"Expectations and Monetary Policy in An Open Economy: Should Canada Follow U.S. Interest Rates?"
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Working Paper No. 293 January 1982
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The purpose of this paper is to analyse the appropriate response of monetary policy in Canada to disturbances in the capital account of the balance of payments. In particular we consider the question of whether an increase in U.S. interest rates should be accommodated by a comparable increase in Canadian rates, a depreciation of the Canadian dollar, or some combination of the two. In commenting on the Bank of Canada's options in the face of a rapid increase in U.S. short-term rates, Governor Gerald Bouey stated:

The Bank of Canada could, if it chose, try to resist firmly the upward pressure on Canadian short-term interest rates exerted by steeply rising interest rates abroad and accept the inflationary repercussions on our own economy of a sharp decrease in the foreign exchange value of the Canadian dollar as investors responded to the widening gap between interest rates in this country and the rates obtainable south of the border. On the other hand the Bank of Canada could, if it chose, firmly resist any downward pressure on the Canadian dollar by ensuring that short-term interest rates in this country rose as fast and as far in relation to rates abroad as might prove necessary for the purpose. In fact the Bank of Canada has chosen a course of policy which lies between these two extremes.

In defending the Bank of Canada's policy of resisting exchange rate depreciation the governor argued as follows:

The reason why there is a very real limit to how far the Bank of Canada can prudently go in present circumstances in insulating the Canadian interest rate structure from steeply rising interest rates abroad and accepting the exchange rate consequences of such a policy is the danger of making our already severe inflation problem considerably worse. It would not be safe to assume that the consequent decline in our dollar, or the high U.S. interest rates that precipitated it, would be quickly reversed. We could expect the domestic prices we have to pay for our imports and for the export-related commodities we consume here in Canada to rise before long by a substantial proportion of the percentage decline in the foreign exchange value of the Canadian dollar. In Canada's current environment of highly charged fears and expectations of worsening inflation, a substantial jump in prices that raised our present double-digit inflation rate
even higher would be likely to trigger a further escalation of wage increases.

Thus the stated policy of the Bank of Canada is to adopt a middle ground. The analysis of this strategy presented below identifies two important considerations. First, the appropriate response depends on whether the increase in the foreign interest rate is transitory or permanent, and second, it depends on whether the increase in the foreign nominal interest rate represents an increase in the real rate or an increase in the expected foreign rate of inflation. The model to be used is outlined in Section I below and in Section II we consider the effects of a transitory change in the foreign interest rate. The case of a permanent change is considered in Section III and conclusions are stated in Section IV.

I The Model

We consider a small open economy that faces given foreign prices and interest rates and we distinguish between nontraded and traded goods in describing goods market equilibrium. The model draws heavily on Dornbusch (1976a, 1976b) and Turnovsky (1981), but extends their analysis by using a staggered wage contract approach to aggregate supply. The following system of equations describes the model:  

\[ M = b_0 - b_1 r + b_2 Y + P \]  \hspace{1cm} (1)

\[ r = r^* + \tilde{E}_{0,1} - E \]  \hspace{1cm} (2)

\[ N^d = c_0 + c_1 Y - c_2 (r - \tilde{P}_{0,1} + P) + c_3 Q + c_4 G \]  \hspace{1cm} (3)
\( N^s = d_0 + d_1 (p^N - W) \)  
(4)

\( N^d = N^s = N \)  
(5)

\( T = e_0 + e_1 (P^T - W) \)  
(6)

\( Y = \gamma N + (1 - \gamma) T \)  
(7)

\( P^T = E + P^* \)  
(8)

\( W = \sum_{i=0}^{N} \beta_i [p^T_{i-1,0} - Q_{i-1,0}] \)  
(9)

\( Q = p^T - P^N \)  
(10)

\( P = \gamma P^N + (1 - \gamma) P^T \)  
(11)

