THE TRANSMISSION MECHANISM OF MONETARY POLICY IN THE JAMAICAN ECONOMY

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Abstract

The issue of the effects of monetary policy on prices and real economic activity lies at the core of macroeconomic theory and at the heart of monetary policy. It is generally agreed that monetary policy, specifically unanticipated monetary shocks, have a significant effect on the economy, even if it is at least in the short run. Changes in monetary policy are 'propagated' throughout the economy via a transmission mechanism, commonly called the monetary transmission mechanism. This paper attempts to assess the channels through which monetary policy is transmitted in Jamaica since economic liberalisation.

Using a Vector Autoregressive model, the analysis points to a process where monetary policy impulses are transmitted by both the money channel and the credit channel via a process of portfolio substitution. Monetary policy, through its primary and by all indications, most effective tool- reverse repurchase rate, exerts significant leverage over the financial system. The market dynamics which consist of portfolio shifts in the financial system itself tends to reinforce monetary impulses. Thus, changes in the central bank's indicative rate will affect the entire spectrum of interest rates. The resulting adjustments in the banking system's balance sheet are transmitted to the real sector and prices through the foreign exchange market. This occurs as market participants adjust their own portfolios in response to the signals from the financial system. The results pointed to the possible use of a monetary conditions index (MCI) as an intermediate target for monetary policy, a measure similar to that used by the Bank of Canada. This construct would be a weighted average of the domestic deposit rates and exchange rate.

The impact of monetary policy was found to be immediate and pervasive, albeit short lived, lasting between two to eight months. Following a unit shock to the reverse repo, the inflation rate decelerates within two months by approximately 0.1 percent per month, whilst the rate of depreciation declines significantly over the space of five months following a unit shock to the repo rate. Concurrently there are very strong, albeit temporary, real sector effects, as real economic activity declines by approximately 2.0 percent in four months.

Although the transmission mechanism indicates that monetary policy can be highly effective, the process is influenced by the state of the financial system, expectations and other structural variables which impact on the ultimate target -inflation. Economic policy therefore, whilst remaining resolute in its focus on stabilization, cannot ignore the implications of a weak financial sector, and an inefficient production structure.

1.0 *Introduction*

The issue of the effects of monetary policy on prices and real economic activity lies at the core of macroeconomic theory and at the heart of monetary policy. It is generally agreed that monetary policy, specifically unanticipated monetary shocks, have a significant effect on the economy, even if it is only in the short run. This as money, being the most accepted medium of exchange, has become the most important commodity in modern economies. To successfully conduct monetary policy therefore, policy makers must have an appreciation of the timing and effect of their policies on the economy.

Changes in monetary policy are "propagated" throughout the economy via a transmission mechanism, commonly called the monetary transmission mechanism. Generally the conduct of monetary policy relies on instruments such as reserve ratios and open market operations, to influence intermediate targets such as interest rates or a monetary aggregate, in the pursuit of a desired inflation or output target. Until recently however, the literature has been silent on what happens in the intermediate stages. As Bernanke and Gertler (1995) note "to a great extent empirical analysis of the effects of monetary policy has treated the monetary mechanism itself as a 'black box.'"[1] Further, the analysis of developing economies is based on the assumptions of capital controls, financial repression, limited availability of financial instruments, and hence the conduct of monetary policy via interest rate manipulation.

The goal of monetary policy in Jamaica, which is price stability, has been pursued primarily with the use of indirect instruments since 1985. Whilst a number of studies, notably, McIntosh(1984), Robinson(1986), Brown(1985), and Robertson(1995), have examined monetary policy in Jamaica, very little attempt has been made to empirically assess the precise nature of the transmission process, particularly in the post liberalization era. Recent works by, Shaw(1992), Ghartey(1995) and Robinson(1996) have highlighted broadly the transmission process of monetary policy in Jamaica. It is suggested that the transmission runs from the central bank's operating target , base money, to domestic interest rates, and then to exchange rates, output and prices. Robinson(1996) concludes that monetary policy effects have a lag impact of at least two months and are generally

long-lived. The analyses however excluded intermediary channels such as private agents' balance sheets, the role of information, and credit. Also, no distinction is made as to the relative importance of the various policy instruments and the vulnerability of various sectors.

This paper will attempt to address these issues (although not in full details for certain areas) with specific reference to Jamaica. The analysis has as its starting point, that the monetary transmission in Jamaica is an eclectic combination of the Keynesian and Monetarist perspectives. Thus monetary policy effects are propagated through the central bank's leverage over short term real interest rates, given price rigidities. This in turn affects the balance sheet of the commercial banking system by inducing portfolio and liability composition shifts. Consequently the supply of credit is affected. Also the balance sheet of firms is affected by its influence on what is called the 'external financing premium.' Concurrently, the households' balance sheets are affected via Modigliani's(1971) permanent income and Patinkin's(1989) wealth effects. Therefore the demand for credit is also affected. The resultant changes in the credit market and the corresponding liabilities of the banking system induce changes in the supply of money and overall absorption or aggregate demand (through changes in consumption patterns) by the private sector. The response of the private sector however depends on whether the monetary impulse is viewed as permanent or transitory. Commodity (real goods) and asset (foreign exchange, longer term real and financial capital) prices will then adjust as economic agents equate the marginal utilities of the various assets. The overall endogenous price level in the 'long run' will adjust so as to clear any deflationary or inflationary gap that was created by changes in aggregate demand.

[1] Bernanke and Gertler (1995) pg.27

2.0 *Theoretical Framework*

The monetary transmission mechanism is one of the least understood economic processes but yet the successful conduct of monetary policy requires a clear understanding of the process by which changes in monetary policy affect the economy. Further its precise definition varies according to the structure of the economy and across business cycles.

The monetary policy transmission mechanism describes the channels through which changes in monetary policy affect the objective target. It describes how private sector agents respond to the policy actions of the monetary authorities. The channels through which monetary policy are transmitted are varied and complex, depending on the financial structure, expectations, openness of the economy and production functions. In the long run the price level is determined solely by the actions of the monetary authorities. This stems from the fact that the central bank alone creates the ultimate means of payments, base money, on which a monetary economy depends. By altering the terms at which this means of payment is provided, the authorities are able to determine the nominal value of transactions in the economy and hence the price level in the long run.

