Canada's Pioneering Experience with a Flexible Exchange Rate in the 1950s: (Hard) Lessons Learned for Monetary Policy in a Small Open Economy*

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This paper revisits Canada's pioneering experience with a flexible exchange rate over the period 1950–62. It examines whether the floating rate was the best option for Canada in the 1950s by developing and estimating a New Keynesian small open-economy model of the Canadian economy. The model is then used to conduct a counterfactual analysis of the impact of different monetary policies and exchange rate regimes. The main finding is that the flexible exchange rate helped reduce the volatility of key macroeconomic variables. The Canadian monetary authorities, however, did not understand all of the implications of conducting monetary policy under a flexible exchange rate and a high degree of capital mobility. The paper confirms that monetary policy was more volatile in the post-1957 period and Canada's macroeconomic performance suffered as a result.

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Reflections on Canada's Exchange Rate and Monetary Policies: 1950–62

Milton Friedman:

"Floating rates are not a guarantee of sensible internal monetary policy. . . . All floating rates do is make it possible for you to have a sensible internal monetary policy without considering the rest of the world."

"The reason Canada went off floating rates [in 1962] was because they were working so well, and their internal monetary policy was so bad."

(Friedman and Roosa 1967, p. 122)

Robert Mundell:

"Whether insulation is achieved or not depends on the precise behaviour of the monetary authorities."

"The tight monetary policy. . . . suggests a faulty understanding of how the advantages of a flexible exchange rate system can be exploited."

(Mundell 1964, pp. 82, 85)

James Coyne (Governor, Bank of Canada, 1955–61):

On the definition of "tight monetary policy":

"To the extent that the phrase might be taken to imply a contraction in the availability of money, it is not applicable. In this sense of the phrase there has never been a 'tight monetary policy' in Canada."

(Bank of Canada, *Annual Report 1957*, p. 15)

"[I] have always felt a special responsibility as Governor. . . to protect the value of the Canadian dollar."

(July 10, 1961 testimony before the Canadian Senate, p. 340)[1]

[1]The Canadian Senate defeated the Government bill declaring the position of Governor of the Bank of Canada vacant on July 14, 1961; nonetheless, Coyne resigned immediately thereafter.

1. Introduction

On September 30, 1950, the Canadian government took the bold step of allowing the Canadian dollar to float, which meant leaving the Bretton Woods par-value system less than five years after its establishment.[2] This action marked the beginning of the first policy experiment with a flexible rate by an industrialized country in the post-war period.[3] Canada's decision to adopt a flexible exchange rate in 1950 was bitterly criticized by the International Monetary Fund (IMF) because Canada was a founding and integral member of the IMF and the Bretton Woods system, and IMF officials were concerned that other member countries might follow suit. Milton Friedman, in contrast, cited the Canadian situation in the late 1940s as one highly amenable to floating in his famous 1953 article "The Case for Floating Exchange Rates."[4] In this article, he argued that a floating exchange rate provides two key benefits—insulation from external shocks and monetary independence. Canadian officials subsequently used Friedman's article and these arguments as an intellectual justification for their choice of exchange rate regime.

Despite the fact that Canada's flexible exchange rate remained remarkably stable for more than ten years (indeed, perhaps it was too stable), the experiment ended in May 1962 amidst a storm of controversy over the recent management of domestic monetary, exchange rate, and fiscal policies. This political uproar forced the resignation of James Coyne, the Governor of the Bank of Canada. His dismissal over his conduct of monetary policy was unprecedented among industrial countries and it initiated far-reaching reforms to clarify the relationship between central banks and governments, their

[2]The floating rate period actually began the following Monday on October 3, 1950. Canadian commercial banks established an interbank market for foreign exchange over the weekend.

[3]Earlier experiences with floating include the U.S. Greenback period (1862–78); Austria-Hungary (1896–1914); and the United Kingdom (1931–39).

[4]Although the essay was written in 1950, Friedman had in 1948 engaged in a radio debate at the University at Chicago with Deputy Governor Donald Gordon and Professor W. A. Mackintosh (Queen's University) in which he strongly advocated that Canada float rather than impose currency controls to protect reserves. Friedman, Gordon, and Mackintosh (1948) and Powell (2005) provide further details.

political masters.[5] Furthermore, the relatively poor performance of the Canadian economy and the controversy over monetary and fiscal policies served as the inspiration for Mundell's contribution to the Mundell-Fleming model.[6, 7]

Friedman's view of the Canadian experience with a floating exchange rate over this period is neatly summarized by the second quote given above: the flexible rate was successful to the extent that it behaved much as Friedman had expected given the fundamentals, but its ultimate demise was due to misguided monetary policy. James Coyne, on the other hand, felt his monetary policies were anything but misguided; he was committed to low inflation and maintaining the value of the dollar. Although these two goals could be simultaneously achieved with a tight monetary policy, such a policy was often inconsistent, especially in the short run, with achieving a full employment level of output when the economy experienced export and fiscal demand shocks.

The purpose of this paper is to revisit Canada's experience with a floating rate from 1950–62 to reevaluate the conduct of monetary policy under a flexible exchange rate and a high degree of capital mobility. Such reconsideration is timely because the implementation of monetary policy under a flexible exchange rate and mobile capital is an important issue in a world where more and more small open economies are adopting floating rates and global financial markets are becoming more integrated. In particular, the role of the exchange rate in the transmission of monetary policy, the appropriate response of monetary policy to exchange rate movements, and the choice of a nominal anchor are critical monetary policy questions.

[5]The Bank of Canada Act was amended so that in the event of a disagreement over monetary policy, the government would have to issue and publish a directive to the Governor and the Governor would be forced to resign.

[6]See Gordon (1961) for a detailed analysis of the Bank of Canada's controversial monetary policies during the Coyne era. Mundell's research on the small open-economy model and the assignment problem were motivated by Canada's monetary and fiscal problems. Mundell's research clearly showed that under a flexible exchange rate, tight monetary policy and expansionary fiscal policy were inimical to a full employment level of output in a small open economy. See Mundell (1964) and Bordo, Gomes, and Schembri (2010) for further details.

[7]The ruling Diefenbaker Conservative government was elected in 1958 in a landslide; it was defeated in the 1963 election primarily because of Canada's poor economic performance stemming from mistaken monetary and fiscal policies.

In this regard, useful lessons can be drawn from Canada's early experience with floating rates. In addition, Canada's decisions in 1950 and 1962 to change exchange rate regimes provide useful insights in the debate on the choice of exchange rate regimes, which has been revived recently in the international policy arena for emerging-market countries, for potential euro-zone members, and also with respect to Canada's current adherence to a floating exchange rate coupled with explicit inflation targets versus some form of credibly fixed exchange rate with the U.S. dollar.[8]

The paper makes an important contribution to the earlier literature on Canada's flexible exchange rate experience in the 1950s by developing and estimating a dynamic stochastic general equilibrium (DSGE) model of the Canadian economy in order to conduct a counterfactual analysis of the impact of different exchange rate and monetary policies—in particular, the monetary policy of James Coyne—on the performance of the Canadian economy. The theoretical model is largely based on the recent work of Galí and Monacelli (2005) and is estimated using Bayesian techniques as in Smets and Wouters (2003) and Lubik and Schorfheide (2007).

Two counterfactual experiments are conducted. The first assumes that the monetary policy of the period, until 1956 (the "pre-Coyne" period) is maintained throughout the sample period and the second assumes that Canada remained on a fixed exchange rate over the 1950–62 period rather than adopting a floating rate. The adoption of the pre-Coyne monetary policy would have reduced the volatility of output and interest rates by allowing the inflation and exchange rates to adjust more fully to exogenous shocks. Had the pre-Coyne monetary policy been in place throughout the sample period, it is likely that Canada would not have returned to the Bretton Woods par-value system in 1962, only to abandon it for good in 1970. The second experiment shows that had Canada remained on a fixed exchange rate and essentially followed U.S. monetary policy over this period, the volatility of output and inflation could have increased significantly. Thus, even though the monetary policy in the post-1957 ("Coyne") period is found to be highly volatile, it was still better than having a fixed exchange rate.

[8]For references on the recent debate in Canada, see Lafrance and Schembri (2003).

The unique Canadian experiment with a flexible exchange rate sparked extensive research, most of which was published in the 1960s and early 1970s in an era when the Bretton Woods par-value system was undergoing severe strains and debates raged about viable alternatives.[9] This earlier literature on the Canadian experience focused on the merits of floating exchange rates by analyzing whether the regime's performance was satisfactory in terms of the stability of the exchange rate, the overall macroeconomic performance of the Canadian economy, the ability of the flexible rate to provide insulation from external shocks, and the amount of monetary independence actually achieved under the flexible rate regime. Following Friedman's arguments on stabilizing speculation, much of the research focused on the first issue, the stability of the exchange rate, and the role of short-term capital movements. The consensus opinion from this research was that, on the whole, the Canadian experience was successful, and this finding contributed to the case for generalized floating and the dismantling of the par-value system between 1971 and 1973.[10]

Our general conclusion is similar to that of the older literature in the qualitative sense that our research indicates that Canada's flexible rate performed reasonably well in terms of helping the Canadian economy adjust to shocks. Its effectiveness was, however, hindered by inappropriate monetary and fiscal policies—policies that did not fully incorporate an understanding of the response of a flexible exchange rate in an environment of capital mobility. Our results are generally consistent with Friedman's and Mundell's opening quotes: namely, that the Canadian floating rate experiment demonstrated that a flexible rate combined with a sensible monetary policy allowed the exchange rate to play a stabilizing role in the face of external asymmetric shocks; as a result, Canada's economic performance over approximately the first half of the period, 1950–56, was reasonably good. Over the second half of the period, 1957–62, however, the evidence indicates monetary policy under Governor Coyne was sometimes too tight and the government reacted to the growing output gap by expanding fiscal policy, which only made matters worse.

[9]See Yeager (1976) for a useful critical survey of the older literature.

[10]The United Kingdom and West Germany also considered the adoption of a floating rate in the 1950s, but, in the end, both decided against it.

The resultant high unemployment set in motion the political unrest that led to Coyne's departure. Coyne and other Canadian officials, however, were not alone in their mistaken beliefs about the effects of monetary and fiscal policies under a flexible exchange rate and capital mobility because they were not well understood until the pioneering theoretical work of Mundell and Fleming.[11]

In the next section of the paper, we review the history of Canada's exchange rate and monetary policy experience in the 1950s and the debates over the floating exchange rate regime and the conduct of monetary policy. In section 3, the behavior of the floating Canadian dollar is examined in more detail. In section 4, a DSGE model of the Canadian economy is developed, then estimated and used to conduct counterfactual exercises. The final section provides some concluding remarks on lessons learned from Canada's floating rate experience.

2. Historical Background

In this section, we provide an overview of Canada's exchange rate and monetary policy experience from 1950 to 1962 by summarizing briefly the historical experience and highlighting the key issues. Monetary policy in Canada over this period was primarily directed by the Bank of Canada, which was established in 1935 by the Bank of Canada Act. The Act, however, did not clearly define the independence of the Bank of Canada over the conduct of monetary policy. This lack of clarity would become a significant political issue toward the end of the floating rate period as pressure mounted on the government for a change in the direction of monetary policy. Graham Towers served as Governor of the Bank of Canada for the first twenty years of its existence from 1935 through 1954. He was succeeded by James Coyne, who was eventually forced to resign by the government in July 1961, six months before the end of his seven-year term, essentially over differences in views concerning domestic economic policy, including fiscal and commercial policy as well as monetary policy (Powell 2009).

[11]Haberler (1937) and Meade (1951) developed many of the ideas that were later expanded and formalized by Mundell and Fleming. See Bordo and James (2001) for more details.

