Aspects of Canadian monetary policy conduct in the 1990s: dealing with uncertainty

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Introduction and conclusions

This paper examines the conduct of monetary policy in Canada following the disinflation of the early 1990s. Since 1992 the inflation rate has generally been stable and below the centre of the inflation target range.[1] The Bank of Canada has not sought further disinflation, and monetary conditions have eased substantially. Even so, economic activity has remained quite weak, with persistently high excess capacity and unemployment. This was not expected to happen. Standard macroeconomic models incorporating an expectations-augmented Phillips curve predict that, following a period of disinflation, the economy will grow rapidly until output returns to its potential level.

This raises the question: given that inflation was quick to decline to the lower part of the target range, why did monetary conditions not ease even more rapidly between 1992 and 1996?[2]

Our answer focuses on uncertainties and adverse risk perceptions that came to a head in the first half of the 1990s. 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 uncertainties about employment. In addition, the experience of two decades of inflation created a lingering credibility problem for monetary policy. These problems affected output through a negative impact on household spending, and through people's growing awareness that widespread cuts in government programs or increases in taxes had become unavoidable. Economic activity was further weighed down by the increases in borrowing costs at all maturities caused by the perceived increase in risk.

Several bouts of financial market turbulence were particularly jarring. During these episodes, and in their aftermath, any easing of monetary conditions had to be put on hold, since this turbulence was associated with a perception in the markets that rates ought to be raised. In fact, the evidence from various episodes of this kind suggests that attempts to resist such a tightening can lead to sharp increases in interest rates and to weakness in the Canadian dollar. Tactical choices in the implementation of policy over the past several years have repeatedly been influenced by this danger.

Mindful of the need to build credibility and to not exacerbate the prevailing uncertainty and risk premiums, the Bank of Canada gave a high priority to reducing, or moderating increases in, the risk premium in interest rates through: (1) initiatives designed to reduce the uncertainty about monetary policy actions; and (2) employing cautious tactics – especially during, and in the aftermath of, the periods of turbulence. A lower risk premium would improve the short-term output-inflation trade-off, and eventually allow monetary easing to take place with less likelihood that it would be interpreted, wrongly, as a sign of weakening commitment to inflation control. This approach did not promise or produce quick results. Adverse perceptions had become deeply entrenched, especially in the light of the rapid pace of the growth of government debt at the time.

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1 Inflation targets were first introduced in 1991. The target announced in December 1993, for the period until the end of 1998, is to keep the rate of increase of the consumer price index (CPI) within a range of 1 to 3%. The inflation control targets have been announced jointly by the government and the central bank.

2 For a recent discussion of various other aspects of the conduct of monetary policy in Canada, see Freedman (1996).

However, 1996 has seen a marked change for the better. A substantial strengthening in public finances has been effected, and the determination of the Bank to keep inflation within the target range has been made evident. Financial markets have come to focus on the favourable economic fundamentals in Canada as uncertainty regarding fiscal policy has been reduced, and as constitutional wrangling has receded from the headlines. Moreover, the Bank has taken increased care to provide information about the conduct of monetary policy to the public, with the intention of reducing the surprise element in policy actions to a minimum.[3] In the improved environment, the Bank has been able to ease monetary conditions more assertively. Interest rates have fallen significantly below those in the United States – an outcome that many financial commentators had thought unlikely.

Nevertheless, 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 seek a firmer basis for assessing an appropriate level for the Monetary Conditions Index (MCI).[4] In response, the Bank is becoming more explicit in its *Monetary Policy Report* about its economic outlook. However, this provides rather limited information about the expected path for monetary conditions, largely because the Bank itself is confronted with considerable uncertainty in this regard. One of the difficulties is the well-known fact that the lags in the effects of its actions on inflation are fairly long and uncertain. While transparency and more open communications have been very helpful in building credibility, the keystone for monetary policy has been the Bank's ability to keep the rate of inflation within the announced target range.

The rest of this paper is organised as follows. Section 1 outlines the broad macroeconomic facts and uses a simple model to describe the background for the conduct of monetary policy in Canada in the first half of the 1990s, focusing on the implications of the increase in risk premiums, low consumer confidence, and the fiscal situation. Section 2 provides statistical evidence from the term structure of interest rates and aggregate demand functions. Section 3 discusses the cautious approach adopted in the conduct of monetary policy. Section 4 outlines current reforms that improve the transparency of the Bank's operating framework.

1 Policy environment

1.1 Broad facts

1.1.1 Monetary policy goals and operating targets

Monetary policy achieved a substantial disinflation. The targets instituted in 1991 for controlling the rate of increase in the consumer price index (CPI) have been met. Indeed, inflation has generally been below the midpoint of the target range. However, despite the persistent excess supply gap, prices blipped upwards in 1995 – the year-over-year increase in the CPI touching 2.9% in May – as the effects of prior exchange rate depreciation and commodity price increases came through.

Activity has been sluggish. GDP has increased at an average rate of less than 2½% since 1991, not even keeping pace with the growth of potential output. The annual increase in final domestic demand has averaged only one percent. Household spending has been held back by uncertain employment income prospects associated with:

- economic restructuring in both private and public sectors;

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[3] The Governor of the Bank has put much emphasis on the need for reducing uncertainty in the conduct of monetary policy; see Thiessen (1995).

[4] The MCI serves as an operational target. It is constructed by combining the 3-month interest rate and the G-10 effective exchange rate with weights of 1 and 1/3, respectively; see Freedman (1995).

- a gap between real wages and productivity;
- high real interest rates; and
- unsustainable government deficits.

Table 1
Monetary policy goals and operating targets
In percentages

	Inflation			Output growth		Output gap
	Target range	CPI	Core CPI	GDP	FDD	(GDP)
1990	n.a.	4.9	3.9	-1.9	-1.9	0.5
1991	n.a.	4.1	2.7	0.0	1.2	-3.1
1992	2 - 4	1.8	1.6	0.5	-0.3	-4.3
1993	1⅔ - 3⅔	1.8	1.8	3.1	2.0	-4.3
1994	1⅓ - 3½	0.0	1.6	4.9	2.6	-2.6
1995	1 - 3	2.1	2.2	0.7	-0.1	-2.4
1996	1 - 3	1.5	1.4	1.2	1.4	-3.2

	90-day interest rate		Real exchange	Real
	nominal	real	rate	MCI
1990	13.0	9.9	0.0	0.0
1991	8.9	6.0	0.3	-3.7
1992	6.7	5.5	-7.2	-6.5
1993	5.0	3.9	-14.5	-10.9
1994	5.7	4.9	-21.2	-12.4
1995	7.2	5.7	-23.1	-12.0
1996	4.8	4.0	-23.1	-14.6

Top panel: Target: December/December change in CPI; 1993 and 1994 interpolated from actual target ending mid-1994. Core CPI: excludes food, energy and indirect taxes. Columns 2-5: 4th quarter to 4th quarter percentage change – except 1996: 2nd quarter to 4th quarter annualised. **Bottom panel:** Real 90-day rate: nominal less lagged 4-quarter change in GDP deflator. Real exchange rate: Canadian dollar against 5 currencies, adjusted with GDP deflators. Real MCI: calculated from preceding 2 real variables. Columns 3 and 4: change from 1990 – except 1996: first 3 quarters.

The problem has not been entirely on the demand side, since productivity growth has also been 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 condition. The real monetary conditions index (MCI) – a weighted sum of the real short term interest rate and the real value of the G10-weighted exchange rate – fell 5½ percentage points from 1992 to 1995. Since the real interest rate did not show a net decrease, this took the form of currency depreciation, which stimulated activity by contributing to a rapid growth in net exports. Thus, the easing of monetary conditions had its effect on output primarily through the external channel.

Increased risk premiums raised interest rates. Unusually 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, as is clear from the depreciation of the exchange rate and also from the steepening of the yield curve over the period. The latter is shown in Section 2 to be a significant factor in the weakness of economic activity.

1.1.2 Government debt growth

Gross government debt, provincial and federal combined, has approached 100% of GDP in recent years, as Canada accumulated budget deficits at a rate well above the G7 countries as a whole (Table 2). The public increasingly came to recognise 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 anxieties. Expectations of government retrenchment depressed household spending even before the actual large cuts in 1995 began to bite.

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

	Gross debt					Budget balances				
	1990	**1992**	**1994**	**1996P**	**1997P**	**1990**	**1992**	**1994**	**1996P**	**1997P**
Canada.....	73	87	97	99	98	-4.1	-7.4	-5.3	-2.9	-1.8
United States ..	56	62	64	64	64	-2.7	-4.4	-2.3	-1.9	-1.8
Japan	65	64	73	89	95	2.9	1.4	-2.1	-4.8	-3.7
Germany.....	46	46	52	64	66	-2.1	-2.8	-2.5	-4.1	-3.6
France.....	40	46	55	60	62	-1.6	-4.0	-5.8	-4.3	-3.7
Italy.....	106	117	124	123	123	-10.9	-9.5	-9.0	-6.7	-6.4
United Kingdom.....	39	48	55	61	62	-1.2	-6.3	-6.8	-4.8	-3.7
Total G7	59	63	68	74	75	-2.1	-3.8	-3.5	-3.4	-3.0

Source: OECD Economic Outlook, June 1996 (P: projected value).

The cuts since then have been major. The total projected decline in the overall budget deficit from 1994 to 1997 amounts to over 4.5% of GDP, which is much larger than the adjustments applied elsewhere in the G7 area. As a result, the government deficit in Canada is currently significantly below the G7 average.

1.1.3 International indebtedness

Growth in external liabilities also accelerated in the early 1990s, as the current account deficit reached almost 4% 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 ERM and Mexico, that otherwise did not materially affect its economy (Section 3).

Table 3
International accounts: percentage of GDP

	1990	**1992**	**1994**	**1996P**	**1997P**
Current account	-3.8	-3.7	-3.0	-0.1	1.2
Net foreign liabilities	36.9	42.6	45.2	42.9	40.0

Source: See Table 2.

In the past couple of years, with the rapid increase in net exports, the current account has improved dramatically. It is expected to be in surplus in 1997. 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, and revised its expectations for the Canadian dollar accordingly.