To a large extent the debate on the transmission mechanism is centered on the precise temporal impact of monetary shocks on the economy and the means by which such shocks are propagated. The intellectual divide on this issue involves the classical /monetarist school (Friedman, Cagan, Meltzer, MaCallum, Lucas et al) and the Keynesians/Neo-Keynesians such as Grossman, Mankiw and Romer among others. The central thesis of the Monetarist school is the long run neutrality of money. If expectations are rational, then only unanticipated monetary shocks will affect output in the short run. In the long run real variables will return to their long run level whilst nominal variables will be higher. The most important prescription that emerged from this body of work is that monetary policy should be conducted based on rules rather than discretionary actions[2]. Keynes in contradiction to the classical economists emphasized that because wages and prices are rigid, the economy will not always be at the full employment level, thereby creating a role for monetary policy. This was crystallised by the Phillips curve

[2] Sargeant and Wallace(1975).

analysis in which there exist a trade off between inflation and unemployment. Most recently, both the Monetarists and Keynesian positions have been challenged by real business cycle theorists. The proponents such as Plosser, King and Barro, argue that the causation is reverse in that it is real shocks to the economy such as innovations in technology that generates monetary disturbances. Therefore there is no scope, whether in the long or short run for monetary policy to affect the economy.

Underlying the various hypotheses however is some notion of the demand for money. In essence, the analysis of the monetary transmission mechanism involves a coherent theory of the demand for money and the supply of money and how they relate to aggregate demand and output. Practically, the transmission itself and hence the conduct of monetary policy, depends on a stable money demand function.

Theories of the demand for money had their genesis in the traditional quantity theory. The Cambridge version posits that the amount of money that a society holds is "identical" to a fraction, k, of the value of total transactions planned. This yields the famous Cambridge equation M= kPT. Newcomb and Fisher replaced k, by its reciprocal - the velocity of circulation of a unit of money, to obtain the equation of exchange MV=PT.

Building on the Cambridge approach, Keynes analysed the demand for money in terms of the transaction, speculative and precautionary motives.[3] His analysis however identified only two assets - money and bonds, which are perfect substitutes. Given the assumption of a two asset economy, price rigidities and a stable money demand function, interest rates in the Keynesian system, provides the conduit through which monetary impulses are transmitted to the real sector. As Pierce and Tysome(1985) notes, "if *ex ante* S(savings)=I(investment) -goods market equilibrium, but $M^d \neq M^s$ then the rate of interest will adjust to equate the two directly by influencing the demand for idle balances and indirectly by altering I and C, AE(=Py) and hence the demand for active cash balances."[4]

The monetarists argue however, that the Keynesian treatment of the demand for money is simplistic and prescribes the incorporation of a wider range of assets which are

[3] See Mishkin(1989) and Pierce and Tysome(1985) for an exposition.
[4] D. Pierce and P.Tysome (1985) "Monetary Economics. Theories, Evidence and Policy." Butterworth pg126.

not necessarily perfect substitutes. Money is therefore only one asset amongst a range of assets, which include other financial assets, physical and human capital and consumer goods. The demand for money will therefore depend on wealth, the relative return on money versus all other assets and desired expenditure. More importantly monetarists believe that the relation between the quantity of money demanded, other assets and desired expenditure is stable. Given this stable relation, and the fact that all markets clear, the monetarist analysis leads to the important conclusion that in the long run the change in the price level is directly proportional to the change in the money supply. As Friedman posits, "there is perhaps no other empirical relation in economics that has been observed to recur so uniformly..... as the relation between substantial changes over short periods in the stock of money and prices .... one is invariably linked with the other and in the same direction."[5]

The process by which this occurs is one of portfolio adjustment, the equilibrium outcome being income and prices. An increase in the nominal money supply, lowers the marginal rate of return on money balances relative to all other assets in the portfolio. Economic agents will then re-balance their portfolios until the marginal returns are equated (i.e. the ratio of marginal utilities is equal). As Laidler(1978) notes these rates of return involve interest rates on securities, lending rates set by financial intermediaries, and implicit rates of return on assets such as consumer durables. Consequently relative prices will change as economic agents attempt to restore portfolio equilibrium. These changes in turn influence the demand and supply of commodities in the economy. Therefore to the monetarist, "monetary impulses are conveyed by a process of general substitution driven by changes in relative prices 1) of various financial assets, 2) real assets and their services and 3) of assets and output."[6]

For practical purposes, there is no real difference in the schools of thought. Within any economy there are certain basic channels through which monetary policy is effected. These can be explained by either theory or more appropriately a combination of both. The following therefore presents an eclectic view of the monetary transmission process.

[5] M. Friedman (1956), "The Quantity Theory of Mone: a restatement.' in Friedman (ed) *Studies in the Quantity Theory of Money*. Chicago. pp 3-21

2.1 The Transmission of Monetary Policy:

The schema of the transmission process in any economy begins with the discretionary actions of the monetary authorities and the response of financial aggregates (money, and interest rates). The second stage involves the link between changes in financial variables, aggregate demand and prices.

Monetary policy generally, operates directly through the monetary base, reserve requirements, the discount rate and special deposits. MacIntosh(1984) and Brown(1985) described the evolution of monetary policy during the early 1980s. During this period, monetary policy utilised credit and interest rate controls as against the market mechanism.

Currently, the main operating target in Jamaica is base money, the management of which is done through repurchase agreements on the open market. The idea is that limited free reserves inhibits banks' lending activities and other non-intermediary activities such as taking positions in the foreign exchange market. To maintain the current account balances at their normal operating level, the central bank issues short term securities (repurchase agreements) at rates which alter the incentive away from lending and other expansionary activities.[7] Alternatively, adjustments in reserve requirements are used. In the event where no free reserves are available, the central bank increases the bank rate or restricts liquidity support to the entities in order to curtail expansionary activities.

Monetary policy changes are first transmitted to the financial markets, which as the monetarists explain, arises from the fact that information and transaction costs are lower. Therefore changes in the Central Bank's indicative short term rate (repo rate) will affect a wide spectrum of interest rates, altering the whole term structure of interest rates within the financial market. However, the effect of monetary policy on financial markets (and hence the economy) depends on economic agents' perception of the nature of the central bank's action and expectations about future economic developments. If agents perceive the central bank's action as being permanent, then one can expect longer term rates to be most responsive.

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[6] K. Brunner and A. Meltzer, "Money and Credit in the Monetary Transmission Process" AER vol. 78 No2. 1988 pg 446-447.

The second stage is the core of the transmission mechanism, which has been explained from different angles. Several channels through which financial variables affect demand and prices have often been cited in the literature. We will however classify them into two broad channels; the monetary channel and the credit channel:

(a) The monetary channel -

Given the stickiness of prices and nominal wages, higher nominal rates imply in the short run higher real rates. Higher real rates in turn reduce the demand for money and credit. This affects aggregate demand in three ways. First, is the widely accepted Keynesian effect on private investment, which was later extended by economists to household behaviour. The change in interest rate alters the inter-temporal consumption pattern of economic agents. A higher real rate induces a switch from current consumption of both consumer and capital goods towards savings. The reverse occurs in a context of lower real rates. The component of spending (housing, consumer durables, business fixed and inventory investment) which is affected will depend on the response of the term structure of interest rates.