Like the U.S. Federal Reserve, the Bank of Canada has a relatively diffuse legal mandate, but in the years immediately after World War II, the Bank was much less transparent. The responsibility for Canadian monetary policy rested solely with the Governor and so, in contrast to the Federal Reserve, there are no minutes from meetings to explain the process by which monetary policy decisions were reached.[12] Information was provided via the Bank's annual report, speeches by the Governor, parliamentary testimony, and a limited number of other publications. Moreover, unlike the Federal Reserve, the Bank did not consistently employ a small set of well-defined indicators/intermediate targets for monetary policy such as free reserves in the banking system.[13]

In our review of the Bank's publications and public pronouncements as well as secondary sources, it appears that monetary policy over the period was guided by the principles of maintaining low inflation and relatively stable output growth. In addition to measures of inflation and economic activity, the Bank also considered a variety of other indicators such as commercial bank cash reserves, market interest rates, and measures of aggregate liquidity such as bank loans. The concept of an intermediate target is not used initially, but later the Bank Rate, the rate at which chartered banks can borrow from the Bank of Canada, is linked to the short-term Treasury-bill (T-bill) rate. The implementation of monetary policy changed over the period as financial markets developed. Initially, moral suasion and quantitative restrictions on commercial bank lending were used and then open-market operations and changes in the Bank Rate became the preferred instruments to influence short-term market interest rates.

The Canadian federal government was responsible for exchange rate policy and made the decisions to change the exchange rate parity rates and the exchange rate regime after World War II.[14] These

[12]Although the monetary policy at the Bank of Canada has become more transparent, the Governor remains solely responsible for its conduct.

[13]See Romer and Romer (2002).

[14]The federal government is also responsible for international reserves, which are held in the Exchange Fund Account, and thus, for foreign exchange market intervention as well. The Bank of Canada, as the financial agent for the government, actually performs the intervention.

decisions were somewhat more transparent than the Bank's monetary policy decisions because they were debated in Parliament. Although the government (Department of Finance) and the Bank of Canada had different responsibilities in terms of economic policy, there was regular consultation between them, especially on exchange rate and monetary policy.

2.1 Prelude: 1946–50

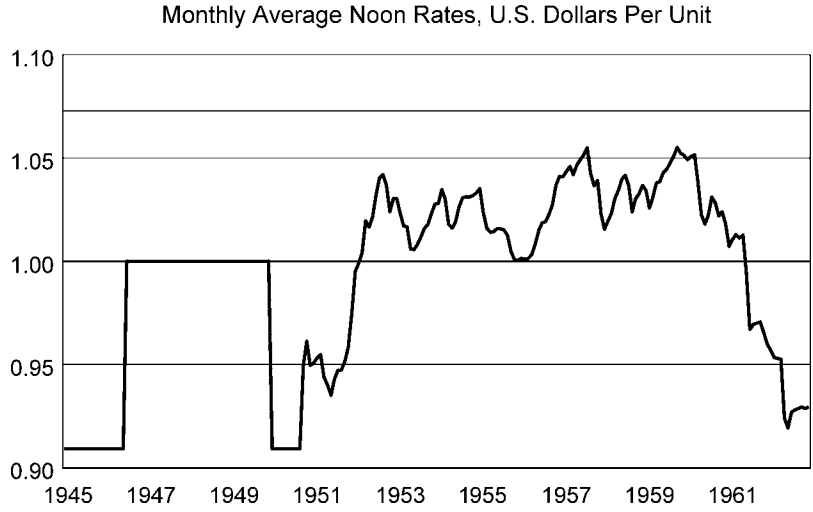
Canada allowed its currency to float in October 1950 after two unsuccessful attempts to establish a sustainable Bretton Woods par value. In July 1946, the Canadian dollar was revalued from a wartime discount with the U.S. dollar to parity. It soon became evident that this rate was too high and, beginning in 1948, official reserves began to decline, creating deflationary pressure. In September 1949, Canada followed the United Kingdom and thirty other countries and devalued its currency back to the pre-July 1946 level of US$0.909. International economic conditions, however, soon changed in favor of Canada's exports and this rate became too low; there were strong capital inflows beginning in 1949 and continuing into 1950 (reflecting the demand for Canadian resources for the Korean War, which began in June 1950) and these led to a significant increase in official reserves (driven, in part, by speculation of another revaluation) and the money supply. To offset this inflationary pressure, the Canadian authorities decided to float the dollar rather than try to pick another par value only to find out, as in 1946 and 1948, that it would soon prove to be inappropriate. The decision to float was presented as a temporary move, presumably with a return to the par-value system once a new "fundamental equilibrium" had been attained.[15]

2.2 1950–51: Transition to a Free Float

Figure 1 shows that over the next eighteen months the Canadian dollar appreciated markedly from US$0.909 to US$1.02, a 12

[15]In a speech on October 20, 1952, the Conservative Minister of Finance, Douglas Abbott, said, "At some future time conditions may develop in Canada in which it would be appropriate to establish a fixed rate of exchange for the Canadian dollar." See Binhammer (1964, p. 639) and Yeager (1976, p. 544) for further details.

Figure 1. Exchange Rate

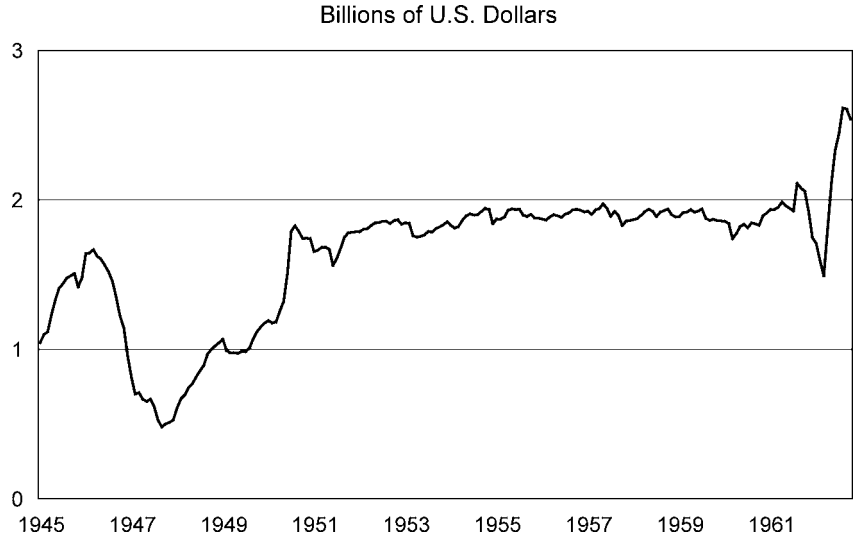


Source: Bank of Canada.

percent increase. This rapid appreciation has largely been explained by the massive capital inflows—largely foreign direct investment (FDI) from the United States to develop Canada's natural resources (Yeager 1976, p. 544), as shown in figure 2. The Korean War boom was associated with very rapid real growth, which put upward pressure on Canadian interest rates and provided further support for the appreciating currency.

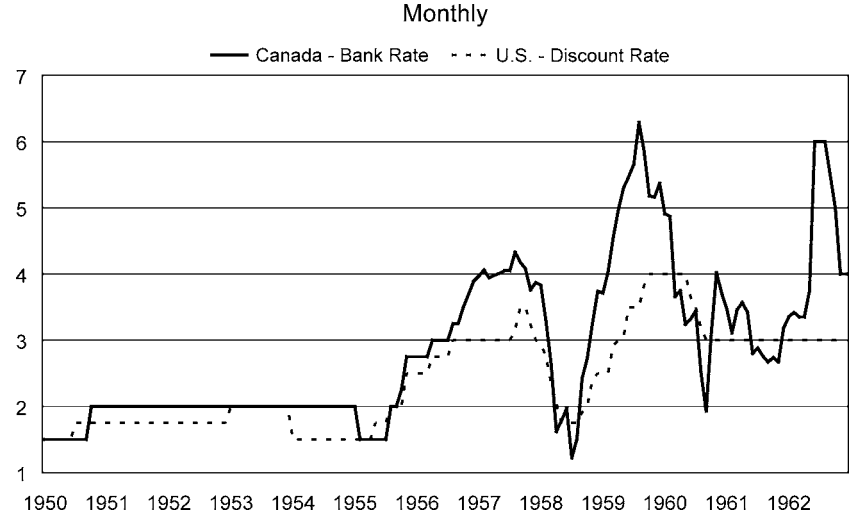
When the floating rate period started in October 1950, foreign exchange controls were still in place in Canada and an active market for short-term government securities did not exist; neither did an overnight market for reserves. Chartered banks rarely borrowed from the Bank of Canada and so the Bank Rate, which was perhaps the most visible instrument of monetary policy, was largely ineffective in influencing monetary conditions. For example, in October 1950, it was raised to 2 percent from 1.5 percent and it remained at that level until February 1955, when it was reduced back to 1.5 percent (figure 3). As a consequence, monetary policy was also conducted through various forms of open-market operations involving government securities and government deposits held by the

Figure 2. Canadian Official Holdings of Gold and U.S. Dollars



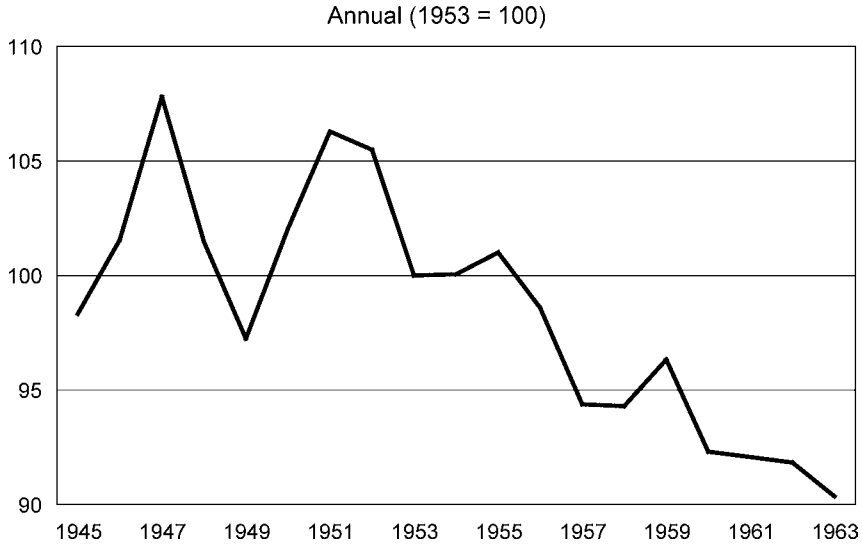
Source: Bank of Canada.

Figure 3. Interest Rates



Source: Statistics Canada and the Bank for International Settlements.

Figure 4. Canadian Real Commodity Price Index



Source: Bank of Canada.

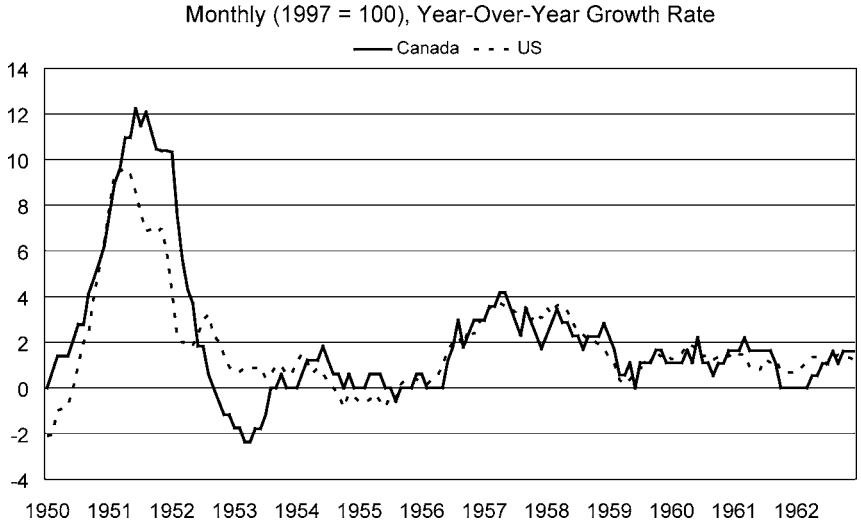
chartered banks, and by moral suasion and direct regulation to influence the volume of chartered bank lending.

