EMPIRICAL EVIDENCE OF THE STRUCTURALIST POSITION

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Introduction

There are different approaches regarding the nature of the money supply and monetary policy variables. Within the mainstream framework, the money supply is viewed as being under the control of the monetary authorities via the base money multiplier process. It is assumed that there is a stable relationship between the money supply and the base money. The latter, which constitutes the liability of the central bank, is presumed to be directly controllable by the monetary authorities. The money supply function should therefore be modeled as vertical in interest-money space. The money supply is an exogenous variable determined by the actions of the central bank.

In contrast, Post Keynesians insist that the money supply should be viewed as endogenous, credit driven and demand determined. The monetary authorities' power is confined to administering exogenously the supply price of additional bank reserves which, in turn, governs short-term market interest rates. The money supply function should therefore be modeled as horizontal in interest-money space, and resting at the level of interest rate administered by the central bank. The money supply is an endogenous variable determined by market forces.

The concept of endogenous supply of credit money has now been widely accepted among the Post Keynesian economists. However, within the Post Keynesian theory of endogenous money, there are two different approaches.

According to horizontalism, the central bank cannot control the quantity of money but it can determine interest rates. The central bank determines the base rate, and all other market interest rates are adjusted to that rate. Therefore, the central bank ultimately determines the level of interest rates. The money supply is best viewed as a horizontal line because the supply of credit money is infinitely elastic at a given interest rate.

In contrast, the main idea of structuralism is that the money supply is determined endogenously. However, because of the non-accommodation of the central bank and other market phenomenon such as liability management, liquidity preference and increasing risk, the central bank cannot exogenously control interest rates. Any excess demand for credit places an upward pressure on interest rates. So, the credit money supply curve is upward sloping.

Nowadays, revolutionary changes in both the payment system and the reserve requirements system make it difficult to explain the money supply within the conventional framework. Therefore the first question that I wish to address is whether or not money is endogenous, as is widely held by the Post Keynesians. In order to answer this question, I analyze the history of Canadian monetary policy during the past twenty years, and try to show that the endogenous money explanation is more consistent with historical observations. If we follow the endogenous money approach, interest rates become a crucial policy instrument. So, the next question to be posed has to do with the extent to which interest rates can be treated as an exogenous variable. This question is related to the two different Post Keynesian approaches. To answer the question that

interest rates can be treated as exogenous variables, I adopt Pollin's method of causality test.

Following the introduction, the first chapter of this paper outlines the basic ideas of the Post Keynesian endogenous money theory, as well as the two competing approaches advocated by Post Keynesians. Chapter 2 reviews the literature dealing with the two different Post Keynesian approaches. The purpose of the review of the literature is to identify why the money supply curve is presumed upward sloping because of the non-accommodation of the central bank and other market phenomenon, such as liability management, liquidity preference and increasing risk.

In chapter 3, I study the empirical evidence in support of the structuralist position. At first, I analyze the history of the past twenty years with monetary policy – the earlier experience with monetarism and the more recent monetary policy framework with zero reserve requirements in Canada – and explain why within this framework the results are more consistent with the argument of Post Keynesian endogenous money theory. This is then followed by causality tests between the administered interest rate and market rates, with the empirical results highlighting the differences between the two policy regimes. Finally, conclusions are derived on the basis of these causality test results.

Chapter 1. Theoretical controversies over the money supply function

There are numerous points of contention surrounding the issue of money and interest. At the most basic level, a widely accepted definition of the money supply and the rate of interest remains to be established. An examination of the determinants of the slope of the money supply function reveals many important aspects of the monetary transmission mechanism, including the interplay between the monetary authorities and the banking system.

The orthodox neoclassical synthesis is based on the exogenous supply of money, represented by a vertical curve in interest-money space, with the quantity of money determined solely by the central bank. Interest rates are determined endogenously within the IS-LM framework either by the forces of productivity and thrift or by portfolio adjustment via liquidity preference.

Post Keynesian economists argue that the orthodox view, that the growth of monetary aggregate can be exogenously controlled, is misleading. The supply of credit money is credit-driven, so that the money supply responds to changes in the demand for bank credit. The supply of credit money is, therefore, also endogenous. The exogenous variable is the price at which central banks supply base money on demand, which determines short-term interest rates.

Among these Post Keynesian economists, horizontalists assert that the determination of the base rate[1] is purely a supply-side phenomenon and is not the product of interdependence between demand and supply conditions. Central banks can exogenously determine the base rate. All other interest rates may vary above the base rate but their variation is not due to demand side factors such as the perception of lender's risk and other considerations. As a result, the money supply curve is horizontal in interest-money space.

An alternative approach, also widely held among Post Keynesians, asserts that the money supply curve is neither vertical nor horizontal, but rather is upward-sloping in interest-money space. Structuralists suggest that the central bank does not fully accommodate the banking system's required liquidity due to other priorities such as concern over inflationary and exchange rate pressures. Moreover, demand side factors in the financial market also influence interest rates. These demand side forces include changes in liquidity preference, increasing risk, liability management and financial innovation. Because of the non-accommodation of the central bank and demand side forces, the money supply curve is upward-sloping in interest-money space.

Among these three different approaches, the fundamental difference pertains to the issue of endogeneity or exogeneity of the money supply. However, horizontalism and structuralism subscribe to the same endogenous money approach but provide competing explanations about the determination of interest rates. The purpose of the following

[1] The base rate is the price at which the central bank is able to provide reserves to the banking system. It is the discount rate in the U.S. and the bank rate in Canada.

section is to review the Post Keynesian approach and explain why this approach is more reasonable with respect to the development of the modern payment systems and the environment of financial innovation.

A. The endogeneity of the money supply

Orthodox theory tends narrowly to define money to include the highly liquid assets included in M1 or M2, that is, some of the liabilities of banks and financial intermediaries. In particular, this theory gives a special role to demand deposits. Demand deposits are supposed to be closely related to spending and prices, while other private liabilities are relegated to secondary. Orthodox monetary policy focuses on this narrowly defined money since it is assumed to circulate as a medium of exchange. Orthodoxy finds a high correlation between spending and this definition of money or between prices and this definition of money. To control the growth of prices or spending, one would have to constrain the rate of growth of money, so defined. In order to constrain the rate of growth of the money supply, one must first control bank reserves.

This conventional view of money stock determination begins by formally recognizing the joint influence of the central bank, the banks, and the public. This approach is summarized by the following familiar expression:[2]

(1) $M = m H$

[2] Goodhart, C. (1992), pp. 727-730.

where M is monetary aggregate (M1, M2); H is high powered money (the monetary base) with H = C + R, where C is currency held by the general public and R is the cash reserves of the banking sector; and m is the base money multiplier such that m = (1+ C/D)/(R/D + C/D) where D is deposits held by the general public. With H as exogenous (i.e., under the potential control of the central bank), controlling the monetary aggregate turns on the central bank's ability to forecast m, which is jointly determined by the action of the banks (excess reserves, borrowings, etc.) and the actions of the public (currency demand, composition of deposits, etc.). Empirical applications of the reserve multiplier approach tends to abstract from the short-term dynamics of adjustment by banks and the public, and so leaves the role of interest rates implicit rather than explicit. The control mechanism implied is that deposit expansion of the banking system is quantity-constrained through the central bank's control over the sources of bank reserves.

However, the development of the financial system and the payment system makes it difficult to explain the monetary control mechanism based on this kind of conventional framework. The conventional framework [the above equation (1)] is based on the reserve requirements system and base money multiplier equation (M = mH, H = C + R). Traditionally, reserve requirements are justified for two reasons. Banks are required to hold a minimum level of cash reserves to assure that they can satisfy depositors' demands to convert their deposits into currency. Failure to meet these demands jeopardizes the confidence of its depositors and may precipitate a run on the bank. The second purpose is efficient monetary control. It is generally recognized that reserves serve as a control device by which the central bank can influence the quantity of bank deposits.

The monetary base equation is an accounting framework for the quantitative analysis of the basic determinant of the money supply. But, nowadays, the liquidity problem can be solved by government deposit insurance or the central bank advances as a lender of last resort.[3] Therefore, monetary policy does not require high reserve ratios to assure predictability of banks' response to monetary policy.[4] However, reserve requirements are costly for the financial institution to which they apply. Cash reserve requirements force these institutions to hold a portion of their assets in a form that does not earn any interest return and makes them less able to pay competitive return on their deposits vis-a-vis any other competing financial institutions.[5] So, many countries have lowered their legal reserve requirements ratios and some countries, like Canada, have zero legal reserve requirements.[6] In addition to this zero legal reserve requirements, owing to the development of a clearing system, banks can have close to zero reserves ($R \rightarrow 0$).[7]

Among the two components of base money, reserves (R) have become less and less significant and the only element of H remaining is central bank notes (C).[8] But this

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[3] Diamond, D. W. (1983), pp. 413-417.

[4] Johnson, H. G. (1976).

[5] Another explanation about the economic disadvantage of reserve requirements is its implicit tax effects. "Reserve requirements force banks to hold liabilities of the public sector that pay no return, and are therefore effectively a tax on financial intermediation by banks. This tax has three adverse effects: Unclear incidence, arbitrary discrimination and reserve avoidance." (Clinton, 1997, p. 3)

[6] Clinton, C. (1997), p. 1.

"A number of countries now have no reserve requirement, such as Austrailia, Belgium, Canada, Sweden and the United Kingdom. In others, including the United States and France, the level of minimum deposits at the central bank has fallen to very low levels, ..."

[7] I will discuss in details the Large Value Transfer System in Canada in a later chapter.

[8] Rymes, T. K. (1995), pp. 122-123.

currency should be supplied on demand. Therefore, under this framework, base money cannot be treated as an exogenous variable. Within this new framework, the only possible monetary controlling mechanism is changing the cost of funds to commercial banks. It follows that the more exogenous, or policy-determined, variable is the rate of interest, while both the monetary base and monetary aggregates are endogenous variables.

Furthermore, the evolution of payment system makes it difficult to define the quantity of money. When commodities such as gold serve as money, or when money is confined to that of government fiat, it is possible to envisage an independent supply of money function, conceptually distinct from the demand for money function. Historically, however, we have been progressing toward a world in which bank deposits dominate the payment system and central bank notes are supplied on demand. When inside bank monies dominantly serve as money, it is impossible to define an independent supply of money.

We are in a world of fiat money in which government, through central banks, monopolizes the supply of fiat money. We use this fiat money and some types of bank monies as means of payments. However, the payment system is changing according to the development of computer technology and financial innovation. In general, the evolution has been from tangible to intangible money.[9] This trend of evolution suggests that we are moving further into an age in which payments will be increasingly done by electronic money,[10] which may well become the dominant medium of exchange. In a

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[9] Most payments systems were first based on commodity money, subsequently supplemented by representative paper money issued by banks and fiat money issued by government. Nowadays, the dominant money has become bank deposits, and payments are primarily effectuated by means of checks.

currency-based system, each transactions involves the intervention of physical medium of exchange which serves as temporary abode of purchasing power. So, it is possible to define a stock of money. In contrast, in a developed payment system, the notion of a physical medium practically disappears. Therefore, money, as some finite stock, is becoming increasingly difficult to define.

Modern economies are quickly evolving toward the stage of a comprehensive electronic fund transfer system, in which a nation-wide computer network electronically records transactions and transfers funds instantaneously. For such an accounting system, there need not be any physical currency whatsoever. Indeed, even the whole notion of a tangible quantity of money is cast in doubt. Computerization of the payment mechanism will eventually make clear that monetary control, based on the quantity principle, is no longer possible. Central banks can only set their price of liquidity consistent with a desired level of aggregate demand.

In an alternative perspective, it has been recognized by the Post Keynesians that the conventional view, that the growth of a monetary aggregate can be quantity-constrained via the control of sources of bank reserves, represents a fundamental analytical misunderstanding of the nature of the money supply process.

In a credit money economy as distinct from a commodity money economy, the money stock is determined basically by the demand for bank credit, which governs the volume of bank intermediation.[11] This conclusion arises from studying different

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[10] See more details about the development of payment system in Canada, Stuber, G. (1996).

