Overshooting and the Canadian Exchange Rate

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Abstract

This paper tests the Dornbusch overshooting hypothesis for Canadian nominal exchange rates using a VAR of Canadian, American, Japanese, and British data from January 1975 to December 2004. It finds that delayed overshooting occurs and rejects Dornbusch's hypothesis.

1 Introduction

Since its publication in 1976, Rudiger Dornbusch's "Expectations and Exchange Rate Dynamics" paper been has been cited in over 1,000 published articles and included in the reading list of almost every top-ranked graduate international finance course because of its elegant explanation of why instantaneous movements in exchange rates tend to exceed their long-run values. While investigations of nominal exchange rate fluctuations show that exchange rates overshoot in response to a monetary shock, the overshooting reaches its zenith between three months and three years after the shock. This contradicts Dornbusch's hypothesis that the maximum level of overshooting occurs instantaneously. This paper investigates whether Dornbusch's hypothesis holds for changes in the nominal exchange rates of Canada's major trading partners - the Canadian-U.S. Dollar, Canadian Dollar-Yen and Canadian Dollar-British Pound exchange rates - with data from January 1975 to December 2004. It finds that delayed overshooting occurs with the maximum overshoot occurring 18, 31, and 13 months, respectively, after a monetary shock and therefore rejects Dornbusch's hypothesis. Section 2 summarizes Dornbusch's model and the previous econometric tests of it, Section 3 discusses the data used to test it, Section 4 presents the results, and Section 5 offers the conclusion.

2 Literature review

Assume that a small country with perfect capital mobility exists. The country takes the world nominal interest rate, i^*, as exogenously determined. This implies that uncovered interest rate parity, expressed in equation 1 where e is the nominal exchange rate, holds. All variables in this paper, except interest rates, are expressed in logarithms.

$$i_{t+1} = i^* + E_t(e_{t+1} - e_t). \tag{1}$$

The demand for money, equation 2, is a function of the money supply, m, the price level, p, interest rate, i, and output, y.

$$m_t - p_t = -\eta i_{t+1} + \phi y_t. \tag{2}$$

Output and the price level are sticky so they adjust sluggishly as described in equation 3 and 4. Long-run equilibrium rates are denoted with bars and foreign variables with asterisks. Aggregate demand is denoted as y_t^d, and the real exchange rate is denoted as q and defined in equation 5.

$$y_t^d = \overline{y} + \delta(e_t + p^* - p_t - \overline{q}),\ \delta > 0. \tag{3}$$

$$p_{t+1} - p_t = \psi(y_t^d - \overline{y}) + e_{t+1} - e_t. \tag{4}$$

$$q \equiv e + p^* - p. \tag{5}$$

The money market reacts instantly so it is always in equilibrium. In the long run money is neutral so that a permanent change in the money supply yields a proportional change in the long-run price level and long-run nominal exchange rate. Since output and the price level are temporarily fixed, any increase in the money supply must result in an instantaneous proportional decrease in the interest rate. The uncovered interest parity condition implies that this must result in an expected appreciation in the exchange rate. In the long run, however, an increase in the money supply must lead to a long-run depreciation of the exchange rate. Dornbusch's model reconciles these two seemingly contradictory statements by predicting the initial exchange rate depreciation is greater than it its long-run depreciation, *i.e.* it overshoots. This leaves room for the later appreciation to bring the exchange rate to its long-run level. Mathematically the overshoot may be expressed as

$$m_t - e_t + q_t = -\eta(e_{t+1} - e_t) + \phi\delta(q_t - \overline{q}). \tag{6}$$

The parameterization of the adjustment function expressed in equation 6 is too complex to test economically. In their 1995 paper, "Some Empirical Evidence on the Effects of Shock to Monetary Policy on Exchange Rate," Martin Eichenbaum and Charles Evans suggest using a VAR to estimate the effect of a monetary shock on the exchange rate because a VAR does not require a specific parameterization of the model and the effect of shocks to the system are easy to estimate. In their paper they investigate the response of the U.S. Dollar-Yen, U.S. Dollar-Deutschmark, U.S. Dollar-Lira, and U.S. Dollar-British Pound nominal exchange rates to monetary shocks using an unstructured VAR. The VAR contains data on U.S. output, price level, the ratio of non-borrowed reserves to total reserves, which act as a monetary policy variable, the U.S. and foreign interest rates, and the exchange rate. They find that while overshooting does occur, maximum impact on the exchange rates occurs 24 to 39 months later. Because monetary shocks accounted for between 18 and 43 percent of exchange rate variance, they consider monetary policy an important determinate of the exchange rate even though they reject Dornbusch's overshooting hypothesis. Their results have come to be known as the delayed overshooting result.

