December 1997

Constraints on the conduct of Canadian monetary policy in the 1990s:

Dealing with uncertainty in financial markets

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ACKNOWLEDGEMENTS

The authors would like to thank Pierre Duguay, Charles Freedman, Agathe Côté and other colleagues at the Bank of Canada for their helpful suggestions and comments. Neil Beattie and Rebecca Szeto provided invaluable technical assistance.

ABSTRACT

Canada's economic performance in the first half of the 1990s was adversely affected by high premiums in interest rates that were brought on by political and economic uncertainties. The short-term output-inflation trade-off was worsened since these uncertainties weakened the value of the Canadian dollar at the same time as they raised domestic interest rates. In this environment, attempts by the Bank of Canada to ease monetary conditions were liable to be misinterpreted by the market as a sign of weakening commitment to inflation control. On several occasions, such fears led to sharp increases in interest rates.

The first part of this report presents a simple theoretical model that shows the qualitative impact of the increased interest rate premiums on economic performance. Some evidence is presented that suggests high Canadian interest rate premiums were an important factor explaining the general weakness of economic activity. This is followed by a discussion of the tactical conduct of monetary policy when the need to build credibility often seemed to be in conflict with the desired easing of monetary conditions. Finally, the report describes steps that the Bank has taken to reduce uncertainty about how it conducts monetary policy.

RÉSUMÉ

La tenue de l'économie canadienne au cours de la première moitié des années 90 s'est ressentie du niveau élevé des primes incorporées aux taux d'intérêt par suite de l'incertitude politique et économique. Celle-ci a entraîné un recul du dollar canadien et fait augmenter les taux d'intérêt, d'où une détérioration de l'arbitrage à court terme entre la production et l'inflation. Dans ce contexte, toute tentative par la Banque du Canada d'assouplir les conditions monétaires risquait d'être interprétée par le marché, à tort, comme l'indice d'un relâchement de l'engagement des autorités envers la maîtrise de l'inflation. À plusieurs reprises, des craintes de cette nature ont donné lieu à de fortes hausses des taux d'intérêt.

Dans un premier temps, les auteurs de l'étude présentent un modèle théorique simple qui illustre l'incidence qu'a, sur le plan qualitatif, la hausse des primes incorporées aux taux d'intérêt sur la tenue de l'économie. Selon les résultats obtenus, le niveau élevé des primes incorporées aux taux d'intérêt canadiens aurait été un facteur déterminant de la faiblesse générale de l'activité économique. Les auteurs analysent ensuite les considérations d'ordre tactique qui ont guidé la conduite de la politique monétaire depuis le début des années 90, durant lesquelles le besoin d'établir la crédibilité de cette politique a souvent semblé inconciliable avec l'assouplissement souhaité des conditions monétaires. Ils décrivent enfin les mesures que la Banque a prises afin de réduire

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1 Introduction

This paper examines the conduct of monetary policy in Canada from the disinflation of the early 1990s through 1996. After 1992, the inflation rate was generally stable and below the midpoint of the inflation-control target range.[1] As a result, the Bank of Canada did not seek further disinflation, and monetary conditions eased substantially. Even so, economic activity remained quite weak, with persistently high excess capacity and unemployment. This was unexpected. Standard macroeconomic models, incorporating an expectations-augmented Phillips curve, predict that the economy will grow rapidly following a period of disinflation until output returns to its potential level.

This paper explores why output did not grow more strongly between 1992 and 1995 and why monetary conditions did not ease even more rapidly.[2] We argue that uncertainties and adverse risk perceptions that came to a head in the first half of the 1990s answer in large part both these questions.

Several factors led to heightened uncertainties: rapid growth in government debt and uncertainty about Quebec's role in Confederation undermined the confidence of consumers and investors alike; at the same time, large-scale restructuring in the Canadian private and public sectors engendered further insecurity about employment; and the chronic inflation of the preceding two decades created a lingering credibility problem for monetary policy. These problems had a negative impact on economic activity — through shocks to confidence; through people's growing awareness that widespread cuts in government programs or increases in taxes had become unavoidable; and through the higher borrowing costs caused by the perceived riskiness of Canadian assets. All this also worsened the

1. Inflation reduction targets were announced in 1991, calling for an annual rate of increase of the consumer price index (CPI) of 2 per cent by the end of 1995. In late 1993 the target was set at the range of 1-3 per cent to the end of 1998. By the latter date, a decision will be taken on a future range consistent with price stability.

2. For a recent discussion of various other aspects of the conduct of monetary policy at low rates of inflation, see Freedman (1996).

short-term output-inflation trade-off, since increased risk premiums were accompanied by a weaker value for the Canadian dollar.

Lack of confidence in financial markets also created tactical difficulties for the Bank in the implementation of monetary policy by increasing the likelihood that monetary easing might be wrongly interpreted as a sign of weakening commitment to inflation control. Several bouts of financial market turbulence were particularly jarring. During these episodes, any easing of monetary conditions had to be put on hold. In fact, initial attempts to resist tightening led to, after a short lag, some sharp increases in interest rates and to weakness in the Canadian dollar. Tactical choices in the implementation of policy through this period were repeatedly influenced by this market perception.

Mindful of the need to reduce the risk premium in interest rates and build credibility, the Bank of Canada gave a high priority to reducing uncertainty about the conduct of monetary policy. This was reflected in generally cautious tactics — especially during and after the periods of turbulence. More fundamentally, the Bank also undertook initiatives designed to make its conduct more transparent, and to reduce the surprise element in monetary policy actions.[3]

This approach did not promise or produce quick results. By 1996, however, perceptions began to change, mainly due to a substantial strengthening in public finances and a lengthening period with inflation within the announced target range. In this improved environment, the Bank was able to ease monetary conditions more assertively. Nominal interest rates fell significantly below those in the United States — an outcome that many financial commentators had thought unlikely.

The rest of this paper is organized as follows. Section 2 outlines broad economic facts of the 1990-1996 period, and uses a simple theoretical model to describe implications of an increase in risk premiums, low consumer confidence, and a weak fiscal situation for the short-run trade-off

3. The Governor has placed much emphasis on the need for reducing uncertainty in the conduct of monetary policy — e.g., Thiessen (1995).

between output and inflation. Section 3 provides statistical evidence from the term structure of interest rates and aggregate demand functions. Section 4 discusses the cautious approach adopted in the conduct of monetary policy. Section 5 offers some concluding remarks and highlights some current initiatives to improve the transparency of the Bank's operating framework.

2 Monetary policy environment

This section outlines the prominent features of the recent economic environment, and presents an analysis of the policy options using a standard model of a small open economy.

2.1 Goals and operating targets of monetary policy

Table 1 describes the evolution, over the period 1990-1996, of some important measures of macroeconomic performance — inflation, output, and the gap between actual and potential GDP — and of the operating target for monetary policy — the monetary conditions index (MCI), the components of which are the short-term interest rate and the exchange rate. These salient features stand out:

Monetary policy achieved a substantial disinflation
The targets instituted in 1991 to control the rate of increase in the consumer price index (CPI) were met. Indeed, inflation was generally below the midpoint of the target range. The upward blip in 1995 — the year-over-year increase in the CPI touching 2.9 per cent in May — was due to prior exchange rate depreciation and commodity price increases.

Activity was sluggish
GDP increased at an average rate of less than 2 1/2 per cent since 1991, not keeping pace with the growth of potential output. The annual increase in final domestic demand averaged only one per cent. Household spending was held back by uncertain employment income prospects associated with

- economic restructuring in both private and public sectors
- a gap between real wages and productivity
- high real interest rates
- unsustainable government deficits.

Table 1: Economic performance variables (Q4/Q4 per cent change)

	Inflation			Output growth		Gap: actual-potential GDP (level)
	Target range	CPI	Core CPI	GDP	Final domestic demand	
1990	NA	4.9	3.9	-1.9	-1.9	0.3
1991	NA	4.1	2.7	0.0	1.2	-3.1
1992	2-4	1.8	1.6	0.5	-0.3	-4.2
1993	1 2/3-3 2/3	1.8	1.8	3.1	2.0	-4.0
1994	1 1/3-3 1/3	0.0	1.6	4.9	2.6	-2.1
1995	1-3	2.1	2.2	0.7	-0.1	-1.9
1996	1-3	2.0	1.5	2.3	4.2	-2.7

Monetary policy operating target (per cent)

	90-day interest rate		Real exchange rate	Real MCI
	Nominal	Real		
1990	13.0	9.9	0.0	0.0
1991	8.9	6.0	0.4	-3.7
1992	6.7	5.5	-7.1	-6.8
1993	5.0	3.9	-14.4	-11.0
1994	5.7	4.9	-21.1	-12.4
1995	7.2	5.7	-23.0	-12.6
1996	4.3	3.1	-22.1	-14.9

Top panel Target: December/December change in CPI; 1993 and 1994 interpolated from actual target ending mid-1994. Core CPI: excludes food, energy, and the effect of indirect taxes.
Bottom panel Real 90-day rate: nominal less lagged 4-quarter change in GDP deflator. Real exchange rate: Canadian dollar index, against 5 currencies, adjusted with GDP deflators, base year 1990. Real MCI: increase in real interest rate, plus one third of the percentage increase in the real exchange, from the base year 1990.

The problem with output was not entirely on the demand side, since productivity growth was also mediocre. Thiessen (1996b) stresses that this in part reflects the transitional effect of a large, somewhat delayed, economic restructuring in Canada.

There was a considerable easing of monetary conditions

Although interest rates and the exchange value of the Canadian dollar both declined over the whole period, from 1992 to 1995 the decline in the MCI, 5 1/2 percentage points in real terms, was entirely through currency depreciation. This stimulated activity by contributing to a rapid growth in net exports — the easing of monetary conditions during this period had its effect on output through the external channel — but it also directly raised consumer prices.

Real interest rates were high

High real interest rates persisted throughout the first half of the decade. Heightened risks — especially with respect to the longer term — were largely responsible for this. Growing risk premiums were reflected in the depreciation of the Canadian dollar and in a steepening of the yield curve, as well as in the high overall level of rates. The high risk premiums are shown in Section 3 to be a significant factor in the weakness of economic activity.

Government debt grew rapidly until 1995

Gross government debt, provincial and federal combined, approached 100 per cent of GDP, as Canada accumulated budget deficits at a rate well above the G-7 countries as a whole (Table 2). The public increasingly came to recognize that the growth in public debt was not sustainable, and that governments would ultimately have to cut their deficits. Furthermore, the longer the adjustment was put off, the bigger the cuts would have to be, and the delay in introducing adequate reductions in government deficits exacerbated public anxiety. Expectations of government retrenchment must have been a significant factor weighing down household spending even before actual large cuts began to bite in 1995.

Table 2: General government debt and budget balances as percentage of GDP

	Gross debt					Budget balances				
	1990	**1992**	**1994**	**1996**	**1997P**	**1990**	**1992**	**1994**	**1996P**	**1997P**
Canada	73	87	98	100	97	-4.1	-7.4	-5.3	-1.8	-0.2
U.S.	56	62	63	64	64	-2.7	-4.4	-2.3	-1.6	-1.1
Japan	65	64	73	86	91	2.9	1.5	-2.1	-4.4	-3.1
Germany	46	46	52	65	66	-2.1	-2.8	-2.4	-3.8	-3.2
France	40	46	56	63	64	-1.6	-3.8	-5.6	-4.2	-3.2
Italy	105	117	126	125	124	-11.0	-12.1	-9.6	-6.7	-3.2
U.K.	39	48	54	61	61	-1.2	-6.3	-6.8	-4.4	-2.8
Total G-7	58	63	68	74	75	-2.1	-4.0	-3.6	-3.1	-2.1

Source: *OECD Economic Outlook* June 1997. P: projections

The cuts since 1995 have been of major proportions. In 1997, Canada would appear to be the only G-7 country without a significant budget deficit.