[11] Moore, B. J. (1988a), pp.12-14.

characteristics of the monetary system pertaining to the definition of money, the behavior of commercial banks, and the role of central banks. Post Keynesians focus on credit money instead of fiat money, the profit maximizing banking firm instead of a financial intermediary. They also focus on the markup behavior of banks and the lender of last resort function of central banks.

In orthodoxy, money is narrowly defined and the medium of exchange function of money is emphasized. So, currency and demand deposits are important. Currency is the debt of the government and is the legal tender which must therefore be accepted as a medium of exchange. Demand deposits usually serve as a medium of exchange, and almost always trade at par with legal currency. However, in the endogenous money approach, money is broadly defined and the unit of account function is emphasized. Credit money is a type of financial asset and a liability of commercial banks. Moore defines it as a promise to pay fiat money.[12] Similarly, Wray defines it as a debt issued primarily to transfer purchasing power from the future to the present.[13]

Contrary to commodity and possibly fiat money, the supply of bank credit money is not exogenous. Credit money represents both a private liability and private asset.[14] Whenever bank customers borrow from their bank, deposits and credit monies are created. Since the supply of credit money is furnished by the extension of credit, the

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[12] Moore, B. J. (1988a), p. 19.

[13] Wray, L. R. (1990), pp. 10-13.

[14] Moore, B. J. (1988a), p. 20.

supply schedule is not independent of demand. Therefore, Post Keynesians argue that the supply of this credit money is endogenously determined.

According to orthodox theory, a bank is assumed to be able to increase its loans only after depositors have increased their balances there, so that the bank has excess cash reserves. But unlike this orthodox story, in real world economies, banks do not wait for excess reserves to provide new loans to the public. Rather than passively waiting for deposits before making loans, banks seek profits through the expansion of their balance sheets. The quantity of investment is not dependent on savings. Rather, investment is financed through credit which is extended by banks to entrepreneurs. Due to this behavior of the banking system, loans create deposits. The amount of this loans depends on demand. Money does not arise as a result of reserve injection by the central bank. Money is created when new loans are granted by commercial banks. Loans are at the initiative of the borrowers. So, the money supply is endogenous in the sense of being credit-driven and demand determined.[15]

The orthodox theory assumes symmetrical effects of the central bank on the total money supply. However, Post Keynesians argue that the central bank cannot in general directly reduce the level or rate of growth of money. In the face of strong loan demand, profit-maximizing banks have no incentive to run down their commercial loans. Rather they will bid directly for any funds needed in excess of their deposit inflows and reduce their portfolios of marketable securities to their minimum defensive position. This can

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[15] Moore, B. J. (1988a), p. 46.

increase financial risk. The monetary authorities' major function is to support the stabilization of the domestic financial system. When loans and deposits increase and demand for required reserves rise, reserves must be provided by the monetary authorities. The monetary authorities' power is confined to administering exogenously the price of additional bank reserves.

The orthodox theory of interest determination is an equilibrium approach associated with demand and supply analysis. However, Post Keynesians adopt a markup theory[16] of the interest rate. The revenues of a bank are largely derived from interest rates charged against bank loans. The interest rates, or prices, of loans are determined by a markup over the cost of funds. The lending rates of banks are based on the cost of funds and the interest rate spread needed to achieve a bank's profit goal. The interest rate spread is simply the margin, or markup, between the bank costs and what banks charge for their loans.[17] In relation to the central bank, the commercial bank is the price taker. The commercial bank sets its own lending rate as a markup over the base rate. The prime lending rate is the rate at which banks lend to their credit-worthy customers. The prime rate is a markup over the commercial bank's costs. Thus, commercial banks are price-setters in the retail market and price takers in the wholesale market.[18]

This story implies that the interest rate is the central bank's principal instrument in implementing monetary policy. Thus the quantity of credit demand can be indirectly

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[16] Markup theory assumes an economy in which there is large concentration of market power. This assumption may be appropriate for the Canadian banking system where there are several dominant banks.

[17] Rousseas, S. (1985b), pp. 135-136.

[18] Rousseas, S. (1985b), p. 136.

controlled through central bank regulation of the base rate. The base rate is the price at which the central bank is able to provide reserves to the banking system. This base rate is an administrated rate, which means that its level is determined at the discretion of the central bank. In contrast to the vertical neoclassical money supply function, this money supply function is horizontal at the level of interest at which the central bank chooses to provide reserves.

B. Two theories of money supply endogeneity

Although all Post Keynesians can be generalized as horizontalists rather than verticalists, there are different opinions among them concerning whether horizontalism can be maintained regardless of the demand for credit. Conflict arises over the degree to which supply accommodates to changes in demand. Such lack of accommodation would cause the money supply curve to become upward sloping and is contrary to the concept of the base rate being exogenously determined by the central bank regardless of demand factors. Pollin terms these two distinct theories accommodative endogeneity (horizontalism) and structural endogeneity (structuralism).

The notion of endogenous money is an important concept of the Post Keynesian description of the macro economy. Within this approach, the conventional reasoning that deposits create loans is reversed, and instead bank lending creates deposits. Even though

Post Keynesians are in broad agreement about causation from loans to deposits, there are still points of disagreement.[19]

According to horizontalists, the short-term cost of funds is pegged by the central bank. Banks then act as markup pricing firms which make loans that carry a fixed markup over the cost of funds. The loan supply schedule is therefore horizontal at the given loan rate, and the level of bank lending is determined by the level of loan demand. Moreover, the central bank must provide reserves on demand if banks experience difficulty in obtaining reserves to back up their increased lending to support the stabilization of the financial system.

In contrast, the structuralist position maintains that the aggregate loan supply schedule is positively sloped, and that the volume and terms of bank lending reflect both loan demand and supply considerations. The slope of this supply schedule is significantly influenced by the policies of the central bank. The slope of the money supply curve depends on the degree of central bank accommodation. As the amount of lending increases, banks have to get more reserves. In order to get more reserves, banks have to pay higher costs regardless of the sources of reserves. As a result, the loan supply schedule is positively sloped.

"In principle there are three sources of funds: borrowing from the discount window, borrowing on the federal funds market, and attracting additional funds from the non bank public. For structuralists, the critical assumption is that the marginal costs for each source of funds are rising. Thus, for window borrowings banks pay the discount rate and a frown cost[20] that is a positive function of the level of borrowed reserves. In the federal funds market, increased demand raises the fund rate, while getting the nonbank public to hold

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[19] Palley, T. I. (1991), p. 397.

[20] See page 19 for a precise definition of frown cost.

additional bank liabilities and perhaps change the composition of their holdings in favor of those with lower reserve requirements calls for higher interest rates. The implications are that the banking system must ultimately pay more to obtain additional funds, and this makes the aggregate loan supply schedule positively sloped." (Palley, 1991, p. 399)

Another explanation of structuralism is based on liquidity preference. Liquidity preference is the propensity to change less liquid assets for more liquid assets. Liquidity preference determines asset pricing. If liquidity preference rises due to a loss of confidence in less liquid assets, then asset prices will be depressed as the public tries to obtain money either by decreasing new purchases of less liquid assets or by selling assets. Liquidity preference is dependent on the action of all agents and is outside the control of the central bank. Therefore, if changes in the demand for funds occasion changes in liquidity preference, this results in a less than fully elastic money supply function.

From these explanation we can capture two mechanisms that structuralists identify to explain the upward-sloping money supply curve. The first mechanism is related to the degree of accommodation of the central bank. The second mechanism pertains to liquidity preference.

"Two main mechanisms have been offered by structuralists to explain the upward-sloping money supply curve. The first mechanism is related to the degree of accommodation of the monetary authorities. Interest rates rise in expansion because the central bank refuses to accommodate the needs of the financial system. Interest rates may rise directly, following changes in the discount rate for instance; or interest rates rise because, following the lack of accommodation, the cost of funds for banks, on their liability side, is increased. The second mechanism can assume that the central bank accommodates, and is associated with the general notion of liquidity. The argument can be subdivided into three: interest rate rise because banks become illiquid; interest rates rise because their customers become less liquid; or interest rates rise because uncertainty rises in the view of the banks and the public." (Lavoie, 1996, p. 277)

These two mechanisms basically pertain to the determination of interest rates. There are various explanations about the determination of interest rates within the structuralist approach. But, all these explanations are related to two main subjects. The main subjects have to do with: (1) the degree of accommodation of central banks and the determinants of the base and prime rate and (2) the liquidity preference and the determinants of the market interest rate. These two main issues will be the object of inquiry of the following section.

Chapter 2. Structuralism and the upward-sloping money supply curve

A. Central bank accommodation and determinants of interest rate

(1) Central bank accommodation

Central banks have a variety of roles as monetary authority. However, as we can see in the following passage, horizontalists highlight the lender of last resort role of the central bank.

" In all countries, governments and their central banks stand protectively behind bank liabilities, both as insurer of bank deposits against the contingency of individual bank failure, and as "lender of last resort" to tide individual banks over crises of liquidity and insolvency. ... Central banks were created to insure an elastic supply of reserves in order to maintain system liquidity and prevent financial panics." (Moore, 1989b, p.12)

Central banks are ultimate provider of liquidity. So, central banks have incentives to follow continually accommodative policies to prevent financial crisis.[21] If the central bank refuses to accommodate the demand for reserves, the reserves will be sought elsewhere, requiring the sale of financial assets. These sales will cause falling asset prices and rising interest rates. Such a situation may ultimately lead to a financial crisis. Hence central banks have always been prepared to provide commercial banks with reserves that they need to maintain convertibility.

However, structuralists do not agree with this argument that central banks always fully accommodate bank demand for reserves. They admit full accommodation as a special case. According to Wray (1992), central banks abandon quantity constraints only

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[21]Lavoie, M. (1984), p. 780.

if necessary to maintain parity between privately issued bank money and high-powered money. However, central banks can use a combination of quantity and price constraints to implement monetary policy except in this special case. Similarly, Palley states that under normal conditions central banks do not fully accommodate, but during times of financial crisis they can accommodate since the consequence of being non-accommodating would be too great.[22]

"Over the last half century, central banks have demonstrated their willingness always to place financial stability before any other goals. This does not mean that central banks always fully accommodate bank demand for high-powered money, but that they will abandon quantity and price constraints if necessary to maintain parity between privately issued bank money and high-powered money." (Wray, 1992, p. 307)

The structural endogeneity approach does not recognize any imperative on the part of the central bank in pursuing full quantitative accommodation in normal times. Structuralists believe that central banks can impose significant quantity constraints on the total reserves available to financial markets if they try to restrict the growth of reserves. The presence of frown costs also implies that central banks may not always be accommodative. Frown costs are the implicit costs associated with borrowing from the central bank. The frown costs associated with borrowing at the discount window is the possibility of future refusal to provide borrowed reserves. Existence of these frown costs implies that constraints on monetary creation exist in the system.[23] Thus, as Pollin (1991) explains, restrictions on discount window borrowing are real and effective.

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[22] Palley, T. I. (1991), p. 400.

[23] Before implementing new monetary policy framework with zero reserve requirements, chartered banks were limited in their borrowing from the Bank of Canada by "Rules Governing Advances".

"Even though discount rates are typically below money market rates, banks and other intermediaries are generally reluctant to seek discount window funds except in emergencies." (Pollin, 1991, p. 374)

On the other hand, the central bank could restrict borrowed reserves to prevent a high rates of inflation or to avoid a devaluation of the domestic currency.[24] As a result of these kinds of restrictive policy concerns, the quantity of reserves supplied by the central bank can significantly be restrained. So, it is unrealistic to assume that the central bank would constantly follow accommodative policies, considering that one of the goals of the central bank is to control the inflation rate.