1.1.4 Improvement in 1996

Improving fundamentals – substantial declines in budget and external deficits, durable low inflation – have come to the fore this year, as markets have become less concerned about the immediate political situation in Quebec. Published commentary in the press and by private-sector analysts, reflecting this, has undergone a remarkable change and is now very positive. All this has had favourable implications for the exchange rate, and for international interest rate differentials. Short-term interest rates and the MCI have both declined by more than 250 basis points from 1995. Because of the lags in the effects of monetary policy, an acceleration of activity through 1997 is in the cards. Given the excess capacity in the economy, this should not lead to an increase in the underlying rate of inflation.

1.2 A model

Mainstream macroeconomic theory predicts that confidence problems and unsustainable budget positions will result in weakened economic activity and a worsening of the short-run trade-off between output and inflation. The deterioration follows from 4 standard assumptions:[5]

- slowly adjusting output prices, so that output may diverge from its potential level in the short run (Phillips curve);
- instantaneously adjusting asset market prices (open economy asset market equilibrium à la Dornbusch) – the possibility of jumps in the exchange rate implies that the CPI might also move quickly in the short run;
- equality of the domestic interest rate with the foreign interest rate *plus* the expected increase in the price of foreign exchange *plus* a time varying risk premium (perfect capital mobility); and
- aggregate demand responds negatively to the real interest rate and to the real exchange value of the currency (open-economy IS equation).

The real exchange rate moves to maintain equilibrium in the output market in the long run – i.e. to remove any excess supply (demand), the real exchange value of the currency falls (rises). Monetary policy actions can affect the real interest rate in the short run, through the conventional liquidity effect, but not in the long run.[6] Here, some results from the model are outlined, and their relevance to the current situation in Canada is assessed.

1.2.1 Increased risk premium in interest rates

Conceptually, the risk premium problem differs from the credibility problem. A risk premium in interest rates implies that investors *expect* a higher return for bearing extra risk, whereas a credibility problem implies that investors suspect that monetary policy may be looser than the central

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5 A model with these features is analyzed in Appendix 1. It shares characteristics with R. Dornbusch *Open Economy Macroeconomics*, 1980, Chapter 11. The key 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.

6 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.

bank has pledged and hence they *may not expect* the additional return they receive. However, the two are observationally equivalent, since it is not possible to tell from data on returns whether or not the ex post results conform to ex ante expectations.

A shock to confidence (of either kind) does not affect the equilibrium value of the MCI. The interest rate in the long run has to increase by the same amount as the risk premium, and the equilibrium price of foreign exchange has to rise (i.e. currency depreciates) so as to keep the MCI at its original level. In the new equilibrium, the higher interest rate compresses domestic demand, while the currency depreciation creates an exactly offsetting increase in net exports, to maintain output at is potential level. However, during the movement towards the new equilibrium in the model, the increase in consumer prices would temporarily exceed the target, because of the exchange rate feed-through. This means that the short-run output-inflation trade-off necessarily worsens, regardless of the response of the monetary authority.[7]

In short, such a shock has effects that accord with salient facts about the Canadian economy in recent years:

- increased level of domestic interest rates, possibly with overshooting early in the adjustment phase, and hence low domestic demand;
- a depreciation of the currency, causing an expansion of net exports; and
- a worsened short-run trade-off between output and CPI inflation.
- The model also illustrates one reason why the exchange rate is liable to respond in an unstable manner to changes in risk assessments. In numerical terms, on the basis of the Bank of Canada's MCI, in which the weight on the interest rate is 3 times that on the exchange rate, an increase in the risk premium in Canada of 50 basis points would imply a depreciation of the equilibrium value of the Canadian dollar of about 1.5%. 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 IS equations range from 2 to 5. In the example of a 50-basis point increase in the premium, the change in the equilibrium real price of foreign exchange might be anywhere in the range 1 to 2.5%. More generally, uncertainty with respect the long-run value of the exchange rate is several times that with respect to the interest rate, which itself may be sizable. 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 often give rise to questions about the commitment of monetary policy to inflation control, and thereby call for some response from the central bank. Section 3 describes some of the practical consequences of this for policy actions of the Bank of Canada.

1.2.2 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

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[7] 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 of itself 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.

shock, the easing of monetary conditions must be accomplished entirely through an increase in the price of foreign exchange. In the short run the depreciation of the domestic currency implies a worsened output-inflation trade-off.[8]

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

1.2.3 Correction to unsustainable budget position

The relevant exercise here is not a simple matter of comparative statics because it involves an initial situation that was not sustainable.[9] In this situation behaviour would already be affected by an expectation of future government retrenchment, and by uncertainty as to the size, timing and incidence of the measures to be adopted. Nevertheless, as an initial step in the analysis, one can consider the effects of cuts in government spending in an economy which is in equilibrium. This shifts the aggregate demand schedule downward. Maintenance of full employment then requires a monetary easing. Some of this would come about through an induced decline in the risk premium on the country's assets, in response to the stronger fiscal position. On its own, this effect might not be large enough to offset completely the short-run negative effect of the initial cutback, in which case the currency must depreciate.

- Thus, budget retrenchment might produce a *short-run* worsening of the output-inflation trade-off[10] – the emphasis is on *short-run* because, eventually, a stronger fiscal position results in an *improved* trade-off on the path to long-run equilibrium, as the reduction in debt leads to a reduced risk premium, an increase in the real exchange value of the currency and an increased private-sector capital stock.
- However, only a part of the weak macroeconomic performance in 1995 and early 1996 can be plausibly attributed to the tightening of fiscal policy:
  - empirically, a systematic fiscal policy effect on output in Canada is hard to find[11];
  - 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, the public seems well aware that long-run prospects for future income are 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, without any decline in the Canadian dollar;
  - the cuts introduced in 1995 will have most impact in 1996 and 1997, yet the consensus outlook shows an acceleration of GDP growth through this period.

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8 The exchange rate might or might not overshoot in response to these shocks. If the central bank resists some of the short-run upward pressure on the price level, the interest rate increases during the transition path. Covered interest parity can then be maintained with a monotonic depreciation of the currency, as sketched in Figures A2 and A3.

9 A point stressed in Thiessen (1996a).

10 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, and his argument was borne out by the early success of such a combination in the US in the early 1980s; see 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.

11 No economically significant effect was found for fiscal policy variables in the estimated equations for GDP reported later in this paper. The traditional multiplier effect seems to be much weaker than many economists have thought.

2. Estimates of the increase in risk premiums and its effect on activity

2.1 Inferences from the behaviour of the long-term interest rate

As recently as the 1980s empirical tests generally accepted the hypothesis of perfect substitutability between Canadian and US assets.[12] In particular, there was no evidence that changes in relative supplies of government debt exerted any impact on bond spreads. However, the joint hypothesis of rational expectations and a time-invariant risk premium *was* rejected, 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 in the risk premium that took place.[13]

The risk premium in Canadian interest rates in the 1990s has been affected by political uncertainty as well as by increasing debt. We use the behaviour of the yield curve as a gauge of the overall increase of the premium in long-term rates. Our approach is based on the expectations theory.[14] It assumes that the underlying equilibrium path of the nominal exchange rate follows a random walk, as a result of the multifarious disturbances that may arrive, but that changes in current monetary conditions may lead the actual exchange rate to be above or below long-run equilibrium, and hence create the expectation of a definite change in the exchange rate in the short run.[15] 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 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. The exchange rate then is expected to return to its perceived 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 US rate plus a time-varying risk premium.

The following equation can be derived from these assumptions (Appendix 2):

$$RL_t - RL_t^* = \gamma\left(R90_t - R90_t^*\right) + \upsilon_t \qquad (1)$$

That is, the long-term differential is a function of the cross-country difference in short-term interest rates and the time-varying term-risk premium (the difference between the risk premium on a bond and that on a short-term asset). This may be interpreted as saying that the Bank of Canada has some leverage (γ) on bond yields, through its influence on short-term interest rates. The coefficient γ may be thought of as the length of time that monetary actions in Canada can exert an independent influence on the short-term interest rate, measured as a fraction of the duration of the bond.

In the light of the way budgets, monetary policy and political risks evolve in Canada, over periods of quarters and years, the bond risk premium would be serially correlated. Moreover,

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[12] Boothe et al. (1985), Murray and Khemani (1989).

[13] See Fillion (1996). Orr et al. (1995), in a multicountry study, find that both fiscal deficits and current account deficits significantly increase domestic real interest rates.

[14] It is a quantitative version of an argument used by Goodfriend (1993).

[15] 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.

since short rates are also affected by risk perceptions, $R90_t$ is not independent of υ_t. In view of these statistical dependencies, we use a VAR to estimate the bivariate relationship between the long- and short-term spreads implied by (1).

