Measuring the Impact of an Interest on Reserves Regime on Monetary Policy Effectiveness: Evidence from New Zealand

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Economics Senior Thesis Capstone

The College of New Jersey

Spring 2011

I. Introduction

According to Adam Smith (1776), the father of modern economics and free market capitalism, the most efficient allocation of scare resources occurs in free markets, where the interaction between market participants ensure a mutually beneficial exchange of goods and services. The competition for the scare resources amongst participants will act as the "natural force" designed to self-regulate the markets from any externalities or failures. This "invisible hand" theory has proven to be the backbone on which many economies have thrived, yet observed externalities have proven that the practical application is more complex than theory dictates.

Imperfections to the free spread of information, labor, and capital manifest into a series of economic growths and contractions best known as the "business cycle."[1] Markets expand and contract to offset any divergence from the equilibrium allocation of resources, resulting from these market imperfections. The frequency and size of such fluctuations are often unpredictable, yet historically; severe economic recessions have been the primary catalyst in changing social and economic norms to develop a more sustainable growth model, using increased regulation and intervention. This gradual change in ideology culminated in the mid-twentieth century and ushered in a new wave of economic thought known as "Keynesian economics", under which active government policy would offset or mitigate market failures and (negative) externalities by targeting price stability and full employment.

According to Keynesian economics, active policy responses by the government can be classified into two branches: fiscal and monetary policy. The implementation of fiscal policy relies on changes in government expenditures and/or revenue (i.e. taxation) to affect future expectations of consumption, investment, and savings. Monetary policy has traditionally relied on changes within the supply of money to affect market interest rates, in hopes of affecting aggregate demand. Both fiscal and monetary policy ultimately influences the rate of interest within an economy; however, due to the lags between the

[1] O'Sullivan, Arthur; Steven M. Sheffrin (2003). *Economics: Principles in action*. pp. 57

implementation and its effects becoming detectable, monetary policy has become the preferred method of intervention. Monetary policy is best suited to address and correct fluctuations stemming from short-term market volatility, whereas fiscal policy is designed to address a systematic or prolonged market failure. This framework has been attributed with being the foundation for maintaining sustainable growth.

The underlying cause for any effective monetary policy lies within the positive demand for money. Keynes (1936) did acknowledge, however, the implications of an economy with a perfectly elastic demand for money, where changes in the supply of money would not alter market interest rates. Under this scenario, monetary policy becomes impotent, as attempts to stimulate the economy, through monetary injections, become futile, as interest rates are unresponsive. This phenomenon has become known as a liquidity trap, and applies furthermore to an economy with nominal interest rates at/or approaching zero, yet expectations or willingness to invest remain pessimistic. With an impotent monetary policy, massive expansionary fiscal policies become the only viable economic and political option; which due to a larger time lag can be associated with larger economic costs. The case of Japan in the 1990's, with a decade of stagflation and nominal interest rates at the zero bound level, does highlight the large economic cost and time required to re-stimulate the economy solely through fiscal policy, as a result of impotent monetary policy. Currently, the United States and many European nations are seeking solutions for this issue, after the most recent financial crisis in 2007, hoping to re-stimulate their fragile economies and forgo falling back into another recession.

It is therefore the goal of this paper to illustrate a monetary system, based on the U.S. Federal Reserve System, which will explain and suggest a possible tools of monetary policy to stimulate an economy in the midst of a possible liquidity trap, as well as prevent possible future liquidity traps from coming into effect. The new monetary system will target the market for reserves, and analyze the effect of paying interest on reservess. The paper hypothesizes that a monetary system, which pays interest on reserves is more effective at influencing market interest rates as well as other vital economic indicators, as opposed to a system which does not pay interest on reserve, and targets the supply of money to indirectly affect market interest rates. The implementation of such a monetary system should help control future growth and inflation expectations by creating a permanent but flexible demand for money and provide the central bank with greater oversight and influence over financial markets.

To test the aforementioned hypothesis, this paper will use the case of New Zealand and its transition, in 1999, from a monetary system that solely manipulated the supply of money within reserve account balances, to a monetary system which pays interest on reserve account balances at a set rate. Prior to the 1999 change, New Zealand's central bank authority, the Reserve Bank of New Zealand, used a Monetary Conditions Index (discussed later) to determine its policy stance, whereas currently the Reserve Bank sets an Offered Cash Rate (OCR) which is the average of the interest rate paid on account balances, as well as the minimum interest rate from which any member institution can borrow. Data from before and after the transition period will test (using linear regression) each monetary instrument's influence over short-term interest rates, the total value of government securities issued, money supply (M1), as well as a trade weighted index (TWI) to determine which system offers the Reserve Bank of New Zealand greater influence over domestic markets and their fluctuations. This result will provide empirical evidence, from which certain inferences can be made about the impact of paying interest on reserve account balances within the United States.

II. Theoretical Foundation for an Interest on Reserves Regime

In order to begin discussing and analyzing the new monetary system, proper definitions must first be assigned, and certain scenarios will require an analytical overview to provide the best introduction for the new system.

Liquidity Trap

According to Keynes (1936), the liquidity trap refers to monetary policy being unable to stimulate the economy through lowering interest rates or increasing the money supply due to an infinitely elastic demand for money. The infinitely elastic demand for money arises as an economic contraction places downwards pressure on interest rates until they approach or reach the zero bound, as mentioned by Hicks (1937). Moreover, expectations of adverse effects like deflation, reduced aggregate demand, and global financial uncertainty pin the interest rates at the zero bound. The combination of nominal interest rates at zero and pessimistic expectations of the economy create the infinitely elastic demand for money (Dotsey, 2001).

The "trap" comes from the inability for interest rates to become low enough to stimulate economic activity, as nominal interest rates cannot drop below zero: lenders lose all incentive to lend at a rate where any loan incurs a nominal loss (Fisher 1930). This decrease in lending activity paralyzes financial markets as consumption and output fall accordingly as a result of possible deflation. According to Fisher equation, nominal interest rates are equal to real interest rates plus the expected rate of inflation. With nominal interest rates at zero, real interest rates must become negative to reach equilibrium. Expectations of inflation must therefore be equal and the opposite (positive), yet deflation is causing negative inflation expectations, preventing interest rates from reaching equilibrium. The economy is "trapped", unable to stimulate growth.