In a more realistic framework, the money supply curve should be drawn as an upward-sloping curve. However, horizontalists have questioned this upward-sloping curve by positing the existence of a set of horizontal supply curves. In the case where the central bank is following a policy of leaning against the wind, there will be a set of horizontal lines which will constitute a positively sloped interest-money supply relation. When both the demand curve and the horizontal supply curve shift up, an upward sloping curve can be generated. Thus, according to Lavoie (1996), the upward-sloping curve is a special case, based on a particular feedback rule, of the more general horizontal depiction.[25]

"Banks were told that advances were neither intended to be a substitute for adjustments in the money market nor an ongoing source of reserves. Rather, they were intended to be used as a last resort for the adjustment of cash reserves when a temporary and unexpected situation arose." (Howard, 1992, p. 8)

[24] Pollin, R. (1991), p. 374

[25] According to Lavoie (1996), the simplest representation of this feedback rule is $i = i_0 + \eta (M - M^*)$ where the rate of interest i set by the central bank depends on the difference between a demand determined stock of money M and a targeted money supply M^*. In such a model, a shift in the demand for money will generate an increase in the interest rate set by the central bank. According to horizontalism, the central bank does not have to remain accommodative at a fixed interest rate. It can instead increase the

If we consider the central bank reaction function, the horizontalist position can be described by a set of horizontal lines where the central bank is accommodative at each level of the base interest rate. This is the more realistic model depicting the horizontalist position. The main point that the horizontalists highlight is that the base interest rate is not a market phenomenon. The central bank can fix the base rate with absolute precision.

"The upward slope of the dynamic supply curve rests on the non-accommodating behaviour of the central bank. Had the central bank pegged the federal funds rate, the dynamic supply curve of credit-money would be perfectly flat. If the central bank had decided to decrease the federal funds rate, the dynamic credit-money supply curve would be downward sloping." (Lavoie, 1996, p.281).

According to this explanation of the central bank reaction function, regardless of whether the central bank is accommodative or not, the horizontalist position may hold. But, there are those who believe that a long run upward-sloping curve could exist when central banks are non-accommodating.

(2) Liability management and structural endogeneity

A lack of accommodation by the monetary authorities would be countered by changes in the composition of portfolios and by financial innovations, in order to save on reserve requirements or cash requirements. Under the structural view, a lack of accommodation by the central bank creates some inconvenience to commercial banks or

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interest rate and be accommodative at the new interest rate. Thus the central bank does not maintain the interest rate at a particular level regardless of changes in the demand for credit. The central bank can instead change the exogenous rate of interest.

their customers, and, as a consequence, lending rates will rise, even when there is no change in the base rate.

If the demand for base money does not entirely create its own supply, banks can engage in a type of activity called "liability management", over which the central bank has almost no control.[26] In earlier times, when virtually the sole source of incremental funds for bank lending was the creation of bank deposits, bank loan expansion created a roughly similar amount of additional demand deposits, which required a specific amount of bank reserves. A given growth rate of reserves would normally be accompanied by a roughly equal growth rate of both credit and money. Now, however, the great bulk of incremental funds for bank lending comes from the bank's borrowing non-deposit obligations. Banks today can secure funds to cover the reserves they need as a result of their aggressive lending by borrowing various types of non-deposit funds, such as large negotiable certificates of deposit, federal funds, or bank commercial paper. Historically, all of these liabilities have very low or no reserve requirements. These could create free reserves which the banks can use to cover new liabilities created by expanded lending.

If central banks are non-accommodating over a long period, lending banks would find it necessary to induce more holders of demand deposits to transform them into competing forms. These term deposits are less liquid and therefore less attractive in the eyes of the public. Higher interest rates on term deposits or improved facilities for these deposits might thus be offered to depositors to induce them to modify the structure of their deposit balances. The liabilities of the banks become more heavily weighted towards

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[26] Earley, J. and Evans, G. (1982), pp. 54-56.

less liquid deposits which carry higher rates of interest than demand deposits. The rising cost of funds on the liability side leads to increases in the lending rate of interest. This argument that markups on base rate eventually rise has been explained in particular by Seccareccia in his empirical research.

"This emphasis on the structure of ΔM has some important implications for the well-known post-Keynesian hypothesis, defended by N. Kaldor and B.J. Moore, among others, on the infinite elasticity of the supply of money to a given interest rate. At the purely logical level, it is perfectly correct to assume that commercial banks can always borrow at the discount window of the central bank at the pre-specified rate of interest. Except under more extreme circumstances, as was the case in Canada during 1985, however, commercial banks would not normally behave in this manner to provide business firms with credit to finance their productive activities. Faced with an increased demand for credit, the banking institutions would instead first attempt to restructure their liability side which, under specific conditions, could result in an increased overall cost of financing." (Seccareccia, 1988, p.58)

For structuralists, a crucial point is that the growth of liability management must exert upward pressure on interest rates within a given institutional structure. This upward pressure on interest rates, due to the higher interest costs of liability management, will impose changes on the liability side of banks' balance sheets. If banks seek to maintain their interest rate spread, these higher costs will have to be passed on to their borrowers. The upward interest pressure can lead to financial innovation, producing a new institutional environment whereby rates on managed liabilities need not continue to rise, even if the central bank continues to constrain reserve growth. Following such a successful financial innovation, the upward pressure on intermediaries' lending rates will also diminish. In this view, contrary to the accommodative endogeneity perspective, interest rate determination is not a one way process initiated and controlled exclusively

by the central bank. Rather, it is an interactive process in which the central bank certainly retains significant influence, but where market forces also play a major role.[27]

Overall, then, the financial market described by proponents of structural endogeneity is one in which the central bank need not and does not necessarily accommodate fully, and intermediaries consequently practice liability management. As a result of non-accommodating behavior of central bank, upward interest rate pressure is imposed on the liability side, and an incentive for financial innovation to counter the upward interest rate pressure may emerge.

B. Liquidity preference and determinants of the market interest rate

(1) Liquidity preference

In the previous section we discussed the different views about the degree of accommodation of the central bank and determinants of the interest rate. We now look at liquidity preference and the determinants of short and long term interest rates.

The liquidity preference concept can be interpreted as a preference for a liquid asset over any illiquid assets, be they bonds, shares, commercial or industrial loans, or capital goods.[28] Liquidity preference in practice determines the difference between the interest rate on liquid deposits and on less liquid substitutes. The monetary authorities set

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[27] Pollin, R. (1991), p.376.

[28] Dow, A.C. and Dow, S.C. (1989), pp. 148-149.

the rate at the short-term end of the spectrum and liquidity preference determines the spread vis-a-vis the long-term rates. Similarly, Wray defines liquidity preference as a desire to exchange illiquid balance sheet items for more liquid items.[29]

This liquidity preference, according to Wray (1990), determines interest rates. Wray distinguishes money demand and liquidity preference. Money demand is defined as a willingness to issue debt to finance spending and it can always be met via quantity adjustment. Therefore, interest rates are not directly affected by the demand for money. However, liquidity preference relates to a stock demand. So, price adjustments are required to bring liquidity preference into equality with the supply of liquidity.[30] Therefore a rise in liquidity preference should be matched with an increase in interest rates even with central bank accommodation.

The determination of both long and short-term interest rates can be explained by liquidity preference. The explanation of long-term interest rates is as follows. Liquidity preference can be measured as the interest rate differential required to induce savers to exchange bank deposits for long-term bonds. Investment projects are initially financed by long-term loans. Banks then sell long-term bonds to fund long-term loans. To encourage savers to forgo liquidity by purchasing these long-term bonds, an interest rate differential between long and short rates is necessary, giving rise to the usual positively sloped yield curve. Short-term interest rates, on the other hand, respond to changing liquidity preference of banks. Short term interest rates tend to rise as banks try to expand their

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[29] Wray, L. R. (1990), pp. 163-164.

[30] Wray, L. R. (1990), p. 74.

balance sheets. As the debt to equity ratios of borrowers increases, the riskiness of loans increases and commercial banks have to be rewarded with higher interest rates to encourage them to forgo liquidity and enter into illiquid industrial loans. Growing loans to deposits of a bank may affect the commercial bank's perceptions of risk. As a bank provides short term loans and issues liabilities, it leverages equity and cash assets. Innovations may allow banks to expand portfolios without raising interest rates. Eventually, however, only a rise in the liquidity premium would induce banks to expand loans further. That is, the money supply curve is upward-sloping relative to interest rates even though there is no strict quantity constraint on bank lending.

If liquidity preference of banks is taken into account, as the explanation of Wray (1990) and Dow and Dow (1989) implies, the supply of credit is not always fully accommodating and is influenced by liquidity preference. A given base rate set by the monetary authorities is consistent with varying rates on bank loans.[31] Thus, liquidity preference determines the spread between the short-term interest rate and the long-term interest rate. This implies that the long-term interest rate is market-determined instead of being at the discretion of the central bank. The view being held by the proponents of liquidity preference theory is that even when base money or reserves are forthcoming without any restrictions at a constant base interest rate, it is very likely that increased activity will induce credit restrictions and rising lending rates.

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[31] Dow, A.C. and Dow, S.C. (1989), p.158.

(2) The liquidity ratio of borrowers and the principle of increasing risk

According to the Kaleckian principle of increasing risk, the money supply curve becomes upward -sloping as banks continue to satisfy increasing levels of credit demand because banks are placing themselves in risky, more illiquid position. The higher the debt to equity ratio, the more risky the borrower, and hence the less likely the borrower will remain credit worthy. As lending increases, lender's risk rises due to the increased possibility of default. The cost of funds is directly related to the degree of anticipated risk. The rising supply curve incorporates lender's risk as firm's debt to equity ratios increase upon refinancing. The greater the overall level of firms' indebtedness, the greater the risk for banks, and therefore, firms may be forced to borrow at a higher interest rate.

The belief that the leverage ratio of industrial firms rises when economic activity increases is at the base of Minsky's financial fragility hypothesis. This hypothesis involves the process of firm financing throughout the business cycle assuming that there is a tendency for any stable system to move towards instability. During a boom, new investment projects are evaluated using less conservative estimates of prospective cash flows, so that with these rising expectations there is rising investment.[32] More external finance is needed to fund the increased level of investment, and these external funds are forthcoming because the banking sector shares the increased optimism of investors. Firms take on increasingly riskier leverage positions as increased financing is required. As the boom develops, the acceptable leverage level may rise and hence firms become more

[32] It is related to Keynes' notion of animal spirits.

speculative, causing their profit expectations and, consequently, their amount of borrowing to increase. Thus, as the boom progresses, aggregate firm debt to equity ratios increase. [33]

The liquidity of firms is reduced by the rise in debt to equity ratios, making firms more susceptible to increased interest rates. The general decrease in liquidity and the rise in interest paid on highly liquid instruments triggers a market-based increase in the interest rate, even without any attempt by monetary authorities to control the boom. Financial fragility increases as all agents find it increasingly difficult to pay back their debts in an environment where there is a rising cost of finance. According to Minsky's hypothesis, increased activity in a boom must raise leverage ratios and hence raise interest rates, even when the central bank is fully accommodating. Consequently, although the money supply curve is horizontal in the short-run, as the boom develops the curve becomes upward-sloping due to demand pressure.

But Lavoie argues that the case of the representative firm developed by Minsky does not necessarily carry over to the macroeconomic setting. The assumption that the debt to equity ratio rises with increased borrowing is reasonable when dealing with a single firm taken in isolation but this may not be so at the macroeconomic level as is suggested by the following paragraph:

"When investment increases, profits increase as well, unless other elements induce reduced profits, such as higher rate of savings by households or a deficient trade balance. Assuming away these external factors, the realized leverage ratio is just as likely to fall, although entrepreneurs and their bankers are willing to increase debt ratio. Individual efforts to increase leverage ratios may lead to lower aggregate debt to equity ratio, while

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[33] Minsky, H. P. (1975), Chapter 5 and 6.

any effort to reduce leverage ratios may lead to higher actual leverage ratios." (Lavoie, 1996, p. 286)

Based on these theoretical and historical evidences[34], Lavoie concludes that "neither Kalecki's principle of increasing risk nor Minsky's financial fragility hypothesis can sustain the hypothetical construction of an upward-sloping credit-money supply curve." (Lavoie, 1996, p. 287)

(3) Determination of the interest rate and interest rate differentials

According to horizontalists, the interest rates charged on loans are a markup over the cost of funds. Thus, an increase in demand relative to supply does not automatically transform itself into an increase in the loan rate. The markup, or spread, can be approximated by the difference between the prime rate and the base rate. The central bank can determine the cost of borrowed funds, and therefore sets the base rate. Indeed, the central bank ultimately determines the retail loan rate because banks fix a markup on the cost of funds, this cost being determined exogenously by the monetary authority. Even though we introduce liquidity preference theory, if liquidity preference does not determine the level of interest rates but determines interest rate differentials, horizontalism can still apply.

