Small-Open-Economy Monetary Policy and Real and Nominal Exchange Rates: The Canadian Case

John E. Floyd
University of Toronto[1]
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Abstract

This paper presents an analysis of the relationship between Canadian monetary policy and real and nominal exchange rate movements vs. the U.S. using broad-based theory and 1974-2010 quarterly data. Contrary to the situation in the United States, real interest rates relevant for investment in Canada are determined in the world market and are not controlled by the central bank. Major continuing effects of real shocks on Canada's real exchange rate render a fixed exchange rate unacceptable. Given trivial observed effects of monetary shocks on the real exchange rate, the conclusion is that the Bank of Canada avoids exchange rate overshooting by following an 'orderly markets' approach that generates results virtually identical to U.S. policy. It is argued that such an approach arises automatically as a consequence of the Bank's continuing maintenance of a specific target for the overnight borrowing rate. Significant direct exchange rate pressures would be required to respond to U.S. based international crises or inappropriate domestic inflation expectations. These pressures can be produced in part by changes in the Bank's target overnight rate but may also require additional carefully engineered changes in the stock of base money that lead to real exchange rate changes which put pressure on aggregate demand. Otherwise, the orderly markets framework associated with a given level of the overnight rate has important advantages.

[1]342 Max Gluskin House, Toronto, M5S1A1, floyd@chass.utoronto.ca (email) , 416-978-4349 (Office), 419-992-5143 (Cell), 416-769-8245 (Home), 416-978-6713 (Fax). All data and other files referred to in this paper can be found at the author's website http://homes.chass.utoronto.ca/floyd/cmpdat.html. The theory and evidence presented here are extensions and refinements of material presented in the author's recent book, John E. Floyd, *Interest Rates, Exchange Rates and World Monetary Policy*, Springer, 2010.

I: Introduction

This study analyzes the relationship between Canadian monetary policy and the movements of Canada's real and nominal exchange rates with respect to the United States and, less directly, with respect to the rest of the world.[2] The focus is upon Canada because it is an excellent venue for small-open-economy analysis, being a major trading partner with the large United States economy to the south. The analysis here encompasses, extends and broadens a range of more narrowly-focused theoretical efforts that dealt with specific details relating the real exchange rate to utility functions in endowment models or relating expected changes in real exchange rates to real interest rate differentials in asset pricing models, and also efforts that dealt with specific individual sources of real exchange rate fluctuations in models with traded and non-traded goods or with productivity shocks and market frictions.[3]

Section II develops a broad-based theory to form the basis for subsequent empirical analysis that can reflect directly on the practical implementation of monetary policy in small open economies like Canada. The model suggests

[2]Many thanks are given to John Murray and Bob Amano of the Bank of Canada for their insightful comments on an earlier draft of this paper.

[3]See, for example, William D. Lastrapes, "Sources of Fluctuations in Real and Nominal Exchange Rates," *Review of Economics and Statistics*, 74, 1992, 530-539, David Bachus and Gregor W. Smith, "Consumption and Real Exchange Rates in Dynamic Economies with Non-traded Goods," *Journal of International Economics*, 35, 1993, 297-316, Robert A. Amano and Simon Van Norden, "Terms of Trade and Real Exchange Rates: The Canadian Evidence," *Journal of International Money and Finance*, 14, 1995, 83-104, Michael B. Devereux, "Real Exchange Rates and Macroeconomics: Evidence and Theory," *Canadian Journal of Economics*, 30, 1997, 773-808, Pierre-Richard Agénor, "Capital Flows, External Shocks and the Real Exchange Rate," *Journal of International Money and Finance*, 17, 1998, 713-740, Bill Frances, Iftekhar Hasan and James R. Lothian, "The Monetary Approach to Exchange Rates and the Canadian Dollar Over the Long Run," *Applied Financial Economics*, 11, 2001, 475-481, Yu Sheng and Xinpeng Xu, "Real Exchange Rate, Productivity and Labor Market Frictions," *Journal of International Money and Finance*, 30, 2011, 587-603, and Ron Alquist and Menzie D. Chinn, " Conventional and Unconventional Approaches to Exchange Rate Modelling and Assessment," *International Journal of Finance and Economics*, 13, 2008,2-13. Tino Berger and Bernd Kempa,"Taylor Rules and Canadian-US Equilibrium Exchange Rate," *Journal of International Money and Finance*, 31, 2012, 1060-1075, Rokon Bhuiyan, "Monetary Transmission Mechanism in a Small Open Economy: A Bayesian Structural VAR Approach, *Canadian Journal of Economics*, 45:3, 2012, 1037-1061, Amir Kia, "Determinants of the Real Exchange Rate in a Small Open Economy: Evidence from Canada," *Journal of International Markets, Institutions and Money*, 23, 20'13, 163-178, For a tiny rigorous precursor of the model developed here, see Peter Neary, "Determinants of the Equilibrium Real Exchange Rate," *American Economic Review*, 78, 1988, 210-215. And for a broader model applied to exchange rate policy in developing countries, see Sebastian Edwards, *Real Exchange Rates, Devaluation and Adjustment*, MIT Press, 1989. Finally, the very first real exchange rate analysis of the sort conducted here can be found in John W. Johnston, "Real and Nominal Exchange Rate Determination in a Small Open Economy: An Empirical Investigation of the Canadian Case," University of Toronto Ph.D Thesis, 1993.

and incorporates a wide range of factors determining Canada's real exchange rates with respect to the United States and the world at large and outlines the short-run and long-run effects of monetary policy on nominal and real exchange rates. It finds some specific implications of real and nominal exchange rate shocks for the choice of a fixed as opposed to flexible exchange rate regime and for the conduct of monetary policy under flexible exchange rates. An important consideration arising within the theory is the possibility and implications of exchange rate overshooting.[4]

Implications of the theory are tested empirically in Section III. The major factor affecting Canada's real exchange rate with respect to the United States is found to be changes in the flow of world real investment into and out of Canada as compared to its southern neighbor. A lesser, but important factor is changes in world energy prices. The effects of Canadian and U.S. real income are those predicted by the Balassa-Samuelson hypothesis, with short-run employment effects operating, as would be expected, in the opposite direction.[5] And effects of world commodity prices and Canadian terms of trade changes turn out to be important as well. A very important empirical result is that unanticipated monetary shocks, despite the possibility of overshooting, have no measurable effects on short-run real and nominal exchange rate changes, a fact that has important implications for interpreting the on-going conduct of monetary policy.

Section IV brings the theory and evidence together to reach an understanding as to how monetary policy in a country like Canada should be conducted. Given the evidence that can be extracted as to what the Bank of Canada is in fact doing, the general conclusion emerges that it is doing things correctly, automatically following a virtually identical policy to that in the United States, by ensuring orderly foreign-exchange markets via. continual maintenance of a target level of the overnight rate at which it lends and borrows reserves to and from the Canadian banking system. Although the United States authorities purport to operate on real interest rates and thereby on domestic investment, that option is basically not available to a small country like Canada embedded in a world capital market. But control of overnight borrowing rates in Canada nevertheless provides a good method of influencing the expected domestic inflation rate, which turns out to be crucially important for policy. And it also enables the Bank to change the profitability of holding, and thereby induce gradual adjustments of, bank reserves with eventual effects on the stock of base money. In the process, particular interest interest rates at which the commer-

[4]For an interesting discussion of this issue, see Mathias Hoffman, Jens Sondergaard and Niklas J. Westelius, "The Timing and Magnitude of Exchange Rate Overshooting," *Deutsche Bundesbank Discussion Paper 28*, 2007.

[5]B. Balassa, "The Purchasing Power Parity Doctrine: A Reappraisal," *Journal of Political Economy*, 72, 1964, 584-96, and Paul A. Samuelson, "Theoretical Notes on Trade Problems," *Review of Economics and Statistics*, 46, 1964, 145-154.

cial banks loan funds to specific borrowers may also be affected while domestic portfolio equilibrium is being re-established through the purchase or sale of assets in international markets with ultimate effects on the value of the Canadian dollar. Straight open-market operations by the Bank of Canada, on the other hand, will lead directly and almost exclusively to portfolio adjustment pressures on the dollar's value.

While nominal exchange rate adjustments, and associated short-run real exchange rate changes thus turn out to be an important monetary policy instrument for a small-open-economy like Canada, potentially observable direct short-term pressure by the Bank of Canada on the exchange rate through base money stock adjustments is desirable only in a situation of major world crisis reflected in the U.S. or under circumstances where the Canadian inflation rate is continually deviating substantially from an appropriate level. The empirical evidence uncovered here makes it possible to arrive at a rough estimate of how far the Bank of Canada would have to change the nominal and real exchange rates, under the critical circumstances above, to move the unemployment rate in a desired direction by one percentage point, with the real exchange rate and employment returning to their long-run equilibrium levels as inflation expectations and wages and prices eventually adjust. An obvious related conclusion is that, for political reasons, the Bank of Canada should not publicly claim credit for any short-run real and nominal exchange rate changes that economic conditions require it to engineer.[6]

I: The Theory of Real Exchange Rate Determination

The real exchange rate can be interpreted as the relative price of domestic output in terms of foreign output and can be expressed as

$$Q = \frac{\Pi P}{\tilde{P}} \tag{1}$$

where Q is the real exchange rate, Π is the nominal exchange rate defined as the foreign currency price of domestic currency, P is the domestic price level and $\tilde{P}$ is the foreign price level. At a given level of the real exchange rate, the nominal exchange rate will be inversely related to the ratio of the domestic over the foreign price level resulting from past domestic relative to foreign inflation. The domestic and foreign price levels can be expressed as geometrically weighted averages of the prices of the traded and non-traded components of the domestic and foreign outputs:

$$P = P_N^{\theta} P_T^{1-\theta} \tag{2}$$

[6]For a fundamental analysis of the role played by the exchange rate in Bank of Canada policy, see Christopher Ragan, "The Exchange Rate and Canadian Inflation Targeting," *Bank of Canada Working Paper 2005-34*, November 2005.

and

$$\tilde{P} = \tilde{P}_N^{\tilde{\theta}} \tilde{P}_T^{1-\tilde{\theta}} \tag{3}$$

where $1 > \theta > 0$ and $1 > \tilde{\theta} > 0$ are the fractions of domestic and foreign output represented by non-traded components. Here it is assumed that all goods have traded and non-traded components.[7] Substituting the above two equations into (1), we obtain

$$\begin{aligned} Q &= \frac{\Pi\, P_N^{\theta} P_T^{1-\theta}}{\tilde{P}_N^{\tilde{\theta}} \tilde{P}_T^{1-\tilde{\theta}}} = \frac{\Pi\, P_N^{\theta} (\tilde{P}_{T_D}/\Pi)^{1-\theta}}{\tilde{P}_N^{\tilde{\theta}} \tilde{P}_T^{1-\tilde{\theta}}} \\ &= \frac{(\Pi/\Pi^{1-\theta})\, P_N^{\theta} \tilde{P}_{T_D}^{1-\theta}}{\tilde{P}_N^{\tilde{\theta}} \tilde{P}_T^{1-\tilde{\theta}}} = \left[\frac{(\Pi P_N)^{\theta}}{\tilde{P}_N^{\tilde{\theta}}}\right] \left[\frac{\tilde{P}_{T_D}^{1-\theta}}{\tilde{P}_T^{1-\tilde{\theta}}}\right] \end{aligned} \tag{4}$$

where $\tilde{P}_{T_D}$ is the foreign currency price of the domestic traded component of output. The real exchange rate of Canada with respect to the United States will thus depend on the ratio of the prices of the non-traded components of Canadian output to the prices of the non-traded components of U.S. output and on the prices of the Canadian traded output components relative to the prices of the U.S. traded output components.