International indebtedness grew rapidly until 1995

Growth in external liabilities also accelerated in the early 1990s, as the current account deficit reached almost 4 per cent of GDP (Table 3). This added to the perception that Canada was becoming a riskier place to invest, and there were many stories in the media about the extent to which Canadian governments were "relying on foreign lenders." At a minimum, growing international indebtedness made Canada vulnerable to the backwash of nervousness from disturbances, such as those in the European Exchange Rate Mechanism (ERM) and Mexico, that otherwise would not materially affect the domestic economy (see Section 4).

Table 3: International accounts: percentage of GDP

	1990	**1992**	**1994**	**1996**	**1997P**
Current account	-3.8	-3.7	-3.0	-0.2	-0.2
Net foreign liabilities	38	43	45	41	39

Source: *OECD Economic Outlook* June 1997 and Canadian national accounts

In the past couple of years the current account has improved dramatically with the rapid increase in net exports. The exchange market has interpreted the swing in the balance of payments as positive news, since it points to a substantial decline in the external debt ratio in the foreseeable future. Exchange market expectations for the Canadian dollar have been revised accordingly.

In 1996, improved fundamentals affect market perceptions

Improving economic fundamentals — substantial declines in budget and external deficits, durable low inflation — came to the fore of attention during 1996. The political question of Quebec was no longer an immediate preoccupation for financial markets after the October 1995 referendum. Published commentary on the Canadian economy by private sector analysts underwent a remarkable change and became very positive. By the fourth quarter of 1996, short-term interest rates had declined to about 3 per cent, and the MCI was at its lowest level ever. Because of the usual lags, this was forecast to result in an acceleration of activity through 1997 and hence a reduction in the excess capacity in the economy.

2.2 A standard open-economy model

Mainstream macroeconomic theory provides a useful framework for analysing the situation just described. In a standard open-economy model, increased perceptions of risk and a need for budget retrenchment create economic problems qualitatively similar to those experience in Canada. Appendix 1 outlines such a model.[4] The basic assumptions are:

- Output prices adjust slowly, so that output may diverge from its potential level in the short run (Phillips curve).

4. The model shares characteristics with that in R. Dornbusch *Open Economy Macroeconomics*, 1980, Chapter 11. The primary difference is that in the present model the central bank targets the inflation rate or price level, and the money stock as such plays no role.

- Asset-market prices adjust instantaneously, so that asset markets are always in equilibrium — the possibility of jumps in the exchange rate implies that the CPI might also move quickly in the short run.

- The domestic interest rate is equal to the foreign interest rate *plus* the expected increase in the price of foreign exchange *plus* a time varying risk premium (perfect capital mobility, but imperfect asset substitutability).

- Aggregate demand responds negatively to the real interest rate and to the real exchange value of the currency (a standard open-economy "IS" equation).

This model can be used to derive some implications of shocks relevant to the recent history of Canada; notably, an increased risk or credibility premium in interest rates, a drop in household confidence, and a reduced budget deficit.[5]

Increased risk and credibility premiums in interest rates

Conceptually, the risk premium problem differs from a credibility problem. A risk premium in interest rates implies that investors demand a higher return for bearing extra risk. In contrast, a "credibility premium" exists when investors suspect that monetary policy may be looser than the central bank has pledged. In a situation where the central bank keeps to its announced policy, these investors would be surprised at how low the inflation rate turns out to be, and the realized real interest rate would exceed what they had expected. In the first case expectations are unbiased, but investors are averse to random changes in returns; in the second case their expectations of inflation are biased upwards. However, the two kinds of premium are observationally equivalent: in both cases, ex post real interest rates would look abnormally high.

5. A long-run monetary policy effect is possible to the extent that the central bank's actions influence the risk premium. However, this would usually go in the opposite direction to the conventional liquidity effect.

A shock to confidence (of either kind) does not affect the equilibrium value of the MCI. In the long run, the interest rate has to increase by the same amount as the risk premium, and the equilibrium price of foreign exchange has to rise (i.e. the currency depreciates) to keep the MCI at its original level. In the new equilibrium, the higher interest rate depresses domestic demand, while the increased price of foreign exchange creates an exactly offsetting increase in net exports, which maintains output at its potential level. However, during the movement towards the new equilibrium in the model, the increase in consumer prices temporarily exceeds the target, because of the exchange rate feed-through. This worsens the short-run output-inflation trade-off, regardless of the response of the monetary authority.[6]

Drop in household confidence

Increased reluctance of households to spend on housing and consumer goods reduces the desired level of the MCI (i.e., the equilibrium MCI in the model). In the long run, since the real interest rate is determined by the foreign rate plus a risk premium that does not change under this shock, the easing of monetary conditions must be accomplished entirely through a real currency depreciation. In the short run, monetary conditions ease through both an interest rate decline and a depreciation.

Thus, reduced household confidence would inhibit activity, weaken the currency, and thereby worsen the short-run, output-inflation trade-off.

Correction of an unsustainable budget position

The relevant exercise here is not a matter of simple comparative statics because behaviour at the outset would already be affected by an expectation of future government retrenchment, and by uncertainty as to

6. Boessenkool et al. (1996) argue that the central bank should not raise the interest rate at all in the event of a drop in the exchange rate prompted by political worries. This argument is not correct. If the risk premium increases, asset-market equilibrium requires that real domestic interest rates must eventually rise by the full amount of the premium. An attempt to hold rates constant would set off a depreciation / inflation spiral. In the case where a political shock alone pushes down aggregate demand, some easing of monetary conditions would be required. In the short run, this might or might not be consistent with an unchanged interest rate, depending on the extent of the decline in the exchange value of the currency.

the size, timing, and incidence of the measures to be adopted. Nevertheless, the hypothetical short-run effects of a cut in government spending in an economy in equilibrium provide some insight into the impact of recent budgetary actions in Canada. A spending cut shifts the aggregate demand schedule downwards. Maintenance of full employment then requires a monetary easing. Some of this would come about through a decline in the risk or credibility premium on the country's assets, in response to the stronger fiscal position. On its own, this effect might not be large enough to completely offset the short-run negative effect on aggregate demand from the initial cutback. In this case, the currency must depreciate, causing a worsened *short-run* output-inflation trade-off.[7] The emphasis is on the short-run because eventually a stronger fiscal position results in an improved trade-off, through reduced risk and credibility premiums in interest rates, an increase in the real exchange value of the currency, and an increased private sector capital stock and higher potential output.[8]

Nevertheless, only a part of the weak macroeconomic performance in 1995 and early 1996 can be plausibly attributed to the tightening of fiscal policy, for the following reasons:

- Empirically, a systematic fiscal policy effect on output in Canada is hard to find, at least in single-equation models of GDP.[9]

- The lifting of uncertainties engendered by what was widely considered to be an unsustainable fiscal policy in itself had some positive effect on demand. Indeed, there was considerable

7. This is not a new result. Mundell (1971) showed that the reverse case — a tight-money, easy-fiscal mix — has desirable short-run effects in a country with no risk premium and a floating exchange rate. His argument was borne out by the early success of such a combination in the United States in the early 1980s — Sachs (1985). This does not imply that the Mundell mix is a desirable policy, since his argument ignores the effects of debt accumulation. Over time, increased budget deficits (and hence debt) would raise interest rates, weaken the currency, and reduce economic welfare.

8. The analysis by Macklem (1994) illustrates this point.

9. No economically significant effect was found for fiscal policy variables in the estimated equations reported later in this report.

awareness that long-run prospects for future income would be improved by the release of productive resources from the state to the private sector.

- The fiscal cuts encouraged a substantial decline in the Canadian interest rate risk premium and thereby allowed real monetary conditions to ease through lower borrowing costs.

- Because of lags, the fiscal cuts would have most of their impact in 1996 and 1997, yet a marked acceleration of domestic demand became evident through this period.

The three shocks combined

To summarize, the three shocks taken together would produce effects that accord with salient facts about the Canadian economy in the 1990s. That is, during the period before 1995, when budget deficits were very large, and the credibility of monetary policy was still questioned, they would imply:

- increased domestic interest rates and, hence, low domestic demand

- currency depreciation, which causes an expansion of net exports and a worsened short-run trade-off between output and CPI inflation

After 1995, with fiscal consolidation, increased confidence in price stability, and reduced political uncertainty, one would expect these effects to diminish.

The theoretical model indicates that the exchange rate is liable to respond in an unstable manner to changes in expectations and risk assessments.

For example, the Bank of Canada's MCI has a weight on the interest rate 3 times that on the exchange rate. This means that to keep the Bank's MCI constant, given an increase in the interest rate premium in Canada of 50 basis points, a depreciation of the equilibrium value of the Canadian dollar of about 1.5 per cent would be required. However, the margin of uncertainty here is considerable. Estimates at the Bank of the weight of the interest rate relative to that of the exchange rate in aggregate demand equations range from 2 to 5. In the example of a 50-basis point increase in the risk premium, the change in the equilibrium real price of foreign exchange might be anywhere in the range 1 to 2.5 per cent.

More generally, quite aside from the value of particular estimates of the coefficients, it is clear that uncertainty with respect to the long-run value of the exchange rate must be several times that with respect to the interest rate. The known economic factors at a given point in time do not provide a firm guide as to where the equilibrium price of foreign exchange should be. This gives a wide field of play for extrapolative behaviour and other such aberrations in exchange markets. Although these are essentially short-run phenomena, they may encourage "tests" by financial markets of the tolerance of the central bank for currency depreciation, and to associated questions about the commitment of monetary policy to inflation control, and thereby call for some response from the central bank.

3 Estimates of the increase in long-term premiums and its effects on activity

3.1 Estimate of Canadian long-term interest premiums

As recently as the 1980s, empirical tests generally accepted the hypothesis of perfect substitutability between Canadian and U.S. assets.[10] In particular, there was no evidence that changes in relative supplies of government debt had an impact on bond spreads. However, the joint hypothesis of rational expectations and a time-invariant risk premium was rejected in these tests, leaving open the possibility that changes in the risk premium might cause significant variation in the long-term interest rate in Canada independent of that in the United States. More recent econometric research, which benefits from the development of cointegration techniques and from data in which relative debt growth diverges more markedly across countries than in the past, shows that the rapid accumulation of government debt in Canada during the past decade can explain much of the increase that took place in the premium (Fillion 1996).[11]

Our approach is based on the cross-border interest differentials and the expectations theory of the term structure of interest rates.[12] It assumes: (a) that the underlying equilibrium path of the nominal exchange rate follows a random walk, as a result of the numerous disturbances that may arrive; and (b) that changes in current monetary conditions may cause the actual exchange rate to be above or below long-run equilibrium, and hence create the expectation of a change in the exchange rate in the short run.[13] That is, the market has information about monetary policy actions (and possibly other variables too) that in the short run is reflected in the level of the current exchange rate relative to its presumed underlying equilibrium

10. Boothe et al. (1985), Murray and Khemani (1989).

11. Orr et al. (1995), in a multicountry study, find that both fiscal deficits and current account deficits significantly increase domestic real interest rates.

12. It is a quantitative version of an argument used by Goodfriend (1993).

13. In empirical tests of long-term interest rate equations, the assumption that the expected change in the exchange rate is zero has often proved more successful than more complex hypotheses.

rate. To be more precise, changes in the short-term interest spread are accompanied by immediate changes in the exchange rate, as in the Dornbusch model, after which it reverts to its long-run equilibrium level. For Canada this implies that the Bank of Canada may set the short-term interest rate independently in the short run but that over time the Canadian rate must converge to the U.S. rate plus a time-varying risk premium.

