

# Inflation and the Macroeconomy: Changes from the 1980s to the 1990s

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David Longworth, Adviser

- *The level of inflation in Canada has been much lower in the last 10 years or so than in the previous two decades. The changes in the behaviour of inflation have, however, been much more profound. In particular, inflation has been much more stable and predictable. Moreover, the dynamics of the inflation process have changed in ways that tend to reinforce the stability of inflation.*
- *The variability of a wide range of other macroeconomic variables has also declined significantly. As well, the growth rates (or levels) of these variables have changed in ways that have produced macroeconomic benefits. For most of these variables, changes can largely be explained by the adoption of an inflation-targeting monetary policy regime and the increased credibility of that regime.*
- *The variability of output growth has declined, not only in Canada but in the United States and elsewhere. There is some dispute about the role that a lower variability of external surprises (such as oil-price changes) and improved private sector behaviour resulting from the employment of new technology, such as in inventory management, have played in leading to this change. It appears, however, that better monetary policy has contributed significantly to this decline.*

**T**his article is a survey of data and economic research. It attempts to answer three questions. First, how have the growth rates (or levels), variability, and behaviour of some of the major macroeconomic variables in Canada changed between the 1980s and 1990s? Second, what does the existing economic literature (theoretical and empirical) have to say about how these changes are linked to a monetary policy geared to producing low and stable inflation? Third, what economic benefits have followed from these changes in Canada?

Canada adopted inflation targets in February 1991. An examination of changes in the behaviour of the major macroeconomic variables since then should enhance our understanding of how the macroeconomy works with such targets and of the benefits of low, stable, predictable inflation. Canada's initial targets were aimed at reducing 12-month consumer price inflation to 3 per cent (plus or minus 1 per cent) by the end of 1992 and to 2 per cent (again, plus or minus 1 per cent) by the end of 1995. Since then, the inflation-control target has been left unchanged at 2 per cent (plus or minus 1 per cent). In May 2001, this target was extended for five years to the end of 2006 (Bank of Canada 2001).

Monetary policy has been successful in achieving its target in most months, with total CPI inflation averaging close to 2 per cent since December 1994.<sup>1</sup>

## Monetary Policy and Changes in Major Macroeconomic Variables

This section documents the changes in the properties of major Canadian macroeconomic variables from the

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1. Because December 1995 was the date when the target for 12-month inflation first became 2 per cent, December 1994 is the relevant base for examining average inflation for the period in which the target became 2 per cent.

period 1981–90 to the period 1991–2000 (henceforth referred to in the text as the “1980s” and the “1990s”). It also connects those changes to a monetary policy that, since the early 1990s, has provided low, stable, and predictable inflation. Tables 1 through 7 summarize these changes by showing values for both periods. These tables also indicate which changes are consistent with what economic theory predicts would happen when monetary policy becomes geared to producing low and stable inflation. (Other factors, such as a lower variability of external surprises—such as oil-price changes—may also have been at play.)

A few words are in order about the choice of the periods used for analysis, since there is always an element of arbitrariness about such a choice. As noted above, February 1991 marked the start of the inflation-targeting regime in Canada; 12-month inflation rates came down sharply over the subsequent year or so. Thus, from a monetary policy perspective, 1991 is a useful point at which to divide the period as a whole. As well, the statistical tests by McConnell and Perez-Quiros (1998) and Debs (2001), which are discussed in more detail below, show that the variability of Canadian output growth also declined significantly beginning in the first half of 1991. To appreciate the significance of the change in 1991 in a longer-term context, it is useful to examine data for at least 10 years before and after the event. It is important to note, however, that the recession of the early 1980s and the subsequent decline in inflation through early 1984 meant that the behaviour of a number of macro variables was significantly different in the 1985–90 period than in the early 1980s. Thus, for some variables it is useful to look at the 1985–90 subperiod. In the 1990s, the behaviour of certain variables adjusted only slowly to the new monetary policy regime. Thus, significant differences in their behaviour are apparent only in the second half of the decade, which makes the 1996–2000 period a useful one to examine. Thus, the subperiods 1985–90 and 1996–2000 are also shown in Tables 1 to 7. As well, many of the economic and financial variables are plotted in continuous graphs so that readers can draw their own conclusions about when behaviour of these variables changed.<sup>2</sup>

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2. Peak-to-peak or trough-to-trough comparisons would lead to slightly different calculations, but the graphs clearly show that, for many variables, the key changes came in the late 1980s and early 1990s. Moreover, adding the year 2001 to the data series for which it is available does not change the comparison with the 1981–90 period, nor with the 1985–90 period.

The variables considered are grouped into subsections that consider, in turn: the level, variability, and uncertainty of inflation as measured by total CPI inflation and two measures of underlying inflation; the dynamics of inflation; the growth of the monetary aggregates; the variability and level of certain financial market variables, particularly interest rates, and the spreads of those interest rates relative to those in the United States; the length and nature of labour and financial contracts, as well as the extent of labour market disruptions; the variability of relative prices and wages; and the variability and level of output growth and the unemployment rate.

### **Inflation: Level, variability, and uncertainty**

With the move to inflation targeting in February 1991, the Bank of Canada expected both lower and more stable inflation. Not only did monetary policy deliver lower and more stable inflation in the 1990s than in the 1980s, but inflation also became less uncertain or, put another way, more predictable.

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Inflation in Canada rose significantly in the 1970s and early 1980s (Chart 1) and then declined by 1984 and again after 1991. CPI inflation averaged 6 per cent in the 1981–90 period and 2 per cent in the 1991–2000 period (Table 1). Chart 2 shows the behaviour of total CPI (and core CPI) inflation plotted against the inflation-control targets.

The general pattern of movements in the rate of inflation is similar for measures of underlying inflation, such as the CPI excluding food, energy, and the effect of changes in indirect taxes (CPIXFET), and the Bank of Canada’s new core measure of inflation, which excludes the eight most volatile components of the CPI as well as the effect of changes in indirect taxes on the remaining components. (See Bank of Canada 2001 for a description.)