Second, higher real rates will lower asset prices and hence real wealth. This marks one of the departures between the Keynesian and Monetarist treatment of the subject as the latter argue that one needs to look at the whole range of relative asset prices and real wealth. The fact is that monetary impulses change the marginal utility of money relative to other assets, both foreign and domestic. To restore equilibrium therefore, relative prices will change. One such relative price, which has received much attention in the literature, is the ratio of the market value of firms to the replacement cost of capital or Tobin's q. If 'q' increases, then investment spending will increase as companies can obtain a higher price for its equities relative to the cost of investment.

From the Monetarist perspective, changes in money supply affect individual's expenditure on equities. In this context changes in monetary policies influence the value of Tobin's 'q' through its effect on equity prices and hence investment spending. Alternatively changes in interest rates affect the relative returns on equities to bonds, which in turn influences the price of equities, and hence the value of 'q' and ultimately

[7] This requires fiscal support either through the issuance of securities by central government or an increase on government deposits at the central bank.

investment. In the Jamaican context, where the capital market is relatively small, this has been a significant channel through which monetary policy has been propagated.

Changes in the price of equities and other asset prices (eg. government securities) as explained by Modigliani(1971) and Patinkin(1985) affects future income stream and hence overall wealth. This in turn determines consumption spending and hence aggregate demand. This is the typical wealth or real balance effect[8]. Changes in monetary policy therefore influence consumption through wealth effects to the extent that it affects a wide range of asset prices.

Thirdly, the analysis of relative prices can be extended to an open economy. A rise in real short-term interest rates, assuming that there are no restrictions to capital flows, will lead to an appreciation of the nominal exchange rate and also the real exchange rate if prices are sticky. Consequently, *ceteris paribus*, imports will become cheaper in terms of domestic currency thus depressing the economy through a reduction in the net trade balance. This occurs as exchange rates affect relative prices. The magnitude of the changes in the exchange rate will depend on economic agents' expectations.

This process is derived from the interest parity relationship whereby, assuming capital mobility, the interest rate differential relative between any two countries is equal to the expected change in their bilateral exchange rate. The existence of this relation however has been questioned in the context of the presence of country specific risks and cross border restrictions

Relative price effects therefore affect both consumer spending and private investment. The magnitude of their impact on aggregate demand however depends on the relative strengths of the income and substitution effects.

(b) The credit channel -

This channel focuses on the asset side of commercial banks' balance sheet, as against the money channel, which looks at the liability side. Commercial banks' assets, which are for this purpose defined in terms of loans, are not necessarily a perfect substitute for other sources of credit. Consequently shocks to commercial banks' balance

[8] The efficacy of this it has been argued depends on whether bonds constitute inside or outside money. See Barro(1974) and Pesek and Saving (1967).

sheet can affect the position of borrowers, normally businesses and households, who can't turn to the capital market. The credit channel is important when there are no alternatives for 'smoothing desired consumption and investment spending.' The effectiveness of the credit channel depends on the inter-temporal elasticity of substitution. Dane and Haldane(1993) showed that the credit channel could increase the potency of monetary policy if bank lending rates move more than one-for-one with changes in market interest rates.

The credit channel amplifies the effects of monetary policy induced changes in lending rates by affecting the 'external finance premium (*efp*)' which is the difference in the cost of external and internal finance. There is a positive relation between this premium and the movements in bank lending rates. Bernanke and Gertler (1995) suggest that the complementary movement in lending rates and the *efp*, as against pure interest rate changes, better explains the strength, timing and composition of monetary policy effects. The media through which this occurs are the 'balance sheet or net worth medium' and the 'bank lending channel.'

The balance sheet medium arises from the fact that a borrower's credit worthiness depends on his net worth or his financial position, which is comprised of liquid and non-liquid marketable assets. With a stronger financial position a borrower can secure loans on more favourable terms, consequently the *efp* is lower and vice versa. Since the *efp* depends on the borrower's financial position, then the amount of credit accessed and hence the level of permissible spending depends on the quality of the borrower's balance sheet. In the context where firms and individuals have outstanding debt, monetary policy affects their balance sheet directly as increases in interest rates increase interest costs, thereby reducing net cash flows. Also, as discussed above higher interest rates imply lower asset prices, which reduce the value of the borrowers' assets (and by extension available collateral). Indirectly, monetary policy affects the net cash flow of firms to the extent that it affects consumer spending throughout the money channel noted above. This mechanism, Bernanke(1995) notes, may explain why the impact on spending may persist even long after a monetary impulse.

Monetary policy also affects the *efp* through its influence over the supply of intermediated credit by what is known as the bank lending mechanism. The potency of this mechanism is derived from the fact that commercial banks are the dominant source

of short to medium term lending. A shock to this supply increases the cost to the borrower in finding alternate sources. Moreover, failure to do so will increase his interest costs as loanable funds are rationed at a higher rate.

A priori, the *efp* does not adequately explain the effect of the credit channel in Jamaica. The high leverage of Jamaican firms and households would imply a very high *efp* or opportunity cost of borrowing.[9] The fact is that in the absence of a viable capital market, firms will have to bear the costs associated with a high *efp*. One may argue however that historically the *efp* faced by Jamaican firms and households have been low given the negative real interest rates. This would have served to offset other adverse balance sheet items. One would think that the balance sheet medium, as it affects the quantum of credit, is more important for the credit channel in Jamaica.

The preceding analysis discussed the importance of the credit channel in terms of the extent to which monetary policy affects the cost of credit. However the nature of credit arrangements also reinforces monetary policy effects. Two features are of importance in this regard - the maturity / interest rate structure of credit arrangements and currency composition of credit contracts. The shorter the maturity of the credit, the quicker the terms on which credit granted can respond to monetary policy impulses, particularly unanticipated impulses. Also the ease with which interest rates can be adjusted (variable interest rates) within a particular contract enhances the effects of monetary policy. Borio(1995) noted that the larger the share of variable rate financing, the stronger will be the income and cash flow effects of monetary policy. Further variable rate financing can complicate the pursuit of exchange rate and inflation targets, as it amplifies the transmission of higher short-term rates used. Changes in domestic interest rates following a monetary impulse do not affect the demand for foreign currency denominated credit. The incidence of foreign currency denominated debt however enhances the role of the exchange rate in the monetary transmission mechanism.

The credit channel it must be noted is not an alternative to the monetary channel, but is an additional avenue through which monetary impulses are transmitted. As Bernanke notes, the credit channel "amplify and propagate conventional interest rate effects." The distinction between the two is that the credit channel relies on the special

[9] Data inadequacies prevent a thorough empirical analysis of this proposition.

role that commercial banks play in overcoming information asymmetries in credit markets. In many developing countries, where commercial banks are the main if not the only source of capital, this role assumes more importance. One can therefore argue that the actual channels through which monetary policy affects the economy depend on the level of financial intermediation, its openness and production function. Further some have argued that the relative importance of these channels varies across business cycles.