"The central bank determines the base rate, and all other rates are adjusted to that rate, through liquidity preference or other considerations. Liquidity preference does not

[34] "With respect to history, Isenberg (1988) has shown that the debt ratios of manufacturing firms in the 1920's diminished rather than increased during the boom preceding the Great Depression." (Lavoie, 1996, p. 286)

determine the rate of interest, as we were led to believe by the narrow interpretation of liquidity preference offered by the standard IS-LM model. Rather liquidity preference determines the *differential* between the base rate and all the other rates. Looking more specifically at the liquidity preference of banks, it could be argued that it is measured by the differential between the base rate and the prime lending rate." (Lavoie, 1996, p.293-4)

If this differential between the base rate and the prime lending rate is not very sensitive to changes in demand over the business cycle, even though liquidity premium factors such as liquidity and risk can affect the markup, interest rates still can be controlled by the central bank. Therefore the question of constant markups is not the main issue separating the two different approaches. The key issue has to do with the cyclical variation of the markup in incorporating a premium for liquidity preference and risk.[35] If the markup is sensitive to business cycle activity, this would substantiate the structuralist position.

In the previous two chapters, we reviewed the subject of endogenous money and the slope of the money supply curve. The main disagreement about the nature of the money supply curve is that the money supply should be viewed as under the exogenous control of central banks or be viewed as endogenously determined. Among the endogenous money approaches, another disagreement is whether central bank can exogenously determine the interest rate or not. The main idea of structuralism is that the money supply is determined endogenously. But because of the non-accommodation of the central bank and other market phenomenon like liability management, liquidity preference and increasing risk, the central bank cannot exogenously control interest rates.

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[35] There is some empirical work on this issue. See for more details the paper by Deriet, M. and Seccareccia, M. (1996), pp. 137-161.

Therefore, the money supply curve is upward-sloping. To verify whether structuralism is a more reasonable approach in explaining the real economy, I analyze in the following chapter the actual monetary policy in Canada and suggest that the evolution of the Canadian monetary system is more consistent with the endogenous money approach. This will be followed by econometric tests to verify which approach among the various endogenous money approaches provides a better explanation when considering different policy regimes.

Chapter 3. Empirical evidence of the structuralist position

A. Actual monetary policy instruments in Canada and the endogenous money supply

The conventional implementation of monetary policy which alters the reserve position of the banks through an injection or withdrawal of high-powered money is quite simply not relevant in Canada. If we analyze the history of the past twenty years with monetary policy, the endogenous money explanation is more consistent with the historical observations.

Let us begin during a period in which the framework of monetary policy seemingly appeared to be similar to the conventional monetary transmission mechanism. In the 1970s monetarism was popular in Canada. There were legal reserve requirements, the money multiplier was approximately 2.84 (m = M1B/ B, average 1970-1974), the prime rate was 10.75% (1974) and the base money proportion to GDP was 5.49% (Base/ GDP, 1974) before the adoption of the monetarist policy of monetary gradualism.[36]

As Canada's economy entered 1975, economic policy makers had to contend with both slow growth and intensifying inflation. In 1975, the Bank of Canada adopted a new strategy called gradualism. Gradualism was a policy of gradually reducing the rate of growth of narrowly defined money (M1) from the high ranges that had prevailed in the early 1970s to a range that would be consistent with long term stability.[37] This approach

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[36] Data source: Cansim. See Table 1.

had the theoretical background of monetarism. That is, monetary policy affects the economy mainly by altering the supply of money. The Bank of Canada affects the money supply by operations that change the size of the monetary base.[38] The most important operations were the purchase of government securities, management of the federal government's cash deposits.

Canada's experience with gradualism, as well as that of other countries under various targeting regimes, point out that there are considerable problems with monetary control. In 1982, these problems led the Bank of Canada to abandon the monetary targets that it had been using under gradualism. With respect to this failure of gradualism, some economists suggested that the broad aggregates (M2 or broader) would be more appropriate.[39] Contrary to this approach, we can consider an alternative approach that posits that central banks cannot control the quantity of money, and the only thing that they can do is to set the borrowing cost of base money.

In order for the monetary authorities to control exogenously the money supply, they have to observe the course of monetary aggregates. But the definition of money becomes an intractable problem as the Canadian monetary authorities began to face a situation well known to the advocates of the Banking school in the nineteenth century, in

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[37]Boreham, G. F. and Bodkin R. G. (1993), pp. 609-611.

" Monetary expansion, as measured by the rate of currency and chartered bank demand deposits (M1), accelerated in the second and third quarters of 1975. In the third quarter M1 grew at a seasonally adjusted annual rate of 25 percent. The policy target range was 8-12 percent a year in 1976, 7-11 percent in 1977, 6-10 percent in 1978, 5-9 percent in 1979, 4-8 percent in 1981-the fifth such reduction since the Bank of Canada adopted a monetarist and gradualist strategy in late 1975."

[38] Howitt, P. (1986), p. 34.

[39] Howitt, P. (1986), pp. 38-44.

which the "... restrictive control of one narrow group of monetary aggregate (i.e., M1) leads to an endogenous expansion of other forms of less liquid and highly interest-bearing financial instruments."[40] As can be seen from Figure 1 which depicts various monetary aggregates for the period 1971 to 1985, it is clear that in the late 1970s, there was an explosion of the more broad aggregates such as M2 and M3. Also as can be found in Figure 2, while various ratios of monetary aggregates to the monetary base were relatively stable during the pre-1975 period, there was a major widening during the experience under monetary gradualism (1975-1982).

"In fact, while the m1 ratio continued its gentle downward trend, all other ratios grew tremendously under the monetarist experience, conforming a movement towards the less liquid and highly interest-bearing financial instruments. This evidence, therefore, shows how elastic the fragile link between the monetary base and the volume of other liquid assets became as the borrowing firms increased their financial acquisition and the lending public transformed its portfolio holdings into less liquid financial assets that gave a greater degree of freedom to the banking system. This greater elasticity of the monetary system must thus be seen as a largely endogenous response to the monetarist restriction on the growth of a limited group of monetary aggregates." (Seccareccia, 1988, pp. 62-65)

Moreover, successive financial innovations have led to an increasingly nebulous definition of money, furthering the banking system's independence from the Bank of Canada through the practice of liability management.[41] The developments of wholesale market with such instruments as Certificates of Deposits (CDs) precludes the exogeneity of the money supply. Here, a financial institution can finance its lending, not from available excess reserves or an inflow of retail deposits, but rather by securing wholesale

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[40] Seccareccia, M. (1988), p. 62.

[41] Freedman, C. (1983), pp. 101-106.

Figure 1

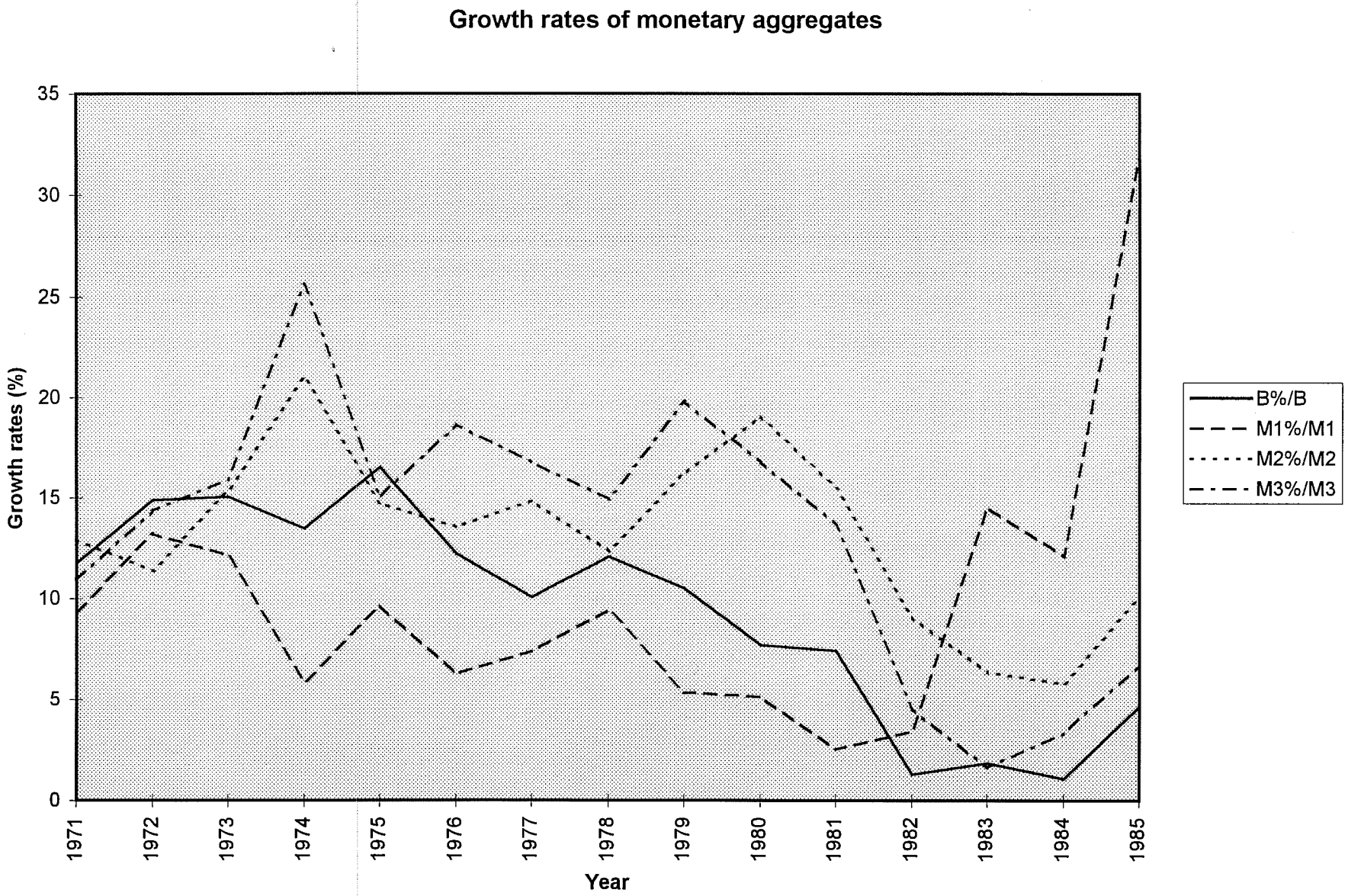
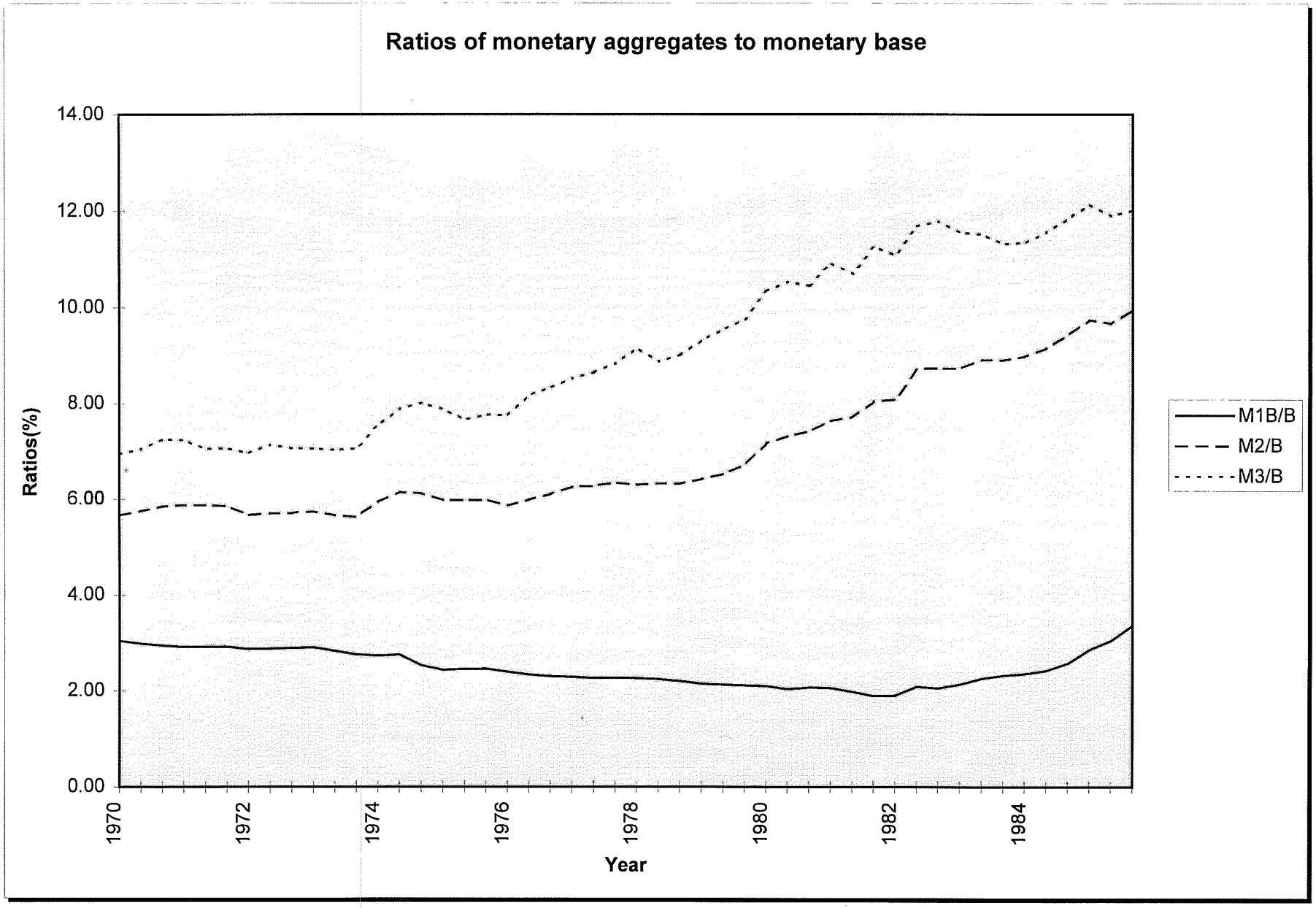