From these assumptions the following equation can be derived (see Appendix 2):

$$RL_t - RL^*_t = \gamma(R90_t - R90^*_t) + \psi_t \quad (1)$$

where *RL* is the long-term bond interest rate, *R90* is the 90-day commercial paper rate, and asterisks denote the U.S. rates. That is, the long-term differential is a function of the cross-country difference in short-term interest rates and the time-varying premium in the long-term domestic interest rate ψ_t. The Bank of Canada's direct leverage on bond yields, through its influence on short-term interest rates, is measured by γ. This coefficient reflects the length of time that monetary actions in Canada can exert an independent influence on the real short-term interest rate, relative to the duration of the bond.

Given the way budgets, monetary policy, and political risks evolve in Canada, over periods of quarters and years, the premium for risks and credibility would be serially correlated. Moreover, since short as well as long rates are affected by risk perceptions, $R90_t$ is not independent of ψ_t. In view of these statistical dependencies, we use a vector autoregression (VAR) to estimate the bivariate relationship between long- and short-term cross-border spreads implied by equation (1).

ADF tests show that both short and long spreads have followed I(0) processes — the unit-root hypothesis is easily rejected (Table 4). That is, over time, both interest differentials have tended to revert to their long-run average historical values — as would be expected in a world with high capital mobility, similar monetary policy histories, and with a premium on Canadian assets that has varied over the long run without a definite trend.

Even though the unit root is rejected, the large estimated sum of coefficients on the lagged dependent variable in the reduced form implies that movements in the long-term yield differential are quite highly auto-correlated (Table 4). In contrast, the sum of coefficients on the short rate differential is not significantly different from zero.

Table 4: VAR equation for the long-term differential

Estimation period June 1970 to December 1996

Reduced-form lag coefficients		
	Sum	**F-statistic probability value**
RL-RL*	0.881	0.00
R90-R90*	0.016	0.12

ADF tests for unit root		
RL-RL*	-4.23	*Critical value at 0.01 probability =-3.43*
R90-R90*	-5.23	

The system impulse-response function for a unit shock to *R90* shows a peak effect on *RL* of just 0.08 in the second quarter, after which the effect tapers off quickly (Figure 1). This small effect is close to the value of 0.05 derived a priori in Appendix 2.

Figure 1
Impulse-response function for a 100-basis point shock to R90
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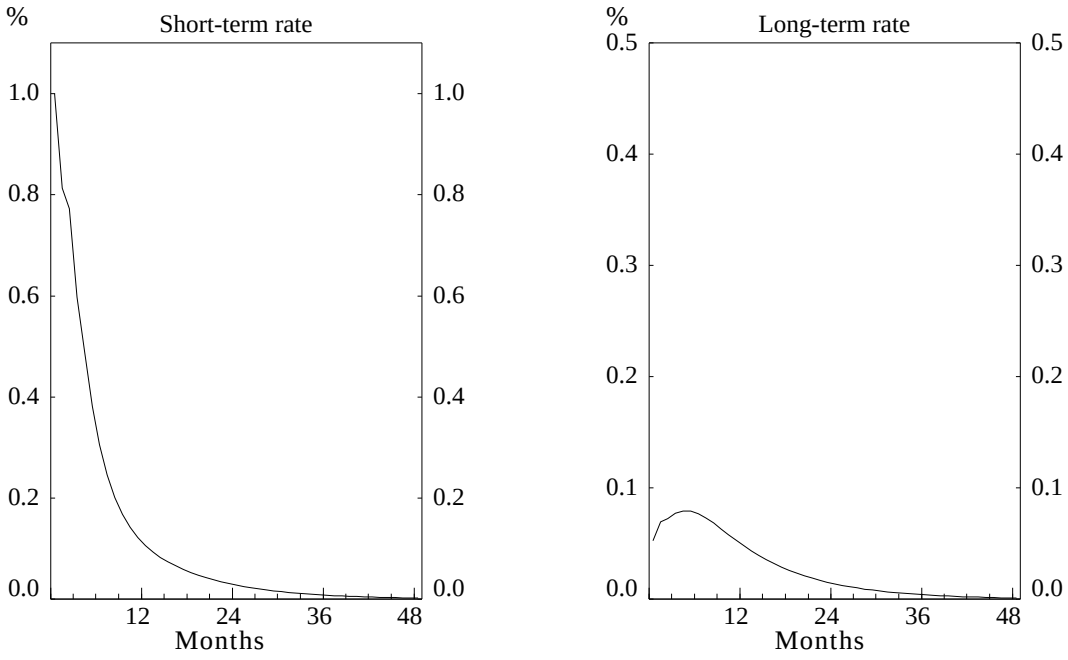

It is apparent that, as predicted by theory, exogenous policy-driven changes in Canadian short-term interest rates have minor effects on the long-term interest rate spread. It can be inferred from this that the main element in its movements is revisions to risk or credibility premiums. This would imply that the long-term cross-country spread itself provides a good gauge of the combined premiums for risk and credibility.

Figure 2
Canada-U.S. long-term interest rate differential

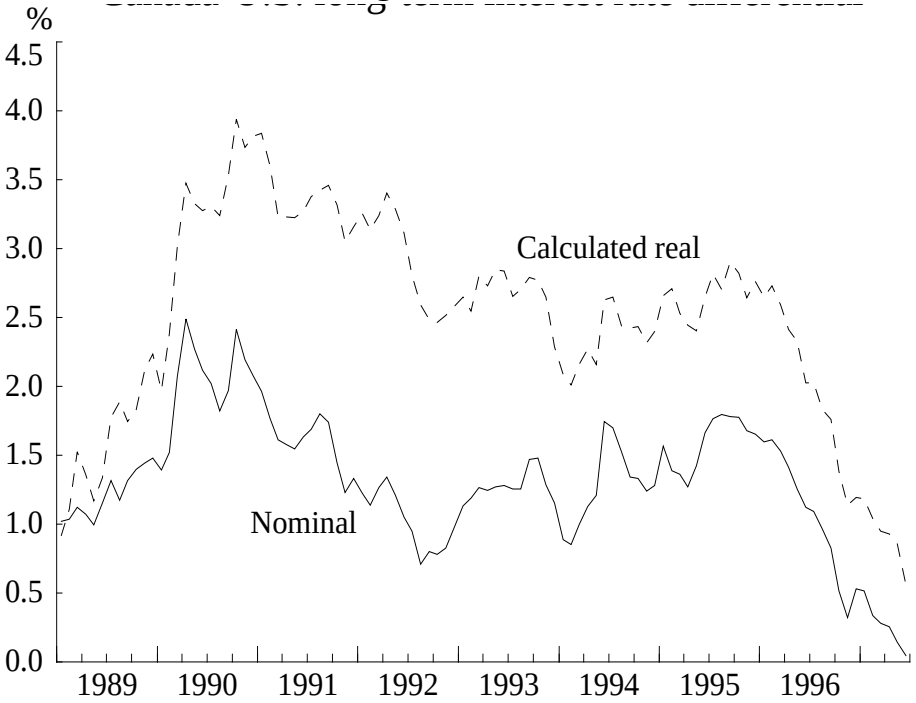

Figure 2 plots the long-term differential on federal government bonds, in both nominal and real terms. To approximate real interest rates in each country, the centred 8-quarter core-CPI inflation rate is subtracted from the nominal interest rate.[14] The nominal differential averaged about 140 basis points, 1990-1995, some 20 basis points greater than the pre-1990 average. Over the same years, the calculated real differential was about 260 basis points above its long-run average value. With the improved environment in 1996, the nominal spread fell to a historical low, near zero, while the real spread returned to a value near its historical average. Thus, taking account of the relative improvement in Canada's inflation performance, one can infer that, between early 1995 and late 1996, the interest premium fell from an abnormal level to something closer to the historical norm.

14. For the purposes of this calculation, assumptions were made about inflation in 1997 and 1998. The Canadian core rate was assumed to be 2 per cent and the U.S. rate 2.5 per cent.

Most of the peaks in the premium follow periods of sharply increasing unease with fiscal policy or of setbacks to Canadian political unity, while the large decline starting in 1995 followed shortly after the implementation of credible programs of fiscal restraint, and was only interrupted by the Quebec referendum later that year.

3.2 Estimated effects of interest rate premiums on GDP

In this section two models are used to gauge the effect on output of shocks to risk and uncertainty premiums. The first is the aggregate demand function developed by Duguay (1994), and the second is the yield curve indicator model explored by Cozier and Tkacz (1994).

3.2.1 Aggregate demand function — Duguay model

Table 5: Estimated equation for quarterly percentage change in GDP

Variables	Sums of distributed lag coefficients (standard error)	
	Basic	**Augmented**
U.S. GDP	0.86 (0.07)	0.76 (0.07)
Real R90	-0.60 (0.18)	-0.42 (0.19)
Real exchange value of C$	0.10 (0.08)	0.08 (0.08)
Relative commodity price	0.10 (0.05)	0.10 (0.05)
RL-RL*		-0.41 (0.17)
Standard error of estimate (SEE)	0.75	0.73
Estimation period	1962Q4-1996Q4	
Explanatory variables are differenced and have distributed lags, except for RL-RL which enters as a level, current value only.*		

The basic model of the aggregate demand function includes the relative price of resource-based commodities, increases in which have a positive effect on Canadian activity, as well as the real interest rate and real exchange rate. Estimates of the basic model, and a version augmented with the differential *RL-RL**, as a proxy for risk and credibility premiums, are presented in Table 5. In the augmented model this proxy variable has a sizable negative coefficient.

3.2.2 Yield-curve model

A yield-curve model for GDP can be derived from the idea that the spread between long- and short-term interest rates embodies gaps between the expected return on investment and the real short-term interest rate as well as gaps between the current and expected rates of inflation. This leads one to expect a positive correlation between the slope of the yield curve and future changes in economic activity. But, to the extent that this spread also contains a time-varying risk and credibility premium, this correlation would be weakened or even inverted.

Appendix 2 derives an equation for the term spread that involves three weighted components:

$$RL_t - R90_t = (1-\gamma)[\bar{r}_t - r_t] + (1-\gamma)[\boldsymbol{E}\overline{\Delta p}_t - \Delta p_t] + \psi_t \qquad (2)$$

where (1-γ) is the weight on the long-term components in the determination of the bond yield. The three weighted terms have a straightforward economic interpretation:

- $[\bar{r}_t - r_t]$ is the gap between Wicksell's natural rate and the current real interest rate.
- $[\boldsymbol{E}\overline{\Delta p}_t - \Delta p_t]$ is the expected acceleration in the inflation rate.
- ψ_t is the country long-term risk and credibility premium.

Changes in the first component imply changed incentives to spend — e.g., given the expected real return to investment, a reduced real short-term interest rate, which will cause an increase in spending and the bringing forward of planned future expenditures. This term would capture the usual short-run liquidity effect of monetary policy. The second component is the expected acceleration of inflation: this would capture any credibility premium that was present.

If the variance of the term spread is dominated by the first factor, there would be a positive correlation between the spread and near-term changes in GDP. A wider-than-average term spread would imply rapid GDP growth in the following quarters. The reverse would hold for a nega-

tively sloped yield curve. If, on the other hand, the risk or credibility premiums have high variance, any positive correlation between output and the first term might be outweighed.

