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The Behaviour of Consumer Prices Across Provinces

by Gordon Wilkinson

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Acknowledgements

Abstract

Measures of core inflation enable a central bank to distinguish price movements that are transitory and generated by non-monetary events from those that are more permanent and related to prior monetary policy decisions. The author uses standard statistical measures to assess the behaviour of consumer prices across provinces and identify price components with more divergent price patterns. The results indicate that energy, shelter and tobacco prices are the most volatile across provinces. Very large price movements restricted to one or a few provinces suggest that the forces or events triggering those movements may be province specific and unrelated to national demand pressures. Such results suggest that constructing a type of core inflation measure called the "trimmed mean" that excludes components with exceptionally large price changes at the provincial level may offer an alternative means of assessing underlying inflationary pressures.

JEL classification: E31
Bank classification: Inflation and prices

Résumé

Les mesures de l'inflation fondamentale permettent à la banque centrale de distinguer les mouvements de prix passagers causés par des chocs non monétaires et les mouvements plus persistants liés à ses décisions de politique monétaire antérieures. L'auteur utilise des mesures statistiques standards pour analyser les différences de comportement des prix à la consommation entre provinces et isoler les composantes qui présentent des évolutions bien distinctes. D'après les résultats qu'il obtient, ce sont les prix de l'énergie, du logement et du tabac qui varient le plus d'une province à l'autre. Les mouvements très prononcés qu'on observe dans une ou quelques provinces seulement donnent à penser que les forces ou facteurs à l'œuvre sont propres à cette ou ces provinces et indépendants des pressions qu'exerce la demande à l'échelle nationale. Il se pourrait donc que la construction d'une mesure de l'inflation fondamentale – une « moyenne tronquée » – qui exclurait les composantes affichant de très fortes variations au niveau provincial offre un autre moyen d'évaluer les pressions inflationnistes sous-jacentes.

Classification JEL : E31
Classification de la Banque : Inflation et prix

1 Introduction

In preparation for the renewal of Canada's inflation target at the end of 2011, considerable research has been undertaken at the Bank of Canada and elsewhere on various aspects of inflation targeting. Core inflation and its measurement are recurrent subjects for analysis in research programs on inflation targeting. Measures of core inflation enable a central bank to distinguish price movements that are transitory and generated by non-monetary events from those that are more permanent and related to the pace of aggregate economic activity and prior monetary policy decisions. As a contribution to the extensive literature on the measurement of core inflation, this paper reviews the behaviour of consumer prices across provinces. It uses standard statistical measures to identify price index components with more divergent price patterns at the provincial level. A price component exhibiting sharply varying price movements by province may warrant exclusion from a measure of underlying inflation if such patterns originate from events specific to one or just a few provinces and are less responsive to domestic monetary policy. Events that might trigger idiosyncratic price movements within a province include tax and regulatory price changes or transitory supply shocks. Price effects from supply shocks may vary by province, given differences in industry structure or resource endowment. Since large but temporary price changes in specific components in only one or just a few provinces are likely to be related to forces or events unique to such provinces, and unrelated to aggregate demand conditions, a new measure of core inflation that excludes extraordinary province-specific price changes may offer an alternative means of gauging the underlying rate of inflation.

2 Excluding Volatile Provincial Price Movements from the CPI

Exclusion-based methods for measuring core inflation use volatility as the criterion for excluding a component on the grounds that extraordinary price changes arise from forces or events unrelated to aggregate demand pressures and decisions taken by the monetary authority. This exclusion methodology can perhaps be extended to price changes at the provincial level, based upon the idea that sharp and transitory price changes in one or a few provinces arise from province-specific conditions or events and not national demand conditions. To construct a measure of inflation uncontaminated by extraordinary province-specific price changes, results from standard statistical measures reported in this paper suggest that energy, shelter and tobacco prices are sufficiently volatile to warrant exclusion.[1] Applying a type of core inflation measure called the "trimmed mean" to

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1. Tobacco price movements are dominated by provincial excise tax changes, so, more precisely, it is only the tobacco tax component that warrants exclusion.

provincial rather than national components of the consumer price index (CPI) may be a reasonable way to exclude volatile provincial price movements. In contrast to other measures of core inflation, the trimmed mean excludes more volatile price components on a temporary basis. Such components are reintroduced into the measure when the price volatility subsides, thereby minimizing information loss.

This paper uses a variety of standard statistical measures to examine the behaviour of consumer prices across provinces. The results of this statistical analysis are as follows:

(i) Dispersion measures show that inflation rates across provinces are the least divergent for consumer price indexes that exclude energy, shelter or tobacco prices. These index components, either singly or in combination, were responsible for the abnormally high, albeit temporary, peaks in the dispersion of inflation rates across provinces since 2000.

(ii) Measures of standard deviation show that inflation variability for most CPI components within each province lessened in the low-inflation period after 1992, but remained relatively high for the energy and tobacco components. Indexes that exclude these components have the lowest variability.

(iii) A large set of first-order autoregressions suggests some decline in inflation persistence during the low-inflation period since 1992, particularly for clothing and footwear; household operations, furnishings and equipment; and health and personal care.

(iv) Correlation analysis shows that linkages between provincial and national inflation rates have weakened since 1992, which may be an indication that province-specific relative price changes are less obscured by nationwide inflationary forces when inflation rates are lower. Correlation analysis also shows that the linkages in inflation rates between provinces were stronger in the high-inflation period prior to 1992 and have weakened since then.

3   Measuring Core Inflation

Mankikar and Paisley (2004) review the various approaches used in the literature to measure core inflation. They group the approaches into two broad categories: statistical and model based. Statistical methods are subdivided into two main types: (i) those that remove volatile components from an index, often referred to as exclusion-based methods, or those that reduce the impact of such volatile components by reweighting, and (ii) those that identify the "persistent" or "durable" elements in a price index that best provide information on future inflation.[2] Model-based approaches draw upon economic theory to

2. A study by Bilke and Stracca (2008), conducted for the euro area, is a more recent example of the construction of new measures of core inflation based upon reweighting price components according to their relative persistence. They measure persistence in various ways; for example, by its autoregressive properties and also by its correlation with headline inflation one year ahead.

construct multivariate econometric relationships between inflation and its various cyclical and long-run determinants, in order to disentangle that part of measured inflation related to aggregate demand pressures from that part driven by transitory forces.

This paper draws upon exclusion-based statistical approaches in its analysis of price behaviour across provinces. Exclusion-based approaches remove components from price indexes that are the most volatile, on the grounds that such price changes are temporary and arise from forces or events unrelated to monetary policy decisions such as bad weather, changes in taxes or subsidies, or changes in export policies.[3]

Extreme volatility in a price component between provinces may suggest that the dominating influences are province specific and unrelated to inflationary or disinflationary pressures influenced by national monetary policy decisions. Some of these province-specific influences on prices include provincial indirect tax or excise tax changes, regulatory price changes, more pronounced effects from supply shocks due to differences in industry structure or resource endowments, or spillover effects from supply shocks to other sectors such as housing. Given that the preferred measures of inflation for monetary policy are those less influenced by sharp price swings unrelated to underlying aggregate demand pressures, there may be some benefit to examining the volatility of price changes in price index components at the provincial level to determine whether forces or events unique to one or just a few provinces are at play.

4   Stylized Facts on Provincial Inflation Rates

This section examines the statistical properties of major CPI subcomponents at the provincial level using standard statistical measures. The aim is to better understand inflation behaviour at the provincial level and to discuss what these statistical results may mean for the measurement of core inflation at the national level.

4.1   Average inflation rates

Average inflation rates across provinces for the main components of the CPI are reported in Table 1, and those for the various subaggregates of the CPI are reported in Table 2.[4] Each table shows average inflation rates over two different time periods: the upper half covers the period 1980M1 to 1991M12, and the lower half covers the period 1992M1 to 2008M12. These averaging periods were selected based upon previous research showing some evidence of a regime change in Canadian inflation data occurring in the early

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3. The argument for excluding components little influenced by monetary policy is made by Svensson (1999, 8): "Eliminating components over which monetary policy has little or no influence serves to avoid misleading [public] impressions of the degree of control," as well as by Blinder (1997, 160): "I always preferred to view the inflation rate with its food and energy components removed as our basic goal. . . . The real reason was that prices of food and energy are, for the most part, beyond the control of the central bank."

4. The inflation rates were computed as year-over-year changes in the unadjusted monthly consumer price indexes.

1990s.[5] This regime shift roughly coincides with the announcement of explicit inflation targets in February 1991 and the setting of the first target of 3 per cent at the end of 1992.

For every CPI component and subaggregate, inflation rates in Canada and across provinces averaged considerably lower over the inflation-targeting period 1992M1 to 2008M12 than in the earlier period 1980M1 to 1991M12 (Tables 1 and 2). Over both periods and across virtually all provinces, the two CPI components with the strongest average price increases were energy and alcohol and tobacco products. Tax changes played a dominant role in price changes in alcohol and tobacco products. The two CPI components with the lowest average price increases were (i) household operations, furnishings and equipment, and (ii) clothing and footwear. Furnishings, equipment, clothing and footwear are tradable goods, so it is conceivable that average price increases in these CPI items over the 1992 to 2008 period were restrained by economic globalization, the North American Free Trade Agreement, competitive pressures from the entry of new foreign-based retailers (e.g., Wal-Mart) and the steady appreciation of the Canadian dollar over most of the period since 2003. The abolition of textile quotas by the World Trade Organization in January 2005 may have contributed further downward pressure on clothing prices.

During the period 1980M1 to 1991M12, Ontario and Quebec experienced the strongest rates of inflation. Since then, inflation rates have averaged the highest in Manitoba, Saskatchewan and Alberta. In the case of Manitoba, this was due mainly to above-average price increases in food; household operations, furnishings and equipment; and clothing and footwear. For Alberta and Saskatchewan, it was related in large part to above-average rates of growth in energy,[6] shelter, and alcohol and tobacco prices (Table 1). Over the same period, consumer price inflation was weakest in Quebec (1.7 per cent), due primarily to rates of price increase in energy and in recreation, education and reading that were the lowest in the country. Over both periods, the smallest increases in shelter prices were reported in British Columbia. This outcome seems puzzling given British Columbia's above-average population growth since 1980 and above-average economic growth over the past several years. Moreover, Multiple Listing Service (MLS) resale housing price data show stronger average price increases in British Columbia than in Canada over both periods.[7]

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5. Hogan, Johnson and Laflèche (2001, 11) summarize this work.
6. Energy is a special aggregate that includes the gasoline component of transportation, and the electricity, natural gas and fuel oil components of shelter.
7. Year-over-year growth in MLS resale housing prices in British Columbia averaged 8.2 per cent from 1980M1 to 1991M12 and 6.2 per cent from 1992M1 to 2008M12, versus 7.8 per cent and 4.4 per cent, respectively, for Canada. According to the Prices Division of Statistics Canada, the less-rapid growth in British Columbia's shelter costs since 1980 came mainly from substantially lower-than-average growth in the replacement cost of housing and in homeowners' and mortgage insurance.