Growth rates of monetary aggregates
Growth rates (%)
35
30
25
20
15
10
5
0
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
Year
B%/B
M1%/M1
M2%/M2
M3%/M3

Figure 2


Ratios of monetary aggregates to monetary base
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Ratios(%)
1970
1972
1974
1976
1978
1980
1982
1984
Year
M1B/B
M2/B
M3/B

funds from the market by issuing CDs. This clearly impairs the monetary authorities' ability to control the money supply and the expansion of bank's balance sheets through the control of the monetary base.

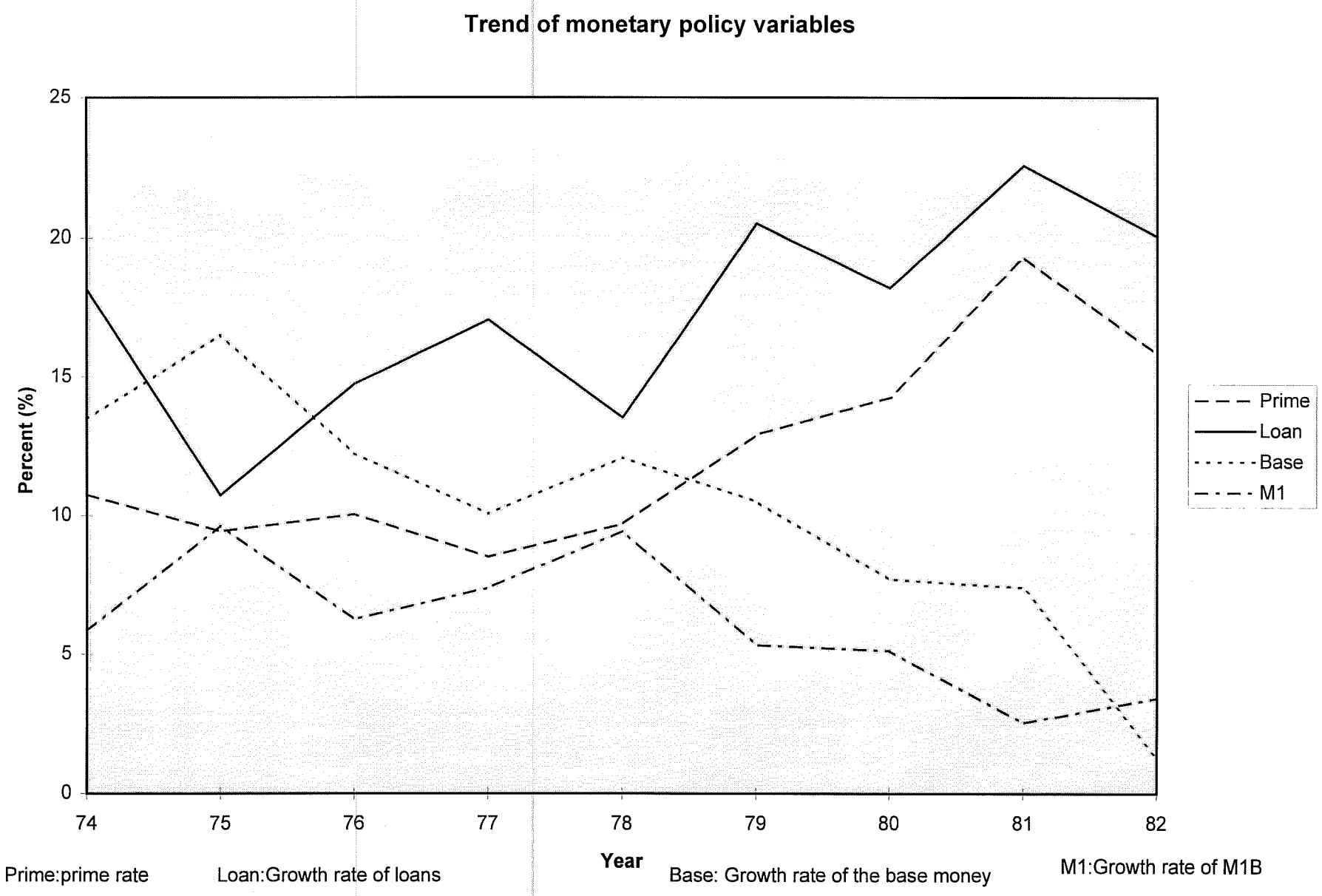
Table 1

Year	*74*	*75*	*76*	*77*	*78*	*79*	*80*	*81*	*82*
M1/B	2.61	2.46	2.33	2.27	2.22	2.11	2.06	1.97	2.01
M3/B	7.81	7.76	8.08	8.67	9.2	9.54	10.44	10.96	11.52
B/GDP(%)	5.49	5.67	5.52	5.51	5.57	5.39	5.17	4.83	4.65
M1/GDP(%)	14.33	13.93	12.85	12.52	12.35	11.38	10.66	9.51	9.36
Prime(%)	10.75	9.42	10.04	8.5	9.69	12.9	14.25	19.29	15.81
Loan ↑(%)	18.15	10.72	14.74	17.05	13.52	20.50	18.18	22.57	20.04
B ↑(%)	13.48	16.51	12.22	10.05	12.08	10.49	7.69	7.39	1.29
M1↑(%)	5.84	9.63	6.25	7.38	9.43	5.33	5.11	2.53	3.42

Data source: Cansim (each year average)
B; Base money , M1; M1B, M3; M3B, Loan ↑; growth rate of loans, B ↑; growth rate of base money, M1↑; growth rate of M1B, Prime; prime rate.

Other results of controlling a monetary aggregate, as can be seen in the above Table 1 and Figure 3, were that the prime rate was increased quite high (19% in 1981) but the growth rates of loans remained very high. This evidence implies that the central bank cannot control the quantity of credit money merely by trying to control narrowly defined monetary aggregates, such as M1. This evidence is more consistent with the arguments of Post Keynesian theorists of endogenous money who argue that central banks cannot

Figure 3


Trend of monetary policy variables
25
20
15
10
5
0
Percent (%)
74
75
76
77
78
79
80
81
82
Year
Prime
Loan
Base
M1
Prime:prime rate
Loan:Growth rate of loans
Base: Growth rate of the base money
M1:Growth rate of M1B

control the quantity of credit money because the money supply is determined by demand. In the environment of a non-accommodating central bank policy, however, financial innovation such as liability management can permit more loans but eventually it will lead to an increase in interest rates.

Additionally, the recent elimination of the minimum reserve requirements for members of the Canadian Payments Association renders the conventional implementation of the money supply control impossible. The new framework of monetary policy in a system with zero reserve requirements was introduced in November 1991.[42] Under the zero reserve requirement system, the minimum cash reserve requirement that applied to the chartered banks has been replaced by a settlement balance requirement that applies to all direct clearers. The new settlement balance requirements differ from the former reserve requirements in the treatment of currency held by banks. Currency is not used in any way for the interbank settlements. Thus, to meet zero requirement, the settlement balances do not include currency holdings, whereas the reserve requirements did count the currency held by chartered banks.

This system applies a double cost on banks' negative balances.[43] The settlement period in the new arrangements embodies two separate dimensions: a daily requirement and a requirement to be met over a reserve averaging period. The daily requirement means that each direct clearer must maintain at least zero actual settlement balance on each business day. If a clearer's day of clearing results in a negative settlement balance, it

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[42] Bank of Canada, (1991a), p. 25.

[43] Bank of Canada, (1991b). pp. 23-28.

must take an overnight overdraft loan from the Bank of Canada sufficient to restore the balance to zero. There is no limit to the frequency of such overdraft loans, but the borrowing institution must pay interest on the loan at the daily equivalent of the bank rate. The reserve averaging period requirement means that each institution must maintain a zero net settlement balance, on average, over a month long average period. For the purpose of meeting the settlement balance over the averaging period, borrowings of one day counts as one with a negative settlement balance. If the negative net balance on that day is not offset by a positive net balance on another day, then the institution will be required to take another advance from the Bank of Canada at the bank rate at the end of the averaging period.

The combined effect of the two levels of the zero balance requirements have important consequences. Implementation of this double cost rule is designed to enhance the effectiveness of the monetary policy. The Bank of Canada wishes to ensure that the institutions aim to hold either zero or positive rather than negative balances to maintain control over its advances.[44] Permitting negative balances would be the same as providing

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[44] The theoretical background is based on the basic liquidity management model of Baltensperger (1980). Even under the absence of statutory reserve requirements, each bank holds reserves to meet its potential interbank clearing obligations. These obligations arise when the quantity of bank j's notes and checks deposited into rival banks, which return them for settlement, exceeds the quantity of rival bank's liabilities collected by bank j between clearing sessions. Bank j optimizes by equating the marginal cost of holding settlement balances (foregone interest) to the marginal benefit (the value of the reduced probability of default on clearing obligations) at a positive level of settlement balances. Formally, following Baltensperger's model, optimization implies a choice of Sj such that $r = p \int_{sj}^{\infty} f(x)\,dx$, where Sj is the quantity of settlement balances held by bank j at the onset of the planning period, r and p represent the per dollar opportunity cost of reserve holding and the per dollar adjustment of a settlement balance deficit respectively, x represents the net settlement balance loss of bank j over the course of the period, and f(x) is the density function of x . Where x is symmetrically distributed with mean of zero, the above equation implies that Sj will be positive if and only if $p>2r$. In the case of Canada, the bank rate was one-quarter of one percent above the latest 91-day Treasury Bill rate which is determined on the auction market (here, r) and double cost rule is also applied ($p>2r$). But this framework will be changed in the Large Value

advances to direct clearers on demand. By limiting settlement balances to zero or above, the Bank of Canada retains the initiative to determine whether a bank or other financial institutions would respond quickly to the Bank's initiatives to change available liquidity. The double cost for failing to meet zero settlement balance requirement assures a quick response. To the extent that financial institutions are required to hold more balances than they would voluntarily, the cost of the marginal dollar of balances exceeds its benefits to the institution. As a consequence, financial institutions will continuously strive to minimize their balances. Given this imbalance between costs and benefits of balance holdings, they can be expected to respond quickly and predictably to any changes in the availability of liquidity.

