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# Core inflation at the Bank of Canada A critique

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# Core inflation at the Bank of Canada: A critique

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ABSTRACT. Core inflation is a useful concept for the theory and practice of monetary policy. The Bank of Canada maintains, in addition, that core inflation should be, and has in fact been, a useful predictor of headline inflation. Under the bank's policy of inflation targeting, however, this is incorrect: over horizons of a year or more the best forecast should be the 2 percent target; and core inflation should have no predictive content. Post-1995 evidence confirms this argument.

## 1. Introduction and summary

The Bank of Canada has been a leader in the development of the concept of core inflation and its measurement.[1] Core inflation strips out one-off price level changes from the headline (or overall) rate of inflation. The variable has a key role in the transmission of monetary policy, and for the accountability of the central bank. However, the bank's argument that core inflation should also be an indicator of future headline inflation does not withstand scrutiny.

Under the official inflation targeting regime, core inflation is not a good predictor of headline inflation, in principle or in practice. The Bank of Canada acts to keep inflation on the 2 percent target within a 6-to-8 quarter horizon. Following any deviation, headline inflation should systematically revert to 2 percent, within one to 2 years, regardless of the current rate of core inflation. And in fact, after 1995, as a predictor of headline inflation, the constant 2 percent easily beats core inflation, which has no predictive content. Results covering earlier years, which suggest that core was a useful predictor, merely pick up the common effects of regime shift on both variables.

Moreover, predictive content is not a useful gauge of the usefulness of core inflation to monetary policy. With a constant inflation target, the variance of headline inflation is dominated by transitory factors. Predictive power derives from ability to predict the *non-core* component. This is not a property that a useful measure of core inflation need have.

## 2. Theoretical approach

### 2.1 Case for core inflation

The distinction between sticky prices, which adjust over time, and flexible prices, which adjust instantaneously, underlies much macroeconomic theorizing. Measures of core, versus non-core, inflation embody the distinction in an operational way. The Bank of Canada has distilled several empirical core indexes from the consumer price index (CPI), which a priori seem adequate for various purposes, and which behave in broadly similar

[1] Its recent contributions include: Hogan et al (2001), Macklem (2001), and Armour (2006).

fashion. CPIX, which excludes the 8 most volatile components of the CPI, as well as indirect taxes, is the variable the bank prefers.

Most consumer goods and services have sticky prices, and the Phillips curve describes a process of adjustment for these prices. Core inflation can be entered directly as the dependent variable in the augmented Phillips curve, as a function of expected inflation and a demand pressure variable. This gives core inflation an intrinsic role in the policy transmission mechanism. Monetary policy, through its effect on spending, has a handle on core inflation, through which it controls headline inflation.

An illustration of the usefulness of core inflation followed the cut in tobacco taxes in 1994, which reduced the rate of increase of the CPI to zero that year. This was obviously an event beyond the responsibility of monetary policy: CPIX continued to increase, showing that policy was not that far off track. That core inflation could not, beforehand, predict zero headline inflation was irrelevant to its usefulness.

This one-off event is symptomatic of the issue with any non-core change in headline inflation. Consider a more general case, in which non-core inflation shows systematic, serially correlated, year-over-year deviations from the target rate. A simple autoregressive equation would yield good forecasts of CPI inflation 1- or 2-years ahead, while CPIX inflation would not. Such a result, however, would take nothing from the usefulness of CPIX, as it would correctly indicate, through the cyclical fluctuations, that inflation basically stays on target.

If one wants to use predictive ability to judge between different measures of core inflation, a better criterion might be capacity to predict *core inflation itself.*[2] Under an inflation-targeting regime, however, all such approaches suffer from the objection that, for horizons of a year or more, a constant forecast, based on the target, should beat a conditional forecast, based on lagged inflation. The methodology that the Bank of Canada has applied seems to be a holdover from days when inflation was not stationary.

Over longer periods, e.g. the typical 5-year spans between inflation target announcements, it may be convenient for core and headline inflation to have the same trend: then the central bank targets 2 percent core to hit 2 percent headline. But this is not critical property. Over the cycle, or even over the long run, the relative prices of non-core items may change. The central bank might often find itself in a situation, like that of the last 5 years, where it has to target a different rate for core inflation to achieve the target for overall inflation. In general, the central bank would, over time, vary the core inflation target needed to keep headline inflation on track.