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

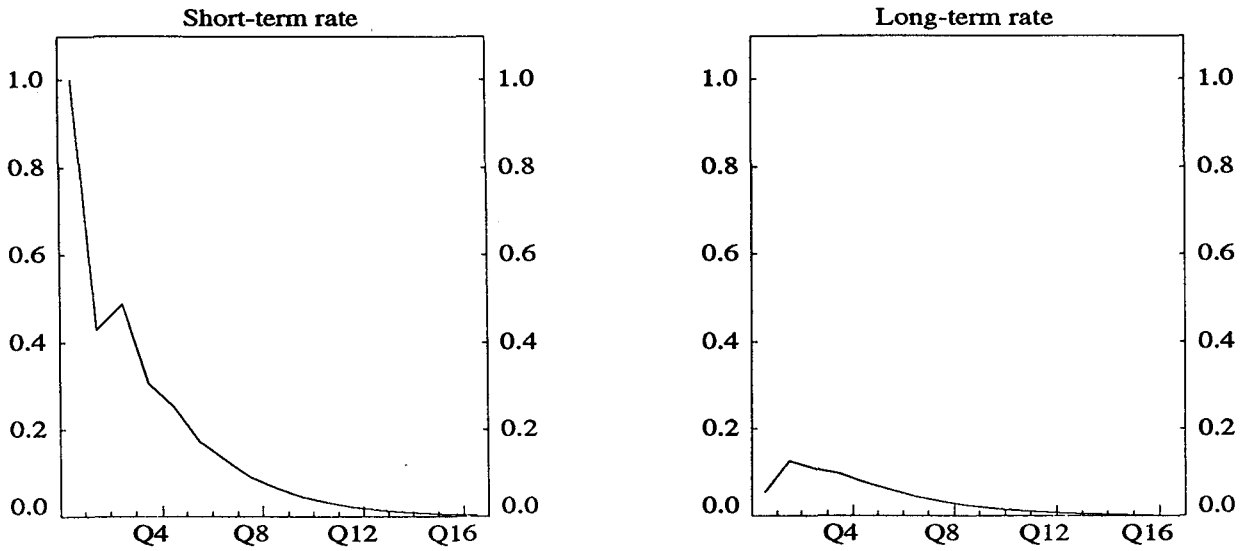
Table 4
VAR equation for the long-term differential

	Coefficient (SE) *t*-1		**Coefficient (SE)** *t*-2	
Constant	0.35	(0.08)		
$RL–RL^*$	0.77	(0.10)	-0.14	(0.09)
$R90–R90^*$	0.08	(0.02)	-0.02	(0.02)
Estimation period	1962 Q4-1990 Q2		SEE 0.28	
ADF test for unit root (probability value) 1962 Q2-1996 Q2				
$RL–RL^*$	-2.93	(0.042)		
$R90–R90^*$	-3.68	(0.004)		

Even though the unit root is rejected, the estimates of the coefficients on the lagged dependent variable in the reduced form imply that movements in the long-term yield differential are quite highly autocorrelated. This is consistent with the spread being dominated by rather persistent movements in the risk premium.

The system impulse-response function for a unit shock to *R*90 shows a peak effect on *RL* of just 0.13 in the second quarter, after which the effect tapers off quickly (Chart 1). This small effect is close to the "armchair derived" value of 0.10 in Appendix 2.

Chart 1
Impulse response function for a 100 basis point shock to *R*90

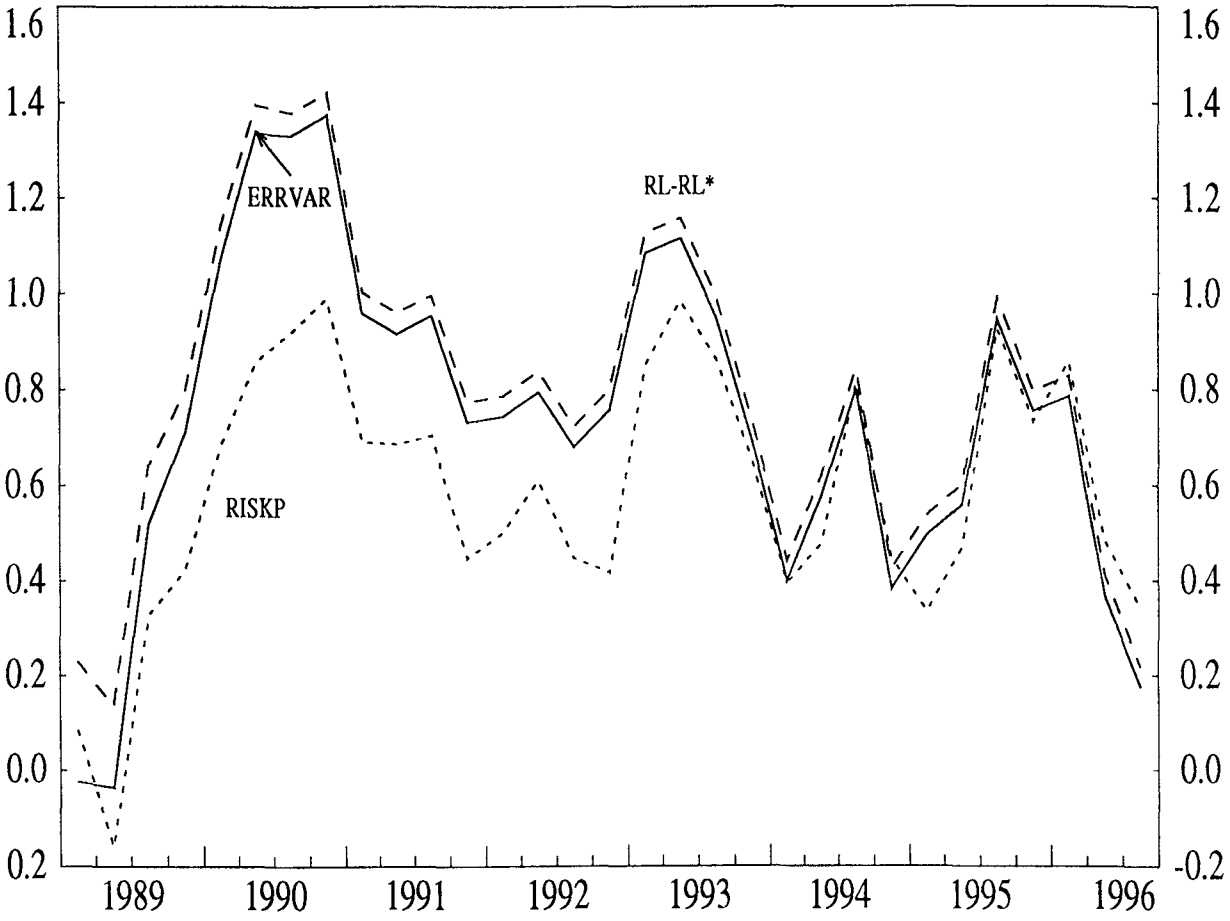


On these grounds, an approximate indicator of the term-risk premium would be given by:

$$RISKP = \left(RL - RL^{*}\right) - 0.10\left(R90 - R90^{*}\right) \qquad (2)$$

The second term in this expression takes out the predicted effect of changes in the current short-term spread (which can be attributed to changes in monetary conditions). Chart 2 plots both *RISKP* and *RL-RL** (less the long-run historical values of 97 and 105 basis points respectively), along with the dynamic forecast errors from the VAR (*ERRVAR*).

Chart 2
Canada-US long-term interest rate premium



Each of these lines can be interpreted as estimates of the increases in the long-term risk premium in the 1990s, with the raw spread the least and the VAR error the most sophisticated.[16] ERRVAR is positive throughout, confirming that the structure generating the Canadian bond rate did shift upwards.[17] The VAR simulation is initialised in 1990 Q3, using the actual lagged value of the

[16] These measures are not necessarily good indicators of the level of the risk premium at a point in time. We use them only to gauge the movement over time.

[17] This finding stands in contrast to other studies. Clinton and Howard (1994) present an equation for the 5-year bond rate that remained stable. However, that study used a shorter-term interest rate, a much shorter estimation period and a less restrictive specification of the expectations theory than the present one. Gerlach (1996), using a very different approach that does not directly incorporate international asset substitutability, finds that the expectations theory with a

spread as a starting point, so it does not, at first, show large errors. However, as the effect of initial conditions fades, the *ERRVAR* converges to the other measures in the chart. The average of all the measures for the period 1990 Q2 - 1995 Q4, centres around 60 basis points, which indicates the extent to which the nominal long-term interest rate in Canada was unusually high. In real terms the increase would be somewhat greater, given the opening of a favourable inflation differential against the United States (of about 1.3% for core inflation over the last 4 years).

Most of the peaks in the chart follow periods of sharply increasing unease with fiscal policy or of setbacks to Canadian political unity. However, the movements in the long-term interest differentials differ significantly from those in the money market differentials discussed in Section 3. The long-term differential has been more affected by low-frequency movements in such variables as the fiscal position and the constitutional conflict, and less by short-lived market disturbances. This might be expected a priori, but it also reflects the firm strategy of the Bank of Canada, which left the markets in no doubt as to the stance of monetary policy, and thereby put them in a better position to look through the short-run volatility.

Since 1995, the chart features a large decline in the long-term premium. This started after the implementation of a credible program of fiscal restraint, by the federal government as well as the majority of provinces, and resumed after the Quebec referendum later that year.

2.2 Estimates of the negative effect of the risk premium from models of changes in GDP

This section uses two models to provide evidence that output has been sensitive to shocks to the risk premium in long term interest rates, and that the increase in the premium caused a reduction in Canadian output growth. The first model is the aggregate demand function developed by Duguay (1994), while the second is based on properties of the yield curve explored by Cozier and Tkacz (1993).

2.2.1 Estimated IS model

The basic model includes the relative price of resource-based commodities, increases in which have a positive effect on Canadian activity, as well as the usual variables in an aggregate demand function. In the augmented model *RISKP* has a sizable negative coefficient.

Table 5
Estimated IS model for quarterly change in GDP

	Basic	**Risk-premium augmented**
US GDP	0.85 (0.07)	0.80 (0.07)
Real *R*90	-0.61 (0.18)	-0.68 (0.18)
Real exchange value of C$	0.11 (0.09)	0.11 (0.09)
Relative commodity price	0.11 (0.05)	0.10 (0.05)
RISKP		-0.38 (0.16)
SEE	0.76	0.74
Estimation period	1962 Q4 - 1995 Q4	

Notes: Variables are differenced, except *RISKP*. Listed coefficients are sums over a distributed lag. No lag for *RISKP*. Standard errors in parentheses.

constant risk premium can be accepted for Canada but not for the United States. It might be difficult to reconcile this with our maintained hypothesis.

2.2.2 Estimated 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 the gap between expected returns on real investment and the short-term interest rate and the expected rate of inflation. This leads one to expect a positive correlation between the slope of the yield curve and future changes in economic activity. However, to the extent that this spread also contains a time-varying risk premium, this correlation could be weakened or even inverted.

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

$$RL_t - R90_t = (1-\gamma)\left[\bar{r}_t - r_t\right] + (1-\gamma)\left[E\overline{\Delta p}_t - \Delta p_t\right] + \upsilon_t \qquad (3)$$

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

- the first is the gap between Wicksell's natural rate and the current real interest rate;
- the second is the expected acceleration in the inflation rate;
- the third is the term-risk premium.