The link between monetary policy actions and the ultimate target of price stability is aggregate demand and supply. Prices are really endogenous in the process as they adjust to clear any excess demand or supply. Therefore, in effect a Central Banks inflation target is an excess demand target. The key therefore is the link between monetary policy and aggregate demand. However, economists vary in their thinking on this issue. Real Business Cycle theorists emphasise that the link is reversed, as aggregate demand and supply disturbances determine monetary changes. The Keynesians and Classicals accept the fact that changes in prices depend on the resultant slack in the economy following an exogenous shock such as a monetary disturbance.

2.2 The Role of the Financial System

From the above discussion, it is clear that the effectiveness of monetary policy or the efficiency of the monetary transmission mechanism depends on the state of the financial system. The transmission of monetary impulses depends on the elasticities of the demand and supply of financial and real assets to changes in the money market. These elasticities depend on the level of development of the financial sector in terms of the level of competition, information flow and availability of instruments.

The implications of the level of development of the financial system and the transmission mechanism have been explored theoretically by Monteil(1991) and King(1994) in the context of controlled interest rates, limited array of instruments and other financial restrictions. In a cross country study, which included Jamaica, Cottarelli and Kourelis(1994)[10] found that there was a strong correlation in the response of the financial variables to monetary impulses and the structure of the financial system.[11] A

[10] See also S. Pelzman(1969) "The Banking Stucture and the Transmission of Monetary Policy" Journal of Finance vol. 14.

[11] See also K. Brunner and A. Meltzer(1963), "The Place of Financial Intermediaries in the Transmission

weak financial structure impedes the transmission process. They suggested that the transmission mechanism can be enhanced through the existence of a viable market for short -term instruments, the containment of unnecessary or random fluctuations in money market rates, and the reduction of constraints on bank competition. Cottarelli and Kourelis concluded that the "transmission mechanism can be enhanced by policies aimed at enriching the financial structure ..... and by removing barriers to competition"[12] However they noted that policies encouraging mergers may not be inconsistent with competition.

Other studies have looked at the importance of financial sector soundness and bank regulation. The fact is that unhealthy financial institutions may respond perversely to policy signals. They may, for example, expand credit in a context of rising interest rates, in order to cover non-performing assets. Kareken(1984)[13] looking at developments in U.S. regulatory policies argued that *proper* bank regulations are necessary for the conduct of monetary policy, particularly open market operations. At the opposite extreme, he suggested that a laissez faire approach to bank regulation would render monetary policy ineffective.

Whilst financial sector legislation aim at ensuring soundness it should be noted that soundness is best guaranteed by a deeper market. Thus financial legislation whilst seeking to ensure soundness should facilitate a deepening of the market. The simultaneous effect of which would be to enhance the transmission of monetary policy.

2.3 Expectations and Uncertainty

Apart from the financial structure, the fluency of the transmission mechanism to a large extent is determined by economic agents' expectations. In a small open economy such as Jamaica, it is known that expectations about the exchange rate feed directly into prices, avoiding demand effects. This tends to frustrate the stabilization process. The monetarists strongly insist that economic agents response to monetary changes depending on whether they perceive or expect monetary policy changes to be permanent or

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of Monetary Policy." American Economic Review vol. 53

[12] C. Cottarelli and A. Kourelis (1994), "Financial Structure and Bank Lending Rates" IMFSP vol.41 no.4

[13] See also J. Tobin and W. Brainard(1963), "Financial Intermediaries and the Effectiveness of Monetary

transitory. Any misperception or uncertainty about monetary policy may cause undesired fluctuation in prices and output. The more confident agents are about the monetary authority's intentions the quicker will nominal and real variables respond.

Theissen(1995) suggests that in order to reduce uncertainty, the central bank should clearly establish the long run goal of monetary policy, the shorter term operational targets and its own interpretation of current and future economic developments. In other words the transparency of monetary policy and the reasoning which informs the central bank activities are essential. Theissen concludes that "it is important not only that the ultimate objective of monetary policy be clear but also that the implementation of policy be as transparent as possible."[14]

To summarise, the transmission mechanism being proposed is an eclectic combination of the Keynesian and Monetarist perspectives, whereby monetary policy effects are propagated through the central bank's leverage over short term interest rates. This in turn affects the balance sheet of the commercial banking system by inducing portfolio and liability composition shifts. Consequently, the supply of credit is affected. Also the balance sheets of firms are affected by their influence on what is called the 'external financing premium.' Concurrently the households' balance sheets are affected via Modigliani's(1971) permanent income and Patinkin's(1989) wealth effects. Consequently the demand for credit is also affected. The resultant changes in the credit market and the corresponding liabilities of the banking systems induce changes in the supply of money and overall absorption or aggregate demand (through changes in consumption patterns) by the private sector. The response of the private sector however depends on whether the monetary impulse is viewed as permanent or transitory. Commodity (real goods) and asset (foreign exchange, longer term real and financial capital) prices will then adjust as economic agents equate the marginal utilities of the various assets. The overall endogenous price level in the 'long run' will adjusts so as to clear any deflationary or inflationary gap that was created by changes in aggregate

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Controls." American Economic Review vol.53

[14] G. Theissen (1995) "Uncertainty and the Transmission of Monetary Policy in Cananda." BIS Review no. 63 pg. 17

demand. This system is essentially circular, closed by a policy reaction function and underpinned by a sound financial system and a transparent and credible monetary policy.

3.0 *Empirical Analysis*

3.1 Methodology and Data

One of the reasons why there is a lack of theoretic consensus on the monetary transmission mechanism, is that it is difficult empirically to disentangle movements in the various macroeconomic variables over time, into that portion which is directly attributable to monetary policy innovations, other shocks and that which reflects endogenous changes. This paper will attempt to identify the impact of monetary policy using Structural Vector Autoregressions(SVARs).

The strategy is to first estimate a compact reduced form system, which explains the predictable co-movement of the variables. The transmission process can be derived from the estimated co-movements. The unexplained portion is then given a structural interpretation, by decomposing the movements of the endogenous variables into the portion which is caused by the variables' own innovations and the portion caused by other shocks. This allows us to uncover some insights into the transmission process in terms of the timing and significance of monetary policy shocks.

