THE ROLE OF MONEY DEMAND IN MONETARY POLICY

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Abstract

This study uses cross-sectional time-series data from five (5) countries in estimating a money demand function. We found valid and consistent results for the money demand model and established a stable long run relationship between money demand and its regressors: real output, exchange rate, inflation rate and long and short-term interest rate. Stability tests conducted showed the presence of structural breaks possibly due to changes in monetary regimes and other financial deregulations.

Money demand elasticities play a vital role in monetary policy formulation and the existence of a stable demand for money is very important, even in the use of inflation targeting, for the conduct of monetary policy even though its impact may not be explicitly seen.

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CHAPTER 1

1.1 Introduction

The relationship between monetary aggregates and economic variables, such as the level of real income, inflation, interest rates and exchange rates, have been significant targets in monetary policy formulation. The demand for money has largely influenced the behavior of these variables and has since become an interesting concept in monetary policy. A high rate of growth of the money stock is expected to lead to increased prices, affecting real income and an economy's stability. Hence, the goal of monetary policy has been to promote the economic and financial well-being of a nation's citizens by keeping inflation low, stable and predictable to foster confidence in the value of money and contribute to sustained economic growth, employment gains and improved living standards.

Monetary policy has evolved as economies have transitioned, and the influence of money demand questioned. Policy rules and inflation targeting have replaced discretionary monetary policies in countries such as, Canada, Norway, Australia, Switzerland and the UK[1] among others. The new rule-based policy sets inflation ranges explicitly ranging from 1.5% – 2.5%, has an internal conditional forecast by the central bank and is extremely transparent and accountable (Svensson, 2000). This current model of monetary policy no longer concentrates on the mechanisms of monetary aggregates. Recent Keynesian optimizing models do not explicitly include monetary aggregates (Clarida, Gali, & Gertler, 2002; Rotemberg & Woodford; Taylor 1999). In most of the monetary models employed

[1] Inflation targeting has gained popularity with its success in balancing the economy since its introduction. Australia introduced this policy in 1990, Canada in 1991, UK in 1992, Switzerland 1999, and Norway in 2001 making them some of the first countries to implement this policy.

in academics and in policy institutions, the stock of money has disappeared, to be replaced by a feedback policy rule and a process determining inflation. For this reason, these models have come to be oddly known as “moneyless” monetary models.

After the Employment Act passed in 1946 in the US, fiscal policy instruments became the key tool for sustaining the economy. Government spending was reinforced to ensure high and stable levels of employment. Interest rate was used only to reduce the cost of government borrowing and fund government spending. Increased inflation and the economic problems of the time led to the importance and role of the quantity of money in macroeconomic policy. Friedman (1972 pg. 183) viewed that, “the most important single instrument available to the government to affect total spending and to control inflation” then, was the quantity of money, even though he was cautious of the relationship between money and other macroeconomic variables and how that impacted the economy.

Traditional monetary policy used money demand and supply dynamics to control the rate of inflation (Hayo, 1999). The quantity of money supply was determined by the nations’ central banks based on the demand for money (Bakhouche, 2006). An increase in income or wealth would be an indication for the supply of money to increase. Policy makers then made monetary decisions based on factors that influenced money demand at the time such as inflation rate, interest rate and the exchange rate. The money demand function then was instrumental in traditional policy making. Then came financial deregulations, financial innovations, increased oil prices and economic instability causing money supply and demand dynamics to fail to stabilise the economy.

To stimulate aggregate demand post - 2008 crisis, most countries use monetary policy by rapidly reducing policy rates or by using more unconventional measures to support the functioning of financial markets (OECD, 2009), hence inflation targeting. This new approach has been criticized by some monetary economists. Models giving money no role are argued to provide a distorted representation of the sources of cyclical fluctuations and the transmission of shocks that arise from monetary sources. Regardless, there have been several justifications for the use of a rules-based approach in monetary policy. The relationship between monetary aggregates and real activity is weakening over time. It could be the case that a rule -based monetary policy has affected the money demand in ways we have not seen studied.

In this study, we aim to analyse a long run money demand function for Australia, Canada, Norway, Switzerland and UK to assess the impact of money demand in present day monetary policy. A long run money demand function establishes a longer-term equilibrium between real money balances and its determinants. To achieve this, we use a cointegration analysis to ensure that the variables are tied together in the long run so that they move towards a long-run equilibrium even though they may move apart for prolonged periods in the short run (Haug, 2006). Unit root tests are conducted to ensure stationarity of the series to avoid spurious results. Any deviations are sure to be corrected in the long run when stationary variables are used and the relations between money demand variables are expected to hold. We use both the Augmented Dickey Fuller and Philip-Perron tests to capitalise on each tests strength and ensure the validity of our results.

A foreshadowing of results shows that our variables (broad money, interest rates, output, exchange rate and inflation rate) are stationary in first differences and hence, cointegration is employed. Johansen’s (1995) maximum likelihood-based method is used to test for the presence of the long run relationship. We find results that long run relationship exist between money demand and its regressors and employ the Vector Error Correction Model (VECM). The findings of cointegration tests, however, do not necessarily imply that the relation is stable over time. Tests for stability are applied to ensure that the model and results are impeccable. Cumulative Sum (CUSUM) of squares test show instabilities due to structural breaks, confirmed using the Chow breakpoint test. Several diagnostic tests are performed for further stability purposes.

According to Keynes' (1930) analysis, the demand for money is driven by the motives that prompt people to hold cash balances. These include the transactions demand (making payments), precautionary demand (meeting unforeseen contingencies or opportunities) and speculative demand (motives as an asset or store of value). A simple theoretical money demand model relates the demand for real money balances to a measure of transactions, or scale variable, and the opportunity cost of holding money which is the market rate of interest and measures the opportunity cost of holding money (Gujarati, 1968). The relationship between the demand for money balances and its determinants is one of the fundamental building blocks in most theories of macroeconomic behaviour and is a critical component in the formulation of monetary policy.

Considering interest rates and the money stock is necessary to assess exactly how monetary policy impacts an economy (Valadkhani, 2008). As the interest rate rises, the opportunity cost of holding money also rises and the demand for money falls (Gujarati, 1968). The interest rate variable was first introduced by Baumol (1952) and Tobin (1956) in the demand for money, however the causal relationship is not clear when considering different time horizons. With regards to short- and long-term interest rates, Ericsson (1998) suggests that long-term rates should not be included in models that incorporate narrow forms of money. However, when modelling with broader forms of money, he found it essential to use longer-term interest rates in the demand for money function so as to capture financial asset substitutions. This study therefore uses both short run and long run interest rates to observe the impact of these variables on the money stock (broad money). We expect the money stock (broad money) to rise with a fall in interest rates.

The inclusion of the exchange rate in money demand estimations enable the consideration of currencies of different countries as substitutes. Mundell (1963) pointed out the existence of the relationship between the demand for money and the exchange rate. Studies by Arize & Schwiff (1993) and Bahmani-Oskooee & Rhee (1994) found significant results when official exchange rates were included in the analysis of a money demand. An increase in exchange rate (depreciation) leads to increase in wealth as the value of foreign securities held by domestic residents' increase. This leads to a rise in the demand for money. (Arango & Nadiri, 1981). However according to Bahmani-Oskooee & Pourheydarin (1990) and Arize (1989), expectations would lead to counter results with currency depreciation. Expectation of further depreciation would cause asset holders to transfer portfolios into foreign currencies and decrease the demand for money. Hence, the impact of exchange rate on money demand could be positive or negative, depending on individual response to the change.

The quantity theory of money establishes the relationship between money and the rate of inflation. An increase in the quantity of money is expected to lead to an increase in inflation, ceteris paribus. The quantity of money and inflation are directly related. Studies including inflation rate in the money demand model include Khan (1994), Pradhan &

Subramanian (1997), Obben (1998), Bahmani-Oskooee & Bohl (2000), Bahmani-Oskooee, Bahmani & Rehman (2005).

There is a direct relationship between money demand and output. Income tends to be one of the main motivations for the demand for money. The higher the income, the more money is demanded.

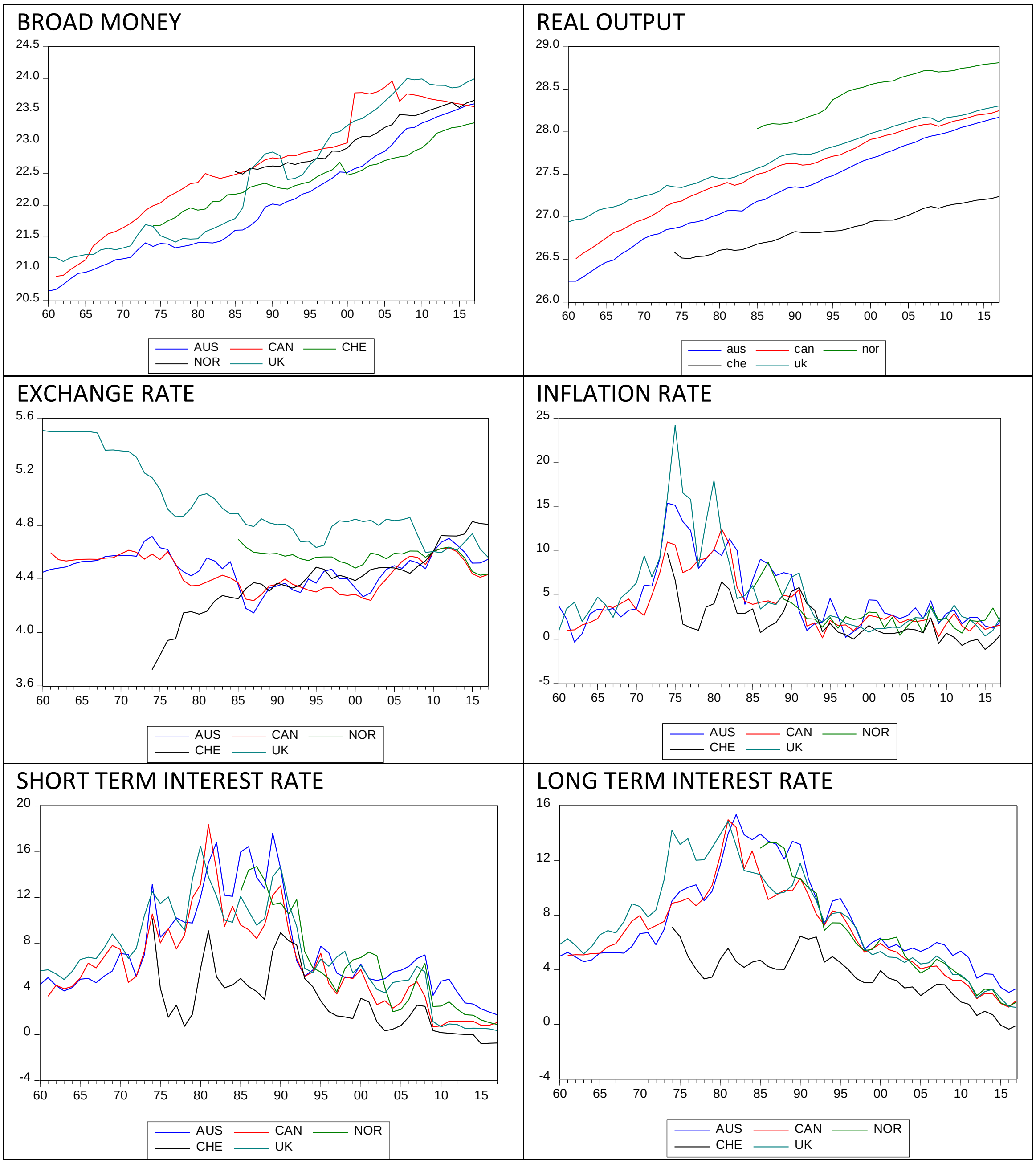


Figure 1-1 Trend in Selected Variables

Sources: International Financial Statistics (IMF Data), World Bank's World Development Indicators

In Figure 1-1 a trend analysis on the variables used in the analysis of our money demand model show several movements that can be attributed to the changes in policies over the years. Periods of structural changes and financial crisis are captured in the upward and downward trends exhibited above. There is a generally upward trend in real output for all countries. We see no significant trend in the output variable for all countries. Significant upward and downward trend is seen for exchange rate, inflation and interest rate variables. These are attributed to several changes the countries' economies faced over the years as a result of recessions, drastic fall in oil prices, financial deregulations and regime changes.

1.2 Background

From the quantity theory of money through the equation of exchange to a monetary policy rule, the dynamics of the role of money demand are very evident. Noteworthy is the fact that distinct money dynamics have led country specific money demand functions to be imposed by contextual dependence and specifications. This drives the direction of this research. Money demand is important to how monetary policy affects investment spending through interest rates. Financial market liberalisation affects both the interest elasticity of different monetary aggregates and the balances held at each level of interest rates, so the overall effect is ambiguous. Financial development is usually considered to decrease the income elasticity of the demand for money making portfolio choices and consumption spending more stable.

Money is neutral in the long run, thus, has no consequences for real economic magnitudes. It is held to perform financial transactions and has no intrinsic utility. Money essentially provides liquidity. Money demand, hence, is the demand for real balances. A money demand function gave information about consumer's portfolio distributions (Duca & Vanhoose, 2004) and played a key role in creating an efficient and effective monetary policy strategy (Friedman ,1959; Friedman & Schwartz, 1982).

The use of money in narrow forms for transactions purposes or in a broader sense defines the concept. Some theorists argue that broad money, including less liquid forms such as savings and deposits accounts, should be considered in measuring money's form. Felmingham & Zhang (2001) considered this in their approach to money demand estimations and found consistent results that factored in financial asset substitution.

An important feature of a money demand function is its stability. A stable money demand function implies a stable velocity and in turn an increased predictability of the impact of the money supply on the domestic price level and domestic output. Even in a rule-based monetary policy, stable money demand function insures a smooth and predictable transition between interest rate targets and inflation. A stable money demand function will exist as long as there is the inclusion of all the relevant variables of money demand and a proper specification of the money demand function. If money demand fluctuates unpredictably, the transmission mechanism of monetary policy becomes extremely complicated, and the ability of the central bank to control money, and thereby inflation, is severely reduced.

A study on monetary policy and money demand is incomplete without the discussion and analysis of the two central models and schools of thought on the subject.

The IS-LM model incorporated money demand in a more sophisticated way than the earlier Quantity Theory. This model, developed in the 1930s, assumes that the central bank sets the quantity of money as its monetary policy tool. The framework purports an equilibrium in both the goods market and the money market that determines the market rate of interest and real income. The price level is assumed fixed so that all the adjustment to a monetary policy is born by real income and the real interest rate. An important assertion in this model is that money demand always equals the money supply.

$$M_d = ky - hi = M_s \tag{1}$$

In (1), y is real income and i is a real interest rate. Solving for the interest rate gives

$$i = \frac{ky - M_s}{h} \tag{2}$$

$$\frac{\partial i}{\partial y} = \frac{k}{h} > 0 \tag{3}$$

This simple arithmetic derivation from the money demand function shows the slope of the LM curve with income elasticity, k, and interest rate elasticity h. The slope is positive because money demand is higher at higher levels of income, hence the equality of the money supply and money demand will only occur at a higher rate of interest. This implies that the rate of interest varies directly with income. The larger the income elasticity, and the lower the interest rate elasticity of the demand for money, the steeper the LM curve will be.

The dynamics of the adjustment process in the money market is straightforward. If the money supply exceeds money demand, interest rates will fall. This is because at fixed levels of income, the rate of interest must fall so that the demand for money rises to equal the higher level of the money supply. In the Keynesian explanation, bond prices rise, and their yields fall as investors use the excess money in their portfolios to purchase bonds. Investment spending in the goods market increases in response. The LM curve shifts outward to the right in (i, y) space.

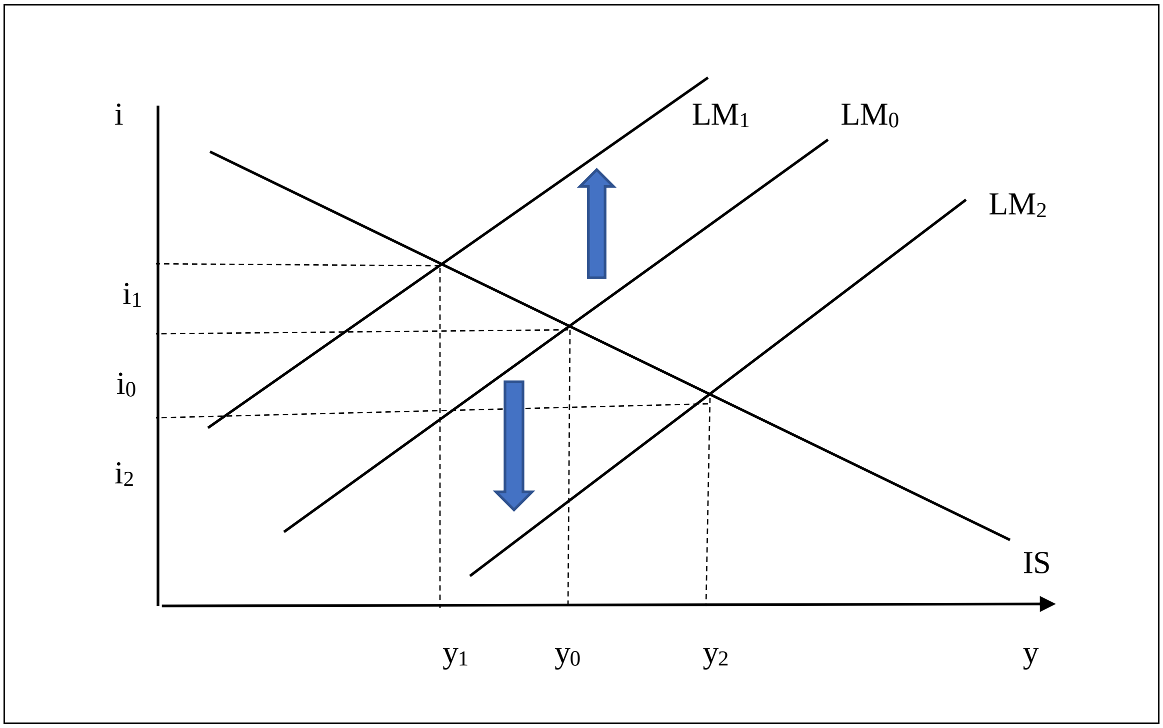


Figure 1-2 Shifts in LM Curve

In Figure 1-2 a shift in the LM curve caused by a disequilibrium of money supply over money demand. An increase in the money demand function will also cause the LM curve to shift to the left. As the money demand function for a given level of income rises, interest rate is lowered and the level of income falls. Income levels will rise when money demand for a given level of income falls.