In fact, the variance of the short rate has been much greater than that of the long rate. This suggests that the liquidity effect might account for a substantial portion of the variance of the term spread. Consistent with this, in Canada the correlation between the current term spread and the change in output over the next four quarters has been strongly positive. Empirical "indicator models" for output exploit this property of the term spread. To gauge the effect of risk and credibility premiums we have re-estimated these models, as before using *RL-RL** as an approximation. If variables not relevant to the present discussion are ignored, the form of the estimated equations is:

$$GDP_{t+4} - GDP_t = \xi_0 + \xi_1(RL_t - R90_t) + \xi_2\, RR90_t + \xi_3 RISKP_t \qquad (3)$$

where *RR90* is the real 90-day commercial paper rate.[15]

15. To be more precise, *RR90* is the eight-quarter lagged moving average of the 90-day commercial paper rate less the four-quarter change in the GDP deflator.

Table 6 contains estimates of two variants of equation (3). The basic equation, which ignores the premium, is similar to equations estimated by Cozier and Tkacz (1994). Such equations overestimate GDP growth after 1990 by a wide margin. Part of the explanation for the bias appears to be the increased interest rate premiums. The augmented equation brings in *RL-RL**. Its estimated coefficient is negative, as expected, and is virtually the same size as that of the term spread. This has the plausible implication that an increase in the slope of the yield curve that reflects an increase in the long-term premium is not followed by an acceleration in output growth.

Table 6: Yield-curve model of 4-quarter-ahead percentage change in GDP

	Basic	**Augmented**
RL-R90	0.88 (0.09)	0.82 (0.10)
RL-RL*		-0.82 (0.37)
RR90	-0.28 (0.05)	-0.26 (0.05)
SEE	1.65	1.63
Estimation period	1970Q3-1996Q4	
Estimated by Hodrick-Hansen GLS procedure, allowing for 4-quarter moving average in the error		

3.2.3 Inferring the impact on activity

An idea of the effect of high interest rate premiums on output implied by these equations can be obtained from simulations in which the nominal cross-country long-term interest differential is held, counterfactually, at 25 basis points — a value in the range that held after the restoration of confidence in 1996 (it later fell to less than zero). The difference between the simulated level of output and the actual level gives an estimate of the impact of abnormal risk and credibility premiums on activity in the first half of the 1990s (Table 7).[16]

The cumulative estimated impact, especially with the IS model, suggests that the persistence of heightened risk and credibility premiums had a serious effect on the economy. Indeed, by 1995 these estimates imply a cumulative output loss of the same order of magnitude as the output gap.

Table 7: Effect of abnormal long-term interest premium on GDP growth: estimates from counterfactual model simulations

	IS model	Yield-curve model
1991	-2.27	-1.64
1992	-1.33	-0.90
1993	-1.73	-0.50
1994	-1.77	-0.87
1995	-2.27	-0.85
Sum	-9.37	-4.76

Fourth-quarter to fourth-quarter percentage change — simulated minus actual value

16. The prediction errors of the models are removed in these simulations, and hence do not affect the estimates in Table 7.

4 How confidence problems affected the conduct of monetary policy

The Bank of Canada, through its operations in financial markets maintains the overnight interest rate within a band that it varies as necessary to achieve a desired path for monetary conditions. Freedman (1995) notes that there are "tactical" elements in the process, since the Bank has to take into account the situation in financial markets. In the first half of the 1990s the Bank's tactics were designed to reinforce the credibility of monetary policy, which was not yet established, and to reduce risk premiums.

During the period of heightened uncertainties, the strategic easing of monetary conditions often had to give way to the tactical necessity of promoting orderly markets.[17] Although the Bank could not prevent interest rate premiums from rising through this period, promoting orderly markets was viewed as a helpful way of containing them, while ensuring that the desired easing could eventually be achieved. Pursuing unconstrained easing might have been interpreted by the market as a relaxation in the Bank's resolve to keep the rate of inflation from moving above the inflation- control range, which in turn could have triggered even higher premiums and prevented the desired easing in monetary conditions from taking place.[18]

During these recurring episodes of heightened uncertainty, a sharp increase in short-term Canadian interest rates — reflecting a change in investors' willingness to hold Canadian dollar denominated assets — was only partially offset by a weaker exchange rate. The Bank's operations helped financial markets find viable trading ranges for interest rates and the exchange rate.

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17. See Zelmer (1996) for a discussion of several such episodes.

18. Actions to tighten the stance of monetary policy might not have been subject to an analogous constraint. Such actions, even if not expected by market participants, are not likely to cause them to wonder whether the Bank's policy goal has changed. Instead, they are more likely to assume that the Bank is better-informed about the state of the economy and that inflationary pressures are more intense than they had previously thought. As a result, they would likely respond quickly to ratify the Bank's desire for tighter monetary conditions with higher interest rates and possibly a firmer exchange rate.

It can be tactically appropriate to postpone achieving a given desired path for the MCI in the short run when markets are unsettled. This does not mean that the Bank has to wait entirely on the market. In those periods when the Bank and the market differ over the appropriate course for monetary policy, the best approach for the Bank is to try to develop an appreciation in the market of the economic fundamentals that the Bank thinks are relevant. By communicating the economic rationale underlying its policy stance (and by being clear about the way in which policy is being implemented), the central bank can minimize the uncertainty about its policy intentions and ensure that it does not add to risk and credibility premiums already present in interest rates.

4.1 Winter 1994-1995: An example of heightened market volatility

The episode of market volatility in winter 1994-1995 demonstrates what can happen when the Bank attempts to achieve easier monetary conditions than the market views appropriate; Figures 3 through 7 provide a graphical summary of events through this period. Turbulence in financial markets emerged in response to:

Positive output surprise

- There were growing expectations in the market that the stance of monetary policy in Canada and the United States would have to be tightened in the near future.

- The release of data suggesting that the U.S. and Canadian economies were expanding at a rapid pace in the fourth quarter led some economists, who relied on models that emphasized the rate of growth in output as an indicator of future inflation, to predict that the core rate of inflation would rise. This view was not shared by the Bank because its model emphasizes instead the output gap, which remained wide.

- By late December the Bank had reassessed its economic outlook and concluded that, as a result of the narrowing in the output gap, it

should accept the tightening that had developed in the market. It was reluctant, however, to raise the overnight rate again to ratify the further increase taking place in short-term interest rates because it was concerned that, given the limited liquidity in markets around the holiday season, such an action might trigger even higher rates.

Risk assessment or credibility shift

- The Mexican financial crisis focussed investor attention on countries experiencing large fiscal and current account imbalances.

- The Bank's initial resistance to the increase in short-term interest rates led to concern about the credibility of monetary policy.

Negative spreads between Canadian and U.S. short-term interest rates

- Many commentators did not believe that the negative interest rate spreads achieved in the fall of 1994 were sustainable, given Canada's debt problems.

Figure 3
Monetary Conditions Index
(Nominal, 1987 = 0)