We can expect Canada's real exchange rate with respect to the U.S. to rise when the prices of commodities and energy rise in international markets, relative to the prices of other goods, because production of these traded commodities represents a higher proportion of Canadian output than United States output. More broadly, we would expect that a rise in Canada's terms of trade with respect to the rest of the world relative to the U.S terms of trade with the rest of the world would also lead to an increase in the real exchange rate. And, according to the Balassa-Samuelson hypothesis, we would also expect the real exchange rate to rise in response to an increase in domestic relative to foreign full-employment income.[8] As income rises so do real wages and the relative increase in real wages increases the cost of producing the non-traded components of domestic output relative to the cost of producing foreign non-traded output components. By contrast a temporary increase in output and employment in Canada relative to the U.S. will increase the supply of Canadian relative to U.S. output, lowering its relative price. A further obvious factor causing the real exchange rate to rise will be shifts of demand of domestic residents from

[7] Even the classic non-traded good, haircuts, has traded components because hair stylists will be using clippers, chairs and other things that can be imported from abroad. And a classic traded good like wheat will have cost components representing domestic labour required to arrange storage, transport and sale.

[8] See reference in footnote 5 above.

goods with low non-traded components to those with high non-traded components. While shifts of this sort are extremely difficult to measure, one obvious measurable factor might be the share of government expenditure in domestic output since there are obvious political pressures on government to channel its spending as directly as possible to domestic residents.

Finally, we can expect that a decision of international investors, in response to new technological developments, to increase their real investment in Canada relative to their investment in United States will produce an increased demand for the non-traded components of Canadian as compared to U.S. output as the Canadian-employed capital stock expands relative to that in the U.S., requiring a higher relative price of Canadian output to achieve equilibrium. This rise in the real exchange rate will have to reduce the current account surplus, or increase the current account deficit, sufficiently to offset the increase in net borrowing abroad. This follows from the fact that domestic income, denoted by Y, can be divided into the components

$$Y = C + I + B_T + DSB \tag{5}$$

where C is total private plus government expenditure on consumption, I is total private plus government expenditure on investment, B_T is the balance of trade in goods and services excluding the services of capital, and DSB is the debt service balance which equals income from foreign employed capital owned by domestic residents minus income from domestically employed capital owned by foreigners. These variables should be viewed as real magnitudes. Subtraction of total consumption and investment from both sides produces the expression

$$S - I = CAB \tag{6}$$

where $S = Y - C$ is the level of savings and $CAB = B_T + DSB$ is the current account balance. These conditions are true by definition when the variables are the actual values and represent the condition of output-market equilibrium—the equality of aggregate demand and supply—when the variables are the desired magnitudes. For equilibrium to occur, the real exchange rate, and perhaps also the level of income and thereby savings must adjust to ensure that the above equality holds.

The role of real exchange rate adjustment becomes obvious when we recognize that the current account balance can be expressed as

$$CAB = B_T(Q, Y, \tilde{Y}) + DSB \tag{7}$$

where Y and $\tilde{Y}$ are the levels of domestic and foreign real income, $\partial B_T/\partial Q < 0$, $\partial B_T/\partial Y < 0$ and $\partial B_T/\partial \tilde{Y} > 0$. A fall in the real exchange rate increases exports relative to imports and thereby the current account balance, while an

increase in domestic real income increases imports and an increase in foreign real income increases domestic exports. After substituting equation (6) into the above expression, it can be written as

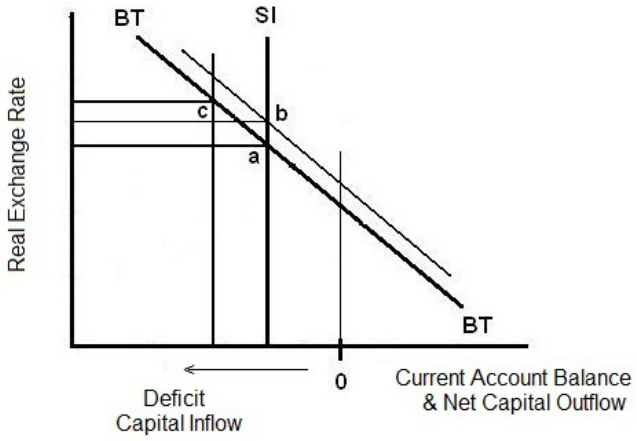
$$I - S + DSB = - B_T(Q, Y, \tilde{Y}) \tag{8}$$

which states simply that the net capital inflow plus debt service balance must be equal to the negative of the balance of trade in goods and services. When additional real capital flows in, a rise in the real exchange rate will be required to increase imports relative to exports and thereby decrease the balance of trade surplus or increase the balance of trade deficit to create an additional flow of goods into the country equal to the increased inflow of ownership claims to capital. The main determinant of the current account balance is thus the inflow or outflow of real capital investment with the real exchange rate adjusting to produce equilibrium. A change in the demand for domestic imports or exports will simply lead to an offsetting movement of the real exchange rate with an unchanged trade balance. This is the mechanism by which changes in commodity and energy prices and other terms of trade changes result in real exchange rate movements.

An appropriate graphical presentation of the above simultaneous relationship under full-employment conditions is presented in Figure 1 below which, it should be noted, is not an **IS-LM** graph. The vertical **SI** line gives the excess of savings over investment at the current level of full-employment income and the **BT** curve gives the response of the real exchange rate to changes in the full-employment net capital outflow. An associated increase in domestic investment relative to savings shifts **SI** to the left causing the real exchange rate to rise and the current account surplus (deficit) to decline (increase) as the equilibrium moves from point **a** to point **c**. An increase in commodity or oil prices in the Canadian case, or an increase in that country's terms of trade, holding the U.S. situation unchanged will cause the **BT** curve to shift upward to the right moving the equilibrium from point **a** to point **b**. An upward shift of **BT** will also occur in response to an increase in Canadian full-employment real income holding income abroad constant.

The question immediately arises as to the validity of the assumption that the **SI** line is vertical. It would seem reasonable to expect that a change in the real exchange rate would have effects on the net capital inflow in both directions. The fact that the relative price of Canadian in terms of world output increases with a rise in the real exchange rate can be reasonably expected to make additional in investment in Canada profitable. At the same time, however, the effect of the rise in the real exchange rate on the wealth of Canadian holders of domestic-employed capital will probably result in some increase in domestic savings. The fact that investment and savings move in the same direction makes

Figure 1. Real Exchange Rate Determination



the combined effect on the slope of **SI** unclear. Given our lack of knowledge about the magnitudes of the opposing effects, the best alternative would seem to be to continue assuming that the **SI** line is vertical, recognizing that some bias in our results in one direction or the other may be present.

Short-run transitory changes in income and employment will affect the two curves in opposite directions. An increase in output and employment, holding the full-employment level of income unchanged, will result in an increased supply of domestic goods in world markets, causing the **BT** curve to shift downward to the left.[9] At the same time, the public's recognition that the increase in income is transitory will cause savings to increase as consumption is maintained at its inter-temporally optimal level, causing the **SI** line to shift to the right. The real exchange rate will decline and the current account balance will increase.

Letting domestic consumption and investment be functions of the real interest rate and domestic income, the domestic aggregate real goods market equilibrium condition becomes

$$Y = G_D(\tilde{r} + \rho, Y, \Phi_D) + B_T(Q, Y, \tilde{Y}, \Phi_F) + DSB \tag{9}$$

where the function $G_D(\quad)$ is domestic private plus public aggregate demand for home-produced goods and services, with $\tilde{r}$ being the world real interest rate and ρ the risk premium on domestic-employed capital, and Φ_D and Φ_F are shift variables.

Full equilibrium also requires conditions of asset equilibrium. For a small open economy like the Canadian one operating in a world capital market, asset equilibrium can be represented by a single equation setting the equality of the

[9]This is clear from the signs of the partial derivatives of Y and Q in $B_T(Q, Y, \tilde{Y})$.

demand for real money balances with the supply, where a risk premium or discount on Canadian employed assets is encorporated, along with the expected rate of inflation, in the interest rate variable. Given the world real interest rate and the risk premium on Canadian assets, a zero excess demand for money implies a zero excess demand for non-monetary assets. With the nominal money supply on the left side, the asset-equilibrium equation becomes

$$\begin{aligned} M &= P\,L(\tilde{r}+\rho+E_p, Y, \Phi_M) \\ &= P_N^{\theta}(\tilde{P}_T/\Pi)^{1-\theta}\,L(\tilde{r}+\rho+E_p, Y, \Phi_M) \end{aligned} \tag{10}$$

where M is the nominal money stock, the Canadian real interest rate is $\tilde{r}+\rho$ and E_p is the expected rate of Canadian inflation, making $\tilde{r}+\rho+E_p$ the domestic nominal interest rate. And the function $L(\tilde{r}+\rho+E_p, Y, \Phi_M)$ is the demand function for domestic real money balances with Φ_M being another shift variable.[10]

Finally, from equation (1) the nominal exchange rate must be equal to

$$\Pi = \frac{Q\tilde{P}}{P}\,. \tag{11}$$

Equations (9) and (10) and (11) form the complete model relevant for the anaysis that follows. The model solves for the three variables $\Pi\,, Y$ and $\tilde{Y}$ under less-than-full-employment conditions with price level rigidity or the three variables $P\,,\ \tilde{P}$ and Pi', under full-employment conditions real incomes and the real exchange rate fixed at their full-employment levels.

The domestic authorities have two basic options—they can either fix the exchange rate or let it float. Let us begin by assuming that Canada adopts a fixed exchange rate with respect to the U.S. dollar. Under conditions of price flexibility and full-employment, where $Y = Y_f\ \ \tilde{Y} = \tilde{Y}_f$ and $Q = Q_f\,$, the real goods market equilibrium equation (9) becomes purely descriptive and, given the fixed level of $\Pi\,$, the equilibrium price level is determined by equation (11) as

$$P = \frac{Q_f\tilde{P}}{\bar{\Pi}}$$

where $\bar{\Pi}$ is the fixed U.S. dollar price of the Canadian dollar. The equilibrium Canadian price level will rise and fall through time proportionally with the full-employment real exchange rate. As will be established in the empirical work below, Canada's real exchange rate with respect to the U.S. has varied very substantially over the years making a fixed exchange rate policy, and the resulting

[10]It is assumed throughout the analysis that follows that no changes occur in the United States.

equilibrium price level variability, a poor choice. Given the full-employment levels of output and prices, the asset equilibrium equation (10) simply determines the nominal money stock the authorities must maintain in order to validate the fixed exchange rate—this level of domestic liquidity can be maintained by appropriate open market operations in domestic securities or through purchases and sales of U.S. dollar reserves in the open market.

Turning now to the short-run situation where the domestic and foreign price levels cannot adjust, we impose on the model the additional assumption that $P = \bar{P} = 1$.[11] Equation (11) now produces the short-run equilibrium level of the real exchange rate

$$Q = \frac{\bar{\Pi}\,\bar{P}}{\tilde{P}}$$

which will not vary in response to changes in its full-employment equilibrium level. This real exchange rate level plugs into the output-flow equilibrium equation (9) to produce the short-run equilibrium level of Y which will differ from Y_f and, when substituted into the asset stock equilibrium equation (10), again determines the level of liquidity that the Canadian authorities must supply to maintain the fixed exchange rate.

Clearly, an independent Canadian monetary policy is not possible. But the domestic authorities could still bring about appropriate variations in the level of domestic output and employment by a properly constructed fiscal policy that shifts Φ_D and can also make economically inefficient variations in the level of output through tariff and trade policies that shift Φ_F. Note also that changes in the full-employment equilibrium level of the real exchange rate will create deviations of Q from Q_f. To the extent that Q_f falls relative to Q, domestic output becoming over-priced in the world market, domestic exports will decline relative to imports, reducing the level of Y in the goods market equilibrium equation (9).[12] The very substantial changes in the full-employment equilibrium real exchange rate through time that will be shown empirically below will have major short-run effects on output and employment in the process of generating the substantial long-run effects on the equilibrium Canadian price level. This makes the argument against adopting a fixed exchange rate with respect to the U.S. dollar even stronger.[13]

[11]This assumption is based on the fact that it takes time for the price level to adjust to changes in aggregate demand.

[12]This is represented by a change in Φ_F which reduces Y, requiring a fall in Q equal to the fall in Q_f to return Y to its initial level.