In this vein, special direct restrictions on consumer and bank credit were implemented in 1950 and 1951 to help manage the abrupt inflationary pressure stemming from the Korean War expansion in the United States. The U.S. expansion also caused commodity prices to rise sharply (see figure 4). Although the Canadian dollar appreciated over this period, the appreciation did not completely offset the inflationary impact of the increase in reserves and the money supply and the rise in commodity prices. CPI inflation was 6 percent in 1950 and rose to over 10 percent in 1951 (figure 5), and much of it was driven by food prices.

2.3 1952–56: The Textbook Case

The 1952–56 period was the heyday of the floating regime; the Canadian dollar traded at a substantial premium relative to the U.S. dollar (figure 1), and FDI-driven capital inflows continued (figure 3). With the exception of the brief post-Korean War recession in

Figure 5. Consumer Price Index



Source: U.S. Bureau of Labor Statistics and Statistics Canada.

1953–54, growth was robust and inflation remained relatively low. Monetary policy was somewhat countercyclical; the actions were modest and slow to respond to cyclical output movements. Consequently, exchange rate adjustment was hindered and the full insulating value of a flexible exchange rate was not realized.

By the end of 1951, inflationary pressure was waning as commodity prices started to decline. Exchange controls were lifted in December 1951, and direct restrictions on consumer and bank credit were removed in 1952.[16] The Bank of Canada took several important steps in 1953 toward encouraging the development of a broad and active market in Treasury bills by shifting from a biweekly to a weekly auction, increasing the range of maturities to 273 days, and by entering into purchase and resale agreements with dealers of government securities. This latter innovation—along with the change to the Bank Act in 1954, which raised the primary (i.e., non-interest

[16]Canada was the second country after the United States to remove exchange and capital controls after WWII. Indeed, the removal in 1951 restored the situation to what it was before WWII. See Powell (2005) for further details.

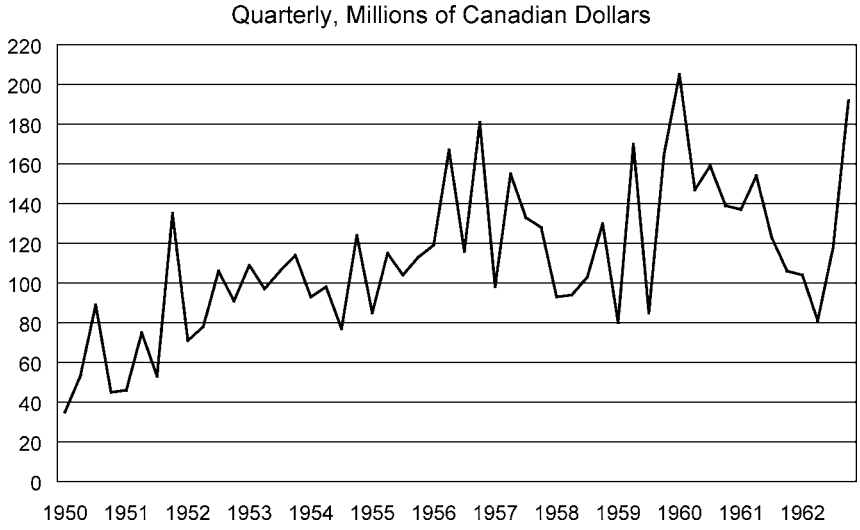
bearing) reserve requirement from 5 percent to 8 percent—spurred the establishment of a day-to-day loan market among the bank and investment dealers as banks became more interested in managing their reserves and the investment dealers were able to use the purchase and resale agreements to obtain cash from the Bank of Canada.

The period of slow growth in Canada, which began in the second half of 1953, in part as a result of reduced defense expenditures on both sides of the border, continued through most of 1954 and inflation remained close to zero. Interest rates also remained relatively low and so in February 1955 the Bank Rate was reduced to 1.5 percent because the Bank felt that this rate should be more "flexible and bear a closer (but not fixed) relation to other short-term interest rates."[17] This change marked the beginning of more frequent use of the Bank Rate as an instrument of monetary policy.

The Canadian and (to a lesser extent) U.S. economies grew strongly through the rest of 1955, 1956, and into 1957. Investment boomed in both countries, and in Canada it was centered on the development of natural resources. As aggregate demand grew, inflation pressures began to mount, and for the first time in the floating rate period, the inflationary pressure was domestic in origin. Although inflation was again almost zero in 1955, it jumped to 3 percent in 1956. The Bank reacted by offering increased resistance to the expansion in bank credit through open-market sales. As a result of the higher demand for credit for investment, market interest rates rose and the Bank Rate was increased three times in 1955 to 2 percent until it reached 2.75 percent by November. Because the banks were making more use of the lending window to meet reserve requirements, the increases were affecting interest rates at the short term. The banks also agreed to maintain voluntarily—starting May 31, 1956—a minimum liquid asset ratio (cash, Bank of Canada deposits, day-to-day loans, and Treasury bills) of 15 percent to deposits in addition to the 8 percent primary reserve requirement. In 1956, the Bank Rate was again raised on three occasions

[17]This quote was taken from a public statement by the Bank of Canada on February 14, 1955, and published in the 1955 *Annual Report* (p. 7).

Figure 6. Direct Investment in Canada

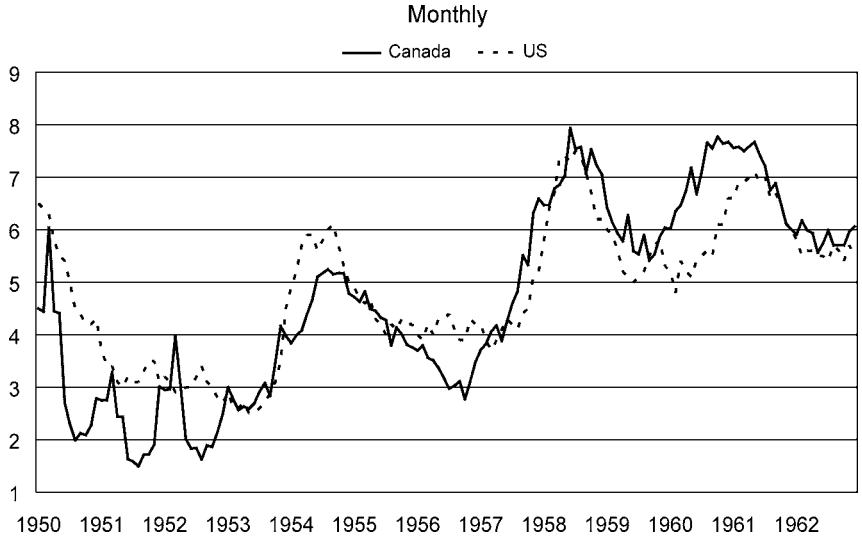


Source: Statistics Canada.

until it reached 3.5 percent by October. In November, the decision was made that the Bank Rate would float and be equal to 25 basis points more than the Treasury-bill rate established at the weekly auction, and at the end of 1956, the Bank Rate closed at 3.92 percent, which represented an increase of almost 250 basis points in less than twenty-three months.

Over the 1950–56 period, monetary policy and exchange rate movements seemed to have been reasonably effective in managing inflationary pressures, especially those stemming from the Korean War expansion, but there is less evidence of a significant countercyclical impact on output growth (see figures 1 and 6.) Graham Towers retired as Governor of the Bank of Canada at the end of 1954 and James Coyne began his tenure in January 1955. Although the economy continued to grow from 1956 into 1957, higher interest rates and a stronger dollar—which had appreciated by almost 7 percent over 1955 and 1956 to a premium of US 4¢ by the end of 1956—were starting to have an impact. These were the seeds of the later controversy surrounding the conduct of Canadian monetary policy.

Figure 7. Unemployment Rate



Source: Statistics Canada and U.S. Bureau of Labor Statistics.

2.4 1957–60 Deteriorating Performance and Questionable Policies

In 1957, the economy began slowing after more than two years of rapid growth. Because this deceleration was marked by a sharp increase in the rate of unemployment, from 4 percent to 7 percent (see figure 7), observers began to question the wisdom of Canadian monetary policy, especially as the Bank continued to tighten monetary conditions until August 1957 with the Bank Rate rising to 4.33 percent and the Canadian dollar appreciating to a peak of US$1.06 at the same time. This further tightening seemed unwarranted since the signs of a slowdown were apparent as the inflation rate started to decline early in 1957 and ended up the year at 2.2 percent, down from 3 percent in 1956.

These criticisms were further supported by the fact that the Canadian economy seemed to slow well before the U.S. economy, indicating that the source of the adverse shock was not foreign but domestic (i.e., tight monetary policy). Indeed, Canada's economic performance during the 1957–58 recession was probably worse than that of the United States, as growth was slower and

unemployment higher. Controversy also swirled around the money-supply figures provided in the 1957 *Annual Report*.[18] Indeed, the tone of the 1957 *Annual Report* (and subsequent *Annual Reports* while Coyne was Governor) changed; they became more defensive and responded directly to criticisms, as illustrated by the opening quote from Coyne concerning the money supply.

The Bank also argued that the increase in the unemployment rate was due to structural factors—in particular, the rapid growth of the labor force because of massive immigration and a higher labor force participation rate. The structural argument, which can be interpreted as an increase in the natural rate of unemployment, should not be immediately dismissed. The unemployment rate in the United States also increased by almost the same amount as the recession deepened into 1958. Although U.S. immigration rates were much lower, the two countries shared a similar demographic profile and were undergoing comparable socioeconomic changes that likely had similar labor market effects. Hence, it would not be unreasonable for the natural rate of unemployment to have increased in both countries.

The trough in the recession in both countries was reached in the spring of 1958 and large-scale monetary expansions helped both economies recover quickly; interest rates in Canada fell as the Bank Rate declined from 3.92 percent at the end of 1957 to a low of 1.91 percent in July 1958. This monetary easing was part of an effort in both countries to convert or roll over into longer maturities government bonds that were issued to finance WWII defense expenditures and were coming due shortly.

As both economies rebounded in the second half of 1958, interest rates rose sharply to levels that existed at the beginning of the year, especially in Canada, where the recovery was much stronger. In the 1958 *Annual Report*, the Bank blamed the higher interest rates on higher expected future inflation (investor "inflation psychosis," p. 3). The critics, however, blamed the higher rates on monetary policy that was too tight. Since neither side had the benefit of Mundell's later work, neither recognized that under a floating

[18] Gordon (1961, p. 11) argued that the Bank broke with IMF data-reporting guidelines and used a "shallow statistical trick" to hide the fact that money supply had, in fact, increased over the last four months of the year by four times less than the Bank reported in the 1957 *Annual Report*.

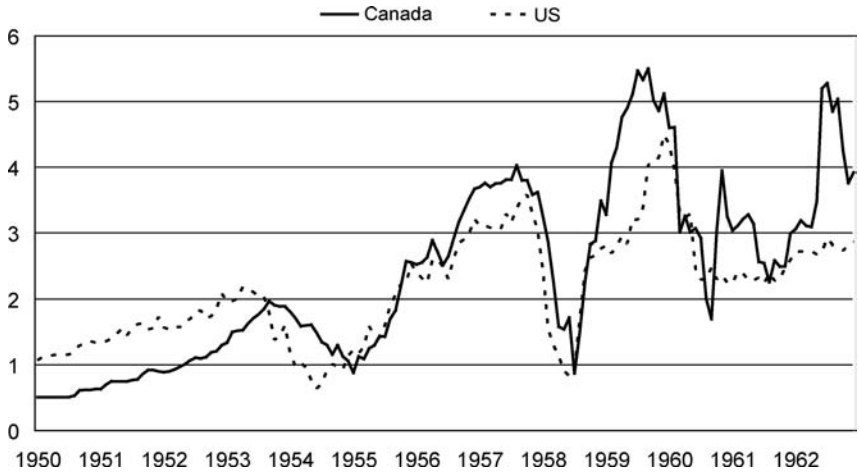
rate, the government's countercyclical fiscal expansion would also contribute to higher interest rates and a stronger Canadian dollar. The currency appreciated by roughly 2 percent in 1958 and remained at a substantial premium to the U.S. dollar.