Figure 4
Overnight Rate versus 3-Month Treasury Bill Rate

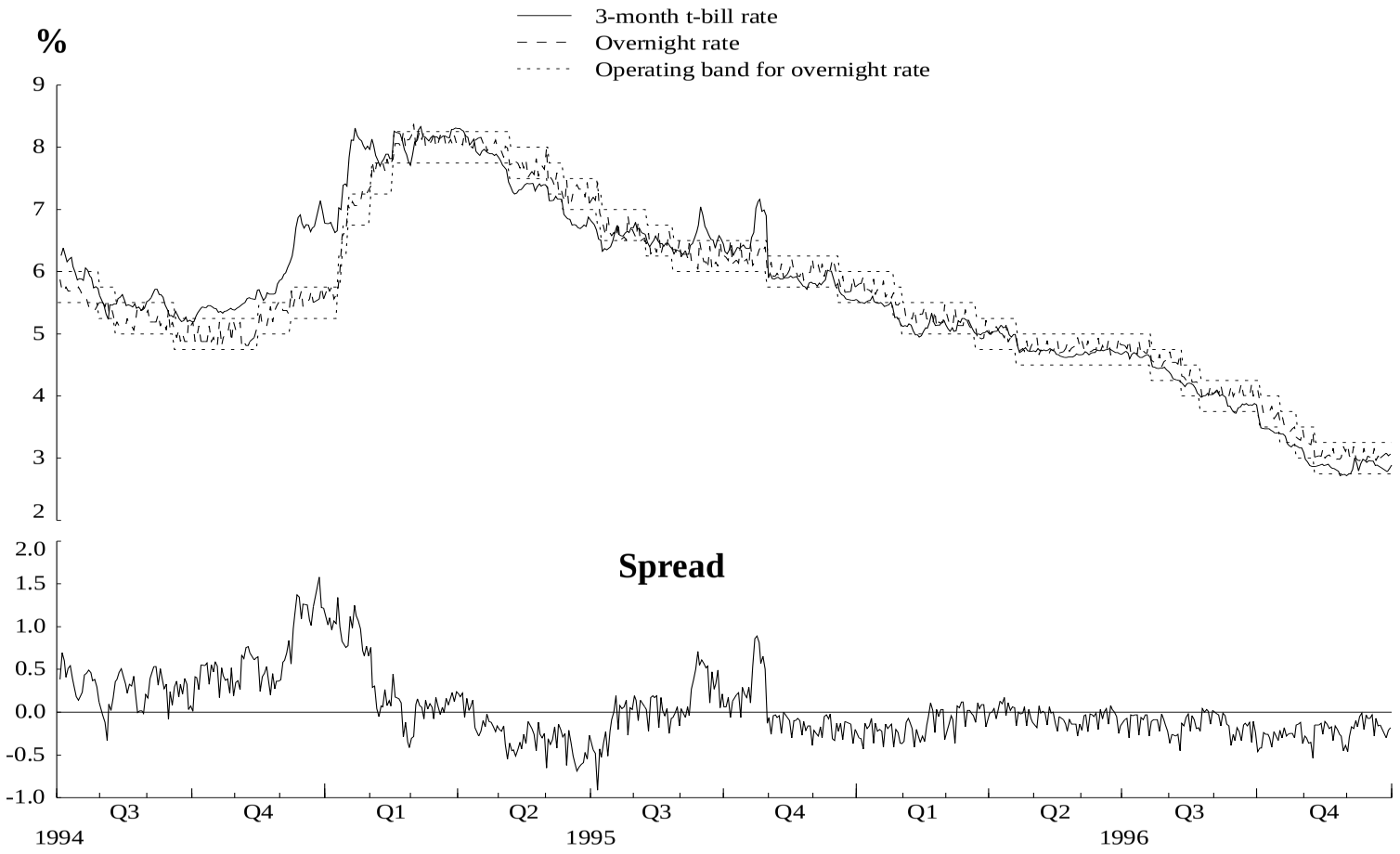


Figure 5
3-Month Interest Rates

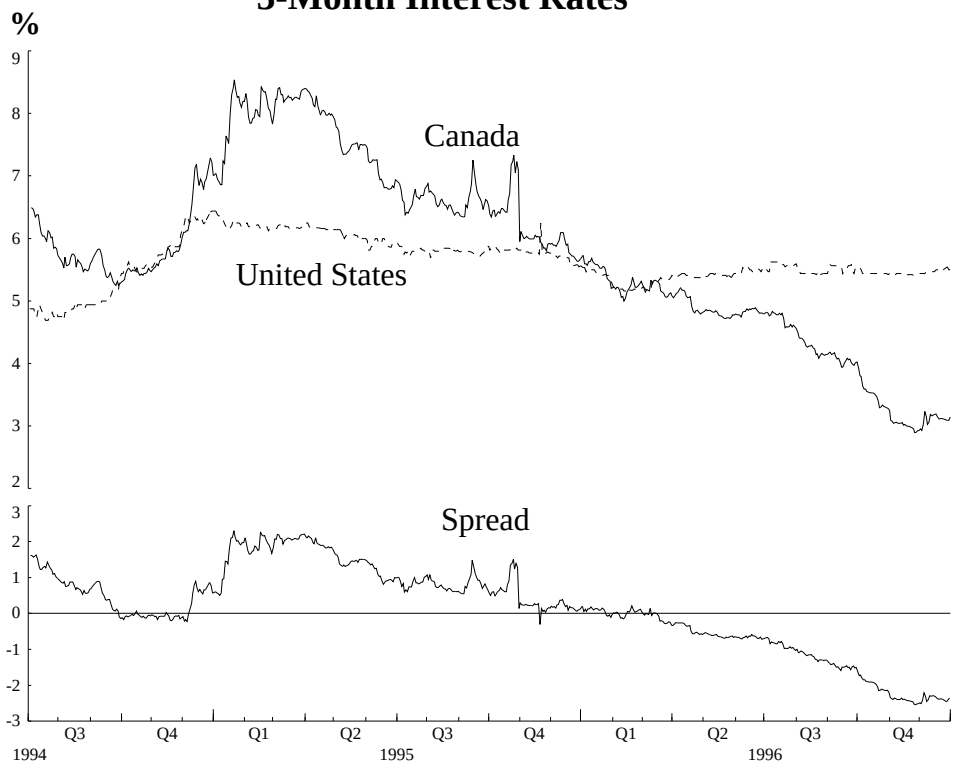


Figure 6
Long-Term Bond Yields

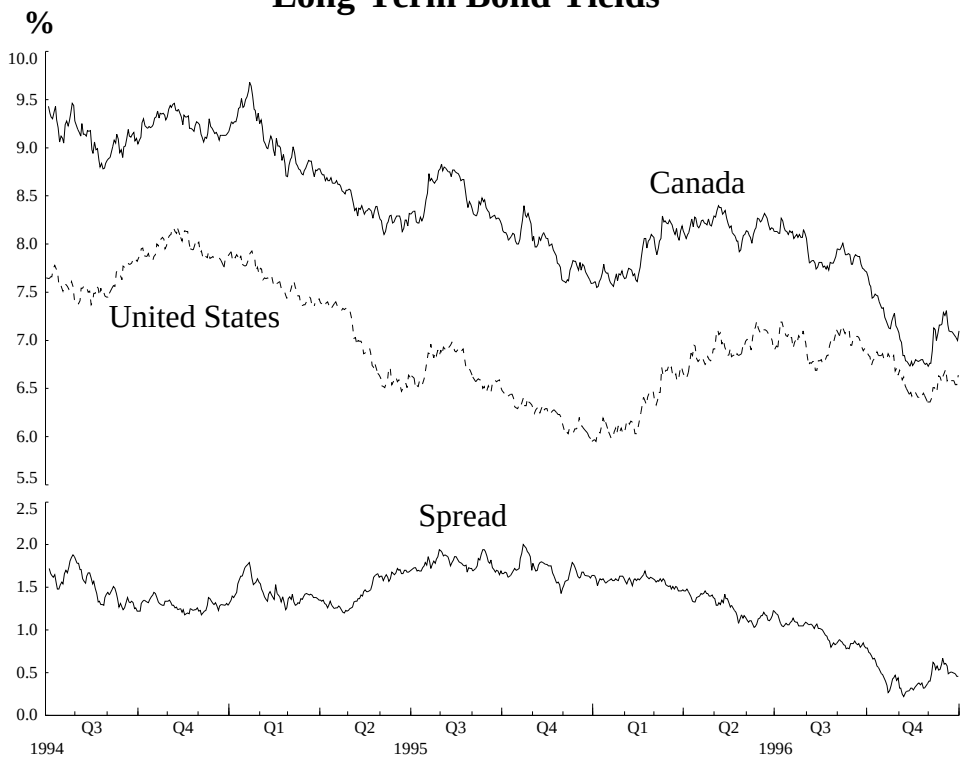
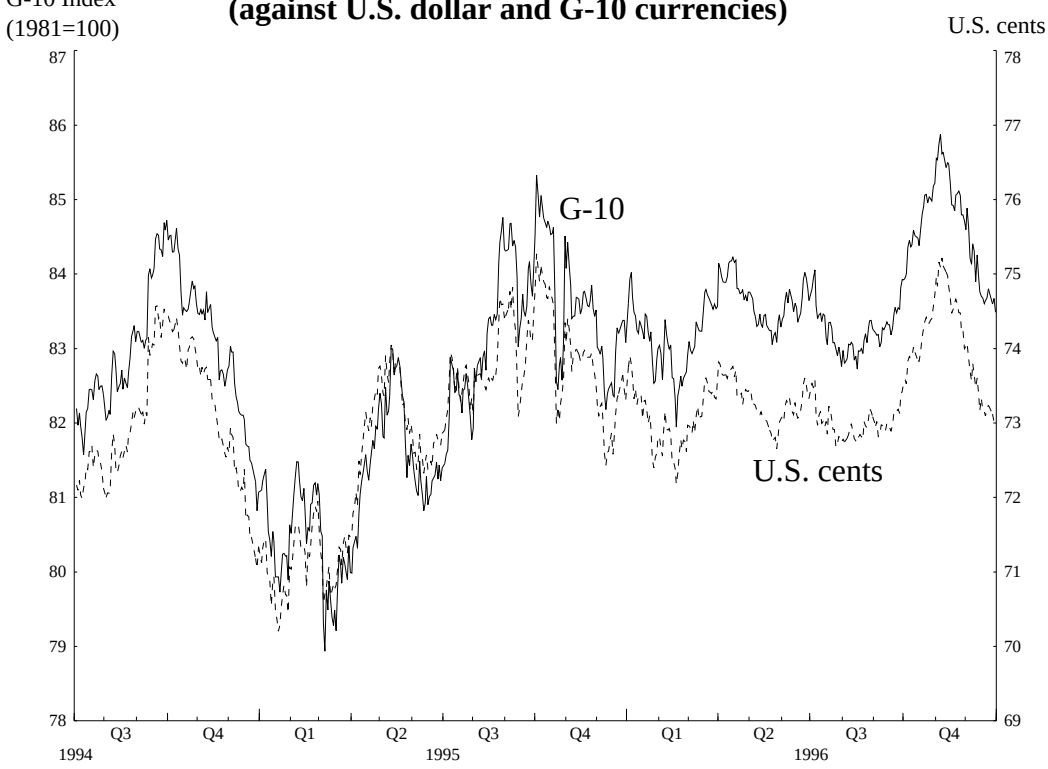


Figure 7
Canadian Dollar
(against U.S. dollar and G-10 currencies)



Market pressures — evident in the rise of 1- and 3-month interest rates — obliged the Bank on several occasions to raise the operating band for the overnight rate to avoid the risk of a loss of confidence in foreign exchange and bond markets. The sizable increase in other short-term interest rates that had taken place in December and early January was clear evidence that the financial markets expected a steep rise in the overnight interest rate. The Bank's initial hesitancy to raise the operating band may have contributed to their uncertainty: it appeared to engender a perception that the Bank was more willing to tolerate exchange rate depreciation than in the past. There was also the prospect of a worsening fiscal balance in the wake of the higher interest rates. Investors shifted their funds away from Canada, thereby causing interest rates in Canada to move even higher and the value of the Canadian dollar to decline even further.

The widening of the spread between Canadian and U.S. interest rates was largely confined to the short end of the term structure — the spread between long-term bond yields did not begin to widen significantly until early January — implying that market participants did not expect the increase in Canadian interest rates to persist for an extended period of time. When the turbulence did begin to spill over into the bond market, the Bank moved quickly to calm markets by further increasing the operating band for the overnight interest rate. And the disturbance in the bond market was short-lived.

The market's questioning of the Bank's policy stance raises a couple of questions: did the market fail to understand the economic rationale behind the Bank's initial stance in December, or did it simply take a different position on the economic outlook from the Bank? If the answer to the first question is yes, the policy stance would have been credible (and market volatility reduced) if the market had possessed more information on the economic rationale underlying the stance. On the other hand, a positive response to the second question implies that the market understood the Bank's actions but disagreed with its view of the economy and feared that the risk of inflation / exchange rate depreciation was greater than that perceived by the Bank. If so, this suggests that although the activities of the Bank were transparent to financial markets, the Bank lacked the credibility to prevent, in the short run, an undue tightening in monetary conditions.

Either way, this episode demonstrates that the Bank needs to ensure that market participants understand its views on the economy and the inflation outlook that underlie a particular policy stance and that the Bank's actions are predictable. This is similar to the argument of Goodfriend (1986) that increased transparency of monetary policy would benefit society because: (1) the amount of guess work involved in market responses to policy action falls, thereby making the market's responses to policy actions more predictable and improving the information content of financial market prices; and (2) some resources previously wasted, from a social point of view, on monitoring central bank activities are turned to productive uses.

4.2 Has the focus on the MCI caused some confusion?

Some market participants argue that the market has considerable difficulty determining the appropriate path for the MCI, since the lags in its effect on inflation are fairly long and since the market does not receive much practical guidance from the Bank.[19] Moreover, they believe that the Bank's resistance to rapid exchange rate movements has led the market to the (incorrect) conclusion that the Bank's MCI target has been quite rigid in recent years. The misperception in the market is that the Bank will eventually adjust interest rates in order to keep monetary conditions broadly unchanged (even in circumstances where the change in the currency was caused by a shock that did imply a change in the desired path for the MCI). This behaviour implies a systematic negative relationship between changes in interest rates and the value of the Canadian dollar, even in periods where market conditions are tranquil.

Zelmer (1996), in contrast, suggests that the negative relationship described above is significant only in periods when there are weakly grounded (and, hence, varying) views regarding Canada's fiscal and political situation.[20] In essence, variations in the market's confidence in Canada can be viewed as portfolio shocks that cause Canadian interest rates and the value of the Canadian dollar to move in opposite directions but which should not affect the desired longer-term path of monetary conditions. Thus, changes in short-term interest rates have frequently been required to offset the macroeconomic impact of changes in the exchange rate. The market appears to have recognized this point (which may have been reinforced by the Bank's focus on the MCI as its operational guide to policy) and has

19. See, for example, the comments by Neufeld on Zelmer (1996).

20. An alternative (and observationally equivalent) interpretation is that in the event of portfolio disturbances in exchange markets, the Bank was asymmetrically sensitive to Canadian dollar depreciations. In an environment such as the early 1990s in which expectations regarding monetary policy were not completely anchored and government and external indebtedness were growing rapidly, it would be tactically appropriate to defend the currency against rapid depreciation. Such an approach would help to contain risk premiums and help build credibility for monetary policy, thereby facilitating a more durable easing when circumstances become more propitious.

tried to anticipate the Bank's policy response in periods where these shocks are present.

The main empirical distinction between these two hypotheses is whether or not an inverse relationship between changes in short-term interest rates and in the value of the Canadian dollar is present on a regular basis. If this behaviour is confined to periods associated with readily identifiable portfolio shocks, this would suggest that the Bank's operational focus on the MCI does not systematically hinder policy implementation.

To obtain evidence on these hypotheses, one can posit a simple relationship between daily movements in the Canada-U.S. short-term interest rate spread and changes in the value of the Canadian dollar (in U.S. cents):[21]

$$\Delta Spread_t = \beta_0 + \beta_1 \Delta \log XR_t + \beta_2 \Delta \log XR_{t-1} + \varepsilon_t \qquad (5)$$

To estimate this relationship empirically, the daily change in the 3-month bankers' acceptance-U.S. eurodollar interest rate spread was regressed on the daily percentage change in the value of the Canadian dollar.[22] One lag of the daily percentage change in the exchange rate was included in the analysis because it was significantly correlated with changes in the current interest rate spread in some periods.