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4.2 Variability of inflation rates

The prices of some components of the CPI, as well as changes in indirect taxes, can cause considerable short-term volatility in total CPI that can obscure signals for underlying inflationary pressure, which is what the monetary authority is most interested in. This section examines the volatility of provincial CPI components and subaggregates over time to highlight which CPI components are candidates for possible exclusion from an inflation measure based upon variability in their price movements.

The variability of annual inflation rates, as measured by the standard deviation, was more muted in the lower-inflation period of 1992M1 to 2008M12 than in the earlier period of higher inflation (Tables 3 and 4). This is evident at both the national and provincial levels for all CPI components except alcohol and tobacco products and for all CPI subaggregates with year-over-year inflation data available for the entire high-inflation period of 1980M1 to 1991M12.[8] The positive association between inflation variability and the rate of inflation is well documented and has been observed in many other countries.[9] The higher volatility of prices for alcohol and for tobacco products over the lower-inflation period seems to stem largely from two episodes of exceptionally large changes to provincial excise tax rates (Figure 1).[10]

Inflation variability at both the national and provincial levels was highest for the two consumer product categories having the highest average inflation rates: (i) energy and (ii) alcohol and tobacco products. Not surprisingly, provincial CPI subaggregates that exclude these components had the lowest inflation variability (see bottom half of Table 4). Prices for energy and for alcohol and tobacco products tend to be buffeted by forces unrelated to monetary policy – supply shocks in the case of energy prices, and federally and provincially legislated changes in excise tax rates in the case of alcohol and tobacco prices. Such features may provide some justification for excluding these two components from any measure designed to capture underlying inflation pressures.

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8. Differences in inflation rate variability were not evident for CPI subaggregates excluding alcohol and tobacco or shelter, because historical year-over-year inflation rates for these series started only in 1985M1 and are not representative of the entire high-inflation period of 1980M1 to 1991M12.
9. For examples, see Okun (1971); Logue and Willet (1976); Taylor (1981). More recently, Ricketts and Rose (1995) applied Markov switching models to CPI inflation in the G-7 countries and found that higher levels of inflation tend to be associated with higher volatility.
10. The federal government and the provincial governments of Newfoundland, Nova Scotia, New Brunswick, Quebec and Ontario reduced tobacco taxes dramatically in early 1994 to counteract widespread cigarette smuggling in Ontario and Quebec. In March 2002, Alberta introduced substantially higher tobacco taxes to discourage consumption, which coincided with, or was followed by, tobacco tax increases in other provinces for similar reasons and to deter interprovincial smuggling.

4.3 The persistence of provincial inflation rates

To better understand the inflation process, it is helpful to examine whether shocks to inflation are transient; that is, whether inflation reverts quickly to its initial level, or whether the shocks persist over an extended period of time. Inflation persistence can be measured in various ways, and "none [is] perfect" (Stock 2001, 381). A commonly used procedure is autoregressive modelling, whereby inflation is regressed on one or more of its own lags (Pivetta and Reis 2006, 1328–29; Mishkin 2007). The closer the estimated coefficients on the own lags sum to one, the more persistent is any shock to inflation.

Tables 5 and 6 show the estimated coefficients from first-order autoregressions on CPI components and subaggregates for Canada and all provinces.[11] For the sample period 1980M1 to 1991M12, the coefficient values on lagged inflation are close to one for virtually all provincial CPI components and subaggregates, suggesting that inflation was highly persistent in the 1980s and not mean-reverting. The only exceptions were CPI excluding alcohol, CPI excluding tobacco and CPI excluding shelter in Manitoba (Table 6); CPI excluding shelter in Nova Scotia (Table 6); and semi-durables and clothing and footwear in Prince Edward Island (Tables 5 and 6). In these instances, the autoregressive coefficient was 0.84 or less.

The drop in the autocorrelation coefficients for most provincial CPI components and subaggregates over the period 1992M1 to 2008M12 suggests that inflation has become less persistent as the rate of inflation has fallen.[12] The drop in persistence has been most pronounced for (i) clothing and footwear, (ii) household operations, furnishings and equipment, and (iii) health and personal care, suggesting that shocks to the prices of these items are less long-lasting. The autoregression results also suggest far less persistence in energy price inflation in Ontario and most of the Western provinces than in the past. Provincial inflation rates for alcohol show less persistence, notably in Ontario and Prince Edward Island (Table 5). Inflation rates for tobacco, however, seem to be equally or more persistent than before, which may be consistent with "permanent" tax changes being applied to these items. Except for Alberta, British Columbia and Ontario, the degree of inflation persistence in shelter prices remains relatively high. Provincial subaggregates that exclude tobacco or shelter tend to show the least-persistent inflation rates (Table 6).

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11. Bils and Klenow (2004) use an AR(1) process to assess persistence in aggregate inflation and inflation across 123 consumer goods in the United States, as does Cutler (2001) for all 80 categories of the United Kingdom's target rate of inflation – retail prices excluding mortgage interest payments.
12. Similar results were reported for national inflation rates in Benati (2008). Using AR(p) models, inflation persistence in countries such as New Zealand and Canada declined during periods when inflation targeting was in effect.

As noted earlier, core inflation measures have also been constructed based upon the degree of inflation persistence in price index components. Components showing more inflationary persistence are viewed as representing the durable part of inflation that provides some information on future inflation, and so they are weighted more heavily in the core inflation measure. It is recognized, however, that exclusion-based and persistence-based approaches can yield substantially different definitions of core inflation (e.g., see Bilke and Stracca 2008, 6). A component that might be excluded from a measure of core inflation based upon its variability, such as tobacco prices, could exhibit high persistence, thereby justifying its inclusion in measures of core inflation defined according to persistence.

4.4 The relationship between national and provincial inflation rates

The correlation coefficients reported in Tables 7 and 8 show how tightly provincial inflation rates for various CPI components and subaggregates move with the national inflation rate. There are many reasons for differences in inflation rates across provinces, despite the implementation of a monetary policy that is common to all regions. Some of these reasons include one-off changes in provincially regulated prices and provincial indirect taxes; differences in cyclical phases; differences in provincial fiscal policy stances; and regional differences in economic structure and resource endowments, which cause national or global supply shocks to affect regions differently.

The adjustment of relative prices across regions is a normal feature of market-based economies and allows for markets to adapt to changing conditions that "may give rise to short-lived inflation differentials across the regions . . . in the face of demand and supply shocks"; more persistent inflation differentials across regions, however, can arise from region-specific rigidities that delay the required price adjustments (González-Páramo 2005, 3). Given the potential economic consequences of differing inflation rates across jurisdictions sharing a common monetary policy, it is beneficial to observe how closely national and provincial inflation rates in Canada are related.

Tables 7 and 8 show that provincial inflation rates across virtually all CPI components and subaggregates were very strongly correlated with national inflation rates during the higher-inflation period of 1980M1 to 1991M12. The main exceptions are (i) price changes for alcohol and tobacco products, which are dominated by excise tax changes set by provincial governments, and (ii) changes to consumer price indexes excluding alcohol, tobacco or shelter, which, because of data limitations, are computed from 1985M12 and so are not representative of the entire high-inflation period of 1980M1 to 1991M12.

The correlations between national and provincial inflation rates are considerably weaker for many CPI components and subaggregates in the lower-inflation period of 1992M1 to

2008M12. The correlations that declined the most are shaded in grey in Tables 7 and 8, although it should be noted that some of these correlations do remain relatively strong. The deterioration in the relationship between provincial and national inflation rates is more pronounced for correlations involving food; shelter; household operations, furnishings and equipment; and clothing and footwear in most provinces; and for total CPI; CPI excluding food and energy; CPI excluding alcohol and tobacco; and CPI excluding energy, goods, semi-durable goods, and services in the four Western provinces and in two or more Atlantic provinces.

One may have expected to see higher correlations between national and provincial inflation rates over the period 1992M1 to 2008M12, given that the inflation targets in effect over this period aimed to confine fluctuations in national CPI inflation within a narrower band. Provincial inflation rates, however, became less correlated with the national rate over this period. This result seems to be consistent with the argument that, during periods of high inflation, price movements are dominated by inflationary forces while relative price changes triggered by real forces (for example, the relative abundance or scarcity of a good or service) become obscured. In such an inflationary environment, market participants can no longer be sure whether price changes are signalling a change in supply or demand conditions for a good or service – which would necessitate a reallocation of resources – or whether such price changes are derived from generalized inflationary pressures.[13]

Based upon the above argument, correlations between provincial inflation rates and the national rate would tend to weaken during periods of low inflation if price changes arising from conditions or events unique to each province are no longer masked by inflationary movements related to aggregate demand. The greater the synchronization of price movements between provinces and the national average, which was especially evident over the high-inflation period of 1980M1 to 1991M12, the stronger the signal that these price movements originate from national demand conditions that monetary policy would more likely respond to. When inflation moderates, the impact of province-specific price changes – such as those arising from tax policies, regulatory policies, or differences in supply shock effects due to provincial variations in industry structure or resource endowments – would tend to be more apparent. This could result in less-synchronized price movements between provinces and the national average, as occurred during the low-inflation period of 1992M1 to 2008M12 for some CPI items and subaggregates.

Given that energy prices are largely determined in global markets, inflationary pressures in energy prices would tend to be similar across provinces, so it is perhaps not surprising that energy and transportation price movements in all provinces continue to show high

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13. For further discussion on the issue of inflation masking relative price signals, see Ragan (2005, 11–13); Rodriguez Palenzuela, Camba-Mendez, and Garcia (2003, 11–12); Issing (2002, 3; 2001, 183); Edey (1994, 113–14).

correlations with their national counterparts during the 1992M1 to 2008M12 period. The stronger correlations between provincial and national alcohol and tobacco price changes in the 1992M1 to 2008M12 period are likely related to the two episodes previously discussed – 1994 and 2002 – when extremely sharp tax-induced changes in tobacco prices occurred across many or most provinces.[14]

4.5 Inflation dispersion across provinces

Measures of inflation that exclude more volatile price components are of interest to policy-makers because they better portray price movements related to aggregate demand conditions. As suggested earlier, it may also be useful for the conduct of policy to be able to identify components with more divergent price changes at the provincial level, given that such changes are more likely to be related to forces or events unique to one or a few provinces and not to demand conditions prevailing in the country as a whole. Two approaches can be used in the construction of a price index that excludes more divergent provincial price changes: the small number of components with the widest dispersion across provinces over time could be excluded on a permanent basis, or different provincial components could be excluded each month if their price changes exceeded some pre-specified threshold.