\( P^C = \lambda P^N + (1 - \lambda) P^T \)  
(12)

The notation is defined as follows (upper case letters denote logarithms):

- **E**: exchange rate (domestic currency price of foreign exchange).
- **G**: government expenditures on non-traded goods.
- **M**: nominal money stock.
- **N**: output of non-traded goods (superscripts s and d indicate supply and demand respectively).
- **P**: domestic price level (GNP deflator).
Equation (1) equates the real money stock to the demand for real balances and Equation (2) is the interest parity condition that equates the domestic interest rate to the foreign rate plus the expected rate of depreciation of the domestic currency. The third equation relates the demand for non-traded goods to income, the real interest rate, the relative price of traded and non-traded goods, and government demand, while the supply curve for non-traded goods is represented by Equation (4). Equation (5) is the equilibrium condition for the non-traded goods market and equation (6) determines the output of traded goods. The wage rate is determined by equation (9) which is discussed further below, and the remaining equations are identities that define real income, and various price indexes.

Since the focus of this paper is on the effects of interest rates and the exchange rate on the domestic rate of inflation, the specification of the supply
side plays a key role. To begin with a choice has to be made between the traditional separation of goods into domestically produced exportables and foreign produced importables, and the alternative approach which distinguishes between domestic non-traded goods and traded goods which are domestically produced and may be either imported or exported at prices determined in world markets. The latter approach is used here as it is clearly more relevant to a small open economy like Canada with a substantial fraction of exports accounted for by raw materials. It allows for a direct effect of changes in the exchange rate on the price of domestic output as well as direct effects operating via the non-traded goods market.

To incorporate these influences, we use the aggregate supply model formulated by Gray (1976) and utilized in an open economy context by Turnovsky (1981). This approach is generalized by assuming staggered contracts as is done by Fischer (1977) and Taylor (1980). This approach allows for wage-price spiral effects operating through current wage negotiations while maintaining some stickiness of wages and prices to account for unemployment.

We assume that wage contracts are for n+1 periods and stipulate the wage rate to be paid in the current period and each of the n future periods. The wage rate negotiated in period t-i for period t (V_{t-i,t}) is determined by anticipated labor demand in the traded and non-traded goods industries, which depends on the real wage in terms of the expected prices of output (\hat{P}_t^T_{t-i,t} and \hat{P}_t^N_{t-i,t}), and labor supply which depends on the real wage in terms of the expected consumption goods price index (\hat{P}_t^C_{t-i,t}). In particular, we postulate:

$$V_{t-i,t} = \alpha \left[ \delta \hat{P}_{t-i,t}^N + (1-\delta) \hat{P}_{t-i,t}^T \right] + (1-\alpha) \hat{P}_{t-i,t}^C$$
Using equations (10) and (12), this expression can be simplified to:

\[ V_{t-i,t} = \frac{\tilde{p}^T}{t-i,t} - \Theta Q_{t-i,t} \]

where

\[ \Theta = \alpha \delta + (1-\alpha) \lambda \]

Assuming the average wage rate in period \( t \) is given by:

\[ W_t = \sum_{i=0}^{n} \beta_i V_{t-i,t} \quad (\sum_{i} \beta_i = 1) \]

we arrive at equation (9). Actual labor demand and output of non-traded and traded goods are then determined by the wage rate and actual prices as indicated in equations (4) and (6) respectively.

