002	5.25	0.25	0.55	-0.01	-0.03	0	0	0
27	15/05/2002	5.50	0.25	0.50	-0.02	-0.04	0	0	0
28	03/07/2002	5.75	0.25	0.16	0.01	-0.03	0	0	0
29	14/08/2002	5.75	0	-1.21	-0.02	-0.04	0	0	0
30	02/10/2002	5.75	0	1.00	0.02	0	0	0	0
31	20/11/2002	5.75	0	-0.14	0.01	0	0	0	0
32	23/01/2003	5.75	0	-1.14	0.01	-0.04	0	0	0
33	06/03/2003	5.75	0	1.09	0	0.05	0	0	0
34	24/04/2003	5.50	-0.25	-1.51	-0.23	-0.24	0	0	0
35	05/06/2003	5.25	-0.25	0.31	0.06	0.05	0	0	0
36	24/07/2003	5.00	-0.25	1.29	-0.04	-0.01	0	0	0
37	04/09/2003	5.00	0	-0.05	0	0	0	0	0
38	23/10/2003	5.00	0	0.35	0	0.01	0	0	0
39	04/12/2003	5.00	0	-0.11	-0.11	-0.15	0	0	0
40	29/01/2004	5.25	0.25	-0.46	0.15	0.22	0	0	0
41	11/03/2004	5.25	0	-2.94	-0.12	-0.15	0	0	0
42	29/04/2004	5.50	0.25	-1.22	0.12	0.12	0	0	0
43	10/06/2004	5.75	0.25	-0.96	0.01	0.05	0	0	0
44	29/07/2004	6.00	0.25	0.21	-0.01	0.04	0	0	0
45	09/09/2004	6.25	0.25	1.13	0	0.05	0	0	0
46	28/10/2004	6.50	0.25	-1.39	0.02	-0.03	0	0	0
47	09/12/2004	6.50	0	-0.10	0.02	0.04	0	0	0
48	27/01/2005	6.50	0	0.77	-0.05	-0.05	0	0	0
49	10/03/2005	6.75	0.25	-0.03	0.03	0.12	0	0	0
50	28/04/2005	6.75	0	0.01	0.03	0.01	0	0	0
51	09/06/2005	6.75	0	-0.10	-0.01	-0.02	0	0	0
52	28/07/2005	6.75	0	0.06	0	0	0	0	0
53	15/09/2005	6.75	0	0.45	0	0.01	0	0	0
54	27/10/2005	7.00	0.25	-0.62	-0.02	0	0	0	0
55	08/12/2005	7.25	0.25	-2.19	-0.05	-0.05	0	0	0
56	26/01/2006	7.25	0	0.44	0.02	0.01	0	0	0
57	09/03/2006	7.25	0	0.54	0.05	0.02	0	0	0

58	27/04/2006	7.25	0	0.85	0	0.03	0	0	0
59	08/06/2006	7.25	0	0.40	0	-0.01	0	0	0
60	27/07/2006	7.25	0	-0.58	-0.01	-0.03	0	0	0
61	14/09/2006	7.25	0	1.68	0.02	0.08	0	0	0
62	26/10/2006	7.25	0	-0.70	-0.2	-0.18	0	0	0
63	07/12/2006	7.25	0	-0.01	-0.01	0.05	0	0	0
64	25/01/2007	7.25	0	0.01	-0.07	-0.01	0	0	0
65	08/03/2007	7.50	0.25	-0.75	0.05	0	0	0	0
66	07/06/2007	8.00	0.25	0.44	0.16	0.2	0	0	0
67	26/07/2007	8.25	0.25	-0.41	0.14	0.07	0	0	0
68	13/09/2007	8.25	0	0.41	-0.07	-0.03	0	0	0
69	25/10/2007	8.25	0	-0.11	0	-0.01	0	0	0
70	06/12/2007	8.25	0	0.94	-0.01	0.01	0	0	0
71	24/01/2008	8.25	0	0.29	-0.03	-0.01	0	0	0
72	06/03/2008	8.25	0	0.55	-0.03	0.03	0	0	0
73	24/04/2008	8.25	0	-0.48	0	-0.03	0	0	0
74	05/06/2008	8.25	0	-1.40	-0.01	0	1	-0.01	0
75	24/07/2008	8.00	-0.25	-1.90	-0.11	-0.13	1	-0.11	-0.13
76	11/09/2008	7.50	-0.5	-2.21	-0.28	-0.26	1	-0.28	-0.26
77	23/10/2008	6.50	-1	-2.59	0.02	0.1	1	0.02	0.1
78	04/12/2008	5.00	-1.5	0.19	-0.03	0.07	1	-0.03	0.07
79	29/01/2009	3.50	-1.5	-0.87	-0.22	-0.23	1	-0.22	-0.23
80	12/03/2009	3.00	-0.5	1.86	0.1	0.3	1	0.1	0.3
81	30/04/2009	2.50	-0.5	0.84	-0.19	-0.15	1	-0.19	-0.15
82	11/06/2009	2.50	0	1.18	0.07	0.13	1	0.07	0.13
83	30/07/2009	2.50	0	-0.99	0	0.01	1	0	0.01
84	10/09/2009	2.50	0	0.00	0	0.03	1	0	0.03
85	29/10/2009	2.50	0	-3.13	0	-0.01	1	0	-0.01
86	10/12/2009	2.50	0	1.75	0	0.01	1	0	0.01
87	28/01/2010	2.50	0	-0.18	0	0.01	1	0	0.01
88	11/03/2010	2.50	0	-0.14	0	0.04	1	0	0.04
89	29/04/2010	2.50	0	0.74	0	-0.01	1	0	-0.01

90	10/06/2010	2.75	0.25	0.82	0.1	0.06	1	0.1	0.06

Source: Reserve Bank of New Zealand