The concept of base money is still important because it provides the ultimate form of liquidity in the financial system. Traditionally, commercial banks held a certain amount of base money because of legally imposed reserve requirements. However, since the elimination of reserve requirements in Canada, a demand for base money by banks and certain other important financial institutions exist because they settle the net outcome of the daily clearings of payments directly on the books of the Bank of Canada. The Bank of Canada can adjust the supply of settlement balances available to the direct clearers by transfers of government deposits between the direct clearers and the Bank of Canada.[45] The Bank of Canada is able to provoke a reaction from the direct clearers by confronting them with an excess or shortfall of settlement balances. They act promptly to eliminate

Transfer System. Under the new framework, cost-minimizing banks can have the incentive to target zero balances.

[45] For a detailed explanation of government deposit transfer mechanism, see Clinton, K. (1991), pp. 16-20.

the imbalance because of cost consideration. Excess balances are costly because no interest is paid on them to financial institutions, and shortfalls have to be covered by overdraft loans from the Bank of Canada at a penalty rate of interest. In essence, the Bank of Canada uses control over settlement balances to influence the interest rate most relevant to transactions by financial institutions aimed at adjusting these balances. It is only if the Bank of Canada acts to create an overall shortfall or surplus for the group as a whole relative to their desired balances at the Bank of Canada that it can alter the overnight interest rate. Faced with a shortfall, the direct clearers' actions tend to put upward pressure on short term interest rates. These actions of the Bank of Canada to alter the short term rate will influence the rest of the term structure of interest rates. Movements in overnight rates influence the whole spectrum of market rates and rates of return on a wide variety of assets and liabilities. Thus, the central bank plays upon the relative price of banking services in order to expand or contract the total level of banking intermediation.[46] So, the transmission mechanism from monetary policy instruments to output stems from the Bank of Canada's influence over interest rates, not money, as the Quantity Theory of Money suggests.

Under the new framework this can be more clear. According to the new framework of Large Value Transfer System, there is a target rate of overnight interest rate. The upper and lower limit is established by the rate applied to the deficits and surplus of the participants with the Bank of Canada. Deficits on the books of the Bank of Canada at the end of the LVTS day would be financed at the Bank Rate. Participants with

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[46] Clinton, K. and Howard, D. (1994), p.15.

surplus balances at the end of the LVTS day would receive interest on these balances at a rate 50 basis point below the Bank Rate. The existence of a 50 basis point spread between the rate charged on overdraft and that paid on surpluses would provide a fairly strong cost incentive for the participants to deal in the market rather than to rely on the central bank, and the cost of overnight rate loans in the market would thus fluctuate between the rate on positive settlement balances and the Bank Rate. The rate spread at the central bank would encourage the participants to hold a zero balance every day.

"Appropriate cost incentives become very important in the absence of minimum reserve regulations. Deficits on settlement accounts must be subject to a charge in excess of the interest rate in the overnight market to encourage banks to seek financing actively in the market rather than to rely passively on automatic financing from the central bank. Likewise, to encourage banks to lend out surpluses on settlement accounts in the market, the yield on a surplus at the central bank must be less than that in the market. Cost-minimizing banks will target zero balances if the charge for borrowing from the central bank on its settlement account is equal to the opportunity cost of holding a surplus on this account." (Clinton, 1997, p. 5)

In implementing monetary policy, the Bank of Canada operates through its influence on the overnight interest rate. Changes in the overnight rate is the first stage in the transmission mechanism whereby the monetary policy actions taken by the Bank affect total spending in the economy and, possibly, inflation. The method used by the Bank of Canada to implement monetary policy is closely linked to the system through which payments clear and settle on a daily basis. The current framework contains a significant degree of uncertainty about settlement balances following the daily check clearing, and this uncertainty is a central point to influence the overnight interest rate. However, under the Large Value Transfer System this uncertainty will be removed

because banks can know with certainty their final LVTS balance at the end of the day. So, banks can have exactly zero reserves (R→ 0).

"The current environment, where paper-based payment items clear and settle on a retroactive (back-dated) basis, is characterized by uncertainty about the level of settlement balances during, and at the close of, the business day. This uncertainty reflects the fact that the net outcome of settlements and of the Bank of Canada's drawdown or redeposit of government balances is not known until the following morning. In contrast, participants in the LVTS would have accurate information about payment flows affecting their settlement balances throughout the day and would know with certainty their final balance at the end of the day." (Bank of Canada, 1995, p. 3.)

According to the conventional view the base money is composed of currency held by the general public (C) and cash reserves of the banking sector (R), and the reserves of banking sector are composed of the legal required reserves and excess reserves. Now in Canada, legal reserve requirements are zero and in the near future excess reserves will be close to zero. In the following table we can see that the reserve ratio is closely approaching zero.

Trend of currency and reserve

(%)

Year	1975	1980	1985	1990	1995	1996
C/M1	26.7	29.9	24.8	23.1	21.2	19.5
R/D	5.91	5.37	7.02	2.28	0.86	0.86

C/M1; currency/ M1B R/D; reserve/ Deposits (total deposits)
Data for C/M ; Cansim , annual average
Data for R/D ; Bank of Canada review (Bank of Canada liability and chartered banks liability)

Now, the only remaining portion of base money is currency (C). However, with the development of electronic payment system, the currency (central bank notes) should be supplied on demand.[47] Even under the conventional base money equation, we can anticipate that the base money eventually becomes demand determined as a result of zero reserve and demand determined currency supply.[48] Rymes explains that Canada is fast approaching a world not so much of endogenous money but one without outside fiat money in the following paragraph:

"We are fast approaching a world not so much of endogenous money but one without outside fiat money and without meaning to concepts such as "the" money supply. Take Canada as an illustration. I ignore the fact that we are an open economy and examine the Bank of Canada's balance sheet, particularly its liabilities. The liabilities of the Bank are essentially the stock of outstanding notes in circulation and the stock of positive settlement balances carried by the direct clearers with the Bank. On the other side of the balance sheet one finds, in addition to Government bonds, the stock of negative settlement balances. A banking equilibrium, defined as a situation in which the Bank is content with the *level and changes* of bank's overdrafts and deposits, exists when the stock of positive and negative settlement balances across all the banks are equal, so that the net claims of the banks on the Bank are zero. When the Bank would like the system to be expanding at a rate greater than it is the Bank will put the banking system into a net positive settlement balance position while in the case where the Bank wishes the system to contract the Bank will put the banking system into a net negative settlement balance position.

When the banking equilibrium exists, the only outside money is then Bank notes. Since these are supplied by the Bank on demand, I shall henceforth assume that the note

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[47] Nowadays currency (non interest-bearing central bank liability) is a convenient medium of exchange because of the simplicity of its use. But technological progress may make more convenient using interest-bearing bank deposits. With the development of technology, inside bank money can dominate the payment system. Under this circumstance, exogenous control of supply currency cannot be meaningful as a monetary policy. Because of the convertibility between inside money and outside money only the price of the currency is important. Its supply will be demand determined.

[48] If we assume that we are moving toward cashless society, it will become evident that it is impossible to define a quantity of money. And the theory of controlling money stock as a monetary policy would be useless. See more details about the possibility of progressing to the cashless society in U. S., Hoenig, T. M. (1995), pp. 5-9.

"Over the next decade, I think that we will continue to see progress toward a cashless/paperless society, both in the United States and elsewhere." (Ibid, p. 9)

issue has been turned over to private banks. For the economy in question, then, there exists no net outside fiat money. Therefore, there is no question of substitution between the use of fiat money and other resources in the provision of transactions services." (Rymes, 1995, pp. 122-3)

According to our analysis of actual monetary policy in Canada, we have seen that the evidence is more consistent with the endogenous money approach. In support of the arguments of Post Keynesian economists, the ability of the central bank in controlling money supply is indeed very limited. It was shown that the central bank cannot reduce the credit money supply as was the case during the restrictive monetary regime of the period 1975-1982. When the central bank tried to control the quantity of narrowly defined money, other near monies exploded. Although the growth rates of base money and M1 were declining as a result of controlling these monetary aggregates, the growth rates of loans moved in the opposite direction. This implies that a central bank cannot control credit money as is described in the conventional monetary base equation.

If we carefully analyze the evolution of the monetary system, it becomes clearer than ever that the money supply is endogenous. Even under the conventional base money multiplier framework, if we consider the development of financial system, such as zero reserve system and electronic money, we can get the same implication of endogeneity of the money stock. The only effective instrument that central banks can use is their control of short-term interest rates. Now the next question to be posed has to do with the extent to which these rates of interest can be treated as exogenous variables. To answer this question, I wish to adopt Pollin's method of causality tests that seeks to evaluate the implications of two different enodgenous money approaches.

B. Causality tests between the administered and market interest rates

(1) Pollin's Econometric tests

Pollin sets up three sets of empirical tests to discriminate between the accommodative and structuralist positions.[49]

1. Proportionality in the relative movement of loans and reserves;
2. Close substitutability between non-borrowed and borrowed reserves;
3. Causality running from the central bank to financial market interest rates.

The proportionality between loans and reserves emerges since by definition a fully accommodative regime is one that responds to lending growth by supplying a sufficient amount of reserves, either through open market operations or discount window borrowing. If nonborrowed and borrowed reserves are perfect substitutes at the administered interest rate and the demand-determined reserve supply is infinitely elastic, it then follows that an increase in loan demand will be matched by an increase in reserves. A perfectly accommodating system should imply the existence of constant proportionality between loans and reserves over time. His reasoning is that an accommodative central bank would respond to credit demand by supplying a desired amount of reserves, either through open market operations, or through the discount window. From the perspective of structural endogeneity, we would not anticipate

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[49] Pollin, R. (1991), pp. 367-403.

proportionality over time between loans and reserves. Rather, we would expect loans to grow relative to reserves. In addition, the relative growth of loans should be increasingly supported through the growth of liability management. Pollin's results were supportive of the structuralist over the accommodative endogeneity approach. Loans have not grown proportionally over time relative to reserves. The reason for the absence of proportionality among these variables is that the practice of liability management has permitted lending growth in excess of reserves. However, according to Moore (1991), even in the presence of accommodation, banks will want to economize on reserves since they are non-earning assets.[50] Such behavior results in an increasing ratio between loans and reserves which is independent of central bank behavior. Thus, for Moore, this test proves nothing against horizontalism. Instead, it proves that all commercial banks practice profit maximization through liability management.

"The very substantial fall in the ratio of R/L in the United States over the postwar period, from 0.273 to 0.039 as shown in Pollin's Table 1, is perfectly consistent with the position that loans make deposits. The stability of L/R is in no sense a test for the two positions. As Holmes said, banks make loans first, and look for the reserves later. In the process, they of course continuously seek to reduce their effective reserve requirements, since reserves are nonearning assets." (Moore, 1991, p. 407)

The second test measures the degree of substitutability between borrowed reserves and non-borrowed reserves [$BOR = \alpha + \beta (NBOR)$]. A significant inverse relationship between changes in borrowed reserves and changes in non-borrowed reserves would imply substitutability. Structuralists do not accept the view that discount window borrowing is a close substitute for non-borrowed reserves (open-market operations) due

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[50] Moore, B. J. (1991), p. 407.

to the restrictions placed by frown costs. These anticipated results flow from the notion that central banks are able to quantity-constrain the reserves they supply since borrowed reserves are not adequate substitutes for a limited supply of non-borrowed reserves. Pollin's result shows that borrowed reserves amount to only a small fraction of the reserve total, the average proportion for the full period being 2.6 percent.[51] These figures suggest that borrowed reserves can be regarded as a significant substitute for non-borrowed reserves at most in a limited sense. The extent of substitutability appears weak and to be diminishing with time as liability management grows in importance.

But, according to Moore (1991), Pollin's reserve tests are misspecified because both borrowed reserves and non-borrowed reserves are capable of meeting total reserve requirements and are, therefore, perfect substitutes. A negative β coefficient only implies perfect substitutability if total reserves remained constant throughout the period tested. If total reserve requirements were, instead, increased (in periods when the Fed wishes to restrain money supply growth), both borrowed reserves and non-borrowed reserves would increase, causing the sign of the coefficient to be positive. Thus the β coefficient is not relevant in testing for the degree of substitutability.[52]

The third test was about interest rate determination. Pollin did Granger-Sims causality tests between the interest rates that the Federal Reserve controls and overall market interest rates. The accommodative position would have expected to find one-way Granger-Sims causality running from discount rate and Federal Funds rate to short-run

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[51] Pollin, R. (1991), p. 383, Table 3.