Regressions were run on a rolling 3- and 12-month basis; the sums of the exchange rate coefficients from each regression are plotted in Figures 8 and 9.[23] Shaded areas represent those periods where the rolling regres-

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21. The interest rate spread is used instead of the level of the Canadian interest rate in order to focus on changes specific to Canada, as opposed to common international changes.

22. The bankers' acceptance-U.S. eurodollar spread is used here because it is used by market practitioners to price currency and foreign exchange swaps. Moreover, short-term interest rate futures contracts are priced with reference to these interest rate series. As a result, this interest rate spread tends to be more sensitive to exchange rate developments than differentials on either commercial paper or treasury bills.

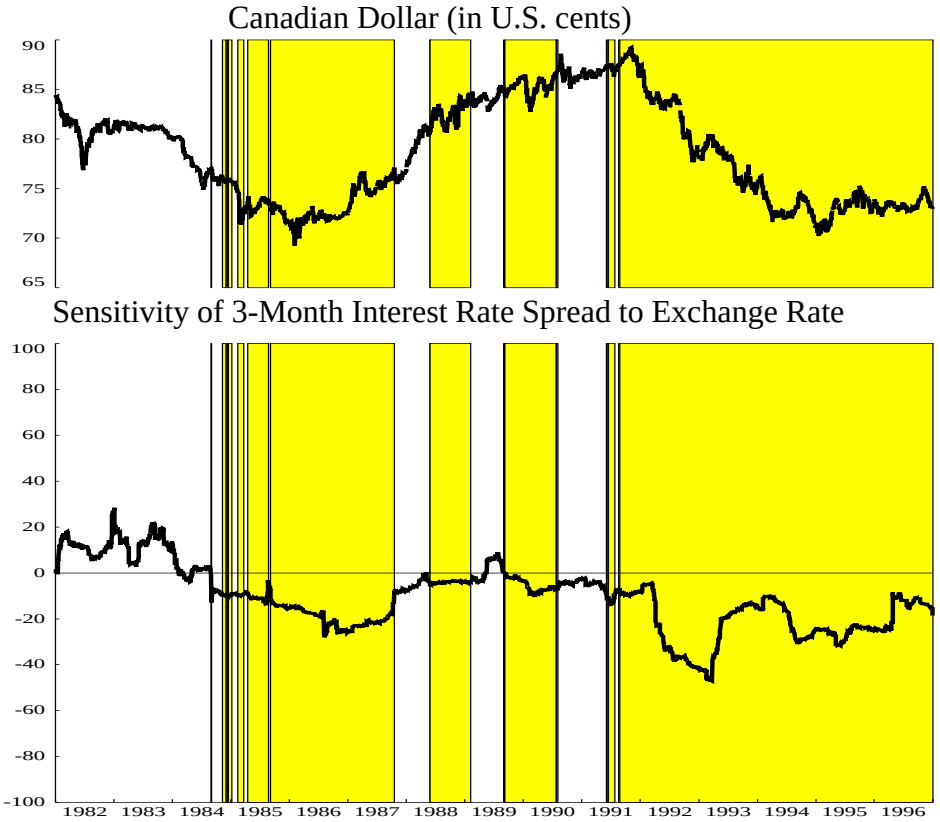
23. The coefficient values are plotted at the midpoint of the regression period; e.g., the sum of the exchange rate coefficients for a regression run over the 1 January 1996 - 31 March 1996 period would be plotted on the figure at 15 February 1996.

sions generated statistically significant negative coefficients. Admittedly, the estimated coefficients are biased, since both the interest rate and the exchange rate may respond to common shocks. For the purposes of this analysis, however, the main point of interest is the time pattern of the coefficients not their values per se.

The plot of the coefficients from the rolling 12-month regressions (Figure 8) offers some support to the view that the short-term interest rate spread became more sensitive to exchange market developments in the 1990s. It is not surprising that some market participants noticed this trend from market data even before 1994, when the Bank published articles clarifying its use of the MCI in the conduct of monetary policy.[24]

24. See Freedman (1995).

Figure 8
Exchange Rate Coefficients
(rolling 12-month regressions)

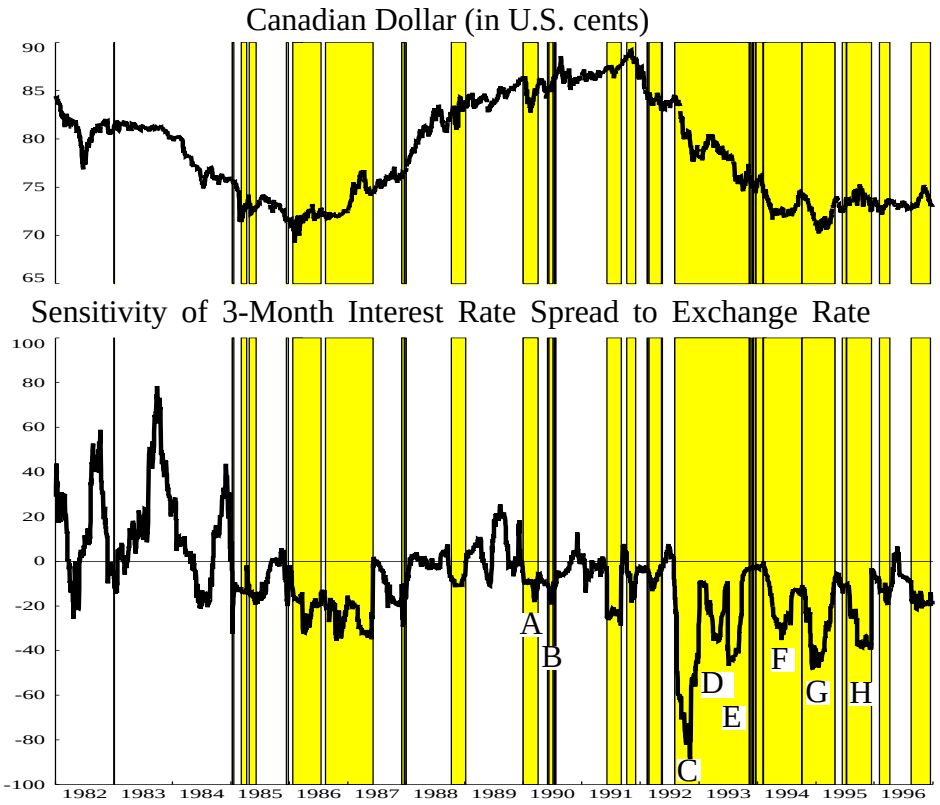


Shaded areas represent statistically significant negative coefficients.

However, the pattern of changes in the coefficients in the rolling 3-month regressions (Figure 9) suggests that the episodes of negative relationships observed in the 1990s have occurred mainly in response to changing perceptions regarding the appropriate premium for uncertainties affecting Canada. Indeed, the timing of the largest negative spikes are broadly consistent with episodes of rapid exchange rate depreciation that were motivated at least in part by bouts of pronounced uncertainty regarding the fiscal situation in Canada, unresolved constitutional conflicts, the credibility of monetary policy, and the spillover of international market turbulence arising from the ERM and Mexican crises (see Table 8). As the turbulence abated, the exchange rate coefficients tended to move back towards zero. Indeed, there was a significant improvement in the policy environment in 1996. The negative relationship between changing interest

rate spreads and exchange rate movements evaporated in the middle of the year, and the Bank was able to take more direct action in financial markets to achieve the desired easing in monetary conditions.

Figure 9
Exchange Rate Coefficients
(rolling 3-month regressions)



Shaded areas represent statistically significant negative coefficients.

Event	Date	Description of Event
A	January 1990	Unsuccessful attempt to ease monetary conditions
B	June 1990	Collapse of the Meech Lake constitutional accord
	February 1991	Introduction of inflation targets
C	September-November 1992	Concerns over fiscal policy deepens following Standard & Poors downgrade of Canada's foreign currency debt from AAA to AA+
		ERM turbulence
		Defeat of Charlottetown referendum on constitution
D	February 1993	Market's concern regarding fiscal policy deepens after federal budget.
E	August-October 1993	Political uncertainty ahead of federal election
		ERM turbulence
F	February-March 1994	Further market disappointment with federal budget
G	December 1994-January 1995	Spillover of Mexican crisis
		Fiscal situation attracts international attention — "Bankrupt Canada?" headline in *Wall Street Journal*
		Market concern over credibility of monetary policy stance
		Federal budget enacted that market felt dealt forcibly with the fiscal situation
H	October 1995	Quebec referendum

4.3 1995-1996: Improving policy environment

Figures 3 through 7 also summarize conditions in financial markets in 1995 and 1996, the period in which the Bank repeatedly lowered the operating band for the overnight interest rate. If the turbulence preceding the Quebec referendum in October 1995 is ignored, this period witnessed a steady and significant easing in monetary conditions. Interest rates fell sharply, with spreads against U.S. rates declining across the term structure. Indeed, short-term interest rates in Canada moved well below those in the United States in 1996, and the exchange rate remained stable.[25]

Some benefits of giving the market more information on the Bank's desired policy stance were demonstrated in this period. The *Monetary Policy Report* of May 1995 advised that the uptick in inflation would soon be reversed. This helped to ensure that expectations did not become unhinged as the rate of inflation approached the top of the control range, and kept uncertainty to a minimum about how the Bank would respond. The fact that the Bank's projection proved correct then contributed to the market's subsequent willingness to accept easier monetary conditions.

25. Prior to this experience, market participants generally did not believe that Canadian interest rates could move below those in the United States for an extended period. See, for example, comments by Gignac and others in Bank of Canada (1996b).

5 Concluding comments

The Bank of Canada gave a high priority in the first half of the 1990s to reducing market uncertainty about the conduct of monetary policy. Initiatives included:

- introducing explicit inflation-control targets, together with the federal government (1991);
- adopting the operating band for the overnight interest rate, which is the interest rate over which the Bank has the most influence (1994) — and adopting the practice of issuing a press release when there is a change in the band (early 1996);
- publishing the MCI and attempting to clarify how the Bank uses it (1994);
- introducing the semi-annual *Monetary Policy Report* to provide external observers with more information regarding the Bank's outlook for monetary conditions (first issued May 1995);
- introducing more openness in speeches and Bank publications, and holding a conference on money markets and monetary policy operations in 1995.

The Bank has also taken advantage of structural changes in markets in recent years to make its operating framework more transparent (Table 8). This has helped to provide a firmer grounding for expectations and is also useful for accountability after the event.

Table 8: Modifications to Bank of Canada operating procedures

Date	Significant event
March 1980 - February 1996	Bank Rate set at 3-month treasury bill rate + 25 b.p.
November 1991 - June 1992	Operating procedures change in anticipation of the removal of statutory reserve requirements.
June 1992 - June 1994	Statutory reserve requirements phased out
Middle of 1994	Introduction of a 50-basis-point operating band for the overnight rate
February 1996	Bank Rate set at upper limit of the operating band
1998	Planned introduction of Large-Value Transfer System: • Introduction of central bank deposit and lending rates • Announcement of daily target for overnight rate within band

The introduction of the Large-Value Transfer System (LVTS) in 1998 will bring some additional changes that will further increase transparency.[26] Indeed, there will probably be little need for frequent open market intervention to establish the limits of the operating band for the overnight rate under the proposed system. The rather opaque "drawdown and redeposit" mechanism, using government deposits to adjust the balance of liquidity in the system, will come to an end. Announced central bank deposit and lending rates for settlement balances will enforce the band.[27] In addition, the Bank has plans to signal a desired overnight interest rate within the band using SPRA or SRA transactions, as appropriate. One purpose of this could be to provide the Bank with an instrument with which it can indicate to the market any changes in the way it views the outlook for possible future interest rate movements without taking formal action to change the band.