This section identifies those components with more divergent price movements across provinces, the timing of such divergent provincial patterns and possible reasons for such movements. The dispersion of provincial inflation rates around the national inflation rate for total CPI and each of its major components is depicted graphically in Figures 2 to 11. For each chart, dispersion is measured as the unweighted standard deviation of year-over-year provincial inflation rates at a monthly frequency around a national inflation mean.[15] Dispersion summary statistics for each of these components are reported in Table 11.

The dispersion of total CPI inflation across provinces (Figure 2) has been more moderate during the latter half of the 1990s and during some years since 2000 than in the 15-year period prior to 1996. Nonetheless, the period since 2000 was punctuated by two episodes where the dispersion of consumer inflation rates across provinces jumped to much higher levels: from about November 2002 to March 2003 and from about August 2006 to December 2007. An examination of these episodes at the component level suggests that they have been caused by temporary special factors.

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14. For a discussion on the sensitivity of the correlation coefficient (i.e., Pearson's *r*) to extreme values in the data, see Chen and Popovich (2002, 56–57).
15. An unweighted standard deviation would tend to show more pronounced inflation dispersion by giving more weight to divergent price developments in smaller provinces. A weighted standard deviation would tend to show less inflation dispersion because more weight is given to inflation rates in the larger provinces, which tend to differ less significantly from the average national rate, since their contribution to its calculation is more significant. The absence of scaling in the unweighted standard deviation highlights better the differences among the individual provinces, and is computationally less onerous.

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Since 1980, price movements for most of the components of the CPI – namely, food (Figure 4); household operations, furnishings and equipment (Figure 6); clothing and footwear (Figure 7); health and personal care (Figure 9); and recreation, education and reading (Figure 10) – have varied among provinces within a fairly narrow range (see also Table 11). These interprovincial price patterns suggest that price changes for these CPI components have not been sufficiently divergent across provinces to warrant exclusion from any measure of core inflation based upon provincial price behaviour.[16] Price movements across provinces for energy (Figure 3), shelter (Figure 5), transportation (Figure 8), and alcohol and tobacco (Figure 11), however, have been strongly divergent at particular points in time (see Table 11). Specifically, the jump in inflation dispersion from November 2002 to March 2003 was related to more divergent provincial price changes in each of these four components (Figures 3, 5, 8 and 11). For both energy and shelter, the jump in price dispersion was tied largely to an unusually large year-over-year increase in natural gas prices in Alberta associated with a one-time credit to customers in the previous year. For transportation, the sudden rise in dispersion was related mainly to increases in automobile insurance premiums that varied considerably across provinces.[17] The dispersion in year-over-year provincial tobacco prices began to widen considerably earlier – November 2001 – and lasted until about May 2003 as a result of a series of tobacco tax increases across provinces varying in size and by start date.[18]

The most recent spike in inflation dispersion across provinces started about August 2006 and began to subside in December 2007. It originated solely from more divergent provincial inflation in shelter (Figure 5), which was caused by faster housing price increases in Alberta and Saskatchewan relative to increases elsewhere in the country. Of course, house price movements are strongly influenced by monetary policy via the setting of interest rates that are applied nationally, but they can also vary across provinces given the influence of province-specific factors such as population growth, labour market conditions and the availability of land (Égert 2007, 21).

The dispersion of price changes across provinces by CPI components suggests that energy, shelter, and alcohol and tobacco products are the most divergent index components across provinces. There is no published CPI at the provincial level that

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16. Although the variability in food price movements across provinces is low, it is reasonably clear from the literature that at least some food prices should be removed from national indexes used to measure core inflation, because changes in food prices from one time period to the next can be quite variable and subject to various forces unrelated to monetary policy decisions.

17. In November 2002, the year-over-year increases across the country ranged from 50 per cent or higher in Newfoundland, Nova Scotia, New Brunswick and Alberta; between 30 per cent and 40 per cent in Quebec and Ontario; and about 10 per cent or less in the remaining provinces.

18. The provincial governments of Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba increased tobacco taxes in November 2001, which had an impact on provincial tobacco prices ranging from 2 to 12 per cent. In March 2003, tobacco taxes were increased sharply in Alberta and British Columbia, with much smaller increases in Newfoundland, Prince Edward Island and Saskatchewan. Other provinces introduced higher tobacco tax increases in subsequent months.

excludes these three index components simultaneously; however, there are a number of provincial CPIs that exclude them separately. Such provincial subaggregates can be used to show how the exclusion of index items with more volatile price movements across provinces reduces provincial inflation dispersion.

The dispersion of price changes across provinces for various consumer price subaggregates is plotted in Figures 12 to 23. Dispersion summary statistics are reported in Table 12.[19] The subaggregate with the lowest inflation dispersion across provinces is CPI excluding energy, with a standard deviation of 0.65 over the period 1985M12 to 2008M12 and only one episode with inflation dispersion approaching 1.4 percentage points (Figure 18). In contrast, all other subaggregates showed several more episodes of inflation dispersion attaining or exceeding this threshold. CPI excluding food and energy had the second-lowest average dispersion (see both columns, Table 12). Subaggregates excluding tobacco or shelter also tended to have dispersion patterns with softer peaks (compare Figures 16 and 17 with Figure 2) and average dispersion values lower than for total CPI (see right column of Table 12). These results with provincial subindexes suggest that further reductions in the dispersion of inflation rates across provinces may be achieved by the creation of a subaggregate that excludes tobacco, shelter and energy.

One key conclusion that can be drawn from this analysis of price dispersion across provinces is that very large divergences in price movements among provinces are limited to particular categories (energy, shelter, tobacco and transportation) and these episodes eventually unwind. Nevertheless, the effect can be quite persistent, as was the case when shelter prices began to diverge quite sharply across provinces in August 2006 and continued to do so over the next 16 months. The most recent episode of strongly diverging tobacco prices began in November 2001 and lasted 19 months. Insofar as price changes in such components are dominated by forces outside the purview of monetary policy and are a response to events or conditions unique to specific provinces, constructing an index that excludes such components may better capture price changes related to national demand pressures.

A type of core inflation measure called a trimmed mean removes the most extreme price changes according to some pre-specified number of standard deviations by which a price change diverges from the average change.[20] A variation of the trimmed mean based upon the provincial dispersion of price changes may be a useful way of constructing an inflation measure uncontaminated by price effects unique to a single province. A major benefit of such a measure is that components exhibiting extreme price behaviour are not

19. Two different time periods are presented in this table to take into account the fact that data for some of these measures are available only over a shorter sample period.
20. A trimmed mean based upon national CPI data, called MEANSTD, is one of the many alternative measures of core inflation monitored by the Bank of Canada; see Laflèche and Armour (2006).

permanently removed from the measure of inflation. Such components are excluded only when the price changes are unusually large relative to the average price change, which suggests that the causal factor is not likely to be underlying demand pressures. The rest of the time, such components remain in the index, which is important from the standpoint of public communications when an excluded component is relatively large, such as housing. As well, reintegrating such components when the price movements become more subdued may provide additional information on inflation that would be lost if the components were permanently excluded. To maximize the precision of such a measure, provincial CPI data that are more disaggregated than those presented in this document would need to be used in its construction.

4.6   Inflation relationships between provinces

Inflation rate correlations between provinces can provide some information on whether provinces have distinctive inflationary processes or share common inflationary trends, and whether proximity plays a role in these outcomes. During the high-inflation period of 1980M1 to 1991M12, inflation rates, measured either as total CPI or CPI excluding food and energy, were strongly correlated between provinces (top diagonal matrix of Tables 9 and 10). As mentioned earlier, given that price movements during this period were dominated by inflationary forces common to all regions, it is not surprising that correlations between provinces were so strong. In contrast, during the low-inflation period of 1992M1 to 2008M12, inflation rate correlations were considerably lower between many provinces (bottom diagonal matrix of Tables 9 and 10), which once again may be an indication that the impact of relative price changes or province-specific price changes becomes more evident when they are not being masked by high inflation.

In Eastern Canada, inflation rate correlations over the period 1992M1 to 2008M12 and involving neighbouring provinces tended to be stronger than those involving more distant provinces. For example, inflation rates across the Atlantic provinces are very highly correlated, but they become less correlated with other provincial inflation rates as distance increases (i.e., correlations are lower with Quebec and Ontario, but even lower still with the Western provinces). Similarly, for Quebec and Ontario, inflation rate correlations tend to be higher between each other and with the three closest Atlantic provinces than with Newfoundland and the Western provinces. These interprovincial inflation patterns for Eastern Canada suggest that provinces that are closer to each other share similar economic structures. This observation, however, does not hold for Western Canada. Correlation coefficients show that inflation rates in the four Western provinces tend to be equally divergent with both neighbouring provinces and those further away. The most striking example of this is the very weak correlation in inflation between Alberta and British Columbia, despite their proximity. Alberta is more focused on energy, while British Columbia is more focused on forestry and mining, so differences in

industry structure or resource endowment may explain the dissimilar inflationary outcomes between these two adjacent provinces. Interprovincial inflation dynamics are likely to be more related to economic structure than to geographic proximity, although it is beyond the scope of this paper to examine such links.

5   Conclusion

A statistical analysis of provincial inflation rates for various consumer price indexes and components suggests that shelter, energy and tobacco products have more divergent price movements at the provincial level than do other CPI components. The events or forces that trigger extraordinary price movements in one or a few provinces are likely to be unique to those provinces and therefore not indicative of demand pressures in the country as a whole. Given that it is critically important for monetary policy-makers to disentangle inflationary price movements related to aggregate demand pressures from transitory price movements arising from non-monetary forces, some additional insights on underlying inflationary pressures may be gained by monitoring a measure of core inflation that excludes categories more sensitive to province-specific changes. A variant of a measure of core inflation called the trimmed mean that uses provincial rather than national CPI components may be a useful way of excluding the impact of unusual price changes arising from province-specific influences, and could be a useful subject for future research.

Bibliography

Archer, D. 1993. "Relative Prices, Inflation, the Terms of Trade and the Policy Targets Agreement." *New Zealand Reserve Bank Bulletin* 56 (4): 360–74.

Benati, L. 2008. "Investigating Inflation Persistence Across Monetary Regimes." *Quarterly Journal of Economics* 123 (3): 1005–60.

Bilke, L. and L. Stracca. 2008. "A Persistence-Weighted Measure of Core Inflation in the Euro Area." European Central Bank Working Paper No. 905.

Bils, M. and P. Klenow. 2004. "Some Evidence on the Importance of Sticky Prices." *Journal of Political Economy* 112 (5): 947–85.

Blinder, A. S. 1997. "Commentary for 'Measuring Short-Run Inflation for Central Bankers.'" *Federal Reserve Bank of St. Louis Review* 79 (May/June): 157–60.

Chen, P. Y. and P. M. Popovich. 2002. *Correlation: Parametric and Nonparametric Measures*. Thousand Oaks, CA: Sage Publications.

Cutler, J. 2001. "Core Inflation in the UK." Bank of England External MPC Unit Discussion Paper No. 3.