Chart 1

**Consumer Price Index**

Year-over-year percentage change

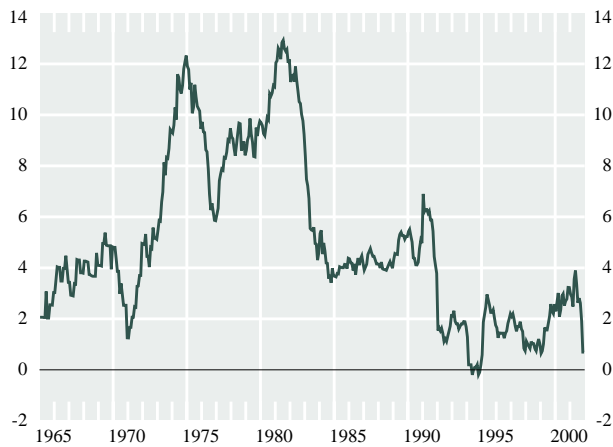


Chart 2

**Inflation and the Target**

Year-over-year percentage change

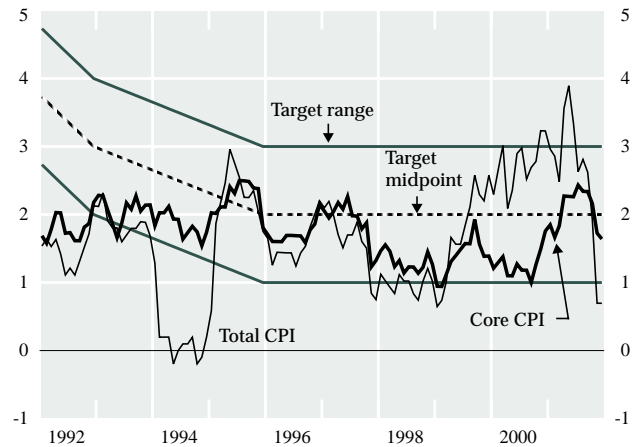


Table 1

**Inflation: Levels, Variability, and Uncertainty from 1981 to 2000**

Variable	1981-90	1991-00	1985-90	1996-00
Average CPI inflation (12-month measure)	5.97	2.00 (A)	4.38	1.73 (A)
Average CPIXFET inflation (12-month measure)	5.64*	1.80 (A)	4.11	1.42 (A)
Average core CPI inflation (12-month measure)	5.30**	1.83 (A)	4.07	1.52 (A)
Standard deviation of CPI inflation (12-month measure, monthly data)	2.96	1.46 (A)	0.48	0.70 (A2)
Standard deviation of CPIXFET inflation (12-month measure, monthly data)	2.77*	0.73 (A)	0.54	0.27 (A)
Standard deviation of core CPI inflation (12-month measure, monthly data)	2.28**	0.51 (A)	0.58	0.33 (A)
Average inflation uncertainty (Crawford-Kasumovich, quarterly data) (data end in 2000Q2)	2.43	1.15 (A)	2.17	1.01 (A)
Dispersion of long-term inflation expectations (max. minus min. forecast, KPMG, average) (data begin in 1982Q4)	6.55	2.91 (A)	5.78	2.49 (A)

\* Statistics Canada's measure for CPI excluding food and energy is used prior to January 1985.

\*\* Statistics Canada's measure for CPI excluding the eight most volatile components is used prior to January 1985.

(A) Accords with expectations from theory of the effect of better monetary policy. (In the 1991-00 column, in terms of change with respect to the 1981-90 column. In the 1996-00 column, in terms of change with respect to both 1991-00 as a whole and 1985-90.)

(A1) Accords with expectations from theory only in terms of the change from 1985-90.

(A2) Accords with expectations from theory only in terms of the change from 1991-00 as a whole.

The variability of CPI inflation, as measured by its standard deviation, followed a pattern similar to that of the level of inflation, declining from the 1981-90 period to the 1991-2000 period, and falling even lower by the 1996-2000 subperiod.<sup>3</sup> This pattern of declining variability was equally true for measures of underlying inflation.

Researchers have examined various measures of inflation uncertainty, based upon either econometric techniques or differences across projections by private sector forecasters.

The average value of one measure of uncertainty about future inflation, estimated in terms of CPIXFET, fell by more than half from the 1980s to the 1990s, and was even lower in the 1996-2000 period (Chart 3).<sup>4</sup>

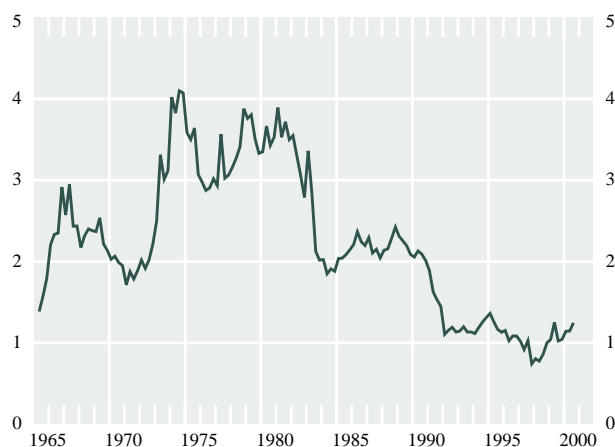
One outcome of reduced inflation uncertainty is a smaller variation of forecasts across forecasters. Amano, Coletti, and Macklem (1999, 36) show that for one-year forecasts, this variation (as measured by the standard deviation) was lower in the 1988-97 period than in the 1985-87 period.

3. Admittedly, inflation variability had been quite low in the late 1980s. But it was even lower in the late 1990s.

4. Crawford and Kasumovich (1996), updated by Jenkins and O'Reilly (2001), calculated this measure of uncertainty about future inflation (one quarter ahead). The authors' results also imply that estimates of uncertainty decline for all horizons. Their measure is the conditional variance of the forecast errors from a model of inflation allowing for generalized autoregressive conditional heteroscedasticity (GARCH) in errors.

**Chart 3**  
**Inflation Uncertainty**

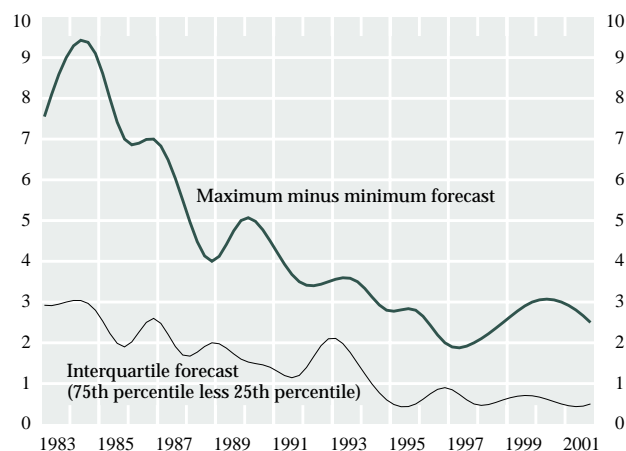
Percentage points



Source: Crawford and Kasumovich (1996), as updated. Inflation uncertainty is measured by the conditional variance of the forecast errors. Inflation is measured by the CPI less food, energy, and the effect of changes in indirect taxes.

**Chart 4**  
**Long-Term Dispersion of Inflation Expectations**

Percentage points



Source: Stuber (2001b). The inflation uncertainty measures are based on the dispersion of forecasts for inflation six to fifteen years ahead by participants in a survey of economists and portfolio managers published by KPMG.

Another measure of inflation uncertainty is the dispersion of *long-term* inflation forecasts made by economists and portfolio managers. Stuber (2001b) and Jenkins and O'Reilly (2001) show that the difference between the maximum and minimum forecasts made for the six- to fifteen-year horizon, as published by KPMG (reproduced in Chart 4), has come down through time. The interquartile range of the same forecasts—the difference between the forecasts at the 75th percentile and the 25th percentile—has also declined through time.

The decline in measures of inflation uncertainty is a strong indication of the increased predictability of inflation under a transparent inflation-targeting regime in which the central bank aims to stay near the middle of its target range.<sup>5, 6</sup>

5. Targeting a constant rate of inflation in an efficient manner also means that, at horizons greater than or equal to the six- to eight-quarter horizon over which the Bank aims to hit its target, there is no information set that can significantly reduce the variance of the inflation forecast. Rowe and Yetman (2000) show that nothing helps explain inflation (relative to its target) eight quarters ahead during the inflation-targeting period in Canada.