Changes in the first two variables imply changes in incentives to spend; e.g. given the real short-term interest rate, either an increase in the expected real return to investment or an expected acceleration of inflation will cause an increase in spending and the bringing forward of planned future expenses. Monetary policy may have effects through both factors; e.g. an easing will reduce the short-term real interest rate (the liquidity effect) and if anything raise the expected inflation rate.

- If the variance of the term spread is dominated by these two factors, it would be positively correlated with 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 negatively sloped yield curve.
- If, on the other hand, the term-risk premium has high variance, any positive correlation between output and the terms in square brackets might be outweighed by the negative correlation between this premium and the desire to spend.

In fact, given the high variance of the short rate, it has been the main component of movements in the spread. Consistent with this, in Canada the historical correlation between the current term spread and the change in output over the next 4 quarters has been strongly positive. Empirical "indicator models" for output exploit this property of the term spread. To gauge the effect of the term-risk premium we have re-estimated these models, as before using the *RISKP* variable as an approximation for it. Ignoring variables not relevant to the present discussion, the form of the estimated equations is:

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

where *RR*90 is the real 90-day commercial paper rate.[18] Table 6 contains estimates of variants of (4) estimated for a period ending 1990 Q2.

The basic equation, which ignores the risk premium, is very similar to equations estimated by Cozier and Tkacz (1994). However, after 1990 such equations overestimate GDP growth by a wide margin.

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[18] To be more precise, *RR*90 is the 8-quarter lagged moving average of the 90-day commercial paper rate less the 4-quarter change in the GDP deflator.

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

	Basic		Risk-premium augmented	
RL-R90	0.89	(0.14)	0.91	(0.13)
RISKP	–		-1.05	(0.40)
RR90	-0.28	(0.06)	-0.26	(0.05)
SEE	1.64		1.59	
Estimation period	1962 Q4 - 1996 Q2			

Note: Estimated by Hodrick-Hansen GLS procedure, allowing for 4-quarter moving average in the error.

Part of the explanation for the bias appears to be the increased risk premium. The second equation extends the estimation period through 1996 Q2 and brings in *RISKP* – and again its coefficient is significant and sizable.

2.2.3 Inferring the impact on activity

The implied effect of the post-1990 increase in the risk premium on output growth can be obtained from model simulations in which the *RISKP* is held to its average pre-1990 value of 0.97. Results are shown in Table 7.

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

	IS model	Yield-curve model
1991	-0.95	-1.03
1992	-0.74	-0.47
1993	-1.26	-0.43
1994	-0.80	-0.68
1995	-0.93	-0.47
Sum	-4.68	-3.08

Note: 4th quarter to 4th quarter percentage change – simulated minus actual.

The cumulative impact suggests that the persistence of heightened risks had a serious medium-term effect on the economy. Indeed, by 1995 the estimated cumulative output loss arising from the increased risk premium is of the same order of magnitude as the output gap.

3. How confidence problems affected the conduct of monetary policy

3.1 Tactical considerations

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 this was a consideration,

particularly in periods in which the Bank wanted to initiate an easing in monetary conditions. Its tactics throughout were designed to reinforce the credibility of monetary policy, which was not yet established, and to reduce risk premiums.

Given the heightened uncertainties, the strategic easing of monetary conditions often had to give way to the tactical necessity of promoting orderly markets.[19] Although the Bank could not prevent risk premiums from rising through this period, given the fiscal and political situation, promoting orderly markets was viewed as a helpful way of containing risk premiums, 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 target range, which in turn could have triggered even higher risk premiums, and prevented the desired easing in monetary conditions from taking place.[20]

During these recurring episodes of heightened uncertainty, monetary conditions tended to tighten relative to the desired path in response to a sharp increase in short-term Canadian interest rates – reflecting a change in investors' willingness to hold Canadian dollar denominated assets – which 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.

It may be tactically propitious to postpone achieving a given desired path for the MCI in the short run if markets are unsettled. This does not mean that the Bank has to wait entirely on the market. In periods when the Bank and the market disagree over the appropriate course for monetary policy, it is incumbent on the Bank to try to develop an appreciation in the market of the economic fundamentals it 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 Bank can minimise the uncertainty about its policy intentions, and ensure that it does not add to the risk premiums already present in Canadian interest rates.

3.1.1 Winter 1994-95: an example of heightened market volatility

The winter 1994-95 episode of market volatility offers an example of what can happen when the Bank attempts to achieve easier monetary conditions than the market views as appropriate; Charts 3 to 7 provide a graphical summary of events through this period. Turbulence in financial markets emerged in response to:

Positive output surprise

- 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 US and Canadian economies were expanding at a rapid pace in the fourth quarter led some economists, who relied on models that emphasised 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 emphasises instead the size of the output gap, which remained wide; and

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[19] See Zelmer (1996) for a discussion of several of such episodes.

[20] 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.

- 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. However, it was reluctant to raise the overnight rate again to ratify the further increase taking place in short-term interest rates because it was concerned that such an action might trigger even higher rates.

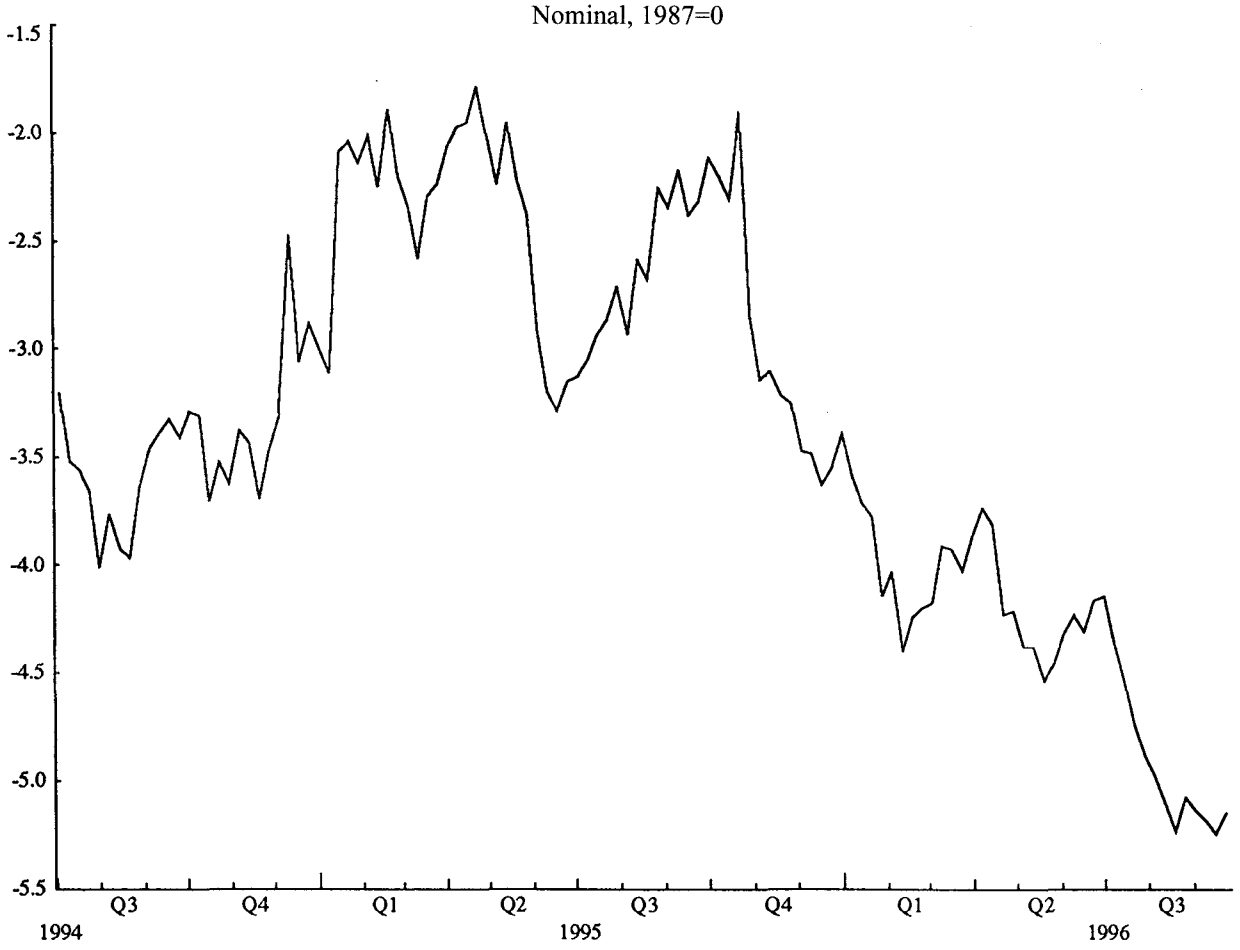
Risk assessment shift

- the Mexican financial crisis focused investor attention on countries experiencing large fiscal and current account imbalances; and
- the Bank's initial resistance to the increase in short-term interest rates led to concern over the credibility of the monetary policy stance.

Negative spreads between Canadian and US 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.