If we take a simple system explaining money (m), income (y) and prices (p) for which we have a vector of endogenous variables denoted as

$$x_t = [\, \Delta y_t, \Delta p_t, \Delta m_t \,]$$

and a corresponding vector of shocks

$$e_t = [e^s_t, \; e^d_t, \; e^m_t \,]$$

where e^s represents supply shocks in the form of *inter alia,* productivity, oil and terms of trade shocks; e^d represents demand shocks such as shifts in consumption patterns; and e^m represents monetary shocks. The corresponding structural model is

$$x_t = A(L)\, e_t \qquad (1)$$

which can be estimated by modelling the vector of endogenous variables as a VAR of the form

$$x_t = C(L) u_t \qquad (2)$$

where u_t is a vector of residuals

$$u_t = [u^y_t, \; u^p_t, \; u^m_t \,]$$

To identify the structural impact of the shocks on the endogenous variables, which can then be used for policy analysis, equation two is mapped into equation one. Note that

since both equations imply that

$$u_t = A(0)e_t \qquad (3)$$

this process involves the derivation of the elements in A(0) by some 'causal ordering' or the imposition of a set of assumptions that allows the separation of the observed contemporaneous correlation in the reduce form errors from the unobserved structural errors. For example one can assume that monetary shocks are independent, output shocks respond to monetary shocks and prices depend on the variation in both money and output. In which case each row of the error matrix is defined as

$$u_t^m = e_t^m$$
$$u_t^y = f_1\, e_t^m + e_t^y$$
$$u_t^p = f_2\, e_t^m + f_3 e_t^y + e_t^p$$

This causal ordering results in a triangularization of the error matrix. In practice this is done by a Choleski decomposition of the error matrix. This allows you to derive the impulse response function, forecast error variance and historical decomposition of the error matrix.

VARs are particularly suited for this exercise, as they require very few restrictions at the outset. This methodology is however limited in that the results are highly sensitive to the pattern of identification restrictions imposed on the errors, and one runs the risk of overparametization. [15]

Likelihood ratio tests, along with the final prediction error, Amemiya, Schwartz and Akaike criteria are used to determine the optimal lag length[16]. A specification search is used to determine the structure of the transmission mechanism. First block exogeneity tests are used to determine whether the money channel or the credit channel should be considered. Block exogeneity tests are the multivariate extension of Granger causality tests and employ a likelihood ratio, which is distributed as chi-square. The null hypothesis is that the lags of a given set of variables do not enter the model. F-tests for

[15] See Leeper, Sims and Zha (1996), Sims(1980), and Greene(1990-2) for an exposition.
[16] The Schawtz criterion tends to be more robust as against the Akaike as it imposes a larger penalty for the degrees of freedom. See Lutkepoj(1985) for an analysis of the power of these criteria for determing a particular lag structure.

exclusion restrictions are then used to determine the causal linkages. This is closer to the traditional Granger test, and looks at the individual variables in each equation of the VAR system, after account is taken of the other variables. This is a more robust approach in comparison to the pairwise causality tests used in Nichols et al (1995) and Barnes(1996).

The error matrix of a compact reduced form system, derived from the previous exercises, is decomposed in order to assess the impact of monetary policy. The decomposition is done by imposing a structure, based on the causation observed, on the pattern of correlation in the residuals across equations.

The variables used in the unrestricted VAR, conform with both the money and credit channels of the transmission mechanism. Thus the model is comprised of interest rates on reverse repurchases – repo (rpr), treasury bills (ijt), time deposit (dr) and loans (lr) and the logs of base money (bm), private sector credit (pcred), M3, the exchange rate(xrate), prices (cpi) and real economic activity (rgdp). The quantity variables are for domestic currency assets and transactions, whilst the interest rate on deposits and loans are weighted average rates of various maturities and loan types. An expenditure measure, derived from consumption taxes, is used to proxy gdp or economic activity. Because we want to uncover the direct effect of policy, the estimation abstracts from seasonal effects.

One of the problems in exercises such as these is to identify the variable, which adequately represents monetary policy. A priori, this would be the repo rate, however we do not impose this, but allow the data from the specification search to identify the variable.

Monthly observations on each variable from September 1991[17] are used. The periodization is designed to account for the liberalisation of the foreign exchange market and the financial system. A priori expectations and preliminary empirical tests show that there are some shifts in the transmission mechanism, particularly where financial variables are concerned. The sample size still provides sufficient degrees of freedom for each equation.

Time series analysis, which employed the Phillips Peron test[18] (see appendix I), indicate that only rgdp, over the period was stationary. The others were I(1), some with

[17] Repurchase agreements were introduced in 1994. Prior to this interest rates on Certificates of Deposits, which REPOs replaced, were used.
[18] See Phillips and Perron (1988) and Robinson(1996).

trend. Consequently, the variables with the exception of rgdp, enter the model in first differences. Granger and Newbold (1974) have showed that one will likely find a strong statistical relation between non-stationary series that are trended, irrespective of whether there is any underlying behavioural relation. Further Engle and Granger(1987) showed that if a linear combination of non-stationary variables is stationary then their exist an error correction representation of the model. This then permits us to estimate a reduce form vector error correction model (VECM).

3.2 Results

The specification search started with an unrestricted VAR system which included all the variables, in first differences, associated with both the money and credit channels. The test for an optimal lag length is shown in ***Table i.*** Some of the criteria showed conflicting results. However the likelihood ratio and the final prediction error tests suggested a lag length of three. Thus a three lag VAR system was estimated.

Table i : Lag Length Selection

	LAGS					
Criteria	**1**	**2**	**3**	**4**	**5**	**6**
Akaike	-4.02	-3.07	-2.11	-1.22	-0.34	-0.33
Scwharz	-12.4	-13.9	-15.3	-16.9	-19.6	-24.9
Log(FPE)	-0.79	-0.68	-0.6	-0.5	-0.5	-0.38
Amemiya	321.37	-212.45	-89.5	-95.12	-90.4	-94.7
χ^2 Significance of the LR for 7 lags	0.00	0.00	0.543	0.999	1.00	1.00

The results of the estimation of the restricted VAR are shown in Table ii. The observations on credit include both domestic and foreign currency loans. This as preliminary block exogeneity tests and exclusion restrictions indicated very weak effects of the credit variables which were denominated in domestic currency. This would suggest that the money channel as against the credit channel is the more relevant means by which monetary policy is transmitted. When foreign currency loans were included, the statistics on the credit block became significant.

The implication of this is that the asset side, or more appropriately the domestic assets of the banking system, relative to their liability side of the balance sheet, is not the

critical channel of monetary policy. However, since 1991 foreign currency operations, of commercial banks have grown significantly. This has included significant increases in their foreign currency loan portfolio. Although its growth has slowed over the past year, foreign currency loans in US dollars, have grown at an annual average rate of approximately 28.0 percent over the past five years. This as agents have substituted high cost domestic debt with low cost foreign currency debt. To account for this diversity in the loan portfolio, total credit inclusive of domestic and foreign currency loans was included in the system.