Source: Author

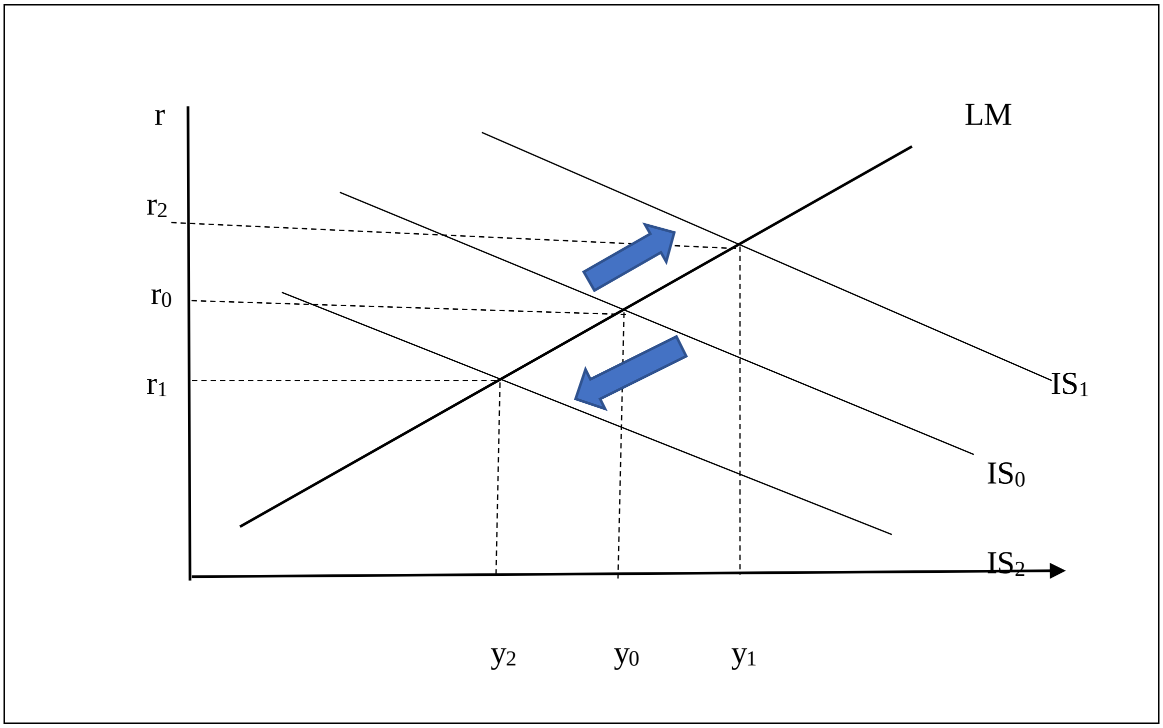


Figure 1-3 Shifts in IS Curve

In Figure 1-3, an increase in output increases the transaction and precautionary demand for money. Interest rate is driven upward, and the IS curve shifts upward. Likewise, a decrease in output drives interest rates downwards and shifts the IS curve to the left.

Source: Author

A stable money demand function forms the cornerstone in formulating and implementing monetary policy in the Keynesian IS-LM model. To have a sound monetary policy, one must be able to predict the impact of the money stock on income, the interest rate, the inflation rate and all forms of macroeconomic variables (Pradhan & Subramanian, 2003). With a stable money multiplier, we can expect a consistent pattern and credibility in monetary policy (Hamori &Tokihisa, 2001)

More recently, the IS-MP model has been developed to assign a different role to monetary policy. The IS-MP model uses the interest rate as the policy instrument and models the central bank's behavior with a policy rule, such as a Taylor rule.

$$r = r^* + b(\pi - \pi^*) + c(Y - Y^*) \quad (4)$$

In (4) we have a typical Taylor Rule for setting the real interest rate: r* is the target real interest rate, π is the rate of inflation, π* is the optimal inflation rate that is consistent with r*, Y is output, Y* is the optimal output that is consistent with r* and b and c are parameters. For simplicity, π and Y will represent the differences in inflation and output from their optimal levels in (4).

Allowing for inflation, we substitute a standard inertial Phillips curve ($\pi = \pi_{-1} + dY + e$) into (4), to derive an Integrated Monetary Policy Rule (MP)

$$r = r^* + b\pi_{-1} + (bd + c)Y + e \qquad (5)$$

This model can target either output or inflation or a blend of the two, with the latter being used by most economies. For inflation targeting, c = 0 in (4). The LM now MP curve is flatter as real interest rates respond less to IS shocks that deviate output from Y*. When the central bank targets output and inflation, the MP curve is upward sloping, and b is very large. With inflation targeting, monetary aggregates are not the variables of concern, they are merely passively adjusted to achieve the interest rate target. The central bank sets an inflation target of 2%, with a target band of 1% to 3%, for most countries, and any deviation outside the target band forces the central bank to act according to its policy rule.

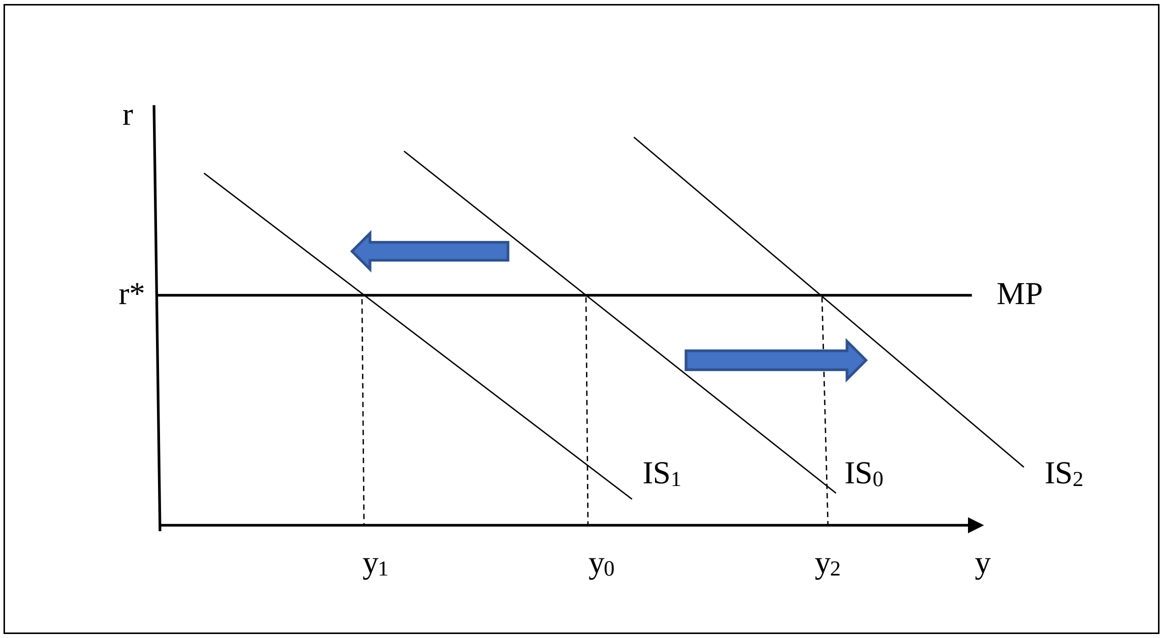


Figure 1-4 Shifts in IS under IS-MP framework

Fig 1.4 presents shifts in the IS curve caused by changes in fiscal policy (expansion or contraction). Under the IS – MP framework, any fiscal stimulus will cause output to change in the direction of the policy. However, when output changes below full employment, the MP curve remains unchanged since there are no inflationary pressures.

Source: Author

Although the IS-MP model is a simple model of a monetary economy that follows a central bank rule, it does not explicitly include money demand in its equations. The equations for the policy rule and the process generating inflation are enough to solve for the equilibrium in the model, relegating an equation for money demand to the background as a residual calculation. Money demand is only interesting to study for its portfolio decisions made by economic agents. Regarding long term analysis, a long-run money demand function is generally defined as an equilibrium relationship between money balances and the determinants of money demand in the longer term.

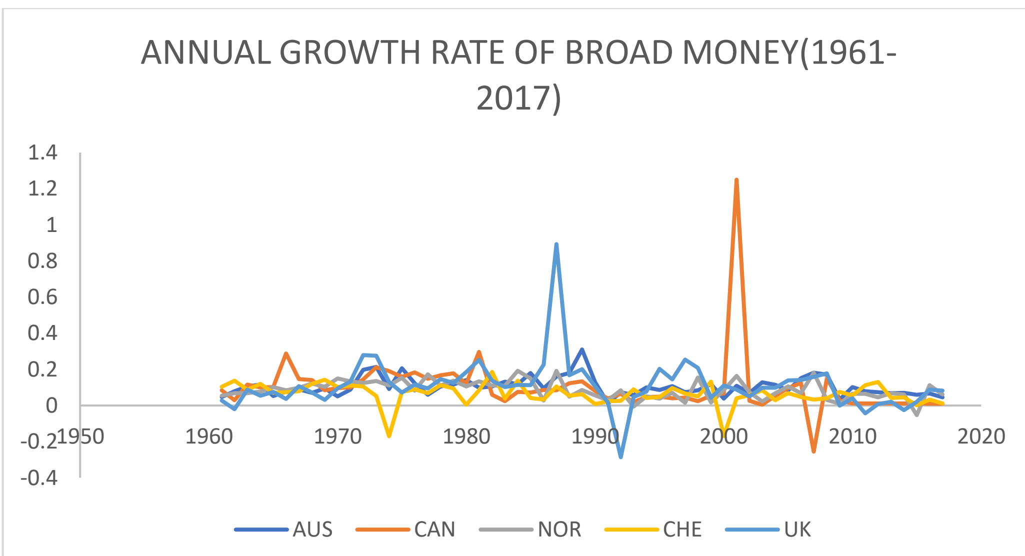


Figure 1-5 Yearly Growth Rate of Broad Money Demand

Source: World Bank's World Development Indicators

Growth rates on broad money have seen spikes and lows over the years. For Australia, the value for broad money was AU$2,050,266,032,025 as of 2017 (this is the maximum value reached and a minimum value of AU$7,400,800,000 in 1960. The value for broad money growth rate (annual %) in Australia was 4.52% as of 2017 with a maximum value of 31.02% in 1989 and a minimum value of 1.18% in 1991. For Canada, broad money reached a maximum value of CAD$2,375,280,000,000 in 2006 and a minimum value of CAD$14,543,000,000 in 1960. The value for broad money growth rate (annual %) in Canada reached a maximum value of 125.03% in 2001 and a minimum value of -25.55% in 2007. Broad money value was CAD$2,276,373,562,571 at 2017 with an annual growth rate of 1.04%.

For Norway, broad money reached a maximum value of Kr2,148,134,000,000 in 2017 and a minimum value of Kr14,543,000,000 in 1960. The value for broad money growth rate (annual %) in Norway reached a maximum value of 19.19% in 1987 and a minimum value of -5.33% in 2007. Broad money value was Kr2,276,373,562,571 at 2017 with an annual growth rate of 1.04%.

For Switzerland the value for broad money in Switzerland was SF1,266,058,255,835 as of 2017 (maximum so far) and a minimum value of 41,126,000,000 in 1960. The value for broad money growth (annual %) in Switzerland was 1.12 in 2017. The maximum value for the broad money annual growth rate was 18.58% in 1982 and a minimum value of -17.05% in 1974. Broad money for United Kingdom was £3,024,921 million in 2017. This increased from £15,905 million in 1968 to £3,024,921 million in 2017. Annual growth rate as at 2017 was 8.27%. Spikes and lows in monetary base growth can generally be attributed to changes in monetary policies and financial regulations.

The countries for this study have evolved in the conduct of their monetary policy. There have been significant changes in Australia's approach to monetary policy since 1976. From the mid-1970s until 1985, annual growth of M3 was the monetary policy target. This was based on assumption that the relationship between inflation and the supply of money was strong and persistent. Due to deregulation of the financial system in 1985, a new approach to monetary policy was implemented, whereby a multitude of indicators such as, monetary aggregates, the GDP growth rate, the shape of the yield curve, exchange rates, and the unemployment rate were considered prior to the implementation of monetary policy because M3 provided a misleading guide to the stance of monetary policy (Grenville, 1990). This was discontinued in 1989 due to the impossibility of monitoring and considering the large number of indicators outlined above. The Reserve Bank of Australia (RBA) has since 1989, set the official cash rate (overnight rate) in the money market as the new approach for monetary policy. Following many other OECD countries, inflation targeting has become the goal of monetary policy in Australia since 1993 (Juttner, Kim, & Hawtrey, 1997).

In Canada, inflation targeting policy was formally introduced in 1991. The Bank of Canada was one of the first worldwide to announce the policy of inflation targeting (IT) between 1 and 3 percentage points per year (Bank of Canada, 2010). This led to shift in the conduct monetary policy (Alstadheim, Bjørnland & Maih, 2013). Since 1970, a continued floating exchange rate regime exists in Canada. The exchange rate movements have become very important in the conduct of monetary policy decisions, but no role in the IT regime in place today.

In Norway, monetary policy is implemented by the central bank; the Norges Bank.

Since the early 1970 changes in the Norwegian economy evolved from industrial production to developing a large oil exporting sector. Several monetary policy changes include a change in the targets for monetary policy from interest rates and credit volume to the exchange rate in 1986, replacement of the system of direct and selective controls of credit volume to a market-oriented policy in 1983, a change from a fixed exchange rate regime in 1992 and the implementation of a flexible inflation target regime which gives weight to other macro objectives such as the output gap and unemployment. The Norwegian inflation target at 2.5 percent is slightly higher than most countries.

Switzerland has had very tight monetary prescriptions (Fischer 1993; Rich 1990). The Swiss National Bank (SNB) has conducted a policy of monetary base targeting since 1973, with few exceptions. The goal has been to maintain price stability (Rich, 1993). In order to achieve this, growth in the nominal money stock has to be equal to growth in the demand for real money balances. In December 1999, the SNB introduced a new monetary policy strategy. This new strategy was aimed at communicating more clearly the SNB's actions, effectively anchoring the public's inflation expectations, while maintaining some continuity with past policy, combined with the announcement of a target range for the three-month Swiss Franc Libor rate (Rossi, 2010).

Evolution of monetary policy in the U.K. began with the introduction of Competition and Credit Controls in 1971 (breaking up the commercial banks' cartel), the removal of the corset, tight monetary control and targeting, and a de facto abandonment of such targeting by the mid-1980s to finally introducing inflation targeting in 1992.

Table 3.2.1-A Notes on Structural Break

Country	Sample Period	Notes on structural break
Australia	1960-2017	The dates of structural breaks points to: -The 1973 oil shock; -Financial deregulation and innovation in the late 1980s. -The RBA implemented monetary policy changes through changes in the official cash rate (1987-1988) -The 1990-91 recession led to introduction of an inflation targeting regime
Canada	1970-2017	In 1991, inflation targeting was introduced as a new monetary policy. This resulted in a structural break that led to a lowered rate of price inflation and a substantial fall in the rate of unemployment.
Norway	1985-2017	Change from industrial production to include a large oil exporting sector from the early 1970s. Monetary changes included: - Determination of interest rates were gradually left to market forces from the early 1980s; -Targets for monetary policy changed from interest rates and credit;

		-A system of direct and selective controls of credit volume was replaced by a market-oriented policy in 1983; -Adopted an inflation targeting regime in 1992 as against the fixed exchange rate regime for effective inflation containment.
Switzerland	1974-2017	In December 1999, the Swiss National Bank (SNB) introduced a new monetary policy strategy involving a formal definition of price stability, the publication of inflation forecasts, and the announcement of a target range for the three-month Swiss franc Libor.
UK	1960-2017	- The abolition of the Corset (in 1980) and the provision by building societies of a full range of banking services -Targeting of monetary aggregates was abandoned in 1986 - Switch to inflation targeting in 1992

1.3 Problem Statement

Analysis of the role of money demand usually considers stability in the money demand model, policy changes, data measurement and model specification (Valadkhani, 2008).

The persistence of money demand and its cointegration with other macroeconomic variables (Ewing & Payne 1999) results in considerable instability in money demand models. Canova & Menz (2011) found unstable results of money demand attributed to changes in monetary regimes. This has led to a more ‘modern’ approach to monetary theory that considers inflation targeting as the conduct for monetary policy (Gali, 2003; Woodford, 2003). A common theme in almost every study is to test for the stability of the money demand function. If money demand is found to be unstable, researchers identify omitted variables from their specifications and show that by including those omitted variables stability could be achieved. For example, in testing for stability of money demand in the US, McNown & Wallace (1992) concluded that in order for the demand for the M1 monetary aggregate to be stable, one must include the nominal effective exchange rate in the specification that accounts for currency substitution between the US and the rest of the world.

Shocks in the economy in the forms of fiscal, inflationary and financial as well as changes in monetary targets impact the stability of money demand models. This development may be attributed to the destabilizing effects of financial innovations and deregulatory measures in many countries. Financial deregulation, inflation regimes, and changes in monetary policy also account for fluctuations in the money demand function by causing shifts in the money demand relationship. The rapid inflation experienced by all major industrial countries after 1973, the concurrent collapse of the Bretton Woods system of fixed exchange rates, and the attempts by most major central banks to control growth in domestic money stocks may all have altered the responses of the demand for money to the standard functional argument (Boughton, 1981). Proponents of the modern monetary theory therefore advocate for targeting policies due to the frequent instability in the money demand sensitive IS-LM model.

