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Heterogeneous response of disaggregate inflation to monetary policy regime change: The role of price stickiness

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ABSTRACT

This paper explores how a monetary regime change affects headline inflation via differential effects on various sectors in the economy. Using disaggregated CPI data for Canada, we find that the response to the adoption of inflation targeting (IT) was quite heterogeneous across sectors. While sticky-price sectors experienced a notable change in inflation dynamics following IT adoption, little structural change was observed in flexible price sectors. Our analysis based on a common factor model suggests that the structural changes in the sticky price sectors are driven by a decline in their responses to common aggregate shocks, including a monetary shock.

1. Introduction

It is widely recognized in the literature that monetary policy regime shifts have been key contributors to the evolution of headline inflation in major industrialized countries (e.g. Benati, 2008; Cecchetti et al., 2007). Despite extensive research on the effects of these regime changes on macroeconomic performance, not much is known about the channels through which they are transmitted to headline inflation. Recent research highlights the importance of understanding the heterogeneous behavior of subaggregate inflation, and so studying sectoral-level responses to a regime change appears to be a promising avenue of investigation. Given that a growing body of research looking at the microdata generally suggests that inflation dynamics differ considerably at the disaggregate level (e.g. Bils and Klenow, 2004; Nakamura and Steinsson, 2008), the qualitative and quantitative effects of monetary regime change are likely to be very different across sectors (e.g. Carvalho and Nechio, 2011). A deeper understanding of how regime change influences the dynamics of subaggregate price indices could prove useful to policymakers in a number of ways. For example, it could help policymakers choose an appropriate price statistic for their inflation target by obtaining a better sense of which sectors of the economy might be more affected by policy decisions (e.g. Boivin and Giannoni, 2006; Bryan and Cecchetti, 1994; Clark, 2001). It may also allow for a deeper

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understanding of the welfare costs associated with inflation, which have been often linked in the literature to the variability in relative prices (e.g. Choi, 2010).

The primary purpose of this study is to offer some insight into how a change in the monetary policy framework impacts the behavior of headline inflation via its subcomponents. Our analysis centers on two questions: (1) which sectoral prices are more responsive to the change in monetary policy regime, as gauged by three measures of inflation dynamics (level, volatility and persistence) and (2) what sectoral characteristics can explain the heterogeneous responses of sectoral prices. We attempt to address these questions by focusing on Canada's experience with the adoption of inflation targeting (IT) more than two decades ago. As a framework for conducting monetary policy, IT is known to be effective in lowering inflation and inflation variability by stabilizing inflation expectations toward a numerical objective.[1] As an early adopter of IT in 1991, Canada has reasonably long time series of price data with which we can compare effectively the periods before and after IT adoption. In addition, the Canadian economy encompasses a diverse range of sectors, with price indices available for a large number of subcategories, enabling a relatively rich disaggregate analysis of the impact of the monetary policy regime change.

A quick glance at Fig. 1 helps grasp important features of Canadian inflation dynamics since 1978. The upper panel of Fig. 1 plots the evolution of the headline inflation rate and three selected disaggregate inflation rates (solid lines) over time, along with the announced target range of inflation (dotted lines).[2] National headline inflation displays two apparent structural changes: one around the year 1983 at the end of the Great Inflation and the other around the year 1991, when IT was adopted. The Canadian headline inflation rate fell into the intended target range immediately after IT adoption, indicating the effectiveness of IT in stabilizing inflation. At the disaggregate level, however, the effect of IT is rather mixed. While inflation rates for both goods and services exhibit a very similar pattern to that of headline inflation, energy inflation fluctuates consistently far outside the target range. The heterogeneity in the dynamics of disaggregate inflation can also be seen in terms of volatility and persistence (based on the twelve-month rate of inflation). As illustrated in the lower panel of Fig. 1, energy price changes are much more volatile but less persistent than the others, and do not exhibit a clear response to IT adoption.

Further information on the behavior of both headline and disaggregate inflation is provided in Table 1, which lists summary statistics for inflation dynamics before and after IT adoption. To facilitate comparison with earlier studies, we consider two subsamples for the pre-IT period, 1978–1991 and 1983–1991. The adoption of IT was clearly associated with a marked reduction in the level and persistence of headline inflation. The behavior of volatility across time periods, however, is sensitive to the starting point used for the pre-IT period. With 1983 as the starting year of the pre-IT period, we find a slight increase in volatility under the IT regime. This implies that the change in monetary regime was effective in lowering but not necessarily stabilizing inflation.[3] Table 1 also shows the heterogeneous dynamics of inflation at the disaggregate level highlighted in Fig. 1. Whereas the price changes in food and services became less volatile after IT adoption, energy prices were much more volatile under the IT regime. This very different pattern exhibited by energy inflation is consistent with the conventional wisdom that energy prices are highly susceptible to ever-changing global market factors, and their heightened volatility is believed to be responsible for the failure of headline inflation to fall in the post-IT period. It is also worth noting that energy inflation exhibits qualitatively different patterns than food inflation, although both are major constituents of so-called *non-core* inflation. Goods inflation also displays a slight increase in volatility under the IT regime, probably in part because of indirect effects of the higher volatility in energy prices on some of its constituents. A similar categorical difference is noted in the effect on inflation persistence, which is known to reflect the formation of inflation expectations (e.g. Amano and Murchison, 2005). The persistence of inflation did fall after the regime change both at the aggregate and disaggregate levels, in line with the basic intuition that a key anticipated benefit of IT adoption is better-anchored inflation expectations. Apart from service prices, however, the persistence of disaggregate inflation was relatively low (below 0.35 in terms of SARC—almost indistinguishable from white noise) even before the adoption of IT. It is the persistence of service inflation that underwent a significant drop under the IT regime, indicative of inflation expectations formation becoming less inertial.