The results in ***Table ii*** indicate that the model explains a significant proportion of the variation in the dependent variables[19]. The second panel presents F-tests of exclusion restrictions where the (i,j) element tests whether the ith variable appears in (or Granger cause) the jth equation. Because of restrictions on the degrees of freedom, a ten percent

Table ii : Summary Results

Test Statistic	Rpr	Bm	lr	dr	Pcred	m3	Xrate	Rgdp	Cpi
Goodness of Fit :									
adj R^2	0.46	0.37	0.40	0.59	0.32	0.34	0.49	0.52	0.74
SSR	0.01	0.77	0.06	0.02	0.05	95.7	108.0	0.06	322.9
SEE	2.50	0.03	1.47	1.38	0.031	0.01	0.04	0.12	0.01
Tests of Exclusion Restrictions: F-Statistics									
Rpr	0.79	3.84*	2.28*	4.63*	0.81	2.83*	2.13	0.52	3.29*
Bm	2.07	2.93*	0.19	1.16	1.35	3.14*	0.45	0.51	1.23
Lr	0.67	3.71*	3.49*	2.51*	2.71*	0.66	2.19	0.97	0.45
Dr	0.12	2.04	1.08	0.64	0.09	0.65	2.43*	0.22	0.24
Pcred	1.28	1.33	3.55*	1.96	1.04	2.26*	1.29	0.50	0.16
m3	1.00	0.77	4.93*	3.55*	0.64	5.44*	0.32	0.08	0.35
Xrate	3.23*	0.81	0.43	4.40*	0.44	3.28*	11.14*	3.22*	13.29*
Rgdp	0.83	0.83	3.04*	1.47	0.09	1.74	0.56	15.48*	1.38
Cpi	1.67	0.51	2.00	2.40	0.63	0.67	1.72	1.00	6.87*

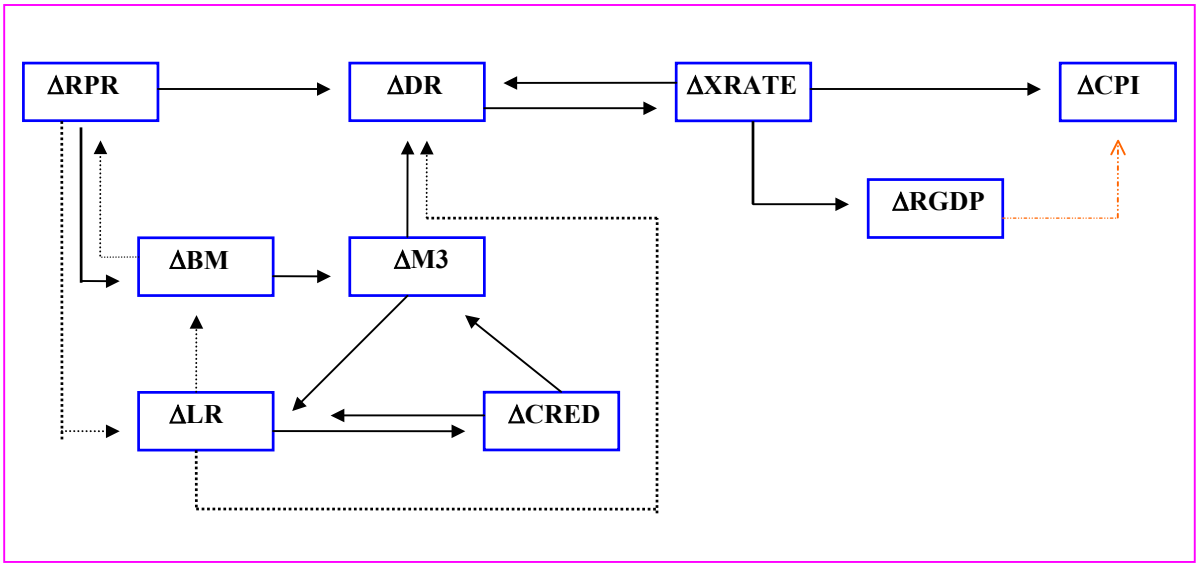
* denotes significance at the 10% level. SSR and SEE are the sum of squared residuals and the standard error of the estimates respectively

[19] The R^2 s by themselves do not have much significance if any at all.

level of significance is used. Thus the column detailing the results for the inflation rates shows that only changes in the exchange rate and repo rates are significant, in a Granger cause sense, after account is taken of the other variables. The pattern of significance among the variables determines how shocks to any one equation are level propagated throughout the system. We can therefore use this pattern of significance, with some intuition, to trace the transmission of monetary policy.

Figure i shows the results of the trace and thus gives an idea of the pattern by which monetary policy shocks are transmitted. The solid arrows denote the main direction of causation whilst the dotted arrows indicate minor effects. It reveals a very complex mechanism, which raises more questions rather than answers. In Table ii, reading down the rpr column, the only variable that was significant in this equation, in a causal sense, was the exchange rate. This would suggest that based on the system, the transmission begins with changes in the reverse repo rates. We can therefore identify this as the unique policy variable, the significance of the exchange rate indicating the monetary policy reaction function. Of note is the fact that the central bank's operating target, base money, is not a true policy lever. Apart from the fact that there is a lag in holding reserves against liabilities, the components of base money, particularly currency and statutory reserves, to a large extent are endogenous, reflecting changes in expenditure decisions.

Figure i : ***The Monetary Transmission Mechanism***



The change in the reverse repo rate, say an increase, directly affects the deposit and lending rates. A higher repo rate raises the return on this instrument relative to other competing bank instruments. To attract deposits, particularly from larger investors who have the option of purchasing repos or government securities through primary dealers, banks will have to raise their deposit rates. Also, if we assume that credit is demand driven, because banks can hold their excess reserves in repos and other securities at a risk free rate, competing borrowers will face an increase in lending rates of at least the amount necessary to cover the risk free premium on repos. More importantly, the effect of the repo rate on lending rate is enhanced in the context where there is a high proportion of non-performing loans. With the pool of loanable funds being less, higher interest rates will be used to recover, at least partially, the bad debts.

Changes in the reverse repo rate also affect interest rates indirectly through the monetary aggregates. An increase in this rate reduces the rate of growth of the current account of the commercial banks, thereby effecting a deceleration in the growth of the money base. For a given money multiplier, lower growth in the money base slows the growth in the money supply. Additionally, the reduction in credit, consequent on higher lending rates, further restrains the money creation process.

One will note however, that there is a feedback from base money to the repo rate. This can be interpreted as a policy reaction to any undesired endogenous growth in the money base. Of note also, is the self-reinforcing process between money growth, lending rates and credit. This suggests that monetary policy can effect a significant dampening influence on financial variables, thereby significantly reducing financial sector activity as both the liability and asset sides of the banking system's balance sheet are affected.

For a given money demand relation, the reduction in money growth from the supply side, precipitates a rise in deposit rates. Increases in domestic deposit rates relative to foreign rates in the context of an open economy with no restrictions on capital, will ceteris paribus, create opportunities for interest rate arbitrage. The resultant capital inflows generate an appreciation in the exchange rate. If prices do not adjust immediately then this also implies a real appreciation. This result lends support to Kouri's (1976) asset market approach to exchange rate determination. The feedback effects of exchange rates on deposit rates reflect the covered interest parity notion that cross border flows, by

depressing domestic interest rates, will continue up to the point where the interest differential is equal to the expected depreciation in the exchange rate.