Inflation in 1959 fell to 2 percent from 2.5 percent in 1958 despite the fact that the strong recovery continued in Canada through to the end of 1959. Nonetheless, the Bank continued to push up short-term interest rates over the first eight months of 1959 (the Bank Rate increased by 257 basis points from 3.85 percent to 6.41 percent over this short period), without much evidence of any significant inflationary pressure. A sizable spread developed in Canada-U.S. interest rates, especially in the first half of 1959, and the dollar appreciated in 1959 by another 1 percent. The unemployment rate fell during 1959 but remained higher than the U.S. level.

The Federal Reserve also had concerns about higher future inflation in 1959 and 1960; it increased its discount rate as well, but less dramatically than the Bank of Canada. The impact of this tightening was felt in 1960 as both economies grew more slowly and inflation fell to 1.3 percent in Canada. The unemployment rate increased sharply from 6.5 percent at the beginning of 1960 to 8.7 percent by the end of the year. In the 1960 *Annual Report* (pp. 15–16), the Bank attempted to shift the blame for the slower growth and higher unemployment from its own policies to "serious structural distortions and inadequacies in the Canadian economy," namely, current account and fiscal deficits. For Coyne, the most significant inadequacy was Canada's "undue" dependence on foreign capital that arose, in his view, because of excessive domestic spending (1958 *Annual Report*, p. 7), and thus he felt that higher interest rates were appropriate to curb this spending. He, however, failed to recognize that higher interest rates made Canada a more attractive destination for foreign capital. As a result, Canadian short-term rates rose well above U.S. levels (see figure 8) and this differential caused portfolio capital inflows to increase and put upward pressure on the Canadian dollar.[19]

[19]Coyne's views on Canada's economic inadequacies and the tight monetary policy that he implemented in order to address them were heavily criticized by the academic community (Gordon 1961). His concerns about Canada's dependence on foreign capital were, however, consistent with the growing political backlash against FDI because of popular anxieties about the perceived U.S. domination of the Canadian economy (Powell 2009).

Figure 8. Three-Month Treasury-Bill Market Yield



The rising unemployment rate and Coyne's contentious arguments, which were repeated in several speeches in 1960 and 1961, embarrassed the government and created substantial political pressure to remove Coyne. In May 1961, the government reacted by introducing legislation to declare the position of the Governor of the Bank of Canada vacant.

In summary, the Bank of Canada's tight monetary policy in the last half of the floating rate period was excessive. The overarching fears of higher future inflation were not realized because of a failure to understand the effectiveness of monetary policy under a floating exchange rate and a high degree of capital mobility. High interest rates served to appreciate the exchange rate and lower inflation by reducing both economic activity and the cost of imported goods.

2.5 1961–62 Transition to a Pegged Exchange Rate

With the resignation of James Coyne, Louis Rasminsky became Governor. Rasminsky accepted the position conditional on a clarification of the responsibility for monetary policy between the central bank and the government. Drafted by Rasminsky, the directive principle, as it came to be known, stated that under normal circumstances

the Bank of Canada was responsible for monetary policy, but if a conflict between the Bank and the government arose, the government was required to issue a specific directive to the Governor which would be published in the *Canada Gazette* (the record of the Parliament). Under these circumstances, the Governor would likely resign. The principle was incorporated into the 1967 revision to the Bank of Canada Act, and thus represented an important achievement because it clearly specified the independence of the central bank for monetary policy and the procedure to be followed in the event of a conflict between the central bank and the government. The extraordinary forced resignation of a central bank governor and the adoption of the directive principle had an impact on policies governing other central banks, including Australia.[20]

Unfortunately, Rasminsky's accomplishment with the directive principle was overshadowed in his first year of office by the government's bungled attempts to depreciate the Canadian dollar in an effort to reflate the economy; this misguided effort eventually precipitated an exchange rate crisis, which required IMF intervention. In response to the weak economy and high unemployment rate, the government's 1961 budget promised a host of expansionary fiscal policy measures. In his budget speech of June 19, 1961, the Minister also declared his desire to see a depreciation of the Canadian dollar (not comprehending that the expansionary fiscal policy would have the opposite effect). To this end, the Bank of Canada was instructed to intervene in the foreign exchange market with unsterilized sales of Canadian dollars, which soon declined from a premium of approximately 1 percent on the U.S. dollar in July 1961 to a discount of US 3¢ less than two months later (see figure 1). Additional intervention in September 1961 led to a further drop in the Canadian dollar to a US 5¢ discount. Several months later, in April 1962, a speculative attack on the dollar occurred which forced the government to repeg the dollar at US$0.925 in an effort to stem the free fall. Speculation continued, however, and it took an austerity program and an IMF/U.S./UK rescue package of slightly more than US $1 billion in June 1962 to restore stability.

[20]For a survey of the experience in other similar central banks, see Tuladhar (2005).

3. The Behavior of the Exchange Rate

This section focuses on two issues: the remarkable stability of the Canadian dollar over the floating period, 1950–62, and the related issue of whether this relatively stable exchange rate actually helped insulate the Canadian economy from external shocks. Over the twelve-year period, the dollar fluctuated in a narrow range of US 13¢, from a low of US$0.93 in early 1950 to a peak of US$1.06 in August 1957. If we focus on the core period, 1952–60, the range was much smaller, only US 6¢, from US$1.00 in early 1952 to US$1.06 in August 1957. Moreover, high-frequency fluctuations were very mild and orderly. Over the whole period, the average daily change was 0.08 percent, and only 5 percent of the daily changes over the whole floating rate period exceeded one-quarter of a percent (Poole 1967).

Several explanations have been put forward to rationalize the dollar's stability. Many attributed it to stabilizing speculation by agents who believed that movements in the rate were temporary (Poole 1967; Marsh 1969; Yeager 1976). This evidence was seen as being consistent with the original assertion by Friedman (1953) that speculation under a floating exchange rate would necessarily be stabilizing in order to be profitable. Others attributed it to the coincidence of Canadian with U.S. cyclical positions and monetary policies (Hawkins 1968, p. 31) (see figures 5, 6, and 8).

It has also been argued that official intervention operations served to reduce the volatility of the Canadian dollar exchange rate, but the literature has concluded that official intervention did not play a significant role in stabilizing the nominal exchange rate because the extent of intervention was limited to simply offsetting short-run fluctuations in order to maintain an orderly market (Plumptre 1970, p. 4). Indeed, net monthly changes in official reserves were less than US $20 million in the majority of months when intervention occurred.[21]

Several observers, including Plumptre (1970, p. 6), argue that the relative stability of the floating Canadian dollar was due, in part, to

[21] See Wonnacott (1965), Yeager (1976), Binhammer (1964), and Royal Commission on Banking and Finance (1964) for more information.

the absence of large shocks during the 1950s.[22] This is a plausible argument because this was a period of relatively stable growth driven by post-war reconstruction and increasing prosperity. Evidence provided by the estimated DSGE model developed in this paper indicates that the structural shocks experienced by the Canadian economy during the floating rate period in the 1950s were generally smaller than those found in subsequent decades.[23]

In summary, the Canadian dollar was stable over this period—not only because shocks were relatively small and to some degree common to both the Canadian and U.S. economies, as evinced by the close correlation of their business cycles, but also because capital was not very mobile globally. Apart from Canada and the United States, capital controls were widespread. Finally, it is important to recognize that Canada was the only major industrialized country that was floating at that time—all other major countries had pegged rates to the U.S. dollar.

In addition to giving the domestic authorities control over monetary policy, the other main benefit of a floating rate is its ability to shelter the domestic economy from external shocks. The observation that the Canadian flexible exchange rate was fairly stable over this period despite the volatility in output growth has led some observers to conclude that Canada's experience did not provide overwhelming evidence on the postulated insulation properties of a floating rate. Wonnacott (1965) compares exchange rate movements with price-level changes and shifts in unemployment and concludes that the evidence that the flexible rate provided insulation from external shocks is mixed at best. McLeod (1965) reaches a similar conclusion for price movements; he argues that Canadian inflation performance was about the same as that of the United States over the floating rate period.[24]

Unfortunately, the qualitative bivariate analysis that these authors conducted is incomplete and does not provide an adequate counterfactual analysis. In particular, it is likely that exchange rate

[22]Plumptre (1970) also notes that when the Canadian dollar floated in the 1930s, its movements were relatively stable as well.

[23]See an earlier version of this paper—Bordo, Dib, and Schembri (2007)—for more details.

[24]Rhomberg (1960), using an econometric model, finds the opposite result: that is, the flexible Canadian dollar did reduce the import of foreign inflation.

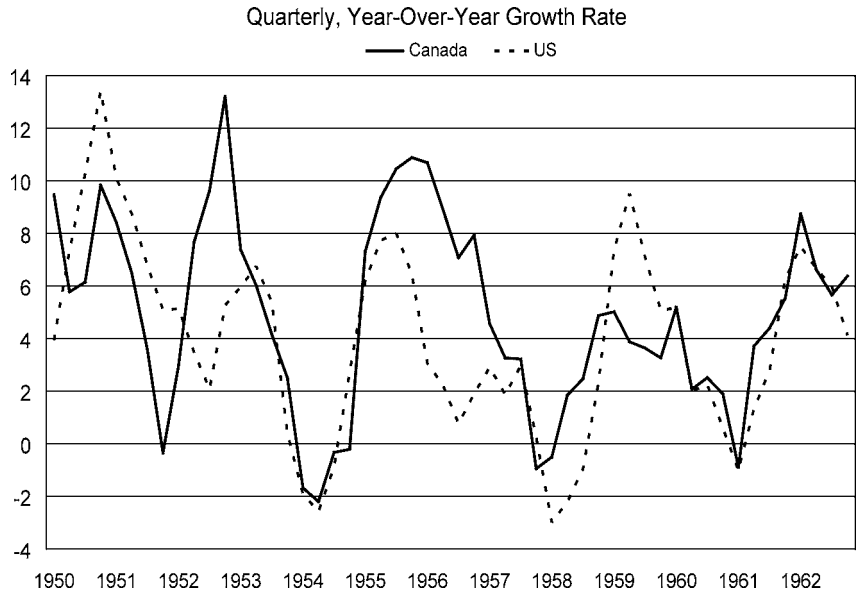
adjustment to movements in U.S. export demand was hindered by weakly countercyclical domestic monetary policy. Mundell (1964), McLeod (1965), and Dunn (1971) argue that Canadian monetary policy was much less countercyclical than U.S. monetary policy in the two coincident recessions of 1953–54 and 1957–58 (figure 9). Not only was the response of Canadian monetary policy and short-term rates weaker, but it was also slower (figure 8). The fact that the peak-to-trough movements in output over these two business cycles were larger in Canada than in the United States (figure 9) is consistent with this view. Consequently, the Canadian dollar tended to appreciate when monetary policy was eased earlier and more aggressively in the United States than in Canada in response to weaker output growth, and thus did not appear to provide much insulation for the Canadian economy in the face of U.S. economic slowdowns and reductions in export demand.[25]

4. Counterfactual Analysis

In this section, we conduct two counterfactual experiments to examine the economic impact of Canadian monetary and exchange rate policies in the 1950s. The first involves eliminating the apparent shift in monetary policy that took place over the second half of the sample by maintaining the monetary policy that prevailed in the first half throughout the floating rate period. The second experiment consists of assuming that the fixed exchange rate parity of 1950 is not abandoned in favor of a flexible exchange rate. To perform these experiments, we proceed in the following steps: firstly, we develop a small theoretical DSGE model of the Canadian economy; secondly, we estimate the key parameters using a Bayesian technique; thirdly, we econometrically extract the shocks that prevailed during this period; fourthly, we conduct the experiments by modifying the monetary and exchange rate polices as required and then simulating the model, adding back the shocks that actually took

[25]The interest rate differential had a significant impact on the Canadian dollar because of the high degree of capital mobility between Canada and the United States. Caves and Reuber (1971), for example, provide empirical evidence of the sensitivity of the Canadian dollar to the short-term interest differential in the 1950s.

Figure 9. Real Gross Domestic Product (1997 Prices)



Source: Statistics Canada.

place; and finally, we calculate and compare the variances of the key macroeconomic variables in the data with those generated by the model with the counterfactual policies.