The key observation here is that the monetary regime change has affected inflation in different sectors in different ways. What then can explain the observed differences? More specifically, what underlying sectoral characteristics might account for the heterogeneous responses to the policy regime change? While a range of sectoral characteristics have featured in the literature exploring pricing behavior, we focus on price stickiness as a potential candidate for explaining the sectoral heterogeneity given the central role played by the distinction between sticky and flexible prices in macroeconomic models (e.g. Aoki, 2001).[4] By relating the degree of price stickiness in the various sectors to the dynamics of Canadian sectoral

[1] Most studies in the inflation targeting literature have focused on the effect of IT at the aggregate level or at a low degree of disaggregation. We are aware of no study that is devoted to highly disaggregated sectoral analysis. For a comprehensive survey of IT, see Walsh (2009).

[2] The Bank of Canada originally set a target inflation range of 2–4%. This was lowered at the end of 1992 to 1.5–3.5% until June 1994 when it was re-adjusted to the current range of 1–3%.

[3] Previous studies (e.g. Longworth, 2002; Benati, 2008) that found a decline in volatility under the IT regime typically had an earlier starting point for the pre-IT period and so included the Great Inflation period. If we extend the pre-IT period to begin in 1978, we also find that volatility declines under the IT regime.

[4] A common practice of distinguishing between core and non-core inflation may have reduced relevance to our case in view of the qualitative difference observed in the dynamics of food and energy inflation.

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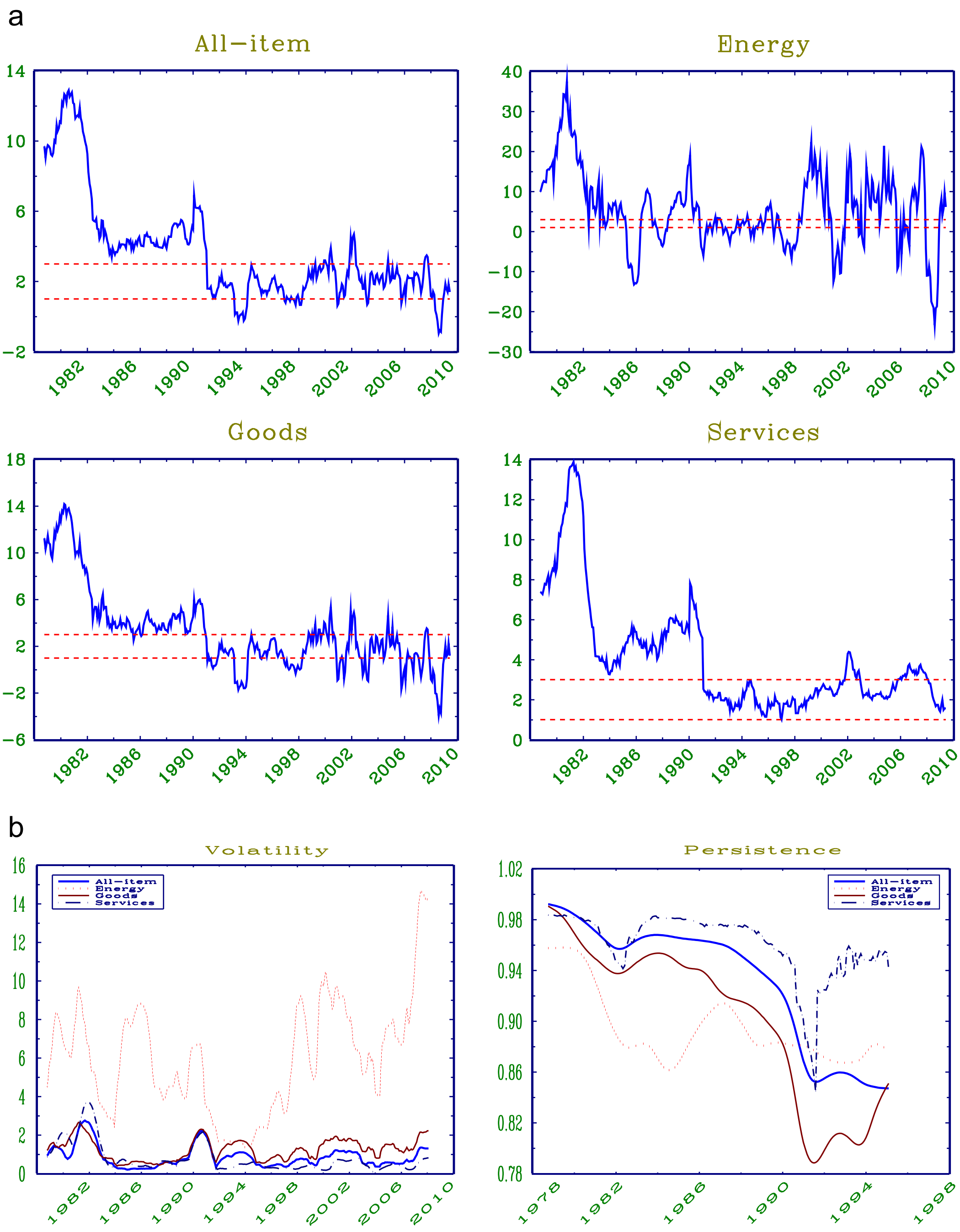