[52] Moore, B. J. (1991), p. 409.

interest rates. Structuralists do not anticipate one-way Granger-Sims causality running from the central bank-controlled rates to market rates, as was the argument from the accommodative endogeneity perspective. They anticipate a significant degree of two-way causality because liability management practices exert upward pressure on interest rates in a given institutional environment.[53]

The results of Pollin's Granger- Sims tests were that (a) there exists a two way causality between the prime and Fed-controlled rates but the primary direction of causality runs from the Fed to the market rates, (b) the ability to explain long-term market interest rates and Fed-controlled rates through their mutual interaction is weaker than with short- term rates. In addition, the primary causality runs from the market to the Federal Reserve, (c) causality runs from the federal funds rate to the discount rate, (d) causality runs from the long-term to the short-term rate. According to Pollin, result (a) favors the horizontalist argument that the central bank can fix the Fed-controlled rates. However, the other results favor structuralism: the long-term market rate determines the bank rate and the long-term market rate determines the short-term market rate. This is consistent with the argument that the central bank has little power in independently setting the base rate.

Moore (1991), however, argues in favour of an alternative interpretation: that the results of the interest rate tests support the horizontalist position not the structuralist position. Pollin's results imply that long-term market rates cause the bank rate. However, long-term rates are based on the expectations of future short-term rates, which are

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[53] Pollin, R. (1991), p. 377.

exogenously determined by the central bank. Moore's interpretation is based on the expectations hypothesis of the yield curve that current long rates are equal to an average of current and expected short rates, namely:

$$i_{nt} = (i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+n}) / n+1$$

If the term structure of interest rate behaves in accordance with the expectations hypothesis, we can conclude that the Federal Reserve actually controls current long rates (i_{nt}) because it sets current short rates (i_t) and presumably thereby, $\Sigma(i^e_{t+n})$, as Moore's explanation would imply. But such a conclusion rests on too strong an assumption. To get this conclusion, we must assume that long-term rates are strictly set according to the expectation hypothesis. But there are other theories about the term structure of interest rates. One leading alternative view is the liquidity preference theory, which argues that in a world of uncertainty, short-term issues are more desirable to investors because they are more liquid. Another position is the preferred habitat theory, which argues that investors may prefer either long or short instruments. According to these theories,

$$i_{nt} = k_{nt} + (i_t + i^e_{t+1} + i^e_{t+2} + \ldots + i^e_{t+n}) / n+1$$

Where k_{nt} is a positive risk premium associated with long-term instruments. According to the structuralist approach, we would expect that k_{nt} will be variable depending on conditions in financial markets. If k_{nt} is incorporated into the yield curve relationship, it

weakens any link between the setting of i_{nt} and i_t. Even if we assumed the expectations hypothesis to be true, for Moore's argument to work (i.e., $k_{nt} = 0$), we also need to make strong assumptions about the determination of $\Sigma\, i^e_{t+n}$. We must assume that expectations of future short rates are based strictly on guesses of central bank behavior in the future, and not on any other variables, such as the future rate of inflation or variations in exchange rates. So, the more reasonable interpretation of the Pollin's results is that interest rates are determined in an interactive process between the market and the central bank. This third test is reasonable and we can get implications about the determination of interest rate based on the test results. In the next section, I will do this kind of causality tests using Canadian data to obtain answers to exactly this question.

(2) Causality tests between the administered interest rate and market rates

Is the upward-sloping curve a special case, based on a particular feedback rule, of the more general horizontal depiction as found in Lavoie's explanation? Or would it be more appropriate to regard the horizontalist framework as a special case of structuralism? Could it be that both views are correct, but each is applicable to different historical periods?

According to the structuralist perspective, the central bank could restrict reserves to prevent high rates of inflation or to avoid a devaluation of the domestic currency. Central bank efforts to control the growth of reserves exert significant quantity constraints on reserve availability. When the central bank does choose to restrict the

growth of reserves, then additional reserves, though not necessarily a fully adequate supply, are generated within the financial structure itself through innovative liability management practices. So, we can assume that the restrictive monetary regime in Canada (1975-1982) is more appropriate to explain structuralism.[54] But under the zero reserve requirements system the central bank does not restrict the quantity of money, there is only a price constraint.[55] The Bank of Canada no longer restricts the frequency of advances or loans. Instead, price incentives are incorporated in the framework.

"Prior to November 1991, chartered banks had a half-monthly averaging period over which to meet their required deposit level at the Bank of Canada and were limited in their borrowings from the central bank by "Rules Governing Advances" (Bank of Canada) rather than by price incentives. Non-banks had no reserve requirements, but were also subject to the administrative rules on borrowings from the central bank." (Clinton and Howard, 1994, p.5)

Now the quantity constrain argument is not effective.[56] So, we can assume the zero reserve requirements regime[57] (1992-1996) is more consistent with the horizontalist

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[54] During this period, the central bank tried to control M1, as a result of its efforts the growth rate of base money was decreased. Also financial innovation was popular especially in this period. This is a state that would better fit the structuralist perspective.

[55] There is no restriction on the frequency of overdraft loans or advances from the central bank but they have to pay for the central bank borrowing at the bank rate.

[56] After introducing new framework, the number of overdraft loans from the central bank was almost doubled. See Howard, D. (1992), p. 15, Table 1.

"The most significant change, evident over both periods, is the increased use of overdraft loans as direct clearers have begun making decisions in response to the new price incentives." (Howard, 1992, p. 15)

[57] Prior to 1992, minimum holdings of primary reserves had been imposed on the chartered banks. Reserve requirements were phased out over a two-year period until June 1994. The introduction of this new framework was accelerated as some banks were beginning to operate in a zero reserve-type environment by virtue of a decline in their required deposit level.

approach. Econometric testing using Canadian data will be performed to determine whether there exists sufficient evidence in favor of an upward sloping money supply curve in both of these two different policy regimes, or perhaps, there exists evidence for one regime but not for the other regime.[58]

In order to examine the slope of the money supply function empirically, we must determine the relative influence of both the monetary authority and the commercial banks on the determination of interest rates. That is, if the central bank exogeneously sets the interest rate structure, this lends support to the horizontalist position. However, if market forces – including bank's liquidity preference – are significant in determining interest rates, the money supply function may be upward sloping, suggesting that demand for credit money is not fully accommodated, consistent with the structuralist position.

Granger tests to determine the direction of interest rate causality are carried out using monthly data from Canadian financial markets. The rates controlled by the central bank, r^f, are the bank rate and the overnight rate. Market interest rates, r^m, are specified in three ways: as the prime bank lending rate, the rate on 30-day CDs, and yield on government bonds (3-5 years). These alternative specifications of r^m were used for two reasons: first, because of the distinct factors influencing short rates (prime and CD rates) relative to long rates (the government bond rate); and second, because of significant differences in the markets for the two short rates chosen – the prime rate being the

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"However, before the two-year phase out of reserves is completed in July 1994, a number of banks are expected to have zero-required deposits as currency holdings grow to a level sufficient to cover reserve requirements." (Howard, 1992, p. 11)

[58] Sub-period 1983-91 is not included because it is merely the transitional period between the two different policy regimes.

benchmark for bank lending rates while the CD rate represents behavior in the market for managed liabilities.

The regression equation for the Granger causality tests is

(1) $$r^m_t = \Sigma\alpha_i\, r^f_{t-n} + \Sigma\beta_i\, r^m_{t-n} + \varepsilon_{1t}$$

(2) $$r^f_t = \Sigma\,\gamma_i\, r^f_{t-n} + \Sigma\delta_i\, r^m_{t-n} + \varepsilon_{2t}$$ [59]

Under this model we can distinguish four cases:

(a) Unidirectional causality from r^f to r^m is indicated if the estimated coefficients on the lagged r^f in (1) are statistically different from zero as a group (i.e., $\Sigma\alpha_i \neq 0$) and the set of estimated coefficients on the r^m in (2) is not statistically different from zero (i.e., $\Sigma\delta_i = 0$).

(b) Conversely, unidirectional causality from r^m to r^f exists if the set of lagged r^f coefficients in (1) is not statistically different from zero (i.e., $\Sigma\alpha_i = 0$) and the set of lagged r^m coefficients in (2) is statistically different from zero (i.e., $\Sigma\delta_i \neq 0$).

(c) Feedback, or bilateral causality, is suggested when the sets of r^m and r^f coefficients are statistically significantly different from zero in both regressions.

(d) Finally, independence is suggested when the sets of r^m and r^f coefficients are not statistically significant in both regressions.

The lags are carried back four months, with this 4 months lags being arbitrarily chosen. To achieve stationary, all variables were prefiltered by taking first differences.[60]

[59] See the Granger causality test model in Gujarati, D. N. (1995), pp. 620-622.

The tests are performed using data for three different periods (the full period 1975-1996, the sub period 1975-1982, and the sub period 1992-1996).[61]

The results of Granger tests are summarized in Table 2, Table 3 and Table 4. Each table is partitioned into five sections. The first three sections report results of causality tests with market interest rates (r^m) specified in three alternative ways, in regressions with administered interest rates (r^f). The fourth section shows causality test results between the two measures of administered interests rates (r^f) and the last section tests the relationship between short- and long-term measures of market interest rates (r^m).

In Table 2, the first set of results, regressions 1-4, test for causality between the prime and the Bank-controlled rates. In the first regression sets, in which the prime rate is the dependent variable and the lags of the bank rate and prime rate are the independent variables, the results indicate significant interdependence. The F-statistic of lags for the bank rate is highly significant in regression 1. And the F-statistic of lags for the prime rate is also significant in regression 2 (at 5% significance level), which reverses the test of causality between the bank and the prime lending rate.

When we substitute the overnight rate for the bank rate in regression 3 and 4, the results change a little. A significant degree of two-way interaction between the market and the overnight rates is indicated by the significant F-statistic for both regressions but the F-statistic indicates that the causality running from the market rate to the overnight rate is more powerful.

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[60] According to the Dickey-Fuller tests the first difference of interest rates is stationary. The results of this test are attached in the appendix.

[61] Data source : Cansim (matrix 2560)

Essentially similar results hold for regressions 5-8, in which the short-term CD rate replaces the prime as proxy for the market interest rate. The main causality runs from the bank rate to short-term CD rate. But there is a significant degree of two-way causality between the market and overnight rate. The conclusions suggested by these tests with short-term rates are therefore as follows: first, the Bank of Canada influences, but does not exogenously control, short-term interest rates through manipulating the bank rate. The bank rate appears to be determined through the interaction of the Bank with financial market forces. That is, although the Bank autonomously sets the bank rate, it does so not simply to influence the market but also to keep apace with it.

The situation changes when we move from short- to long-term rates in regression 9-12. The causality is very weak when we choose the bank rate as an administered rate (in regressions 9-10), but the unidirectional causality runs from the long-term market rate to the overnight rate (in regressions 11-12). This result means that the Bank of Canada cannot control the long-term rates. These findings suggest that market interest rates can affect the administered interest rates.

In regressions 13 and 14, we test for causality between the bank rate and the overnight rate. It appears here that there is a significant two-way causality.

Finally, regressions 15 and 16 test the causal relationship between the short-term CD rate and the long-term bond rate. Here, the predominant causality runs from the long-term to the short-term rate, a finding consistent with the previous results that the Bank of Canada can influence the short-term interest rate but cannot determine the long-term market rates.

According to horizontalism, the central bank cannot control the quantity of money but it can determine the price of credit money (i.e., the administered interest rate). If the central bank determines the administered interest rate, it can affect the short term interest rates, and, in accordance with the expectations hypothesis of the term structure of interests rates, the long-term interest rate. The results of our causality tests are not generally supportive of the horizontalist hypothesis. From the causality tests, we can conclude that short-term rates are controllable by the central bank through the manipulation of bank rates and overnight rates. Long-term rates, however, are not easily influenced by movements in short-term rates. Indeed, long-term rates appear to have a strong influence on the overnight rate and a weak influence on the bank rate.

Overall, therefore, we can conclude from these Granger causality tests that market interest rates are determined through a complex set of interactions between market forces and the central bank policy interventions, as defended by the structuralists who point to the significance of liability management or liquidity preference, etc.[62] Indeed, we could not conclude that the central bank can itself determine market rates through either the bank rate or the overnight rate. When we use the Canadian data from 1975 to 1996 for the causality test between the administered interest rates and market interest rates, the results are more consistent with the argument of the structuralists.