Chart 3
Monetary conditions index
Nominal, 1987=0



Market pressures – evident in the rise of 1- and 3-month interest rates – obliged the Bank to raise the band on several occasions, to avoid the risk of a loss of confidence in foreign exchange and bond markets. Given the sizeable increase in short-term interest rates that had taken place in December and early January, the financial markets clearly expected a steep rise in the overnight interest rate, and 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

Chart 4
Overnight rate versus the 3-month T-bill rate

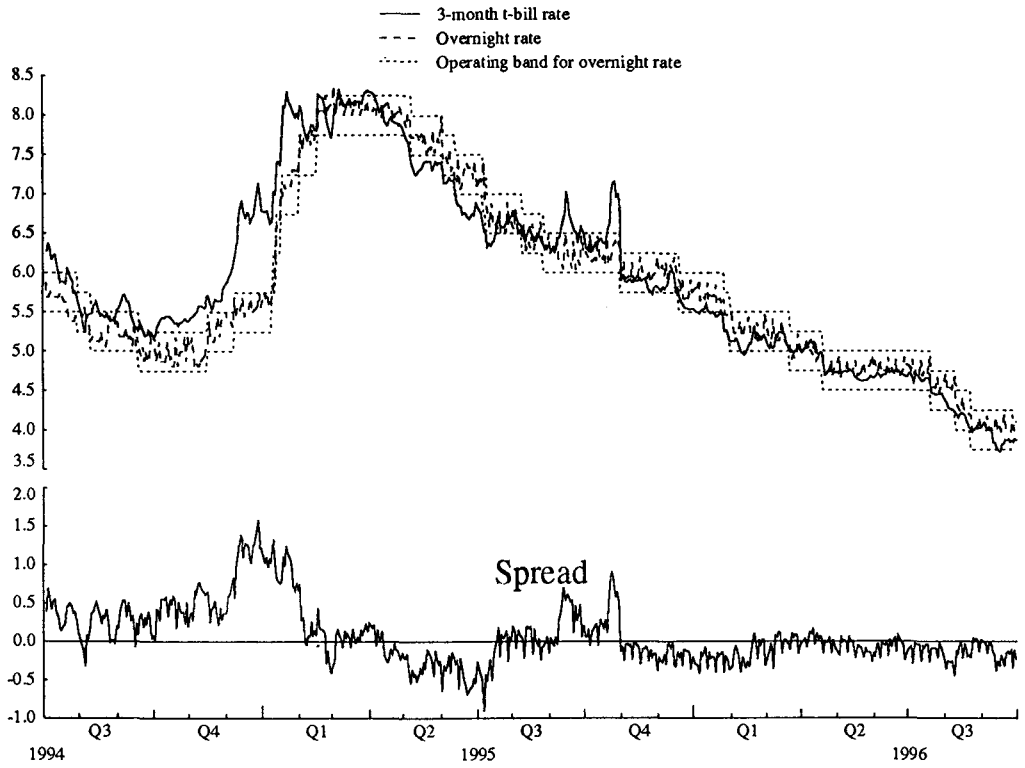


Chart 5
3-month interest rates

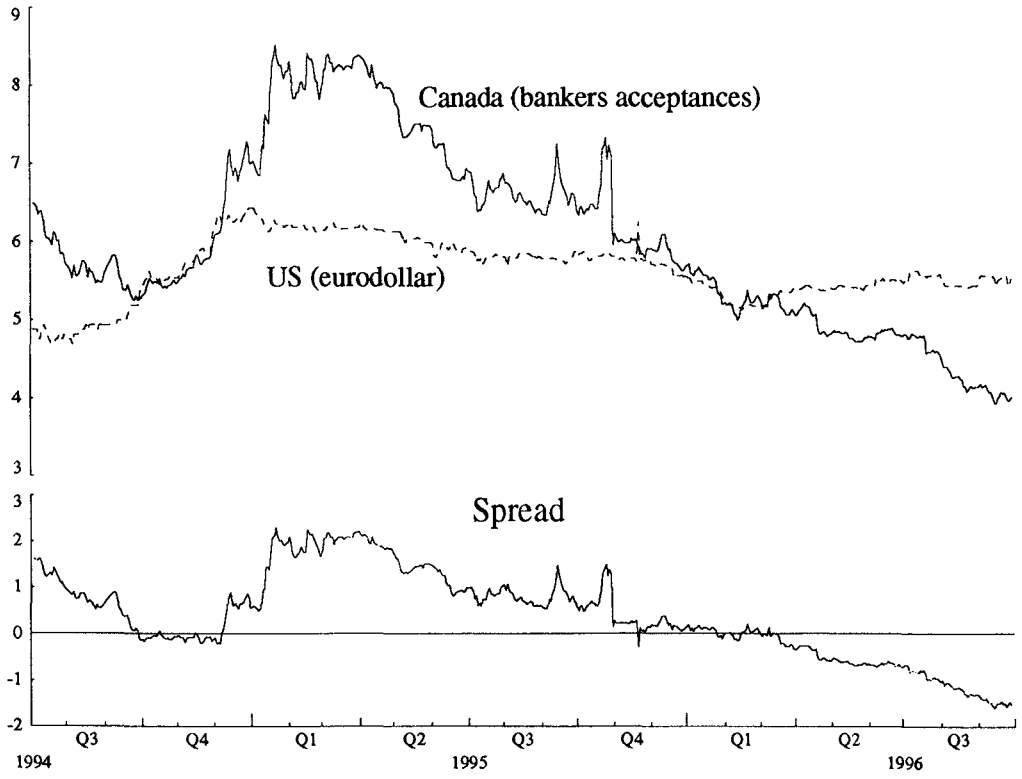


Chart 6
Long-term bond yields

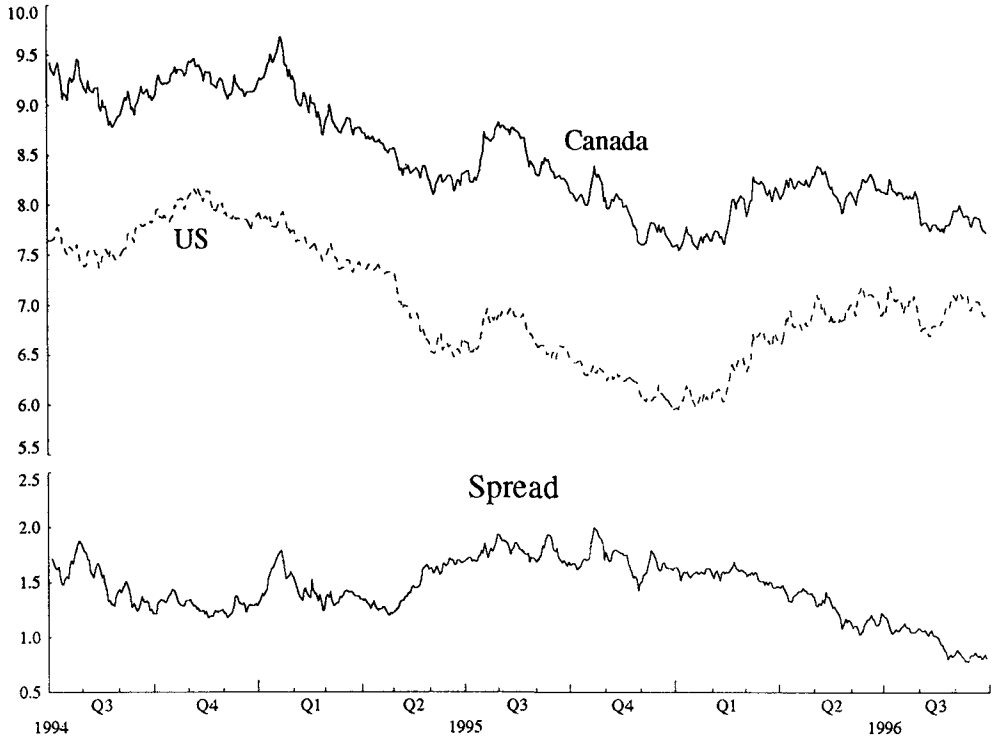
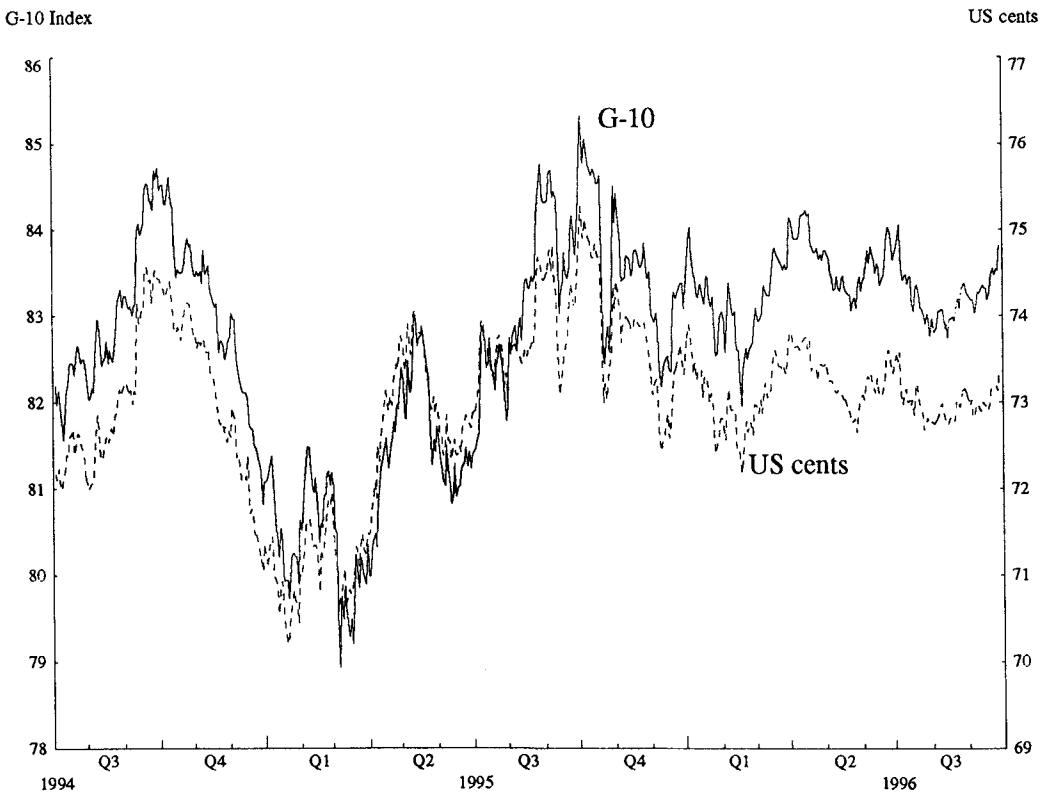


Chart 7
The Canadian dollar



rate depreciation than in the past. There was also the prospect of a worsening fiscal balance in the wake of the higher interest rates. As a result, fears mounted that the as yet unproved government would be tempted to take risks on the side of inflation rather than take tough fiscal measures. 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 US 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 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, it suggests that the Bank needs to ensure that market participants understand its views on the economy and on the outlook for inflation that underlie a particular policy stance, and that its 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.