Dayanandan, A. and M. Ralhan. 2005. "Price Index Convergence Among Provinces and Cities Across Canada: 1978–2001." Department of Economics, Econometrics Working Paper No. EWP0504, University of Victoria.

Edey, M. 1994. "Costs and Benefits of Moving From Low Inflation to Price Stability." *OECD Economic Studies No. 23* (Winter): 109–30.

Égert, B. 2007. "Real Convergence, Price Level Convergence and Inflation Differentials in Europe." William Davidson Institute Working Paper No. 895, University of Michigan.

González-Páramo, J. M. 2005. "Inflation Differentials in the Euro Area." Speech to the Economic and Social Council of the Region of Murcia (May). European Central Bank.

Hogan, S., M. Johnson and T. Laflèche. 2001. "Core Inflation." Bank of Canada Technical Report No. 89.

Issing, O. 2001. "Why Price Stability?" In *Why Price Stability?* 179–202. Proceedings of the First ECB Central Banking Conference, edited by A. G. Herrero, V. Gaspar, L. Hoogduin, J. Morgan and B. Winkler, November 2000. Frankfurt: European Central Bank.

Issing, O. 2002. "Why Stable Prices and Stable Markets Are Important and How They Fit Together." Speech to the First Conference of the Monetary Stability Foundation (December). European Central Bank.

Laflèche, T. and J. Armour. 2006. "Evaluating Measures of Core Inflation." *Bank of Canada Review* (Summer): 19–29.

Logue, D. E. and T. D. Willet. 1976. "A Note on the Relation Between the Rate and Variability of Inflation." *Economica* 43 (17): 151–58.

Mankikar, A. and J. Paisley. 2004. "Core Inflation: A Critical Guide." Bank of England Working Paper No. 242.

Mishkin, F. S. 2007. "Inflation Dynamics." Speech to the Annual Macro Conference, Federal Reserve Bank of San Francisco, San Francisco, California (23 March) in *BIS Review* 29/2007.

Okun, A. M. 1971. "The Mirage of Steady Inflation." *Brookings Papers on Economic Activity* 2: 485–98.

Pivetta, F. and R. Reis. 2006. "The Persistence of Inflation in the United States." *Journal of Economic Dynamics and Control* 31 (4): 1326–58.

Ragan, C. 2005. "Why Monetary Policy Matters: A Canadian Perspective." Available on the Bank of Canada's website at <http://www.bankofcanada.ca>.

Ricketts, N. and D. Rose. 1995. "Inflation, Learning and Monetary Policy Regimes in the G-7 Economies." Bank of Canada Working Paper No. 95-6.

Rodriguez Palenzuela, D., G. Camba-Mendez and J. A. Garcia. 2003. "Relevant Economic Issues Concerning the Optimal Rate of Inflation." European Central Bank Working Paper No. 278.

Stock, J. H. 2001. "Comment on 'Evolving Post-World War II U.S. Inflation Dynamics by Timothy Cogley and Thomas J. Sargent.'" *NBER Macroeconomics Annual* 16: 379–87.

Svensson, L. E. O. 1999. "Price Stability as a Target for Monetary Policy: Defining and Maintaining Price Stability." NBER Working Paper No. W7276.

Taylor, J. B. 1981. "On the Relation Between the Variability of Inflation and the Average Inflation Rate." *Carnegie-Rochester Conference Series on Public Policy* 15: 57–85.

Table 1: Mean Year-Over-Year Percentage Increase in Consumer Price Components by Province (2005 Basket)[*]

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Component	**Mean – Subsample 1980M1 to 1991M12**										
Total CPI	6.3	6.1	6.0	6.1	6.2	6.4	6.5	6.0	5.9	5.9	6.0
Energy	8.4	8.6	8.1	8.5	7.9	9.1	8.1	7.5	8.1	9.1	7.8
Food	5.5	4.8	5.2	5.5	5.5	5.6	5.6	5.0	5.1	5.3	5.5
Shelter	6.5	6.5	5.6	6.2	6.4	7.0	6.9	5.9	6.0	5.6	5.2
Household, furn. & equip.	5.1	4.4	5.1	4.6	5.1	4.9	5.2	5.2	4.8	4.9	4.8
Clothing & footwear	5.2	5.6	4.7	4.9	4.8	5.3	5.3	5.1	5.3	5.0	5.0
Transportation	6.7	6.4	6.4	6.2	6.1	6.5	6.9	6.6	6.1	6.4	7.2
Health & personal care	6.3	6.0	6.8	6.6	6.2	6.4	6.4	5.7	7.5	6.2	5.8
Rec., educ. & reading	6.2	5.7	6.2	6.0	6.2	5.9	6.4	6.1	5.8	5.8	6.3
Alcohol & tobacco products	10.9	10.2	12.5	11.5	12.2	11.5	10.7	10.9	9.9	11.6	10.1
	Mean – Subsample 1992M1 to 2008M12										
Total CPI	1.9	1.8	2.0	2.0	1.8	1.7	1.9	2.1	2.2	2.6	1.8
Energy	4.2	3.9	4.8	4.4	4.4	3.3	4.4	4.0	4.8	6.2	4.1
Food	2.0	1.6	1.9	2.1	2.0	2.0	1.9	2.3	1.8	2.0	2.0
Shelter	2.1	2.2	2.2	2.4	2.1	1.9	2.0	2.2	3.4	3.9	1.0
Household, furn. & equip.	1.1	0.7	1.4	1.0	0.9	1.0	1.0	1.4	0.9	1.1	1.4
Clothing & footwear	0.0	0.2	0.6	0.4	0.2	-0.2	-0.2	0.6	0.2	0.0	0.8
Transportation	3.0	3.2	2.9	2.8	2.8	2.5	3.2	2.8	2.7	3.4	3.1
Health & personal care	1.5	0.8	1.4	1.2	0.9	1.5	1.4	1.6	1.2	1.6	1.8
Rec., educ. & reading	1.6	1.4	1.6	1.9	1.7	0.8	1.8	1.6	1.7	1.8	1.9
Alcohol & tobacco products	3.3	3.1	3.9	3.7	2.6	3.3	3.4	3.2	4.0	4.1	3.1

* Average of monthly year-over-year growth rates

Table 2: Mean Year-Over-Year Percentage Increase in Consumer Price Subaggregates by Province (2005 Basket)[*]

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Subaggregate	Mean – Subsample 1980M1 to 1991M12										
Total CPI	6.3	6.1	6.0	6.1	6.2	6.4	6.5	6.0	5.9	5.9	6.0
CPI ex food	6.5	6.4	6.3	6.3	6.4	6.7	6.7	6.3	6.1	6.1	6.1
CPI ex food & energy	6.3	6.0	6.0	6.0	6.1	6.4	6.5	6.1	6.0	5.9	5.9
CPI ex alcohol & tobacco**	5.0	5.7	4.3	5.7	5.8	6.1	6.2	5.6	5.7	5.6	5.7
CPI ex alcohol***	4.6	3.7	4.1	4.2	4.2	4.7	4.8	4.5	4.3	4.2	4.0
CPI ex tobacco***	4.4	3.5	3.8	3.8	3.8	4.5	4.6	4.2	4.0	4.0	3.9
CPI ex shelter***	4.6	4.0	4.9	4.6	4.6	4.8	4.7	4.8	4.6	4.5	4.4
CPI ex energy	6.1	5.7	5.8	5.8	6.0	6.2	6.3	5.9	5.8	5.7	5.8
Goods	6.0	6.0	6.1	6.1	6.1	6.2	6.0	5.8	5.9	6.0	5.8
Durables	4.4	4.2	4.6	4.5	4.6	4.4	4.5	4.3	4.6	4.4	4.5
Semi-durables	5.2	5.6	4.8	4.7	4.8	5.5	5.1	5.1	5.3	5.1	4.9
Non-durables	7.0	6.7	7.0	7.2	7.1	7.2	7.0	6.6	6.9	7.2	6.7
Services	6.6	6.1	5.9	6.0	6.2	6.7	7.0	6.3	6.0	5.9	6.1
	Mean – Subsample 1992M1 to 2008M12										
Total CPI	1.9	1.8	2.0	2.0	1.8	1.7	1.9	2.1	2.2	2.6	1.8
CPI ex food	1.9	1.9	2.0	2.0	1.8	1.6	1.9	2.0	2.3	2.7	1.8
CPI ex food & energy	1.7	1.5	1.6	1.6	1.4	1.4	1.7	1.8	1.9	2.4	1.6
CPI ex alcohol & tobacco	1.9	1.7	2.0	1.9	1.7	1.6	1.8	2.0	2.1	2.4	1.7
CPI ex alcohol	1.9	1.8	2.0	2.0	1.8	1.7	1.9	2.1	2.2	2.6	1.8
CPI ex tobacco	1.9	1.8	1.9	2.0	1.8	1.7	1.9	2.0	2.1	2.5	1.8
CPI ex shelter	1.9	1.7	1.9	1.9	1.7	1.6	1.9	2.0	1.8	2.1	2.1
CPI ex energy	1.7	1.5	1.6	1.7	1.5	1.5	1.7	1.9	1.9	2.3	1.7
Goods	1.5	1.4	2.0	1.8	1.6	1.4	1.4	1.7	1.7	1.7	1.6
Durables	0.0	0.0	0.3	0.2	-0.1	0.1	-0.1	0.5	0.2	0.0	0.2
Semi-durables	0.2	0.2	0.7	0.7	0.4	0.0	0.0	0.7	0.2	0.2	0.8
Non-durables	2.4	2.3	2.8	2.6	2.5	2.2	2.4	2.6	2.8	3.1	2.5
Services	2.4	2.4	2.0	2.3	2.1	2.1	2.4	2.5	2.9	3.4	2.0

* Average of monthly year-over-year growth rates

** The average for Canada is available only for the period 1982M1 to 1991M12, so it is not strictly comparable with other averages in this table.

*** The averages for both Canada and the provinces are available only for the period 1985M12 to 1991M12, so they are not strictly comparable with other averages in this table.