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[62] Especially according to the Canadian case, there is another explanation about the determinant of long-term bond rates. That is the long-term bond rate in Canada can be affected by the rates of the United States because of the high degree of substitutability between Canadian and United States financial instruments.

"The strength of the foreign influence, even in the short run, is evident in that the contemporaneous coefficient and t-statistics for the United States long-term rate is much larger than those for the domestic short-term rate." (Clinton and Howard, 1994, p. 13.).

These causality tests, although not definitive, certainly provide some evidence against the horizontalist position that the monetary authorities exogenously determine the level of both short-term and long-term interest rates.

In order to find out whether these results are consistent with different monetary policy regimes, especially the periods of targeting a monetary aggregate (M1) and the periods of interest rate targeting under a zero reserve requirement system, we did the same causality tests with data for two different periods.

The results are summarized in Table 3. In the first four regressions, the results are very similar to those for the whole period. There was a significant two-way causality between the prime rate and the administered interest rates. In the second four regressions 5'-8', the results are also substantially the same as those for the whole period. The causality runs from the bank rate to the short-term CD rate. But there is two-way causality between the CD rate and the overnight rate.

In regressions 9'and 10', there is no significant causality between the bank rate and the long-term bond rate. But in regressions 11'and 12', there is a unidirectional causality from the long-term bond rate to the overnight rate. These results are similar to those for the whole period.

Finally, in the last four regressions, the results are similar to those for the whole period. There is two-way causality between the bank rate and overnight rate and two-way causality between short-term CD rate and long-term bond rate. This latter result differs from the evidence of unidirectional causality from the long-term bond rate to the short-term rate in the regression for the whole period.

Overall, therefore, the results are more consistent with the argument of the structuralists. During the first sub-period of 1975-1982, the Bank of Canada used anti-inflation policy and the Bank tried to restrain the monetary aggregate M1. According to structuralism, central banks cannot easily follow accommodative policies when they are also concerned with controlling the inflation rate. Lack of accommodation by the central bank can induce liability management. The growth of liability management exerts upward pressure on interest rates. So, we can anticipate a significant degree of two-way causality. According to Freedman (1983), it was exactly during this period that there were significant financial innovations because of the central bank's explicit targets for the narrow monetary aggregate (M1).[63] Therefore, we can conclude that these results are consistent with the structuralists' position that a lack of accommodation by the monetary authorities would be countered by changes in the composition of portfolios and by financial innovations, in order to save on reserve requirements or cash requirements.

In Table 4, the regression results that were obtained from using data for this latter sub-period are summarized. These results are quite different from those for the first two Tables. In the first four regressions, it appears that the unidirectional causality runs from both the administered interest rates to the prime rate. These results suggest that the central bank can control the prime rate via the bank rate. Contrary to the results of the

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[63] Freedman, C. (1983), pp. 101-103.

"Since the beginning of monetary targeting in 1975, there have been four specific episodes of financial innovations that have had significant impact on the demand for M1, two relating to the household sector and two relating to the corporate sector." According to this paper these innovations are the introduction of daily interest savings accounts in 1979, the spread of daily interest chequing accounts since 1981, cash management packages and the new technology permitted by widespread computerization in the mid-1970's.

period of monetary gradualism, the results are more consistent with the horizontalists argument that the central bank can exogenously determine the base rate. But in the next 5"-8" regressions, the results are quite different from the first four regressions. These results suggest that there is no significant relationship between the administered interest rates and the short-term CD rates. These latter results are similar to those in regressions 9"-12", where there is no significant relationship between the administered interest rates and the long-term bond rate. These results are a little different from the first two periods in that there was found to be a causality running from the long-term interest rate to the administered interest rate.

Overall, the results of the regressions for period 3 (1992.1-1996.12) imply that the central bank can determine the prime rate by the administered interest rate. But the central bank cannot easily control other short-term and long-term interest rates. The explanatory power of the administered rates vis-a-vis the market interest rates is quite weak.

Table 2 (1975.1-1996.12)

	Dependent variable	Independent variable	F-value	R^2
Regression between administered interest rates and prime rate	1. Prime	Bank	27.508**	0.0990
	2. Bank	Prime	6.3461*	0.0943
	3. Prime	Overnight	3.1605*	0.0722
	4. Overnight	Prime	72.944**	0.1775
Regression between administered interest rates and short-term rate	5. CD (30day)	Bank	31.101**	0.1046
	6. Bank	CD (30day)	0.0885	0.1125
	7. CD (30day)	Overnight	12.396**	0.0430
	8. Overnight	CD (30day)	75.729**	0.1157
Regression between administered interest rates and long-term rate	9.G-bond (3-5 years)	Bank	2.3705	0.1675
	10. Bank	G-bond (3-5 years)	2.3342	0.1191
	11.G-bond(3-5 years)	Overnight	0.9008	0.1711
	12. Overnight	G-bond (3-5 years)	50.534**	0.1190
Regression between bank and overnight rate	13. Overnight	Bank	95.956**	0.1861
	14. Bank	Overnight	7.4030**	0.1084
Regression between short- and long-term rate	15. G-bond(3-5 years)	CD (30day)	3.3087	0.1685
	16. CD (30day)	G-bond(3-5 years)	16.182**	0.0629

** : significant at 1% significance level

* :significant at 5% significance level

Table 3 (1975.1-1982.12)

	Dependent variable	Independent variable	F-value	R^2
Regression between administered interest rates and prime rate	1. Prime	Bank	16.460**	0.1319
	2. Bank	Prime	8.3798**	0.1426
	3. Prime	Overnight	4.5298*	0.1276
	4. Overnight	Prime	28.640**	0.2402
Regression between administered interest rates and short-term rate	5. CD (30day)	Bank	11.892**	0.1628
	6. Bank	CD (30day)	0.9030	0.1536
	7. CD (30day)	Overnight	14.005**	0.0814
	8. Overnight	CD (30day)	32.814**	0.1746
Regression between administered interest rates and long-term rate	9.G-bond (3-5 years)	Bank	2.6735	0.2450
	10. Bank	G-bond (3-5 years)	0.6625	0.2068
	11.G-bond(3-5 years)	Overnight	0.5432	0.2283
	12. Overnight	G-bond (3-5 years)	26.318**	0.1902
Regression between bank and overnight rate	13. Overnight	Bank	37.854**	0.2482
	14. Bank	Overnight	6.5810**	0.1726
Regression between short- and long-term rate	15. G-bond(3-5 years)	CD (30day)	4.2958**	0.2619
	16. CD (30day)	G-bond(3-5 years)	6.9263**	0.1290

** : significant at 1% significance level

* :significant at 5% significance level

Table 4 (1992.1-1996.12)

	Dependent variable	Independent variable	F-value	R^2
Regression between administered interest rates and prime rate	1. Prime	Bank	4.1697*	0.1867
	2. Bank	Prime	0.5170	0.1833
	3. Prime	Overnight	7.1177*	0.3989
	4. Overnight	Prime	0.4130	0.2617
Regression between administered interest rates and short-term rate	5. CD (30day)	Bank	1.5077	0.2814
	6. Bank	CD (30day)	2.3079	0.4318
	7. CD (30day)	Overnight	1.6194	0.2416
	8. Overnight	CD (30day)	1.6207	0.4658
Regression between administered interest rates and long-term rate	9.G-bond (3-5 years)	Bank	0.5716	0.4682
	10. Bank	G-bond (3-5 years)	2.1209	0.4505
	11.G-bond(3-5 years)	Overnight	0.2650	0.4941
	12. Overnight	G-bond (3-5 years)	0.0999	0.3437
Regression between bank and overnight rate	13. Overnight	Bank	0.7037	0.2944
	14. Bank	Overnight	2.2303	0.2519
Regression between short- and long-term rate	15. G-bond(3-5 years)	CD (30day)	0.5380	0.4858
	16. CD (30day)	G-bond(3-5 years)	0.0036	0.2724

* :significant at 5% significance level

Conclusion

According to the orthodox monetary theory, the central bank can exogenously determine the money supply and this money supply curve is vertical in interest-money space. But as we analyzed in this paper, in the real world of credit money economies, the money supply should be considered primarily endogenous. Even in the regime in which monetarism was popular (1975-1982 in Canada) the central bank could not control the growth rate of credit money, it could only engage in a high interest rate policy. With the development of the zero reserve system and electronic payments system, it becomes even more clear that not only credit money but also the base money are endogenously determined. So, monetary policy can operate not by denying supply but by manipulating the price at which supply is made available by the central bank. The only possible transmission mechanism is from short-term interest rates to long-term interest rates.

Having concluded from our research that the money supply is endogenous, the next question is whether this kind of simplified transmission mechanism can be empirically validated. According to our causality test, it seems that the central bank can affect the prime rate by manipulating the bank rate. But, overall, the existence of a two way causality suggest that bank liquidity preference and liability management can also affect the determination of the short-term rate. So, we can conclude that the central bank can affect short-term interest rates but it cannot autonomously control short-term interest rates. According to the results of the causality test using the most recent data (1992-1996), it appears that the predominant causality runs from the bank rate and the

overnight rate to the prime rate. In contrast with the monetary targeting period of 1975-1982, the central bank can exogenously determine the base rate as supported by horizontalism. However, it seems that its ability to affect any other market rates is quite weak.

Overall, the results of regressions for the whole period (1975-1996) are consistent with the structuralist position that market interest rates are not strictly governed by central bank intervention and that they are, rather, determined by the interaction between the central bank and the financial markets. However, the results between the period of monetary gradualism (1975-1982) and the period of the new monetary policy framework (1992-1996) are quite different. Even though it is not conclusive, we can say that the earlier monetarist period is more consistent with the structuralist position, while latter period of the new monetary policy framework is more relevant to the horizontalist position, on the basis of the results of our causality tests.

The findings of this paper are not conclusive because of the limited number of observations available for the third period. More empirical research will be needed to confirm the nature of the money supply function under the zero reserve and Large Value Transfer System after the new system is introduced and more data is accumulated.

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Appendix

Stationary Test

VARIABLE : FIRST DIFFERENCE OF BANK RATE (BANK)
DICKEY-FULLER TESTS - NO.LAGS = 8 NO.OBS = 254

NULL HYPOTHESIS	TEST STATISTIC	ASY. CRITICAL VALUE 10%
CONSTANT, NO TREND		
A(1)=0 T-TEST	-5.0144	-2.57
A(0)=A(1)=0	12.595	3.78

VARIABLE : FIREST DIFFERENCE OF OVERNIGHT RATE (OVERNIGHT)
DICKEY-FULLER TESTS - NO.LAGS = 16 NO.OBS = 246

NULL HYPOTHESIS	TEST STATISTIC	ASY. CRITICAL VALUE 10%
CONSTANT, NO TREND		
A(1)=0 T-TEST	-3.4217	-2.57
A(0)=A(1)=0	5.8942	3.78

VARIABLE : FIRST DIFFERENCE OF PRIME RATE (PRIME)
DICKEY-FULLER TESTS - NO.LAGS = 8 NO.OBS = 254

NULL HYPOTHESIS	TEST STATISTIC	ASY. CRITICAL VALUE 10%
CONSTANT, NO TREND		
A(1)=0 T-TEST	-4.5897	-2.57
A(0)=A(1)=0	10.542	3.78

VARIABLE : FIRST DIFFERENCE OF CD (CD)
DICKEY-FULLER TESTS - NO.LAGS = 6 NO.OBS = 256

NULL HYPOTHESIS	TEST STATISTIC	ASY. CRITICAL VALUE 10%
CONSTANT, NO TREND		
A(1)=0 T-TEST	-6.0561	-2.57
A(0)=A(1)=0	18.360	3.78

VARIABLE : FIRST DIFFERENCE OF GOVERNMENT BOND (GBOND)
DICKEY-FULLER TESTS - NO.LAGS = 2 NO.OBS = 260

NULL HYPOTHESIS	TEST STATISTIC	ASY. CRITICAL VALUE 10%
CONSTANT, NO TREND		
A(1)=0 T-TEST	-9.4428	-2.57
A(0)=A(1)=0	44.637	3.78