3.2 Has the focus on the MCI caused some confusion?

Some participants argue that the market has considerable difficulty determining the appropriate path for the MCI, especially as the lags in its effect on inflation must be fairly long, and the market does not receive much practical guidance from the Bank.[21] 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. As a result, market participants may not have tried hard enough to identify whether desired monetary conditions may have changed. On observing a change in the value of the Canadian dollar, they might speculate that the Bank will eventually adjust interest rates in order to keep monetary conditions broadly unchanged. If this argument is correct, it implies a persistent 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 only significant in periods when there are weakly-grounded (and hence varying) views regarding Canada's fiscal and political situation.[22] In essence, variations in the market's perceived risk premium for

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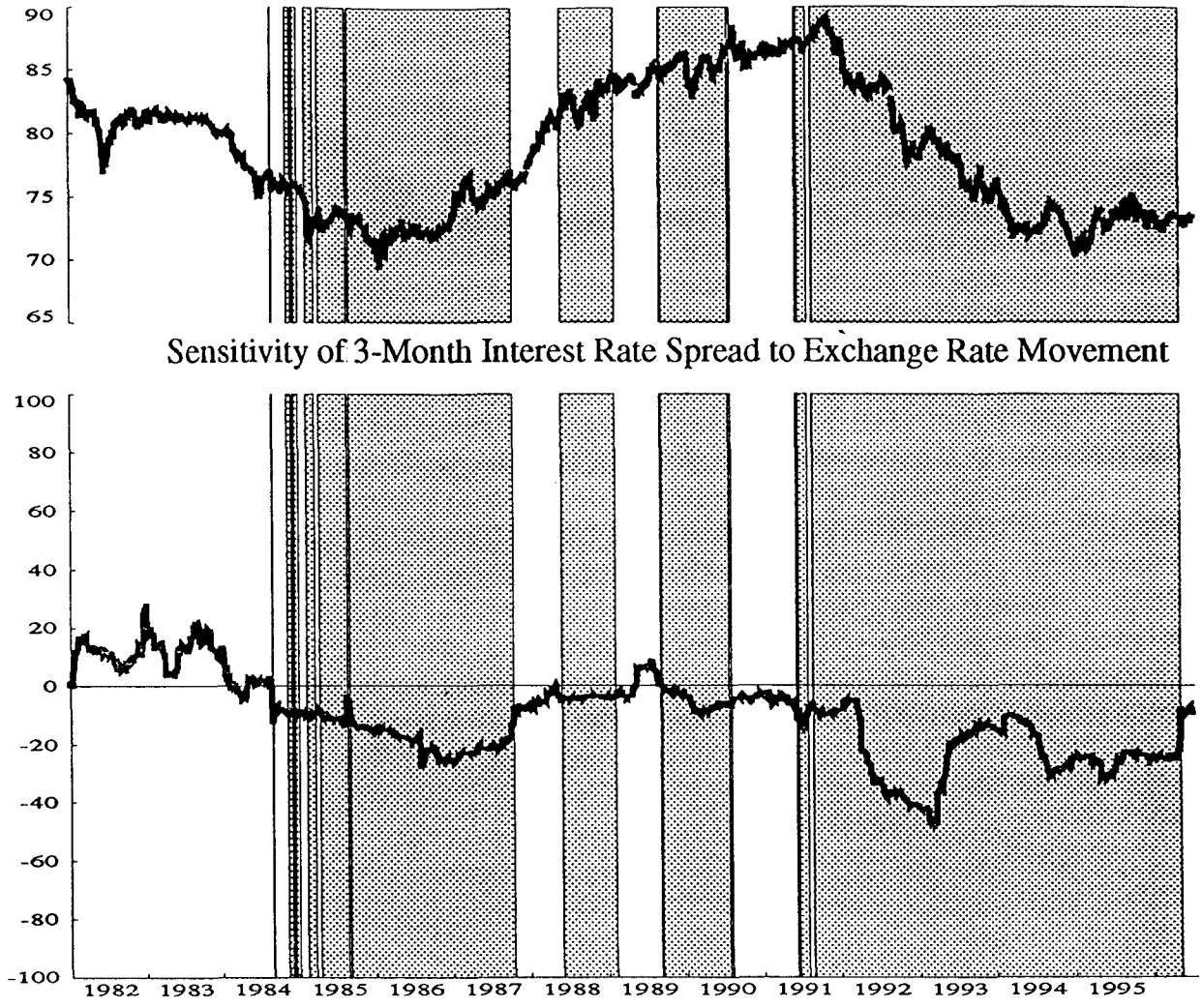
21 See, for example, the comments by Neufeld on Zelmer (1996).

22 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

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 recognised this point (which may have been reinforced by the Bank's focus on the MCI as its operational guide to policy) and has 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.

Chart 8
The Canadian dollar
In US cents



Note: Shaded areas represent statistically significant negative coefficients.

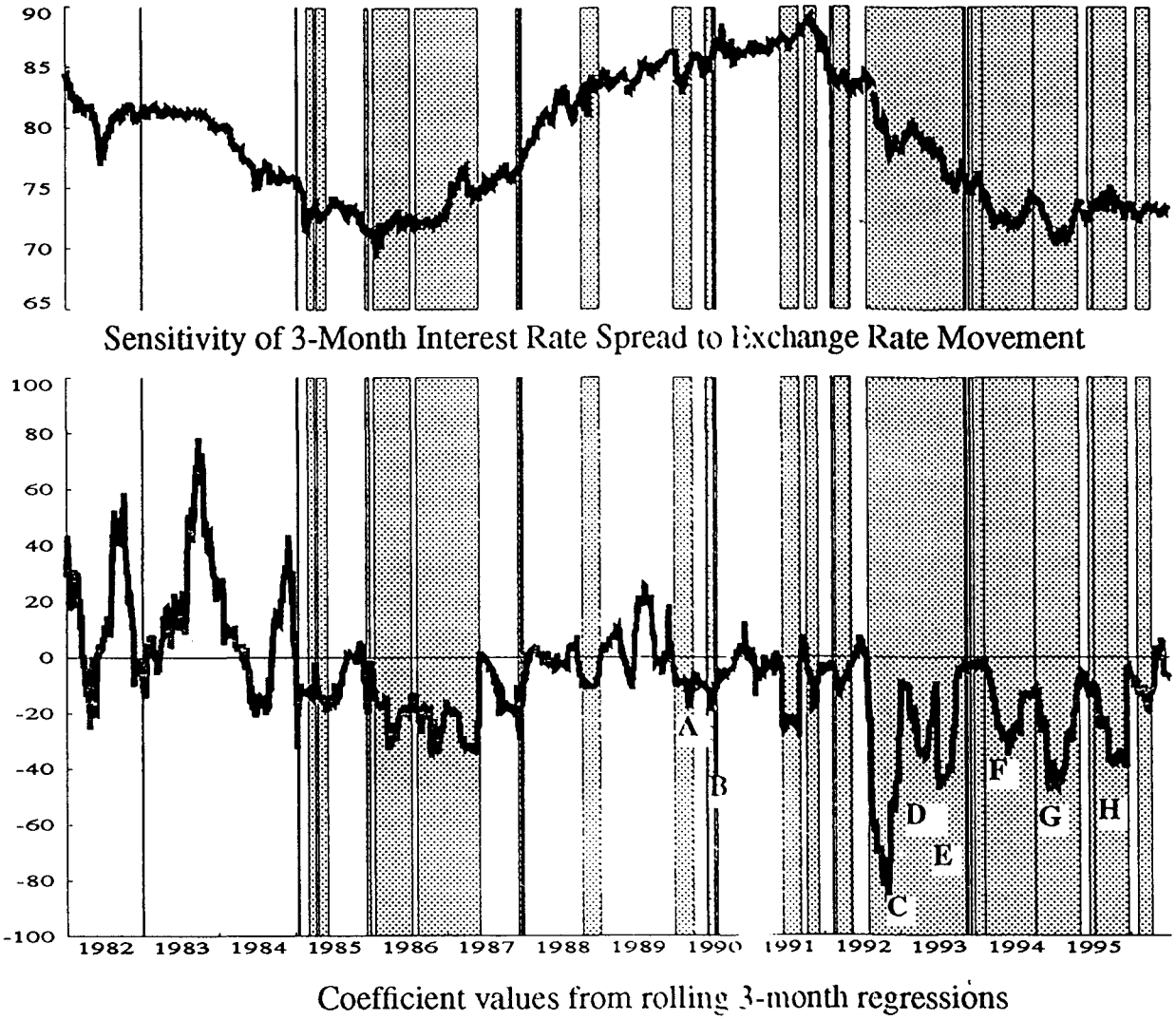
depreciation. Such an approach would help to contain risk premiums and help build credibility for monetary policy, thereby facilitating a more durable easing when circumstances become more propitious.

To obtain evidence on these hypotheses one can posit a simple relationship between daily movements in the Canada-US short-term interest rate spread and changes in the value of the Canadian dollar (in US cents):[23]

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

To estimate this relationship empirically, the daily change in the 3-month bankers' acceptance – US eurodollar interest rate spread was regressed on daily percentage changes in the value of the Canadian dollar.[24] One lag of the daily percentage change in the exchange rate was included in

Chart 9
The Canadian dollar
In US cents



Note: Shaded areas represent statistically significant negative coefficients.

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[23] The interest rate spread is used instead of the level of the Canadian rate in order to focus on changes specific to Canada's risk premium, as opposed to common international changes.

[24] The bankers' acceptance – US eurodollar spread is used here because it is applied 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.

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 sum of the exchange rate coefficients from each regression are plotted in Charts 8 and 9.[25] Shaded areas represent those periods where the rolling regressions 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. However, for the purposes of this analysis, 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 (Chart 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.[26]

However, the pattern of changes in the coefficients in the rolling-3-month regressions (Chart 9) suggests that the episodes of negative relationships observed in the 1990s have occurred mainly in response to changing perceptions regarding the appropriate risk premium for 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, as noted earlier we have witnessed a significant improvement in the policy environment this year. The negative relationship between changing interest rate spreads and exchange rate movements has evaporated and the Bank has been able to take more direct action in financial markets to achieve the desired easing in monetary conditions.