To simplify our model, we reduce it to four equations as follows. First we substitute (6) and (7) into (3) to obtain:

\[ N^d = f_0 + f_1 p^{T-W} - f_2 (r-P_{0,1} + P) + f_3 Q + f_4 G \quad (3') \]

where

\[ f_0 = (1-c_1 \gamma)^{-1} [c_0 + c_1 (1-\gamma) e_o] \]
\[ f_1 = (1-c_1\gamma)^{-1}[c_1(1-\gamma)e_1] \]

\[ f_i = (1-c_i\gamma)^{-1}c_i \quad i=2,3,4 \]

Substituting (8), (10) and (11) into (2), we can write:

\[ r-P_{0,1}^{\*}P = r^*-P^{\*}P^* + \gamma(Q_{0,1}^{\*}Q) \quad (2') \]

Substituting (10) into (4) and combining (2'), (3'), (4) and (5) yields the equilibrium condition for the non-traded goods market in the following form:

\[ (d_1+f_3)Q - \gamma f_2 (Q_{0,1}^{\*}Q) - (d_1-f_1)(P^T-W) = Z \quad (5') \]

where

\[ Z = d_0-f_0 + f_2(r^*-P^{\*}P^*) - f_4G \]

Equations (5'), (9), (2) and (8) constitute four equations in \( E, P^T, Q \) and \( W \) that can be solved for given \( r, r^*, G \) and expectations. Since we treat \( r \) as the instrument of monetary policy, equation (1) serves merely to determine the money supply.

II Effect of A Transitory Change in the Foreign Interest Rate.

Let us assume that the central bank controls the domestic interest rate and that the objective of policy is to insulate the domestic rate of inflation from
the effects of changes in the foreign rate of interest. We first consider an unanticipated transitory increase in the foreign rate. In this case expectations of current and future variables will be unchanged so that equations (2), (8), (5') and (9) reduce to:

\[ \Delta r + \Delta E = \Delta r^* \]
\[ \Delta P^T = \Delta E \]
\[ (d_1 + f_3 + \gamma f_2) \Delta Q = (d_1 - f_1) (\Delta E - \Delta W) + f_2 \Delta r^* \]
\[ \Delta W = \beta (\Delta E - \theta \Delta Q) \]

where
\[ \beta = \beta_0 \]

Using (10) and (11) the domestic price level can be written as:

\[ P = P^T - \gamma Q \]

so that the condition for no change in \( P \) is:

\[ \Delta E = \gamma \Delta Q \]

The solutions for \( \Delta E \) and \( \Delta r \) can be written in the form:

\[ \Delta E = \nu \Delta r^* \]
\[ \Delta r = (1 - \nu) \Delta r^* \]

where
\[ v = \gamma f_2 \left[ \gamma f_2 + f_3 + \phi f_1 + (1-\phi) d_1 \right]^{-1} \]

\[ \phi = (1-\beta) \gamma + \beta \theta \]

\[ 0 < \nu < 1 \]

Thus the policy response that maintains a constant rate of inflation given an increase in the foreign interest rate involves a smaller increase in the domestic rate combined with an exchange rate depreciation. The depreciation raises the domestic price level via four channels:

1. It raises \( P^T \) which feeds directly into \( P \).
2. The increase in \( P^T \) increases \( N^d \) and therefore \( P^N \) via the relative price \( Q \).
3. The increase in \( P^T \) increases \( N^d \) and therefore \( P^N \) via \( T \) and \( Y \).
4. Increases in \( P^N \) and \( P^T \) cause a further increase in \( P^N \) via \( W \).

The increase in the domestic interest rate reduces \( N^d \) thereby offsetting (2), (3) and (4) and inducing a net decrease in \( P^N \) to offset (1).

The change in real income resulting from the policy response described by (13) is given by:

\[ \Delta Y = (1-\gamma) (e_1 - d_1) \Delta E - (\gamma d_1 + (1-\gamma) e_1) \Delta W \]

The effect on total income is ambiguous for two reasons. First, a depreciation leads to a shift in production from non-tradeable to tradeable goods with the net effect depending on the relative elasticities of supply as indicated in the first
term in the above expression. Second, the change in the wage rate is ambiguous since it depends positively on $P^N$ and $P^T$ which move in opposite directions. Thus it is not clear that a policy of insulating the domestic rate of inflation involves a tradeoff between unemployment and inflation of the usual Phillips curve type.