Another challenge to monetary policy and the money demand function is the specification of inflation expectations. Expectations have become pervasive to economic analysis. Measuring inflation expectations is difficult so economists have resorted to different expectations mechanisms that are explicitly included in the structural equations, including an adaptive expectation or rational expectation.

Researchers point out that omitted independent variables result in unstable estimates of money demand and show that if included, stability can be achieved (Valadkhani, 2008). More recently the time-series properties of money demand functions have been questioned. The persistence of money demand and its lack of cointegration with other macroeconomic variables (Ewing & Payne 1999) has contributed to reduced confidence in monetary aggregates as efficient monetary policy tools. Empirical studies of money demand have had to confront such challenges as institutional changes, policy reversals, and regime changes, which have led to large forecasting errors and cast doubt about the usefulness of empirical money-demand models

Empirical estimates of money demand are quite sensitive to the measure of the money stock used. Various measures of the money stock consist of narrow and broad money. Narrow money are assets readily available and transferable in everyday transactions. They have the highest form of liquidity and serve as a medium of exchange. Broad money on the other hand are widely ranging assets that render portfolio opportunities to asset holders. Several measures of money stocks have been used in empirical research. A range of stability tests for a set of demand functions were estimated ((Boughton, 1981)) for two monetary aggregates (M1, M2) in six countries: United States, UK, Canada, Japan, West Germany and France. The major conclusion was that none of the other money demand functions estimated displayed instabilities as severe as those of the M1 function for the United States.

1.4 Research Questions and Objectives

This paper seeks to provide answers to the following questions:

a. Does money demand impact monetary policy?
b. Is there a stable money demand function in the short and long run?

The goal of this study to:

a. Investigate the importance of money demand in conducting a sound monetary policy.
b. Analyse the stability of demand for money.

1.5 Relevance of Study

Present monetary policy gives no consideration to monetary aggregates. It is believed the money demand model is unstable and plays no vital role in the economy. If a stable money demand function is derived in this study, it will open discussions and opportunities to explore policies in line with monetary aggregates (Ball, 2012). As emphasised by Hayo (1999), a stable money demand function is still important in this new era of inflation targeting.

It is relevant to assess the relationship between the quantity of money and other economic variables to enhance policy making. Interest rate, exchange rate, income and inflation among others influence money demand. Causality analysis also show a situation of bi - directionality. Thus, understanding the relationship between money demand and its regressors using most recent data will help contribute to new measures to influence macroeconomic variables.

Attempts by central banks to influence the real effects of the financial market due to the implementation of liquidity easing warrants the consideration of the role of money in monetary policy (Castelnuovo, 2012). The money demand function will give information about the monetary base. This is relevant in determining how much the central bank must shrink the money supply to raise interest rates above zero in the events that the central bank implements a policy of zero interest rate (Ball, 2012).

Money growth affects inflation. In an era of inflation targeting, understanding money in its entirety will inform price stabilisation policies. The relationship between the growth in money and price is relevant in the interest rate driven economy.

Money demand garners a tremendous degree of interest in the economics literature. As economies evolve it has become imperative to analyse the diverse ways that the demand for money has been modelled in the past, and present developments in the area to better formulate effective monetary policy. Estimating money demand functions is still relevant for policy making, despite the popularity of inflation targeting. This paper analyzes the long-run properties of the money demand equation in both small and large open economies across the globe.

There is an extensive empirical literature on money demand and its role in monetary policy. This study is relevant in adding to the available literature of how money demand functions have been modelled over the years and the rationale for these developments. This will give policy makers additional tools to make effective macroeconomic policies.

Although present monetary policy ignores monetary aggregates, money is statistically important for domestic fluctuations in output and inflation. The role of money is changing and an empirical study on the subject is vital for the conduct of sound monetary policy.

1.6 Thesis Organization

The remainder of the thesis is organized as follows. Chapter Two discusses relevant literature related to the topic. The theoretical and empirical models are developed in Chapter Three. In Chapter Four, the estimation results and findings will be discussed. Chapter Five will discuss the meaning and implications of the results found. Chapter Six will offer policy recommendations derived from the study and suggest further areas of study. The final chapter will provide a summary and conclusion to end the study.

CHAPTER 2

2.1 Literature Review

There is an extensive literature on the demand for money due to the attention and dedication to this field of monetary economics and economics as a whole. We provide a review of studies conducted on money demand and its role in monetary policy formulation.

We look at the historical analysis of money demand which focused mainly on the models of money demand, its structure and framework as well as the different schools of thought on the subject.

In Fisher's (1911) introduction of the equation of exchange, money demand is defined as a function of income alone. The relationship between the quantity of money (M) and the velocity of circulation (V), price level (P) and frequency of transactions (T) assumes that the quantity of money and prices move together, given by $MV = PT$. In this model, the interest rate and the quantity of money have no dependence except indirectly through velocity.

Three motives influence why people hold money: as a medium of exchange for transaction purposes, for precautionary measures against future unforeseen circumstances and as a store of value. The liquidity preference theory according to Keynes (1936) formulates a rigorous money demand model following these assumptions. Keynes posits that the rate of interest influences the quantity of wealth people hold in cash and in bonds. High interest rates will lead to less liquidity and vice versa.

Baumol (1952) and Tobin (1956) examined the role and magnitude of interest rates in the money demand model using the similarities between the inventory theory and the monetary theory using a simple money demand model. Baumol found that, as long as an individual withdraws or borrows to meet the transaction costs of his demand, a fee is charged. He characterised this as the interest cost and a broker's fee, thus, the opportunity cost of holding money. According to Baumol and Tobin, people hold part of their wealth in liquid money as well as in bonds.

According to Mundell (1963, pg 484): "the demand for money is likely to depend upon the exchange rate in addition to the interest rate and the level of income." This brings us to the introduction of the exchange rate into the money demand model when countries incorporate international business transactions. In his so-called "monetary approach", Mundell suggests that a depreciation of the domestic currency could reduce money demand.

Chow (1966) identified the concept of the short run and long run models of money demand based on the current and permanent incomes of households. Introducing a mechanism to adjust to actual shocks in a money demand model enables us to distinguish between short run and long run money demand functions.

Adekunle (1968) looked at the differences in money demand models in developed and developing countries. As expected, structural differences influence the nature of demand for money in the two regions. For instance, when forming expectations, the time lag was longer in developed countries than their less developed counterparts, there was strong asset motives in less developed countries which resulted in higher income elasticities of money demand, and the opportunity cost of holding money was more important in less developed countries for real assets and substitution effect in developed countries were accounted for.

Simple money demand functions have been estimated with the focus on the elasticities with respect to income and interest rates, with the inclusion of an exchange rate and inflation in further enhanced and complex studies. Elasticities determine the magnitude of impact between the dependent variable (money demand) and the regressors. Other studies have included country specific variables exclusive to the state of that economy. For instance, Bahmani – Oskooee (1995) included a black-market exchange rate in the money demand model, due to the underdeveloped nature on the Iranian financial system and found it to be statistically significant. With the presence of a strong black market for foreign currency, he found it most appropriate to use the black-market rate instead of an official exchange rate in the money demand model.

Goldfeld (1973) used conventional money demand functions and estimated sensible interest and income elasticities. Income elasticities were significantly less than unity, this he found was due to the quarterly data used. Using quarterly postwar data for Canada, Germany, UK, and US, Arango & Nadiri (1981) found unambiguous evidence that the demand for money is affected not only by changes in domestic variables such as permanent income, domestic interest rates and price expectations, but also by fluctuations in exchange rate expectations and foreign interest rates. Payne (1992) examined the effect of money growth and interest rate volatility on the demand for money and found that both money growth and interest rate volatility measures were statistically insignificant.

Hussain et al. (2006) modelled a money demand function using real GDP, an interest rate, inflation rate and financial innovations with annual data from 1971 to 2005. They found no cointegration or unit root, however out of the forms of money stock used (monetary base, M1, M2), M2 best explained the long run demand model, however using annual data, Qayyum (2005) found that the main determinants for money demand were income, interest rates and an inflation rate. Results showed statistically significant and high magnitudes of coefficients for the own money rate and government bond yield.

Hoque & Al- Mutari (1996) found a long-term relationship between narrow money, output, an interest rate and the price level. Their research concluded there was no instability despite financial innovations and deregulations at the time. As a result of misspecification, Felmingham & Zhang (2001) included an interest rate spread in the money demand model. Inclusion of the interest rate spread showed that a cointegrating vector existed between broad money and the independent variables over the test period.

Khalid (1999) accounts for foreign variables in the money demand model for countries with open economies. In addition to domestic variables such as income, interest rate and exchange rate, he proposes inclusion of foreign measures of these variables and a measure for depreciation on domestic currencies. Empirical analysis on the Philippines, Singapore and South Korea suggested not only a long run relationship between money demand and the foreign variables but also foreign opportunity cost was more relevant and significant in determining money demand than the domestic interest rates. The emergence of globalization of financial markets and financial liberalisation allows for a modern outlook of the money demand model.

Money demand analysis in Australia usually considers periods of structural changes and reforms in the Australian financial system. In Karfakis & Parikh's (1992) test for a long run relationship between money demand and its determinants, for example, the sample period 1973 – 1990 accounts for several structural changes. The central bank lifted the interest rate ceiling on deposits in 1973, abolished exchange rate controls in 1983, and began the use of short-term interest rates in 1985 after abandoning the monetary aggregate

M3 as an operating target (Valentine, 1991). This allows for all short-term instabilities to be accounted for. Pahlavani, Valadkhani & Worthington (2005) account for structural breaks that coincide with significant policy changes and periods of financial instabilities and deregulations associated with economic crises and changes in regimes as well as institutional changes. Structural breaks are endogenously determined using the method of Perron (1997), although multiple breaks were unidentified. Swamy & Tavlas (1989) review the causes and implications of deregulations and found evidence of the breakdown of an otherwise well-behaved money demand model.

Valadkhani (2005) establish the existence of a stable money demand function for the Australia post inflationary targeting era. Using quarterly time series data from 1976:3 to 2002:2, results show that broad money is cointegrated with real income, the rate of return on 10-year Treasury bonds, the official cash rate and the annualised rate of inflation. This adds to the growing consensus that broad money be considered an appropriate measure as a monetary aggregate. Indeed, our research also uses broad money, mostly because of the availability of data for the different countries that use different measures of money.

Bahmani–Oskooee & Xi (2011) also provide strong evidence for a stable long run money demand model using the M3 monetary aggregate by including a measure of economic and monetary uncertainty. These variables are justified to capture financial reforms. The main rationale for the inclusion of these variables were the Global Financial Crisis of 2008 and the financial reforms that came with tightening and loosening policies to combat inflationary and recessionary periods. The results suggest a stable long run money demand in Australia. With regards to the inclusion of new variables, Bahmani–Oskooee & Nayire (2018) add a new measure of uncertainty, policy uncertainty, and find significant long rum impacts on money demand. These attempts have been geared towards branching out and discovering different models to achieve stable long run money demand models for Australia.

In contrast, Hossain (2011) established the presence of a stable long run equilibrium between real narrow money balances and its determinants and found no meaningful and stable results using broad money for the period 1970 to 2009. The independent variables (the yield on Australian government short-term bonds and the nominal effective exchange rate of the Australian dollar) used in the analysis are however different from the variables used by Valadkhani (2005) and other supporters of broad money at the monetary aggregate and this may contribute to the major disparity in the results.

In Canada, Lauma & Formuzis (1968) established a stable demand for money function for the period 1936 – 1960. Interest rate variables were statistically significant with the proper signs, unlike similar tests conducted on the USA over a similar time frame. Demand for money in Canada was found to be more sensitive to long term rates than to short term rates. However, with regards to the income variable (current income or permanent income) there was not very significant changes in results. Money demand was found to be cointegrated with the different forms of income.

Unlike Australia and New Zealand, Canada's inflation and deregulation problems were not as extreme. The goal of the Bank of Canada was mainly to keep prices stable in the early 1980's (Ammer & Freeman, 1995). Canada's economy averaged a real GDP growth rate of more than 4% and was said to be better than any G-7 country except for Japan. Yearly CPI inflation rates were about 5.5% in Canada.

Montador (1995) analysed the techniques employed by the Bank of Canada to impact the levels of short-term interest rates to maintain the bank's monetary policy objectives. Monetary policy remained consistent in spite of a number of regulatory and market driven changes in recent years. The goal of price stability is maintained by analyzing the impacts of interest rate and exchange rate changes on aggregate demand. The Bank of Canada has continuously maintained its influence on short term interest rates.

Haug (2006) examined a money demand function for Canada and found stable ranks for M1 and the presence of a long-term relationship. Stability results for cointegration rank test showed one cointegration vector in the vector error correction model when M1 and long-term interest rates were used. The results are the same for M0 and short-term interest rate specifications. The time frame for the analysis included both historical periods from 1872 and just post-war periods.

Champagne & Sekkel (2017) account for the importance of structural breaks in the conduct of monetary policy. Post inflationary targeting, the impact of monetary policy is skewed when breaks are not accounted for. There is a significant impact on real GDP and prices when the break is accounted for. Similar results are recorded for the US and the UK. There is evidence of the effects of monetary shocks on output and inflation. Thus, accounting for structural breaks allows identification of monetary policy shocks.

For Norway, Bardsen (1992) derived a money demand function for narrow money using as determinants; prices, real expenditures and interest rates. Similar to Australia, Norway has experienced periods of financial deregulation, changes in regimes and changes in economic developments. The research employs cointegration tools to establish long run relationships. Empirical results suggest the presence of a long-term relationship between money demand and prices, real expenditures and interest rates.

Eitrheim (1998) also applies cointegration analysis between money and prices and wages. Shocks due to financial deregulations are accounted for. The results suggest that shocks are absorbed in the long run and a relationship exists between real money and its determinants: real income, yield spread and own real interest rate. Money reacts to shocks in the exchange rate and wealth variable in the short run as it dynamically adjusts to changes in long run targets. The research also takes note of three primary sources of inflation in Norway, namely; imported inflation including currency depreciation, domestic cost pressure, and excess demand in the product market. These are known as the pass-through effect, unit labour costs and the output gap effect respectively.

Allen & Mapfumba (2014) apply cointegration analysis using a neutral real interest rate. This rate is described to be consistent with stable inflation and with an existence of zero output gap, where actual output equals potential output. There is therefore no stimulus or restraint to the economy at this level. The long run relationship is assessed between the real interest rate gap (difference between the real interest rate and neutral real interest level) and inflation. Norway has recorded several periods of high inflation resulting in financial deregulations and structural shocks. Significant long run stable results were found.

Chowdhury (1995) analyzes money demand for Switzerland using an exchange rate and foreign interest rate, testing the significance of these variables in a simple money demand model. Results show that without the inclusion of the two variables, exchange rate and foreign interest rate, other variables are not cointegrated when added to the money demand equation. This gives support to the capital mobility and currency substitution hypotheses. The research also employs two different monetary aggregates; narrow money and the monetary base. Results are statistically significant for both monetary variables.

Rotheli (1988) analysed the role of money demand estimates under new monetary regimes. The Swiss National Bank gained control over the money stock after Switzerland ceased pegging the Swiss Franc to the US dollar. With flexible exchange rates, a dynamic adjustment of price levels was used in the estimation of income and interest rate elasticities. Findings suggested that the partial adjustment process did not describe how price levels adjusted to changes in its determinants. Income coefficients were not statistically significant and stability in prices was achieved when the growth in M1 was significantly lower than the growth in real income.

Kugler & Sheldon (2009) investigated the role of monetary policy changes on the Swiss labour market considering Phillips curve relationships. The expectations of the implementation of inflationary targeting in 1999 were an increase in the flexibility of the real wage, reduction in the rate of inflation and its persistence, a lower level of the non-accelerating inflation rate of unemployment (NAIRU) and lower sacrifice ratio. Results suggested that most of these expectations were met. With regards to reducing inflation, results showed statistically significant estimates. They however suggest that multiple breaks be considered in the data as well as endogenously determined to enable stability and statistical significance.

Tillman (2010) also assesses the impact of inflationary targeting on the inflation persistence in Switzerland. Results significantly showed that the persistence of inflation has fallen after the change in the monetary regime in 2000, suggesting decreases in inflation expectations and increases in money demand.

In the UK, Howells & Hussein (1998) assessed the demand for broad money looking at the role of the cost of credit. The assertion that people hold money and borrow at the same time indicates that a change in wealth affects the quantity of money people hold. Using the dynamic ordinary least squares model and fully parametric least squares, results show that the cost of credit variables are significant determinants of money demand in the UK.

Similar to Australia, Norway and Switzerland, the UK experienced various periods of financial deregulations and innovations that affected the stability of the money demand model. Drake and Chrystal (1994) find evidence of stable long run money demand using a four-stage approach. A nonparametric procedure to determine which monetary asset is weakly separable, the Divisia aggregation procedure, the test for long run money demand conducted using the Johansen maximum-likelihood procedure on the variables derived from the procedure and finally an estimation of an error correction model.

Cuthbertson & Taylor (1987) examine the role on money demand as a buffer stock (money supply shocks are held as additional money balances temporarily) with evidence for the UK. Precautionary money demand was estimated using the M1 money stock, real personal disposable income, local authority three-month rate and the consumer price deflator. Results are significant and stable and indicate that increases in the money supply are taken up partially in additional money balances.

The presence of a long run relationship between money demand variables has led to several models developed with an emphasis on cointegration. Karfakis & Parikh (1993) considered the M3 monetary aggregate and showed that using Johansen's multivariate cointegration technique, M3 is cointegrated with income, an interest rate and the exchange rate, therefore it is a useful aggregate for monetary policy.

Hossain (2012) employed the ARDL cointegration approach and also found the presence of a long-run equilibrium relationship between narrow real money balances, real income, a representative domestic interest rate and the nominal effective exchange rate in Australia. Likewise, De Brouwer, Ng & Subbaraman (1993) and Felmingham & Zhang (2001) employed the Johansen test for cointegration and found evidence of a long run relationship between broad money and variables such as income, inflation rates and interest rates, despite the difference in cointegration systems.