Table 8
Summary of disturbances in market confidence

Event	Date	Description of event
A	Early 1990	Unsuccessful attempt to ease monetary conditions.
B	Mid-1990	Collapse of the Meech Lake constitutional accord.
C	Autumn 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	Spring 1993	Market's concern regarding fiscal policy deepens after federal budget.
E	Summer 1993	Political uncertainty ahead of federal election. ERM turbulence.
F	Spring 1994	Further market disappointment with federal budget.
G	Winter 1994-95	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	Autumn 1995	Quebec referendum.

[25] The coefficient values are plotted at the mid-point of the regression period; e.g. the sum of the exchange rate coefficients for a regression run over the 1st January 1996 - 31st March 1996 period would be plotted at 15th February 1996.

[26] See Freedman (1995).

3.3 1995-96: Improving policy environment

Charts 3 to 7 also summarise conditions in financial markets since the Bank began lowering the operating band for the overnight interest rate in the spring of 1995. Ignoring turbulence preceding the Quebec referendum in October, this period witnessed a steady and significant easing in monetary conditions. Interest rates fell sharply, with spreads against US rates declining across the term structure. The value of the Canadian dollar was stable. Indeed, short-term interest rates in Canada moved below those in the United States in early 1996. [27]

From November 1995, successive *Monetary Policy Reports* had suggested explicitly that monetary conditions might have to ease in order to keep inflation near the mid-point of the inflation control target range. Also, the Bank mentioned the need for easier monetary conditions in press releases accompanying the reductions in the operating band for the overnight interest rate.

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 uptake in inflation would be soon 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 about how the Bank would respond to a minimum. The fact that Bank's projection proved correct contributed to the market's subsequent willingness to accept easier monetary conditions.

4. Recent and prospective changes to operating procedures

The Bank has taken various initiatives in the 1990s to provide a firmer grounding for expectations regarding inflation and to ensure that it's actions in markets were clear. These 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 (1995);
- more openness in speeches and Bank publications, and a 1995 conference on money markets and monetary policy operations.

The Bank has also taken advantage of structural changes in markets in recent years to make its operating framework more transparent (see Table 9 for a chronology). This helps provide a firmer grounding for expectations, and is also useful for accountability after the event.

To adapt to the forthcoming introduction of the Large Value Transfer System (LVTS), the Bank will make changes to its operating procedures which will further increase the transparency of its operation – to such an extent that there will probably be no need for frequent open market intervention to establish the limits of the overnight rate operating band.[28] 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

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[27] Prior to this year market participants were emphatic in their belief that Canadian interest rates could not move below those in the United States for an extended period. See, for example, comments by Gignac and others in Bank of Canada (1996b).

[28] Bank of Canada (1996a).

balances will enforce the band.[29] In addition, the Bank has plans to signal a desired overnight interest rate within the band using SPRA or SRA transactions, as appropriate. If that proves useful, one purpose of this would 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.

Table 9
Evolution of Bank of Canada operating procedures

Date	Description of event
March 1980 - February 1996	Bank rate set at 3-month Treasury bill rate + 25 basis points.
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.
1997	Planned introduction of LVTS: • Introduction of central bank deposit and lending rates. • Announcement of daily target for overnight rate within band.

[29] The profile of the drawdown and redeposit mechanism has already receded since the introduction of the operating band for the overnight interest rate, which is implemented using highly visible buy-back operations (SPRA/SRA). However, this mechanism is still used for the crucial job of controlling the supply of settlement balances.

Appendices

1. Implications of shocks to the risk premium and confidence and of budget retrenchment

Notation

cpi	consumer price index
cpi^T	central bank target for *cpi*
e	price of foreign exchange
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: $i_t - E\Delta p_{t+1}, \left(i_t^* - E\Delta p_{t+1}^*\right)$
RL, (RL^*)	domestic (US) over-10-year bond yield average
$R90$, $(R90^*)$	domestic (US) 3-month commercial paper rate
x	real exchange rate: $e_t - p_t + p_t^*$
$y, \bar{y}$	actual and potential output
$\bar{e}, \bar{x}, etc.$	expected long-run equilibrium values
u	term-risk premium
υ	country risk premium

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 in 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.*[30] Thus, the central bank is assumed to set monetary 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% confidence that 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:

$$cpi_t^T = cpi_0 + tINFLT \tag{A1}$$

[30] 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.

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:

$$cpi_t = \alpha p_t + (1-\alpha)\left(e_t + p_t^*\right) = p_t + (1-\alpha)x_t \tag{A2}$$

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:

$$\Delta cpi_t = \beta\left(cpi_t^T - cpi_{t-1}\right) \tag{A3}$$

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.[31]

Expectations-augmented Phillips curve:

$$\Delta p_t = \pi\left(y_t - \bar{y}_t\right) + INFLT \tag{A4}$$

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 function:

$$y_t = \mu_t + \delta x_t - \sigma r_t \tag{A5}$$

where μ represents the effects of exogenous variables such as foreign demand, fiscal policy and consumer confidence. In equilibrium, A2-A5 jointly determine the 2 short-run rates of inflation, the level of output and *real* monetary conditions. 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:

$$r_t = r_t^* + E\Delta x_{t+1} + \upsilon_t \tag{A6}$$

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 risk 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:

$$E\Delta x_{t+1} = \theta\left(\bar{x}_t - x_t\right) \tag{7}$$

i.e., the exchange rate is expected to move in steps from the current to the equilibrium level.[32] This yields the short-run asset market equilibrium condition:

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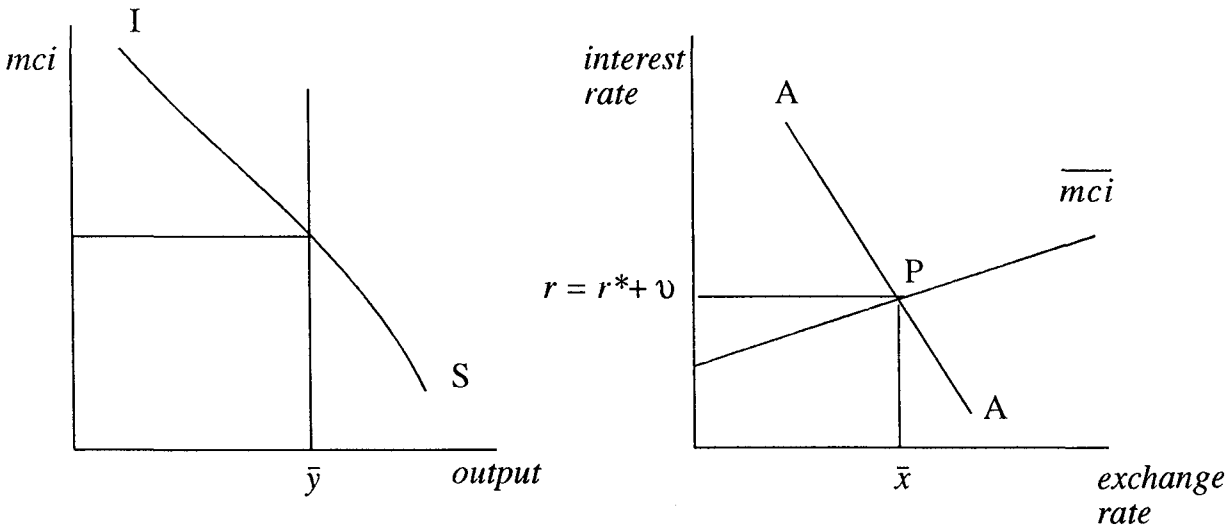
[31] These approximations are based on the formula, $p = 1-(1-\beta)^n$, where p is the proportion of the gap that is closed after n periods. The value for β of 0.3 would close more than 90% of any gap within 2 years.

$$r_t = r_t^* + \theta\left(\bar{x}_t - x_t\right) + \upsilon_t \qquad (8)$$

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 $\overline{mci}$ is shown as a line, the slope of which is δ/σ.[33]

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 -θ (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 line at P is the unique point at which the assets and goods markets are in equilibrium.[34]

Risk premium/credibility shock

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

$$r_t = r_t^* + E\Delta x_t + \upsilon_t + d\upsilon$$

In Figure A2 this is depicted by shifting the long-run horizontal asset market equilibrium line upward 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

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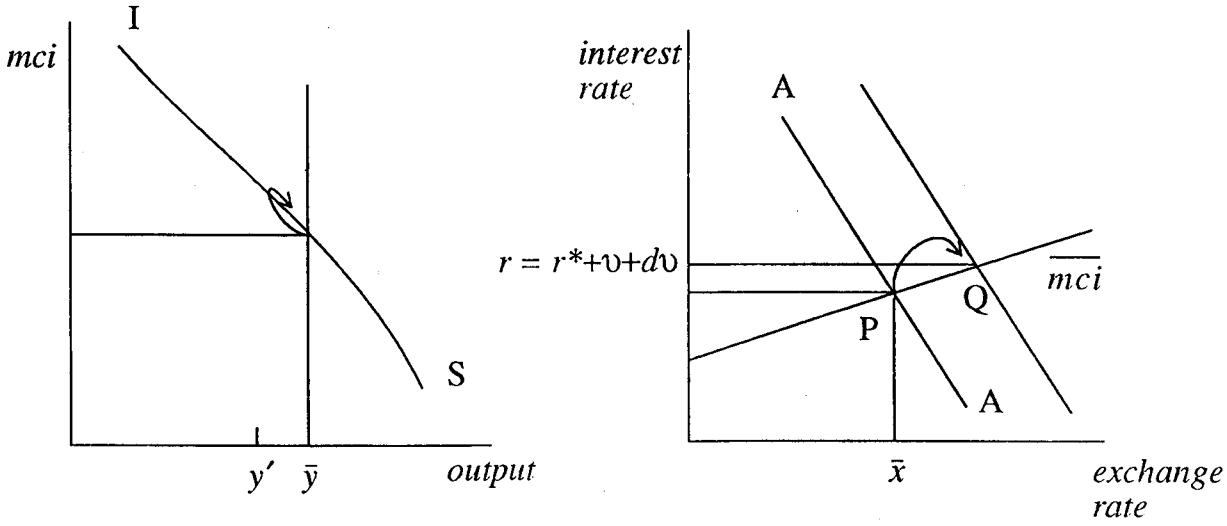
32 With rational expectations, the speed of adjustment represented by θ would be a function of all other parameters in the system.