Table 3: Standard Deviation of Consumer Price Inflation by Province and Component (2005 Basket)*

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Component	Standard Deviation – Subsample 1980M1 to 1991M12										
Total CPI	3.0	3.7	3.4	3.0	3.0	3.2	2.8	2.6	2.9	3.6	3.5
Energy	10.3	11.4	13.3	10.9	11.0	11.0	10.1	9.5	10.9	13.6	10.9
Food	3.1	4.0	3.2	3.7	3.4	3.7	3.3	2.9	3.3	3.2	3.3
Shelter	3.6	5.4	5.0	4.3	4.5	3.6	3.1	3.2	3.8	5.9	4.9
Household, furn. & equip.	3.1	3.3	3.2	3.2	3.4	2.9	3.2	2.8	3.3	3.3	3.7
Clothing & footwear	2.9	3.7	3.6	3.3	3.0	3.6	2.7	3.1	3.9	3.4	3.4
Transportation	5.4	5.3	5.9	4.7	4.7	6.1	5.3	5.5	5.4	5.5	6.1
Health & personal care	2.7	3.0	2.9	3.3	3.1	2.6	2.7	2.7	6.1	3.6	3.5
Rec., educ. & reading	2.2	2.0	2.4	2.1	2.6	2.6	2.4	1.7	2.2	2.2	2.3
Alcohol & tobacco products	3.7	5.8	4.9	4.0	5.9	5.5	3.9	3.8	3.3	4.9	3.7
	Standard Deviation – Subsample 1992M1 to 2008M12										
Total CPI	0.9	1.2	1.6	1.4	1.3	1.1	1.0	0.8	0.9	1.6	0.9
Energy	7.1	8.3	12.0	9.6	7.8	7.2	7.4	6.7	5.4	12.6	7.4
Food	1.4	1.8	1.8	1.8	1.6	1.6	1.8	1.6	1.9	2.2	1.4
Shelter	1.5	3.0	3.6	2.7	1.8	1.2	1.7	1.5	2.7	4.6	1.9
Household, furn. & equip.	0.7	1.2	1.1	1.1	1.0	1.2	0.9	1.4	1.2	1.2	1.2
Clothing & footwear	1.3	2.7	2.4	2.9	2.4	2.0	1.9	2.5	2.7	1.6	1.7
Transportation	2.9	3.9	4.2	3.9	4.3	3.1	3.1	3.0	3.0	3.5	2.7
Health & personal care	0.8	1.3	1.4	1.0	1.2	1.0	0.9	1.2	1.3	1.0	1.1
Rec., educ. & reading	1.2	1.5	1.1	1.2	1.3	1.6	1.7	1.5	1.2	1.3	1.6
Alcohol & tobacco products	7.0	4.0	8.5	7.6	8.1	9.6	7.4	4.9	6.6	7.8	3.8

* Standard deviation of monthly year-over-year growth rates.

Table 4: Standard Deviation of Consumer Price Inflation by Province and Subaggregate (2005 Basket)*

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Subaggregate						Standard Deviation – Subsample 1980M1 to 1991M12					
Total CPI	3.0	3.7	3.4	3.0	3.0	3.2	2.8	2.6	2.9	3.6	3.5
CPI ex food	3.1	4.0	3.8	3.2	3.3	3.4	2.9	2.8	3.0	3.9	3.8
CPI ex food & energy	2.5	2.9	2.4	2.3	2.3	2.7	2.4	2.3	2.6	3.3	3.3
CPI ex alcohol & tobacco**	2.1	3.6	2.2	3.2	3.1	3.2	2.9	2.7	3.1	3.7	3.6
CPI ex alcohol**	0.8	1.6	1.9	1.3	1.6	1.3	0.7	0.8	1.2	1.5	1.2
CPI ex tobacco**	0.7	1.3	1.7	1.2	1.4	1.1	0.8	0.7	1.2	1.4	1.2
CPI ex shelter**	0.8	1.4	1.6	1.1	1.4	1.6	0.7	0.7	1.6	1.4	1.1
CPI ex energy	2.5	2.9	2.4	2.3	2.3	2.7	2.4	2.2	2.5	3.1	3.1
Goods	3.3	4.0	4.3	3.5	3.6	3.5	3.4	3.1	3.2	3.4	3.5
Durables	3.2	3.1	4.0	3.6	3.1	3.1	3.3	3.3	3.0	3.2	3.4
Semi-durables	2.6	3.2	2.9	2.6	2.7	3.5	2.3	2.5	3.4	2.9	2.8
Non-durables	4.1	5.0	5.4	4.4	4.6	4.4	4.1	3.7	4.1	4.6	4.3
Services	2.9	3.3	2.2	2.7	2.4	3.0	2.6	2.4	3.1	4.3	3.9
						Standard Deviation – Subsample 1992M1 to 2008M12					
Total CPI	0.9	1.2	1.6	1.4	1.3	1.1	1.0	0.8	0.9	1.6	0.9
CPI ex food	1.0	1.4	1.9	1.6	1.6	1.3	1.0	0.9	1.0	1.8	1.0
CPI ex food & energy	0.7	0.9	1.1	1.0	1.2	1.1	0.7	0.6	0.8	1.3	1.0
CPI ex alcohol & tobacco	0.8	1.2	1.6	1.4	1.3	0.9	1.0	1.0	1.0	1.6	1.2
CPI ex alcohol	0.9	1.2	1.6	1.4	1.4	1.1	1.0	0.9	0.9	1.6	0.9
CPI ex tobacco	0.7	1.1	1.5	1.3	1.2	0.8	0.8	0.9	0.9	1.5	0.9
CPI ex shelter	1.0	1.0	1.4	1.2	1.5	1.2	1.1	1.0	1.0	1.2	0.9
CPI ex energy	0.7	0.8	1.0	0.9	1.0	1.0	0.7	0.6	0.8	1.2	0.9
Goods	1.4	1.6	2.6	2.1	1.8	1.7	1.7	1.4	1.5	2.3	1.2
Durables	2.2	2.3	2.2	2.3	2.6	2.1	2.3	2.5	2.4	2.2	2.3
Semi-durables	1.2	2.2	2.0	2.3	1.9	1.6	1.8	2.3	2.4	1.3	1.6
Non-durables	2.8	2.8	4.4	3.7	3.2	3.2	3.3	2.4	2.2	4.2	2.0
Services	0.7	1.3	1.0	1.0	1.2	0.8	0.7	0.7	1.4	1.8	1.2

* Standard deviation of monthly year-over-year growth rates.

** The standard deviation for Canada is available only for the period 1982M1 to 1991M12, so it is not strictly comparable with other standard deviations in this table.

*** The standard deviations for both Canada and the provinces are available only for the period 1985M12 to 1991M12, so they are not strictly comparable with other standard deviations in this table.

Table 5: First-Order Autoregressions of Consumer Price Inflation by Province and Component (2005 Basket)*

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Component					Value of Coefficient on Lagged Inflation – Subsample 1980M1 to 1991M12						
Total CPI	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.96	0.98	0.99	0.99
Energy	0.96	0.97	0.97	0.97	0.97	0.96	0.92	0.86	0.92	0.94	0.96
Food	0.94	0.93	0.95	0.95	0.93	0.92	0.93	0.85	0.90	0.92	0.94
Shelter	0.99	0.98	0.97	0.99	0.98	0.99	0.99	0.98	0.99	0.99	0.99
Household, furn. & equip.	0.98	0.93	0.97	0.96	0.94	0.95	0.96	0.95	0.97	0.97	0.97
Clothing & footwear	0.96	0.91	0.84	0.91	0.92	0.96	0.94	0.90	0.93	0.94	0.95
Transportation	0.98	0.99	0.99	0.98	0.98	0.98	0.94	0.91	0.95	0.96	0.98
Health & personal care	0.97	0.96	0.93	0.97	0.97	0.94	0.97	0.93	0.90	0.98	0.97
Rec., educ. & reading	0.97	0.94	0.96	0.96	0.97	0.96	0.97	0.94	0.95	0.95	0.91
Alcohol	0.97	0.94	0.93	0.87	0.91	0.93	0.96	0.95	0.93	0.94	0.93
Tobacco	0.93	0.92	0.87	0.86	0.93	0.93	0.93	0.86	0.87	0.87	0.92
					Value of Coefficient on Lagged Inflation – Subsample 1992M1 to 2008M12						
Total CPI	0.86	0.83	0.90	0.87	0.89	0.85	0.84	0.80	0.82	0.82	0.87
Energy	0.85	0.89	0.92	0.88	0.88	0.84	0.78	0.81	0.75	0.67	0.79
Food	0.94	0.83	0.90	0.88	0.89	0.90	0.93	0.85	0.88	0.87	0.79
Shelter	0.94	0.91	0.94	0.92	0.92	0.95	0.87	0.93	0.97	0.80	0.86
Household, furn. & equip.	0.83	0.67	0.83	0.76	0.77	0.82	0.84	0.85	0.81	0.84	0.80
Clothing & footwear	0.67	0.62	0.35	0.57	0.64	0.57	0.59	0.71	0.82	0.56	0.51
Transportation	0.85	0.91	0.89	0.87	0.89	0.83	0.83	0.82	0.80	0.85	0.84
Health & personal care	0.80	0.82	0.79	0.68	0.83	0.76	0.74	0.82	0.86	0.79	0.77
Rec., educ. & reading	0.90	0.87	0.87	0.88	0.91	0.85	0.93	0.90	0.62	0.88	0.88
Alcohol	0.85	0.91	0.75	0.85	0.86	0.89	0.79	0.88	0.85	0.89	0.87
Tobacco	0.94	0.90	0.95	0.96	0.93	0.93	0.93	0.95	0.94	0.95	0.93

* $\pi_\tau = \alpha + \rho\pi_{\tau-1} + \varepsilon_\tau$, where π_τ is the rate of inflation at time t.

Table 6: First-Order Autoregressions of Consumer Price Inflation by Province and Subaggregate (2005 Basket)*

	Canada	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Subaggregate	Value of Coefficient on Lagged Inflation – Subsample 1980M1 to 1991M12										
Total CPI	0.99	0.99	0.98	0.98	0.98	0.98	0.98	0.96	0.98	0.99	0.99
CPI ex food	0.99	0.99	0.98	0.99	0.98	0.98	0.98	0.97	0.98	0.99	0.99
CPI ex food & energy	0.99	0.98	0.98	0.98	0.97	0.98	0.99	0.98	0.98	0.99	0.99
CPI ex alcohol & tobacco**	0.95	0.98	0.93	0.99	0.98	0.98	0.98	0.96	0.97	1.16	0.99
CPI ex alcohol***	0.90	0.94	0.93	0.91	0.92	0.91	0.92	0.70	0.86	0.93	0.93
CPI ex tobacco***	0.88	0.93	0.92	0.90	0.90	0.89	0.95	0.69	0.87	0.93	0.94
CPI ex shelter***	0.88	0.92	0.91	0.82	0.88	0.92	0.85	0.49	0.87	0.89	0.87
CPI ex energy	0.98	0.98	0.98	0.98	0.97	0.97	0.98	0.96	0.97	0.98	0.99
Goods	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.93	0.95	0.97	0.98
Durables	0.98	0.94	0.97	0.96	0.98	0.97	0.97	0.95	0.96	0.97	0.97
Semi-durables	0.96	0.91	0.82	0.93	0.94	0.95	0.94	0.89	0.93	0.95	0.96
Non-durables	0.98	0.98	0.97	0.97	0.96	0.97	0.96	0.91	0.94	0.95	0.97
Services	0.99	0.98	0.98	0.99	0.98	0.98	0.99	0.97	0.98	0.99	0.99
	Value of Coefficient on Lagged Inflation – Subsample 1992M1 to 2008M12										
Total CPI	0.86	0.83	0.90	0.87	0.89	0.85	0.84	0.80	0.82	0.82	0.87
CPI ex food	0.86	0.86	0.90	0.89	0.90	0.87	0.83	0.78	0.82	0.82	0.89
CPI ex food & energy	0.87	0.83	0.88	0.88	0.91	0.87	0.86	0.81	0.87	0.95	0.93
CPI ex alcohol & tobacco	0.82	0.85	0.88	0.89	0.89	0.82	0.85	0.84	0.85	0.82	0.91
CPI ex alcohol	0.86	0.83	0.90	0.88	0.88	0.85	0.85	0.80	0.82	0.82	0.87
CPI ex tobacco	0.82	0.83	0.88	0.87	0.86	0.76	0.80	0.81	0.82	0.80	0.87
CPI ex shelter	0.84	0.76	0.85	0.84	0.87	0.84	0.84	0.79	0.81	0.86	0.83
CPI ex energy	0.87	0.79	0.88	0.86	0.90	0.87	0.88	0.83	0.87	0.94	0.92
Goods	0.83	0.82	0.89	0.86	0.86	0.84	0.81	0.80	0.82	0.69	0.73
Durables	0.97	0.93	0.94	0.94	0.95	0.95	0.96	0.95	0.99	0.96	0.95
Semi-durables	0.69	0.61	0.44	0.52	0.61	0.52	0.66	0.76	0.84	0.53	0.57
Non-durables	0.88	0.86	0.92	0.90	0.89	0.89	0.86	0.82	0.79	0.72	0.74
Services	0.89	0.93	0.90	0.91	0.92	0.85	0.88	0.85	0.96	0.98	0.95