6. Crawford (2001b) illustrates further theoretical implications of targeting a specific inflation rate. He concentrates on the decline in uncertainty of successively longer moving averages of inflation. He shows that, under certain conditions, uncertainty regarding the annualized inflation rate is proportional to the reciprocal of the square root of the length of the averaging period. For example, if 12-month inflation can be kept within  $\pm 1$  per cent of target, then 48-month inflation expressed at an annual rate can be kept within  $\pm 0.5$  per cent of target.

## Inflation dynamics

In addition to changes in the level and variance of inflation, there also appear to have been fundamental changes in its dynamics. These changes have explanations grounded in economic theory.

From the 1973–74 to 1983–84 period, inflation in Canada seemed to be very persistent—when it moved up, it tended to stay up, and when it moved down, it tended to stay down. Since that time, the inflation rate has become much less persistent. Ricketts and Rose (1995) show that inflation expectations through time can be well approximated by a process in which there are three regimes, one of which is associated with extremely high inflation persistence,<sup>7</sup> and the other two of which are processes with fairly low persistence and with low and moderate mean inflation rates, respectively. They find that there is a high probability of being in the regime with high persistence through the 1975–83 period. This probability then falls off quite rapidly.<sup>8</sup>

Table 2 shows that the persistence of total CPI inflation (measured by the autocorrelation coefficient between

7. There is a unit root in inflation in this regime.

8. Fillion and Léonard (1997) use these regimes to model expectations in their work, which explains inflation in terms of inflation expectations and the output gap.

Table 2

**Inflation Dynamics: 1981 to 2000**

Variable	1981-90	1991-00	1985-90	1996-00
Correlation coefficient of CPI inflation [t] with CPI inflation [t-12], monthly data	0.80	0.35 (A)	-0.11	-0.04 (A)
Correlation coefficient of CPIXFET inflation [t] with CPIXFET inflation [t-12], monthly data	0.79*	0.56 (A)	-0.37*	-0.13 (A)
Correlation coefficient of core CPI inflation [t] with core CPI inflation [t-12], monthly data	0.84**	0.54 (A)	-0.35**	0.16 (A)
Average slope of the Phillips curve (Kichian 2001) (quarterly data end in 1999Q4)	0.80	0.50 (A) (91Q1-99Q4)	0.67	0.58 (A1) (96Q1-99Q4)

See notes for Table 1.

12-month inflation rates 12 months apart) fell considerably from the 1981-90 period to the 1991-2000 period and became essentially zero in the late 1990s. Since monetary policy aims to get inflation back to the target midpoint over a horizon of 18 to 24 months, one would expect inflation rates not to show any persistence through time over such horizons. Over a 12-month horizon, however, 12-month inflation rates need not be totally free from persistence. The results for the late 1990s, therefore, stem in an important way from the particular shocks over that period. St-Amant and Tessier (2000) demonstrate that the extremely high level of persistence in inflation disappeared during the inflation-targeting period, not only in Canada but in most other major inflation-targeting countries. As shown in Table 2, measures of underlying inflation have also become much less persistent through time.

Movements in short-run inflation ( $\pi$ ) are typically explained using: (i) inflation expectations ( $\pi^e$ ) (with a coefficient of one or close to one), (ii) an output gap ( $y$ , the difference between actual output and production potential), and (iii) influences of relative price movements ( $q$ ).<sup>9</sup> This can be written as

$$\pi = \pi^e + by + cq + \varepsilon,$$

where  $b$  and  $c$  are coefficients and  $\varepsilon$  is an error term. There is some evidence that the behaviour of the first term and the coefficients of the second and third terms have changed through time.

Through the 1990s, various measures of expectations of future inflation became closely aligned with the midpoint of the inflation-control target range, starting with nearer-term expectations and subsequently moving out to longer-term expectations. This is shown in

9. A model describing movements in inflation in this way would typically be called an inflation-expectations-augmented Phillips curve.

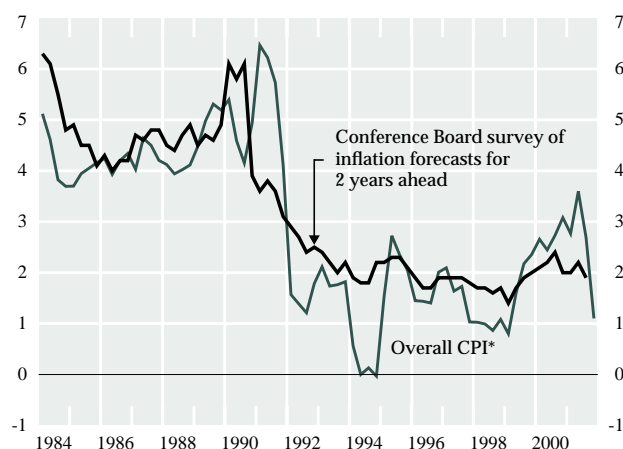
Charts 5 and 6 for the two-year-ahead Conference Board survey of forecasters, the 6-to-10-year-ahead Consensus Economics Inc. survey of forecasters, and the yield differential between 30-year conventional and Real Return bonds.<sup>10</sup> As well, expectations two years and more ahead were influenced very little by current actual total or core CPI inflation (except in the general sense that these too were also typically within the target range).<sup>11</sup> (See Chart 5, and compare Chart 6 with actual inflation in Chart 2.) This behaviour is consistent with inflation and inflation expectations both becoming less persistent (in other words, surprises are quickly reversed) and with monetary policy becoming more credible.

Some researchers have examined changes in the effect of the output gap on inflation. Dupasquier and Ricketts (1998a, b) ask whether the influence of the output gap on inflation is an increasing function of the uncertainty regarding, or the level of, the rate of inflation.<sup>12</sup> Dupasquier and Ricketts find that the effect of the output gap on inflation becomes smaller at low

Chart 5

**Expected and Observed Inflation Rates**

Per cent



\*The low point in 1994 reflects a cut in taxes on tobacco products.

10. Côté et al. (1996) explain why the differential between 30-year conventional and Real Return bonds contains information about the expected 30-year inflation differential rate.

11. This means that inflation expectations are not well captured by the first lag of inflation. Therefore, the inflation process is not well captured by a model in which the change in inflation depends on the output gap (the “accelerationist” Phillips curve).

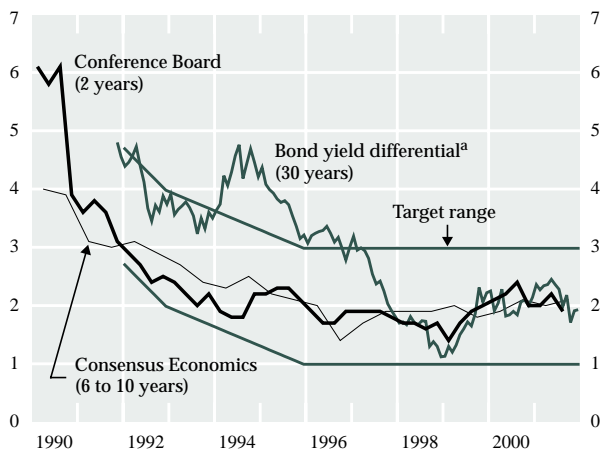
12. The first would be consistent with the misperception (or signal-extraction) model of Lucas (1972, 1973), while the second would be consistent with the model of Ball and Mankiw (1994) in which it is costly to adjust prices.