Bahmani & Bahmani-Oskooee (2005) used the bound testing approach to co-integration and demonstrated that indeed the exchange rate and interest rate hypothesis matter in Iran. Their study suggested that the money demand function should be augmented with a measure of exchange rate volatility. However, Bahmani-Oskooee & Rehman (2005) found that even though real M1 and M2 monetary aggregates were cointegrated with relevant independent variables, the estimated parameters were unstable in some Asian countries. They concluded that for formulating an appropriate monetary policy, both the M1 and M2 aggregates should be considered, particularly in developing countries.

Analysing the money demand model for Bangladesh, Islam (2000) employs cointegration techniques and quarterly time series data. Results showed a single cointegrating vector, proof of a long run relationship with the variables and money demand. Islam employs the multivariate cointegration technique of Johansen and Johansen- Juselius (1992). Results are stable and statistically significant. The maximum likelihood estimation procedure enables simultaneous analysis of a system involving two or more variables.

Bahmani-Oskooee & Rhee (1994) assess long run elasticities of money demand for Korea using cointegration analysis. They employ the Engle and Granger (1987) model to determine the presence of long run relationship for M1 and other monetary aggregates. Results indicate that only M1 is cointegrated with income, interest rates and an exchange rate, and hence for monetary policy formulation, the target monetary variable must be M1 for Korea.

Using the Bayer–Hanck combined cointegration and Johansen cointegration approaches, Ahad (2017) estimates the long run money demand relationship for Pakistan. The independent variables include financial development, industrial production, income and exchange rate. For Pakistan, financial development is the primary determinant of money demand and all the variables in the model are cointegrated with money demand. Results are stable and significant.

Bahmani–Oskooee & Shabsigh (1994) test for cointegration in Japan using the Johansen–Juselius technique. Quarterly data is used. For long run stable results, the research finds that it is important to include the nominal effective exchange rate of the Yen in the money demand model. Under floating exchange rate regimes, a broad money demand equation requires the incorporation of an exchange rate variable to ensure stable results.

Anwar & Asghar (2012) use the Autoregressive Distributed Lag (ARDL) approach to estimate a long run money demand relationship for money, real income, inflation and exchange rate. Results suggest that money aggregates and its determinants are cointegrated but not stable for M1.

This section looks at works on money demand analysis using error correction models (ECM) among countries of interest as well as other cross-country studies. The presence of cointegration allows the use of error correction models to test for the magnitude of the long run relationships. ECM provide short run and long run estimates, even though most studies focus on the long run results due to the issues with stability and efficiency. The short run models show how the dynamic adjustment mechanism works. Any external shocks will revert to equilibrium condition. The error correction model contains a lagged error term. The error correction term (ECT) shows how fast shocks in the short run will be corrected for in the long run so that the system moves to a long run equilibrium. To be valid, ECT must be negative and statistically significant.

Using an error correction model, Ahmad et al. (2007) estimated a long run money demand function with real income and a call money rate. Results showed that both variables were statistically significant given the date in the time period used: 1953–2003. However, the money–income proportionality did not hold for both M1 and broad money M2.

Mutluer & Barlas (2002) construct an error correction model for Turkey using quarterly data and the M2X monetary aggregate. A long run relationship was established for income, interest rate on deposits, interest rate on government securities, inflation rate and real exchange rate. The exchange rate and inflation rate are found to be most relevant and statistically significant. The error correction term is negative and significant indicating that the model used is valid.

Maysami & Koh (2000) estimate a vector error correction model for Singapore's stock market. They found that using Johansen's vector error correction model yielded more efficient results than the use of the Engel and Granger two step error correction model. Results show the relationship between the Singapore stock market and macroeconomic variables.

Mukherjee & Naka (1995) also apply the Vector Error Correction Model (VECM) in a system of seven equations and found that compared to the vector autoregressive model, the VECM has better forecasting abilities. Results are robust and significant, and the models pass the validity tests.

Hansen & Seo (2002) examined a two-regime vector error-correction model with a single cointegrating vector and a threshold effect in the error-correction term. They find strong evidence of a threshold effect, however, recommend the multiple cointegrating vectors in the vector error correction model.

A common thread in all the money demand analysis suggests that, in the presence of structural changes and innovations, the money demand model is subject to instabilities and irregularities. Several tests have been conducted on money demand using techniques to capture such occurrences to ensure effective money demand modelling.

Boughton (1981) accounts for instabilities in the money demand model using a simplified form of Goldfeld's log-linear real balance function. Consistent results are derived using this method given the several shifts in the money demand function. Bataa et al. (2011) account for structural breaks in the coefficients by employing an iterative procedure using a covariance matrix system of equations. Using inflation dynamic analysis, they identify regions leading in inflation.

Breuer & Lippert (1996) examine structural breaks in money demand to avoid non stationarity result estimations when otherwise ignored. They use the Gregory and Hansen (1992) econometric technique. This allows for structural breaks in a cointegrating model. Error correction models used in the analysis also incorporate structural breaks. Significant breakpoints are identified that coincide with the period of deregulation of the banking industry.

Kumar (2010) accounts for the impact of financial reforms on the money demand model using an estimate for two sets of sub-samples and two break dates. This allows for structural breaks in the model to be accounted for. Using the CUSUM and the CUSUMQ tests, results indicate that money demand functions are temporarily stable for the selected countries.

Karfakis & Sidiropoulos (2000) model a stable long run money demand model for Greece using time series methods. The Hansen–Johansen (1993) stability analysis affirms long run money demand functions for periods with monetary deregulations.

Nchor & Adamec (2016) investigate the stable money demand function in Ghana using the CUSUM test and account for structural breaks using the Chow breakpoint test. Results show a stable money demand with no evidence of structural breaks. Money demand can thus be used for monetary policy implementation to achieve macroeconomic stability.

Bahmani (2008) incorporated the CUSUM and CUSUMQ tests into the cointegration analysis for Middle Eastern countries for stable model demand results. This method was used to avoid spurious estimates at a result of instabilities due to structural changes. Results show that money demand was stable regardless of the unstable nature of the region.

Lucas & Nicolini (2015) tested the stability of money demand and find that regulatory changes in the banking sector resulted in instabilities in money demand functions over the change period.

To account for endogeneity, Thenuwara & Morgan (2015) employ an endogenous approach based on the ARDL model. This is used to explain instabilities in the money demand model. Results indicate that endogenous money demand functions exist due to the liquidity demands on banks. Causality tests between the money supply and the credit banks provide a money multiplier between broad money and bank credit.

A consumer theory-based systemic approach is used by Calania, Fuentesc & Schmidt-Hebbel (2013) to assess the money demand model in Chile. This model is derived from a utility maximizing framework and a quasi-concave utility function and results from the analysis are robust and consistent with economic theory. Results are stable and statistically significant.

There is an extensive literature on stable money demand models as well as the impact of structural breaks due to financial deregulations and economic instabilities on money demand. When analyzing a money demand model, most studies found have attempted to establish a stable and consistent relationship between the quantity of money and its determinants. In economic theory, money demand elasticities impact monetary policy formulation especially when looking at the IS-LM model however, profound analysis of this is not prominent in the literature.

CHAPTER 3

3.1 Model Specification and Econometric Methodology

This section discusses the methods employed in the study to estate money demand functions for a selection of developed countries. Theoretical and empirical frameworks, data sources as well as estimation methods are highlighted. We also justify the variables used in the analysis.

In as much as empirical evidence is needed to choose between theoretical approaches, theory is also needed to interpret empirical evidence. Theories of the demand for money attempt to explain one or more of the characteristics of money, stressing the role of money as medium of exchange in transactions, and as a store of value. Traditional monetary theory (McCallum, 2000; Nelson, 2002; Nelson. 2003; Piergallini, 2006) models the money demand function following the quantity theory equation of exchange based on the Fisher rule (1911). Consequently, there are several theories developed to explain the demand for money, including the Cambridge approach (Pigou ,1917; Marshall 1923), the neoclassical approaches (McCallum & Goodfred ,1987; Cannon, 1921; Laidler, 1993), the Keynesian theory of money demand (Keynes, 1930; Keynes, 1936), post–Keynesian theories of money demand, the inventory theoretic approach (Baumol, 1950; Tobin, 1956), the precautionary demand approach (Whalen, 1966; Dornbush & Fisher, 1990; Miller & Orr, 1968), money as an asset theory (Judd & Scaddup, 1982) and consumer demand theory (Barnett ,1980; Goldfeld, 1987).

The empirical modelling is also extensive, although many of the studies tend to be country specific as detailed in the literature review. Various forms of money demand functions have been estimated by including a host of different variables in the money demand functions. Researchers have recently employed time-series econometric techniques in estimating the demand for money functions.

3.2 Theoretical Model

We explore two theoretical frameworks of money demand; the Monetarist and the New Keynesian models that guide the empirical modelling of this research.

3.2.1 Monetarist Model

This school of thought focuses on the role of money as only a medium of exchange. Thus, money is used to facilitate transaction purposes. According to Milton Friedman, “inflation is always and everywhere a monetary phenomenon” (Friedman, 1992). There is the belief that through monetary policy, or rather the actions of the central bank, inflation can be controlled.

3.2.2 New Keynesian Model

The New Keynesian model is based on real income and interest rates (Ericsson (1998). This focuses on money as a medium of exchange as well as a store of value. This school of thought argues that central banks can only influence interest rates through affecting the rate of inflation. This implied that money growth rate determined the rate of inflation in the long run. According to Ireland (2004,979): “the monetary authority must choose the steady-state rate of inflation, which is ultimately determined by the rate of nominal money growth, exactly as described by the quantity theory of money.”

3.2.3 Money Demand Function

Conventionally the demand for money is specified as a function of real income, a long run interest rate on substitutable non-money financial assets, a short-run rate of interest on money itself, and the inflation rate. More specifically, following, inter alia, Ericsson (1998), Beyer (1998) and Coenen & Vega (2001), the demand for money function is specified using Cagan's (1957) double log form given by:

$$m_t = \beta_1 + \beta_2 y_t + \beta_3 ex_t + \beta_4 IFL_t + \beta_5 R_t + \mu \qquad (6)$$

Note: All variables shown in lowercase (i.e. m, y, ex and p) are in logs and the remaining variables (i.e. IFL, R) are in levels. The expected signs of the slope coefficients are: $\beta_2 > 0$, $\beta_3 >$ or < 0, $\beta_4 < 0$ and $\beta_5 < 0$.

3.3 Empirical Model

This paper will analyze different modelling techniques of money demand functions and how they impact money demand's role in monetary policy. Several tests have been mentioned in the empirical literature that will be utilized. Our analysis will be limited to a pooled time-series cross-section sample of developed countries to ensure that data for the necessary variables are available with a certain quality. This is an issue in the cointegration tests since these tests require time-series data for a lengthy period.

3.4 Estimation Techniques

To estimate the long and short run relationships between money demand and its determinants, we apply the Johansen multivariate approach to cointegration and error-correction models. The first step is to estimate the data time series properties using the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and the Phillip-Perron (PP) test (1988). These test for the stationarity of each time series.

3.4.1 Unit Root Test

The use of cross-sectional time series macroeconomic data for the study presupposes the presence of non-stationarity of the variables. To test for stationarity of the endogenous and exogenous variables we use the ADF and PP tests to find robust conclusions. These tests were employed to ensure a reliable result of the stationarity tests due to the weaknesses in each individual technique. Similar as they are, there are significant differences in how autocorrelation in the residuals is corrected for each technique.

The ADF test does not take into consideration heteroscedasticity and non-normality of the residuals and is unable to discriminate between stationary and non-stationary series with a high degree of autocorrelation in the residuals. As such, the PP test is employed to solve these problems. The PP unit root test differs from the ADF test mainly in how it deals with serial correlation and heteroscedasticity in the errors. Where the ADF test uses a parametric autoregression to approximate the ARMA structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression. The PP test can be considered therefore as nonparametric. Whereas the ADF assumes the error terms are independent with a constant variance, the PP test assumes the error terms are weakly dependent and distributed heterogeneously providing robust estimates over the ADF test.

A variable is considered stationary if its mean and variance are constant over time and the covariance between the two time periods depends only on the distance between the two time periods and not the actual time at which the covariance is computed. Unit root tests are meant to avoid a spurious correlation, which is a common problem with macroeconomic time series data (Gujarati, 2007). To test for stationary, both the ADF and PP tests will be used.

Using the ADF and PP tests, the null hypothesis (H_0), suggests non-stationarity of a series (contains a unit root) whilst the alternative hypothesis (H_1) suggests stationarity in the series (no unit root). If the t-statistic is less than the critical values in absolute terms, we fail to reject the null hypothesis, and this implies that the series is non-stationary. Also, if the p-value is greater than 0.05, the same conclusion is drawn. On the contrary, if the t-statistic is greater than the critical values in absolute terms, we reject the null hypothesis for non-stationarity and the alternative hypothesis (stationary) is not rejected. Likewise, with a p-value of less than 0.05, we reject the null hypothesis and conclude that our series is stationary. For stationarity at the levels we assume that the series are integrated of order zero I(0), implying that the residuals in a cointegrating regression are stationary. However, if stationarity occurs at the first difference of the series then the series is integrated of order one I(1). Critical values for the ADF and PP t-statistic are given in Mackinnon (1991).

3.4.2 Cointegration

The notion of cointegration provides a tool for identifying long-run relationships, to be embedded in dynamic error correction models with constant parameters. The assumed exogeneity status of variables for the parameters of interest can also be assessed.

To test for the presence of an equilibrium long run relationship among time series variables, the Johansen (1988) technique is employed in this study. The Johansen procedure is preferred to other tests of cointegration because it involves full information maximum likelihood estimation that treats all variables in the system. The Johansen cointegration procedure generates two likelihood ratio tests, known as the maximum eigenvalue and trace tests, to determine the number of cointegrating vectors using the maximum-likelihood estimation procedure. Johansen (1988) and Johansen & Juselius (1990) developed a multivariate method that explicitly uses the vector autoregressive (VAR) and the vector error correction model (VECM). These frameworks allow to test for cointegration and estimate short and long run relationships when analysing stationarity in macroeconomic time series models. The impact of shocks or disturbances, anticipated or otherwise, are captured. The VAR and VECM tests enable individual regressors to explain variations in endogenous variables by regressing each variable on itself lagged and all the other variables in the system lagged (Narayan, 2010).

Although Engle and Granger's (1987) two-step error-correction model may also be used in a multivariate context, the VECM yields efficient (smallest variance) estimators of the cointegrating vectors. This is because the VECM is a full information maximum likelihood estimation model that allows for testing for cointegration in a whole system of equations in one step and without requiring a specific variable to be normalized. This allows us to avoid relying on estimates of the errors from the first step into the second, as would be the case if Engle-Granger's methodology is used. It also has the advantage of not requiring a priori assumptions of endogeneity or exogeneity of the variables, although exogeneity of variables can be imposed and tested.

The error correction model has several desirable features. First it avoids the possibility of spurious correlation among strongly trended variables. Second the long run relationships that may be lost by expressing the data in differences to achieve stationarity are captured by including the lagged levels of the variables on the right-hand side. Third the specification attempts to distinguish between short run (first difference) and long run (lagged levels) effects. Finally, it provides a more general lag structure, which does not impose too specific a lag shape on the model (Hendry, 1980).

All of the short run models of money demand to be estimated are built up from equation 1. We will also estimate models that consider the long run relationship between money demand and these determinants. Co-integration models of money demand will be developed to analyse these. The presence of cointegration suggests that the variables share a long run relationship.

From eqn. 6, the error correction model is defined below:

$$\Delta m_t = \beta_1 + \beta_2 \Delta y_t + \beta_3 \Delta ex_t + \beta_4 \Delta IFL_t + \beta_5 \Delta R_t + e_{t-1} + \varepsilon_t \quad (7)$$

Where, Δ is the first difference term, e_{t-1} is the error correction term; the lagged residual and ε_t is the white noise error term.

3.4.3 Causality

The Granger causality test allows us to determine whether one time series is useful in forecasting another. It determines whether one time series is a useful predictor of another but not cause in the sense of cause and effect. Therefore, it reflects the extent to which the lag process in one variable explains the current values of another variable. If the variables in the series are co-integrated, then the causal relationship between the variables is examined with the help of the Engle & Granger (1987) causality procedure.

To test for the direction of causality in our model, the following regression equations are used:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{n} \emptyset_{1i} \Delta Y_{t-i} + \sum_{i=0}^{n} \beta_{1i} \Delta X_{t-i} + \lambda_{1i} ECT_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{n} \emptyset_{2i} \Delta X_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta Y_{t-i} + \lambda_{2i} ECT_{t-1} + \mu_t \quad (9)$$

where $\mathbf{\Delta Y_t}$ and $\mathbf{\Delta X_t}$ are the dependent and the explanatory regressors, ECT is the error correction term, $\boldsymbol{\lambda_{1i}}$ and $\boldsymbol{\lambda_{2i}}$ are the speed of adjustments, $\mathbf{n}$ is the optimal lag order determined by applying the Akaike Information Criterion, Δ represents the difference operator, subscripts t and t-i denote the current and lagged values, $\boldsymbol{\varepsilon}$ and $\boldsymbol{\mu}$ are the stochastic disturbance terms. The error term disappears if the series show no cointegration. However, we can apply the Engle & Granger (1987) tests since this test is based on the error correction model.

To test for causality between real money demand and its determinants; output, the exchange rate, inflation rate and interest rates, the VEC Granger Causality (Block Exogeneity Wald Test) developed by Granger (1988) is used to identify the direction of causality.

3.4.4 Stability

Given extensive financial deregulation and innovations introduced over time, stable results are pivotal in modelling money demand. The CUSUM and CUSUM of squares tests are conducted to reveal a stable element in the regressors. These tests were proposed by Brown, Durbin & Evans (1975) to the residuals of the optimum error-correction model. The sample period is split into two sub-samples and the CUSUM and CUSUM of squares statistics are computed from the estimated residuals and updated recursively and plotted against the break points. If the plot of CUSUM or CUSUM of squares stays within a five per cent significance level (portrayed by two straight lines whose equations are given in Brown et al. (1975), then the coefficient estimates are said to be stable.