III Effect of a Permanent Change in the Foreign Interest Rate.

Suppose now that the change in the foreign rate is perceived to be permanent. In this case, the interest parity condition cannot be accommodated simply by a change in the spot exchange rate since the rate will not be expected to return to its initial equilibrium level. The effect on the expected future exchange rate will depend on whether or not the change in the foreign rate of interest represents a change in the real rate.

If we have an increase in the foreign rate that is perceived to be an increase in the nominal rate only caused by an increase in the expected rate of foreign inflation, there will be no effect on the domestic economy if the central bank takes no action to change the domestic interest rate. The interest parity condition (2) will be maintained by a fall in the expected future exchange rate ($E_{0,1}$) equal to the rise in the foreign interest rate ($r^*$). The relative price of traded goods ($Q$) will be expected to remain constant since the expected rise in the foreign rate of inflation will be offset by an expected appreciation of the domestic currency. Thus, the domestic rate of inflation and real income are unaffected.\(^6\)

Now suppose that the change in the foreign interest rate represents an increase in the real rate of interest with no change in expected inflation.
Consider first the comparative statics of the long-run adjustment of the domestic economy. In a steady state with \( Q \) constant and \( \Delta E = \Delta P - \Delta P^* \), our model reduces to:

\[
\begin{align*}
\Delta P = r^* - \Delta P^* \\
Q = h^{-1}(d_0 - f_0 + f_2(r - \Delta P) - f_4 G)
\end{align*}
\]

where

\[
h = f_3 + \theta f_1 + (1-\theta)d_1
\]

The effects of a change in the foreign real rate of interest are illustrated in Figure 1. Equation (14) indicates equality of the foreign and domestic real rates of interest and is represented by the horizontal schedules \( r'r' \) and \( r'r'' \). Equation (15) describes the combinations of \( r-\Delta P \) and \( Q \) consistent with equilibrium in the market for non-traded goods and is represented by the schedule NN. An upward shift in the \( rr \) schedule moves the equilibrium point from \( A \) to \( D \) and involves an increase in the relative price of traded goods to offset the reduction in demand caused by the increase in the real rate of interest.

To determine the adjustment path to the new long-run equilibrium, we require a solution for expectations. Taking expectations conditional on information available at time \(-m\) in equations (2), \((5')\), (8) and (9) we obtain:

\[
\tilde{r}_{-m,0} = \tilde{r}^*_{-m,0} + \tilde{E}_{-m,1} - \tilde{E}_{-m,0}
\]
Figure 1

A Change in the Foreign Real Rate of Interest.
\[(d_1+f_2+\gamma f_2)Q_m,0 - \gamma f_2 Q_m,1 - (d_1-f_1)(p_t^T - \tilde{w}_{m,0}) = \tilde{z}_{m,0} \quad (17)\]

\[\tilde{p}_m^T = E_{m,0} + p_{m,0} \quad (18)\]

\[\tilde{w}_{m,0} = \sum_{i=0}^{n+1} \beta_i [p_t^T - \tilde{Q}_{m,0}] = p_t^T - \tilde{Q}_{m,0} \quad (19)\]

Substituting (18) and (19) into (17) yields:

\[(h+\gamma f_2)Q_{m,0} - \gamma f_2 Q_{m,1} = \tilde{z}_{m,0} \quad (20)\]

The stable solution to (20) is

\[Q_{m,0} = (h+\gamma f_2)^{-1} \sum_{t=0}^{\infty} \mu t \tilde{z}_{m,t} \quad (21)\]

where

\[\mu = (h+\gamma f_2)^{-1} \gamma f_2\]

It follows that a permanent increase in the foreign real interest rate that occurs in period \(t\), but is not anticipated in period \(t-1\), will lead to an adjustment of \(Q\) to the new long-run equilibrium value in period \(t+1\). The same holds true for output of traded and non-traded goods.