In research and communications, the Bank of Canada has put too much emphasis on the predictive content of core inflation. Successful inflation targeting implies that, over a

[2] Empirically, since 1995, the 2 percent target beats current core inflation on this criterion (a result not shown in this paper).

long enough frequency, the variance of inflation will be reduced to noise, which core inflation (or any other variable) will have difficulty predicting. [3]

### 2.2 Accountability

The central bank might approach the definition of core inflation by asking what inflation rate it most directly controls. The answer, as above, is the variable in the Phillips curve. In the hierarchy of operational targets, core sits just below headline.

Movements in a set of volatile prices may, or may not, have a monetary origin, but they cannot be systematically linked to monetary policy actions in the short or medium run. For the real-time accountability of monetary policy, it is better to set them aside, and to focus on core inflation.

In assessing past performance of monetary policy, over longer periods of time, the behaviour of headline inflation is the crucial factor. Core inflation is, however, still useful, as an indicator of how well policy contained inflationary or disinflationary pressures.

Looking ahead, the bank could publish a track for core inflation consistent with its aim to keep headline inflation at 2 percent over a 6-8 quarter horizon. Depending on the expected behaviour of non-core prices, this track may differ from the forecast path of the headline rate.[4]

## 3. Empirical evidence

### 3.1 Inflation regimes

Until 1991 monetary policy regimes were not defined by numerical objectives, and it is not easy to pinpoint regime changes in these terms from official statements. But changes there were.

Following the disinflation of the early 1980s, in the second half of the decade the CPI increased at a steady rate of about 4 ½ percent. However, this was never, even implicitly, the objective of the bank. In his final *Annual Report* (published in 1987) Gerald Bouey deplored that inflation seemed to have become so entrenched. And in early 1988, the new Governor, John Crow, argued that the proper goal was *price stability*. Although he did not define a numerical goal, Crow made it clear that the objective was a rate of increase in the general price level not much above zero. However, the actual rate of inflation rose above 5 percent in 1990, and the introduction of the GST would push the rate even higher in 1991. The awkward dissonance between the announced objective of price stability and the actual, increasing, inflation rate indicates that the monetary regime had still to solidify.

The announcement of explicit *inflation-reduction* (<u>not</u> inflation) targets in 1991 brought some clarity to the long-run objective of price stability, which was defined as a rate of

[3] Nick Rowe originated this argument, and applies it in other contexts (e.g. Rowe, 2002).

[4] Following Lars Svensson's argument (1997) that, under inflation targeting, the central bank's inflation forecast is an intermediate target, this proposal would add a further, complementary, intermediate target.

inflation "clearly below 2 percent." And the numerical targets mapped out a 4-year path to this end.[5] As it turned out, inflation fell much more quickly than envisaged—to less than 2 percent in 1992. For the bank, this meant that policy was ahead of schedule towards price stability, not that it missed an inflation goal.[6] The idea of symmetry, around a given numerical inflation target, came a little later.

The current inflation targeting regime, as such, with a symmetric, 1-to-3 percent target of indefinite duration, was introduced in the December 1993 agreement between the bank and the government, on the appointment of Gordon Thiessen as Governor. This agreement dropped the price stability objective. Expectations as well as policy adjusted in due course: by the end of 1995 the *Consensus Economics* forecast, and other indicators of inflation expectations, had converged on the 2 percent target-range midpoint.[7]

Thus, in terms of objectives for inflation, one can identify 3 monetary policy regimes over the past 20 years:

- the second-half 1980s regime was *ambiguous*, delivering moderate inflation despite central bank declarations for price stability
- the first half of the 1990s was a *period of transition*—first to an objective of price stability—and after December 1993 to a symmetric 2 percent inflation target
- since the end of 1995, the *2-percent inflation-target* has been an established, credible objective[8]

Data from previous unsettled regimes are likely to yield misleading inferences about the stable, post-1995, state of affairs.