Chart 6

### Longer-Term Inflation Expectations

Per cent

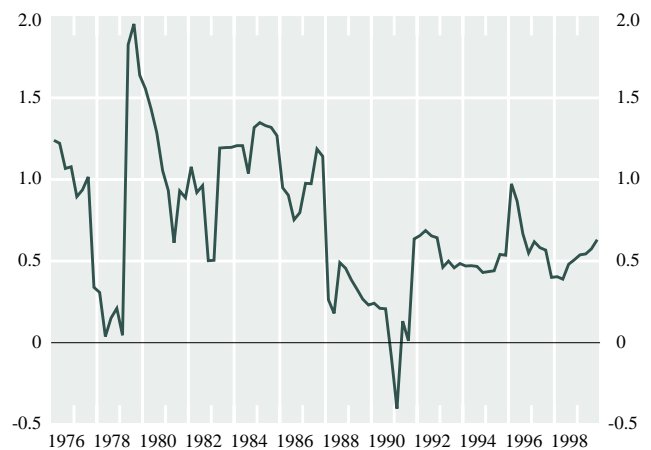


a. Difference between the yield on nominal and Real Return 30-year bonds.

Chart 7

### Slope of the Phillips Curve

Coefficient of the output gap



Source: Kichian (2001)

and stable rates of inflation, but that it is not possible to distinguish empirically whether this reflects the greater stability or the lower level of inflation. Kichian (2001), using another technique (a linear, time-varying parameter framework), finds that the effect of the output gap on inflation has been much lower since late 1987 than it was in the late 1970s and the first part of the 1980s (Chart 7 and Table 2). Beaudry and Doyle (2001) use yet another method (a 15-year rolling regression of the change in inflation on the lag of the output gap) to show that the effect of the output gap on inflation was much higher in the 1982–94 period than it was before or afterwards. Beaudry and Doyle attribute the decline in this effect through the last part of the 1990s to a more focused monetary policy—in particular to a better response of the central bank to real shocks to the economy. In summary, all the authors quoted find that a change in monetary policy diminishes the effect of the output gap on inflation. It is not clear, however, whether this results from monetary policy that produces a lower rate of inflation, a lower variance of inflation, or a greater response to real shocks.

Another element of interest in the inflation process is the degree of pass-through of relative price changes into inflation. In Canada, the most important relative price change is the exchange rate, but the pass-through of energy prices is also of interest. Fillion and Léonard (1997) find that the pass-through of exchange rate changes in Canada fell around 1982–83. They estimate

that the pass-through coefficient (the coefficient of exchange rate changes in the inflation equation) fell from about 0.50 to 0.14 at that time. Kichian (2001), using a model in which a number of parameters describing the inflation process are allowed to vary through time, finds that the pass-through coefficient was high in the late 1970s and early 1980s but averaged just above zero from about 1983 (Chart 8). Taylor (2000) attributes the decline in exchange rate pass-through, which was observed in a large number of countries by the 1990s, to the increased concentration of monetary policy on low and stable inflation.<sup>13</sup> Stuber (2001a) notes that the pass-through of the significant rise in oil prices in 1999–2001 also seems to have been lower than that experienced in earlier episodes of oil-price increases. In summary, the pass-through of relative price changes into inflation has decreased.

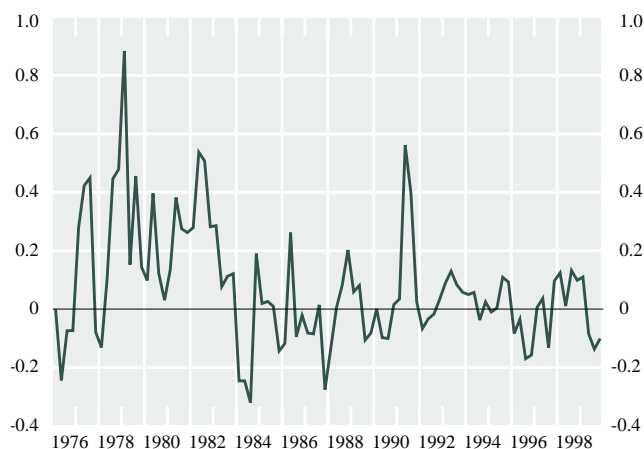
### Monetary aggregates

The Bank of Canada uses monetary aggregates as indicator variables for inflation. One would expect that lower and less variable inflation would be accompanied by lower and less variable growth rates for monetary aggregates. This is exactly what was

13. In many countries, inflation came down in the early 1980s and again in the early 1990s. Bank of Canada (2000) discusses the empirical evidence in Canada regarding pass-through and its implications for monetary policy.

Chart 8

**Pass-Through Coefficient**



Source: Kichian (2001)

observed for the broad monetary aggregate M2++ (Table 3). For the narrow monetary aggregate M1, however, one observes exactly the opposite. This aggregate was subject to sizable downward shifts in demand in the early 1980s and a sizable upward shift in demand in the 1990s (Aubry and Nott 2000). In combination with the positive effect that a decline in interest rates has on the quantity of money demanded, these shifts led to a more rapid growth in M1 in the 1990s than in the 1980s. Moreover, the episodic nature of the demand shift in the 1990s led to slightly more variable M1 growth during parts of that period than had been observed earlier.

**Table 3**  
**Monetary Aggregates: 1981 to 2000**

Variable	1981-90	1991-00	1985-90	1996-00
Average M1 growth (12-month measure)	5.24	9.94	5.72	11.69
Standard deviation of M1 growth (12-month measure, monthly data)	5.25	5.04 (A)	5.08	5.54
Average M2++ growth (12-month measure)	10.94	6.40 (A)	10.97	6.37 (A)
Standard deviation of M2++ growth (12-month measure, monthly data)	1.80	1.18 (A)	1.31	0.91 (A)

See notes for Table 1.

**Interest rates: Levels, variability, and spreads**

Theory would predict that a reduction in the level of inflation would lead to lower nominal interest rates, all else being equal. And less variability in inflation would also tend to lead to a lower variance in interest

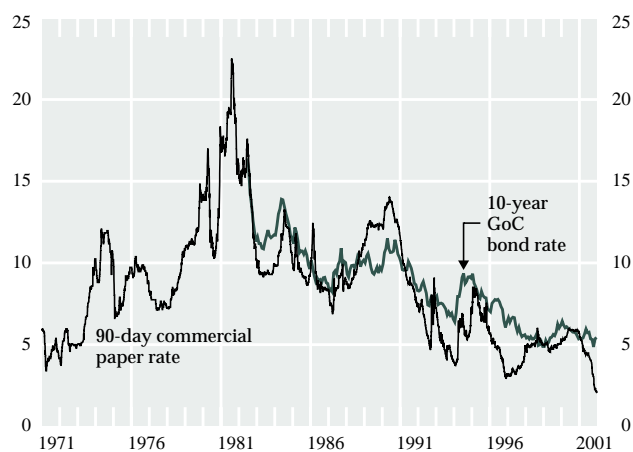
rates.<sup>14</sup> To the extent that inflation in Canada fell relative to that in the United States, as indeed it did in the 1990s, interest rate spreads between Canada and the United States would tend to move down. Finally, since the variability in inflation has decreased in both the United States and Canada, one would expect that spreads would tend to become less variable as well.