[13]For a broad discussion of the merits of a flexible exchange in the Canadian case see John Murray, "Why Canada Needs a Flexible Exchange Rate," *North American Journal of Economics and Finance*, 11, 2000, 41-60. For an analysis similar in important respects to

Suppose alternatively what is in fact the case—that Canada allows the dollar to float freely in international markets. Under conditions of price flexibility and full employment, the imposition of $Y = Y_f$ in the asset equilibrium equation (10) generates an equilibrium real stock of money M/P. The domestic authorities can then fully control the price level in the long run through variations in the nominal money supply. That equilibrium level of prices, together with the full-employment equilibrium level of the real exchange rate, generates the equilibrium nominal exchange rate

$$\Pi = \frac{Q_f \tilde{P}}{P}.$$

The major variations in Q_f through time will now simply result in proportional variations of Π with the Canadian price level being fully under the control of the domestic authorities. As in the fixed exchange rate case the real goods market flow equilibrium equation (9) becomes purely definitional—the full-employment levels of outputs and the real exchange rate must be such as to satisfy the equation.

Now let us impose short-run rigidity of the Canadian price level, making for the moment an assumption that there is pricing to market—that is, that the Canadian prices of traded goods are fixed independently of movements in the exchange rate.[14] When we plug this fixed price level into the asset equilibrium equation (10) we obtain the following relationship between the nominal money supply and output.

$$M = \bar{P}\, L(\tilde{r} + \rho + E_p, Y, \Phi_M) \tag{12}$$

The short-run equilibrium level of output must respond positively to changes in the money supply, and negatively to positive shifts in the demand for liquidity. When we plug this level of output into the goods market equation, that equation generates the short-run equilibrium level of the real exchange rate which, when plugged into equation (11), produces the equilibrium level of the nominal exchange rate.

Clearly, when the exchange rate is flexible the Canadian authorities are able to conduct a counter-cyclical monetary policy. Moreover, as can be seen from the goods market equation (9) combined with the fact that the level of

the work developed here but using a much smaller period, see J. L. Carr and John E. Floyd, "Real and Monetary Shocks to the Canadian Dollar: Do Canada and the United States Form and Optimal Currency Area?," *North American Journal of Economics and Finance*, 13, 2001, 21-39.

[14]See C. Betts and Michael B. Devereux, "Exchange Rate Dynamics in a Model of Pricing to Market," *Journal of International Economics*, 50, 2000, 215-44, for a discussion of pricing to market.

domestic output and employment must be consistent with the condition of asset equilibrium, fiscal policy or tariff produced shifts in Φ_D or Φ_F, holding the money stock constant, will lead to sufficient opposite changes in Q to neutralize any effect on income and employment.

The above result that monetary policy works only under flexible exchange rates and fiscal policy only under fixed exchange rates goes back to the path-breaking work of Fleming and Mundell.[15]

A difficulty in the flexible exchange rate case is the possibility of exchange rate overshooting if the Canadian authorities operate directly on the monetary aggregates. A monetary expansion results in the attempt by asset holders to re-balance their portfolios by exchanging money holdings for non-monetary assets in world markets. This causes the nominal and real exchange rates to devalue and thereby leads to an expansion of exports relative to imports and an increase in domestic output and employment sufficient to increase the demand for money holdings to equal the new higher stock of nominal money balances, as is evident from the asset equilibrium equation (10). An increase in M on the left side of that equation must be matched by and equal increase in the right side for asset market equilibrium to be maintained. Since output prices cannot change in the short-run, the fall in Π will reduce the real exchange rate and shift world demand onto domestic output, causing Y to increase by an amount which, together with any exchange rate induced rise in the domestic price level, will increase the right side of the equation to equal the increase in the left side.

The problem is that it takes time for the balance of trade and the level of real income to respond to a fall in the real exchange rate. Until an output response can take place the fall in the nominal exchange rate which, under the pricing-to-market assumption above holding all nominal prices constant has no effect on the right-hand side of (10), will continue indefinitely so there is no equilibrating mechanism. When we relax the assumption of pricing to market and assume that

$$P = P_N^{\theta}(\tilde{P}_T/\Pi)^{1-\theta}\,, \tag{13}$$

a devaluation of the nominal exchange rate (fall in Π) causes a rise in the domestic prices of at least some of the traded components of output. Taking the logarithm of equation (10) under these circumstances where output prices and the real and nominal interest rates and real output are constant, and the

[15] J. M. Fleming, Domestic Policies under Fixed and Flexible Exchange Rates, *International Monetary Fund Staff Papers* 9, 1962, 369-379 and R. A. Mundell, Capital Mobility and Stabilization Under Fixed and Flexible Exchange Rates, *Canadian Journal of Economics and Political Science*, 29, 1963, 475-485.

constant term is simply ignored, we obtain

$$\begin{aligned} log(M) &= \theta\, log(P_N) + (1-\theta)[log(\tilde{P}_T) - log(\Pi) + log(L(\tilde{r} + E_p, Y)) \\ &= -(1-\theta)\, log(\Pi) \end{aligned} \tag{14}$$

which can be rewritten as

$$log(\Pi) = -\frac{1}{1-\theta}\, log(M)\,. \tag{15}$$

Under the assumption that one-third of domestic output consists of traded components that vary in price with changes in the nominal exchange rate, a one percent increase in the nominal money supply will cause the nominal exchange rate to fall by three percent. But this now ignores the fact that it will take at least some finite period of time for the domestic currency prices of the traded components of output to adjust to the exchange rate change. In the days during which these prices remain unchanged the nominal exchange rate may fall much further, with the only equilibrating mechanism being a speculative one arising from knowledge that there has to be a lower limit to its long-run equilibrium level. The expectation that the real exchange rate will eventually rise back to its full-employment level implies that the price of domestically employed capital will rise relative to the price of capital employed abroad, signifying a real capital gain. This expectation of a capital gain will cause the current price of domestically employed capital to rise relative to its cost of production, lowering the domestic real interest rate, which can then be expressed as

$$r = \tilde{r} + \rho - E_q \tag{16}$$

where E_q is the expected rate of change in the real exchange rate. Equation (14) must then be modified, becoming

$$\begin{aligned} log(M) &= \theta\, log(P_N) + (1-\theta)[log(\tilde{P}_T) - log(\Pi)] \\ &\quad + \eta\,(\tilde{r} + \rho - E_q + E_p) + \epsilon\, log(Y)\,, \end{aligned} \tag{17}$$

where the interest rate variable and its components are not expressed in logarithms and $\epsilon > 0$ is the income elasticity of demand, and $\eta < 0$ the interest semi-elasticity of demand, for real money balances. An increase in E_q lowers the domestic real and nominal interest rates, increasing the right side of the equation and thereby requiring a smaller decline in the real and nominal exchange rates to produce equilibrium.[16]

[16]For the original formulation of this this equilibrating mechanism, see Rudiger Dornbusch, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, 84, 1976, 1161-76.

Quite apart from overshooting exchange rate effects of money supply shocks, there are also good reasons to believe that potential overshooting exchange rate effects of shocks to the demand for money will occur from time to time. During the period between late-1962 and early-1970 when Canada was on a fixed exchange rate and, for reasons noted above, the supply of money was endogenous, the standard deviations of the month-to-month percentage changes in the monetary base, M1 and M2 were 2.4, 3.6 and 2.6, suggesting substantial short-run exchange rate effects had Canadian liquidity growth been held constant and the dollar allowed to float. This presence of money demand shocks rules out money growth rules as a policy focus. Indeed, given exchange rate overshooting pressures resulting from demand for money shocks, a central background feature of Bank of Canada policy must be the maintenance of orderly markets—the accusation of permitting or creating market instability is a central banker's nightmare.

The standard way to ensure orderly markets is to continually adjust base money growth and credit provision to the banking system to prevent sharp day-to-day short-period exchange rate movements outside a normal trading range. The problem with this approach, of course, is that the Bank will end up financing all major changes in the domestic demand for liquidity with the result that it will finance any changes in the expected rate of inflation. Any major independent influence by the Bank on domestic output and employment and, in the longer run, inflation will necessarily involve significant pressure on the nominal exchange rate. The problem is that when the Bank induces changes in the market value of the Canadian dollar it loses sight of the full-employment-equilibrium level of that exchange rate.

Contrary to popular opinion, it is unreasonable to expect the Bank of Canada to be able to manipulate the domestic real interest rate. Normal adjustments of the nominal money supply will induce small relative changes in the world demand for domestic assets and it is thus difficult to imagine that ρ, the underlying risk premium on domestically employed real capital, will be significantly affected.

Even though it has no significant control over r, the underlying level of domestic real interest rates relevant for aggregate investment decisions, there are four reasons why it makes good sense for the Bank of Canada to announce targets for, and exercise control over, the interest rate at which it will lend reserves to the domestic banking system, and thereby use this overnight interest rate as its policy instrument. First, by controlling the rate at which it will lend to the banking system and at which the commercial banks will be able to borrow from each other, the Bank of Canada can affect the profitability to commercial banks of expanding their reserves and deposits and thereby influence the level of the money supply to produce, hopefully gradual, nominal and real exchange

rate changes in appropriate directions. Second, since shifts in the public's demand for money will put pressure on the banks to expand or contract credit and thereby create deviations of the overnight rate from the target set by the Central Bank, the resulting adjustment of the stock of overnight borrowings required to keep the rate on target will finance these desired demand-for-money shocks and thereby have a smoothing effect on the exchange rate to avoid overshooting. The Bank of Canada will thus not have to maintain order in the foreign exchange market by making minute-by-minute purchases and sales in that market.[17] Third, setting a target for the overnight lending rate helps establish public awareness of the Bank's commitment to its inflation target. It is extremely important that the public have an appropriate expected inflation rate because by keeping the nominal exchange rate from jumping sharply outside normal trading ranges, the Bank will end up financing that expected inflation rate. Finally, a Central Bank financed expansion of reserves and deposits by the commercial banks associated with adjustments of the overnight-rate target will result in an expansion of bank loans, leading to a decline in the interest rates to borrowers who borrow only from the banking system, thereby inducing some direct effect on investment. Loans from outside the banking system to borrowers who do not borrow exclusively from domestic commercial banks will be reduced, offsetting any expansion of commercial bank loans to those borrowers, since outside lenders can obtain interest rates within the domestic economy and abroad that have not been reduced by commercial bank expansion. Of course, no declines in the interest rates to exclusive borrowers from the commercial banks will arise when the Bank of Canada expands the money supply directly through open market operations, in which case the re-establishment of asset equilibrium will occur exclusively through direct pressures on the exchange rate with domestic interest rates falling only to the extent that perceived exchange rate overshooting occurs.

In the long-run, of course, the expansion of output and employment resulting from the devaluation of the Canadian dollar and fall in the real exchange rate that will inevitably result from increased domestic monetary expansion will lead to upward pressure on and increases in the Canadian price level that will eventually eliminate that excess output and employment and raise the real exchange rate to its full-employment level.