The next stability test is the Chow breakpoint test (Chow, 1960). This is a more formal test for any structural changes that may occur in the model and hence cause instability. The procedure estimates the sum of squared errors from each sub-sample regression, then tests for significant difference using an F test.

3.4.5 Residual Diagnostic Tests

Additional diagnostic tests are conducted to further ascertain the validity of the money demand model. Tests for serial correlation, multivariate normality, and heteroscedasticity are also considered.

3.5 Data

This study uses cross sectional times series secondary data in the analysis. The primary variables used include: broad money (LCU[2]) sourced from the World Bank's *World Development Indicators*; output, an exchange rate, inflation rate and price data taken from the International Financial Statistics of the International Monetary Fund, and interest rates from the statistical database of the OECD. Output is measured in millions, Gross Domestic Product, Real, Spliced Historical Series, Domestic Currency. The exchange rate is a real effective exchange rate index that utilizes weights determined by bilateral trade values. The inflation rate is the percentage change in the consumer price index of all items measured as a percentage change over previous period prices. The short-term interest rate is the 3-Month yield and the long-term interest rate is long term government bonds yields (10 years). The use of annual data in cointegration analysis is not uncommon, although most studies done in the countries of interest have used monthly and quarterly data in the analysis. The period of study for most of the countries enables us to capture periods of regime changes and financial deregulations. We provide descriptive statistics of all the

[2] Local currency units.

variables and data in Appendix A. All analysis is computed using the Eviews statistical package.

CHAPTER 4

4.1 Empirical Results

4.1.1 Unit Root Tests

The Johansen Multivariate Approach to cointegration test requires that all the variables are integrated of order one (1). Therefore, as a first step in the estimation process, the study investigated the stationarity properties of both the endogenous and the exogenous variables. The tests were done within the framework of the Augmented-Dickey-Fuller (ADF) test procedure (Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips & Perron, 1988). Each of the variables was tested in levels and in first differences (Δ). The automatic lag length selection per the Akaike Information Criterion (AIC) and the Newey-West bandwidth with a maximum lag length of 8 periods were used for the ADF and PP tests respectively. The study presented and used the P-values for making the unit root decision.

Results from the unit root tests presented below suggest that all the variables are integrated (difference stationary) of order one and have a deterministic trend.

Table 4.1.1-A Results for ADF and PP tests for Australia (1960-2017)

Variable	ADF t-stats	p-value	PP t-stats	p-value
m	-1.094639	0.9209	-1.231243	0.8942
Δ(m)	-5.909621	0.0000***	-5.930593	0.0000***
y	-2.556010	0.3014	-2.886598	0.1746
Δ(y)	-5.613729	0.0000***	-5.475253	0.0000***
ex	-2.600231	0.2819	-2.164275	0.4997
Δ(ex)	-5.580753	0.0001***	-5.332908	0.0003***
IFL	-2.235643	0.4612	-2.269232	0.4433
Δ(IFL)	-6.934809	0.0000***	-7.089284	0.0000***
RS	-1.986191	0.5962	-1.847304	0.6684
Δ(RS)	-8.082616	0.0000***	-12.40701	0.0000***
RL	-1.160009	0.9090	-1.214991	0.8977
Δ(RL)	-5.808702	0.0001***	-5.634723	0.0001***

Note: *MacKinnon (1996) one-sided p-values. ***, **, * denotes the rejection of the null hypothesis of the unit root at 1%, 5%, 10% significance level respectively

Table 4.1.1-B Results for ADF and PP tests for Canada (1970 -2017)

Variable	ADF t-stats	p-value	PP t-stats	p-value
m	-2.556010-	0.8117	-1.500256	0.8179
Δ(m)	7.807202	0.0000***	-7.808111	0.0000***
y	-4.064757	0.0120	-20.75016	0.0001***
Δ(y)	-13.25256	0.0000***	-14.63750	0.0000***
ex	-2.106329	0.5308	-1.603901	0.7790
Δ(ex)	-5.205033	0.0004***	-4.994544	0.0008***
IFL	-2.460472	0.3459	-2.341905	0.4051
Δ(IFL)	-6.583269	0.0000***	-6.651531	0.0000***
RS	-2.468957	0.3418	-2.256709	0.4498
Δ(RS)	-6.993340	0.0000***	-8.435580	0.0000***
RL	-1.666039	0.7531	-1.634315	0.7666
Δ(RL)	-6.272985	0.0000***	-6.183491	0.0000***

Note: *MacKinnon (1996) one-sided p-values. ***, **, * denotes the rejection of the null hypothesis of the unit root at 1%, 5%, 10% significance level respectively

Table 4.1.1-C Results for ADF and PP tests for Norway (1985-2017)

Variable	ADF t-stats	p-value	PP t-stats	p-value
m	-5.518711	0.0008***	-2.457800	0.3453
Δ(m)	-1.405725	0.8328	-7.399191	0.0000***
y	-0.954833	0.9365	-1.328583	0.8622
Δ(y)	-2.826285	0.1991	-2.836087	0.1959
ex	-2.377969	0.3830	-1.954796	0.6029
Δ(ex)	-4.304191	0.0095***	-4.216284	0.0117*
IFL	-4.852097	0.0028***	-2.495507	0.3280
Δ(IFL)	-2.989732	0.1531	-8.450504	0.0000***
RS	-2.830330	0.1978	-2.403422	0.3709
Δ(RS)	-5.320517	0.0008***	-6.837049	0.0000***
RL	-1.922792	0.6195	-1.447751	0.8265
Δ(RL)	-5.780237	0.0002***	-10.71238	0.0000***

Note: *MacKinnon (1996) one-sided p-values. ***, **, * denotes the rejection of the null hypothesis of the unit root at 1%, 5%, 10% significance level respectively

Table 4.1.1-D Results for ADF and PP tests for Switzerland (1974-2017)

Variable	ADF t-stats	p-value	PP t-stats	p-value
m	-1.995520	0.5872	-2.046512	0.5599
Δ(m)	-6.562324	0.0000***	-6.567812	0.0000***
y	-3.651663	0.0372	-4.824261	0.0018**
Δ(y)	-6.266737	0.0000***	-11.99383	0.0000***
ex	-3.650417	0.0371**	-3.629378	0.0389**
Δ(ex)	-5.115008	0.0008***	-5.824766	0.0001***
IFL	-4.534058	0.0040***	-4.534058	0.0040***
Δ(IFL)	-5.959726	0.0001***	-6.252962	0.0000***
RS	-3.769090	0.0284	-3.607153	0.0409**
Δ(RS)	-5.939964	0.0001***	-13.25654	0.0000***
RL	-2.178245	0.4891	-2.498401	0.3274
Δ(RL)	-5.202471	0.0006***	-5.991162	0.0001***

Note: *MacKinnon (1996) one-sided p-values. ***, **, * denotes the rejection of the null hypothesis of the unit root at 1%, 5%, 10% significance level respectively

Table 4.1.1-E Results for ADF and PP tests for UK (1960-2017)

Variable	ADF t-stats	p-value	PP t-stats	p-value
m	-2.928916	0.1616	-2.498022	0.3280
Δ(m)	-4.931971	0.0010***	-4.966978	0.0009***
y	-2.703707	0.2392	-2.112656	0.5277
Δ(y)	-5.554588	0.0001***	-5.295638	0.0003***
ex	-2.279288	0.4378	-1.860126	0.6619
Δ(ex)	-5.420616	0.0002***	-5.456736	0.0002***
IFL	-2.759673	0.2179	-2.708566	0.2373
Δ(IFL)	-7.363663	0.0000***	-10.00050	0.0000***
RS	-1.957514	0.6110	-1.705882	0.7358
Δ(RS)	-7.215363	0.0000***	-10.72798	0.0000***
RL	-1.673899	0.7500	-1.542769	0.8028
Δ(RL)	-6.180828	0.0000***	-8.096975	0.0000***

Note: *MacKinnon (1996) one-sided p-values. ***, **, * denotes the rejection of the null hypothesis of the unit root at 1%, 5%, 10% significance level respectively

The results from the ADF and PP Tests for the sample countries in Tables 4.1.1.A to 4.1.1.E suggest that for the most part, all of the variables were non-stationary at the levels, but stationary in first differences.

After first differencing, the tests suggest stationarity of the differenced variables with p-values less than 5% for both the ADF and PP tests. The tests performed in levels and first-differences suggest that the time series are integrated of order one, or I(1), satisfying the condition for the application of the Johansen maximum likelihood approach.

4.1.2 VAR Lag Selection Order Results

The selection of an appropriate lag length is a problem in the estimation of VAR models. The lag length plays a crucial role in diagnostic tests as well as in the estimation of VAR models for cointegration. The appropriate lag length was determined using the Akaike Information Criterion (AIC) that ensures normally distributed white noise errors with no serial correlation. The objective is to choose the lag length that minimizes the AIC value obtained from each VAR estimation with different lag length. Due to the modest number of annual observations, the number of lags was limited to a maximum of five years. Other lag selection statistics are also included in Tables 4.1.2.A to 4.1.2.E and are listed in the notes to Table 4.1.2.E.

Table 4.1.2-A VAR Lag Selection for Australia (1960 -2017)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-274.3229	NA	0.001582	10.57822	10.80128	10.66400
1	107.9840	663.6271	3.37e-09	-2.489963	-0.928599*	-1.889538*
2	146.3150	57.85804	3.25e-09	-2.577923	0.321752	-1.462848
3	181.5491	45.20601	3.85e-09	-2.549021	1.688965	-0.919296
4	220.4635	41.11717	4.59e-09	-2.659001	2.917297	-0.514626
5	295.3579	62.17646*	1.80e-09*	-4.126713*	2.787896	-1.467688

Table 4.1.2-B VAR Lag Selection for Canada (1970-2017)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-194.2220	NA	0.000361	9.100999	9.344297	9.191226
1	62.32064	431.4580	1.63e-08	-0.923665	0.779425*	-0.292077*
2	95.90562	47.32429	1.99e-08	-0.813892	2.348990	0.359057
3	147.4316	58.55226*	1.27e-08*	-1.519619	3.103055	0.194692
4	185.8677	33.19480	1.98e-08	-1.630349*	4.452115	0.625322

Table 4.1.2-C VAR Lag Selection for Norway (1985 -2017)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-60.69586	NA	2.98e-06	4.302959	4.580505	4.393432
1	118.1263	276.8860*	3.11e-10	-4.911377	-2.968556*	-4.278066*
2	161.2978	50.13462	2.60e-10*	-5.374053*	-1.765956	-4.197904

Table 4.1.2-D VAR Lag Selection for Switzerland (1974 -2017)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-46.50832	NA	5.22e-07	2.561381	2.812148	2.652697
1	171.8157	362.0983	7.31e-11	-6.332472	-4.577105*	-5.693264*
2	216.1055	60.49340*	5.47e-11	-6.736853	-3.476886	-5.549753
3	261.1272	48.31603	4.87e-11*	-7.176938*	-2.412372	-5.441946

Table 4.1.2-E VAR Lag Selection for UK (1960 -2017)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-296.4331	NA	0.003644	11.41257	11.63562	11.49834
1	24.09351	556.3858	7.99e-08	0.675716	2.237080*	1.276142

2	78.96183	82.82010	4.13e-08*	-0.036295	2.863379	1.078780*
3	101.8701	29.39172	7.78e-08	0.457733	4.695719	2.087458
4	143.0382	43.49836	8.52e-08	0.262710	5.839008	2.407086
5	209.4182	55.10790*	4.62e-08	-0.883704*	6.030906	1.775321

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The VAR results show the optimal lag length based on the Akaike Information Criterion.[3] Using this optimal lag length, the likelihood ratio test that depends on the Maximum Eigenvalues of the stochastic matrix of the Johansen (1991) procedure for exploring the number of cointegrating vectors was used.

4.1.3 Cointegration Results

Cointegration establishes the existence of a long-term relationship among the variables of interest (Johansen, 1991). This also allows researchers to determine if a disequilibrium exists in various markets, Pesaran & Shin (1995). Johansen (1991) emphasises that cointegration allows for the specification of a process of dynamic adjustment among the cointegrated variables and any such disequilibrium in the markets. With the series integrated of order one, I(1) the results of both the trace and the maximum-eigenvalue statistics of the Johansen cointegration tests are presented below in Tables

[3] AIC = 2K - 2lnL where L is the log-likelihood. The most appropriate model is determined by choosing the AIC value with the largest negative value.

4.1.3.A to 4.1.3.E. These statistics test for the number of cointegration regressors for each country.

Table 4.1.3-A Results for Trace and Maximum Eigenvalue Tests Australia (1960 -2017)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.	Max-Eigen Statistic	Prob.
None *	0.934089	285.0211	0.0000	141.4113	0.0001
At most 1 *	0.761530	143.6098	0.0000	74.54255	0.0000
At most 2 *	0.458964	69.06721	0.0002	31.94203	0.0129
At most 3 *	0.313384	37.12519	0.0060	19.55095	0.0820
At most 4 *	0.268128	17.57424	0.0240	16.23179	0.0241
At most 5	0.025486	1.342448	0.2466	1.342448	0.2466

Table 4.1.3-B Results for Trace and Maximum Eigenvalue Tests Canada (1970 -2017)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.	Max-Eigen Statistic	Prob.
None *	0.888759	264.6694	0.0000	94.43053	0.0000
At most 1 *	0.790275	170.2389	0.0000	67.16410	0.0000
At most 2 *	0.731776	103.0748	0.0000	56.58509	0.0000
At most 3 *	0.394997	46.48972	0.0003	21.60847	0.0428
At most 4 *	0.321365	24.88124	0.0015	16.66986	0.0204
At most 5 *	0.173836	8.211382	0.0042	8.211382	0.0042

Table 4.1.3-C Results for Trace and Maximum Eigenvalue Tests Norway (1985 – 2017)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.	Max-Eigen Statistic	Prob.
None *	0.949704	204.1079	0.0000	89.69479	0.0000
At most 1 *	0.869673	114.4131	0.0000	61.13133	0.0000
At most 2 *	0.550943	53.28181	0.0142	24.01815	0.1341
At most 3	0.415162	29.26367	0.0575	16.09260	0.2195
At most 4	0.354992	13.17106	0.1087	13.15480	0.0743
At most 5	0.000542	0.016267	0.8984	0.016267	0.8984

Table 4.1.3-D Results for Trace and Maximum Eigenvalue Tests Switzerland (1974 -2017)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.	Max-Eigen Statistic	Prob.

None *	0.742152	148.9133	0.0000	54.21536	0.0007
At most 1 *	0.684353	94.69795	0.0002	46.12517	0.0011
At most 2 *	0.513051	48.57278	0.0427	28.78387	0.0350
At most 3	0.254074	19.78891	0.4373	11.72517	0.5750
At most 4	0.173687	8.063738	0.4586	7.631265	0.4174
At most 5	0.010754	0.432473	0.5108	0.432473	0.5108

Table 4.1.3-E Results for Trace and Maximum Eigenvalue Tests UK (1960 -2017)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.	Max-Eigen Statistic	Prob.
None *	0.917108	255.4728	0.0000	129.4912	0.0000
At most 1 *	0.644436	125.9816	0.0000	53.77059	0.0001
At most 2 *	0.447195	72.21099	0.0001	30.82302	0.0185
At most 3 *	0.357338	41.38797	0.0015	22.99111	0.0271
At most 4 *	0.190542	18.39686	0.0178	10.99229	0.1546
At most 5 *	0.132722	7.404567	0.0065	7.404567	0.0065

Note: Trace and Maximum Eigenvalue tests indicates the number of cointegrating vectors at the 0.05 level.

* indicates rejection of hypothesis at 0.05 level

** Mackinnon- Haug – Michelis (1999) p-value

From the tables above, there is at least one cointegrating equation for each of the countries of interest indicating the potential for a long run relationship to exist among the variables. The trace statistics for the unrestricted cointegration rank test for all countries have p-values of less than 5%, therefore rejecting the null hypothesis that there exists no cointegration among the data series. The model has rank and this means there is cointegration. The Maximum Eigenvalue test confirms this result for all the countries.

Specifically, the results from both tests for Australia show that there is at most four (4) cointegrating equation with trace and eigenvalue statistics of 17.57424 and 16.23179 respectively and p-values less than 0.05. Canada has three (5) cointegrating vectors, Norway with three (2) cointegrating equations, Switzerland indicates two (2) cointegrating equation and finally UK with at most five (5) cointegrating equations among the variables (broad money, output, exchange rate, inflation rate and interest rates)

We can conclude based on the Maximum Eigenvalue test (Enders, 2004), that there is a long run relationship among the variables thus they move along together in the long run and that short-term deviations will be corrected towards an equilibrium. The selected variables share a common stochastic trend and will grow proportionally.

4.1.4 Vector Error Correction Model

The results from the cointegration analysis reported above establish a long-run relationship for our model. We can then use EViews software to estimate a VECM for each country. This normalises the first variable (the dependent variable) in the VAR model. The results for all the countries are given below in Tables 4.1.4.A and 4.1.4.B.