Traditional monetary policy will be unable to reverse the effects, as an increase in money supply would only exacerbate the problem. With zero bound interest rates, the opportunity cost of holding cash is removed, creating excess liquidity (Keister, Martin, McAndrews, 2008). Yields within the bond market will drop, as short-term bond yields will reach zero. As cash becomes a perfect substitute for bonds, typical open market operations which alter relative bond and money amounts within a portfolio is now completely futile (Dotsey, 2010). Moreover, additional injections of money will just be absorbed as prices and inflation will no longer be affected by monetary policy.

The Market for Reserves and Traditional Monetary Policy

With the liquidity trap phenomenon and its effects defined, a definition and analysis of bank reserves and their corresponding market will provide insight into overcoming the liquidity trap. Within the monetary system, bank reserves serve as a buffer against liquidity shortages, clearing needs, as well as other uncertainties, and are maintained within an account held at the central bank (Frost, 1971; VanHoose &Humphrey, 2001). The amount of reserves that are required, are set by the central bank and is dependent upon the total amount of demand deposits within a certain maintenance period (Meulendyke, 1998). From this total figure, a specific ratio is applied to determine "required reserves". Intra-day or overnight overdrafts (account balance reaching zero) result in large fees and ensure account balance maintenance. For this model, the maintenance period is two weeks, similar to the Federal Reserve System. Any number of reserves in excess is called "excess reserves". These terms will play an important role in overcoming the liquidity trap.

Additional terms that will be defined and analyzed follow the formula for the components and determinants of total reserves. The demand for total reserves is calculated by the addition of required reserves and excess reserves; however, the supply of total reserves is comprised of "borrowed reserves" and "non-borrowed reserves"[2]. Borrowed reserves consist of secured loans from the central bank and it is these reserves that classify the central bank to be the "lender of last resort."[3] Non-borrowed reserves comprise of applied vault cash and balances held with the central bank[4]. These balances consist of any bonds, securities, or other non-cash denominated assets. The demand for total reserves must equal the supply of total reserves.

The market for these reserves will be similarly based on the Federal Funds market. One exception will be the exclusion of Government-Sponsored Enterprises (GSEs), as their participation within the market for reserves follows different rules. The market for reserves allows for the distribution

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[2] Meulendyke: (1998) U.S. monetary policy and financial markets. Ch. 6.

[3] Glossary: lender of last resort. FRB Minneapolis. http://www.minneapolisfed.org/glossary.cfm?js=0#l

[4] Meulendyke: (1998) U.S. monetary policy and financial markets. Ch. 6.

of reserves amongst financial institutions and to allow for possible central bank intervention. The distribution of reserves is defined within the model as lending of surplus “excess” reserves to an institution in need of reserves, and to clear payments amongst members. Central bank intervention can be defined as the traditional tools of monetary policy: open market operations and secured loans. Open market operations are the buying and selling of reserves by the central bank in exchange for bonds or other government-issued securities. Secured loans provide credit at a set interest rate to financial institutions, which are unable to acquire necessary funds through normal money markets. It should be noted that for large financial institutions, the direct borrowing from the central bank creates an alienating stigma of insolvency or financial weakness[5].

The importance of the market for reserves and the rate, to which each member lends to another at, is the benchmark for all lending rates within the economy. An interest rate is targeted by the central bank; however, the rate upon which member financial institutions agree upon for overnight collateralized loans is the actual inter-bank lending rate. Term loans require higher rates, dependent upon maturity. For this model, the focus will be on the target and actual inter-bank lending rates. It is assumed that at a rate of zero or within twenty-five basis points (0 - .25bp), the demand for reserves becomes inelastic and any change to the supply of reserves will be absorbed into excess reserve account balances. Furthermore, the rate at which the central bank directly lends (secured loans) to any financial institution is known as the discount rate. The discount rate is intended to hold an additional “penalty” rate and therefore, must be the highest rate within the market. The final key market rate will be defined as the “interest on reserves”. This rate is the interest rate paid by the central bank on reserve account balances and will serve as the foundation for this model.

Implications of Paying Interest on Reserves

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[5] "The Primary & Secondary Lending Programs." *The Federal Reserve Bank Discount Window & Payment System Risk Website*. <http://www.frbdiscountwindow.org/programs.cfm?hdrID=14>.

In order to fully analyze the effect of the interest rate paid on reserves on monetary policy in this model, theoretical solutions to a liquidity trap must first be outlined to determine whether or not all criterions have been met. As mentioned earlier, according to the Fisher equation, a negative real interest rate or a positive expectation of inflation must be achieved in order to achieve the necessary equilibrium. The yield on reserve accounts will provide the central bank with the necessary ability to achieve each of these targets.

The first measure which must be taken by the central bank must be to establish a proper yield on each reserve account balance to alter the real interest rate within the economy (Goodfriend, 2000). The yield paid on the required reserve balances must differ from that on excess reserve balances in order to manage the demand difference between required reserves and excess reserves (Frost, 1971). Within a liquidity trap, the excess liquidity offers banks enough money to hold higher levels of capital as a "buffer" against default, primarily due to the increased pessimism throughout the economy (VanHoose & Humphrey, 2001). This unpredictable demand for reserves will then create unpredictable price levels and economic activity (Hall, 2002). Thus, varying the yields on each reserve balance will shift the demand for reserves, giving the central bank greater influence.

The first yield which must be calculated will be for excess reserve balances. Paying a lower interest rate on excess reserves allows for a greater incentive for member financial institutions to holding higher levels of required reserves (Klein, 1974). Furthermore, as economic uncertainty grows and a liquidity trap forms, total excess reserve balances grow (Frost, 1971). This relationship allows for the yield on excess reserve balances to be determined by other economic factors. According to Hall (1983, 2002), the proper yield should be based upon factors like economic growth estimates, previous yields on reserve balances, and most importantly price level. This will allow the yield to fluctuate to accommodate changing economic conditions especially inflationary concerns. Interest is to be paid daily to remove further volatility and any unexpected fluctuations within the market (VanHoose & Humphrey, 2001).

The yield on each reserve balance does hold an important relationship to other key market rates. The relationship between the yield on reserve balances and the inter-bank lending rate, the discount rate, as well as the yield on short-term bonds can allow the central bank greater influence in affecting other market rates. Understanding these relationships will be important in determining the yield, and will also prevent any yield equation from becoming an automatic stabilization policy (Goodfriend, 2000). It must be understood that any valuation of the yield on reserve balances must be used as a guideline, which can be readily changed to address any additional market externalities not addressed within the paper. Automatic stabilization policies implicitly face a systematic risk in their immediate responsiveness to volatile endogenous or exogenous shocks (large or small), which may unnecessarily cloud economic forecasts or predictions.