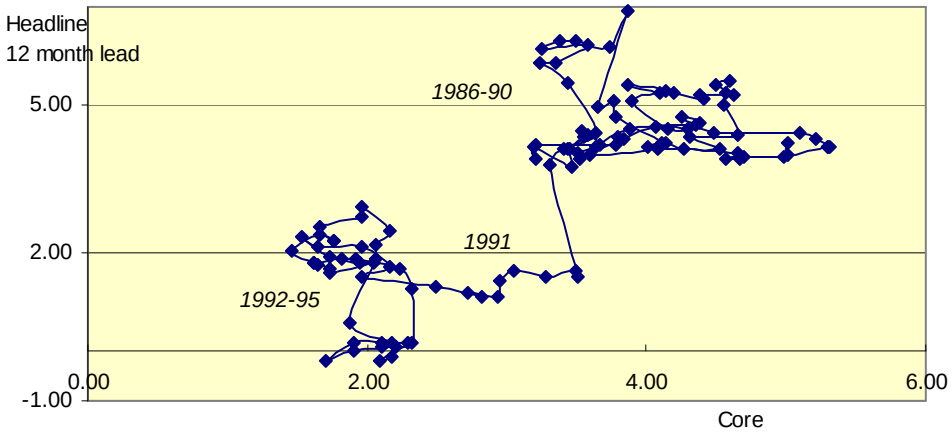
### 3.2 Charts

Scatter diagrams for 12-month CPI and CPIX inflation (lagged 12 months) illustrate the point. Chart 1 is for January 1986-December 1995.

During the second half of the 1980s, under the ambiguous regime, CPI inflation clusters around 4 ½ percent. If CPIX were a useful leading indicator, the scatter diagrams would show a positive slope. But instead the points in the north-east corner bunch randomly—CPIX inflation does not contain information that might improve on an unconditional 4 ½ percent forecast.

[5] Crow spells this out clearly in his memoire *Making Money* (2002).
[6] In any case, there was no technical miss because year-end inflation did not fall below the lower boundary of the target range.
[7] For example, Bank of Canada, *Monetary Policy Report*, April 1996.
[8] Beaudry and Doyle (2001) Kichian (2001), Demers (2003) and others, using statistical methods, find shifts in time-series properties more or less in line with this historical sketch.

**Chart 1**
**Core and headline inflation under changing policy objective: 1986-95**
percent 12-month rate

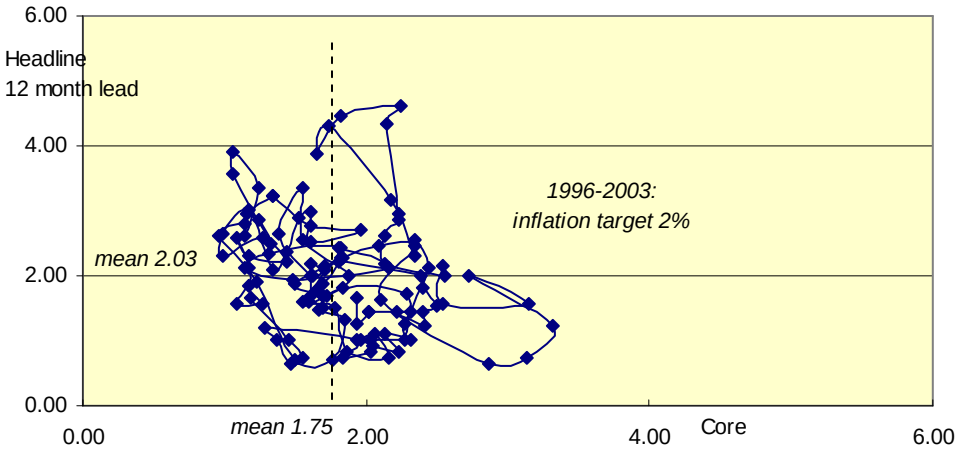



The transition period, 1991-95, shows a decline in both headline and core inflation. The introduction of the GST in 1991, as well as the tobacco tax cut in 1994, amplify the drop in CPI inflation. The decline in CPIX inflation, however, clearly reflects the policy of inflation reduction (i.e. tight money).

During the 1996-2005 period (Chart 2), headline inflation averages 2 percent, and core inflation a bit less (the difference mainly reflecting steep post-2000 increases in energy prices). The data points, now in the south-west, bunch randomly again. As in the 1986-90 stable-inflation period, there is no sign from the scatter that core might predict future headline inflation.

In fact, the correlation between lagged core and current headline is confined to the 1991-95 period, and is produced entirely by the regime shifts. The positive Bank of Canada findings on core inflation as a predictor, which derive from pre-1995 data, therefore have to be taken with a grain of salt.

**Chart 2**
**Core and headline inflation under 2 percent inflation target: 1996-2005**
percent 12-month rate




### 3.3 Simple statistics

Table 1 shows the size of errors from 3 different forecasts for CPI inflation, over 12-month and 24-month horizons. The first uses current CPI inflation as predictor: it forecasts unchanged headline inflation. The second uses CPIX inflation: it forecasts that headline inflation will converge to current core inflation. The third uses the inflation target: it forecasts that headline inflation will be 2 percent. Dark shading denotes the ambiguous 1980s regime; light shading the transition period in the first half of the 1990s. The rows not shaded cover the period of the 2 percent inflation target.