4.1.4.1 Vector Error Correction Model using short run and long run interest rates

Table 4.1.4-A Results for VECM

Variable	Australia	Canada	Norway	Switzerland	UK
m(-1)	1.000000	1.000000	1.000000	1.000000	1.000000
y(-1)	-1.32327*** (0.00878) [-150.656]	-2.38208*** (0.18301) [-13.0159]	29.81808*** (2.03696) [14.6385]	-0.64996*** (0.11955) [-5.43647]	-3.69391*** (0.15925) [-23.1954]
ex(-1)	-1.09128*** (0.02739) [-39.8356]	3.106158*** (0.28641) [10.8450]	6.956961*** (1.75993) [3.95298]	-1.63055*** (0.19659) [-8.29407]	-1.70542*** (0.19265) [-8.85256]
IFL(-1)	0.034826*** (0.00190) [18.3474]	-0.23899*** (0.01654) [-14.4475]	-0.64599*** (0.14252) [-4.53261]	-0.069991** (0.02416) [-2.89657]	0.142253*** (0.01336) [10.6462]

RS(-1)	-0.04411*** (0.00359) [-12.2847]	0.142933*** (0.03110) [4.59519]	1.528715*** (0.13443) [11.3720]	0.077979*** (0.02313) [3.37083]	0.249975*** (0.03182) [7.85648]
RL(-1)	0.062497*** (0.00379) [16.4746]	-0.021981 (0.03819) [-0.57562]	0.544371** (0.19447) [2.79925]	-0.049870* (0.02751) [-1.81277]	-0.40952*** (0.04880) [-8.39101]
C	18.66195	29.57724	-915.2059	2.255852	88.81209
ect	0.385832 (0.325673) [1.184724]	-0.300569 (0.211358) [-1.422085]	-0.004696 (0.011323) [-0.414762]	-0.585149*** (0.162072) [-3.610420]	-0.470496*** (0.099253) [-4.740386]

Note: ***SE in () and t-statistics in [], ***, **, * represent 1%, 5% and 10% level of significance respectively**

4.1.4.2 Vector Error Correction Model using time trend

Table 4.1.4-B Results for VECM using Time Trend

Variable	Australia	Canada	Norway	Switzerland	UK
m(-1)	1.000000	1.000000	1.000000	1.000000	1.000000
y(-1)	-0.913065*** (0.07775) [-11.7433]	4.427696*** (0.69043) [6.41299]	2.248214*** (0.11603) [19.3768]	-7.151069*** (1.02179) [-6.99854]	-2.002934*** (0.33507) [-5.97759]
ex(-1)	-1.010850*** (0.02267) [-44.5990]	2.304852*** (0.25029) [9.20875]	0.008546 (0.13233) [0.06458]	-1.173008*** (0.32127) [-3.65121]	-1.285247*** (0.14763) [-8.70573]
IFL(-1)	0.023470*** (0.00241) [9.72768]	-0.245163*** (0.01605) [-15.2727]	-0.004892 (0.00963) [-0.50781]	0.014054 (0.02873) [0.48912]	0.079574*** (0.00813) [9.78438]
RS(-1)	-0.040180*** (0.00275) [-14.6096]	0.106944*** (0.02197) [4.86879]	0.138829*** (0.00831) [16.7007]	0.097992** (0.04442) [2.20584]	0.075965*** (0.02120) [3.58336]
RL(-1)	0.061125*** (0.00283) [21.6155]	-0.076788** (0.02875) [-2.67106]	-0.072757*** (0.01682) [-4.32522]	0.011210 (0.03719) [0.30141]	-0.155356*** (0.02994) [-5.18972]
@TREND	-0.015408*** (0.00286) [-5.39597]	-0.194562*** (0.01851) [-10.5140]	-0.063002*** (0.00318) [-19.8284]	0.128179*** (0.02251) [5.69441]	-0.032457*** (0.00980) [-3.31054]

C	7.602499	-148.3112	-86.43841	171.6111	40.53254
ect	0.418970 (0.415955) [1.007248]	-0.011260 (0.211755) [-0.053173]	-0.065610 (0.151405) [-0.433342]	-0.171347 (0.246355) [-0.695526]	-0.777200 (0.126025) [-6.167013]

Note: *SE in () and t-statistics in [], *, **, * represent 1%, 5% and 10% level of significance respectively**

This paper estimates two (2) long run models for consistent results. For proof of a correct, valid and stable model, the error correcting term (ECT) must have a negative coefficient and be statistically significant so that deviations in the short run can be expected to self-correct in the long run. When using the EVIEWS software, the signs on regressors are reversed in the long run, therefore negative coefficients of output reported are actually positive and consistent with the literature and theory.

4.1.5 VEC Granger Causality/Block Exogeneity Wald Tests Results

We test the nature of the causalities that exist between the variables in the VEC system as it is imperative to establish if the assumed exogenous variables are in fact exogenous. We computed the VEC Granger Causality/ Block Exogeneity Wald test to test for exogeneity of the independent variables. The VEC model does not incorporate lagged independent variables (in differenced form), so that it might be prudent to expect that the causality between the independent variables and money demand are simultaneous. Changes in the money growth rate could affect the growth rate of real income if monetary policy is not neutral. Certainly, the nominal exchange rate could also be affected if speculators pay attention to the money growth rate. Short and long-term interest rates could be affected by money growth if the central bank is using money growth as a tool to target interest rates. As well, the relationship between money growth and inflation is well-known. The null hypothesis of this test is that there is no Granger-causal relationship between the variables, hence the explanatory variable is not exogenous. The results are shown below in Tables 4.1.5.A to 4.1.5.E.

Table 4.1.5-A Granger Causality results for Australia (1960 – 2017)

Dependent Variable	Explanatory Variable	df	Chi-square	Prob	Decision
m	y	5	4.115070	0.5330	Fail to reject H0
	ex	5	2.433162	0.7865	Fail to reject H0
	IFL	5	7.696285	0.1738	Fail to reject H0
	RS	5	4.866823	0.4323	Fail to reject H0
	RL	5	9.890343	0.0784	Reject H0
	all	25	25.97257	0.4091	Fail to reject H0
y	m	5	11.33960	0.0450	Reject H0
	ex	5	2.381245	0.7943	Fail to reject H0
	IFL	5	12.01186	0.0346	Fail to reject H0
	RS	5	5.378963	0.3714	Fail to reject H0
	RL	5	10.31687	0.0667	Reject H0
	all	25	44.26977	0.0101	Reject H0
ex	m	5	2.889767	0.7170	Fail to reject H0
	y	5	4.073549	0.5389	Fail to reject H0
	IFL	5	6.647398	0.2482	Fail to reject H0
	RS	5	1.377962	0.9267	Fail to reject H0
	RL	5	4.124650	0.5316	Fail to reject H0
	all	25	27.06595	0.3526	Fail to reject H0
IFL	m	5	29.79354	0.0000	Reject H0
	y	5	28.16220	0.0000	Reject H0
	ex	5	40.36080	0.0000	Reject H0
	RS	5	14.25598	0.0141	Reject H0
	RL	5	35.10518	0.0000	Reject H0
	all	25	112.3724	0.0000	Reject H0
RS	m	5	9.365515	0.0953	Reject H0
	y	5	0.367718	0.9962	Fail to reject H0
	ex	5	5.778401	0.3284	Fail to reject H0
	IFL	5	4.692929	0.4545	Fail to reject H0
	RL	5	4.641042	0.4612	Fail to reject H0
	all	25	52.66697	0.0010	Reject H0

RL	m	5	2.903771	0.7148	Fail to reject H0
	y	5	2.322534	0.8030	Fail to reject H0
	ex	5	6.990499	0.2213	Fail to reject H0
	IFL	5	5.185639	0.3936	Fail to reject H0
	RS	5	4.243199	0.5150	Fail to reject H0
	all	25	36.17987	0.0689	Fail to reject H0

Table 4.1.5-B Granger Causality results for Canada (1970 – 2017)

Dependent Variable	Explanatory Variable	df	Chi-square	Prob	Decision
m	y	4	4.801110	0.3083	Fail to reject H0
	ex	4	2.393158	0.6639	Fail to reject H0
	IFL	4	0.949769	0.9173	Fail to reject H0
	RS	4	3.531679	0.4731	Fail to reject H0
	RL	4	3.623551	0.4593	Fail to reject H0
	all	20	13.35254	0.8618	Fail to reject H0
y	m	4	5.395193	0.2491	Fail to reject H0
	ex	4	3.683488	0.4505	Fail to reject H0
	IFL	4	7.705861	0.1030	Fail to reject H0
	RS	4	11.03855	0.0261	Reject H0
	RL	4	8.003463	0.0915	Fail to reject H0
	all	20	46.51124	0.0007	Reject H0
ex	m	4	4.418586	0.3523	Fail to reject H0
	y	4	16.78044	0.0021	Reject H0
	IFL	4	8.866326	0.0645	Reject H0
	RS	4	6.617668	0.1575	Fail to reject H0
	RL	4	5.514529	0.2385	Fail to reject H0
	all	20	46.53666	0.0007	Reject H0
IFL	m	4	4.315134	0.3650	Fail to reject H0
	y	4	6.102334	0.1916	Fail to reject H0
	ex	4	3.466266	0.4830	Fail to reject H0
	RS	4	7.977951	0.0924	Reject H0
	RL	4	0.492818	0.9742	Fail to reject H0
	all	20	50.29018	0.0002	Reject H0
RS	m	4	1.503195	0.8261	Fail to reject H0
	y	4	2.095217	0.7183	Fail to reject H0
	ex	4	2.591318	0.6284	Fail to reject H0
	IFL	4	4.290122	0.3682	Fail to reject H0
	RL	4	0.938820	0.9189	Fail to reject H0

	all	20	10.78869	0.9515	Fail to reject H0
RL	m	4	1.391448	0.8457	Fail to reject H0
	y	4	2.980937	0.5610	Fail to reject H0
	ex	4	1.892542	0.7555	Fail to reject H0
	IFL	4	6.410074	0.1705	Fail to reject H0
	RS	4	3.346870	0.5015	Fail to reject H0
	all	20	13.66600	0.8470	Fail to reject H0

Table 4.1.5-C Granger Causality results for Norway (1985 – 2017)

Dependent Variable	Explanatory Variable	df	Chi-square	Prob	Decision
m	y	2	1.779489	0.4108	Fail to reject H0
	ex	2	0.701659	0.7041	Fail to reject H0
	IFL	2	1.241188	0.5376	Fail to reject H0
	RS	2	0.292339	0.8640	Fail to reject H0
	RL	2	0.223656	0.8942	Fail to reject H0
	all	10	3.713699	0.9593	Fail to reject H0
y	m	2	0.607449	0.7381	Fail to reject H0
	ex	2	3.136683	0.2084	Fail to reject H0
	IFL	2	2.706663	0.2584	Fail to reject H0
	RS	2	0.503350	0.7775	Fail to reject H0
	RL	2	9.863410	0.0072	Reject H0
	all	10	19.78012	0.0314	Reject H0
ex	m	2	1.438284	0.4872	Fail to reject H0
	y	2	0.278188	0.8701	Fail to reject H0
	IFL	2	1.769749	0.4128	Fail to reject H0
	RS	2	0.636532	0.7274	Fail to reject H0
	RL	2	0.077578	0.9620	Fail to reject H0
	all	10	7.723483	0.6558	Fail to reject H0
IFL	m	2	0.580196	0.7482	Fail to reject H0
	y	2	7.413977	0.0246	Reject H0
	ex	2	5.842598	0.0539	Reject H0
	RS	2	2.029564	0.3625	Fail to reject H0
	RL	2	4.088683	0.1295	Fail to reject H0
	all	10	14.16589	0.1656	Fail to reject H0
RS	m	2	3.298867	0.1922	Fail to reject H0
	y	2	4.298595	0.1166	Fail to reject H0
	ex	2	1.104417	0.5757	Fail to reject H0

	IFL	2	0.081612	0.9600	Fail to reject H0
	RL	2	1.137002	0.5664	Fail to reject H0
	all	10	7.603111	0.6675	Fail to reject H0
RL	m	2	6.094869	0.0475	Reject H0
	y	2	1.722797	0.4226	Fail to reject H0
	ex	2	1.042679	0.5937	Fail to reject H0
	IFL	2	4.719309	0.0945	Reject H0
	RS	2	2.314683	0.3143	Fail to reject H0
	all	10	13.34601	0.2050	Fail to reject H0

Table 4.1.5-D Granger Causality results for Switzerland (1974 – 2017)

Dependent Variable	Explanatory Variable	df	Chi-square	Prob	Decision
m	y	3	0.208482	0.9762	Fail to reject H0
	ex	3	4.926454	0.1773	Fail to reject H0
	IFL	3	11.43706	0.0096	Reject H0
	RS	3	7.796758	0.0504	Reject H0
	RL	3	7.556655	0.0561	Reject H0
	all	12	40.92700	0.0003	Reject H0
y	m	3	1.669293	0.6438	Fail to reject H0
	ex	3	2.563731	0.4639	Fail to reject H0
	IFL	3	3.659131	0.3007	Fail to reject H0
	RS	3	2.383313	0.4967	Fail to reject H0
	RL	3	1.888831	0.5958	Fail to reject H0
	all	12	33.52214	0.0040	Reject H0
ex	m	3	0.781932	0.8538	Fail to reject H0
	y	3	6.956143	0.0733	Fail to reject H0
	IFL	3	1.902310	0.5929	Fail to reject H0
	RS	3	2.710240	0.4385	Fail to reject H0
	RL	3	4.953758	0.1752	Fail to reject H0
	all	12	19.84812	0.1778	Fail to reject H0
IFL	m	3	2.851742	0.4151	Fail to reject H0
	y	3	4.145277	0.2462	Fail to reject H0
	ex	3	4.061412	0.2549	Fail to reject H0
	RS	3	1.372475	0.7120	Fail to reject H0
	RL	3	10.50634	0.0147	Fail to reject H0
	all	12	39.95008	0.0005	Reject H0
RS	m	3	1.778593	0.6196	Fail to reject H0
	y	3	22.14572	0.0001	Reject H0
	ex	3	23.22783	0.0000	Reject H0

	IFL	3	37.31842	0.0000	Reject H0
	RL	3	6.773421	0.0795	Fail to reject H0
	all	12	104.0207	0.0000	reject H0
RL	m	3	1.424383	0.6998	Fail to reject H0
	y	3	8.626238	0.0347	Fail to reject H0
	ex	3	6.599527	0.0858	Fail to reject H0
	IFL	3	7.376551	0.0608	Reject H0
	RS	3	8.841361	0.0315	Reject H0
	all	12	28.82425	0.0169	Reject H0

Table 4.1.5-E Granger Causality results for UK (1960 – 2017)

Dependent Variable	Explanatory Variable	df	Chi-square	Prob	Decision
m	y	5	6.294423	0.2786	Fail to reject H0
	ex	5	27.86611	0.0000	Reject H0
	IFL	5	27.21125	0.0001	Reject H0
	RS	5	19.06524	0.0019	Reject H0
	RL	5	30.14839	0.0000	Reject H0
	all	25	74.72320	0.0000	Reject H0
y	m	5	0.702109	0.9829	Fail to reject H0
	ex	5	1.661596	0.8937	Fail to reject H0
	IFL	5	6.168164	0.2902	Fail to reject H0
	RS	5	1.603250	0.9009	Fail to reject H0
	RL	5	3.515957	0.6210	Fail to reject H0
	all	25	22.52237	0.6054	Fail to reject H0
ex	m	5	7.494041	0.1864	Fail to reject H0
	y	5	7.627116	0.1780	Fail to reject H0
	IFL	5	6.777373	0.2377	Fail to reject H0
	RS	5	11.14119	0.0487	Fail to reject H0
	RL	5	5.188229	0.3933	Fail to reject H0
	all	25	24.10839	0.5131	Fail to reject H0
IFL	m	5	5.108295	0.4028	Fail to reject H0
	y	5	2.531825	0.7717	Fail to reject H0
	ex	5	4.657188	0.4591	Fail to reject H0
	RS	5	3.033352	0.6948	Fail to reject H0
	RL	5	11.15609	0.0484	Reject H0
	all	25	50.54056	0.0018	Reject H0
RS	m	5	8.651128	0.1238	Reject H0
	y	5	10.92259	0.0529	Reject H0
	ex	5	3.587853	0.6101	Fail to reject H0

	IFL	5	9.259161	0.0992	Reject H0
	RL	5	2.654725	0.7530	Fail to reject H0
	all	25	53.90654	0.0007	Reject H0
RL	m	5	10.50492	0.0621	Reject H0
	y	5	12.98972	0.0235	Fail to reject H0
	ex	5	7.084966	0.2144	Fail to reject H0
	IFL	5	5.105168	0.4032	Reject H0
	RS	5	6.271910	0.2807	Fail to reject H0
	all	25	50.12547	0.0021	Reject H0

Note: *, **, *** represent the level of significance of 1%, 5%, 10% respectively.

We find statistically significant causal relationships in the short run between some of the VEC system variables for all of the countries. However, because the test results suggest a bidirectional causality between the system variables, the null hypothesis of no uni-directional causality between the variables could not be rejected in most cases. An important finding from the Granger causality test is that money balances do not only adjust to the determinants of money demand but there seems to be a causal link running from excess money balances to real income and domestic interest rates – a finding consistent with the monetarist monetary transmission mechanism (Friedman and Schwartz, 1963; Laidler, 1980).

4.1.6 Stability Tests

Stability results reported below, overall reveal in-sample outliers in all the countries except Switzerland. The CUSUM of squares test results are showed below.

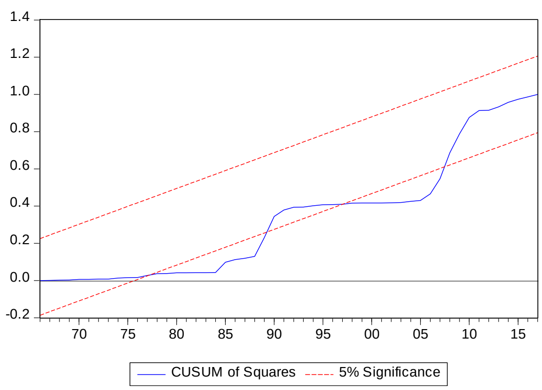
4.1.6.1 Cumulative Sum of Square test

Results for the CUSUM of squares test show a dynamically unstable model for all countries but Switzerland. This indicates structural breaks in our model. The breaks are however not definite and easy to attribute to a specific time period. Results fall outside the 0.05 band

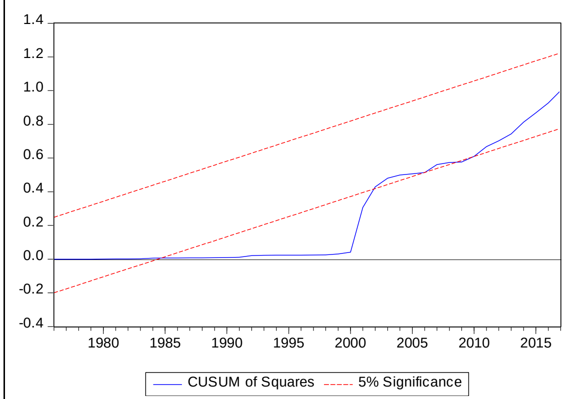
and indicate financial deregulations and changes in regimes over time led to significant structural breaks.