These adjustments in the exchange rate directly affect prices given the cost structure of domestic output, the ratio of tradeables to non-tradeables in domestic consumption and the pricing strategies of firms, which of itself is a function of the less than perfect competitive market structure which exists. Further, the information content on the future path of prices, contained in movements in the exchange rate is very strong. Consequently inflationary expectations are strengthened with any depreciation in the exchange rate.

There is also an indirect effect through aggregate demand and supply as the exchange rate act as an expenditure switching mechanism. Theoretically, a real appreciation will expand demand and constrict output and vice versa. In which case the indirect effect of exchange rate on prices, through aggregate demand, counters the direct effect. This channel is not very clear however as it depends on the relative elasticities of exports and imports. In Jamaica's case, during the episodes of appreciations and depreciations of the exchange rate, the direct effect on prices has swamped the indirect effect.

The transmission mechanism outlined above however, raises some questions. First the causal link running directly from changes in lending rates to deposit rates seems rather dubious. One may argue that this reflects the effects of the interest rate spread. This is plausible only if the determinants of the spread such as administrative costs, the level of non-performing loans, are more strongly correlated with the lending rates. A more plausible explanation is that commercial banks' lending portfolio is easier to adjust (and does so more quickly) in response to innovations in the repo rate. This then elicits compensating adjustments to their liabilities. Alternatively, although the changes in deposit rates have a higher variance, both series, with a correlation coefficient of approximately 82 %, tend to move together in levels. The model therefore could be picking up this strong co-movement between interest rates, consequent on monetary tightening. In any event the impact of repo rates on this co-movement suggests that the central bank's instrument -the repo rate, is a very powerful tool for monetary policy. It must be noted however, that commercial banks engage in other forms of lending which

are off balance sheet items, particularly commercial paper, which may skew the information conveyed in the model about the credit market.

Secondly, one would have expected a more direct effect of the credit channel on the exchange rate and expenditure or GDP. The absence of the former impact can be explained by the fact that the rise in imports attributable to credit has been more than offset by the capital inflows generated from interest rate differentials. This again highlights the potent stabilization effects of the repo rates. The absence of the direct effect of credit on expenditure or GDP would indicate that the Keynesian cost of capital effect is non-existent. However one cannot be definitive on this issue as the significance of other forms of commercial bank lending noted above has increased. This in itself will circumvent the potential impact of monetary policy. Further the result may be due to the proxy used.

Thirdly, changes in deposit rates, through wealth effects, should have a direct influence on expenditure and GDP. It maybe the case however that this additional wealth is channelled into the foreign exchange market, either for hedging or speculation. Hence the direct causation from changes in deposit rates to the exchange rate.

Finally, it is important to note that the imposition of special deposits, reserve ratios, primarily the cash reserve ratio, and the issuance of government securities in tandem with adjustments in the central bank's indicative rate, may impede the smooth transmission of monetary impulses generated by changes in the repo rate. These factors create distortions which send wrong signals to portfolio holders. It is against this background that it has been argued that the reduction of these distortions will enhance the effectiveness of monetary policy.

Despite these reservations, the results indicate that monetary policy is transmitted via both the money and credit channels. The underlying processes involve both the Keynesian cost and the Monetarist portfolio adjustment effects. The low standard errors across equations, and the existence of a stable money demand function,[20] would imply that the portfolio shifts were consistent and predictable over the sample period. These portfolio adjustments result in a reinforcement of monetary policy effects in the financial

[20] See Craigwell 1993.

markets. The linkages this has with the exchange rate, create a direct channel for monetary policy to affect prices, even in the short run.

Although the framework of analysis may not be ideal for identifying a suitable intermediate target, the transmission process outlined would suggest that the central bank would want to consider the use of deposit rates or a combination of deposit and exchange rates as an intermediate target. This, as these variables directly reflect the effects of changes in monetary policy, and provide a clear signal to the rest of the economy. With respect to the latter measure, as practiced by the Central Bank of Canada and the Reserve Bank of New Zealand, weights can be assigned to the deposit and exchange rate to derive a monetary condition index (MCI).

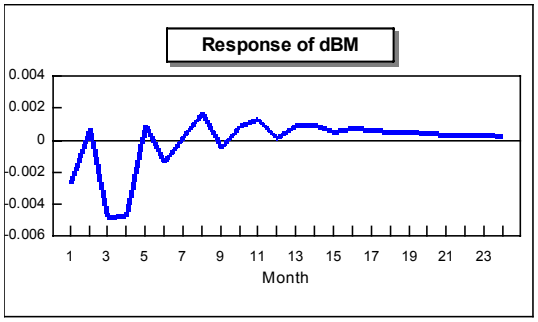
The preceding discussion speaks to the statistical significance and the direction of the relation amongst the variables and not to the magnitude. We will therefore use this causal structure to estimate the impulse response function. Because there is evidence of a contemporaneous correlation in the residuals for the various interest rates, they are replaced by an indicative rate, the treasury bill rate. Because the repo rate emerged as the main policy tool we consider the responses to a unit shock lasting one month to this rate. The responses are shown in ***figure ii***.

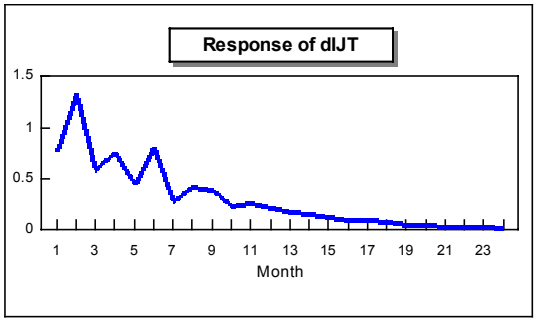
The inflation rate declines sharply within the first two months. At the end of which it decelerates by approximately 0.1 percent point per month from its base line rate. Simultaneously the rate of depreciation in the exchange rate slows to just under 0.6 percent per month within the first two months, while the interest rates rise sharply.
Although the rate of depreciation increases sharply in the third month, it decelerates even more precipitously over the next two months to approximately 0.2 percent per month. The initial reaction in the first three months may reflect uncertainties in the market about the intent of the policy change.