33 A 1:3 ratio was adopted for use in the Bank's MCI index from a range of estimates for σ and δ .

34 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.

conditions is unaffected. The interest rate rises by $d\upsilon$, so the equilibrium exchange rate has to rise by δ/σ times $d\upsilon$.

Figure A2

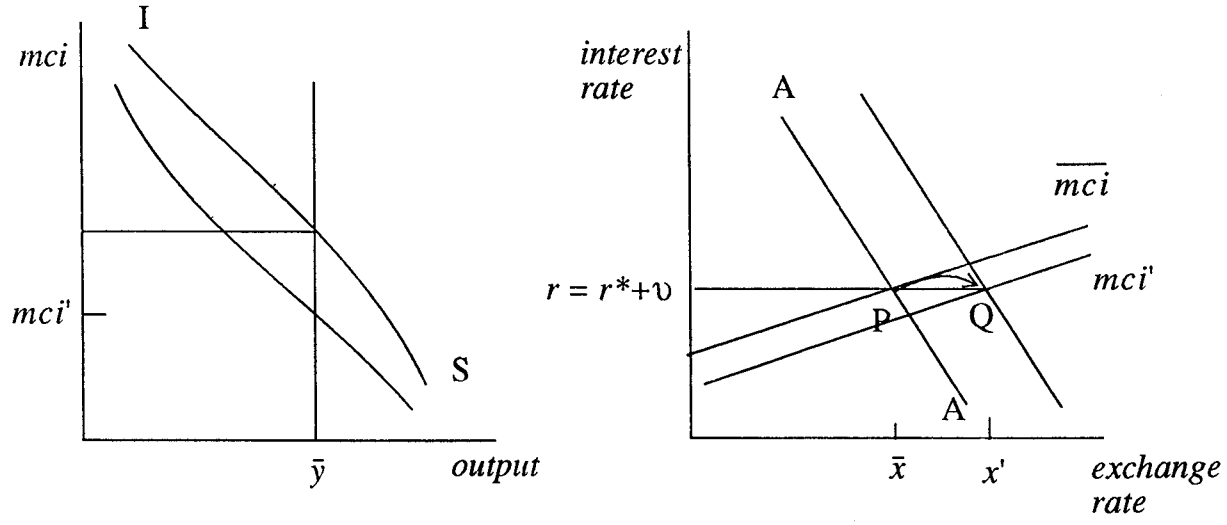


In effect, the higher interest rate compresses domestic demand, while the higher exchange rate creates an exactly offsetting increase in net exports, to maintain full-employment. However, either the increase in consumer prices would temporarily exceed target, because of the exchange rate feed-through, 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 increase in price of foreign exchange, 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

Figure A3



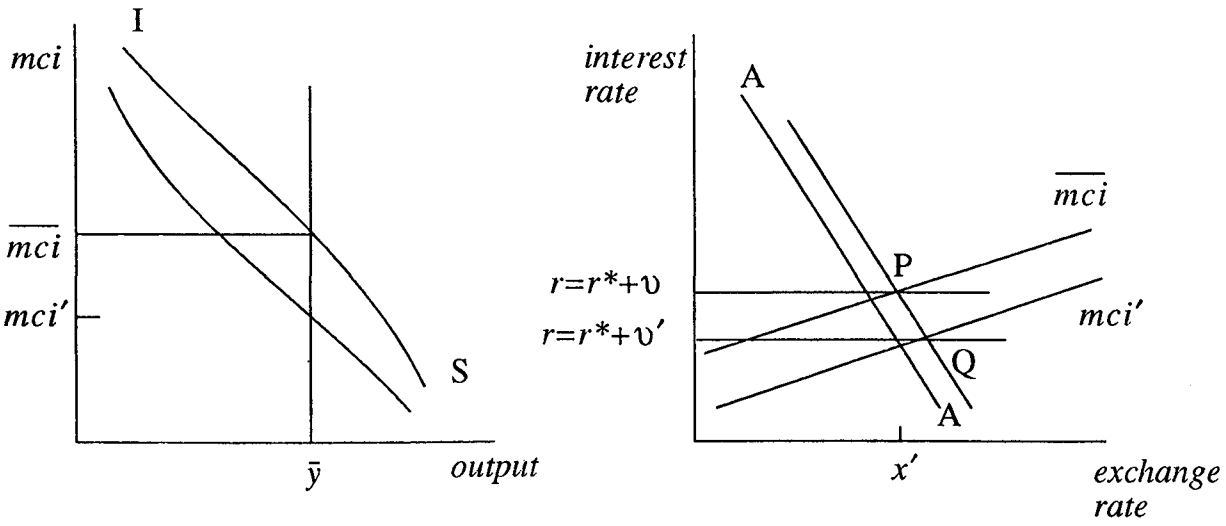
Reluctance of households to spend is represented in the model by m in equation A5, and is graphed as a downward shift in the IS curve in Figure A3. This contractionary disturbance requires

a new equilibrium in which monetary conditions relax to mci'. But this in turn requires a depreciation and here, too, a CPI inflation target would generally not allow the exchange rate to adjust immediately. Even if the MCI declines steadily, as in the figure, the interest rate will generally be above its equilibrium value during the process of adjustment. In any case, the upward pressure on the exchange rate again worsens the policy trade-off.

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

Figure A4



2. Expectations model of the Canadian long-term interest 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 periods, plus a term-risk premium, u_t:[35]

$$RL_t = \frac{1}{T}\left(R90_t + \sum_{i=1}^{t-1} ER90_{t+i} \right) + u_t \qquad \text{(A9)}$$

An identical process would hold abroad.[36] We also assume:

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

- the ***longer run equilibrium*** nominal exchange rate is a random walk. That is, 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;[37]
- bond investors realise 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 implies that monetary policy can independently affect the domestic interest rate through a liquidity mechanism. This effect is assumed to have a maximum duration of J periods.

These assumptions imply that beyond date $t+J$ the domestic short-term interest rate is expected to converge to the foreign interest rate plus a country risk premium, υ_t, which would compensate for the risks of exchange rate changes and default:

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

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

$$RL_t - RL^{*}_t = \frac{1}{T}\left[R90_t - R90^{*}_t + \sum_{i=1}^{J-1}\left(ER90_{t+i} - ER90^{*}_{t+i}\right) + \sum_{i=0}^{T} v_{t+i} \right] \tag{A11}$$

Under a wide range of assumptions about the path by which the short-term interest rate approaches its long-run equilibrium level, this can be simplified to:

$$RL_t - RL^{*}_t = \gamma\left(R90_t - R90^{*}_t\right) + \upsilon_t, \tag{A12}$$

where υ_t is the sum of country risk premium terms at the end of equation A11. As an example of how γ might be interpreted empirically, consider the linear process of adjustment depicted in Figure A5. Linearity provides a good approximation to a variety of economically interesting profiles, e.g. the partial adjustment model.

The initial one-period interest rate differential is $R90_0 - R90^{*}_0$. For simplicity, υ is assumed to be constant over the term horizon i = 0,1,...J,...T. The future expected short-term differential is then equal to v. Arrows indicate the expected adjustment path of the short-term rate. The area between this path and the zero axis corresponds to the summation enclosed in square brackets in equation A11. It is equal to $Tv + \left[\left(R90_0 - R90^{*}_0\right) - v\right]J/2$. In equation A12 this would imply: $\gamma = J/2T$. This would also hold for the more general case in which the term risk premium rises along the yield curve. We may use this approximation to infer the value of γ. $R90$ has a one-quarter and RL an over-10-year term, so that T is equal to at least 40. The horizon J would be roughly equal to 8 quarters, on the usual view of the duration of real effects of monetary policy. This would imply an "armchair estimate" for γ of about 0.10.

- 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

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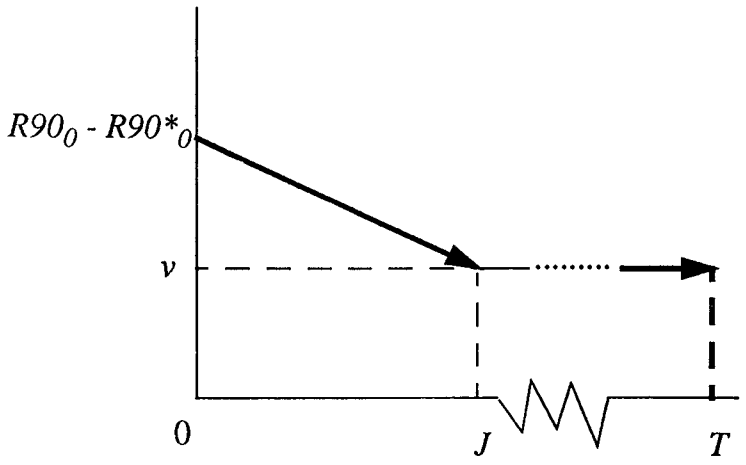
[36] Without loss of generality one may also assume that the domestic and foreign term-risk premiums are equal. A difference in term-risk premiums is not distinguishable from a term-specific foreign risk premium.

[37] 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.

essentially second-order effects on the long-term bond yield, whereas revisions to term risk premiums should have first-order effects. This follows simply from the smallness of J relative to T.

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



3. Decomposition of the Canadian term spread

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

- long-run rate of return on real capital investment, $\bar{r}_t$. In Canada 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.
- term risk premium, υ_t
- long-run expected inflation, $E\overline{\Delta p_t}$
- 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-term and short-term components:

- $$RL_t = (1-\gamma)\left(E\overline{\Delta p_t} + \bar{r}_t\right) + \gamma\left(r_t + \Delta p_t\right) + \upsilon_t \qquad \text{(A13)}$$

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

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

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