The first relationship is with the inter-bank lending rate. If the yield should rise above the targeted inter-bank lending rate, then demand for reserves will rise as banks will receive a greater yield just by holding onto reserves. On the other hand, if the yield on reserve balances is lower than the targeted inter-bank lending rate, the demand for holding reserves will fall. Finally, if the two rates are equal, then there is no incentive for member banks to lend excess reserves in the inter-bank lending market, unless clearing payments require a member bank to borrow from the market. (Hall, 1983)

The second relationship is with the discount rate. If the yield on reserve balances rises about the discount rate, member financial institutions have no incentive for the inter-bank lending market, as borrowing funds directly from the central bank, then holding the reserves will incur a profit. If the yield is lower, then an interest rate corridor is established, through which the inter-bank lending rate can fluctuate. Lastly, if the rates are equal, then the quantity demanded for reserves will become infinite as borrowing directly from the central bank will incur neither a penalty nor profit.

The last relationship is with the yield on short-term bonds. If the yield is higher than the rate on short-term bonds, demand for reserves will rise. On the other hand, if the yield on the short-term bonds is higher, then the demand for reserves will fall. With equal yields, then the presence of perfect substitutes becomes apparent. It is interesting to note this relationship, even though the risk associated with short-term bonds is different than that for reserves. (Walter & Courtois, 2009)

The impact of paying interest on reserve balances will provide the necessary influence to stimulate the economy. The yield on the excess reserve balance will establish an interest rate floor and will prevent the actual inter-bank lending rate from falling below the target rate, as no member financial institution would lend money at a rate lower than the interest received for holding those reserves (Goodfriend, 2000; Walter & Courtois, 2009; Dotsey 2010). This is extremely important as it prevents the actual rate from falling between zero and twenty-five basis point level. Additionally, the difference in the yields between required reserve balances and excess reserve balances will create an even smaller corridor through which the inter-bank lending rate can fluctuate. Member banks will seek to receive a higher yield than paid on excess reserves; however, will not receive a rate greater than that paid on required reserves. The difference in yields can be changed by the central bank to control the corridor. This will allow for more accuracy and less volatility within the inter-bank lending market (VanHoose & Humphrey, 2001).

Lastly, the greatest problem facing central banks is credibility. Through increased liquidity into the market, inflationary concerns are sure to rise once the economy begins to stabilize, yet the public will expect the central bank to reverse this monetary easing once the economy rebounds (Keister, Martin, McAndrews, 2008; Dotsey, 2010; Walter & Courtois, 2009). By establishing permanent yields on reserve balances, any expansionary monetary policy will become permanent, as the central bank can now change the yield to alter the increase or decrease the demand for reserves based on the economic climate.

Furthermore, the implementation of such yields on reserve account balances does not affect the control on the supply of reserves within the economy. Once the inelasticity for reserves is removed, any alteration to the supply of reserves will be met with a corresponding change to the inter-bank lending rate (Hall, 1983; Klein, 1974).

In summary, a monetary system which incorporates paying interest on reserve account balances in conjunction with the traditional tools of monetary policy provides a better theoretical solution to the existence of a liquidity trap and its effects. The permanent installment of such a new regime will offer an easier convergence of inflationary and growth expectations, the interest rate corridor reduces inter-market volatility, and the ability to vary the yields on each reserve account balance offers the central bank a new instrument to influence financial markets and its participants. As theory often diverges from practical reality, testing the model against empirical evidence will solidify and offer support in favor of the hypothesis. Using a linear regression model, data from New Zealand will be tested to determine which monetary policy instrument exerts a greater influence over key economic performance indicators.

III. Practical Application of Interest on Reserves Regime: The Case of New Zealand

To ensure for the best test of the aforementioned hypothesis, data must be drawn from a country which has experienced a change in monetary instruments to a system relying on paying interest on reserve account balances. On March 17, 1999 the Reserve Bank of New Zealand (Reserve Bank henceforth) introduced a new monetary instrument, known as the Official Cash Rate (OCR henceforth) to replace the previous monetary system, which relied heavily on a Monetary Conditions Index (MCI henceforth) to determine appropriate monetary policy stances.[6] An analysis of each policy instrument within the given economic structure and framework, in a given time period, will shed light on the success of how such a transition can be achieved and applied to the United States model.

Characteristics of the Reserve Bank Framework

The framework of the Reserve Bank is important, in that it contains unique characteristics for an OECD member nation. Foremost, the Reserve Bank does not offer deposit insurance, and is owned entirely by the New Zealand Government, which means that all excess revenue goes back into a

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[6] "What Is the Official Cash Rate?" *Reserve Bank of New Zealand*. <http://www.rbnz.govt.nz/monpol/about/0072140.html>.

government account. This varies, from the United States Federal Reserve System, as member banks hold voting power within their respective regional Federal Reserve Banks[7]. Furthermore, the lack of private ownership prevents member banks from participating in accounts similar to the Treasury Tax and Loan Service (TT&L account), where tax receipts are maintained within the banking sector in a Treasury account (aims to limit the effect of taxation on monetary policy). [8]

Next, it is important to note, that member banks, after the 1999 transition, within the monetary system are not required to hold a specified level of reserves. Prior to 1999, no set “floor” was set for account balances, but rather the Reserve Bank would estimate and target account balances based on previous trends and shifts in the MCI. This is different than the Federal Reserve System in the United States, where member financial institutions are required to hold a specific percentage of the nominal value of demand deposits as a “liquidity buffer”, which are calculated and updated daily by the Federal Reserve (Meulendyke 1998). This implies that there is no system of required reserves, or excess reserves within the New Zealand economy. Simply put, member banks are encouraged to hold account balances at the Reserve Bank, because the account is the transmission method by which the Reserve Bank can exchange coins and notes, conduct basic open market operations, and offer member banks a payment clearing system (similar to Fedwire). This inter-bank lending market is uniquely different, as it can only exist given a positive demand for the services of the Reserve Bank.

Lastly, the conduct of open market operations remains the same amongst both monetary systems. Liquid assets can be lent or purchased in exchange for government securities, most commonly in the form of repurchase agreements (repos). One distinction is the Reserve Bank’s current “no limit” on the amount of cash it will borrow or lend to member banks[9]. This corresponds with the lack of “required” reserve within the New Zealand monetary system. Prior to the transition; however, the Reserve Bank

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[7] "The Federal Reserve System in Brief: Organization of the Fed." *The Federal Reserve Bank of San Francisco: Economic Research, Educational Resources, Community Development, Consumer and Banking Information*. <http://www.frbsf.org/publications/federalreserve/fedinbrief/organize.html>.
[8] Meulendyke: (1998) U.S. monetary policy and financial markets. Ch. 6.
[9] Brookes, Andy, and Tim Hampton. "The Official Cash Rate One Year on." *Reserve Bank of New Zealand Bulletin* 63.2 (1999): 53-62. *Reserve Bank of New Zealand.*

relied on changes to their MCI, relative to the targeted level, to determine the quantities of settlement balances necessary for meeting their formal inflation forecast.