For their part, market participants continue to press for more transparency about the conduct of monetary policy, especially with respect to the Bank's views on the transmission mechanism. They would like a firmer

26. Bank of Canada (1996a).

27. The importance of the drawdown and redeposit mechanism as a signalling mechanism to the money market has already receded since the introduction of the operating band for the overnight interest rate, which is implemented using highly visible buyback operations (SPRAs/SRAs). This mechanism is still used, however, for the crucial job of controlling the supply of settlement balances.

basis for assessing the appropriate level for the Monetary Conditions Index (MCI).[28] In response, the Bank has become more explicit in its *Monetary Policy Report* about its economic outlook. The Bank itself is confronted with considerable uncertainty in this regard, however — e.g., the well-known fact that the lags in the effects of monetary policy actions are fairly long and uncertain.

28. The MCI serves as an operational target. It is constructed by combining the change in the 3-month interest rate and the G-10 effective exchange rate, from a base period, with weights of 1 and 1/3, respectively. See Freedman (1995).

Appendix 1

Implications of changes to interest premiums, household confidence and the budget

Notation

cpi_t	Consumer Price Index at time *t*
cpi^T_t	central bank target for *cpi* at time *t*
e	price of foreign exchange
$\boldsymbol{E}$	expectations operator
i, (i^*)	one-period domestic (foreign) interest rate
mci	real monetary conditions index
p	price of domestic output
r, (r^*)	domestic (foreign) real interest rate: $i_t - \boldsymbol{E}\Delta p_{t+1}$, $(i^*_t - \boldsymbol{E}\Delta p^*_{t+1})$
RL, (RL^*)	domestic (U.S.) over-10-year bond yield average
$R90$, $(R90^*)$	domestic (U.S.) 3-month commercial paper rate
x	real exchange rate: $e_t - p_t + p^*_t$
y, $\bar{y}$	actual and potential output
$\bar{e}$, etc.	expected long-run equilibrium values
u_{t+i}	term premium in forward (i-period ahead) one-period interest rate
υ_{t+i}	country premium in forward (i-period ahead) one-period interest rate
ψ_t	long-term premium (an average of υ_{t+i} over i)

All variables in logarithms except interest rates

A simple theoretical model is used here to show how the short-run trade-off between output and inflation would deteriorate as a consequence of problems with confidence and with the fiscal position. The approach to monetary policy is in the spirit of Duguay (1994). *However, this model is not stochastic, and so the monetary policy target applies equivalently to the price level or to the rate of inflation.*[29] Thus, the central bank is assumed to set monetary

29. In practice, the Bank of Canada has an inflation target rather than a target for the trend of the price level. For the purposes of the present discussion this does not matter.

conditions to achieve a path for the CPI that is defined to embody a constant inflation target, *INFLT*.

The public is assumed to believe with 100 per cent confidence that in the long run the target path will be achieved. This, together with the absence of stochastic drift, makes it easy to pin down the equilibrium values of the nominal variables in the model. However, following changes to exogenous variables, in the short run the price level may diverge from the target path, because monetary policy operates with a lag.

Model equations

Monetary policy target and expected path of price level:

$$cpi^T_t = cpi_0 + tINFLT. \qquad \text{(A1)}$$

This defines a path for the target for the price level as the integral of the target rate of inflation, *INFLT*. The public believes with 100% confidence that any deviations from the target path will be strictly temporary.

The CPI is a weighted average of domestic and foreign output prices:

$$cpi_t = \alpha p_t + (1-\alpha)(e_t+p^*_t) = p_t + (1-\alpha)x_t\,. \qquad \text{(A2)}$$

In the long run, *cpi* and *p* change at the rate *INFLT*, and x_t . is constant. However, since changes in exogenous variables may move the real exchange rate, in the short run all variables may deviate from the equilibrium path. The central bank approaches the CPI target via a partial adjustment process:

$$\Delta cpi_t = \beta(cpi^T_t - cpi_{t-1}). \qquad \text{(A3)}$$

The extent to which monetary policy allows deviations of the price level from target is embodied in the parameter β. For example, if following a shock the central bank aims to get back on target within 8 quarters, β would be approximately 0.3 in a quarterly model.[30]

30. These approximations are based on the formula, $p = 1 - (1-\beta)^n$, where p is the proportion of the gap that is closed after *n* periods. The value for β of 0.3 would close more than 90 per cent of any gap within 2 years.

The expectations-augmented Phillips curve is:

$$\Delta p_t = \pi(y_t - \bar{y}_t) + INFLT. \qquad \text{(A4)}$$

In this specification, domestic output prices (and implicitly wages) are set on the basis of the expected underlying rate of inflation, not the expected short-run rate of inflation.

Aggregate demand is a function of the real exchange rate and the real interest rate:

$$y_t = \mu_t + \delta x_t - \sigma r_t \qquad \text{(A5)}$$

where μ represents the effects of exogenous variables such as foreign demand, fiscal policy, and consumer confidence. Equation A5 implicitly defines the equilibrium (or desired, from the viewpoint of the central bank) real MCI, i.e., the set of combinations of the real exchange rate and the real interest rate that result in the targeted inflation rate.

The equilibrium level of the real exchange rate and the real interest rate can then be obtained given the asset market equilibrium condition:

$$r_t = r^*_t + \boldsymbol{E}\Delta x_{t+1} + \upsilon_t \qquad \text{(A6)}$$

i.e., the domestic interest rate is equal to the foreign rate plus the expected change in the price of foreign exchange plus a time-varying premium. In equilibrium, the real exchange rate is constant, so that this condition gives the horizontal line $r_t = r^*_t + \upsilon_t$. However, in the short run the exchange rate might not be at its equilibrium level, in which case it will be expected to move towards it.

The following process is assumed for exchange rate expectations:

$$\boldsymbol{E}\Delta x_{t+1} = \theta(\bar{x}_t - x_t) \qquad \text{(A7)}$$

i.e., the exchange rate is expected to move in steps from the current to the equilibrium level.[31] This yields the short-run asset market equilibrium condition:

$$r_t = r^*_t + \theta(\bar{x}_t - x_t) + \upsilon_t. \qquad \text{(A8)}$$

Model equilibrium

The intersection of the IS curve in Figure A1 with potential output gives the equilibrium or desired level of monetary conditions, $\overline{mci}$. The combinations of real exchange rates and interest rates that yield $\overline{mci}$ are shown as a line, the slope of which is δ/σ.

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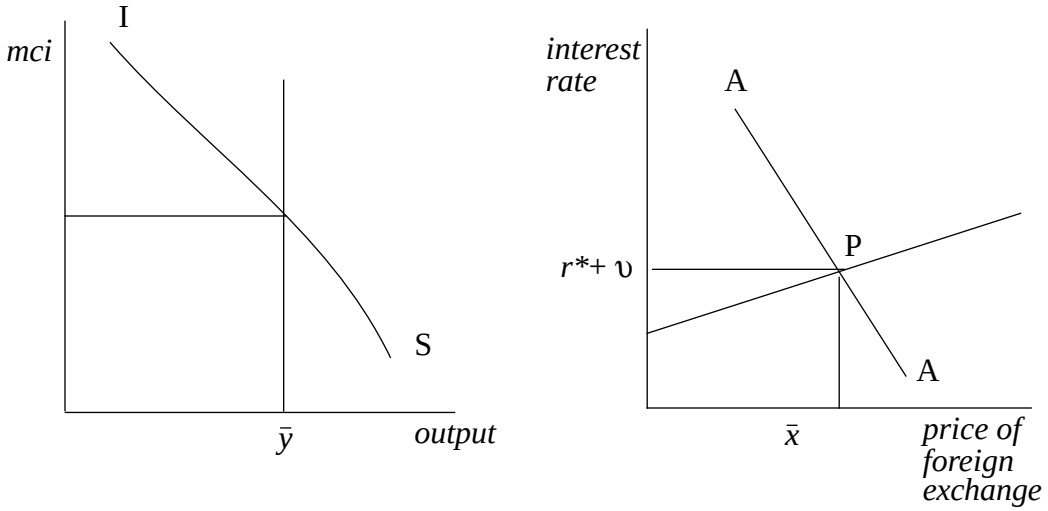
Figure A1



Asset market equilibrium determines the feasible combinations for the interest rate and exchange rate. Equation A8 describes a downward-sloping line with slope $-\theta$ (AA in the figure). Since asset prices adjust immediately, the economy will always be on this line. The intersection of AA with $\overline{mci}$ is the point of joint equilibrium in asset and goods markets. The intersection of AA with the $\overline{mci}$ line at P is the unique point at which the assets and goods markets are in equilibrium.[32]

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31. With rational expectations, the speed of adjustment represented by θ would be a function of all other parameters in the system.

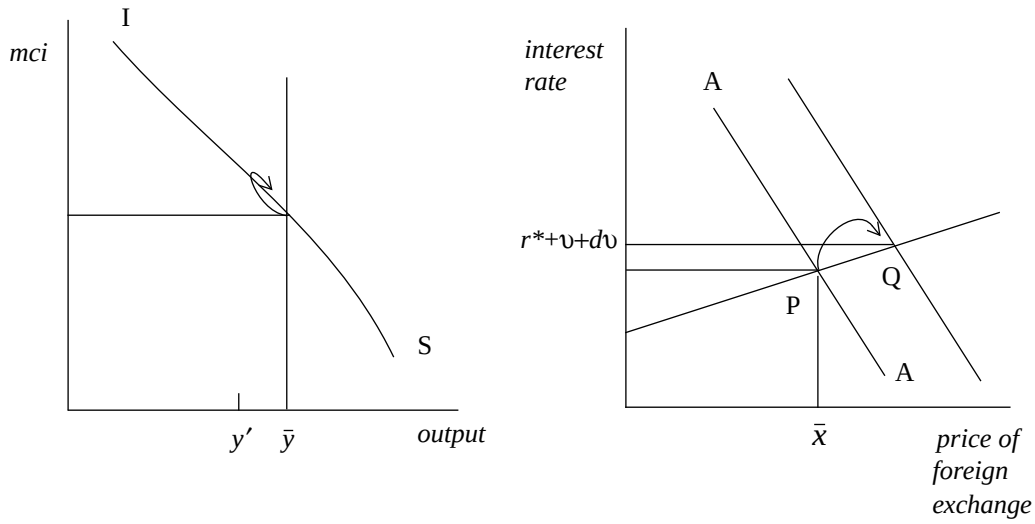
32. A more complete model would embody endogenous asset stocks, as well as flows, and a steady-state equilibrium. This would allow the explicit tracing out of the intertemporal effects of fiscal changes.

Risk premium or credibility shock

Either shock can be represented by an increase in the country premium υ_t, $d\upsilon$.

$$r = r^* + \boldsymbol{E}\Delta x + \upsilon + d\upsilon.$$

Figure A2



In Figure A2 the long-run horizontal asset market equilibrium line shifts upwards by $d\upsilon$, to $r = r^*+\upsilon+d\upsilon$. The short-run asset market equilibrium line AA shifts to the right to intersect the new long-run equilibrium point Q (this shift would be immediate in the case of rational expectations). In turn, Q must be on the $\overline{mci}$ line since the equilibrium level of monetary conditions is unaffected. The interest rate rises by $d\upsilon$, so the equilibrium exchange rate has to rise by σ/δ times $d\upsilon$.