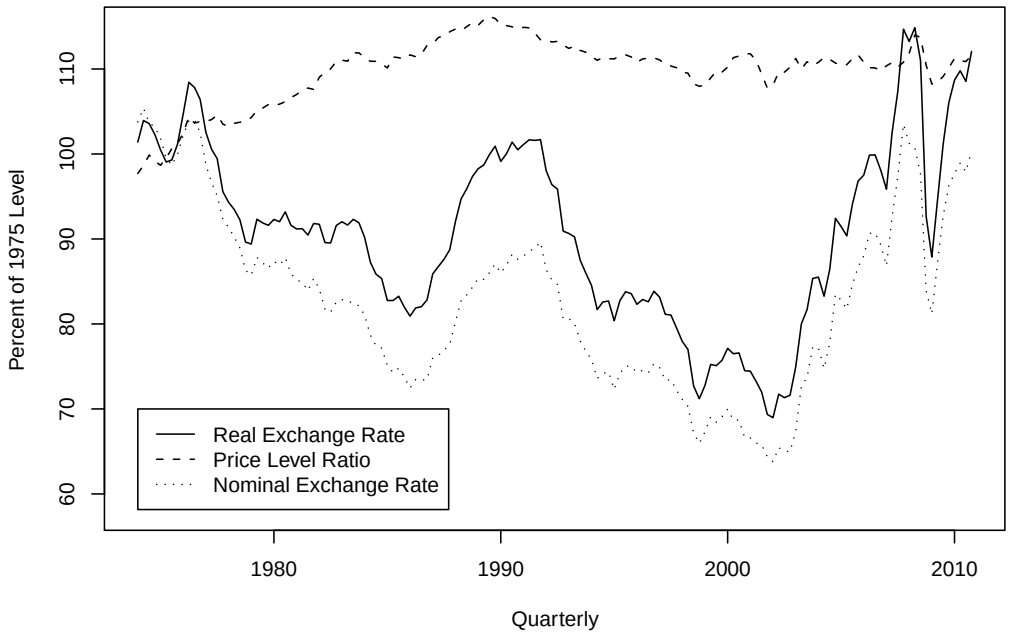
III: The Empirical Evidence

The time paths of Canada's real and nominal exchange rates with respect

[17]While it follows a policy of intervening within 10 minute intervals, the Bank currently sterilizes the money-supply effects of all its interventions, thereby eliminating the possibility of financing the public's demand-for-money changes in this way. See Neil Beattie and Jean-Froancois Fillion, "An Intraday Analysis of the Effectiveness of Foreign Exchange Intervention," Bank of Canada Working Paper 99-4, February 1999.

to the United States and the ratio of the Canadian over the U.S. price levels are shown in Figure 2 below, with all three variables indexed to the base of 1974 = 100.

Figure 2. Canadian Real and Nominal Exchange Rates and Price Level Ratio With Respect to the U.S.



Canada's real exchange rate fell by about 25 percent between the late-1970s and the mid-to-late-1980s and then rose by about 20 percent by the early-1990s. Then after falling about 30 percent by the early years of the 21st century it rose back above its 1974 level by the end of 2010. The Canadian price level rose relative to the United States price level by about 20 percent in the 16 years between 1974 and 1990 and then this ratio declined a bit less than 5 percent by the year 2000 and was trendless thereafter. The relatively smooth behaviour of the price level ratio as compared to the real exchange rate resulted in a pattern of nominal exchange movements pretty-much in step with those of the real exchange rate. There is no doubt that the movements of Canada's real and nominal exchange rates with respect to the United States were very substantial.

The above theoretical analysis suggests that an empirical investigation of the factors determining Canadian long-run equilibrium real and nominal exchange rates should begin by regressing the logarithm of Canada's real exchange rate

with respect to the United States, constructed using the respective GDP deflators as the price level measures, on the following variables.[18]

1) The logarithm of the ratio of the prices of commodities excluding energy in U.S. dollars over an equally weighted average of the U.S. dollar prices of U.S. exports and imports.

2) The logarithm of the ratio of energy prices in U.S. dollars over an equally weighted average of the U.S. dollar prices of U.S. exports and imports.

3) The logarithm of the ratio of Canada's terms of trade with respect to the rest of the world over the U.S. terms of trade with respect to the rest of the world.

4) Canadian government consumption expenditure as a percentage of GDP minus U.S. government consumption expenditure as a percentage of that country's GDP. The use of government consumption rather than total expenditure focuses on a portion of government activity that would seem more likely to concentrate on the use of domestic labor and non-traded resources.

5) The logarithm of Canadian real GDP.

6) The logarithm of United States real GDP.[19]

7) The percentage of the Canadian labour force employed.

8) The percentage of the United States labour force employed.

9) The net capital inflow into Canada plus the debt service balance as a percentage of Canadian GDP minus the net capital inflow into the U.S. plus that country's debt service balance as a percentage of U.S. GDP, where the net capital flows plus the debt service balances are estimated as the negatives of the countries' balances of trade in goods and services.

In the earlier published work, the terms of trade variable, government consumption variable and the two GDP variables turned out to be statistically insignificant and were dropped, and no attempt was made to investigate any implications of the employment rate variables. The regression result in the left-most column of Table 1 below extends that regression to the period from

[18]The data utilized in this study were obtained from the International Monetary Fund, *International Financial Statistics*, from the Federal Reserve Bank of St. Louis Data Base and from the `CANSIM` data base. These data are discussed in detail in the Technical Appendix and are also available on the author's web-site.

[19]Ideally, we would use percapita GDPs were they available quarterly. It turns out, however, that the trend growth rates of real GDP and percapita real GDP differ by only 1.25 percentage points in both countries and the correlations between the detrended logarithms of real GDP and percapita real GDP are 0.97 for the United States and 0.98 for Canada.

1974Q1 to 2010Q4 rather than ending at 2007Q4.[20] And the terms of trade ratio and the excess of Canadian over U.S. government consumption expenditures now turn out to be statistically significant at the 5 percent level and and are therefore included.

Statistical insignificance of the real GDP variables was attributed to the high-correlation between them and the ability of the other series to capture the trend in the data. It turns out, however, that the addition of the employment rates along with the real GDP variables for the period 1976Q1 to 2010Q4 for which employment rate data are available produces results with both the real GDP and employment rate variables being statistically significant. The terms of trade ratio and the difference of government consumption expenditures as percentages of GDP then turn out to be statistically insignificant as shown in the middle regression in the Table. But replacement of the logarithm of the ratio of the Canadian over U.S. terms of trade with the logarithm of the Canadian terms of trade alone in the regression presented in the right-most column of the Table results in a statistically significant coefficient for the latter variable and a P-value for the government consumption difference variable of .051 that indicates statistical significance at roughly the 5 percent level.

This result is consistent with the Balassa-Samuelson hypothesis that an increase in domestic relative to foreign full-employment real income will increase the domestic real exchange rate and, at the same time, consistent with the idea that a short-run increase in a country's domestic output due to greater utilization of domestic resources will increase its supply and cause the relative price of that output to fall.

The question arises as to whether these regression results are spurious. Upon investigation it is clear that there is no basis for such a claim. The commodity price variable is stationary and the fact that it is statistically significant therefore implies that any non-stationary variables in the regression must be cointegrated. Also, while the chances of obtaining statistically significant coefficients in spurious regressions of one non-stationary variable on another are quite high, the chances of obtaining nine statistically significant coefficients with the expected signs in spurious regressions of a non-stationary variable on a constant and nine other non-stationary variables are surely close to zero. Indeed, when ten non-stationary variables are independently constructed by summing normal random shocks having standard deviations of unity, and then one of these variables is regressed on the other nine, all variables will typically be statistically significant with positive (or pre-selected) signs in not even one of 1000 runs. This conclusion is confirmed by Johansen cointegration tests performed on the

[20]For the original result, see page 159 of the author's book cited on the first page. All the statistical analysis that follows is described in the Technical Appendix and the files are available from the author's web-site, noted in the previous footnote.

non-stationary variables in the left-most and right-most regressions in Table 1. These indicate that the the null-hypothesis of no-cointegration can be strongly rejected in both cases.

At this point it is important to recall that the net capital inflow variable is the net capital inflow into Canada from all countries as a percentage of Canadian GDP minus the net capital inflow from all countries into the U.S. as a percentage of that country's GDP. And these net capital inflows, when the debt service balances are added, must equal the values of imports from minus exports to all countries. Since the net capital inflows into both Canada and the United States can arise as a consequence of technological and other developments in third countries, and are associated with capital flows into and out of those countries, a possible source of bias in interpreting the coefficient estimates in the regressions above can be present. The correlation of capital flows into Canada with that country's real exchange rate with respect to the United States will depend on what is happening in third countries to influence their capital inflows and outflows. The real exchange rates of those other countries with respect to the United States will also be changing through time so that a change in Canada's real exchange rate with respect to the United States will not necessarily be a good measure of Canada's real exchange rate with respect to the rest of the world. Subsequent analysis based on the regression coefficient of the net capital inflow variable cannot routinely hold constant the real exchange rates of the U.S. with respect to third countries in order to specify that changes in Canada's real exchange rate with respect to the United States represent proportional changes in her real exchange rate with respect to the rest of the world.

While we cannot include in our regression the real exchange rates with respect to the United States of all the major trading countries in the world because of resulting degrees-of-freedom limitations, it turns out that when the real exchange rates of the United Kingdom and Japan with respect to the United States are added individually to the regression, their coefficients turn out to be statistically insignificant and, when included together, both coefficients are statistically insignificant. There are insufficient data to enable the addition of the real exchange rate of the Euro Area with respect to the United States for the entire period. For the period 1999 onward, however, we can usefully add the real exchange rates of Japan, the Euro Area and the United Kingdom with respect to the U.S. to a regression that includes only the three main variables of interest.[21] When we do this the real exchange rates of the Euro Area and the United Kingdom, but not Japan, turn out to be statistically significant when added separately but the Euro Area and U.K. real exchange rates both are

[21]The Japanese and Euro Area real exchange rates with respect to the United States were constructed using consumer price indexes rather than GDP deflators as price level measures.

Table 1. Regression Results

Dependent Variable	Real Exchange Rate		
Time Period	1974–2010	1976–2010	1976–2010
Constant	0.979	-0.118	-2.120
	(0.663)*	(0.944)	(1.179)***
Commodity Prices	0.342	0.572	0.441
	(0.099)***	(0.111)***	(0.118)***
Energy Prices	0.140	0.158	0.140
	(0.037)***	(0.039)***	(0.034)***
Net Capital Inflow	0.020	0.028	0.026
	(0.003)***	(0.005)***	(0.004)***
Government Consumption	0.017	0.014	0.023
	(0.010)**	(0.014)	(0.014)**
Terms of Trade Ratio	0.326	0.164	
	(0.193)**	(0.211)	
Canadian Terms of Trade			0.738
			(0.285)***
Canadian Real GDP		2.220	2.593
		(0.554)***	(0.520)***
U.S. Real GDP		-1.924	-2.288
		(0.487)***	(0.459)***
Canadian Employment		-0.035	-0.040
		(0.010)***	(0.009)***
U.S. Employment		0.027	0.032
		(0.010)***	(0.009)***
NOBS	148	140	140
DF	142	130	130
RSQ	0.759	0.818	0.835

Notes: The variables are defined in the text and the numbers within brackets are coefficient standard errors, all of which are Newey-West HAC-adjusted with lag equal to 3 to compensate for significant serial correlation in the residuals. The superscripts ***, ** and * denote significance at the 1%, 5% and 10% levels respectively.

Table 2. Regression Result

Dependent Variable: Log Canada vs. U.S. Real Exchange Rate Time Period: 1999Q1–2010Q4		
	Coefficient	Std.-Error
Constant	0.491	0.281**
Log Commodity Prices	0.465	0.085***
Log Energy Prices	0.227	0.024***
Net Capital Inflow Difference	0.022	0.004***
Log UK vs. US Real Exchange Rate	0.184	0.145
Log EA vs. US Real Exchange Rate	0.023	0.126
Number of Observations:	48	
Degrees of Freedom:	42	
R-Squared:	0.967	
Exclusion Test of both Euro Area and U.K. Real Exchange Rates		
F-Statistic:	14.212	
P-Value:	.000002	

Notes: The variables are defined in the text and the superscripts ***, ** and * again denote significance at the 1%, 5% and 10% levels respectively.

statistically insignificant when added together. As the F-test in the regression result presented in Table 2 below shows, the null hypothesis that the Euro Area and U.K. real exchange rates with respect to the U.S. together contribute nothing to the explanation of the Canadian real exchange rate with respect to the United States can be easily rejected.[22]

Finally, it is necessary to determine whether unanticipated money supply shocks have had overshooting effects on the Canadian real exchange rate with respect to the United States. To do this, four estimates of unanticipated shocks to the three monetary aggregates—base money, M1 and M2—in Canada and in the United States were calculated. First, 10-year running regressions of the current level of each monetary aggregate on two-years of quarterly lags of both that aggregate and domestic nominal GDP were used to obtain a fitted value for each period and then a forecasted value for each period based on the 10 previous years of data. Then two additional estimates were calculated by the same method based on two-years of quarterly lags of the relevant monetary

[22]While the sample size is small, bootstrapping to obtain coefficient estimates produces a range of coefficient values consistent with the values obtained in the regression shown. And the coefficient of the net capital inflow variable, which will be important in subsequent analysis, is quite consistent with that obtained in the earlier real exchange rate regressions that did not include third-country real exchange rates with respect to the United States.

aggregate alone, without the inclusion of lagged nominal GDP. The differences between the actual value and each forecasted or fitted value of each aggregate as a percentage of the forecasted or fitted value were then used as estimates of the unanticipated shock to the monetary aggregate in question. Each pair of the four unanticipated shock measures for the relevant Canadian and U.S. monetary aggregate were then added to the long-period regression that included real GDPs and employment rates and Canada's terms of trade with respect to the rest of the world. Our theory tells us that the Canadian unanticipated money shocks should be negatively related to the Canada vs. U.S. real exchange rate and that the U.S. unanticipated money shocks should be positively related. This positive relationship is expected because a U.S. unanticipated money shock will make monetary conditions easier in the United States than in Canada, lowering world interest rates because the U.S. is a large country, and increasing the demand for money in Canada. A potential problem here is that the unanticipated money supply shock is a generated regressor added to our original regression equations and, being such, may not provide a consistent and efficient estimator of the relevant coefficient that will permit valid inferences to be made. This problem is analyzed thorougly by Adrian Pagan[23] who concludes that serious problems are not likely to arise when the generated regressor is a regression-residual, as is the case in half of the regressions presented here.