Given that longer-run equilibrium real interest rates tend to vary only gradually, it is not surprising that lower levels of inflation in the 1990s translated into lower long-term and short-term interest rates (Chart 9). The average yield on 10-year Government of Canada bonds fell from 10.7 per cent in the June 1982-90 period to 7.1 per cent in the subsequent 10 years. The average 90-day commercial paper rate fell from 11.55 per cent in the 1981-90 period to 5.7 per cent in the next decade.

Lower inflation variability has led to a decline in the variability of interest rates. The standard deviation of the 10-year rate came down only marginally between the two decades (and between the 1985-90 and 1996-2000 periods), but in the last five years it has been only half the size that it was in the 1980s as a whole.<sup>15</sup>

Chart 9

**10-Year Bond Rate and 90-Day Commercial Paper Rate**



14. One potential offsetting factor is that, to make inflation less variable, policy interest rates may need to respond more strongly to movements in expected inflation and expected output gaps. As discussed below, this factor does not seem to have been as important as the decline in the variability of inflation.

15. Watson (1999) shows that the variance of changes in U.S. long-term interest rates has actually risen in recent years. He attributes this to higher auto-correlation in changes in U.S. short-term interest rates.

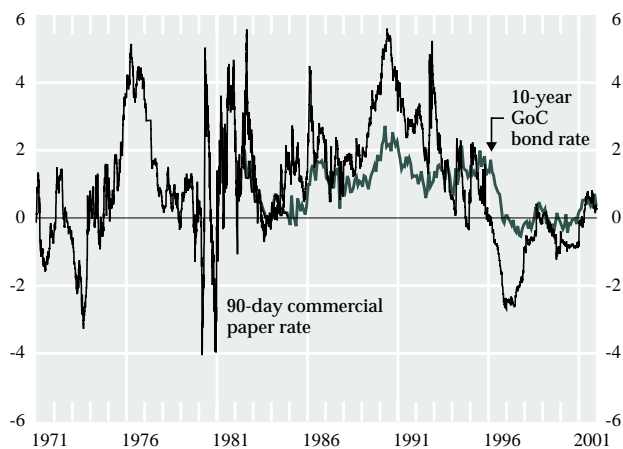
St-Amant and Tessier (2000) show that changes in the level of inflation no longer lead changes in the level of long-term interest rates in Canada and other major inflation-targeting countries (perhaps because inflation itself no longer has much persistence), thus providing one reason for the lower variability of long-term rates. The decrease in the variability of the 90-day commercial paper rate has been more dramatic, the variability falling by half between the two decades, and coming down further in the last five years.

Spreads between Canadian and U.S. interest rates were significantly positive in the 1980s, but averaged close to zero for 10-year bonds and -0.90 for 90-day commercial paper rates in the second half of the last decade (Chart 10 and Table 4). The fall in spreads largely reflects the decline in Canadian inflation relative to U.S. inflation between the two decades, but was also influenced by the fact that the output gap tended to be more positive (i.e., it tended more towards excess demand) in the United States than in Canada on average through the 1990s. An improved fiscal policy in Canada likely also explained part of the decline from the first half to the second half of the past decade, as the risk premium on long-term debt came down with a decline in the actual and anticipated debt-to-GDP ratio.<sup>16</sup>

Chart 10

### 10-Year Bond Rate Spread and 90-Day Commercial Paper Rate Spread (Canada minus United States)

Percentage points



16. See Fillion (1996) for evidence that the Canadian long-term real interest rate is positively related to the debt-to-GDP ratio.

Table 4

### Interest Rates: Levels, Variability, and Spreads, 1981 to 2000

Variable	1981-90	1991-00	1985-90	1996-00
10-year GoC bond yield (average yield) (data begin in June 1982)	10.72 (82M6-90M12)	7.12 (A)	9.97	6.01 (A)
Spread between 10-year GoC and 10-year U.S. Treasury bond yields (average spread) (data begin in June 1982)	1.02 (82M6-90M12)	0.71 (A)	1.21	0.07 (A)
90-day commercial paper rate (Canada) (average rate)	11.55	5.71 (A)	10.33	4.74 (A)
Spread between Canada and U.S. 90-day commercial paper rates (average spread)	2.26	0.51 (A)	2.56	-0.90 (A)
Standard deviation of 10-year GoC bond yield (monthly data begin in June 1982)	1.53 (82M6-90M12)	1.41 (A)	0.83	0.78 (A)
Standard deviation of spread between 10-year GoC and 10-year U.S. Treasury bond yields (monthly data begin in June 1982)	0.70 (82M6-90M12)	0.77	0.66	0.49 (A)
Standard deviation of 90-day commercial paper rate (monthly data, Canada)	3.11	1.64 (A)	1.84	0.84 (A)
Standard deviation of spread between Canada and U.S. 90-day commercial paper rates (monthly data)	1.41	1.74	1.26	0.83 (A)

See notes for Table 1.

Changes in perceptions about fiscal policy were likely the major factor holding up the variability of spreads between Canadian and U.S. short-term and long-term interest rates in the early 1990s. By the second half of the decade, however, the variability of spreads had become quite low.

### Length and nature of labour and financial contracts

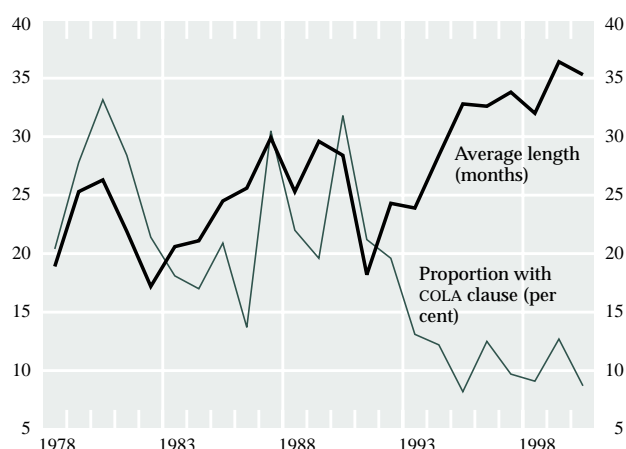
The reduction in inflation uncertainty would be expected to increase the typical length of labour and financial contracts, since the two parties to a contract would tend to have more similar views of the nature of the risks that they were taking on. Other elements of contracts would also be expected to change and, indeed, have changed significantly over the past two decades.