Monetary Conditions Index

As defined by Guender (2005): a Monetary Conditions Index is a simple device that combines movements in different financial variables, notably the interest rate and the exchange rate, into a single number. The concept behind the MCI is that in an open economy both the real interest rate and the real exchange rate are important factors in the determination of aggregate demand.[10] With price stability as one of the, if not the, most important goal of monetary policy, a central bank could forecast the rate of inflation, and prepared a path of the MCI that was thought to be compatible with attainting the objective.

An important feature of the MCI is that the absolute level of the index holds no importance; but rather, the changes in the MCI reflect changing monetary conditions between two points in time. An increase (decrease) in the index indicates that monetary conditions have tightened (eased).[11] Furthermore, the construction of the MCI is relative to the weight assigned to the real exchange rate. This relative weight is not observable and must be estimated, which allows the MCI to fluctuate in accordance with exchange rate movements (Guender 2005). This feature of the MCI makes it unique to the fixed-instrument strategy (setting fixed interest rate), as the index is designed to offset *a portion* of unexpected movements, whereas a fixed-instrument contains *no response* to the unexpected change (Hunt 1999).

A logical rationale for applying a MCI to New Zealand's monetary system was its [New Zealand's economic] dependence and exposure to global price and trade fluctuations. This is derived from Hunt's (1999) defining the two implicit assumptions about achieving the inflation objective embodied in maintaining a MCI:

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[10] Guender, Alfred. "Monetary Conditions Index." *Princeton Encylopedia of the World Economy*. 1-6. Print.
[11] Guender, Alfred. "Monetary Conditions Index." *Princeton Encylopedia of the World Economy*. 1-6. Print

- “The first is that the direct effect of the exchange rate movement on imported goods prices will not become entrenched in generalized inflation expectations.
- The second assumption is that the exchange rate movement is itself in no way related to changes in other real factors in the economy that influence demand conditions.”

The first assumption states that the projected demand conditions prior to the unexpected exchange rate movement will yield similar medium-term inflation outcomes as those after the unexpected exchange rate movement. The second assumption states that the same level within the MCI, prior to the unexpected change, will yield similar demand conditions after the unexpected movement. Any violation of these assumptions alters the effectiveness of the MCI, requiring a greater level of market intervention to reach the inflation target. In New Zealand, the Reserve Bank would publicly signal any gross deviation from the targeted path, and would adjust settlement account balance levels accordingly (Hunt 1999).

In summation, the use of a MCI by the Reserve Bank was a result of New Zealand’s large trade exposure, in an attempt to reach formal inflation targets, realized through changes in the MCI, and implemented through adjusting the supply of settlement balances. The rigidity of the assumptions governing the effectiveness of a MCI system provides a logical path to why the Reserve Bank decided to alter its primary monetary policy instrument, for an Offered Cash Rate (fixed-instrument strategy). It can be inferred that if New Zealand’s economy grew through an intensive economic growth strategy, as opposed to a strategy heavily reliant upon trade revenue, then the probability or systematic risk of violating the MCI assumptions would increase accordingly. Additionally, increasing development and complexity of financial markets has pushed the Reserve Bank to adopt alternate monetary policy instruments to adapt to the changing global economic climate.

Inflation Targeting and Change within the Reserve Bank of New Zealand

The Reserve Bank's primary function, as defined by the Reserve Bank of New Zealand Act 1989 is to provide "stability in the general level of prices." The “inflation forecast targeting” approach

(Svensonn 1997) by New Zealand through explicit formal inflation targets, typically 2 percent per year with an explicit tolerance around ±1 percent per year, seemed to "be sufficient" in achieving the desired economic conditions.[12] The nature of New Zealand's economy to be relatively dependent on trade balances and trade volume with its partners, in comparison to the United States; as well as smaller economic size were key aspects to the Reserve Bank's stance on monetary policy. The Reserve Bank placed (and still does) a considerable weight on incorporating exogenous trade shocks into policy decisions. Overall, the general advantage of inflation targeting, for smaller open economies, includes focusing monetary policy directly on achieving low and stable inflation, and with a specified quantitative target, it provides a measurement of inflation expectations relative to the inflation target (Svensonn 1997).

Although deemed "sufficient", in December 1996, the Reserve Bank indicated that it was reviewing some aspects of the way it implements monetary policy and signaled its desired stance.[13] The Reserve Bank describes the review as: "[the review] has been about how we simply, effectively, and efficiently put the desired [monetary policy] stance into effect."[14] Furthermore the Reserve Bank states: "Much greater emphasis is now placed on interest and exchange rates. As a result, there is much less need for processes which attempt to control relatively precisely the quantities of settlement balances."[15] In addition, inflation reviews and forecasts occurred less frequently (quarterly) as opposed to that in larger economic countries, like the United States (6 weeks), due to a reduced availability of new economic information (Hunt 1999). This lag between economic data releases is mitigated when the primary source of inflationary pressures stem from an exogenous level of demand relative to the economy's productive capacity. The immediate and continuous variation of the exchange rate allows for the Reserve Bank to maintain active oversight over the domestic economy (Hunt 1999); however,

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[12] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*. June 1997. Web. Mar. 2011. <http://www.rbnz.govt.nz/monpol/about/0047964.html>

[13] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

[14] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

[15] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

when inflationary pressures are a result of other endogenous factors, the Reserve Bank must rely on other economic indicators to track and forecast inflation rates. The change to the OCR system culminated in the decision on February 8, 1999, as a result of the Reserve Bank's review.[16]

Offered Cash Rate Regime

The establishment of the OCR was cited as: "Adopting a cash rate system would maximize the scope for, and the benefits of, the sorts of operational reforms; the more the levers are price-based, the less the need to manage the demand for the quantities."[17] The relationship between the quantity of settlement cash supplied, bank behavior, and interest rates proved to not be very tight or predictable (Archer, Brookes, Redell 1999). Previous policy statements proved to hold "too uncertain of an impact and were subject to misinterpretation."[18]

Essentially, the OCR is the mid-point between the interest rate charged for borrowing "unlimited" quantities of settlement cash, and the interest rate paid on settlement account balances (not applicable to account balances in excess of $20 million).[19] The range of each rate is 50 basis points wide[20]. The OCR is reviewed every 6 weeks on pre-announced dates (or 8 times per year) to better align inflation expectations, and can be changed quickly in case of a substantial economic flux. As the mid-point between the "borrowing" and "depositing" interest rates, a "channel" is created, through which inter-bank lending rates can vary[21]. No member bank will borrow at a rate higher than that required by the Reserve Bank, nor would any member bank lend funds at an interest rate lower than that offered by the central bank. This channel allows for greater control over benchmark interest rates with added operational simplicity and transparency.