**Table 1**

| CPI inflation predictors: Simple statistics (%) | | | | | | |
|---|---|---|---|---|---|---|
| | **Root mean squared error (RMSE)** | | | **Bias: Actual-forecast** | | |
| **Jan-Dec** | **CPI** | **CPIX** | **Target** | **CPI** | **CPIX** | **Target** |
| | **12-month horizon** | | | | | |
| **1986-1990** | **0.68** | 0.76 | NA | **0.16** | 0.29 | NA |
| **1991-1995** | 2.38 | **1.55** | 1.69 | -0.52 | **-0.14** | -0.71 |
| | 2% target | | | | | |
| **1996-2000** | 0.93 | 0.95 | **0.74** | 0.11 | **0.02** | -0.27 |
| **2001-2005** | 1.66 | 1.29 | **0.97** | **-0.10** | 0.44 | 0.33 |
| | **24-month horizon** | | | | | |
| **1986-1990** | **0.55** | 0.76 | NA | 0.40 | **0.38** | NA |
| **1991-1995** | 2.46 | **1.47** | 1.69 | -1.49 | **-0.62** | -0.71 |
| | 2% target | | | | | |
| **1996-2000** | 1.24 | 0.94 | **0.74** | 0.43 | **-0.06** | -0.27 |
| **2001-2005** | 1.24 | 1.21 | **0.97** | **-0.08** | 0.46 | 0.33 |
| ***1992-1995 monthly targets:*** *interpolated from year-end targets* | | | | | | |
| ***Bold:*** *least error in each category* | | | | | | |

In terms of RMSE, CPIX is often a better predictor than the CPI, and is the best of all 3 predictors during the 1991-95 transition period. But post 1995, the constant 2 percent easily beats both variables. (In view of the bank's 6-to-8 quarter inflation control horizon, it is surprising that the superiority of the 2 percent forecast is not more marked over the 24-month than the 12-month horizon.) In terms of bias, the record is mixed: core was best 1991-95 and 1996-2000, but the strong non-core inflation 2001-05 throws it well off the scent.

### 3.4 Regression model

This section reports on a linear regression model for predicting headline inflation, over a 12-month prediction horizon. It uses 12-month rates of change, which are conventional, but which imply a high degree of overlap at each data point, and therefore a moving average process in equation errors. The ordinary least squares estimates are likely to be biased, and to exaggerate the explanatory power of the equations.[9] However, since even these estimates reveal obvious weakness in the performance of core inflation, recognition of the bias only reinforces that it is not a good predictor.

The equation is:

$$h_t = \kappa + \alpha h_{t-12} + \beta c_{t-12}$$

with

| | |
|---|---|
| $h_t$ | headline inflation—12-month percentage change in CPI at month t |
| $c_{t-12}$ | core inflation—12-month percentage change in CPIX at month t-12. |

The 12-month horizon is not critical, since the equation allows a longer-lived adjustment (as implied, e.g. by the bank's 6-to-8 quarter inflation-control horizon), if it fits the data better.[10]

By any econometric standard, the estimates of the equation (Table 2) are very poor. A crude way to interpret them, for the purpose at hand, is as a 3-horse race between an unconditional constant forecast, headline inflation, and core inflation—the winner determined by the largest *t* ratio.[11] In the 1986-90 and 1996-2005 races, the constant ($\kappa$) wins hands down, and so the explanatory power of the equation is very low. In the 1991-95 race, however, core wins—the *t* ratio for the constant is also high but this horse takes off in the wrong direction—and for once the $R^2$ looks respectable.

[9] Newey-West corrections resulted in very similar coefficient estimates and somewhat larger estimates of all standard errors. The *DW* statistics remained very low.

[10] Equations for 24-month forecast horizons in any case provide much the same results. A 1-month model, using 1-month increases in the price level, and a 1-month forecast horizon, yields better diagnostic statistics, and coefficients that conform roughly to the mean-reversion (i.e. inflation targeting) model. These tests, which are free of the overlapping data issue, also suggest that core inflation has no value as a predictor post 1995.

[11] Given the biases, however, statistical significance is a concept to avoid.