With less uncertainty about future inflation, labour contracts have become longer, and the use of cost-of-living-adjustment (COLA) clauses has declined (Perrier and Amano 2000, Jenkins and O'Reilly 2001). As shown in Chart 11, wage settlements since 1995 have, on average, been longer and less likely to include COLA clauses than at any time since the database began in 1978. And, partly because of the reduced uncertainty about inflation (but perhaps also



Chart 11

**Wage Settlements: Average Length and Proportion with COLA Clause**



**Table 5**  
**Length and Nature of Labour and Financial Contracts: 1981 to 2000**

Variable	1981-90	1991-00	1985-90	1996-00
Average life of wage settlements (months)	24.41	29.77 (A)	27.22	34.02 (A)
Proportion of wage settlements with COLA clauses (%)	22.34	12.70 (A)	23.08	10.54 (A)
Work stoppages (% of working time lost to strikes)	0.19	0.08 (A)	0.17	0.09 (A)
Ratio of long-term business credit to total business credit (average)	50.94	61.46 (A)	52.70	63.60 (A)
Ratio of bonds and debentures to total business credit (average)	15.23	20.09 (A)	15.11	22.45 (A)
Ratio of equity and warrants to total business credit (average)	24.18	29.78 (A)	24.92	31.56 (A)

See notes for Table 1.

reflecting declining unionization of workers), the percentage of working time lost to strikes fell from 0.19 per cent in the 1981-90 period to 0.08 per cent in the 1991-2000 period (Table 5).

Contracts in financial markets have also tended to become longer than they were in the 1980s. Montplaisir (1996-97) and Howitt (1997) note that the proportion of mortgages with five-year terms was higher in the mid-1990s than in the mid-1980s.<sup>17</sup> Mortgage terms

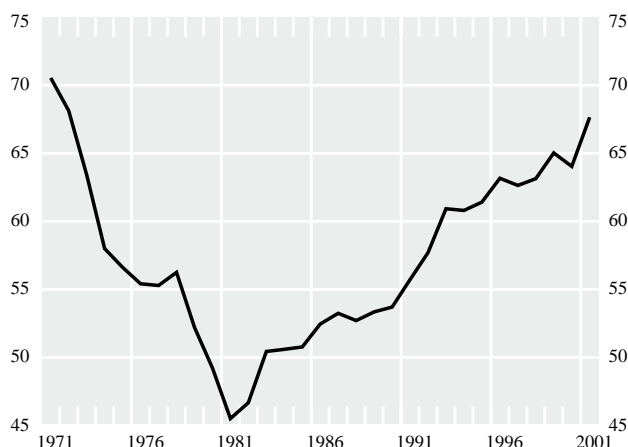
17. Because the variability of short-term interest rates has fallen since the mid-1990s, however, more and more people may have been induced into floating and one-year terms, given that the term structure of interest rates is typically upward-sloping. I am indebted to Paul Boothe for this point. The slope of the term structure may typically have become somewhat flatter, however, in response to this decline in variability, thus reducing the incentive to move to a shorter term.

greater than five years also became available again for the first time since the late 1960s. As well, the ratio of long-term business credit to total business credit has risen significantly since 1981 (Chart 12 and Jenkins and O'Reilly 2001), as both the bonds and debentures component, on the one hand, and the equity and warrants component, on the other, have risen as a proportion of total business credit (Table 5).

Chart 12

**Ratio of Long-Term Business Credit to Total Business Credit**

Percentage



**Variability of relative prices and relative wages**

There is a wide body of theoretical and empirical literature on the effects of the level or variability of inflation on the variability of relative prices (and wages). In some cases, the theory emphasizes the price of the same good across outlets, for which few data are available. There is no strong presumption from theory that relative price dispersion across very different goods and services would fall significantly with a decline in the level or variability of inflation, and empirical work faces the impossible task of controlling for the variability of technological progress across industries.<sup>18</sup> Yet one would expect that a reduction in inflation uncertainty would tend to reduce

18. Baldwin, Durand, and Hosein (2001) show that, in the Canadian business sector, relative productivity growth through time is highly correlated with relative price changes through time (but not relative wage changes through time).

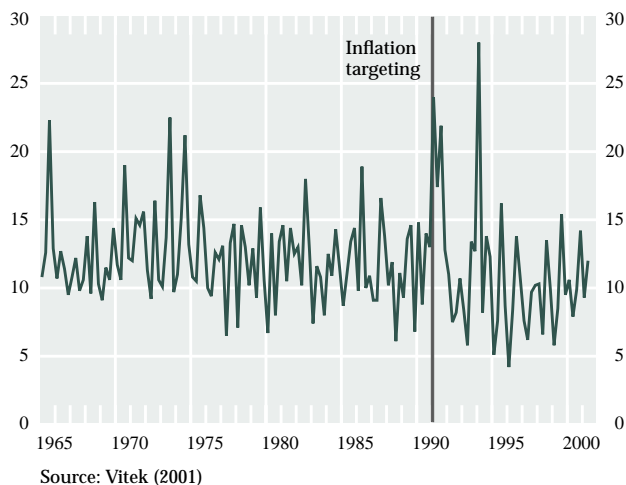
confusion between changes in the price level and changes in relative prices driven by fundamental factors. Thus, on average over longer periods of time and controlling for technology, a reduction in inflation uncertainty would tend to lead to a lower variability of relative prices.<sup>19</sup>

Staff at the Bank of Canada have begun to examine the empirical situation for Canada, using various databases for price components. Vitek (2001) uses a database with 36 CPI components going back to 1961. He has models that include all the components and models that exclude the most volatile components (based on those that are excluded from the Bank of Canada's new core measure of inflation) on the grounds that the volatility of many of these components may have little to do with monetary policy. His measures of the variability across price changes, as measured by the weighted standard deviation of quarterly percentage price changes (with the weights coming from the consumer basket), are found in Charts 13 and 14. These charts and Table 6 show that variability has decreased somewhat through time. There has, however, been no significant change in relative price variability of the

Chart 13

### CPI Relative Price Dispersion

36 components, quarterly 1965 to 2001



19. Put another way, relative prices are real variables (as opposed to nominal variables). Thus, they will be heavily influenced by real factors, and their variability will be heavily influenced by the variability of real factors across industries, producers, retailers, etc. Inflation uncertainty can, however, get in the way by leading to confusion between nominal and real factors.

Chart 14

### CPIX Relative Price Dispersion

36 (minus 8 most volatile) components, quarterly 1965 to 2001

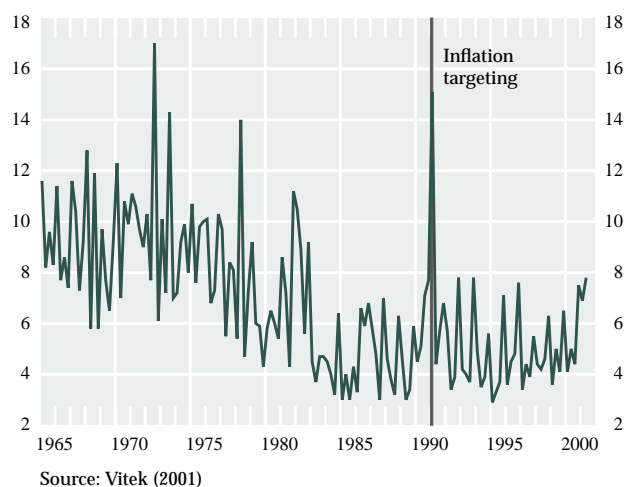


Table 6

### Variability of Relative Prices and Relative Wages: 1981 to 2000

Variable	1981-90	1991-00	1985-90	1996-00
Relative price dispersion (all prices) (Vitek 2001, quarterly)	11.83	11.17 (A)	11.66	9.65 (A)
Relative price dispersion (non-volatile prices) (Vitek 2001, quarterly)	5.45	5.12 (A)	4.86	4.87 (A2)
Standard deviation of private sector wage settlements (average of annual standard deviation)	2.22	1.48 (A)	1.90	1.45 (A)