The behavior of the domestic rate of inflation and the exchange rate will depend on central bank policy with regard to the domestic interest rate. To avoid a permanent increase in the rate of inflation it will obviously be
necessary to raise the domestic interest rate ultimately by the same amount as the foreign rate. The question remains as to the optimal response in the current period.

The impact effect of an increase in the foreign rate can be obtained from equations (2), (5'), (8) and (9) as follows:

\[ \Delta r = \Delta r^* + \Delta E_{0,1} - \Delta E \]

\[ \Delta P^* = \Delta E \]

\[ (d_1+f_3+\gamma f_2)\Delta Q = (d_1-f_1)(\Delta E-\Delta W) + \gamma f_2 \Delta Q_{0,1} + f_2 \Delta r^* \]

If we assume that the total change in \( r \) in the current and following period matches the change in \( r^* \), then

\[ \Delta E_{0,1} = 0 \]

and from (15), it follows that

\[ \Delta Q_{0,1} = h^{-1} f_2 \Delta r^* \]

To maintain the domestic rate of inflation constant, we again impose the condition \( \Delta E = \gamma \Delta Q \). Solving for \( \Delta E \), we obtain

\[ \Delta E = (1-\mu)^{-1} \nu \Delta r^* \]
where $u$ is defined in (21) and $v$ is defined in Equation (13) of Section II above. Thus the required depreciation is larger and the increase in the domestic rate is smaller than in the case of a transitory increase in the foreign rate.

Given this policy response, the path of the domestic economy will involve a current period equilibrium at a point like C in Figure 1 and a subsequent movement to D. An alternative strategy in response to an increase in the foreign real rate of interest would be to use a mixture of monetary and fiscal policy. This would permit an immediate movement to the long-run equilibrium point labeled B in Figure 1. Monetary policy is used to accommodate an increase in the domestic interest rate that matches the increase in the foreign rate, and expansionary fiscal policy is used to offset the depressing effect of higher interest rates on domestic demand.
IV Conclusions.

In general the analysis of this paper supports the policy of the Bank of Canada of responding to increases in the foreign rate of interest with a smaller increase in the domestic rate of interest and a depreciation of the Canadian dollar. Raising the domestic rate to match the increase in the foreign rate would have a deflationary effect on the domestic economy, while maintaining the domestic interest rate would lead to domestic inflation via the direct effect of a depreciation on traded goods prices and indirect effects via the labor market and the non-traded goods market. Two qualifications to this argument emerge. First, if the rise in the foreign rate is an increase in the nominal rate only caused by an increase in the expected rate of foreign inflation, the domestic interest rate can be maintained unchanged with no effects on the domestic economy. The interest parity condition will be maintained by a decrease in the expected rate of depreciation of the domestic currency. Second, if the rise in the foreign rate is a permanent increase in the real rate, a smaller increase in the domestic rate will be an appropriate policy only in the short run. Ultimately the domestic rate must be raised by the same amount as the foreign rate to avoid a permanent increase in the domestic rate of inflation.

2. Signs are included in the equations so as to make all parameters positive, and Greek letters are used for those that lie between zero and one. Time subscripts are omitted on current period realized values of variables.

3. For a comprehensive discussion of exchange rates and the inflationary process, see Dornbusch and Krugman (1976).

4. For a discussion of the latter approach and its antecedents in the literature, see Dornbusch (1974).

5. To insure that \( f_i > 0, i=0,1,...,4 \), we make the reasonable assumption that \( c_1 y < 1 \).

6. If there is a lag in the adjustment of exchange rate expectations, the analysis of temporary changes presented above will apply in the short run and there will be an international differential in real interest rates. For a model of the adjustment process that focusses on this differential, see Frankel (1979).

7. This schedule is analagous to the one used by Dornbusch (1976a, p. 258). However our analysis differs from Dornbusch's in that we do not impose trade balance as a condition of equilibrium.
References.


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