4.1 The Model

In this paper, we use a small theoretical New Keynesian model for a small open economy with Calvo-type staggered price setting. The model is similar to the one used in Lubik and Schorfheide (2007), which is a simplified version of Galí and Monacelli (2005).[26] It is assumed that (i) financial markets are complete; (ii) the law of one price holds; (iii) prices of domestically produced goods are sticky because they are set with Calvo (1983) contracts; and (iv) domestically produced goods are either exported or combined with imported goods to produce final domestic consumption goods using a

[26]See Galí and Monacelli (2005) for a detailed derivation of the model. The full specification of our model is given in appendix 2.

Cobb-Douglas aggregation function.[27] Canada is assumed to be a small open economy that takes import and export prices as well as the foreign nominal interest rate as given.

The log-linear model consists of an IS equation for a small open economy, a New Keynesian Philips-curve equation, an equation determining the nominal exchange rate, and a Taylor-type monetary policy rule. We assume that the evolution of the terms of trade is exogenous and the economy is disturbed by four additional domestic and world shocks.[28] The exogeneity of the terms of trade is motivated by the fact that Canada has limited influence over its import prices and its exports are mainly composed of commodities whose prices are determined exogenously on world markets in U.S. dollars. As shown in Galí and Monacelli (2005), the consumption Euler equation leads to the following IS-curve equation for a small open economy:

$$y_t = E_t y_{t+1} - [\tau + \alpha(2-\alpha)(1-\tau)](R_t - E_t\pi_{t+1}) + \rho_A dA_t + \alpha[\tau + \alpha(2-\alpha)(1-\tau)]E_t\Delta q_{t+1} + [\alpha(2-\alpha)(1-\tau)/\tau]E_t\Delta y^*_{t+1}, \quad (1)$$

where $0 < \alpha < 1$ is the share of imports in domestic consumption, which is a natural measure of the degree of openness of the economy, and $\tau > 0$ is the intertemporal elasticity of substitution. Note that if $\alpha = 0$, equation (1) reduces to its closed-economy variant. The endogenous variables, y_t, R_t, and π_t, denote aggregate output (normalized for technological growth),[29] the nominal interest rate, and the consumer price index (CPI) inflation rate, respectively; the exogenous variables, $dA_{t,}$, Δq_t, and y^*_t, denote the technological growth rate, changes in terms of trade, and world output, respectively. The terms of trade, q_t, is defined as the relative

[27] The composite consumption index is defined by $c_t = c_{h,t}^{1-\alpha} c_{f,t}^{\alpha}$, with $c_{h,t}$ and $c_{f,t}$ being indices of consumption of domestic and foreign goods, and α denoting the share of imports in total consumption. Since there is no investment, $c_{h,t}$ is equal to domestic output, y_t, net of exports.

[28] All the variables in the model are expressed in terms of their log-deviations from steady-state values.

[29] Aggregate output is normalized for trend productivity growth to ensure stationarity.

price of exports in terms of imports and we assume that its first-difference form, Δq_t, evolves exogenously, because Canada is a small open economy and most of the variations in its terms of trade were driven largely by commodity prices.[30]

These exogenous variables evolve according to the following first-order autoregressive processes:

$$dA_t = \rho_A dA_{t-1} + \varepsilon_{At}, \tag{2}$$

$$\Delta q_t = \rho_q \Delta q_{t-1} + \varepsilon_{qt}, \tag{3}$$

and

$$y_t^* = \rho_{y^*} y_{t-1}^* + \varepsilon_{y^*t}, \tag{4}$$

where ρ_A, ρ_q, and ρ_{y^*} are autoregressive coefficients; ε_{At}, ε_{qt}, and ε_{y^*t} are i.i.d. random shocks normally distributed with mean zero and standard deviations σ_A, σ_q, and σ_{y^*}, respectively. The output growth rate computed from the data is defined as $\Delta Y_t = Y_t - Y_{t-1} = y_t - y_{t-1} + dA_t$, where Y_t is the logarithm of real aggregate output per capita.

We introduce price stickiness by assuming Taylor price setting, in which only a fraction of firms producing domestic goods are allowed to change their prices each period with an exogenous probability. Under this assumption, the New Keynesian Phillips curve is given by

$$\pi_t^d = \beta E_t \pi_{t+1}^d + \frac{\kappa}{[\tau + \alpha(2-\alpha)(1-\tau)]}\left(y_t - y_t^p\right), \tag{5}$$

where $0 < \beta < 1$ is the discount factor; π_t^d is producer price index (PPI) inflation—defined as the rate of change in the index of domestic goods prices—and $(y_t - y_t^p)$ is the output gap; and y_t^p is potential output when prices are fully flexible. The parameter $\kappa > 0$ depends on the model's other structural parameters, such as the price-stickiness parameter and labor supply and demand elasticities.

[30]We have estimated the model with an endogenous terms of trade defined as $[\tau + \alpha(2-\alpha)(1-\tau)]\Delta q_t = \Delta y_t^* - \Delta y_t$. Some of the resulting parameter estimates have implausible values, and the model performs very poorly in terms of the in-sample fit; a good fit is critical for the counterfactual analysis. We have therefore decided to maintain the exogenous terms of trade assumption. These results are similar to those found by Lubik and Schorfheide (2007).

In the estimation, this parameter is treated as a structural parameter of the model. In the context of a small open economy, Lubik and Schorfheide (2007) show that potential output can be derived as a linear function of foreign output:

$$y_t^p = -\frac{\alpha(2-\alpha)(1-\tau)}{\tau} y_t^*. \tag{6}$$

Galí and Monacelli (2005) derive the following equation that relates CPI inflation, π_t, to PPI inflation, π_t^d, and changes of the terms of trade, Δq_t:

$$\pi_t = \pi_t^d - \alpha \Delta q_t. \tag{7}$$

Therefore, the equation for the exchange rate, e_t, can be derived from the definition of the CPI, assuming that the uncovered interest rate parity (UIP) and relative PPP always hold:

$$\Delta e_t = \pi_t - (1-\alpha)\Delta q_t - \pi_t^*, \tag{8}$$

where π_t^* is the world inflation rate that evolves exogenously according to the following first-order autoregressive process,

$$\pi_t^* = \rho_\pi \pi_{t-1}^* + \varepsilon_{\pi^* t}, \tag{9}$$

where ρ_{π^*} is an autoregressive coefficient and $\varepsilon_{\pi^* t}$ is a random shock normally distributed with mean zero and standard error σ_{π^*}.[31]

The terms of trade enters in first-difference form because only changes in relative prices affect inflation and real variables via the definition of the CPI. This specification is consistent with our assumption that the Canadian firms had no market power in the international markets; thus the prices of internationally traded goods can be treated as exogenous to the Canadian economy.

For the convenience of the analysis, it is assumed that the Bank of Canada followed a Taylor-type rule to conduct its monetary policy. Thus, it managed the short-term nominal interest rate to respond to deviations of CPI inflation, output, and changes of the nominal

[31] Under a fixed exchange rate regime, $\Delta e_t = 0$, the CPI inflation is fully determined by the PPI inflation rate and the terms of trade, as in equation (7). Nevertheless, equation (8) disappears from the model.

exchange rate from their long-term equilibrium values. This policy rule is the same one used in Lubik and Schorfheide (2007) to examine if the Bank of Canada actively responded to exchange rate movements.[32] This rule allows us to simply compare the reaction of the monetary authority with inflation, output, and exchange rate variations during the pre- and post-Coyne periods. The monetary policy rule is described by

$$R_t = \rho_R R_{t-1} + (1 - \rho_R)[\psi_\pi \pi_t + \psi_y y_t + \psi_e \Delta e_t] + \varepsilon_{Rt}, \tag{10}$$

with all policy coefficients greater than zero. The first variable on the right-hand side of (10) is the smoothing term introduced to match the persistence in the nominal interest rate, where ρ_R is the smoothing coefficient; the term ε_{Rt} is a zero-mean, serially uncorrelated monetary policy shock with standard deviation σ_R. This exogenous monetary policy shock is interpreted as the unsystematic component of monetary policy. The parameters ψ_π, ψ_y, and ψ_e measure the responses of the monetary authority to inflation, output, and nominal exchange rate variations. A unique equilibrium exists as long as the sum of ρ_R, $(1 - \rho_R)\psi_\pi$, and $(1 - \rho_R)\psi_e$ is larger than unity. The model assumes the following UIP condition between the domestic nominal interest rate, R_t, the foreign nominal interest rate, R_t^*, and the expected exchange rate movement, $E_t \Delta e_{t+1}$:

$$R_t = R_t^* + E_t \Delta e_{t+1}. \tag{11}$$

The model of a small open economy given by equations (1), (5), (7), (8), and (10) can be solved using the Blanchard and Kahn (1980) procedure to obtain the following state-space representation:

$$\begin{array}{rcl} s_t & = & \Phi_1 s_{t-1} + \Phi_2 \varepsilon_t, \\ d_t & = & \Phi_3 s_t, \end{array} \tag{12}$$

where the state variable vector s_t includes predetermined and exogenous variables, d_t is a vector of control variables, and the vector ε_t contains the random innovations. The coefficients matrices, Φ_1, Φ_2,

[32] As in Lubik and Schorfheide (2007), we assume that monetary policy is specified in terms of deviations of current output from its steady-state value.

and Φ_3, have elements that depend on the structural parameters of the model. The state-space solution (12) is used to estimate and simulate the model.

4.2 Estimation Procedure and Results

The model's parameters are estimated using Bayesian estimation techniques, as in Lubik and Schorfheide (2007). These techniques update prior distributions for the deep parameters of the model using the actual data.[33] The estimation is done using recursive simulation methods, particularly the Metropolis-Hastings algorithm. This approach—which is described in Schorfheide (2000) and widely used in estimating DSGE models, such as Smets and Wouters (2003)—is system based and fits the solved DSGE model to a vector time series.

The model has five shocks, so we use five aggregate time series in the estimation to avoid the singularity problem. The data series are monthly and consist of the growth rate of the Canadian industrial production index as a measure of real output growth, the nominal ninety-day T-bill interest rate, the annualized monthly CPI inflation rate, the first difference of the nominal exchange rate, and the first difference of the terms of trade. The terms of trade is defined as the relative price of exports in terms of imports. All of the series, including the output growth, are demeaned before estimation, because the model is log-linearized around steady-state equilibrium values.

The vector of observable variables, z_t, is composed of real output growth, the nominal interest rate, the CPI inflation rate, and the first differences in the nominal exchange rate and the terms of trade. Therefore, z_t is given by

$$z_t = [\Delta Y_t, R_t, \pi_t, \Delta e_t, \Delta q_t]',$$

which is a 5×1 vector of observable variables, and $Z^T = \{z_1, \ldots, z_T\}$ represents a $5 \times T$ data matrix of T observations on z_t. The structural parameters of the model are in a 16×1 vector θ. The linear structural

[33] The discount factor, β, is set at 0.998 prior to estimation, because there is insufficient information in the data to estimate it accurately. This calibration implies an annual steady-state real interest rate of 2.5 percent, which matches the historical average for the period 1952–61.

model is reduced to a state-space representation for z_t. Under the assumption that all the structural shocks are normally distributed and uncorrelated, we obtain a likelihood function $L(\theta|Z^T)$ that can be evaluated using the Kalman filter described in detail in Hamilton (1994, ch. 13).

To implement the Bayesian approach, a prior distribution of the parameters is assumed with a density $p(\theta)$. The advantage of the Bayesian technique over other estimation methods is that, by setting prior densities, we can attach implicit weights to the prior information on the structural parameters. Then the data given by Z^T are used to update the prior distribution using the likelihood function. The posterior distribution based on Bayes's theorem is

$$p(\theta|Z^T) = \frac{L(\theta|Z^T)p(\theta)}{\int L(\theta|Z^T)p(\theta)d\theta}.$$

The Bayesian simulation technique, described in Schorfheide (2000), generates random posterior draws of the parameters that are used in the simulation of the model. This approach allows us to estimate structural parameters of the model and at the same time extract the smoothed structural shocks.