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[16] "What Is the Official Cash Rate?" *Reserve Bank of New Zealand*. <http://www.rbnz.govt.nz/monpol/about/0072140.html>.

[17] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

[18] Archer, David, Andy Brookes, and Michael Reddell. "A Cash Rate System for Implementing Monetary Policy." *Reserve Bank Of New Zealand Bulletin* 62.1 (1999): 51-61. Print.

[19] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

[20] "What Is the Official Cash Rate?" *Reserve Bank of New Zealand*. <http://www.rbnz.govt.nz/monpol/about/0072140.html>.

[21] Brookes, Andy, and Tim Hampton. "The Official Cash Rate One Year on."

Brookes and Hampton (1999) argue that the OCR regime has reduced volatility in short-term interest rates as a result in the breakdown of the strong negative relationship between short-term exchange rate movements and the 90 day interest rate (which itself was a direct consequence of the previous implementation regimes). The review conducted by the Reserve Bank even states: "Under this sort of system [OCR regime], the normal inter-day fluctuations in settlement cash balances would be fairly small relative to the average level of those balances - completely inverting the current situation - and there would be little need for active Reserve Bank daily liquidity management operations."[22]

Although there is an extensive amount of information supporting the OCR regime, and its effects on the broader economic spectrum, as statistical test, using linear regression, will prove that the OCR regime is indeed a more significant instrument of monetary policy, reflecting the hypothesis that monetary systems, which pay interest on reserve account balances, do provide for a greater influence over interest rates as well as exchange rates.

IV. Empirical Data and Regression Methods

In order to begin the statistical test of the hypothesis, proposed by the paper, each variable used must be described to highlight their importance to the regression model. Each variable must be a component of a fiduciary system; however, testing each separate and individual component would be too arduous and would most likely dilute the statistical results. Two different linear regression models will be tested to determine how many of the independent variables hold a statistical significance on the corresponding dependent variable. The outline of the empirical results will follow accordingly: defining each variable with an estimated guess on the expected coefficients, a brief discussion on any possible biases, and finally the method used to run the regression.

Dependent and Independent Variables

[22] New Zealand. Reserve Bank of New Zealand. Financial Markets Department. *Monetary Policy Implementation and Signalling*

With the focus of the paper highlighting each monetary policy instrument, both the MCI and OCR will serve as dependent variables (one for each linear regression model). (M1 will also be used as a dependent variable; however, this will be explained later) The time period for each regression model will vary, because the instruments were not used simultaneously (mentioned later). Each dependent variable will be tested against the same independent variables during the corresponding time period, to further ensure statistical accuracy. Each dependent variable must also be a policy instrument that is/was targeted to achieve inflation expectations, as that is the primary goal of the Reserve Bank.

MCI as the Dependent Variable

As the first instrument of monetary policy, the MCI will be the dependent variable for the first regression model. The time period for the MCI regression model will incorporate data from April 1990 to March 1999, using monthly data in the results. The model will have a total of over 100 observations, to ensure statistical accuracy. Furthermore, any MCI level used after March 1999 would be detrimental to the experiment, as the new policy instrument had been implemented. Although data exists for MCI after March 1999, it is not used, because the Reserve Bank solely uses the MCI as an economic indicator, rather than the primary instrument in targeting inflation expectations.

The dependent variable, MCI, will be defined as the level of the MCI at each monthly interval. Although, the absolute level of the MCI holds no significant value, the regression model should capture the variations within the MCI. Furthermore, the level of MCI, as an index requires a base level, which is set as Q4 1996 = 100. This base level is set as no other base year can be found from the Reserve Bank's statistical database.

OCR as the Dependent Variable

As the newer instrument of monetary policy, the OCR will be the dependent variable for the second regression model. The time period for the OCR regression model will incorporate data from May 1999 to April 2008, using monthly data in the results. The model will, once again, have a total of over 100 observations, to ensure statistical accuracy. Furthermore, the decision to use the OCR rate beginning with May 1999 was designed to alleviate any externalities that would arise from the transition process between policy instruments. In addition, as mentioned earlier, data prior to March 1999 simply does not exist because of the implementation date.

The dependent variable, OCR, will be defined as the OCR rate at each monthly interval, set by the Reserve Bank. Although, the OCR rate is reviewed every 6 weeks and is often times not adjusted at every review session, for the purpose of the model, the OCR rate will repeat along each monthly interval, until a change was reported.

Independent Variables

The determinants for both policy instruments can be derived from their function to target and attain formal inflation expectations. Thusly, each regression model can incorporate the same independent variables, assumed to be related to either the short-term interest rate or the exchange rate. This rationale is derived from the MCI equation, which places relative weights on the real exchange rate, as well as real interest rate. Without the relation to the short-term interest rate or exchange rate, any possible variable was deemed unnecessary and excluded from the model.

The first independent variable will be the average of short-term bill yields, as reported by the Reserve Bank. The variable will be the average of the 30 day, 60 day, and 90 day yields. Choosing each individual yield to be an independent variable could offer some insight onto the effect of the policy instrument on various short-term yields; however, due to a possible (probable) correlation problem, the simple average of each yield for each month will be used. The possibility of high levels of correlation still exists, under the framework of the OCR regression model, as structurally, each short-term yield should be based on the OCR rate plus an additional ‘risk premium’ associated with any default risk held by the New Zealand Government. This relationship is similar to that mentioned earlier, in regards to the Federal Funds Rate, as well as the yields on reserves to T-bill yields. Choosing short-term interest rates as an independent variable is important because short-term fluctuations in interest rates will affect ‘borrowing’ costs within the economy, and should be influenced by a monetary policy instrument. We estimate that the average yield on short-term Bank Bills will correspond with a positive coefficient for MCI (higher yields result in contracting monetary conditions, and a positive coefficient for OCR (higher yields result in higher benchmark interest rates).