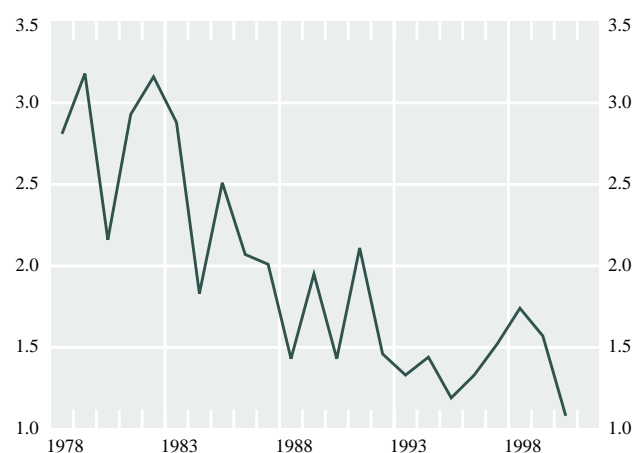
See notes for Table 1.

non-volatile components between the late 1980s and late 1990s. Vitek shows that, over the period from the fourth quarter of 1962 to the first quarter of 2001, the measure of relative price variability that includes all components is either significantly positively related to past 12-month inflation or significantly negatively related to a variable representing the inflation-targeting period. (When both explanatory variables are included, neither is significant.) In contrast, the relative price variability across non-volatile components is not significantly related to either past inflation, inflation uncertainty, or the inflation-targeting period. Overall, therefore, the evidence is fairly weak regarding a direct influence of inflation rates on relative price variability at the quarterly frequency. Howitt (1997)

comes to a similar conclusion with respect to relative price variability based on evidence regarding producer prices from Amano and Macklem (1997).

Crawford (2001a) notes that a decrease in inflation uncertainty would be expected to decrease variability across wage changes. He documents the fact that the variance of private sector wage settlements in Canada falls by more than half as one moves from the 1978–82 period (taken as a whole) to the 1983–91 period, and then by more than half again as one moves to the 1992–97 period. Chart 15 shows that the variability across private sector wage settlements for each year (measured by the standard deviation) has declined fairly steadily over the 1978–2000 period (also see Table 6). Although some part of the reduced variability in the early 1990s may be caused by downward nominal wage rigidity, Crawford shows that this effect is likely to be small. Moreover, the data show that the variability of changes above the median has also fallen significantly.

**Chart 15**  
**Annual Standard Deviation of Wage Settlements: Private Sector**



### Output growth, the unemployment rate, and the output gap

The connections between low, stable inflation and the behaviour of the rates and variability of output growth and the unemployment rate are not expected to be as strong as most of the relationships previously discussed, largely because the favourable effect coming from improved monetary policy could easily be dominated by other factors over any medium-run (or

even longer-run) period.<sup>20</sup> Nonetheless, an economy with low and stable inflation would be expected to have fewer distortions and imbalances than an economy with higher and less-stable inflation rates, and thus, all else equal, would experience a higher level or rate of growth of output. And, all else equal, to the extent that monetary policy becomes more efficient,<sup>21</sup> the variances of output growth, the output gap, and the unemployment rate will tend to fall.

The growth of GDP was higher in the 1991–2000 period than in the period from 1981–90, but this comparison, more than most in Table 7, depends on the specific years chosen. In particular, economic growth was especially weak in 1990 and especially strong from 1996–2000, with cyclical reasons a significant cause in both cases. There were, however, some signs of a pickup in underlying productivity growth in the 1996–2000 period.

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*The variability of quarterly Canadian real GDP growth declined between the 1980s and 1990s.*

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The variability of quarterly Canadian real GDP growth declined between the 1980s and 1990s (Chart 16 and Table 7). Debs (2001) tests for a structural break in the variability of Canadian output growth and finds that there was one in the first quarter of 1991. Tests show that, at about the same time, there were structural breaks (and declines) in the variability of the rate of growth of investment in residential structures and in the variability of the growth rate of personal consumption of goods.<sup>22</sup> Debs uses the same methodology as McConnell and Perez-Quiros (1998, 2000), who find a structural break in the variability of U.S. GDP growth in the first quarter of 1984 and a structural

20. As in the previous subsection, this section deals with real variables, which will respond to real factors as well as to monetary policy.

21. When monetary policy is efficient (Taylor 1979), there is a trade-off between the variance of inflation around its target and the variance of the output gap. But when monetary policy becomes more efficient, both variances can fall.

22. Debs uses Laspeyres data for real output, while the data in the tables and charts in this paper are chain-Fisher data.

Chart 16

**Quarterly GDP Growth at Annual Rates**

Per cent

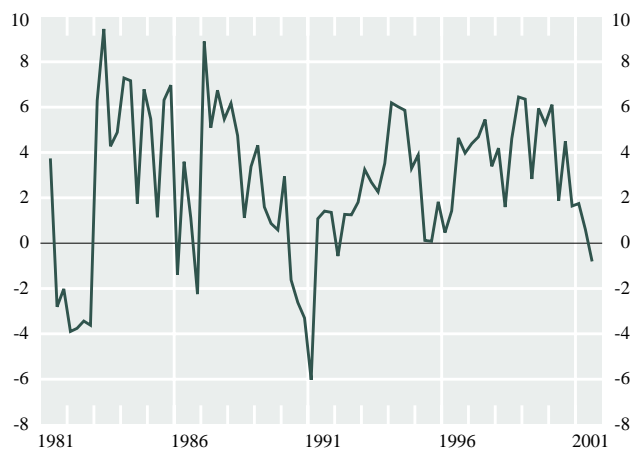


Table 7

**Output Growth, the Unemployment Rate, and the Output Gap: 1981 to 2000**

Variable	1981-90	1991-00	1985-90	1996-00
Average quarterly growth rate (annualized) of GDP (data begin in 1981Q2)	2.50 (81Q2-90Q4)	3.01 (A)	2.72	3.99 (A)
Standard deviation of GDP quarterly growth (data begin in 1981Q2)	4.00 (81Q2-90Q4)	2.48 (A)	3.41	1.81 (A)
Average monthly unemployment rate	9.44	9.41 (A)	8.75	8.28 (A)
Standard deviation of unemployment rate (monthly data)	1.69	1.50 (A)	1.20	1.13 (A)
Standard deviation of the output gap (quarterly data from November 2001 <i>Monetary Policy Report</i> )	2.26	1.79 (A)	1.14	1.63 (A2)

See notes for Table 1.

break in the variability of Canadian GDP growth in the second quarter of 1991 (based on earlier Canadian data, with a shorter sample period). Liu and Painchaud (2001), however, using a less restrictive method, find that the break in the variability of Canadian GDP growth occurs in 1987Q1.