Canada had a flexible exchange rate for the period from 1950:M10 to 1962:M5. However, exchange controls remained in place until the end of 1951, and an active money market was not established until 1953 (Watts 1993). Therefore, we estimate the model over the relevant flexible exchange rate period, 1952:M1 to 1961:M12, and over two sub-samples: the pre-1957 period from 1952:M1 to 1956:M12 and the post-1957 period from 1957:M1 to 1961:M12. The second sub-sample corresponds to the Coyne period.[34] The estimates of monetary policy parameters in the two sub-samples allow us to compare the reaction of the monetary authority with inflation, output, and nominal exchange rate variations.

[34]The estimation sample starts in 1952:M1 because the Bank of Canada abandoned exchange control in December 1951. The sample is divided at the end of 1956 because it roughly corresponds to the change of monetary policy that occurred in the mid-1950s with the change in Governors. With monthly data, there are sixty observations in each sub-sample.

Table 1. Prior and Posterior Distributions of the Parameters

	Priors			Posteriors		
Param.	**Density**	**Mean**	**Std.**	**Entire Period Posterior Means [95% Interval]**	**Pre-1957 Posterior Means [95% Interval]**	**Post-1957 Posterior Means [95% Interval]**
ρ_R	Beta	0.9	0.05	0.852 [0.81–0.89]	0.935 [0.91–0.96]	0.742 [0.67–0.82]
ψ_π	Gamma	1.5	0.3	1.326 [0.92–1.70]	1.141 [0.75–1.51]	1.778 [1.30–2.28]
ψ_y	Gamma	0.5	0.3	0.692 [0.39–0.99]	0.503 [0.23–0.78]	0.627 [0.32–1.01]
ψ_e	Gamma	0.5	0.3	1.716 [1.00–2.39]	1.4915 [0.62–2.30]	0.874 [0.38–1.44]
α	Beta	0.25	0.05	0.217 [0.15–0.28]	0.232 [0.16–0.29]	0.261 [0.18–0.33]
τ	Gamma	0.5	0.05	0.426 [0.34–0.50]	0.458 [0.38–0.53]	0.4590 [0.38–0.54]
κ	Beta	0.5	0.05	0.421 [0.34–0.49]	0.492 [0.41–0.56]	0.433 [0.36–0.50]
ρ_A	Beta	0.5	0.05	0.547 [0.44–0.64]	0.480 [0.41–0.56]	0.567 [0.46–0.67]
ρ_q	Beta	0.2	0.05	0.242 [0.15–0.34]	0.2340 [0.13–0.33]	0.206 [0.13–0.27]
ρ_{y^*}	Beta	0.9	0.05	0.971 [0.95–0.99]	0.977 [0.96–0.99]	0.928 [0.88–0.97]
ρ_{π^*}	Beta	0.7	0.05	0.568 [0.50–0.63]	0.580 [0.50–0.66]	0.656 [0.58–0.73]
σ_R	InvGam	0.01	0.05	0.67 [0.55–0.79]	0.29 [0.22–0.35]	0.91 [0.68–1.13]
σ_A	InvGam	0.01	Inf.	0.73 [0.55–0.90]	0.77 [0.61–0.92]	0.72 [0.54–0.91]
σ_q	InvGam	0.01	Inf.	0.93 [0.83–1.03]	1.07 [0.91–1.22]	0.76 [0.64–0.85]
σ_{y^*}	InvGam	0.01	Inf.	1.85 [1.00–2.68]	1.53 [0.69–2.51]	1.97 [1.03–2.76]
σ_{π^*}	InvGam	0.01	Inf.	1.34 [1.19–1.49]	1.63 [1.38–1.89]	0.90 [0.78–1.02]
Log Data Density				1,946.63	985.40	994.62

Notes: In columns 5–7, posterior means and 95 percent posterior probability intervals [in brackets] are reported.

Table 1 displays the prior and posterior distributions for the structural parameters of the model. The priors used for the monetary policy parameters are the instrumental variable estimates that do not impose the model restrictions. The priors for the autoregressive coefficient

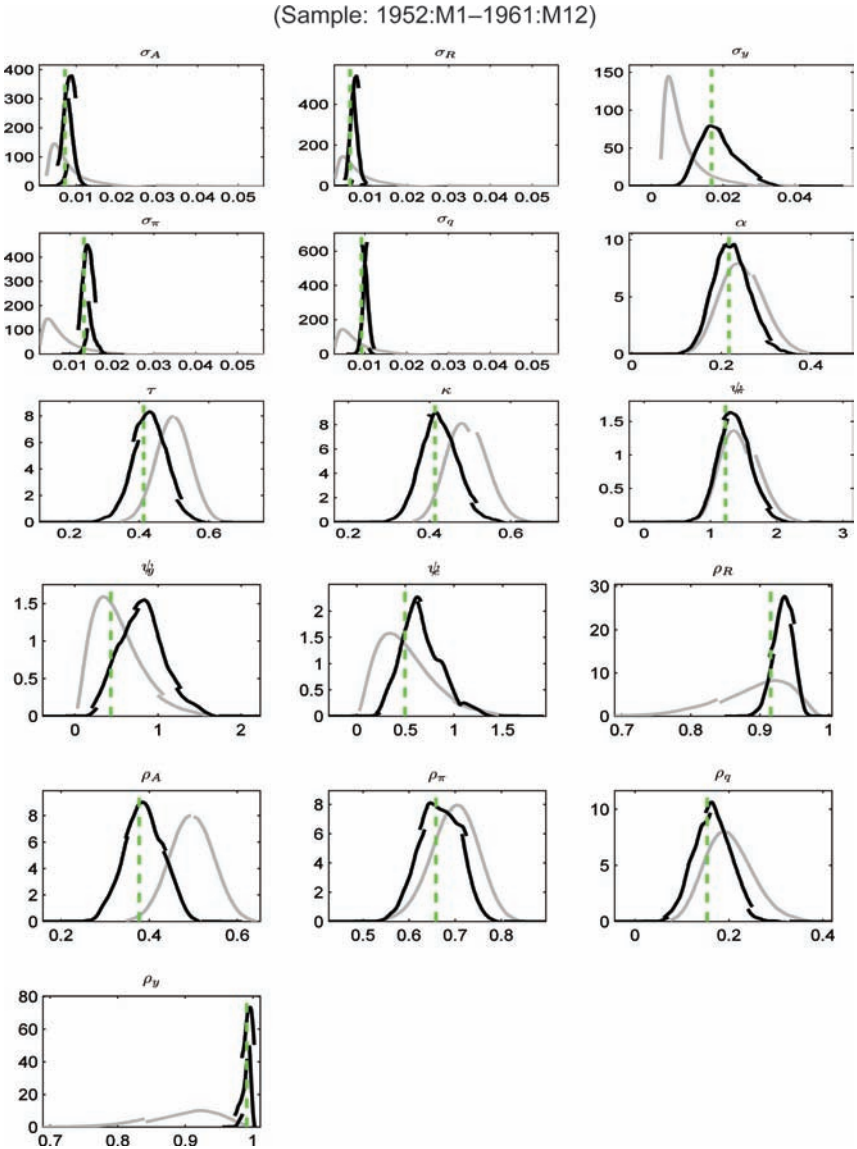
and standard deviations in the exogenous processes are recovered from the least-squared estimation of different laws of motion using the actual data. These priors are estimated using the relevant floating rate period that covers 1952:M1–1961:M12. For the priors of the remaining structural parameters α, τ, and κ, we employ values similar to those used in Lubik and Schorfheide (2007) for Canada. Table 1 also reports the estimation results of the model's structural parameters: the posterior means and 95 percent posterior probability intervals. We evaluate the robustness of the estimation of our model by comparing the prior and posterior distributions (density) for the estimated parameters. Figure 10 plots the prior distributions together with the posterior means and distributions. It shows that actual data are very informative about almost all of the estimated parameters. This is because posterior distributions are significantly different from the prior ones.[35]

We focus our empirical analysis on the estimates of the monetary policy parameters in the pre- and post-1957 periods. The priors of the monetary policy parameters are assumed to be the same for the three samples; that is, they are treated symmetrically a priori. The prior of equal monetary policy pre- and post-1957 does not hold. Indeed, we find significant heterogeneity in the reaction of the monetary authority across the two sub-samples.

The estimates of the policy rule coefficients show that the Bank of Canada did not strongly respond to inflation, output, and exchange rate fluctuations during the pre-1957 period, as the estimates of the coefficients ψ_π, ψ_y, and ψ_e are 1.14, 0.50, and 1.49, respectively. Nevertheless, the responses to inflation, output, and the nominal exchange rate were more aggressive in the post-1957 period. The estimates of the coefficients ψ_π and ψ_y are larger at 1.78 and 0.63, respectively, while the estimate of ψ_e is smaller at 0.87. The estimates of the smoothing coefficient, ρ_R, are 0.94 and 0.74 in the pre- and post-1957 sub-samples. This implies higher interest rate inertia in the pre-1957 period compared with the post-1957 period. It is important to note that the estimated standard error of unsystematic monetary policy shocks, σ_R, is 0.29 percent in the pre-1957 period, whereas it is 0.91 percent during the post-1957 period, indicating

[35]Prior and posterior distribution plots are similar for the three sample estimations, so we report only those for the entire floating-period estimation.

Figure 10. Prior and Posterior Distributions



Note: Posterior distribution = bold line; prior distribution = grey line; posterior means = dashed line.

that monetary policy shocks, in general, were much more volatile in the post-1957 period than in the pre-1957 period.[36] Thus, the Bank of Canada appears to have been more strongly smoothing the nominal interest rate during the pre-1957 period, given the greater estimated interest rate inertia and the lower volatility of policy shocks.

Table 1 also reports the estimates of the remaining non-monetary-policy parameters. The estimate values of α, τ, and κ are very similar in the three samples, indicating some stability in the values of these parameters across the three periods. The estimates of these parameters are also close to those estimated in Lubik and Schorfheide (2007). Technology and world output shocks are similarly persistent and more volatile in the two periods, while terms of trade and world inflation were more volatile in the pre-1957 period.

To evaluate the performance of the model, we report volatilities, autocorrelations, forecast-error-variance decompositions, and the model's fit for output, the nominal interest rate, CPI inflation, and changes of the nominal exchange rate using the estimates for the entire floating and post-1957 periods. These exercises represent different ways of evaluating the performance of our model. Table 2 reports volatilities and autocorrelation functions of key simulated variables (output, the nominal interest rate, inflation, and the first difference of the nominal exchange rate) and compares them with those observed in the data. For the two estimated periods, the model generates unconditional volatilities and autocorrelations that are close to those observed in the data, except for the exchange rate. Overall, these results indicate that the model largely captures the salient features of the Canadian data.

We also consider the forecast-error-variance decompositions. Table 3 shows the variance decompositions of the variables attributed to each of the five shocks for a one-month-ahead horizon. In both periods, foreign output shocks account for the bulk of the fluctuations in these variables. Monetary policy shocks also account

[36]The estimated monetary policy is $R_t = 0.94R_{t-1} + 0.07\pi_t + 0.03y_t + 0.09\Delta e_t$ in the pre-1957 period, while it is $R_t = 0.74R_{t-1} + 0.46\pi_t + 0.16y_t + 0.23\Delta e_t$ in the post-1957 period. Therefore, responses to inflation, output, and changes of the nominal exchange rate were, respectively, seven, five, and three times more aggressive in the post-1957 period than in the pre-1957 period.