Richard Clarida and Jodi Gali use a structured VAR, which includes measures of output, the price level and the exchange rate, to investigate the effect of shocks on the U.S.-Canadian Dollar, U.S. Dollar-British Pound, U.S. Dollar-Deutschmark and U.S. Dollar-Yen nominal exchange rates. In their paper, "Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?" published in 1994, they find that monetary shocks cause exchange rates to overshoot, with the maximum overshoot occurring approximately three months after the shock.

This paper will use a bivariate VAR to estimate the effect of monetary shocks to the Canadian-U.S. Dollar, Canadian Dollar-Yen, and Canadian Dollar-British Pound nominal exchange rates. The overnight interest rate will represent the monetary policy variable. If the maximum effect to the system occurs within one month of the shock, then Dornbusch's overshooting hypothesis will be said to hold.

3 Data

The data begin in January of 1975, when the immediate aftershocks of the collapse of the Bretton-Woods system had worn off. Observations are collected monthly until December 2004. The data come from the International Monetary Funds's International Financial Statistics database. The central banks' discount rates are taken from line 60 and exchange rates from line 63.

4 Results

Graphs of the impulse response functions clearly show that that while overshooting begins immediately after a monetary shock it does not reach its zenith until 18 months after the shock for the Canadian-U.S. Dollar exchange rate, 31 months later for the Canadian Dollar-Yen exchange rate, and 13 months later for the Canadian Dollar-British Pound exchange rate. A decomposition of variance shows that in the long run, monetary shocks account for, respectively, 32, 16, and 15 per cent of the variance in the exchange rate. These results are consistent with delayed overshooting that Eichenbaum and Evans observe.

Figure 1:

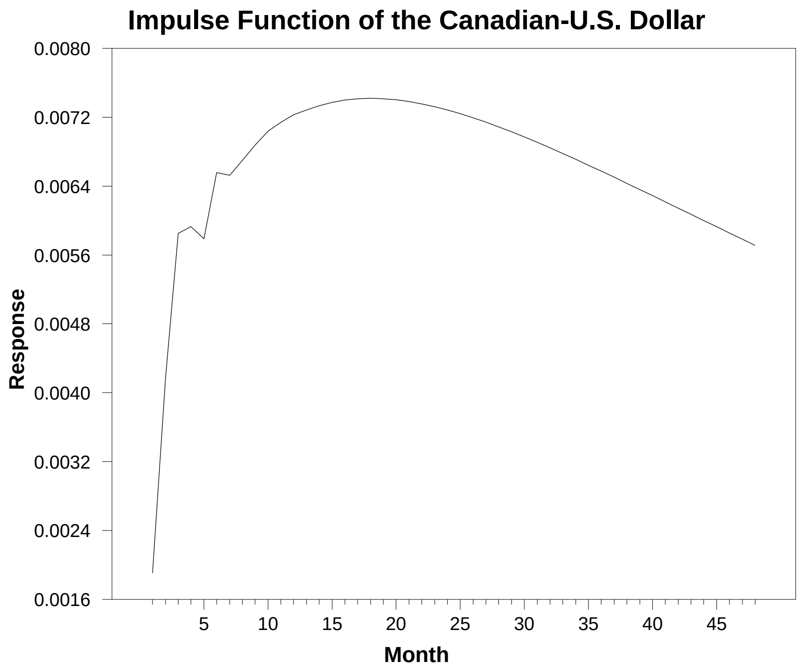

Figure 2:

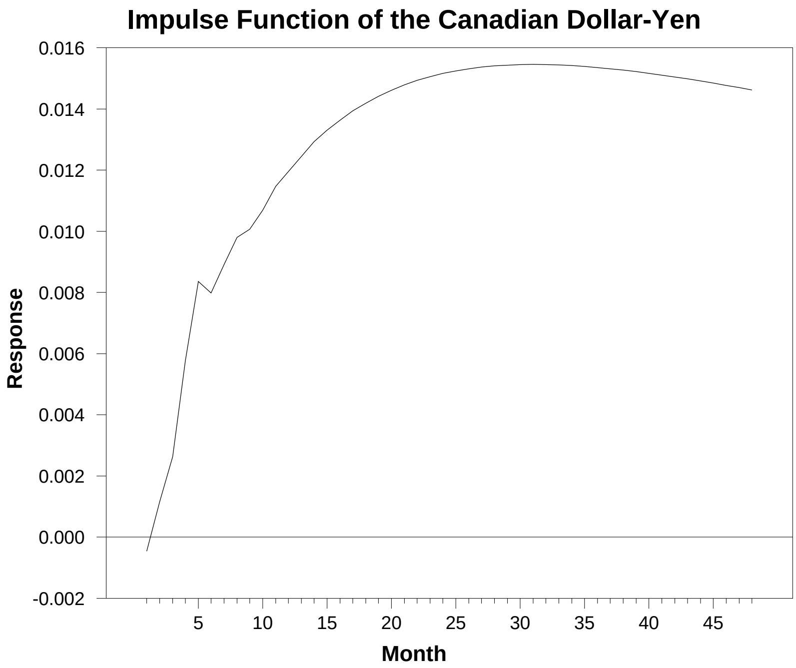

Figure 3:

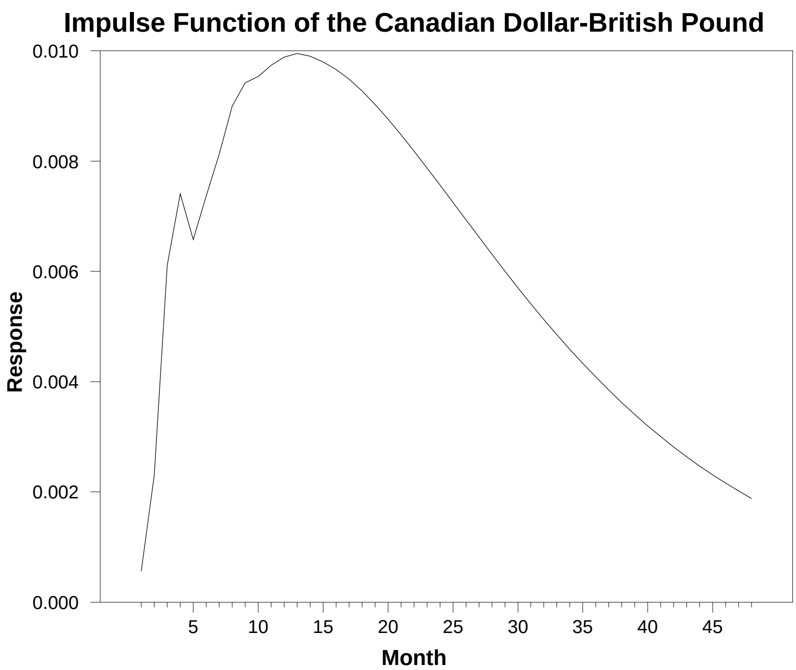

Table 1: Percentage of Variance Explained by Monetary Shocks

Months	Canadian-U.S.	Canadian-Japanese	Canadian-British
12	19.281	5.366	7.275
24	26.080	10.675	12.787
36	29.784	13.996	14.856
48	31.895	16.011	15.389

5 Conclusion

It is not surprising that this paper finds evidence of delayed overshooting and not the instantaneous overshooting predicted by Dornbusch's theory. This result is in keeping with those of other economists who have studied overshooting such as Eichenbaum and Evans. Dornbusch's theory assumes that capital is perfectly mobile and uncovered interest parity holds. Economists have found repeatedly that they do not. This could explain the delay between a monetary shock and the exchange rate reaching its maximum overshoot.

6 Bibliography

Clarida, Richard and Gali, Jordi. "Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks?" *Carnegie-Rochester Conference Series on Public Policy,* 1994, (41), pp. 1-56.

Dornbusch, Rudiger. "Expectations and Exchange Rate Dynamics." *The Journal of Political Economy,* December 1976, 84(6), pp. 1161-1176.

Eichenbaum, Martin and Evans, Charles. "Some Empirical Evidence on the Effects of Shock to Monetary Policy on Exchange Rate." *The Quarterly Journal of Economics,* November 1995, 111(4), pp. 975-1009.