The next independent variable chosen is designed to capture exchange rate fluctuations, as the degree of exposure to the global economy, is still relatively high. Economic shocks within Australia would have profound implications on New Zealand, as the two economies have similar economic structures, and rely upon each other for trade. The variable chosen is the Trade Weighted Index (TWI), as calculated by the Reserve Bank. The base year for the TWI amongst both regression models is 1979. We hypothesize that an increase in the TWI will correspond with a positive coefficient for MCI (higher index level corresponds with a stronger exchange rate and contracting monetary conditions), and a negative coefficient for OCR (higher index level corresponds with a stronger exchange rate and lower interest rates).

The third independent variable tested is the total value of government securities issued. This variable can be defined as the total value of government securities issued by the New Zealand Government (in $NZ million), in order to borrow against or finance public expenditures. This variable was chosen, because of its relationship with borrowing rates and the strength of the currency. If the total value of government securities increases, we estimate that the coefficients for both MCI and OCR will be negative (a higher value of securities issued will lower interest rates and signal expansionary monetary conditions). Additionally, the larger the value of total government securities issued should place a downwards pressure on the currency. The last reason for choosing the total value of government securities as an independent variable lies with the relationship between transmissions of open market operations. Both policy instruments are used in conjunction with the transmission of open market operations, with the MCI relying solely on open market operations to reach the target settlement account balances, and the OCR regime allows for open market operations to smooth out any excess of liquidity within the financial markets.

The final independent variable is the total money supply, as defined by M1. M1 is defined as the total value of currency in circulation in addition to the total value of demand deposits (in $NZ million), as reported by the Reserve Bank. This variable is quite unique and requires additional explanation. M1 was also run as a dependent variable, as a third regression model; however; those results will not be interpreted as M1 proved to be an endogenous variable (associated with a high Hausman statistic), and forced the regression models to use Two-Stage Least Squares Estimation, to account for its endogeneity. Furthermore, a plot graph proved that M1 to be constantly increasing, independent of economic fluctuations or climate. This will be attributed to the change in monetary policy instruments, as the quantity of settlement account balances served a minor role in monetary policy under the OCR regime. A more in-depth analysis of this variable will be mentioned below. Using macroeconomic theory in regards to monetary policy, we estimate that M1 will have a negative coefficient for MCI, as well as for OCR. This arises from the assumption that a higher money supply is a signal of expansionary monetary conditions, and lower interest rates.

Biases/Abnormalities

Within every linear regression model, certain biases must be accounted for and removed as to provide the best statistical result. Within each regression model, there proved to be statistical biases which required either altering the variables or a using a different statistical test to prove the model's significance. M1 proved to be an endogenous variable in addition to MCI and OCR (as assumed). As an endogenous variable, the assumptions for OLS estimation were violated, and so a simple regression model is not appropriate.. M1 also proved, in addition, to be a constantly increasing variable, as a regression model of M1 on MCI and time as well as OCR and time proved that the time variable was highly significant. We will attribute this consistent rise of M1 to two separate events. First, as mentioned earlier, the implementation of a new policy instrument (OCR), the Reserve Bank no longer targets M1 in terms of settlement account balances, but rather focuses primarily on the OCR. This does not mean that M1 is not an important variable, but rather the Reserve Bank's willingness to lend or deposit 'unlimited' quantities of cash to member banks, is met with the demand to borrow or lend massive quantities of cash, which ultimately has a greater impact on the total money supply, as opposed to any variation within the MCI or OCR. Furthermore, the development of financial markets during the 1990's can be attributed to the constant rise in M1, seen during the MCI period. A small open economy like New Zealand must continue to inject money into the monetary system to meet an increasing demand for the currency, driven by the increased demand from consumers; however, more likely from exporting producers, to purchase either domestic or foreign goods and services.

As mentioned above, another possible bias arises from the correlation between the independent variables. The correlation amongst each short-term Bill yield could be classified as positive auto-correlation, and so the average of the yields was taken to mitigate this correlation. Another possible correlation bias may arise from the total value of government securities issued and the average of the Bill yields. Because the yields are from government securities themselves, the correlation would show up as a perfectly negative relationship (an increase in the value of government securities will lower Bill yields). This bias was assumed, and not tested for, because it is assumed that all monetary indicators are correlated (even very weakly) to one another. This assumption of an implicit correlation was expanded to assume a small or weak correlation enough to not have any significant effect on the individual regression results. With the possible biases discussed, the regression procedure can be explained.

Regression Procedure

Prior to determining the endogenous nature of the dependent variables and M1 numerous statistical tests were run using the OLS estimation procedure. In these tests, M1 was treated as a dependent variable, and was tested against the policy instruments, their lag, as well as their difference in relation to the independent variables, as well as a time variable. As mentioned, a test for endogeneity revealed that each dependent variable (MCI & OCR), as well the independent variable: M1, were endogenous and therefore do not provide unbiased estimates, when using OLS estimation in a simple linear regression model. To account for this bias and correct it, each dependent variable was run against the independent variables using the Two-Stage Least Squares Estimation procedure. The remaining variables (those not proven to be endogenous) were classified as the instrumental variables, which addresses the possible correlation bias mentioned above. Each instrumental variable does not itself belong in the explanatory equation and is correlated with the endogenous explanatory variable.

In conclusion, using the Two-Stage Least Squares Estimation procedure, each regression model was run. Each model can be defined as:

- *MCI = Intercept + M1 + TWI + Yield Average + Value of Government securities issued*
- *OCR = Intercept + M1 + TWI + Yield Average + Value of Government securities issued*

Each independent variable will be tested at the 5% significance level.

In accordance with the hypothesis; we estimate that the OCR regression model will demonstrate that each of the chosen independent variables is statistically significant, as opposed to the MCI regression model, where we estimate that only the TWI and Yield Average will be statistically significant. If our estimates are correct, then we can infer that the new policy instrument using the OCR regime is more effective and a better determinant of fluctuations within the economy. If this is valid, then a monetary system that pays interest on reserves is more effective than an instrument that solely targets and influences the account balances to attain and maintain inflationary and growth expectations.