**Table 2**

| **CPI inflation predictors: OLS regression** $h_t = \kappa + \alpha h_{t-12} + \beta c_{t-12}$ | | | | | |
|---|---|---|---|---|---|
| $\kappa$ | $\alpha$ | $\beta$ | $R^2$ | *SEE* | *DW* |
| 1986-90: Ambiguous regime, inflation averages 4 ½ % | | | | | |
| 4.39<br>*0.70, 6.20* | -0.05<br>*0.15, -0.35* | 0.07<br>*0.11, 0.63* | 0.01 | 0.48 | 0.22 |
| 1991-95: Regime transition—inflation reduction | | | | | |
| -3.83<br>*0.78, -4.93* | -0.58<br>*0.15, -3.99* | 3.22<br>*0.44, 7.24* | 0.54 | 1.32 | 0.26 |
| 1996-2005: 2 % inflation target | | | | | |
| 2.97<br>*0.29, 10.24* | -0.06<br>*0.11, -0.52* | -0.46<br>*0.19, -2.45* | 0.09 | 0.83 | 0.25 |
| *standard error,* t *ratio* | | | | | |

These results are consistent with the previous statistical analysis: good forecasting performance of core inflation is confined to the period of transition.

The very low *DW* statistic—another facet of the poor predictive performance of core inflation—is to be expected. Autocorrelation in the residuals is a result not just of the 12-month overlapping rates of change, but more fundamentally of the cyclical behaviour of non-core prices, which core inflation is not designed to predict.[12]

One can interpret the coefficients in various ways. The equation can be re-written as:

$$h_t - h_{t-12} = \kappa + (\alpha+\beta-1)\, h_{t-12} + \beta\,(c_{t-12} - h_{t-12}).$$

If $\alpha + \beta$ is equal to unity, the equation reduces to the error-correction model used by Macklem, in which headline inflation gravitates towards core inflation. The coefficient $\beta$ gauges the speed of adjustment, or the average duration of one-off price level shocks. A zero value for $\beta$ implies no convergence; a unit value implies adjustment within 12 months; and values outside the (0,1) range have no intuitive meaning.

The equation also encompasses a mean-reversion model in which, following any shock, monetary policy systematically pushes back inflation to 2 percent. In this case, $\beta$ is zero, and $\kappa = 2(1 - \alpha)$. The coefficient $\alpha$ in this case represents the speed of adjustment. If $\alpha$ is zero, policy eliminates deviations from target in less than 12 months, and the value of the constant term $\kappa$ would be 2; more generally, $0 < \alpha < 1$, and $\kappa < 2$.

The estimates, however, provide little support for any of these notions. The most one can say is that the 1986-90 and 1996-2005 results are broadly consistent with the mean-reversion model. But the constant term for the latter period is well above the theoretical limit of 2.

[12] That is, GLS adjustments for the moving average will not much reduce the residual autocorrelation.

Apart from a single near-zero estimate, none of the estimated values of $\beta$ make economic sense—in the 1991-95 period, in which core inflation is the best predictor, the estimated $\beta$ is far too large. In numerical terms, the $\beta$ estimates are very unstable.

In summary: under the current inflation targeting regime, current rates of increase of CPIX (and for that matter of CPI itself) have no predictive content for future headline inflation.

## References


Jamie Armour. 2006. “An Evaluation of Core Inflation Measures.” Working Paper 2006-10.

Beaudry, Paul and Matthew Doyle. 2001. "What Happened to the Phillips Curve in the 1990s in Canada?" *Price Stability and the Long-Run Target for Monetary Policy*. Ottawa: Bank of Canada.

John Crow. 1988. "The Work of Canadian Monetary Policy," Eric J. Hanson Memorial Lecture delivered at the University of Alberta, Edmonton, January 1988.

John Crow. 2002. *Making Money : An Insider's Perspective on Finance, Politics, and Canada's Central Bank.* John Wiley & Sons.

Frédérick Demers. 2003. “The Canadian Phillips Curve and regime shifting.” Bank of Canada Working Paper 2003-32.

Maral Kichian. 2001. “On the Nature and the Stability of the Canadian Phillips Curve.” Bank of Canada Working Paper 2001-4.

Tiff Macklem. 2001. “A new measure of core inflation.” *Bank of Canada Review*, August.

Seamus Hogan, Marianne Johnson and Thérèse Laflèche. 2001. *Core Inflation*. Bank of Canada Technical Report 89.

Nicholas Rowe. 2002. “How to Improve Inflation Targeting at the Bank of Canada.” Bank of Canada Working Paper 2002-23.

Lars Svensson. 1997. "Inflation forecast targeting: Implementing and monitoring inflation targets." *European Economic Review*, Vol. 41.