Of the twelve regressions produced by the addition of the above calculated unanticipated money shocks, in only one case was an unanticipated money shock variable statistically significant and in that case the statistically significant United States M2 shock had the wrong sign. These results are similar to those obtained in earlier research using a wider range of measures of unanticipated money shocks.[24] There is clearly no evidence of exchange rate overshooting, a result consistent with the Bank of Canada having maintained orderly markets by accommodating demand for money shocks with appropriate adjustments of the money supply. And any independent monetary policy undertaken by the Bank must have operated through gradual smooth adjustments of the nominal and real exchange rates.

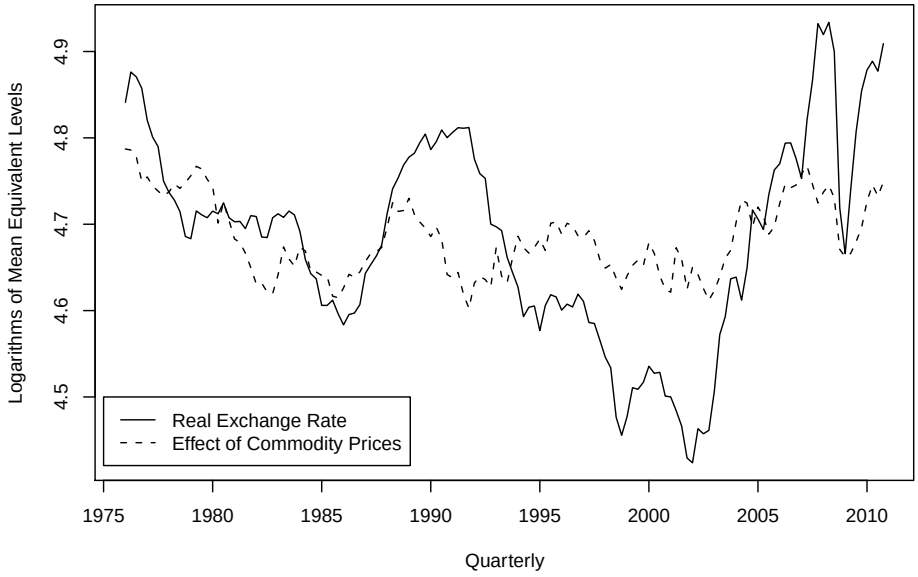
What, then, were the most important factors determining the movements of Canada's real and nominal exchange rates with respect to the United States. The right-most regression in Table 1 indicates that the world prices of energy and commodities excluding energy, Canada's terms of trade with respect to the rest of the world, capital movements into and out of Canada as compared to the United States and Canadian and U.S. output and employment were significantly related to the real exchange rate movements. But how important were

[23]Adrian Pagan, "Econometric Issues in the Analysis of Regressions with Generated Regressors," *International Economic Review*, Vol. 25, 1984, pp 221-247.

[24]See John E. Floyd, *Interest Rates, Exchange Rates and World Monetary Policy*, Springer, 2010, pages 209-222.

specific individual factors? To answer this question, the effects of the individual variables on the real exchange rate over the sample period were calculated and, after adding constant amounts sufficient to equalize the mean value of each calculated effect with the mean value of the real exchange rate, plotted along with the real exchange rate in Figures below.

Figure 3. Effect of World Commodity Prices on Canada's Real Exchange Rate With Respect to the U.S.



The effect of world prices of commodities excluding energy is shown in Figure 3 above. The commodity-price-effect series was shifted up by adding to it the excess of the mean of the log of the real exchange rate over the predicted mean so that the two series on the graph have the same means. The decline in commodity prices was clearly related to the fall in the real exchange rate in the late-1970s, as was the decline and turn-around in the mid-1980s. And commodity prices were roughly related to the real exchange rate movements after 2002.

Figure 4 below presents the effect of energy prices on the real exchange rate of Canada with respect to the United States. The rises in energy prices following the late 1990s are clearly reflected in corresponding changes in the real exchange rate although the relationship before 1990 is not graphically obvious.

The effect on the real exchange rate of the net capital inflow into Canada as a percentage of GDP minus the net capital inflow into the United States as a percentage of that country's GDP is graphed in Figure 5 below. Again, as in the previous two figures the mean of the series is shifted upward to equal the mean of the logarithm of the real exchange rate. It is clear that there was

Figure 4. Effect of World Energy Prices on Canada's Real Exchange Rate With Respect to the U.S.

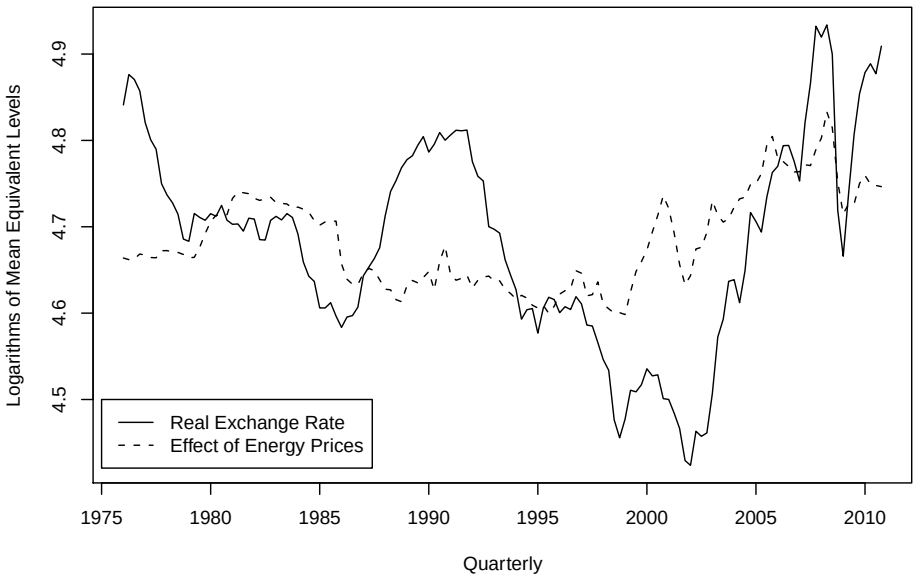
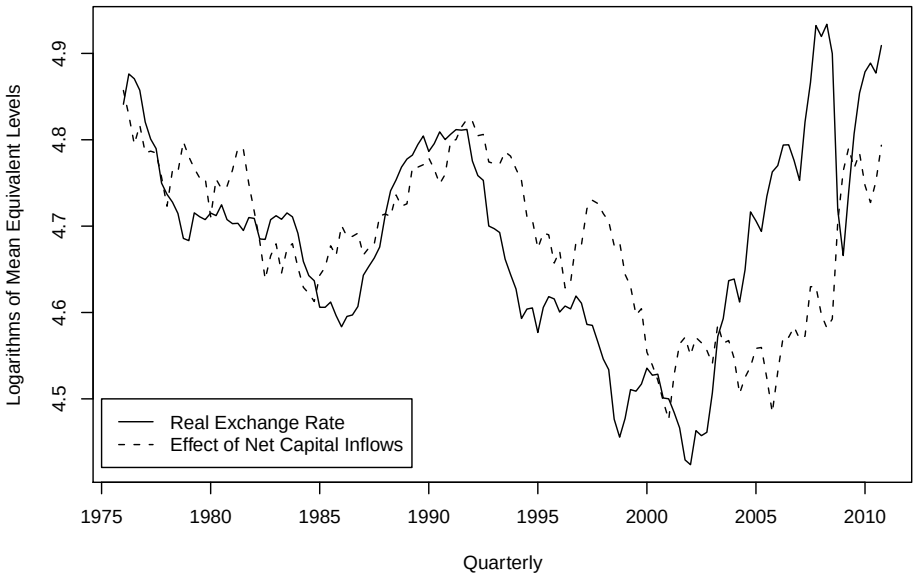


Figure 5. Effect of Net Capital Inflows on Canada's Real Exchange Rate With Respect to the U.S.



a rough but very strong positive relationship between net capital inflows into Canada as compared to the U.S. and the real exchange rate. The fact that the effect of the capital inflow difference lags the real exchange rate movements after 1990 reflects the time it takes for the capital market pressures to become

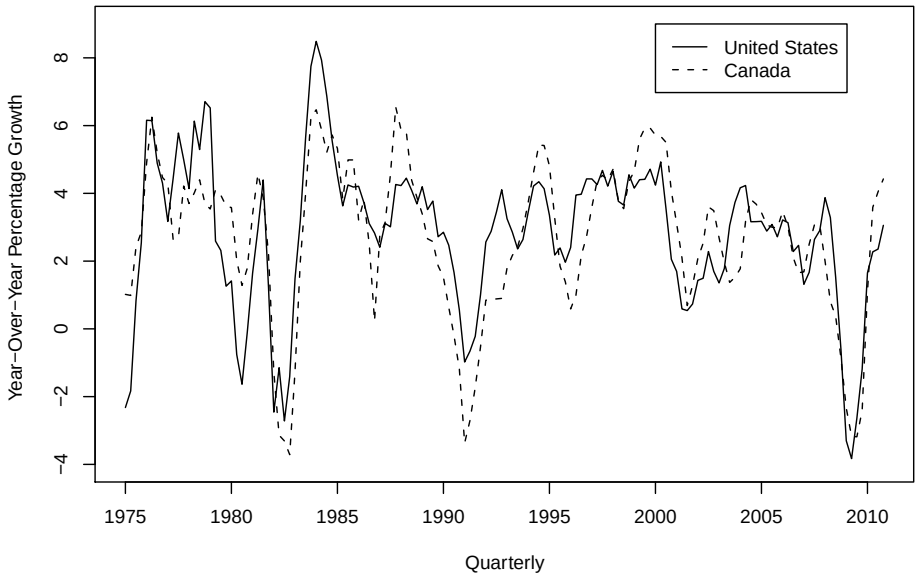
fully translated into a flow of real capital through adjustments of the current account balance in response to resulting movements of the real exchange rate.

The effects of Canadian and U.S. real GDPs and employment rates and of the Canadian terms of trade on the real exchange rate, while very statistically significant, and the effects of the differences in government consumption expenditure as percentages of the GDPs, are not graphically obvious and are therefore not presented graphically.

IV: The Conduct of Monetary Policy

The complete lack of any observable relationship between unanticipated money supply shocks and the Canadian real exchange rate with respect to the United States suggests very strongly that, by maintaining constancy of the overnight borrowing rate at target levels, and thereby offsetting overshooting pressures in the foreign exchange market, the Bank of Canada follows pretty much the monetary policy of the U.S. Federal Reserve System.

Figure 6. Year-Over-Year Real GDP Growth : Canada and U.S.