* $\pi_\tau = \alpha + \rho\pi_{\tau-1} + \varepsilon_\tau$, where π_τ is the rate of inflation at time t.

** The autoregression for Canada is calculated for the period 1982M1 to 1991M12, so it is not strictly comparable with the other autoregressions in this table.

*** The autoregressions for both Canada and the provinces are calculated for the period 1985M12 to 1991M12, so they are not strictly comparable with other autoregressions in this table.

Table 7: Inflation Correlations Between Canada and the Provinces for Consumer Price Index Components (2005 Basket)[21]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Component	Correlation – Subsample 1980M1 to 1991M12 (n = 144)									
Total CPI	0.96	0.94	0.96	0.93	0.97	0.98	0.96	0.94	0.97	0.97
Energy	0.95	0.93	0.92	0.93	0.98	0.98	0.87	0.84	0.92	0.96
Food	0.92	0.87	0.87	0.86	0.93	0.96	0.85	0.78	0.89	0.89
Shelter	0.85	0.87	0.89	0.85	0.95	0.95	0.90	0.92	0.91	0.95
Household, furn. & equip.	0.92	0.84	0.95	0.91	0.93	0.97	0.90	0.92	0.96	0.93
Clothing & footwear	0.69	0.89	0.93	0.95	0.88	0.95	0.92	0.92	0.97	0.93
Transportation	0.95	0.94	0.94	0.88	0.95	0.99	0.89	0.80	0.94	0.95
Health & personal care	0.82	0.88	0.94	0.94	0.94	0.98	0.79	0.34	0.90	0.97
Recreation, education & reading	0.88	0.93	0.82	0.87	0.88	0.97	0.84	0.90	0.95	0.84
Alcohol & tobacco products	0.77	0.79	0.60	0.76	0.89	0.91	0.70	0.80	0.60	0.78
	Correlation – Subsample 1992M1 to 2008M12 (n = 204)									
Total CPI	0.74	0.86	0.79	0.81	0.89	0.94	0.70	0.65	0.67	0.45
Energy	0.88	0.89	0.92	0.89	0.95	0.95	0.86	0.80	0.77	0.88
Food	0.73	0.68	0.62	0.63	0.89	0.91	0.75	0.68	0.61	0.64
Shelter	0.66	0.73	0.67	0.57	0.86	0.86	0.73	0.66	0.70	0.69
Household, furn. & equip.	0.45	0.35	0.28	0.48	0.70	0.82	0.52	0.30	0.55	0.48
Clothing & footwear	0.37	0.20	0.58	0.51	0.67	0.81	0.61	0.39	0.59	0.49
Transportation	0.88	0.89	0.92	0.92	0.94	0.96	0.79	0.84	0.90	0.84
Health & personal care	0.68	0.77	0.61	0.76	0.80	0.89	0.65	0.60	0.72	0.57
Recreation, education & reading	0.75	0.77	0.65	0.69	0.80	0.90	0.81	0.67	0.87	0.62
Alcohol & tobacco products	0.81	0.94	0.92	0.92	0.97	0.99	0.88	0.78	0.72	0.80

[21] Correlation coefficient between the rate of inflation in province i and the rate of inflation for Canada. Based upon the t-statistic $r * (n\text{-}2)^{1/2}/ (1\text{-}r^2)^{1/2}$, where r is the correlation value and n is the number of data points. All but one of the correlations in this table are statistically different from zero at the 5 per cent level. The threshold correlation values for statistical significance at n = 144 and n = 204 are 0.163 and 0.138, respectively.

Table 8: Inflation Correlations Between Canada and the Provinces for Consumer Price Subaggregates (2005 Basket)[22]

	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Subaggregate	Correlation – Subsample 1980M1 to 1991M12 ($n = 144$)									
Total CPI	0.96	0.94	0.96	0.93	0.97	0.98	0.96	0.94	0.97	0.97
CPI ex food	0.94	0.94	0.96	0.93	0.96	0.98	0.95	0.93	0.97	0.96
CPI ex food & energy	0.91	0.95	0.96	0.92	0.94	0.97	0.95	0.91	0.97	0.94
CPI ex alcohol & tobacco**	0.91	0.86	0.92	0.82	0.95	0.96	0.88	0.87	0.93	0.95
CPI ex alcohol***	0.89	0.79	0.87	0.81	0.75	0.58	0.76	0.63	0.79	0.77
CPI ex tobacco***	0.78	0.68	0.81	0.70	0.66	0.55	0.71	0.61	0.73	0.72
CPI ex shelter***	0.92	0.81	0.82	0.71	0.87	0.68	0.54	0.32	0.70	0.80
CPI ex energy	0.94	0.94	0.96	0.92	0.96	0.97	0.96	0.93	0.96	0.95
Goods	0.96	0.92	0.95	0.93	0.97	0.98	0.92	0.88	0.95	0.97
Durables	0.94	0.93	0.97	0.94	0.98	0.98	0.96	0.95	0.96	0.95
Semi-durables	0.74	0.89	0.92	0.94	0.90	0.95	0.90	0.93	0.96	0.91
Non-durables	0.96	0.90	0.92	0.91	0.97	0.98	0.88	0.82	0.91	0.96
Services	0.89	0.94	0.93	0.91	0.96	0.96	0.92	0.92	0.96	0.92
	Correlation – Subsample 1992M1 to 2008M12 ($n = 204$)									
Total CPI	0.72	0.85	0.78	0.82	0.89	0.94	0.70	0.65	0.68	0.42
CPI ex food	0.81	0.89	0.86	0.87	0.90	0.92	0.69	0.64	0.70	0.49
CPI ex food & energy	0.68	0.85	0.79	0.81	0.88	0.88	0.57	0.47	0.60	0.34
CPI ex alcohol & tobacco**	0.78	0.85	0.80	0.79	0.90	0.89	0.73	0.70	0.71	0.55
CPI ex alcohol***	0.73	0.85	0.78	0.80	0.89	0.94	0.68	0.65	0.69	0.46
CPI ex tobacco***	0.78	0.85	0.79	0.79	0.87	0.92	0.72	0.68	0.68	0.53
CPI ex shelter***	0.68	0.78	0.74	0.80	0.85	0.96	0.74	0.62	0.75	0.52
CPI ex energy	0.58	0.77	0.69	0.74	0.86	0.92	0.60	0.56	0.58	0.34
Goods	0.71	0.78	0.77	0.81	0.91	0.95	0.76	0.61	0.67	0.67
Durables	0.82	0.93	0.89	0.90	0.97	0.98	0.95	0.92	0.96	0.95
Semi-durables	0.41	0.37	0.58	0.56	0.64	0.85	0.65	0.45	0.64	0.53
Non-durables	0.79	0.87	0.84	0.84	0.95	0.97	0.83	0.71	0.69	0.77
Services	0.61	0.66	0.74	0.67	0.74	0.80	0.41	0.61	0.79	0.48

[22] Correlation coefficient between the rate of inflation in province i and the rate of inflation for Canada. Based upon the t-statistic $r * (n-2)^{1/2}/(1-r^2)^{1/2}$, where r is the correlation value and n is the number of data points. All but one of the correlations in this table are statistically different from zero at the 5 per cent level. The threshold correlation values for statistical significance at $n = 144$ and $n = 204$ are 0.163 and 0.138, respectively.

** The correlations are computed only for the period 1982M1 to 1991M12 due to data availability.

*** The correlations are computed for the period 1985M12 to 1991M12, so they are not strictly comparable with other correlations in this table.

Table 9: Cross-Correlations of Provincial Inflation Rates: Total CPI (2005 Basket)[23]

Province	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
	Correlation – Subsample 1980M1 to 1991M12 (n = 144)									
Newfoundland	1.00	0.95	0.98	0.97	0.94	0.92	0.94	0.94	0.93	0.94
Prince Edward Island		1.00	0.96	0.94	0.93	0.89	0.90	0.93	0.93	0.95
Nova Scotia			1.00	0.96	0.94	0.93	0.95	0.93	0.94	0.95
New Brunswick				1.00	0.92	0.89	0.92	0.93	0.90	0.92
Quebec					1.00	0.92	0.92	0.90	0.95	0.93
Ontario						1.00	0.94	0.92	0.93	0.94
Manitoba							1.00	0.93	0.92	0.92
Saskatchewan								1.00	0.93	0.93
Alberta									1.00	0.96
British Columbia										1.00
	Correlation – Subsample 1992M1 to 2008M12 (n = 204)									
Newfoundland	1.00	0.82	0.88	0.83	0.57	0.63	0.60	0.56	0.58	0.43
Prince Edward Island		1.00	0.85	0.82	0.75	0.78	0.59	0.61	0.57	0.43
Nova Scotia			1.00	0.91	0.63	0.70	0.55	0.57	0.63	0.30
New Brunswick				1.00	0.67	0.73	0.54	0.55	0.66	0.29
Quebec					1.00	0.82	0.54	0.43	0.47	0.25
Ontario						1.00	0.67	0.57	0.50	0.32
Manitoba							1.00	0.65	0.42	0.41
Saskatchewan								1.00	0.50	0.47
Alberta									1.00	0.22
British Columbia										1.00

[23] Correlation coefficient between the rate of inflation in province i and the rate of inflation for Canada. Based upon the t-statistic $r * (n-2)^{1/2}/(1-r^2)^{1/2}$, where r is the correlation value and n is the number of data points. All correlations are statistically different from zero at the 5 per cent level. The threshold correlation values for statistical significance at n = 144 and n = 204 are 0.163 and 0.138, respectively.