Figure 4-1 Results for CUSUM of Squares Test 1

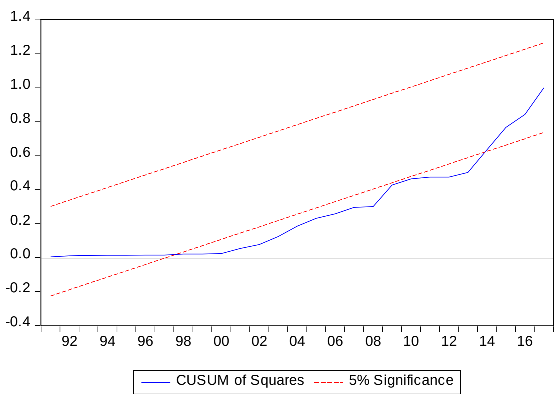
Australia



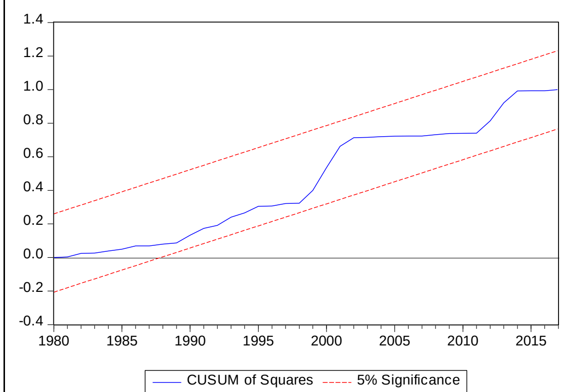
Canada



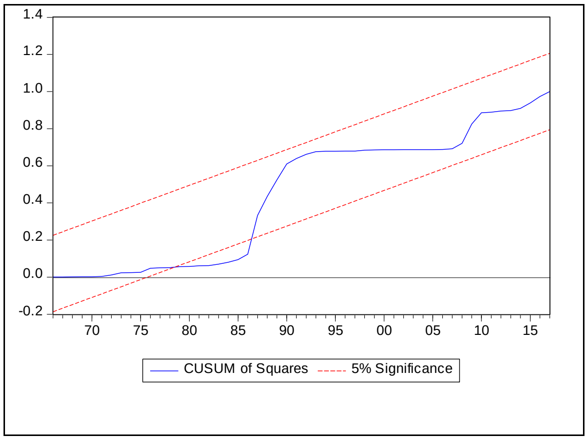
Norway



Switzerland



UK



4.1.6.2 Chow Breakpoint test

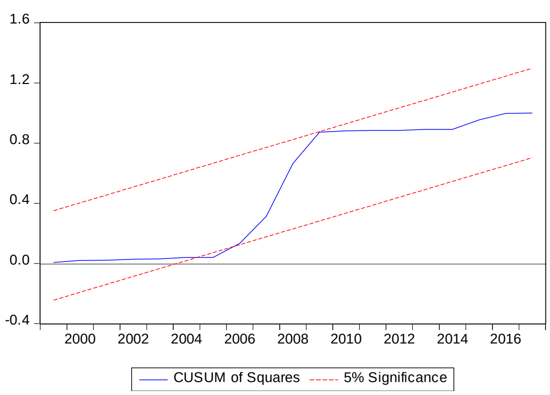
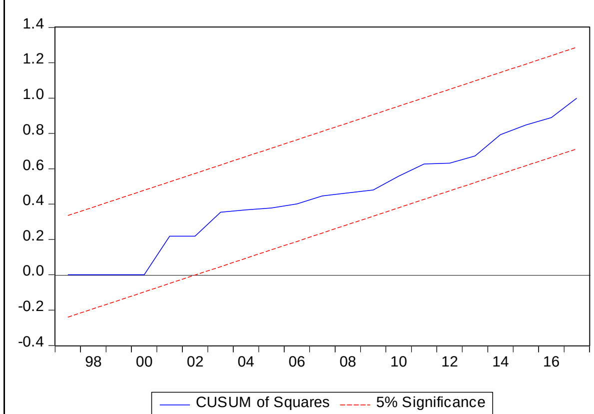
We expect that these breaks are due to the adoption and implementation of the inflationary targeting polices as well as other structural and financial deregulations that may have occurred in these countries. Due to the nature of our data and sample size, we perform the Chow Breakpoint test (with an a priori time break of when inflation targeting was implemented).

Table 4.1.6-A Chow Breakpoint test

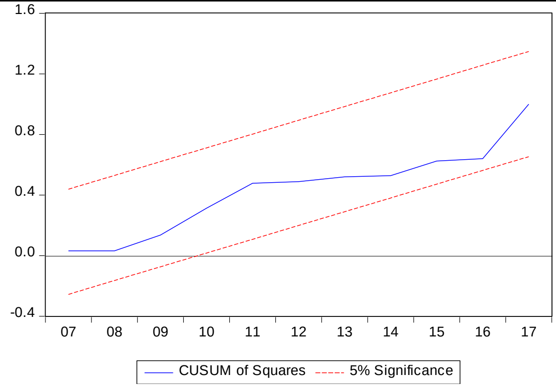
Country	F-Statistic	Prob. F	F-Critical	Decision
Australia	7.067782	0.0000	2.303509	Reject H0
Canada	1.984493	0.0936	2.363751	Reject H0
Norway	44.85489	0.0000	2.572712	Reject H0
Switzerland	4.037876	0.0040	2.399080	Reject H0
UK	1.178780	0.3342	2.303509	Fail to reject H0

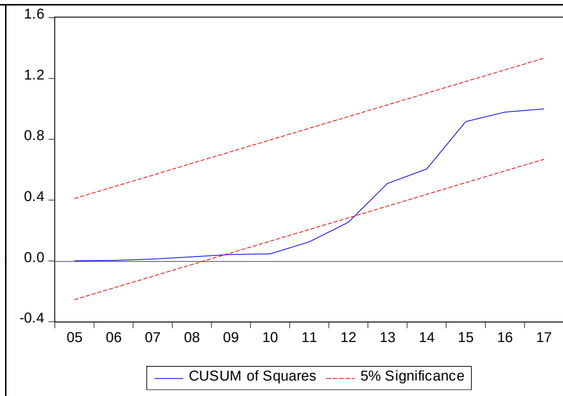
Results from Table 4.1.6-A show that in the periods inflation targeting was implemented, a break occurred that needs to be accounted for, except for the UK. Breaks could affect the stability of the money demand model. To account for a structural break, usually two separate models need to be ran, one accounting for periods before the break and another after the break. To ensure that data for the necessary variables are available with a certain quality our time period, 1960 – 2017 limits us in this capacity. Instead we create a time dummy[4] variable for the period the expected break occurred and interact with our independent regressors to create a new money demand model. This is a simple acceptable process to account for structural breaks. We run a simple ordinary least squares model with our new money demand equation and run the Chow test on those results. Rejecting the null hypothesis implies that there were indeed breaks at the specified breakpoints, which in this case are the periods inflation targeting was implemented for the countries of interest.

Figure 4-2 Results for CUSUM of Squares Test 2

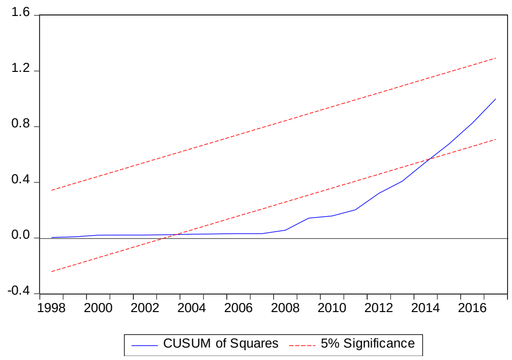
Australia 	Canada 
Norway	Switzerland

[4] See Appendix B for results.





UK



Our initial money demand is remodeled to account for structural breaks and a second stability test is conducted. There is still evidence of instabilities in some countries like the UK, Switzerland and Australia. This implies that there may be other significant breaks in our model not limited to periods of inflation targeting.

4.1.7 Serial Correlation tests

The null hypothesis is that there is no serial correlation in the estimated VECM money demand model. This conclusion will enable to decide the validity of or model and results. The results in Table 4.1.7 suggest no serial correlation and thus no misspecification of the money demand models.

Table 4.1.7-A Results for Breusch-Godfrey serial correlation LM tests

Country	Statistic	Conclusion
Australia	LM F - statistic = 0.039748 P-value = 0.9989	No serial correlation at lag order 5 since the p-value is greater than 0.05.
Canada	LM F - statistic = 2.448304 P-value = 0.0986	No serial correlation at lag order 4 since the p-value is greater than 0.05.
Norway	LM F - statistic = 0.475345 P-value = 0.6313	No serial correlation at lag order 2 since the p-value is greater than 0.05.
Switzerland	LM F - statistic = 1.788521 P-value = 0.1875	No serial correlation at lag order 3 since the p-value is greater than 0.05.
UK	LM F - statistic = 0.952709 P-value = 0.4764	No serial correlation at lag order 5 since the p-value is greater than 0.05.

CHAPTER 5

5.1 Implication of Results

Our research set out to establish the role of money in monetary policy using the most recent data. We first determine the order of integration for each of the variables to enable us to run an error correction model. Second the lag structure is estimated and cointegration regressions are estimated. Finally, we construct the appropriate vector error correction model and determine the validity and stability of our results.

5.1.1 Unit Root

To determine the time series properties of data used, we perform the unit root tests. When analyzing time series properties, the order of integration is especially very necessary for economic modelling. This is the first step in applying the cointegration technique to determine long run stable relationships. To determine the degree of integration, this study uses the ADF and Philip-Perron test for accuracy and robust conclusions. This process shows the number of times each variable needs to be differenced in order to achieve stationarity. Results show that the variables are stationary at first differences for the countries of interest. This allows us to apply the Johansen maximum likelihood approach of cointegration. It should be noted that we apply the unit root test using trend analysis as we expected a trend in our model. Stationarity in unit root tests also implies that results from the cointegration and error correction models will not be spurious and will remain unbiased.

5.1.2 Cointegration

A trace and maximum eigenvalue tests results enables us to determine the presence of a cointegrating vector. Results of cointegration analysis conducted show that there exists a long run relationship within our model. Because this study considers periods of structural breaks, we limit our study to countries that have experienced these monetary transformations for policy relevance. Also, availability of data eliminated countries such as New Zealand, Sweden and USA from this study. Interestingly, we were able to analyse data for economies with well developed financial institutions: Australia, Canada, Norway, Switzerland and UK.

Studies conducted by Bahmani-Oskooee & Bohl (2000) and Hossain (2010) proved that there is indeed a long run relationship between money demand and regressors such as interest rates, an exchange rate, real income and an inflation rate. The presence of a long run relationship allows stakeholders to make projections with a higher level of certainty and predictability.

5.1.3 Vector Error Correction Model

Information on the short and long run relationships are derived when using the vector error correction model, however only long run results are reported due to objectives of this study. We also run two vector error correction models, one without a trend variable and one with a trend variable. Trend analysis conducted and unit root test show the presence of a trend in our money demand model. Model 2 enables us to account for changes in the variables over time and smoothen our regression results.

Before error correction results are discussed, we ran a simple OLS model on the regressors to have an idea of the direction and magnitude the coefficients will take. Results[5] indicate that income elasticities are generally more elastic and interest rate elasticities are

[5] See Appendix C

more inelastic, consistent with most studies (Koranchelian, 2003) as well as theory. Inflation results are inelastic and positive for all countries but Australia, and the exchange rate results for all the countries were positive as well. The magnitude however varied for each country. Most regressors were statistically significant.

As stated earlier, money demand does not necessarily play an explicit role in present day monetary policy even though results show that in the periods of regimes shift there was a break in our money demand model. However, the slope of the IS-LM curve ($^{k}/_{h}$) in equation 3 is noteworthy. A large k value (income elasticity) and a small h value (interest rate elasticity) will indicate a steep LM curve, and in response to an increase output, the interest rate must rise by a significantly high value to maintain equilibrium in the money market. The opposite can be true. Flatter LM curves indicate large values of h compared to k.

Australia, Canada and UK have a more elastic income elasticity (1.3%, 2.4% and 3.7% respectively) and a more inelastic interest rate elasticity (-0.06%, -0.14% and -0.25% respectively). Switzerland has a relatively less elastic income elasticity of 0.65% and an inelastic interest rate elasticity of -0.08%. When the slope ratios are therefore considered, Australia, Canada, and UK have very steep slopes and Switzerland has a slightly flatter slope compared to the other countries. Any policy that stimulates output will result in an increase in interest rate drastically for countries like Australia, Canada and the UK for equilibrium to be achieved. A slight increase in interest rate will change output significantly for Switzerland. The policy implications under the IS-LM framework using the slope coefficients show that a country like Switzerland will have to increase output by a large amount in order to ensure equilibrium in the money market.

Norway has really a large negative k (29%) and a positive h (1.5%). This might be due to the nature of Norway's economy and its overreliance to its energy sector (Hutchison, 1994) or some disparities in the data gathered for Norway.

Results on interest rate elasticities show that, apart from Norway, with both positive short term and long-term interest rates, the rest of the countries had alternating signs on the long- and short-term interest rate variables. Absolute values of short-term interest rate elasticities ranged from 0.04 – 1.5 and absolute values of long-term interest rate elasticities ranged from 0.02 – 0.54 in Model 1. Results derived in Model 2 ranged from 0.04 – 0.11 for short term interest elasticities and 0.01 – 0.15 for long term interest elasticities. Inelastic and small interest rate elasticities were consistent for most countries. The interest rate elasticity of money demand allows economists to calculate the welfare cost of long-term inflation. High elasticities mean a high level of sensitivity to interest rate changes. Most well developed domestic financial markets become very interest rate sensitive.

As the regressors are justified earlier in this research, the debate on the appropriate interest rate in a money demand function is tested. Lucas (2000) favoured the use of a short-term interest rate based on an intertemporal optimizing model of the Sidrauski–Brock type (money in the utility function), whereas Nelson (2002) found empirical support for a money demand specification using a long-term interest rate. One justification for the short-term interest rate in the cointegration model could be that it provides information on the short-run dynamic adjustment process in the Vector Error Correction Model that is not present in the long-run rate. Likewise, the long-term rate provides information on the long run dynamic adjustment process. However, it is not the short-run money demand function that is important for rules-based monetary policy, but rather the long-run function, Laidler

(1993). In order to avoid any bias, we used both short-term and long-term interest rates to capture the impact of both short run and long run dynamics. Valadkhani (2005) however argues that, the broader defined money demand would require longer interest rates.

Output elasticities in Model 1 ranged from 0.64 - 29. Norway reported an unusually large output elasticity of 29. According to the quantity theory of money, long run income elasticities should be close to unity (Coenen & Vega, 2001). Our results on Australia, Canada and UK are very elastic compared to results from the studies stated but not unusual. Switzerland is consistent with the expectations of the quantity theory with regards to the magnitude for the income elasticity. UK reports a 3.7% elasticity of income. All the signs are positive and consistent with economic theory. Studies conducted by Beyer (1998), Ericsson (1998) and Ball (2001) report close to unity results for the income elasticity. According to Coeker (1990), real income has long run effects on the demand for broad money supporting the argument that broad money is held to finance transactions and as a store of value. With greater availability of alternative financial assets as money substitutes in household portfolios following financial development, the long-run elasticity should fall towards unity or below, if economies of scale in money holdings become important.

Exchange rate elasticities show whether currency substitution decisions are based on the wealth effect or the expectation effect. Negative exchange rate results show that an increase in the exchange rate (depreciation) causes asset holders to transfer portfolios into foreign currencies and decrease the demand for money whiles the rest of the countries increase their wealth as the value of foreign securities held by the domestic residents' increase. The exchange rate elasticity ranged from .69 – 1.09%.

Results for the inflation rate is negative for Australia and the UK and positive for Canada, Norway and Switzerland, ranging from 0.07 - 0.14. This means that the impact of the expected inflation on real balances is substantially important in the model. A negative sign implies that the economic agents tend to hold real assets instead of money in the case of high inflation expectations in accordance with the economic theory. When compared to the exchange rate elasticity, it can be said that there is a lower degree of substitution between money and real assets than between money and holdings of non-domestic currency.

Finally, the error correction model term provides information about the speed of adjustment to a long-run equilibrium in the dynamic model which could be useful for policy analysis. A negative and statistically significant error correction term implies that changes or shocks in the short run will easily be corrected in long run and that one can expect a disequilibrium to be eventually adjusted. A larger error correction term ensures that the speed of adjustment occurs faster. Thus, for Australia, shocks are expected to be adjusted, 38.6%, 30% for Canada, 0.4% for Norway, 58% for Switzerland and 47% for UK in the long run in Model 1. Results in Model 2 show that 41% of shocks are adjusted for in the long run for Australia, 1.1% for Canada, 6.5% for Norway, 1.7% for Switzerland and 77% for UK. Adjustment coefficients increased for Norway and UK in Model 2 when the trend term is included in the analysis. Also, statistically significant results show that our model is valid and correctly specified. Table 4.1.1.A and 4.1.1.B report results for ECT. Canada, Switzerland and UK show stable and statistically significant results. Countries with positive error correction coefficients were found to be statistically insignificant and therefore, allowing our model to stand.

5.1.4 Causality Analysis

To test the forecasting ability of our model we ran the Granger causality test. Results showed bi-directional causality between some regressors for all the countries of interest. For most of the countries, we did not find enough evidence that past behaviours of one variable significantly influenced the outcome of the regressors. For instance, for Australia, we found no causality from m_t to the regressors (y, ex, IFL, RS, all), Canada showed no causality for m, RS, RL to all the regressors. Likewise, for Norway, there was no causality from m, ex and IFL to all regressor and no causality was found for ex to all regressors for Switzerland. There was no causality between y and ex to all the regressors for UK.