The Canadian data also show that the variability of the output gap and the unemployment rate were also lower in the 1990s than in the 1980s.<sup>23</sup>

23. Dalsgaard, Elmeskov, and Park (2002) have a graph that also indicates a lower variance of the Canadian output gap since the early 1990s. Their work shows that, through the last three decades, the standard deviation of the private consumption “gap” (actual consumption relative to trend consumption) has fallen relative to the standard deviation of the output gap. This is consistent with the decline in the variability of the rate of growth of personal consumption of goods found by Debs.

There have been many more studies in the United States than in Canada exploring the reasons for declines in the variability of output through time. One strand of this literature, associated with McConnell and Perez-Quiros (1998, 2000) and Kahn, McConnell, and Perez-Quiros (2001a and b), has emphasized improved inventory control, particularly in durable goods industries.<sup>24</sup> Other authors, such as Blanchard and Simon (2001) and Mankiw (2001), have surveyed a wide range of factors, including improved financial markets for households and a lower variance of relative price shocks. These authors have concluded that there have, indeed, been a wide variety of factors at play in the United States, including monetary policy that was better in the 1990s than in the 1980s. Finally, other authors, such as Taylor (1998), have stressed that better monetary policy, which has responded more strongly to surprises in inflation and the output gap than in the 1970s and early 1980s, has moved the economy towards its efficient frontier (see Taylor 1979). In other words, better monetary policy has been able to reduce both the variance of inflation around its target (actual or perceived) and the variance of the output gap. Cecchetti, Flores-Lagunes, and Krause (2001) undertake a multi-country study, which shows that Canada was one of many countries that moved towards its efficient frontier going from the 1980s to the 1990s. Overall, there were likely a number of factors reducing the variance of output in the United States and Canada, but better monetary policy was likely a significant one.

A number of authors have discussed the evolution of the Canadian output gap. The Canadian economy was in significant excess supply in the early 1990s. The cause of the size and persistence of this output gap is much in dispute. Fortin (1996, 1999, 2001) expresses the view that monetary policy was mistakenly too tight for too long, and that the Bank’s inflation target was too low. Freedman and Macklem (1998) and Jenkins and O’Reilly (2001) emphasize a combination of factors, including the unexpected slowdown of the U.S. economy in 1990-91, the restructuring of the Canadian economy in the early 1990s, and the difficulties in achieving the desired monetary conditions (in part because of lax fiscal policy).

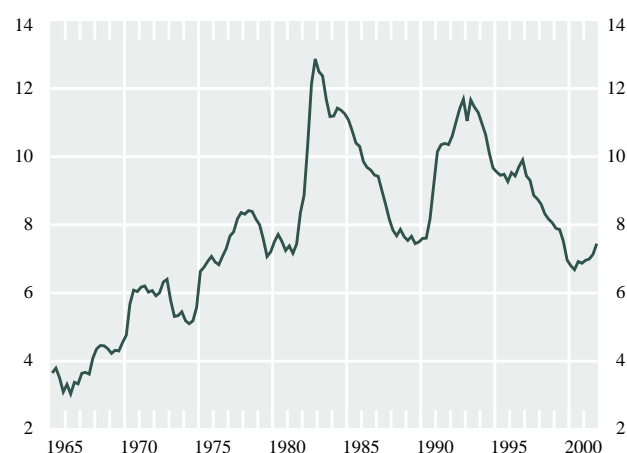
The average unemployment rate was essentially unchanged between the two decades under consideration.

24. Debs (2001) is not able to find any structural break in Canadian inventory behaviour, based on data from 1981 onwards. Liu and Painchaud (2001), however, find a significant decline in the contribution of business inventory investment to the volatility of real GDP growth in 1983Q3.

However, unemployment in the second half of the 1990s was more than a percentage point lower than in the 1980s, and unemployment at the end of the decade was the lowest since 1976 (Chart 17). While a number of factors, including the reform of employment insurance (Sargent 1995), were behind this reduction, the macroeconomic stability stemming from low and stable inflation would at least have been an important supporting element.

**Chart 17**  
**Unemployment Rate**

Per cent



## Macroeconomic Benefits of Low, Stable, and Predictable Inflation

O'Reilly (1998), Coletti and O'Reilly (1998), Perrier and Amano (2000), and Jenkins and O'Reilly (2001) discuss in various ways the macroeconomic benefits of low, stable, and predictable inflation. This section lists the benefits that are implicit in the data examined in the previous section.

The data are consistent with low and stable inflation in Canada feeding back to affect the nature of the dynamics of inflation itself in such a way that, in response to a shock, inflation will now remain more stable than it would have been in the past. The changes in these dynamics include the following:

- the inflation target appears to have a significant weight in the formation of inflation expectations (at least as long as policy remains credible)

- shocks to excess demand and excess supply have less of a direct effect on inflation<sup>25</sup>
- the pass-through coefficients on exchange rate (and perhaps energy) shocks appear to be lower.

As inflation fell in line with the inflation targets and the targets were achieved through time, monetary policy became more credible according to the indicators reported by Johnson (1997, 1998), Perrier (1998), and Perrier and Amano (2000). This credibility fed back to stabilize expectations and reduce uncertainty about inflation.

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*The reduced uncertainty about inflation seems to have had a number of significant benefits.*

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The reduced uncertainty about inflation seems to have had a number of significant benefits. First, it seems to have led to a decline in relative wage variability because of less disagreement about the inflation outlook, therefore leading to a better allocation of labour. Second, it certainly has made planning easier and has led to longer labour and financial contracts, which means lower transactions and bargaining costs for firms and households. Third, it has likely been an important factor in a reduction of days lost to labour disruptions. Fourth, it means that there is less need to protect oneself against unexpected inflation,<sup>26</sup> which is a real saving of resources. Fifth, it has been a factor leading to the development of more complete financial markets (with longer-term instruments), which allows a greater diversification of risks at lower cost. Finally, it has been associated with less variable interest rates, which, in turn, have led to lower capital losses and gains on bonds, and have tended to lead to lower risk premiums on longer-term instruments.

The connection between low, stable, and predictable inflation, on the one hand, and lower output variability, on the other hand, is an area where there has been

25. Although a smaller direct effect may make it more difficult to get inflation back to the target when it has moved away, this may be outweighed by the credibility effect mentioned in the first bullet.

26. The decline in the percentage of labour contracts with COLA clauses is evidence that people find less need to protect themselves against inflation.



considerably more debate. Nevertheless, many authors believe that better monetary policy has been a major factor in leading to this outcome.

## Conclusion

This survey paper posed three questions.

In response to the question of what has changed in the behaviour of major macroeconomic variables in Canada in the last 10 years, the simple answer is, quite a lot. The lower level, greater stability, and increased predictability of inflation have been associated with fundamental changes in typical labour and financial market contracts, lower and less variable interest rates, and generally less volatility in the Canadian economy.

As to the question of the causal relationship between the move to a monetary policy regime that aims to produce low and stable inflation and the rest of the changes in the macroeconomy, this article has argued that the changes are typically what one would expect when the monetary authority sets a target, generally meets that target, and experiences a rise in the credibility that it will continue to meet that target in the future.

What benefits derive from this? Simply put, the benefits are a dynamic behaviour of inflation that tends to reinforce a greater stability of inflation over time and a better allocation of resources. This last benefit arises from a better allocation of labour, lower costs of planning and entering into contracts, and better-functioning and more complete financial markets.

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