Table 10: Cross-Correlations of Provincial Inflation Rates: Total CPI Excluding Food & Energy (2005 Basket)[24]

Province	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
Correlation – Subsample 1980M1 to 1991M12 (*n* = 144)										
Newfoundland	1.00	0.93	0.94	0.95	0.89	0.84	0.93	0.94	0.89	0.88
Prince Edward Island		1.00	0.93	0.92	0.94	0.86	0.93	0.90	0.94	0.93
Nova Scotia			1.00	0.92	0.94	0.91	0.93	0.90	0.94	0.90
New Brunswick				1.00	0.90	0.86	0.92	0.92	0.88	0.86
Quebec					1.00	0.85	0.90	0.86	0.93	0.85
Ontario						1.00	0.92	0.87	0.91	0.89
Manitoba							1.00	0.95	0.90	0.88
Saskatchewan								1.00	0.89	0.87
Alberta									1.00	0.93
British Columbia										1.00
Correlation – Subsample 1992M1 to 2008M12 (*n* = 204)										
Newfoundland	1.00	0.73	0.73	0.77	0.51	0.52	0.45	0.44	0.44	0.47
Prince Edward Island		1.00	0.84	0.85	0.75	0.74	0.49	0.42	0.51	0.29
Nova Scotia			1.00	0.87	0.60	0.74	0.47	0.53	0.58	0.19
New Brunswick				1.00	0.68	0.72	0.55	0.45	0.55	0.22
Quebec					1.00	0.73	0.47	0.31	0.33	0.21
Ontario						1.00	0.51	0.32	0.42	0.04
Manitoba							1.00	0.34	0.22	0.27
Saskatchewan								1.00	0.45	0.31
Alberta									1.00	0.17
British Columbia										1.00

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[24] Correlation coefficient between the rate of inflation in province *i* and the rate of inflation for Canada. Based upon the *t*-statistic $r * (n-2)^{1/2}/(1-r^2)^{1/2}$, where *r* is the correlation value and *n* is the number of data points. All correlations are statistically different from zero at the 5 per cent level. The threshold correlation values for statistical significance at *n* = 144 and *n* = 204 are 0.163 and 0.138, respectively.

Table 11: Dispersion of Inflation Rates Across Provinces by Consumer Price Component

CPI component	Average dispersion (1980M1-2008M12)	Peak dispersion
Total CPI	0.78	1.76
Food	1.22	3.01
Household, furn. & equip.	1.01	2.27
Clothing & footwear	1.58	3.29
Health & personal care	1.16	6.75
Recreation, education & reading	0.92	1.72
Energy	3.85	17.35
Shelter	1.81	4.60
Transportation	1.57	4.37
Alcohol & tobacco products	2.76	9.32

Table 12: Average Dispersion of Inflation Rates Across Provinces for Various Consumer Price Subaggregates

Subaggregate	1980M1–2008M12	1985M12–2008M12
Total CPI	0.78	0.76
CPI ex food	0.88	0.85
CPI ex food & energy	0.75	0.71
CPI ex alcohol & tobacco**	n.a.	0.75
CPI ex alcohol***	n.a.	0.78
CPI ex tobacco***	n.a.	0.73
CPI ex shelter***	n.a.	0.72
CPI ex energy	0.68	0.65
Goods	1.05	1.07
Durables	0.82	0.76
Semi-durables	1.33	1.40
Non-durables	1.61	1.66
Services	0.95	0.87

** Inflation rates for Canada are available only since 1982M1.
*** Inflation rates for both Canada and the provinces are available only since 1985M12.

Figure 1: Provincial Maximum and Minimum Year-Over-Year Percentage Changes in Alcohol and Tobacco Product Prices
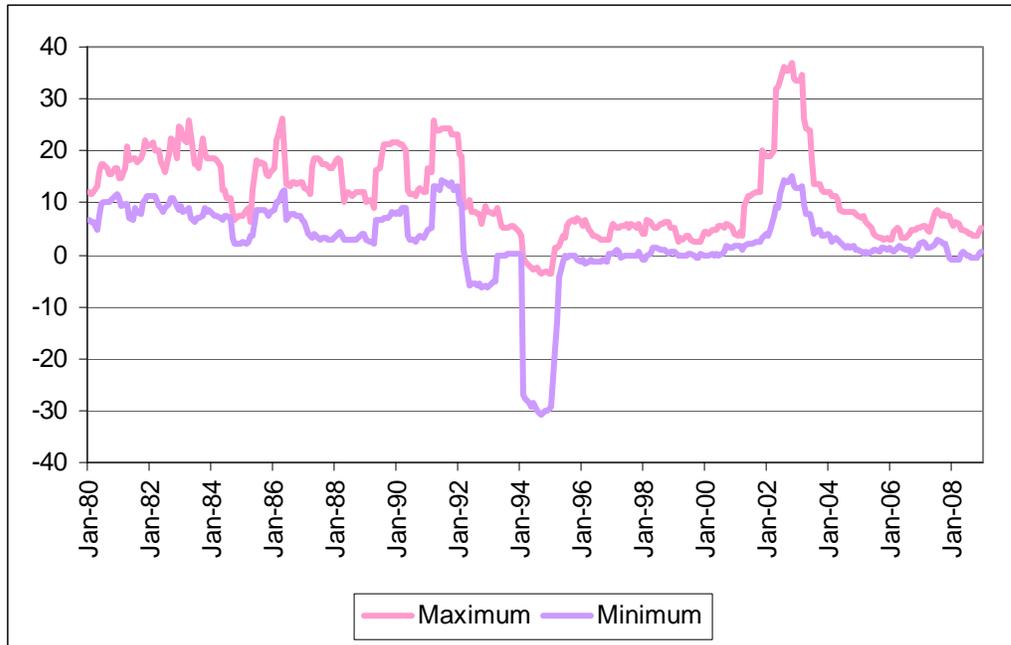
Figure 2: Provincial Dispersion of Consumer Price Inflation
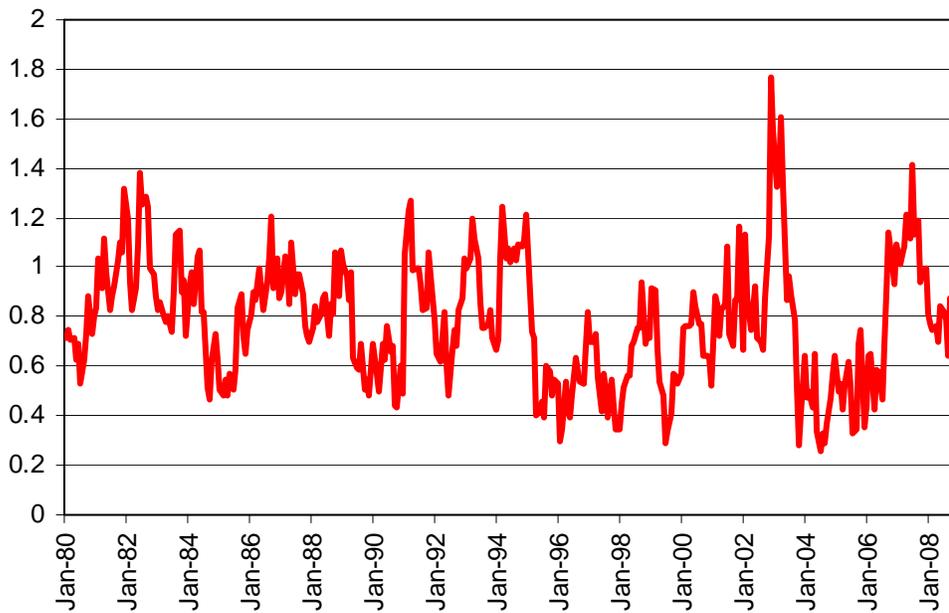
Figure 3: Provincial Dispersion of Inflation in Energy

Figure 4: Provincial Dispersion of Inflation in Food

Figure 5: Provincial Dispersion of Inflation in Shelter

Figure 6: Provincial Dispersion of Inflation in Household Operations, Furnishings and Equipment

Figure 7: Provincial Dispersion of Inflation in Clothing and Footwear
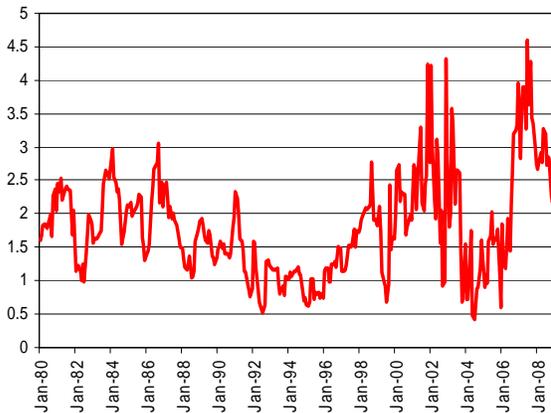
Figure 8: Provincial Dispersion of Inflation in Transportation