Table 2. Volatilities and Autocorrelations: Data and Estimated Model

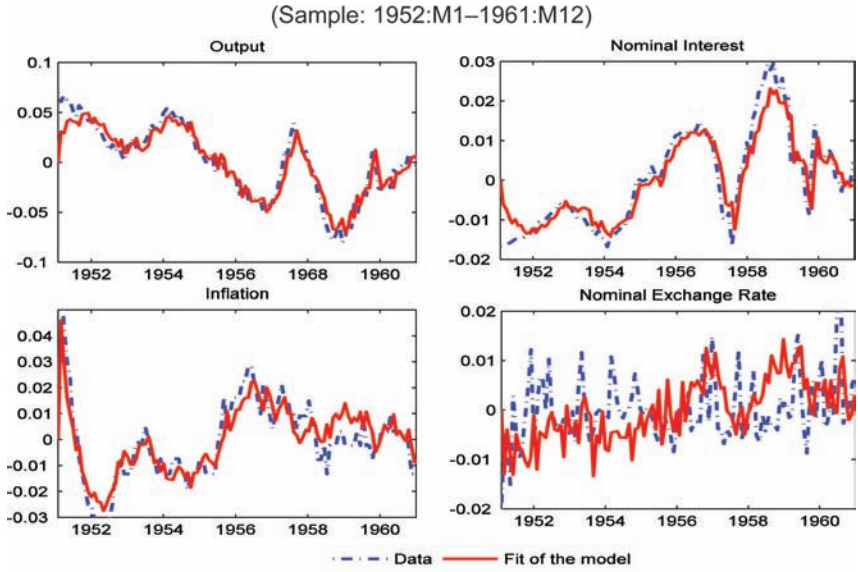
Variables	Volatilities		Autocorrelations	
	Data	Model	Data	Model
A. Post-1957 Period				
Output	2.54	2.76	0.90	0.89
Nominal Interest Rate	1.07	0.95	0.90	0.79
CPI Inflation	1.02	1.25	0.84	0.67
Dif. (Nominal Exchange Rate)	0.69	1.53	0.28	0.61
B. Entire Floating Period				
Output	3.68	4.07	0.95	0.94
Nominal Interest Rate	1.22	1.25	0.96	0.93
CPI Inflation	1.77	1.78	0.93	0.72
Dif. (Nominal Exchange Rate)	0.65	1.85	0.33	0.68

Notes: Volatilities are measured by standard deviations in percentages. Simulated volatilities and autocorrelations are based on the posterior means for the post-1957 period and entire floating period as displayed in table 1.

Table 3. Forecast-Error-Variance Decompositions

Variables	Percentage Owing To:				
	dA_t	ε_{Rt}	Δq_t	y_t^*	π_t^*
A. Post-1957 Period					
Output	1.92	5.93	0.67	90.6	0.86
Nominal Interest Rate	15.5	20.6	1.08	62.1	0.73
CPI Inflation	4.66	24.7	0.17	60.5	9.93
Dif. (Nominal Exchange Rate)	3.08	16.4	13.1	40.1	27.4
B. Entire Floating Period					
Output	0.98	2.71	0.69	93.6	2.05
Nominal Interest Rate	4.27	7.40	0.74	87.5	0.09
CPI Inflation	2.41	16.2	1.18	58.6	21.5
Dif. (Nominal Exchange Rate)	2.23	15.0	9.88	54.1	18.8

Figure 11. Data and Model's Fit: Entire Floating Period



for a significant fraction of the variance in the nominal interest rate, inflation, and the nominal exchange rate, as found in recent studies that have estimated DSGE models for Canada; for example, see Dib (2006, 2010).

To assess the ability of the model to explain the actual data, we plot the data against the model's predictions (at the posterior means) of output, the nominal interest rate, CPI inflation, and changes of the nominal exchange rate. Figure 11 shows that the model does remarkably well tracking output, the nominal interest rate, and inflation. It does, however, less well predicting changes of the nominal exchange rate, which is a variable hardly predicted in standard DSGE models. The model underpredicts the nominal exchange rate before 1957 and overpredicts it after 1957. Nevertheless, overall, the model is successful in fitting the data and it is useful for the counterfactual monetary policy analysis.

4.3 Counterfactual Simulations

In order to perform counterfactual simulations of the model, we need to identify and extract the historical shocks that disturbed

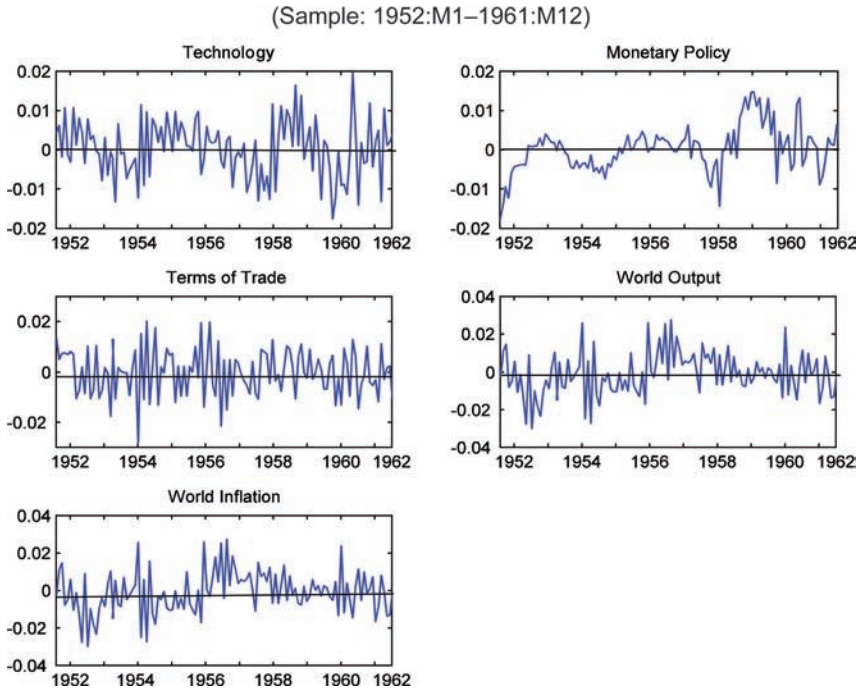
the economy over the counterfactual periods, so that they can be reintroduced when the counterfactual model is simulated. For our rational-expectation model, we use the model's state-space representation, equation (12), to extract the smoothed shocks identified by a record of structural innovations $\{\varepsilon_{At}, \varepsilon_{Rt}, \varepsilon_{qt}, \varepsilon_{yt}, \varepsilon_{\pi t}\}; t = 1, \ldots, T$, using a Kalman filter. We extract the historical shocks for the three estimated periods: the entire floating period, the pre-1957 period, and the post-1957 period. In this procedure, we use the estimates of the model's parameters for the three periods, as reported in table 1. Thus, our approach extends the methodologies used by Leigh (2004) and Boivin and Giannoni (2006) in their counterfactual analysis done for the Japanese and U.S. monetary policies, respectively. Our model is more complex and includes structural (as opposed to non-structural) shocks. All the generated shocks are i.i.d. and serially uncorrelated.

Figure 12 displays the extracted smoothed shocks for the entire floating rate period. What is noteworthy from this figure is that the volatility of the extracted monetary policy shocks is much higher in the second half of the floating period (which is the post-1957 period), reflecting the instability in monetary policy noted earlier. The volatilities of the other shocks are relatively stable throughout the period.

Before examining the results of the counterfactual simulations, it is important to note that conducting a counterfactual experiment in economics is problematic because a controlled experiment is impossible. To conduct the simulation, we set the model's parameters at their posterior mean values reported in table 1. Thus, by leaving the parameters unchanged, we are biasing the volatilities upward in the counterfactual simulations because agents would have likely acted in a way to mitigate welfare-reducing volatility.[37] In conducting the counterfactual experiments, we simulate the estimated model with the new assumptions regarding the conduct of monetary and/or exchange rate policies. We also incorporate the historical smoothed structural shocks, extracted via the Kalman filter, in an attempt to

[37]In fact, we know that some parameters would likely have changed had a different monetary policy or exchange rate regime been in place because agents would have reoptimized.

Figure 12. Smoothed Shocks: Entire Floating Period



duplicate the actual economic circumstances that occurred during the sample periods.

We perform two types of counterfactual experiments. The first one, called the "pre-1957" monetary policy, assumes that the monetary policy of the pre-1957 ("pre-Coyne") period is maintained through the post-1957 ("Coyne") period. This experiment imposes the pre-1957 monetary policy over the post-1957 period and is conducted using the model's structural parameters as estimated over the post-1957 period, except for the monetary policy coefficients. With this counterfactual experiment, we investigate what would have happened to the Canadian economy had the pre-1957 monetary policy been in place during the Coyne period.

In our model, the monetary policy consists of two components: the systematic component represented by the monetary policy rule and the unsystematic component represented by the smoothed monetary policy shocks. Therefore, in the monetary policy counterfactual

experiment, we conduct *three* simulations for the post-1957 period. We then compare the results across simulations and relative to the actual data. In the first or benchmark simulation for the post-1957 period, we simulate the estimated model using the post-1957 monetary policy rule but *without* any monetary policy shocks (monetary policy shocks are set equal to zero). In the second counterfactual exercise, we simulate the estimated model with the pre-1957 monetary policy rule but also *without* monetary policy shocks.[38] Hence the difference between the benchmark and second simulations is simply the pre- and post-1957 monetary policy rules (that is, the systematic component of monetary policy). Finally, we simulate the estimated model with both the pre-1957 monetary policy rule *and* the monetary policy shocks as extracted for the pre-1957 period. This simulation is interesting because the volatility of monetary policy shocks was greater in the post-1957 period than in the pre-1957 period, reflecting the more erratic nature of monetary policy over the latter period. Thus, this simulation captures the impact of this difference in volatility as well as the difference in the monetary rule across the two periods.

The second counterfactual experiment, called the fixed nominal exchange rate (FNER), assumes that instead of having a flexible nominal exchange rate, Canada had remained on the fixed nominal exchange rate over the floating period. Thus, this counterfactual experiment incorporates the commitment to maintain a fixed nominal exchange rate over the 1952–61 period. This is an interesting experiment because it could be argued that given the observed instability of monetary policy during the Coyne period, Canada might have been better off with a fixed nominal exchange rate. In this simulation, we assume that the goal of the monetary authority is to keep the exchange rate fixed, and the Canadian interest rate is simply assumed to follow the U.S. nominal interest rate.

For this experiment, we use the model's structural parameters as estimated over the entire floating period, 1952–61, except for Canadian monetary policy, which is assumed to follow U.S. monetary policy. Therefore, to perform this counterfactual experiment, changes of the nominal exchange rate, Δe_t, and all monetary policy

[38]The unsystematic monetary policy shocks for the post-1957 period are set equal to zero in the first two simulations.

Table 4. Volatilities from Counterfactual Experiments (Standard Deviations in %)

	Monetary Policy (1957:M1–1961:M12)				Fixed NER (1952:M1–1961:M12)	
Variables	**Data**	**1**	**2**	**3**	**Data**	**FNER**
Output	2.54	2.16	1.75	1.50	3.51	4.41
Nominal Interest Rate	1.07	1.35	0.29	0.20	1.22	1.01
CPI Inflation	1.02	1.52	0.95	1.65	1.77	5.24
Δ (Nominal Exchange Rate)	0.69	1.72	0.86	1.34	0.65	0

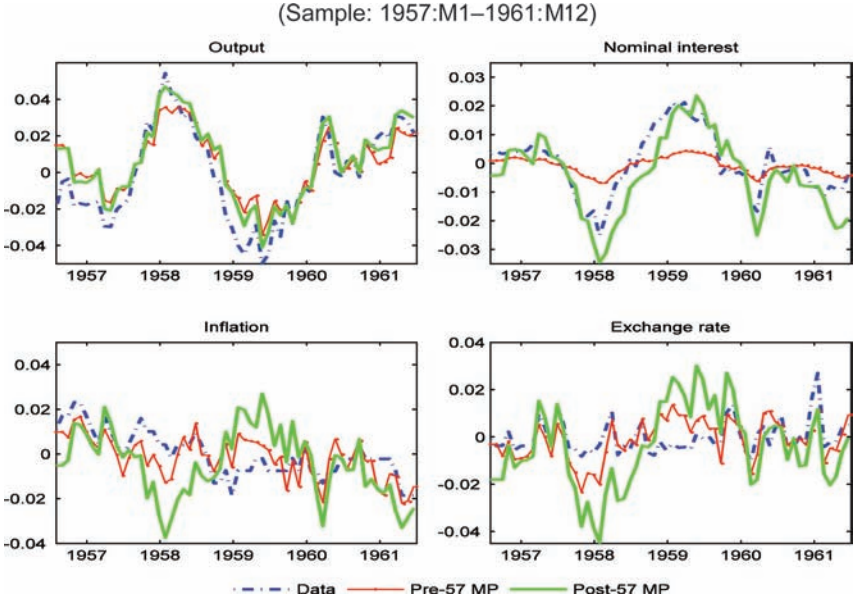
Notes: Results in column 1 are for the post-1957 period monetary policy rule *but* without monetary policy shocks (monetary policy shocks are set to zero). Results in column 2 are for the pre-1957 monetary policy rule *but* without policy shocks (monetary policy shocks are set to zero). Results in column 3 are for the pre-1957 monetary policy rule *and* the pre-1957 smoothed monetary policy shocks. In the FNER column, the monetary policy parameters, ρ_R, ψ_π, ψ_y, and ψ_e are set equal to zero, while the domestic nominal interest rate, R_t, is set equal to the U.S. interest rate, R_t^*.

parameters—$\rho_{R,}, \psi_\pi, \psi_y$, and ψ_e—are set equal to zero, while the Canadian nominal interest rate, R_t, is set equal to the U.S. nominal interest rate, R_t^*, as implied by the UIP condition given by equation (11).