V. Empirical Findings and Analysis

-For the Tables and Figures with the regression results, refer to the **References** *section-*

Running each regression model using Two-Stage Least Squares Estimation accounted for the endogenous bias and provided results that were full rank and the best estimates. Each model is significant, shown by the large 'goodness of fit' with a coefficient of determination (R^2) above .9. If in case, the coefficient of determination (R^2) is not a good measure, then using the Adjusted-R^2 coefficient may help: this is also above .9 as well. The two regression equations read as follows, after removing any statistically insignificant variables:

- *MCI = -4561.38 + 70.42TWI + 106.05Yield Average*
- *OCR = 4.37 + .00022M1 + .73Yield Average - .065TWI - .0001 Value of Government Securities Issued*

The regression model which incorporated the first period using the MCI as the dependent variable is in line with the original estimates. Both the TWI and Yield Average variables are highly significant with coefficient estimates of 70.42 and 106.05 respectively. These positive coefficients are also in accordance with the original estimates. Increases in the TWI and Yield Average should correspond with a positive increase in the MCI, which signals contracting monetary conditions. Furthermore, the model proves the definition of the MCI, which itself is a weighted measure of the interest rate and exchange rate.

The lack of significance in the other independent variables confirms that M1 or the total value of government securities issued are not statistically significant in the MCI regression equation. Furthermore, it is interesting to note the large negative value for the intercept. This would normally provide for concern, however; the absolute level of the MCI does not matter, rather the change from interval periods determines the size and magnitude of the economic contraction or expansion. It is also interesting to note that the government securities variable is indeed significant, but only at a 15% significance level, which does not qualify for acceptance as an explanatory variable.

The regression model which incorporated the second period using the OCR as the dependent variable proves to be in line with the hypothesis. Each independent variable is statistically significant at the .1% significance level! The positive value for the intercept is not a surprise, as a nominal interest rate between 4-5% is not uncommon in smaller open economies. The small positive coefficient for M1 shows a surprising relationship between the money supply and OCR. Original estimates of a negative relationship seem to be incorrect; however, the abnormality of the M1 variable has already been discussed. With an increase in money supply, the expected OCR is predicted to increase. This relationship may require additional research and testing to determine the cause behind the constant growth of M1 across the time period.

The Yield Average variable shows the expected positive coefficient, as benchmark interest rates rise within the economy, yields on government issued securities should be raised as well. The TWI variable shows that an increase in the exchange rate would reduce the predicted interest rate. This relationship is interesting because an increase in the exchange rate should make foreign investment into the domestic economy more expensive, and result in an increase in the OCR, although the TWI shows the opposite. This abnormality may be attributed to a correlation to M1, which was not tested for. If the exchange rate were to appreciate, coupled with an increase in M1 the result should increase in domestic interest rates in the short-run, and in the long-run the increase in M1 would lower the interest rates back to equilibrium levels. Finally, the value of government securities issued is, as expected, statistically significant and has a negative coefficient. With an increase in the value of public debt issuances, interest rates should experience downward pressure as there is greater supply of loanable funds available within the economy.

VI Conclusion

The case of New Zealand's transition from a MCI to an OCR regime provides empirical evidence in support of the original hypothesis.[i] The MCI was a direct function of the interest rate and exchange rate, whereas the OCR is a function of broader economic variables correlated with short-term interest rates and the exchange rate. While both policy instruments are meant to attain and anchor inflation expectations, the OCR regime provides additional oversight and influence for the Reserve Bank over the financial market. This additional oversight and influence, driven by a constant positive demand for money, will give the Reserve Bank greater flexibility in determining a policy stance. In addition to greater flexibility, the implementation of the OCR regime decreased volatility within the inter-bank lending rate, provided greater transparency and clearer inflation expectations through the OCR review process, which allows the Reserve Bank to react to market fluctuations more quickly and effectively. These conclusions are in line with the theoretical solutions to overcoming a liquidity trap detailed earlier.

These empirical conclusions can be extrapolated to make a strong policy suggestion in regards to the United States Federal Reserve System. Although there are various factors which do not allow for a direct comparison of economic, political, and social structures between the United States and New Zealand, the implementation of a monetary policy instrument that pays interest on reserve account balances should have profound effects on the effectiveness of U.S. monetary policy. The requirement for member financial institutions to hold reserves creates the positive demand that, when coupled with an interest rate channel can directly influence variation within interest rates. Achieving inflation expectations through the sole targeting of account balances has proven to be ineffective, and setting the interest paid on reserves has given a greater incentive for member banks to interact and participate with the monetary authority. Lastly, the establishment of the interest on reserves regime would alleviate the administrative efforts and costs incurred by calculating the value of demand deposits everyday.

Ultimately, the U.S. Federal Reserve System would benefit from the implementation of an interest on reserve regime. The yields attributed to each reserve account balance will require additional analysis and should be determined by the current economic climate. Contracting or expanding the monetary climate within an economy can be undertaken without massive transfers of government securities or other assets. The currently high levels of liquidity within the U.S. financial market would imply that using a new policy instrument besides the transfer of assets could also provide a new tool in the Federal Reserve's "Exit Strategy" after the most recent financial crisis in 2007. The evidence from New Zealand offers an easy-to-follow plan and method for implementing the new policy instrument without disruption from domestic or foreign markets. The Federal Reserve currently does offer interest on reserves; however, a greater utilization of the new authority would serve in the best interest of the Federal Reserve System as well as the economic future for the United States of America.

VII References

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VIII Tables and Charts

Table 1: Test for Simultaneity (Hausman test)

		Variable	Coefficent	T-Value
Dep Variable: MCI				
	r	Residual	-3.77542	N/A
	p	Predicted Value of M1	3.77542***	5943934
Dep Variable: M1				
	r	Residual	-4.36331***	-Infty
	p	Predicted Value of MCI	4.36331***	Infty
Dep Variable: M1				
	r	Residual	2228.98096***	Infty
	p	Predicted Value of OCR	-2228.98096***	-Infty
Dep Variable: OCR				
	r	Residual	0.00071328***	Infty
	p	Predicted Value of M1	-0.00071328***	-Infty

***Significant at 1% = Dependent Variable is Endogenous

Table 2: Two-Stage Least Squares Estimation Results

Dependent Variable: MCI

Variable	Coefficent		Std. Error
Intercept	-04561.38***		70.35893
M1	0.004335		0.020342
TWI	70.72467***		2.694826
Yield Average	106.0486***		3.941613
Total Value of Gov't Securities	-0.00697		0.004772
$R2$		0.98949	
Adjusted R2		0.98909	
Prob(*F*-statistics)		2447.67	
Observations		108	