It is clear from Figure 6 above that the pattern of real GDP changes was the same in both countries although the some movements are greater and others are smaller in one or other country. And the two countries' unemployment rates, plotted in Figure 7 below also move in a smiliar fashion from 1980 onward. We

Figure 7. Unemployment Rates: Canada and U.S.

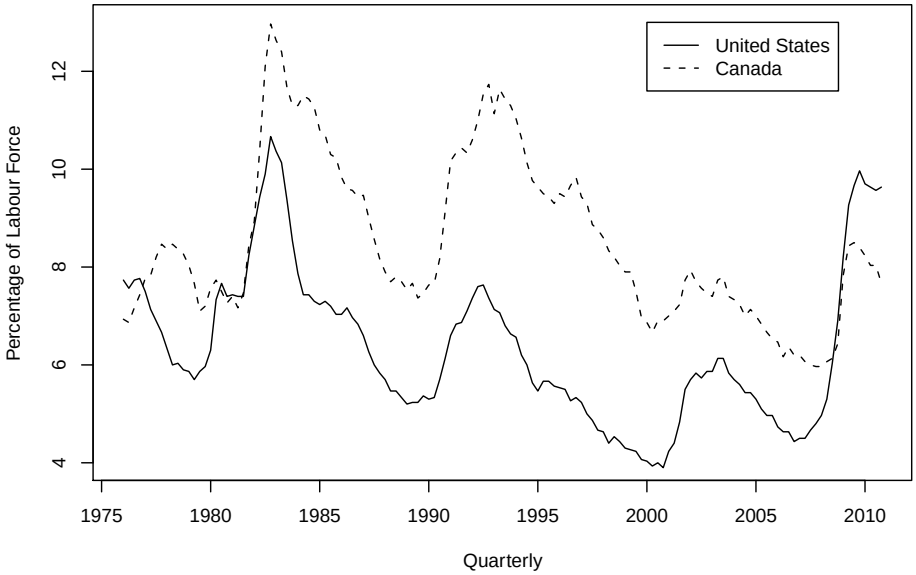
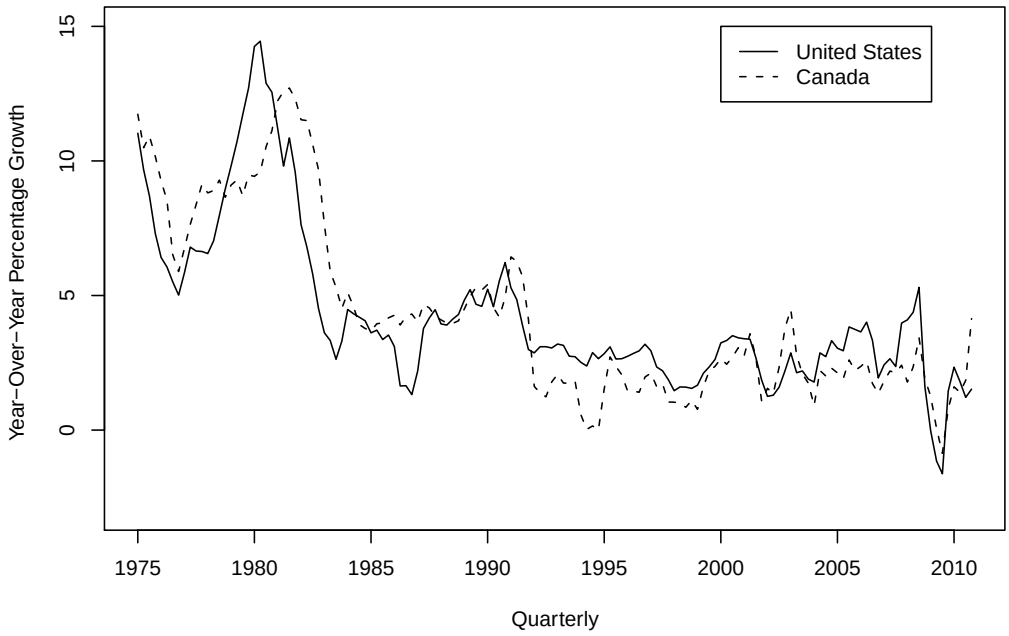


Figure 8. Year-Over-Year Inflation Rates: Canada and U.S.



cannot, however, rule out the possibility that these close relationships were the result of similar real business cycles in both countries.

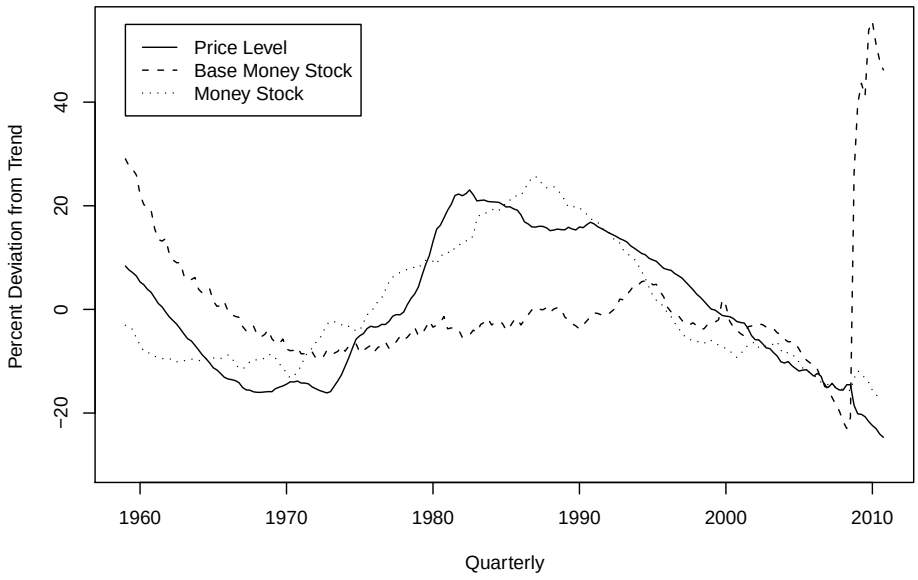
The overall higher unemployment rate in Canada than in the United States

is quite likely the result of different institutional conditions reflecting government policy relating to unemployment insurance. And it is probably the case that the major increase in the U.S. relative to Canadian unemployment rate during the past few years was due to the much greater severity of the recent financial-crises-induced recession in the U.S. because of differences in Canadian and U.S. regulation of their financial institutions.

The Canadian and United States year-over-year CPI inflation rates, plotted below in Figure 8, were both very high until the mid-1980s, having peaked in the mid-1970s and again in the early-1980s. After the mid-1980s the two inflation rates were more stable and highly correlated, averaging much the same.

The Figures 9 and 10 that follow present very strong evidence that the Bank of Canada has been reproducing U.S. monetary policy. The deviations from trend of the logarithms of domestic base money, the domestic money stock calculated as a simple average of M1 and M2, and the consumer price index are presented for the United States in Figure 9 and for Canada in Figure 10. The underlying trends of the logarithms of the variables were upward, reflecting trend growth rates of about 2 percent per year. Notice that the consumer price index and the money supply in the U.S. move more or less together, rising relative to trend until the 1980s and then falling relative to trend thereafter while, at the same time, U.S. base money rose at a rather stable rate relative to trend all the way to the mid-1990s.

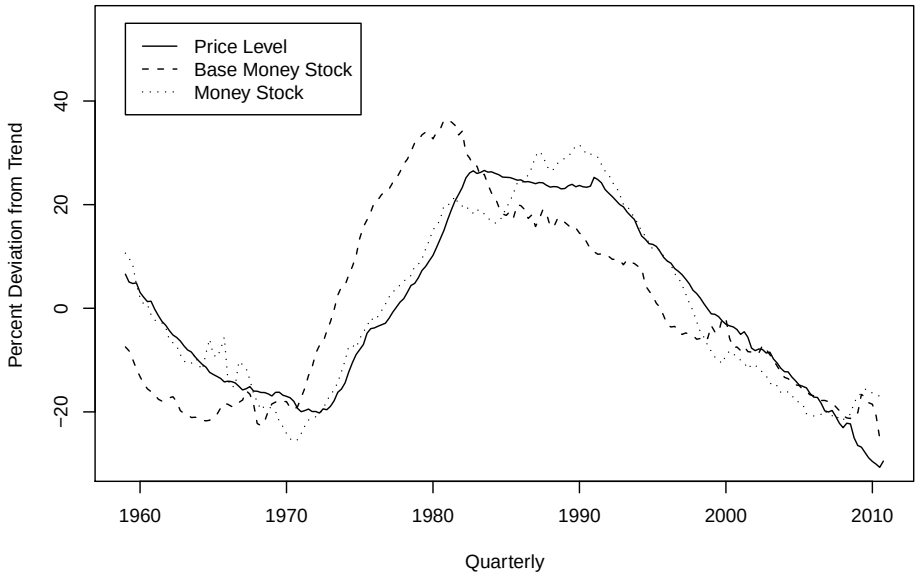
Figure 9. Deviations of Money and Prices from Trend: U.S.



The United States authorities clearly failed to reduce the stock of base money

relative to trend to compensate for the increase in the money multiplier, making the same error they made in the 1930s but in the opposite direction and with much less disturbing consequences. The enormous expansion of base money in the last quarter of 2008 and beyond is an obvious response to the recent financial crisis and recession—Ben Bernanke, who is a scholar of the Great Depression, was not going to repeat those earlier mistakes! And it appears that at least the initial decline in the money stock relative to trend after the mid-1980s was not induced by a downward adjustment of base money. One possibility, noted in earlier research, is that U.S. government deregulation during that period resulted in an increase in the demand for money balances.[25]

Figure 10. Deviations of Money and Prices from Trend: Canada



It is clear from Figure 10 below that the Bank of Canada financed the same degree of inflation in Canada that was occurring in the United States by adjusting the stock of base money as one would expect from an orderly markets approach to policy. Moreover, as noted in the earlier research just cited, it turns out that the authorities in Britain, Japan, France and Germany did essentially the same thing.

A central question here is whether Canada would have been better off following a monetary policy that was independent of and different from that followed in the United States. Given that Canadian monetary shocks operate primarily through exchange rate changes and that overshooting is likely to occur if

[25]See pages 327 to 340 of the author's book cited earlier, and R. A. Gilbert, "Requiem for Regulation Q: What It Did and Why It Passed Away", *Federal Reserve Bank of St. Louis Review*, 1986, 22-37.

these shocks are not carefully controlled, attempts to follow a different policy than that being followed in the United States may lead to market instability. Moreover, after the period of inflation noted above, which hopefully will not be repeated, the U.S. policy makers have been doing about as well as one could reasonably expect. Information available to them is very imperfect and underlying changes in the economic situation can only be observed with a lag. And policy actions will produce results only with a further lag, perhaps one sufficiently long for the impact of the policy to occur after the problem being addressed has dissipated. It is well known that aggregate economic instability arises because the private sector has imperfect information about future forces driving the economy and as a result makes decisions that later turn out to be wrong. If the authorities have information that the private sector does not have, they might best simply publish it so that the private sector can properly take that information into account. If they do not have more information than the private sector has, their short-term monetary actions can make a situation worse by adding further variability to economic conditions and thereby increasing the uncertainty facing private decision makers. Accordingly, it is often argued that, apart from situations of financial crises like the one recently experienced, the U.S. monetary authorities should concentrate on providing stable monetary conditions over the long run that will provide an appropriate long-run inflation rate, and should avoid fruitless attempts to offset business cycles.

The situation is even more difficult for a small open economy like Canada than a big one like the United States. The Canadian authorities have to figure out what is happening in the U.S. together with what that country's authorities are doing and the resulting impacts on both the United States and Canada. They then have to decide what effects various domestic policy actions will have, given the effects of U.S. policy, keeping in mind that domestic policy pressures on Canada's highly variable exchange rate have the immediate effect of making its equilibrium level unobservable. Of course, the Bank of Canada can adjust the overnight rate at which banks can borrow and lend reserves from each other and from itself. To the extent that the impact is slow and gradual, appropriate non-overshooting pressures on the exchange rate may occur. And the variations of the overnight rate together with the presentation of an inflation target may help keep inflationary expectations within a desirable range. The problem is that no obvious effects of such policies are visible in the data, except in so far as they simply produce similar monetary conditions as exist in the United States.