5.1.5 Stability Tests

We tested for parameter stability of the money demand functions using the CUSUM of squares test statistics. Results reveal a problem of within-sample instability and a percent band indicating that there is evidence of structural instability. A stable long run money demand model is essential in order to satisfy the fundamental conditions for an effective conduct of monetary policy. Results from stability tests run by Felmingham & Zhang (2001) confirmed that structural breaks occurred when there were changes in regime in 1991 for Australia.

The diagnostic test statistic shows no evidence of functional form misspecification, no higher – order serial correlation, no problems of non-constant residual variances and no non-normal residuals. The outcome of both of these tests may be taken as evidence that the short-run and long-run elasticity is statistically stable over the sample period.

CHAPTER 6

6.1 Summary, Conclusion and Policy Recommendations

This chapter concludes the entire study. The chapter briefly summarizes the major findings of the research, the policy recommendations and provides detailed conclusions of the study.

6.1.1 Summary

The goal of this research was to estimate stable money demand functions for Australia, Canada, Norway, Switzerland and the UK. The results suggest that a stable and valid money demand function is attainable in this present-day rules-based monetary policy. Expectations in the literature were satisfied for most of the countries regarding the signs and magnitude of the elasticities. The slope of the money market equilibrium (LM) curve was determined for all countries to inform policy implementations.

The empirical findings suggest that broad money is the most appropriate[6] monetary aggregate for our model. When using different countries with different measures of the money stock, using broad money allows for uniformity among the countries. The elasticity results for Norway were rather puzzling for all variables, possibly because of the rather short sample period or the fact that Norway used a slightly higher inflation rate (2.5%) compared to the other countries for inflation targeting or other reasons, such as financial innovations and regulations that could be investigated in further studies.

The rather elastic response of money demand to the real lending rate suggests that interest rate policy would be effective to manage real money demand for a country like

[6] We ran several analyses using other measures of the quantity of money (M1, M2, and M3) and found inconsistent results.

Switzerland. The high-income elasticities derived for Australia, Canada and the UK suggest that income-related policy measures in the fiscal area, such as taxation and changes in investment spending, may prove to be more effective to influence the real demand for money. In this long run equilibrium, the income elasticity is found to be elastic for most countries, a result that is consistent with economic theory and most empirical research.

The elasticity of inflation was found to be lower than that of the real exchange rate for all countries except Canada. It may be concluded that, in the long term, there is a lower degree of substitution between money and real assets than between money and holdings of non-domestic currency in these countries (excepting Canada).

Low inflation rates and stable levels of macroeconomic variables remains the objective of monetary policy. With inflation targeting as the present tool of most central banks in achieving this goal, the role of monetary aggregates has been questioned, especially when financial deregulations and crises were attributed to significant changes in money demand and the money stock. The movement towards flexible exchange rates, financial independence and innovation, and globalisation has resulted in predictable changes in the trend money demand as well as unexpected shocks to money demand. Finding a stable money demand allows for policy makers to take these factors into account when needed in the future.

6.1.2 Recommendations

We believe results on structural breaks can better be explained with a larger sample size. Multiple breaks tests were not conducted due to this shortcoming – only single break tests with the Chow test were feasible. A wider data range will also allow for a more consistent result. Using more countries in a panel analysis would be interesting to determine the differences in estimates of money demand across different monetary policies and regimes.

Some studies incorporated modified versions of variables, such as the interest rate spread (long term minus short term interest rate) for instance. This could bring a new understanding to the money demand model estimated in this study. Country specific variables will also allow us to better explain the money demand model as it applies to specific countries. For instance, Countries like Norway and Switzerland belong to the European Union (EU) and the European Free Trade Area (EFTA) and therefore economic policies from these organisations could affect the country's money demand models. Inclusion of a terms of trade variable for example, may capture the impact of policy change.

We understand that currently the quantity of money plays no significant role in monetary policy under inflation targeting. The money stock and the resultant equilibrium adjustments in money demand are residual outcomes of achieving the inflation target. However, as noted by Freidman (1972), it is important to understand the relationship between the quantity of money and its determinants to better equip with any changes that may occur in the future and how that will impact the economy and policy making altogether.

6.1.3 Conclusion

The principal aim of current monetary policy is to keep inflation at low and stable levels. Given a sample riddled with financial deregulation, changing monetary policy, and an economy switching its basis from industrial production towards oil exportation, one should not be surprised to find an unstable demand for money function. A stable money demand is an essential element of monetary policy. A stable money demand function implies a stable velocity and in turn, a stable velocity increases predictability of the impact of increased money supply on the domestic price level and domestic output. A long run stable money demand does exist for the sample of countries studied from this research if financial innovations and changes in the monetary regime are accounted for. We conclude that a money demand model should include broad money, real GDP, the inflation rate, long and short-term interest rates and the exchange rate as its arguments as these significantly explain the money demand model.

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APPENDIX

A. Descriptive Statistics

AUSTRALIA

	M	Y	EX	IFL	RS	RL
Mean	22.00838	27.28569	4.476641	4.854933	7.418649	7.586475
Median	21.87264	27.31723	4.485219	3.354711	5.650417	6.001917
Maximum	23.59811	28.17045	4.718368	15.41667	17.61167	15.37500
Minimum	20.65037	26.24397	4.145911	-0.319489	1.740000	2.336667
Std. Dev.	0.885112	0.563642	0.125293	3.806229	4.130487	3.448774
Skewness	0.350821	-0.136202	-0.442112	1.110057	0.965675	0.686452
Kurtosis	1.859280	1.926669	3.018498	3.423902	2.879643	2.321244
Jarque-Bera	4.334394	2.963422	1.890303	12.34578	9.049446	5.668475
Probability	0.114498	0.227248	0.388621	0.002085	0.010838	0.058763
Sum	1276.486	1582.570	259.6452	281.5861	430.2817	440.0156
Sum Sq. Dev.	44.65517	18.10847	0.894812	825.7805	972.4725	677.9604
Observations	58	58	58	58	58	58

CANADA

	M	Y	EX	IFL	RS	RL
Mean	22.90783	27.68953	4.427928	4.067436	6.289622	7.051859
Median	22.80067	27.66581	4.401193	2.712179	5.295334	7.249916
Maximum	23.95615	28.22757	4.631160	12.47161	18.37563	14.98917
Minimum	21.64779	26.97235	4.236955	0.165563	0.693822	1.251758
Std. Dev.	0.676806	0.368232	0.123164	3.237288	4.219406	3.462285
Skewness	-0.015103	-0.199701	0.215525	1.100023	0.595734	0.183608
Kurtosis	1.784730	1.879895	1.722795	3.067158	2.862302	2.375866
Jarque-Bera	2.955587	2.828315	3.634115	9.689432	2.877112	1.048783
Probability	0.228141	0.243130	0.162503	0.007870	0.237270	0.591915
Sum	1099.576	1329.098	212.5405	195.2369	301.9019	338.4892
Sum Sq. Dev.	21.52910	6.372968	0.712958	492.5617	836.7592	563.4087
Observations	48	48	48	48	48	48

NORWAY

	M	Y	EX	IFL	RS	RL
Mean	23.04169	28.49054	4.567111	2.857687	6.067948	6.258131
Median	23.02532	28.57547	4.580120	2.329350	5.478333	5.497500
Maximum	23.65460	28.81528	4.697624	8.717047	14.71250	13.30500
Minimum	22.49212	28.03521	4.428369	0.454499	0.890000	1.331667
Std. Dev.	0.398950	0.264055	0.058241	1.883533	4.229426	3.598551
Skewness	0.172913	-0.488316	-0.617112	1.491563	0.676413	0.652485
Kurtosis	1.464906	1.707357	3.576413	4.924252	2.240417	2.391867

Jarque-Bera	3.404648	3.609013	2.551397	17.32746	3.309765	2.850064
Probability	0.182259	0.164556	0.279236	0.000173	0.191115	0.240501
Sum	760.3758	940.1877	150.7147	94.30366	200.2423	206.5183
Sum Sq. Dev.	5.093155	2.231204	0.108546	113.5263	572.4173	414.3861
Observations	33	33	33	33	33	33

SWITZERLAND

	M	Y	EX	IFL	RS	RL
Mean	22.46026	26.87261	4.388519	2.017019	2.956346	3.527264
Median	22.41110	26.84314	4.406578	1.115738	2.527952	3.688792
Maximum	23.29963	27.24932	4.829357	9.767414	10.16524	7.129167
Minimum	21.67786	26.51040	3.720939	-1.143901	-0.783750	-0.362000
Std. Dev.	0.448848	0.225474	0.246749	2.306640	2.862727	1.838517
Skewness	0.199953	0.036538	-0.469755	1.314025	0.855152	-0.270014
Kurtosis	2.259674	1.819256	3.494601	4.536901	2.952290	2.624670
Jarque-Bera	1.298014	2.565745	2.066732	16.99263	5.366932	0.792921
Probability	0.522564	0.277240	0.355807	0.000204	0.068326	0.672697
Sum	988.2513	1182.395	193.0948	88.74885	130.0792	155.1996
Sum Sq. Dev.	8.662988	2.186051	2.618063	228.7853	352.3938	145.3463
Observations	44	44	44	44	44	44

UK

	M	Y	EX	IFL	RS	RL
Mean	22.45103	27.66799	4.954485	5.180803	7.117968	7.561873
Median	22.45301	27.72203	4.846448	3.484453	6.637725	7.266101
Maximum	23.99808	28.27428	5.510319	24.20729	16.50253	14.88333
Minimum	21.11349	26.94403	4.563140	0.368047	0.359142	1.235808
Std. Dev.	1.041245	0.400634	0.296954	4.946140	4.069258	3.629606
Skewness	0.208516	-0.126530	0.776272	1.889021	0.125270	0.212851
Kurtosis	1.470175	1.767869	2.292027	6.352975	2.401532	2.107934
Jarque-Bera	6.076176	3.823618	7.036410	61.66377	1.017257	2.361093
Probability	0.047926	0.147813	0.029653	0.000000	0.601320	0.307111
Sum	1302.159	1604.743	287.3601	300.4866	412.8421	438.5886
Sum Sq. Dev.	61.79889	9.148943	5.026361	1394.465	943.8550	750.9204
Observations	58	58	58	58	58	58

B. OLS Regression Using Dummy Variable and Interaction Terms

AUSTRALIA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-14.49196	1.878199	-7.715884	0.0000
Y	1.341067	0.064071	20.93102	0.0000
EX	0.020317	0.118153	0.171954	0.8642
IFL	-0.004844	0.004093	-1.183448	0.2427
RS	0.006539	0.008397	0.778691	0.4401
RL	-0.035813	0.011403	-3.140584	0.0029
DUM	-22.71893	5.872076	-3.868978	0.0003
DY	0.753926	0.229580	3.283943	0.0020
DEX	0.363949	0.237902	1.529824	0.1329
DIFL	0.005364	0.017611	0.304584	0.7621
DRS	-0.032885	0.019454	-1.690385	0.0977
DRL	0.073289	0.028411	2.579582	0.0132

R-squared	0.996024	Mean dependent var	22.00838
Adjusted R-squared	0.995074	S.D. dependent var	0.885112
S.E. of regression	0.062124	Akaike info criterion	-2.537379
Sum squared resid	0.177532	Schwarz criterion	-2.111081
Log likelihood	85.58399	Hannan-Quinn criter.	-2.371327
F-statistic	1047.686	Durbin-Watson stat	0.745697
Prob(F-statistic)	0.000000		

CANADA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-39.12522	13.35006	-2.930715	0.0058
Y	2.123911	0.407636	5.210314	0.0000
EX	0.712252	0.631906	1.127149	0.2669
IFL	0.017033	0.018955	0.898601	0.3747
RS	-0.012938	0.031910	-0.405460	0.6875
RL	0.019024	0.039789	0.478121	0.6354
DUM	2.069178	3.107879	0.665785	0.5097
DEX	-0.555738	0.742639	-0.748328	0.4590
DIFL	0.057654	0.046405	1.242395	0.2219
DRS	-0.091304	0.051180	-1.783968	0.0826
DRL	0.105147	0.065306	1.610072	0.1159

R-squared	0.947195	Mean dependent var	22.90783
Adjusted R-squared	0.932924	S.D. dependent var	0.676806
S.E. of regression	0.175286	Akaike info criterion	-0.446741
Sum squared resid	1.136837	Schwarz criterion	-0.017924
Log likelihood	21.72178	Hannan-Quinn criter.	-0.284690
F-statistic	66.36957	Durbin-Watson stat	0.881050
Prob(F-statistic)	0.000000		

NORWAY

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.091268	5.216164	1.359479	0.1884
Y	0.606904	0.164802	3.682636	0.0014
EX	-0.349105	0.380405	-0.917720	0.3692
IFL	-0.010236	0.011934	-0.857735	0.4007
RS	0.019339	0.009161	2.111153	0.0469
RL	-0.012257	0.019731	-0.621199	0.5412
DUM	-71.11056	11.74533	-6.054371	0.0000
DY	2.362204	0.400265	5.901601	0.0000
DEX	0.823070	0.413970	1.988234	0.0600
DIFL	0.012278	0.016679	0.736156	0.4698
DRS	-0.013638	0.014827	-0.919822	0.3681
DRL	0.009515	0.032674	0.291196	0.7738

R-squared	0.994497	Mean dependent var	23.04169
Adjusted R-squared	0.991615	S.D. dependent var	0.398950
S.E. of regression	0.036533	Akaike info criterion	-3.505927
Sum squared resid	0.028027	Schwarz criterion	-2.961743
Log likelihood	69.84780	Hannan-Quinn criter.	-3.322826
F-statistic	345.0108	Durbin-Watson stat	1.788977
Prob(F-statistic)	0.000000		

SWITZERLAND

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.50617	3.119568	-6.252845	0.0000
Y	1.520873	0.129304	11.76203	0.0000
EX	0.306876	0.100233	3.061623	0.0044
IFL	0.004042	0.008211	0.492287	0.6259
RS	-0.000143	0.007727	-0.018514	0.9853
RL	-0.058106	0.017083	-3.401453	0.0018
DUM	2.326148	8.237648	0.282380	0.7795
DY	-0.109642	0.318932	-0.343778	0.7333
DEX	0.113445	0.309880	0.366092	0.7167
DIFL	-0.021826	0.020263	-1.077149	0.2895
DRS	-0.000280	0.021460	-0.013064	0.9897
DRL	0.003041	0.043796	0.069434	0.9451

R-squared	0.993514	Mean dependent var	22.46026
Adjusted R-squared	0.991285	S.D. dependent var	0.448848
S.E. of regression	0.041903	Akaike info criterion	-3.279933
Sum squared resid	0.056187	Schwarz criterion	-2.793336
Log likelihood	84.15852	Hannan-Quinn criter.	-3.099479
F-statistic	445.6207	Durbin-Watson stat	1.252263
Prob(F-statistic)	0.000000		

UK

Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	-51.69498	15.09353	-3.424975	0.0013
Y	2.661007	0.484563	5.491558	0.0000
EX	0.240267	0.408629	0.587983	0.5594
IFL	0.006978	0.010470	0.666502	0.5084
RS	0.036482	0.028862	1.263993	0.2126
RL	-0.112123	0.035550	-3.153939	0.0028
DUM	-12.30055	24.52229	-0.501607	0.6183
DY	0.382353	0.873265	0.437843	0.6635
DEX	0.194820	0.878071	0.221872	0.8254
DIFL	0.061151	0.057327	1.066705	0.2917
DRS	-0.048412	0.056888	-0.851002	0.3992
DRL	0.097221	0.072948	1.332741	0.1892

R-squared	0.978078	Mean dependent var	22.45103
Adjusted R-squared	0.972835	S.D. dependent var	1.041245
S.E. of regression	0.171615	Akaike info criterion	-0.505139
Sum squared resid	1.354773	Schwarz criterion	-0.078840
Log likelihood	26.64903	Hannan-Quinn criter.	-0.339087
F-statistic	186.5746	Durbin-Watson stat	0.775424
Prob(F-statistic)	0.000000		

C. OLS Regression Results

AUSTRALIA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.85156	0.773192	-25.67480	0.0000
Y	1.483391	0.020039	74.02579	0.0000
EX	0.378148	0.107970	3.502357	0.0010
IFL	-0.008136	0.004638	-1.754015	0.0853
RS	0.014472	0.009050	1.599085	0.1159
RL	-0.049574	0.010639	-4.659706	0.0000

CANADA

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-32.65007	4.394738	-7.429356	0.0000
Y	1.966916	0.132310	14.86597	0.0000
EX	0.198827	0.275739	0.721068	0.4749
IFL	0.025687	0.015364	1.671884	0.1020
RS	-0.049834	0.023919	-2.083478	0.0433
RL	0.060054	0.030895	1.943801	0.0586

NORWAY

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.891744	8.851715	-0.891550	0.3805
Y	0.908832	0.321195	2.829531	0.0087
EX	1.165427	0.433151	2.690582	0.0121
IFL	0.055535	0.019756	2.811039	0.0091
RS	0.029050	0.020631	1.408089	0.1705
RL	-0.098638	0.037560	-2.626142	0.0141

SWITZERLAND

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.691340	2.110710	-4.591508	0.0000
Y	1.118127	0.088146	12.68491	0.0000
EX	0.519897	0.095359	5.451995	0.0000
IFL	0.001230	0.008054	0.152698	0.8794
RS	0.006951	0.008360	0.831477	0.4109
RL	-0.056699	0.013836	-4.097883	0.0002

UK

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-41.68884	7.452795	-5.593719	0.0000
Y	2.318751	0.221781	10.45514	0.0000
EX	0.088991	0.260187	0.342029	0.7337
IFL	0.005709	0.007748	0.736841	0.4645
RS	0.037921	0.019601	1.934607	0.0585
RL	-0.099939	0.030009	-3.330344	0.0016