Because the model is log-linearized around steady-state equilibrium values, our comparison between simulated counterfactual series and the actual data is based on second moments measured by the standard deviations in percentage. Table 4 reports the second moments of the data and those simulated for key counterfactual series: output, the nominal interest rate, CPI inflation, and changes of the nominal exchange rate. Also, the comparison between counterfactual series and the actual data is illustrated by the plots in figures 13 and 14 for the pre-1957 monetary policy and the fixed nominal exchange rate counterfactual experiments, respectively.

The second moments of the key variables calculated from the three counterfactual monetary policy simulations for the "pre-1957" counterfactual experiment are reported in table 4, columns 1, 2, and 3. First, we note that, under the pre-1957 monetary policy *but*

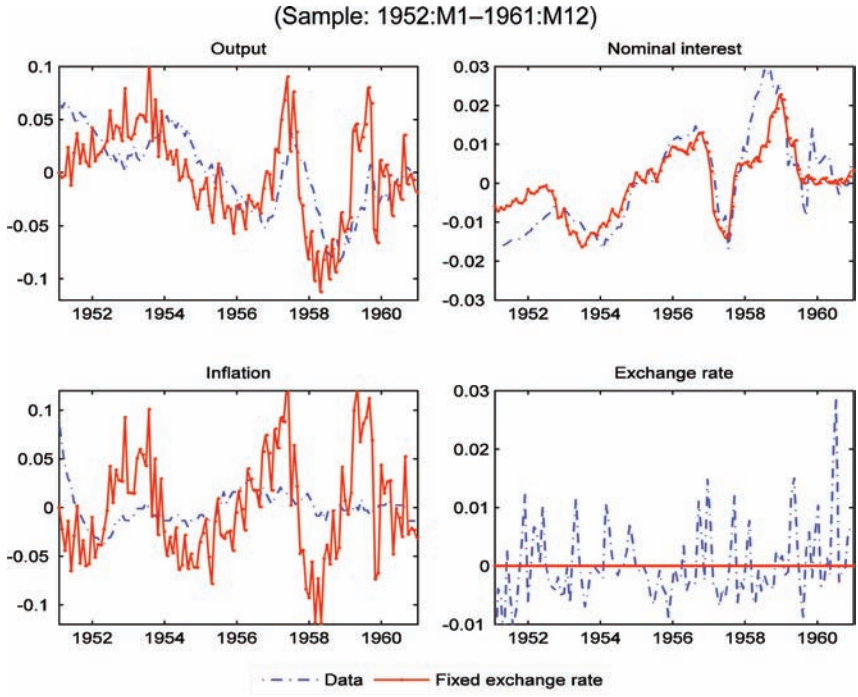
Figure 13. Data and Counterfactual Series: Pre-1957 Monetary Policy (MP) Experiment



without monetary policy shocks, the volatilities of output, the nominal interest rate, and inflation (column 2) are substantially *lower* relative to those of the actual data and of the benchmark case where the post-1957 monetary policy is maintained *but* the monetary policy shocks are set at zero (column 1). This finding is significant because the assumption of unchanged parameters *biases upward* the volatility of the macro variables in the experimental results. We also note that volatility of the nominal exchange rate is slightly higher in the pre-1957 monetary policy simulation without policy shocks, compared with the data, but significantly lower than in the benchmark case. Figure 13 plots the data and simulated series from the two counterfactual simulations with the pre- and post-1957 monetary policy rule but without policy shocks. This figure confirms that the variability of output, the nominal interest rate, and inflation would have been lower under the pre-1957 monetary policy relative to the actual data and the benchmark case.

Column 3 in table 4 indicates that, relative to the data, the volatilities of output and the nominal interest rate are much lower

Figure 14. Data and Counterfactual Series: Fixed Exchange Rate Experiment



in the simulation with the pre-1957 monetary policy *and* the unsystematic policy shocks, which are extracted from the pre-1957 period. In contrast, the volatilities of inflation and the nominal exchange rate are higher.

The counterfactual simulation results suggest that the pre-1957 monetary policy would have dramatically lowered the volatility of the nominal interest rate. This finding can be explained by the higher degree of monetary policy smoothness in the pre-1957 period relative to that in the post-1957 period.[39] It also reflects the less aggressive monetary policy response to inflation fluctuations during the pre-1957 period. In addition, the volatility of the exchange rate is higher

[39]The estimated interest rate smoothing coefficient in the policy rule is 0.94 in the pre-1957 period, but is only 0.74 in the post-1957 period. Therefore, policy rates were much less volatile in the pre-1957 period and thus contribute to more stable output.

in the counterfactual simulation with the pre-1957 monetary policy relative to the data. These results suggest that under the pre-1957 monetary policy there was more scope for the flexible exchange rate to adjust to structural shocks, thereby helping to stabilize output.

In summary, the two sets of counterfactual simulation results displayed in columns 2 and 3 in table 4 indicate that the pre-1957 monetary policy would have stabilized output because simulated output volatility is lower than what was observed in the data and what was generated using the post-1957 monetary policy but without policy shocks. Therefore, changes to the monetary policy rule and monetary policy shocks were the main resources of large output disturbances that occurred in the second half of the 1950s. Thus, we claim that the pre-1957 monetary policy would have reduced the macroeconomic fluctuations in the Canadian economy.

Table 4 also reports the simulation results of the second counterfactual experiment of a fixed nominal exchange rate (FNER). Under this experiment, the volatilities of output and inflation drastically increase, while the volatility of the domestic nominal interest rate is, by assumption, the same as that for the U.S. nominal interest rate.[40] See figure 14. Although these volatilities are biased upward given the assumption of unchanged parameters, they suggest that the flexible exchange rate regime was successful in stabilizing the Canadian economy in the 1950s, even during the post-1957 period when monetary policy was more volatile.

5. Concluding Remarks

The purpose of this paper has been to revisit Canada's pioneering experience with floating exchange rate over the period 1950–62 and to reconsider the evidence and extensive commentary with the benefit of forty to fifty years of improvements in the tools of economic analysis and in our understanding of how monetary policy works in an open economy. Our goal is to draw useful lessons for the conduct of monetary policy today. One key observation is that Canada's floating exchange rate in the 1950s behaved very much like the exchange rate today; it was driven largely by interest rate

[40]The volatility of the changes of the nominal exchange rate is equal to zero under the fixed exchange rate regime.

differentials and by commodity prices. The interesting question is whether the floating rate was the best option for Canada in the 1950s. There is little doubt that in September 1950, when the Canadian dollar was under incredible pressure to appreciate, the float was the correct choice because it removed the speculative pressure that pegged rates often and it sheltered Canada from U.S. inflationary pressures.[41] Our counterfactual analysis indicates that relative to a fixed exchange rate, the flexible rate helped reduce the volatility of key macroeconomic variables, despite the fact the Canadian monetary authorities clearly did not understand all of the implications of conducting monetary policy under a flexible exchange rate and a high degree of capital mobility.

The other counterfactual experiment suggests that had monetary policy not changed during the Coyne period, the Canadian economy would likely have performed much better. The policy was not only more volatile but also produced higher interest rates. Consequently, output was more volatile and growth was likely slower because higher interest rates also generated a more appreciated exchange rate. This misunderstanding of the conduct of a monetary policy under a floating rate unfortunately led to the demise of this regime.

Nonetheless, Canada's floating exchange rate experience in the 1950s was a very useful policy experiment; it demonstrated (and inspired Mundell to show theoretically) that monetary policy is a relatively powerful policy instrument under a floating exchange rate; it also showed that for a flexible rate to work effectively as a stabilizing mechanism, as Friedman argued, monetary policy should not be the source of economic disturbances, but should work in tandem with the exchange rate to facilitate adjustment.

Appendix 1. Data for DSGE Model

Nominal Exchange Rate: Calculated as the monthly average of the daily CDN$-US$ noon spot rate as reported by the Bank for International Settlements.

[41] Mexico, in contrast to Canada, maintained a pegged rate and the inflation rate increased sharply to double-digit levels. See Murray, Schembri, and St-Amant (2003) for more details.

Real Exchange Rate: Calculated as the nominal CDN$-US$ exchange rate deflated by Canadian and U.S. CPI data.

Nominal Ninety-Day T-Bill Interest Rate: Prior to 1962, the Canadian T-bill interest rate is calculated as the average yield determined by auctions for ninety-day Treasury bills. From 1962 onward, the variable is simply the ninety-day T-bill rate. All Canadian data are taken from Statistics Canada. The U.S. T-bill rate is the three-month market yield as reported by the Bank for International Settlements.

CPI Inflation Rate: The year-over-year percentage change in the headline consumer price index as measured by Statistics Canada and the U.S. Department of Labor. The indices are rebased to the year 1997.

Terms of Trade: The price of exports over the price of imports, taken from Statistics Canada.

Industrial Production Index: The Canadian data consist of two series that are spliced together. For months prior to 1971, data are taken from Statistics Canada. After 1971, all data are obtained from the IMF's International Financial Statistics. U.S. data for all periods are taken from the Bank for International Settlements. The indices are rebased to the year 1997.

Commodity Terms of Trade: The price of commodity exports over the price of commodity imports, taken from Statistics Canada.

Unemployment Rate: Canadian data are obtained from hard copies of the "Labour Survey" published by Statistics Canada. U.S. data are taken from hard copies of the Bureau of Labor Statistics' household data publication (the "Current Population Survey").

Appendix 2. Log-Linearized DSGE Equilibrium System

$$y_t = E_t y_{t+1} - [\tau + \alpha(2-\alpha)(1-\tau)](R_t - E_t\pi_{t+1}) + \rho_A dA_t + \alpha[\tau + \alpha(2-\alpha)(1-\tau)]\rho_q \Delta q_t + [\alpha(2-\alpha)(1-\tau)/\tau](\rho_y - 1)y_t^*, \tag{13}$$

$$\pi_t^d = \beta E_t \pi_{t+1}^d + \frac{\kappa}{[\tau + \alpha(2-\alpha)(1-\tau)]}\left(y_t - y_t^p\right), \tag{14}$$

$$y_t^p = -\frac{\alpha(2-\alpha)(1-\tau)}{\tau} y_t^*, \tag{15}$$

$$R_t = \rho_R R_{t-1} + (1-\rho_R)\left\lfloor \psi_\pi \pi_t + \psi_y y_t + \psi_e \Delta e_t \right\rfloor + \varepsilon_{Rt}, \tag{16}$$

$$\Delta e_t = \pi_t - (1-\alpha)\Delta q_t - \pi_t^*, \tag{17}$$

$$\pi_t = \pi_t^d - \alpha \Delta q_t, \tag{18}$$

$$\Delta q_t = \rho_q \Delta q_{t-1} + \varepsilon_{qt}, \tag{19}$$

$$\pi_t^* = \rho_\pi \pi_{t-1}^* + \varepsilon_{\pi^* t}, \tag{20}$$

$$dA_t = \rho_A dA_{t-1} + \varepsilon_{At}, \tag{21}$$

$$y_t^* = \rho_{y^*} y_{t-1}^* + \varepsilon_{y^* t}, \tag{22}$$

$$\Delta Y_t = y_t - y_{t-1} + dA_t. \tag{23}$$

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