An interesting question here is whether one can predict Canadian market interest rates using the Bank of Canada's overnight rate or, in earlier periods, simply the bank rate. This involves using an important test attributable to Clive Granger.[26] To determine whether the variable X predicts or "causes" the

[26]C. W. J. Granger, "Investigating Causal Relations by Econometric Models and Cross-

variable Y, we regress Y on lagged values of itself and X and test whether the lagged values of X are statistically significant, in which case X can be said to predict or "cause" Y. It turns out that the Canadian treasury bill rate predicts the overnight borrowing or bank rate while the latter rate does not predict the treasury bill rate. The treasury bill rate and the Canadian corporate paper rate both predict each other and, not surprisingly, so do the corporate paper rate and the overnight borrowing or bank rate.

Given the evidence it would seem reasonable that, barring a huge world and U.S.financial and economic crises or a rise in Canadian inflation of the magnitude experienced in the 1970s, the Bank of Canada should continue with its present approach to monetary policy implementation. An important additional feature of this orderly markets approach is its neutralization of the Mundell-Fleming result that equilibrating real exchange rate movements will automatically offset the effects of fiscal policy under a flexible exchange rate regime—to the extent that the Bank of Canada continually finances the public's desire to adjust their desired money holdings, it will finance changes in those desired holdings that result from expansionary effects of fiscal policy on domestic output, rendering such policies potentially effective.

In the case of a world economic crises, which will necessarily affect Canada, the Bank will have to gradually force down the nominal and real exchange rates by controlled monetary expansion. Again, this control over the exchange rate will also allow short-term effects of expansionary fiscal policy to take effect. Here it should be kept in mind that this is not a beggar-thy-neighbor policy—to the extent that all countries put similar downward pressure on the values of their currencies, the world money supply will increase and world real interest rates will fall. In a situation where the domestic core inflation rate becomes unacceptably high, the Bank has to tighten money, possibly by increasing substantially its target overnight borrowing rate, and thereby induce appropriate upward movements of the nominal and real exchange rates leading to an increase in the domestic unemployment rate sufficient to induce price and wage setters to modify downward their expected inflation rates and reduce the rates at which they increase wages and prices through time. Once the expected inflation rate has adjusted downward to the appropriate level, that level can then be maintained by an orderly markets monetary policy that roughly finances the desired growth rate of monetary holdings at the current inflation rate.

As a final task, the previous empirical real exchange rate analysis can be used to get an idea of the amount by which the Bank of Canada would have to force the nominal and real exchange rates down or up to expand or contract employment by a specified amount—say one percentage point. The purpose is to determine empirically the effect of a rise or fall in the real exchange rate due

Spectral Methods," *Econometrica*, 37, 1969, 424-438.

to monetary policy on output and employment and the current account balance and net capital flow—that is, to empirically account for and measure the shifts and slope of the **BT** curve in Figure 1 along with shifts of the **SI** line resulting from monetary policy induced short-run real exchange rate changes. Since considerable simultaneity is involved, the best approach is to write down equations representing the determinants of **BT** and **SI** and then see what can be accomplished using the estimated coefficients in the basic regression that includes real GDPs and employment rates, incorporating other available information as necessary. The equation of the **BT** curve can be written as

$$q \;=\; \alpha + \beta\,\hat{B}_T + \gamma\,E \tag{18}$$

where q is the logarithm of the real exchange rate, $\beta < 0$ is the slope of the **BT** curve, $\hat{B}_T$ is the full-employment current account balance and associated full-employment net capital outflow as a percentage of the current full-employment level of domestic GDP under the assumption that the U.S. net capital outflow and full-employment GDP are unchanged and therefore incorporated in the constant term α. Finally, E is the Canadian employment rate (percentage of the labour force employed), with the U.S. employment rate being constant and also incorporated in α, and $\gamma < 0$ is the change in the log of the real exchange rate in response to a change in the percentage of the labour force employed. According to the basic regression result above, $\beta = -.026$, and $\gamma = -.04$. The actual current account balance, which is called B_T, is equal to the full-employment current account balance minus any increase in imports that results from a subsequent change in the employment rate. Thus

$$B_T \;=\; \hat{B}_T - mY \;=\; \hat{B}_T - m\,\delta\,E \tag{19}$$

where m is the marginal propensity to import out of a change in current income Y and δ is the increase in that income, as a percentage of its full employment level, produced by a one percentage point expansion of the level of employment. Finally, it is necessary to impose the fact that savings minus investment under less-than-full-employment conditions must equal the less-than-full-employment current account balance—that is,

$$B_T \;=\; s\,Y - I \;=\; s\,\delta\,E \;-\; I\,, \tag{20}$$

where s is the marginal propensity to save out of the change in current income and I is the underlying level of domestic investment where, by construction, the real interest rate is unchanged and the level of employment and savings and investment do not change abroad. Here it is necessary to allow for the possibility that domestic investment could increase in response to an increase in the employment rate by expressing I as equal to $\mu\,E$ where $\mu > 0$. Equations (19) and (20) together yield the following expression for $\hat{B}_T$,

$$\hat{B}_T \;=\; (m+s)\,\delta\,E \;-\; \mu\,E \;=\; [(m+s)\,\delta \;-\; \mu]\,E \tag{21}$$

which upon substitution into (18) yields

$$q \;=\; \alpha + \{\beta\,[(m+s)\,\delta \,-\mu] \,+\, \gamma\}\,E\,. \tag{22}$$

If the public fully understands what is happening and inter-temporally smoothes consumption, the entire transitory shock to income will be saved, so s will equal unity and m will equal zero. And since the return to investment is unchanged, μ will also be zero. We then need only to specify a value for δ, which represents the change in output as a percentage of its full-employment level resulting from a one percentage point increase in the percentage of the labour force employed. If the aggregate production function is Cobb-Douglas, δ will be roughly equal to the share of labour in output. While there is controversy over the exact magnitude of this share because of the complexities of trying to estimate it from available data, a rough guess would postulate a share of 0.67. However, in the present circumstances where there is a variation of the level of employment of a given stock of labour under given technological conditions the possibility arises that the utilization of capital could change so that the current level of the capital stock could become over- or under-employed in the same way as labour. This would suggest a higher value for δ. In addition, of course, the elasticity of substitution of labour for capital in the full-employment situation may be different from the Cobb-Douglas value of unity. Allowing for the possibility that increased capital utilization could accompany short-run employment expansion, a value for δ of around 0.7 would seem reasonable and an interval of 0.6 through 0.75 would seem a reasonable range to allow for error.[27]

Assuming that a one-percentage-point increase in the level of employment increases output by $.7$ percent of its full-employment level so that $\delta = .7$, and using the values of β and γ implied by the basic regression result, the total differential of (22) implies that

$$dq \;=\; \{\beta\,[(m+s)\,\delta \,-\mu] \,+\, \gamma\}\,dE \tag{23}$$

which, when $dE = 1$, implies

$$\frac{dQ}{Q} = dq = (-.026)(.7) - .04 = -.0582$$

so to increase the level of employment by 1 percentage point, the Bank of Canada would have to expand the money supply sufficiently to reduce the nominal and real exchange rate by about 6 percent. In the case where $\delta = .75$, the above magnitude changes to $-.0595$ and when we let $\delta = .6$, it becomes

[27]The author must thank Margarida Duarte for a helpful discussion of the range of possible values.

$-.0556$. So the range of real exchange rate devaluation required to increase the level of employment by 1 percentage point would be from 5.5 to 6 percent.

The assumption that the public regards the increase in current income as entirely transitory is probably unrealistic, given the lack of current information about the cause of the observed increase in its income. Suppose, to take the most extreme case, that the public incorrectly regards the observed increase in its income as permanent. A long-period average of the ratio of Canadian aggregate private consumption to gross national income yields, when subtracted from unity, an estimated fraction of permanent income saved of approximately .22 and the corresponding average ratio of imports of goods and services to gross national income is approximately .26. Using these values as measures of the marginal propensities, the above expression yields

$$\frac{dQ}{Q} = dq = (-.026)(.22 + .26)(.7) - .04 = -.0487$$

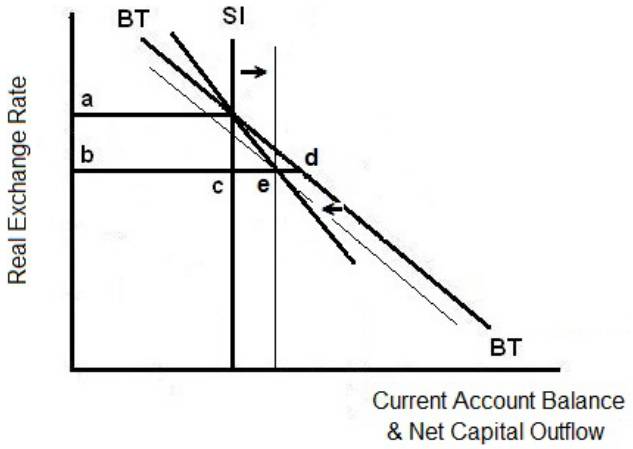
and a monetary expansion induced fall in the exchange rate of slightly under 5 percent would be required to increase the level of employment by 1 percent of the labour force. A smaller fall in the exchange rate and less monetary expansion is required because of the multiplier effect of expansion of consumption expenditure resulting from the increase in employment and income. When δ ranges between .6 and .75 the required fall in the exchange rate ranges between 4.75 and 4.94 percent. How much of an increase in the overnight borrowing rate would be required to accomplish the required money supply change is unclear.

One might also conclude that if the public incorrectly regards the change in income as permanent it might also incorrectly perceive an increase in the return to domestic investment in response to the increase in employment, so that μ will become positive. As can be seen from equation (22), this increase in μ will increase the devaluation necessary to produce a one-percent increase in employment. However, while it is quite plausible that consumers might not fully realize the transitory nature of the increase in their current incomes and, even if they were to do so, smooth their consumption by investing the transitory increase in income in consumer-durables, it is difficult to imagine firms basing their investment plans on transitory deviations of employment from its long-term equilibrium level.

As a rough guess one might conclude that to get a one percent increase in the fraction of the labour force employed, a monetary expansion sufficient to reduce the nominal (and real) exchange rate by between 5 and 6 percent will probably be required.

This process can be seen graphically in Figure 11 above. A fall in the real exchange rate from **a** to **b** will, because of the simultaneity issues involved, increase the current account balance by less than **c d** for one definite reason plus

Figure 11. Real Exchange Rate Determination



another plausible reason. First, the associated short-run increase in employment will increase domestic relative to foreign output, reducing its value in world markets and shifting the **BT** curve downward to the left. In addition, it is quite likely that domestic residents will not realize that the observed increase in output and income is entirely transitory, with the result that consumer spending will increase, shifting the **BT** curve downward to the left by an additional amount. The increase in the current account balance, and in savings relative to investment will thus be of a magnitude like **c e**. And in this event, although the current account balance will increase by less, the level of employment and income will increase by more as a consequence of the multiplier effect of the increase in consumption.

Finally, the fact that a monetary expansion induced fall in the real exchange rate of between five and six percent will increase domestic employment by one percentage point does not mean that the Bank of Canada should try to use nominal exchange rate manipulation to achieve less variability of the Canadian unemployment rate. First of all, as the Bank of Canada begins moving the nominal and real exchange rates it loses sight of their equilibrium levels and, hence, the magnitude of the effect of its policy. Second, the Bank of Canada observes the unemployment rate and current output with a substantial lag, and the effects of its change in the real exchange rate on output and employment will only take place after a further lag. As a result, the expansion of employment induced by Bank policy may well begin to occur just as the economy is recovering from the recession and thereby accentuate subsequent inflationary pressure. Monetary manipulation of the nominal and real exchange rates is a useful policy

only under the circumstances in which the Bank of Canada needs to bring about a significant change in the underlying domestic core inflation rate, or in the event of a catastrophic world and or U.S.crises.