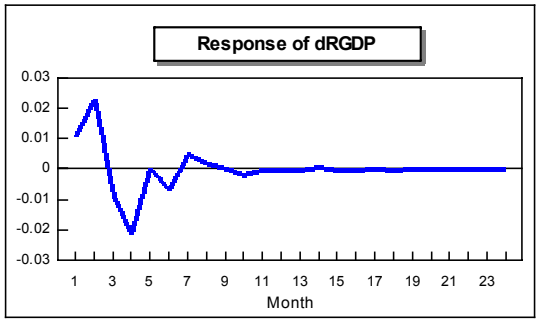
Notably, economic activity increases temporarily in the first month, but declines rather significantly thereafter. In fact after the first four months real economic activity declines by approximately two percent per month. Note also that whereas the response of the nominal variables tends to be below one percent per month, the reaction of this variable is significantly above one percent in either direction. This highlights the significance of monetary policy to real economic activity. There is however some evidence of the neutrality of money. Being the only real variable in the system, its growth

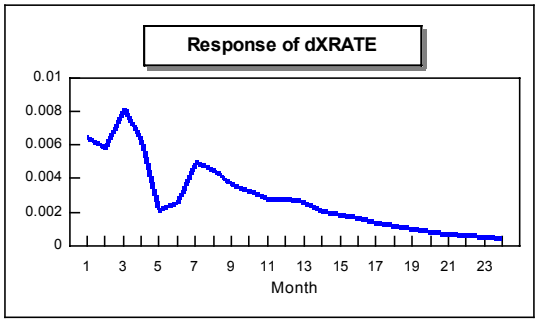
Figure ii

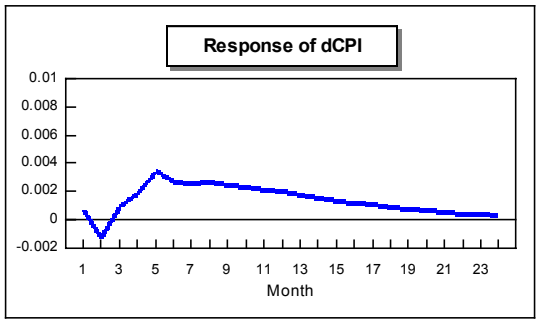
Impulse Response to one S.D shock to growth in REPO Rate

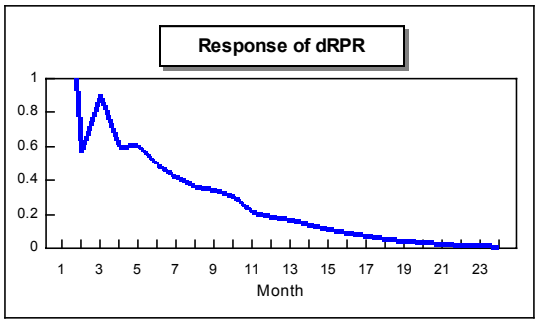












rate actually converges to zero over the medium to long run. Taken together, in support of recent theory, this implies that monetary policy generates very strong real effects, but only in the short run.

As the effects of the shock to the repo rate taper off there is a sharp resurgence, albeit temporary, in inflationary pressures. This temporary resurgence indicates that there is a significant real appreciation in the exchange rate. More importantly however, whilst the response to the repo shock is quick, eliciting very sharp movements, the effects tend to be short lived as much of the fluctuations in the macro-variables, following a disturbance, occurs in the first two to eight months. Thereafter the variables tend to their long run equilibrium.

The variance decomposition of the forecast errors in ***Table iii*** indicates the relative importance of the various shocks on the inflation and exchange rate over different horizons. For the inflation rate, shocks to the exchange rate and to the inflation rate itself accounts for most of the variability in the inflation rate over all horizons. This is followed by shocks to base money and the repo rates, which increase in importance over time. The decomposition of the exchange rate indicates that apart from its own innovations, shocks to base money and repo rates accounts for the major portion of the variability of the exchange rate.

These results are similar to those of Robinson(1996) and highlight the central role that monetary policy can play in macroeconomic stabilisation. This is against the background of the significance of the exchange rate shocks on the variance of the inflation rate and the strong covariance/correlation between exchange rates and monetary variables. It must be noted however that the significance of the variables own innovations do indicate the importance of structural factors such as exogenous supply and demand shocks, terms of trade and productivity shocks and expectations.

Table iii: Variance Decomposition

Horizon (months)	**Variance Due To (%)**						**Standard Error**
	rpr	bm	Ijt	Xrate	Rgdp	Cpi	
Decomposition of CPI :							
1	0.73	2.98	0.91	6.30	6.65	82.43	0.008
6	5.49	5.49	1.79	56.01	4.59	26.6	0.217
12	8.92	7.65	2.95	52.81	3.51	24.16	0.026
18	9.98	8.19	3.14	51.45	3.33	23.89	0.027
24	10.18	8.31	3.17	51.18	3.31	23.85	0.027
Decomposition of XRATE:							
1	3.51	9.81	0.17	86.51	0.00	0.00	0.034
6	7.21	9.41	4.66	69.79	0.96	7.97	0.051
12	9.12	9.74	4.71	66.27	1.00	9.15	0.055
18	9.57	9.94	4.75	65.36	1.00	9.38	0.056
24	9.65	9.97	4.76	65.22	.99	9.40	0.056

4.0 Conclusion

The preceding analysis points to a process where monetary policy impulses are transmitted by both the money channel and the credit channel via a process of portfolio substitution. The underlying processes capture both the Keynesian and Monetarist ideas. Monetary policy, through its primary and by all indications, most effective tool – reverse repurchase rate, exert significant leverage over the financial system. Driven by portfolio shifts, the market dynamics of the financial system, tends to reinforce monetary impulses. Thus changes in the central bank's indicative rate affect the entire spectrum of interest rates. The resulting adjustments in the banking system's balance sheet are transmitted to the real sector and prices through the foreign exchange market. This, as market participants adjust their own portfolios in response to the signals from the financial system. It must be underscored however that the role of the credit channel, in a context where foreign currency credit is significant, may pose a problem for the conduct of monetary policy.

The impact of monetary policy tends to be immediate and pervasive, albeit short lived, lasting between two to eight months. The inflation rate decelerates within two

months by approximately 0.1 percent per month, whilst the rate of depreciation declines significantly over the space of five months. Concurrently, there are very strong real sector effects, as real economic activity declines by approximately 2.0 percent in four months.

Although the transmission mechanism indicates that monetary policy can be highly effective, the process is buffeted by the state of the financial system, expectations and other structural variables which impact on the ultimate target -inflation. Economic policy therefore, whilst remaining resolute in its focus on stabilization, cannot ignore the implications of a weak financial sector, and an inefficient production structure.

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Appendix 1.

Phillips-Peron test for unit root*

Variable	Levels		1st Differences	
	Drift	Drift & Trend	Drift	Drift & Trend
rpr	-2.67	-2.58	-5.52	-5.58
bm	-2.09	-1.03	-11.71	-12.67
lr	-2.14	-1.85	-1.8	-9.09
dr	-2.48	-2.52	-8.26	-8.22
pcred	-0.014	-2.54	-8.26	-8.22
m3	-2.08	-0.87	-11.79	-12.75
xrate	-2.71	-1.62	-4.02	-4.51
rgdp	-3.63	-4.46	-10.85	-10.75
cpi	-2.83	-1.35	-3.15	-4.01
ijt	-2.71	-2.67	-7.52	-7.53

* 5 % critical values are 2.89 with drift and 3.46 with drift and trend.