In effect, the higher interest rate compresses domestic demand, while the higher price of foreign exchange creates an exactly offsetting increase in net exports, to maintain full employment. However, either the increase in consumer prices would temporarily exceed target, because of the exchange rate pass-through, or monetary conditions would be tightened in the short run. In general, there would be some overshooting of the interest rate, as per the arrows in Figure A2. This keeps the price level

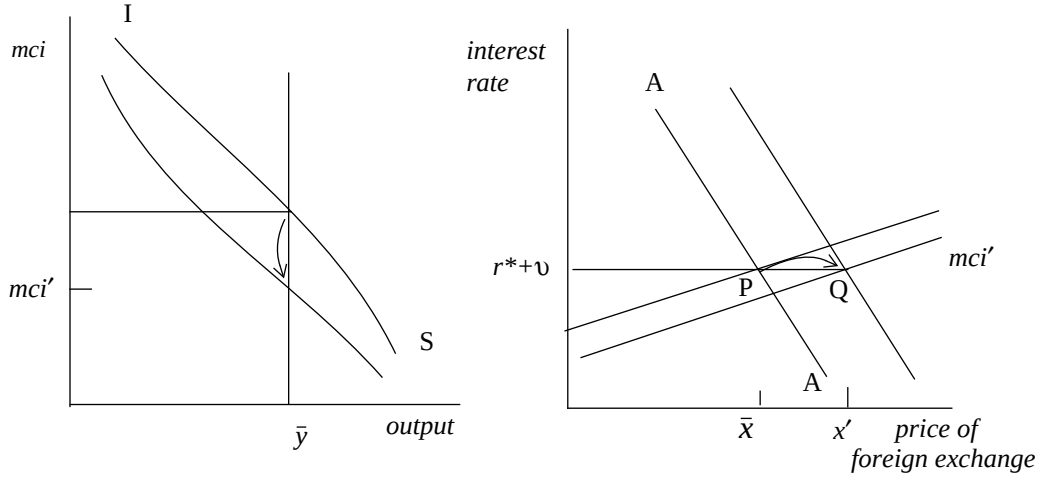
closer to target by (a) moderating the depreciation, and (b) creating some excess capacity, $y' - \bar{y}$.

Regardless of the way the target is approached, the economy suffers in the short run from a worsened policy trade-off: inflation is higher, or unemployment is higher.

Household confidence shock

Reluctance of households to spend is represented in the model by μ in equation A5, and is graphed as a downward shift in the IS curve in Figure A3. This contractionary disturbance requires a new equilibrium in which monetary conditions relax to mci'. But this requires a depreciation, and here too a CPI inflation target would generally not allow the exchange rate to adjust immediately to the new long-run equilibrium. Even if the MCI declines steadily, as in the picture, during the process of adjustment the interest rate will generally be above its equilibrium value. In any case, the upward pressure on the exchange rate again worsens the policy trade-off.

Figure A3

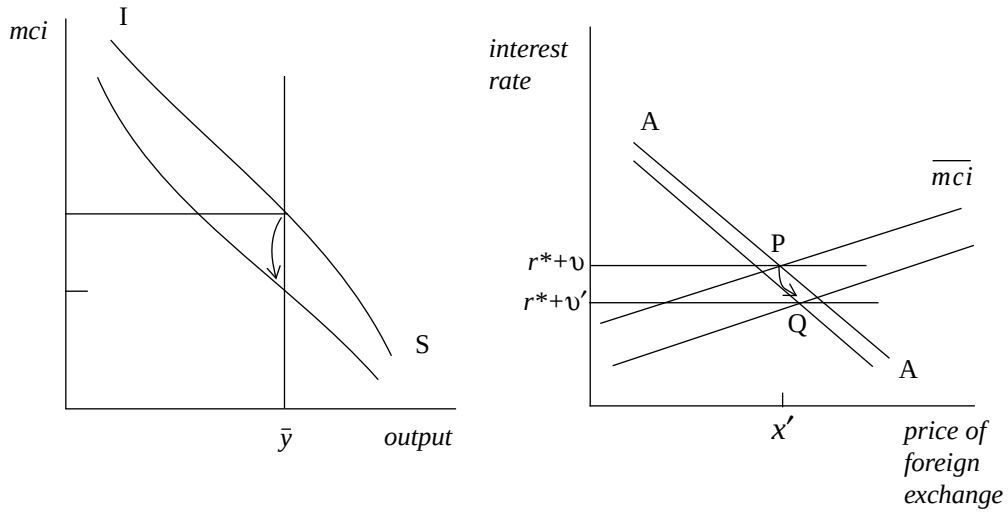


Budget retrenchment

A possible short-run effect of budget retrenchment is illustrated in Figure A4. The spending cut shifts the IS curve downward, lowering the equilibrium MCI to mci'. At least part of the required easing is achieved by

a decline in the interest rate, as the premium falls from υ to υ′. In general, this would not exactly offset the short-run effect on total spending, and some change in the exchange rate would also be required. In Figure A4 exchange depreciation occurs, in the movement of equilibrium from P to Q. But by making the reduction in the interest premium larger, it would easy to set up examples in which the exchange rate remains the same or appreciates.

Figure A4



Appendix 2

A model of the Canadian term structure of interest rates

Effect of short-term interest rate on long-term rate

The expectations theory asserts that the yield on a *T*-period bond at time *t* is equal to an average of the current one-period rate plus the expected one-period rate for the next *T*-1 periods, plus a premium for risk and credibility factors, u_t:[33]

$$RL_t = \frac{1}{T}\left(R90_t + \sum_{i=1}^{T-1} \boldsymbol{E}\, R\, 90_{t+i} \right) + u_t \qquad \text{(A9)}$$

An identical process would hold abroad.[34] We also assume:

- The *longer-run equilibrium* nominal exchange rate is a random walk. That is, at and beyond some point in the future, *t+J*, bond investors expect the period-to-period change in the price of foreign exchange to be zero.[35]

- There is a term-specific country premium, υ_{t+i}, in the forward interest rate for period *t+i*, to compensate for the uncertainty about exchange rate changes and default. It would generally rise with the term horizon, *i*, since further in the future the probability of such events is harder to assess.

- Bond investors realize that the current price of foreign exchange may differ from the longer run equilibrium price, because of the short-run stickiness of output prices. This allows monetary policy to affect independently the domestic interest rate, through a liquidity

33. This is a linear approximation to the time-discounted average, which has geometrically declining weights — Campbell and Shiller (1991). The argument here is not affected by this simplification.

34. Without loss of generality, one may assume that the domestic and foreign term premiums are equal. A difference in premiums across terms within a country is not distinguishable from a term-specific cross-border premiums.

35. Constancy of the expected future nominal exchange rate has been a common assumption in empirical equations for Canadian bond yields. It reflects, among other things, that the rates of inflation in Canada and the United States over the long run have been similar.

mechanism. This effect is assumed to have a maximum duration of *J-1* periods.

These assumptions imply that after date *t+J-1* the domestic short-term interest rate is expected to converge to the foreign interest rate plus the term-specific country premium:

$$R90_{t+i} = R90^*_{t+i} + v_{t+i} \qquad \text{for } i \geq J. \tag{A10}$$

The difference between domestic and foreign bond yields may then be written as:

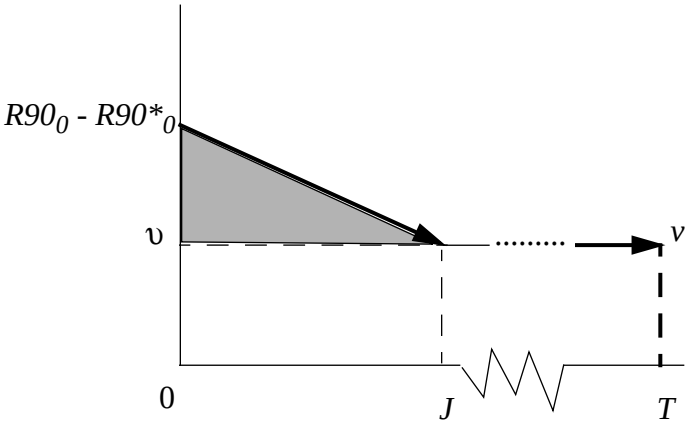
$$RL_t - RL^*_t = \frac{1}{T}\left[R90_t - R90^*_t + \sum_{i=1}^{J-1} (\boldsymbol{E}R90_{t+i} - \boldsymbol{E}R90^*_{t+i})\right] + \frac{1}{T}\sum_{i=J}^{T-1} \upsilon_{t+i} \tag{A11}$$

Under a variety of assumptions about the path by which the short-term interest rate approaches its long-run equilibrium level, e.g., partial adjustment, this can be approximated by the linear function:

$$RL_t - RL^*_t = \gamma(R90_t - R90^*_t) + \psi_t \tag{A12}$$

where ψ_t, the long-term premium, is equal to the mean of the term-specific premiums for risk and credibility across the maturity horizon. As an example of how γ might be interpreted empirically, consider Figure A5.

Figure A5
Term profile of short-term interest rate and risk premium



The initial one-period interest rate differential is $R90_0 - R90^*_0$. For simplicity, the risk and credibility premium, v, is assumed to be constant for all future terms. Arrows indicate the expected path of the short-term rate. The shaded triangle shows the expected short-term differentials up to time J, net of premiums. Its area represents the extent to which domestic monetary policy actions can affect short-term interest rates independently of the foreign interest rate and the premiums demanded by investors. The impact of independent changes in the domestic short rate on the long rate is given by the area of the triangle relative to the life of the bond, $J/2T[(R90_0 - R90^*_0) - v]$. Thus, in this linear approximation, γ would be equal to $J/2T$.

This can be used to make a rough numerical estimate. In the present context, *RL* is the return on bonds with at least 20 years to maturity, so that T is equal to at least 80 quarters, while the term of *R90* is one quarter. The horizon J would be not more than 8 quarters, on the usual view of the duration of real effects of monetary policy. In this case, the approximation would therefore suggest an "armchair estimate" for γ of at most 0.05.

The more general point is that γ depends on the length of the period of adjustment of the domestic interest rate to the foreign rate relative to the life of the bond. Regardless of the precise specification of the adjustment path, the expectations model clearly implies that, unless they have long-term effects on the expected rate of inflation, independent changes in monetary conditions in Canada should have essentially second-order effects on the long-term bond yield, whereas revisions to term risk and credibility premiums should have first-order effects. This follows simply from the smallness of J relative to T (or, more precisely, the smallness of the triangle portion relative to the rectangle portion of the area below the adjustment path).

This argument has implications for the econometrics of equation A12. Risk assessments and credibility affect short-term interest rates to some degree, as well as long-term interest rates. This means that the estimation technique must take account of simultaneity. Simple correlations

between the two differentials will exaggerate the extent to which policy changes to the short rate might affect the long rate.

Decomposition of the term spread

The long-term nominal interest rate at a given point in time can be decomposed into the following elements:

- Long-run rate of return on real capital investment, $\bar{r}_t$. It is reasonable to assume that over time innovations in the underlying real return to capital follow the same path as those in the United States. Thus $\bar{r}_t$ can be thought of as the common North American long-run real return.

- Premium for risk and credibility, ψ_t.

- Long-run expected inflation, $\boldsymbol{E}\overline{\Delta p}_t$

- Short-term real interest rate, r_t, determined in the short run by monetary policy.

- Short-term inflation rate, Δp_t, predetermined in the short run.

The long-term interest rate can then be written as the weighted sum of long-run and short-run components:

$$RL_t = (1-\gamma)(\boldsymbol{E}\overline{\Delta p}_t + \bar{r}_t) + \gamma(r_t + \Delta p_t) + \psi_t, \qquad \text{(A13)}$$

and with $R90_t = r_t + \Delta p_t$ the term spread may be written:

$$RL_t - R90_t = (1-\gamma)[\bar{r}_t - r_t] + (1-\gamma)[\boldsymbol{E}\overline{\Delta p}_t - \Delta p_t] + \psi_t. \qquad \text{(A14)}$$

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