Attempts to bring down an unsatisfactory inflation rate force the monetary authorities to grapple with serious problems. As soon as the authorities push up the real and nominal exchange rates they lose track of their full-employment equilibrium levels. If the Canadian unemployment rate is rising relative to the unemployment rate in the United States, however, and there are no institutional causes relating to the provision of unemployment insurance, the Bank of Canada will have thereby a likely measure of the magnitude of its tight-money policy. Given that this monetary contraction was preceded by an announced and actual increase in the overnight rate, the Bank can announce that it will not lower that rate on the basis of higher existing unemployment because the inflation rate must fall. This should induce a decline in the expected inflation rate. The Bank's problem then is to decide when the expected inflation rate has in fact fallen sufficiently—actual inflation rates respond only with time and the process may take as much as a year even in the best of circumstances. Once the actual inflation rate has adjusted, the Bank can lower the overnight rate appropriately and resume an orderly markets approach to policy, thereby financing the public's new lower anticipated inflation rate.

Appropriate reactions to a major crisis in the U.S. and the world at large are even more difficult to decide upon because real and nominal exchange rates may move directly in response to public views as to the nature and magnitude of the crisis. Although this is a matter of judgment, it is probably reasonable to conclude that, given reasonable estimates of the demand function for liquidity, the real resource costs of an unacceptable increase in the inflation rate are probably smaller than the costs of a major depression.

Of course, while monetary policy necessarily operates through movements of the real and nominal exchange rates, there is no reason for the Bank of Canada to engage in public discussion regarding the pressures it is putting or planning to put on the Canadian dollar. It should merely announce future monetary expansion or contraction through its changes in the overnight borrowing rate and give the reasons why. The last thing the Bank of Canada needs is to be regarded as responsible for the level of the dollar in the international market and therefore be under constant pressure from some private interests to raise the value of the dollar and from others to lower it.

In this regard it is important to make clear that there is no way that the monetary authorities can bring about a permanent change in the real exchange rate. Once wages and prices have adjusted to policy-induced changes in aggregate demand and employment the price level will have changed to completely reverse the policy-induced change in the real exchange rate and the nominal

value of the currency will have adjusted proportionally in the opposite direction to the price level. Attempts to permanently lower the real exchange rate will merely result in continual increases in the domestic inflation rate.

V: Conclusions

In closing it is useful to briefly restate the conclusions emanating from the above research. First, given the equilibrium movements in the full-employment real exchange rate, it makes no sense for Canada to fix its exchange rate with respect to the U.S. dollar unless complete freedom of labour migration between the countries is allowed, which would essentially require political union of the two countries sufficient to make the Canadian Provinces economically equivalent to the U.S. States. Second, given the variability of the equilibrium levels of the available measures of liquidity in Canada, and the problem of exchange-rate overshooting, it makes no sense for a country like Canada to attempt to implement a constant rate of money growth. Third, given the fact the Canadian economy is embedded in a world capital market, the Bank of Canada cannot conduct monetary policy by bringing about changes in the level of Canadian real interest rates relative to those abroad—monetary policy has to operate through its effects on nominal and real exchange rates. Fourth, to prevent exchange rate overshooting under a flexible exchange rate regime, the Bank of Canada must ensure that domestic money supply and demand changes do not lead to period-to-period movements of the real and nominal exchange rates beyond a reasonable trading range. Fifth, by maintaining control of the overnight borrowing/lending rates between the banking system and the Bank of Canada itself, the authorities can bring about changes in commercial bank reserves and thereby induce relatively smooth pressures on the domestic real and nominal exchange rates as well as effects on expected future inflation rates, which it will end up indirectly financing by an orderly markets approach to policy. Sixth, it appears that the Bank would have to expand the money supply sufficiently, possibly by lowering the target overnight rate, to lower the real exchange rate by between 5 and 6 percent to increase employment by one percent of the labour force. Finally, the evidence is quite conclusive that the Bank of Canada has recently been successful in eliminating the potential destabilizing effects of unanticipated money demand shocks on the country's real and nominal exchange rates while maintaining an appropriate monetary policy.

Technical Appendix

The sources of the data series used in this study are as follows, where IMF/IFS refers to the *International Monetary Fund: International Financial Statistics*, FRED refers to the Federal Reserve Bank of St. Louis database, NIAS refers to the United States National Income Accounts Statistics. An additional database used was the Canadian database CANSIM.

1) Canadian Nominal Exchange Rate ($Can per $US)— IMF/IFS 156/RF
2) Japanese Nominal Exchange Rate (Yen per $US) — FRED EXJPUS
3) U.K. Nominal Exchange Rate ($US per Pound) — FRED EXUSUK
4) Euro Area Nominal Exchange Rate (Euro's per US$) — IMF/IFS 163/RF
5) US$ Prices of Commodities Less Energy — CANSIM V36383 and V52673497
6) US$ Prices of Energy — CANSIM V36384 and V52673498
7) Canadian Consumer Price Index — IMF/IFS 156/64
8) United States Consumer Price Index — IMF/IFS 111/64
9) Japanese Consumer Price Index — FRED JPNCPIALLQINMEI
10) United Kingdom Consumer Price Index — FRED GBRCPIALLMINMEI
12) Euro Area Consumer Price Index — IMF/IFS 163/64H
13) Index of United States Export Prices — IMF/IFS 111/75
14) Index of United States Import Prices — IMF/IFS 111/76X
16) Index of Canadian Export Prices — IMF/IFS 156/75
17) Index of Canadian Import Prices — IMF/IFS 156/74
18) Canadian Nominal GDP — IMF/IFS 156/98B.C
19) Canadian National Income — IMF/IFS 156/99A.C
20) United States Nominal GDP — IMF/IFS 111/98B.C
21) Canadian Implicit GDP Deflator — IMF/IFS 156/99BIR
22) United States Implicit GDP Deflator — IMF/IFS 111/99BIR
23) United Kingdom Implicit GDP Deflator — IMF/IFS 112/99BIR
24) Canadian Exports of Goods and Services — IMF/IFS 156/90C.C
25) Canadian Imports of Goods and Services — IMF/IFS 156/98C.C
26) U. S. Exports of Goods and Services — IMF/IFS 156/90C.C
27) U. S. Imports of Goods and Services — IMF/IFS 98C.C
28) Canadian Government Consumption Expenditure — IMF/IFS 156/91F.C
29) Canadian Private Sector Consumption Expenditure — IMF/IFS 156/96F.CZ
30) U. S. Government Consumption Expenditure — IMF/IFS 111/91F.C
31) Canadian Percentage of Labour Force Unemployed — CANSIM V2062815
32) U. S. Percentage of Labour Force Unemployed — FRED UNRATE

33) Canadian Base Money — CANSIM V37145

34) Canadian M1 — IMF/IFS 156/34..B and V37127

35) Canadian M2 — IMF/IFS 156/34B + 136/35 and CANSIM V37128

36) U. S. Base Money — FRED BOGAMBNS

37) U. S. M1 — FRED M1NS

38) U. S. M2 — FRED M2NS

39) Canadian Gross National Income — IMF/IFS 156/99AC

40) Canadian Private Sector Consumption — IMF/IFS 156/99F.CZ

Statistical Analysis

The main calculations are performed in `XLispStat` using the function files (written by the present author) `addfuncs.lsp` and `ourfuncs.lsp` and the input file `rexcaus.lsp` which produces the output file `rexcaus.lou` using the data files `causqdat.lsp` and `moneydat.lsp`. Embedded in the input file `rexcaus.lsp` is another input file `monshkca.lsp`, also available separately, which generates the unanticipated money shock series using the data in `moneydat.lsp`, storing them in the file `umskcaus.lsp`.

The real exchange rate analysis, excluding analysis of the effects of unanticipated money shocks, is cross-checked in a `Gretl` session using the session file `rexcaus.gretl` which includes a file containing the data used and generated in the session.

Data on the shares of consumption and imports in total income are collected in the `Excel` worksheet file `conincca.xls` where the relevant calculations are also performed.

All the plots shown in the paper are constructed in `R` using the input script file `rexcaus.R` which draws on the data files `causqdat.tab`, `gconcaus.tab`, `pexpimpca.tab`, `ipduk.tab`, `umskcaus.tab`, `moneydat.tab` and `cpidata.tab`. These data files contain everything one would need to reproduce using `R` the statistical analysis performed in `XLispStat`.

The Granger causality analysis is performed in `Gretl` using the input file `rexmcaus.inp` which draws on the data file `causmdat.gdt` and produces the output file `rexmcaus.got`.

References

Agénor, Pierre-Richard (1998) 'Capital Flows, External Shocks and the Real Exchange Rate,' *Journal of International Money and Finance*, 17, 713-740

Amano, Robert A, and Simon Van Norden (1995) 'Terms of Trade and Real Exchange Rates: The Canadian Evidence,' *Journal of International Money and Finance*, 14, 83-104

Bachus, David, and Gregor Smith (1993) 'Consumption and Real Exchange Rates in Dynamic Economies with Nontraded Goods,' *Journal of International Economics*, 35, 297-316

Balassa, B (1964) 'The Purchasing Power Parity Doctrine: A Reappraisal,' *Journal of Political Economy*, 72, 584-96

Betts, C. and Michael B. Devereux (2000) 'Exchange Rate Dynamics in a Model of Pricing to Market,' *Journal of International Economics*, 50, 215-44

Carr, J.L. and John E. Floyd (2001) 'Real and Monetary Shocks to the Canadian Dollar: Do Canada and the United States From an Optimal Currency Area,' *North American Journal of Economics and Finance*, 13, 21-39

Devereux, Michael B. (1997) 'Real Exchange Rates and Macroeconomics: Evidence and Theory,' *Canadian Journal of Economics*, 30, 773-808

Dornbusch, Rudiger (1976) 'Expectations and Exchange Rate Dynamica,' *Journal of Political Economy*, 84, 1161-1176

Edwards, Sebastian (1989) *Real Exchange Rates, Devaluation and Adjustment*, MIT

Fleming, J.M. (1962) 'Domestic Policies under Fixed and Flexible Exchange Rates,' *International Monetary Fund Staff Papers 9*, 369-79

Floyd, John E. (2010) *Interest Rates, Exchange Rates and World Monetary Policy*, Heidelberg: Springer Verlag

Frances, Bill and Iftekhar Hassan and James R. Lothian (2001) 'The Monetary Approach to Exchange Rates and the Canadian Dollar Over the Long Run,' *Applied Financial Economics*, 11, 475-481

Gilbert, R.A. (1985) 'Requiem for Regulation Q: What It Did and Why It Passed Away,' *Federal Reserve Bank of St. Louis Review*, 22-37

Granger, C.W.J. (1969) 'Investigating Causal Relations by Econometric Methods and Cross-Spectral Methods,' *Econometrica*, 37, 424-38

Hoffman, Mathias (2007) 'The Timing and Magnitude of Exchange Rate Overshooting,' *Deutsche Bundesbank Discussion Paper 28*

Johnston, John W. (1993) 'Real and Nominal Exchange Rate Determination in a Small Open Economy: An Empirical Investigation of the Canadian Case,' University of Toronto Ph.D Thesis

Lastrapes, William D. (1992) 'Sources of Fluctuations in Real and Nominal Exchange Rates,' *Review of Economics and Statistics*, 74, 530-39

Mundell, R.A. (1963) 'Capital Mobility and Stabilization Policy Under Fixed and Flexible Exchange Rates,' *Canadian Journal of Economics and Political Science*, 29, 475-85

Murray, John (2000) 'Why Canada Needs a Flexible Exchange Rate,' *North American Journal of Economics and Finance*, 11, 41-60

Neary, Peter (1988) 'Determinants of the Equilibrium Real Exchange Rate,' *American Economic Review*, 78, 210-215

Ragan, Christopher (2005) 'The Exchange Rate and Inflation Targeting,' *Bank of Canada Working Paper 2005-34*

Samuelson, Paul A. (1964) 'Theoretical Notes on Trade Problems,' *Review of Economics and Statistics*, 46, 145-54

Yu Sheng and Xinpeng Xu, (2011) 'Real Exchange Rate, Productivity and Labor Market Frictions,' *Journal of International Money and Finance*, 30, 587-603