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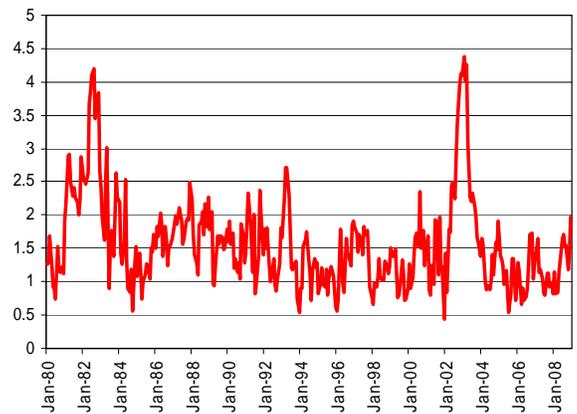
Figure 9: Provincial Dispersion of Inflation in Health and Personal Care
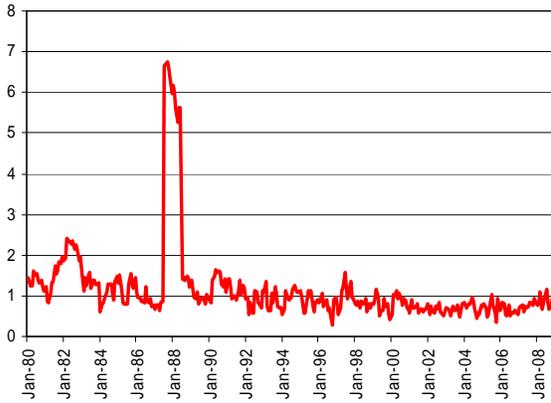
Figure 10: Provincial Dispersion of Inflation in Recreation, Education and Reading
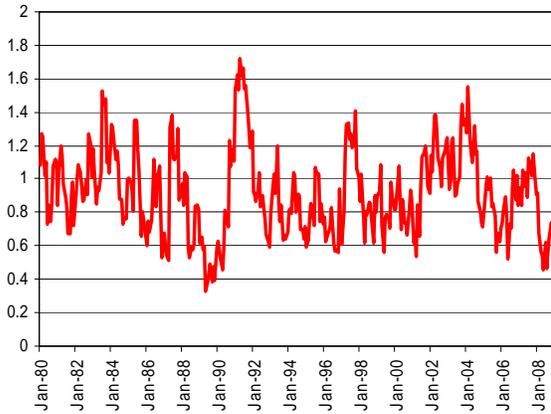
Figure 11: Provincial Dispersion of Inflation in Alcohol and Tobacco
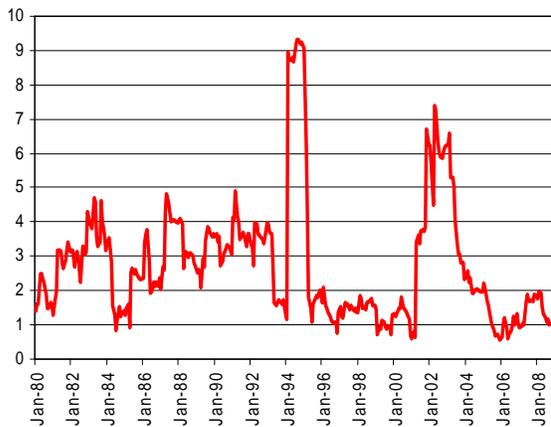
Figure 12: Provincial Dispersion of Consumer Price Inflation Excluding Food
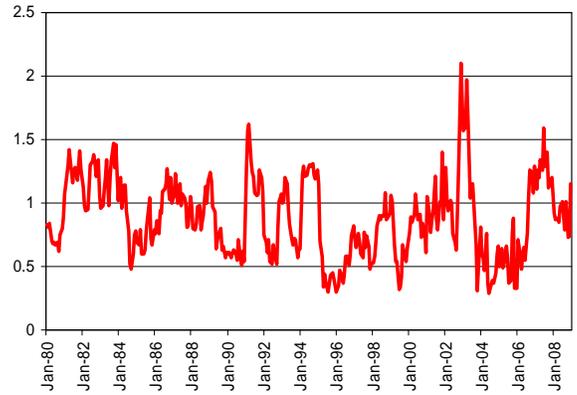
Figure 13: Provincial Dispersion of Consumer Price Inflation Excluding Food & Energy
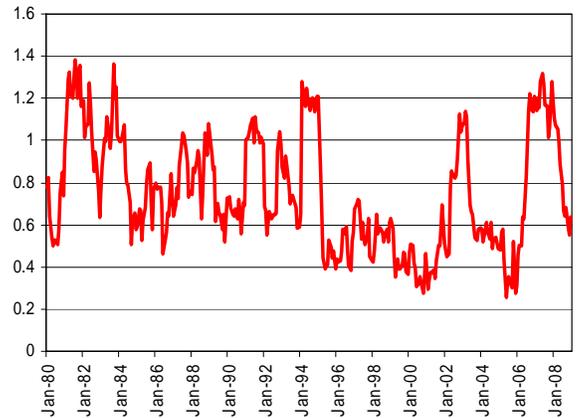
Figure 14: Provincial Dispersion of Consumer Price Inflation Excluding Alcohol and Tobacco

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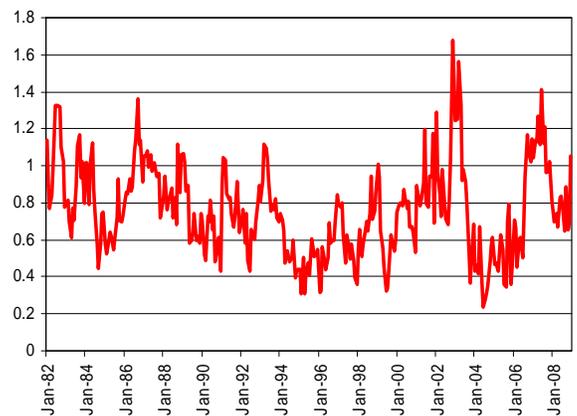
Figure 15: Provincial Dispersion of Consumer Price Inflation Excluding Alcohol
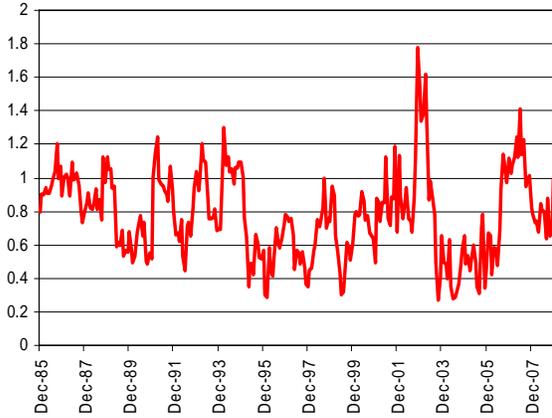
Figure 16: Provincial Dispersion of Consumer Price Inflation Excluding Tobacco
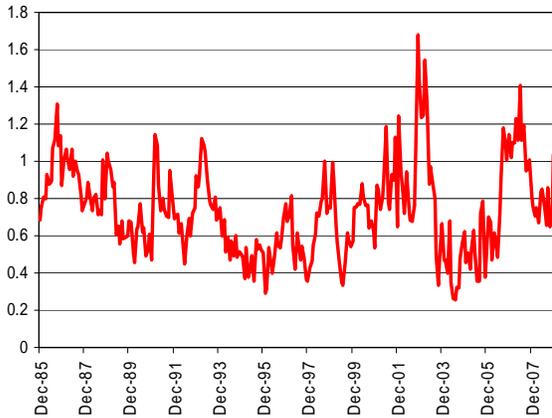
Figure 17: Provincial Dispersion of Consumer Price Inflation Excluding Shelter
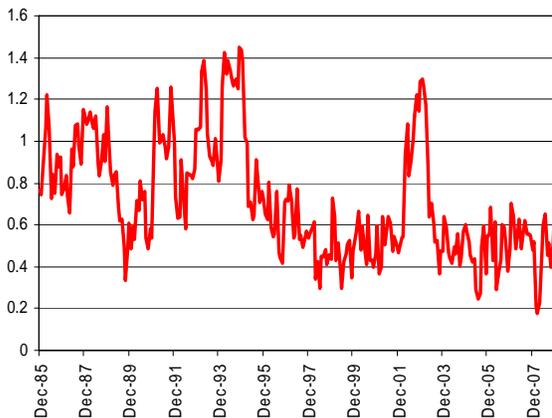
Figure 18: Provincial Dispersion of Consumer Price Inflation Excluding Energy
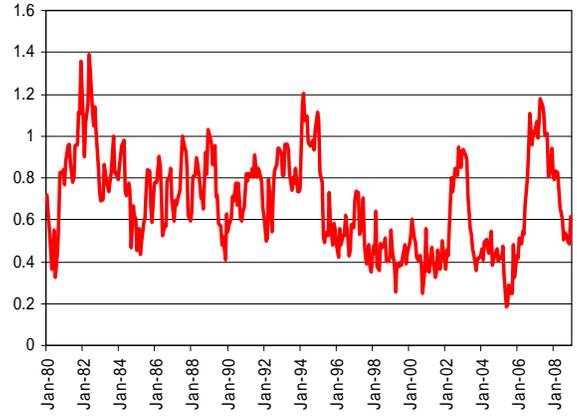
Figure 19: Provincial Dispersion of Consumer Price Inflation in Goods
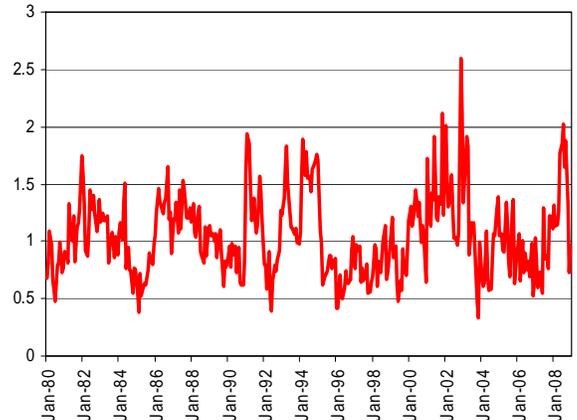
Figure 20: Provincial Dispersion of Consumer Price Inflation in Durable Goods
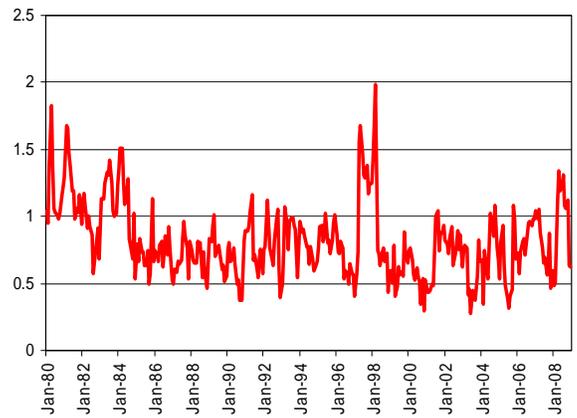
Figure 21: Provincial Dispersion of Consumer Price Inflation in Semi-Durable Goods
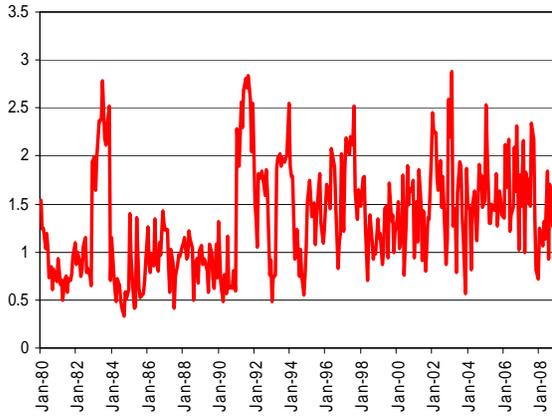
Figure 22: Provincial Dispersion of Consumer Price Inflation in Non-Durable Goods
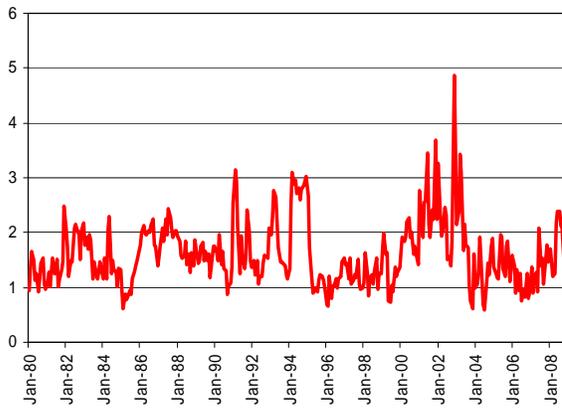
Figure 23: Provincial Dispersion of Consumer Price Inflation in Services

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