***Significant at 1%

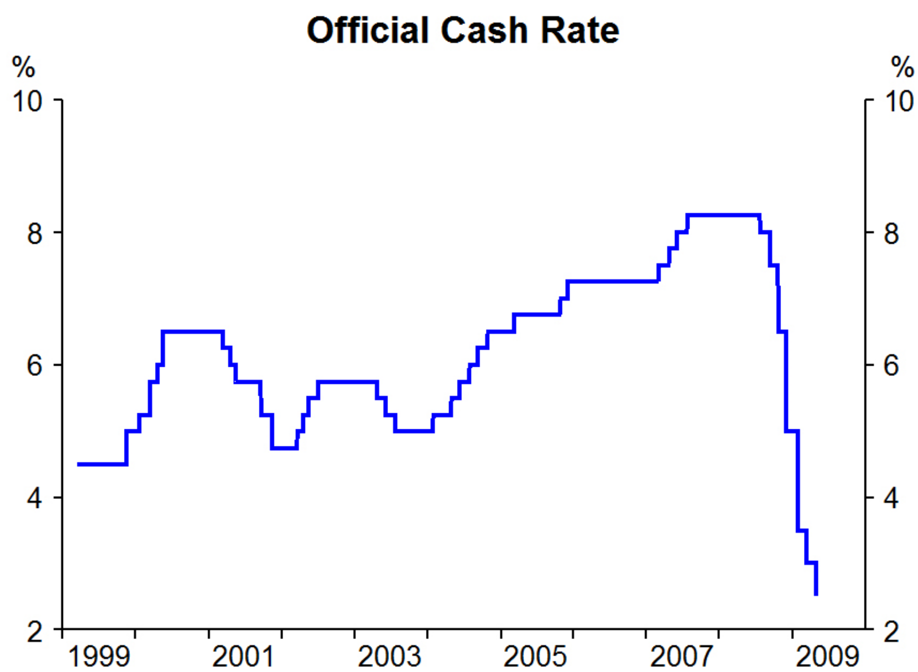
Table 3: Two-Stage Least Squares Estimation Results

Dependent Variable: OCR

Variable	Coefficent		Std. Error
Intercept	4.374772***		1.447072
M1	.000218***		0.000061
TWI	-0.06501***		0.017354
Yield Average	.734208***		0.078311
Total Value of Gov't Securities	-0.00010***		0.000038
R2		0.91179	
Adjusted R2		0.90840	
Prob(*F*-statistics)		268.75	
Observations		108	

***Significant at 1%

Figure 1 – Official Cash Rate

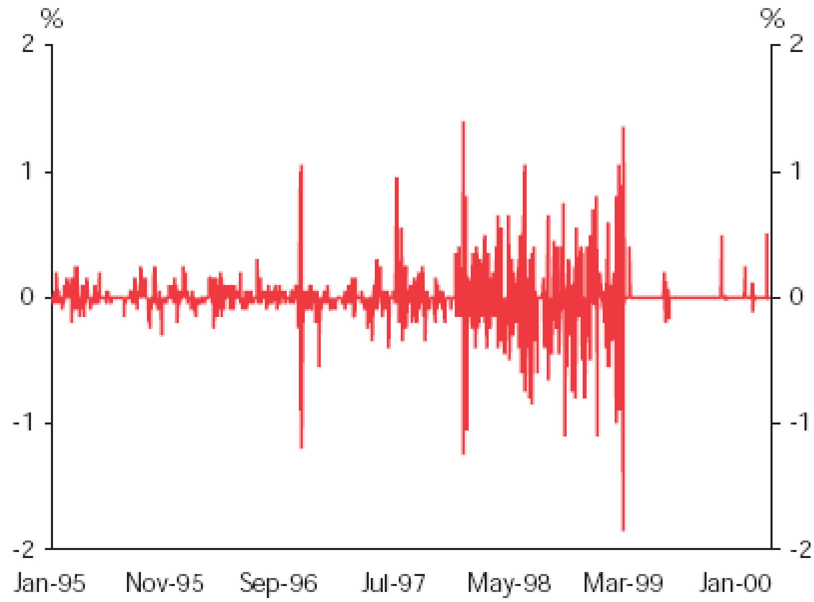


Source: Reserve Bank of New Zealand
(http://www.rbnz.govt.nz/monpol/about/0072140.html)

Figure 2 – New Zealand Overnight Interest Rate

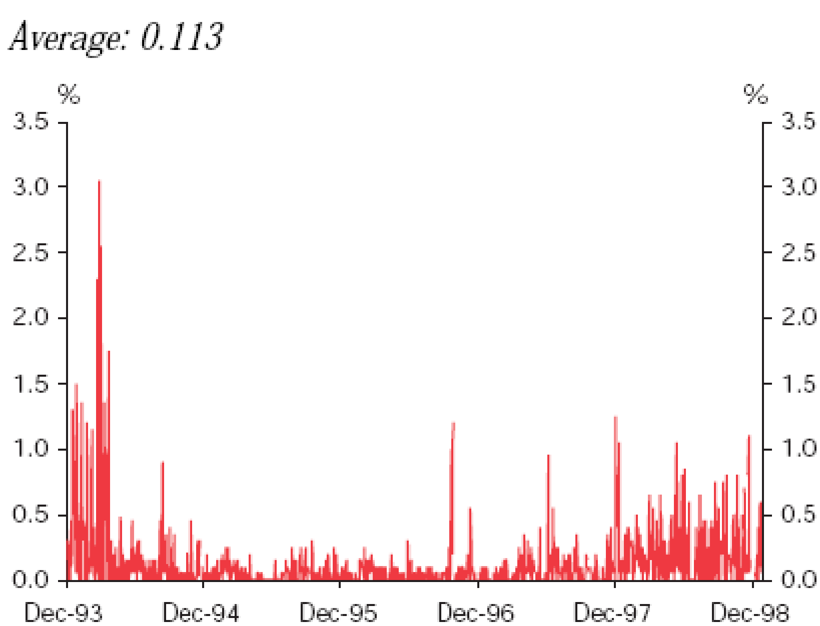
Source: Brookes, Andy, and Tim Hampton. "The Official Cash Rate One Year on."

Figure 3 – Daily Change in New Zealand Overnight Interest Rates



Source: Brookes, Andy, and Tim Hampton. "The Official Cash Rate One Year on."

Figure 4 – Absolute Daily Change in New Zealand Overnight Interest Rate



Source: Archer, David, Andy Brookes, & Michael Reddell. "A Cash Rate System for Implementing Monetary Policy."

[i] Note that explanatory variables are different, so direct comparison is not possible. However, another way of comparison would to measure the variability of inflation and GDP across two regimes to identify the usefulness of the policy change.