Fig. 1. Dynamics of aggregate and disaggregate inflation (1978.9–2010.5). Panel A: Annualized monthly inflation rates and Panel B: Volatility and persistence of inflation rates.

inflation rates, we find that the degree of price stickiness is positively associated with the volatility, but negatively with the persistence of sectoral inflation, consistent with the growing body of micro-data evidence.

To assess the role of price stickiness in determining sectoral responses to the monetary regime change, we group sectoral prices into two categories, a sticky price category that includes sectors in which price adjustments are made relatively infrequently, and a flexible price category. We construct a summary inflation measure for each category and find strong evidence that the sticky price inflation measure responds very differently to the monetary regime change than the flexible price inflation measure. While sticky price sectors experienced a drastic drop in the volatility and persistence of inflation following the monetary regime change, no such structural change is noticed in flexible price inflation. That is, it is the prices in sectors with less frequent price adjustments that react more strongly to the monetary regime change.

Table 1
Inflation dynamics over subsample periods.

Inflation	Mean			Volatility			Persistence		
	1978–1991	1983–1991	1991–2010	1978–1991	1983–1991	1991–2010	1978–1991	1983–1991	1991–2010
Headline	6.4	4.5	1.8	4.9	3.2	3.3	0.85	0.48	−0.32
Food	6.0	4.2	2.0	10.3	9.8	6.9	0.42	−0.57	−0.18
Energy	8.2	3.1	3.6	24.5	19.5	33.0	0.27	0.30	−1.02
Goods	6.3	4.0	1.3	6.6	5.6	7.4	0.77	0.35	−0.32
Services	6.5	5.0	2.3	4.7	4.4	2.6	0.85	0.77	0.35

Note: Mean inflation and volatility are based on the annualized monthly inflation rates and persistence is computed with annualized quarterly inflation rates.

This difference between sticky-price and flexible-price sectors is also reflected in our analysis based on a common factor model, where we decompose sectoral inflation into a part driven by common aggregate shocks (common component) and a part driven by sector specific shocks (idiosyncratic component). The relative importance of common shocks, which is measured by the fraction of the variability of sectoral inflation associated with the common component and labeled as 'share of common component' throughout the paper, dropped considerably after IT adoption. Moreover, this drastic fall is almost entirely driven by the sticky-price sectors, with the share for those sectors plunging from 26.8% to 3.4%. We find that the decline in the common share in the sticky-price sectors is largely attributable to a reduced sensitivity of sticky price inflation to the common factor. In flexible price sectors, where the share of common component was very low even before the monetary regime change, we notice little change in the share, reinforcing our principal argument that the impact of the monetary regime change was transmitted to headline inflation mainly through sticky-price sectors.

The differing responses between sticky and flexible price sectors to the monetary regime change can be explained by the fact that firms in sticky-price sectors are likely to be more forward looking than their flexible-price counterparts. Because they are slower to respond to changes in the current market environment, firms that adjust their prices infrequently may take more account of the future state of the economy and hence incorporate expectations about future inflation (e.g. Bryan and Meyer, 2010; Millard and O'Grady, 2012). Given that IT aims to anchor inflation expectations toward a pre-announced target level and that inflation expectations matter more in the sticky-price sector, one may expect sticky-price inflation to be much more responsive to the adoption of IT than flexible-price inflation. In contrast, flexible price sectors are likely to be less affected by IT adoption because they continue to be able to react quickly to sector specific shocks. In this vein, our empirical finding is similar in spirit to that in Carvalho (2006) that sticky price sectors are the main drivers of movements in aggregate inflation, especially in the event of a monetary policy regime change. Our results also support the view of Boivin et al. (2009) that monetary policy regime change is an important contributor to the change in the dynamics of Canadian sectoral inflation, in light of the fact that the dynamics implied by the estimated common factor track very closely the path of short-run interest rates.

The remainder of the paper is laid out as follows. Section 2 describes the data and provides a preliminary analysis of the heterogeneous patterns in the disaggregate inflation series. In Section 3, we sort CPI items into two categories, sticky price and flexible price inflation, to evaluate the impact of IT adoption on the behavior of sectoral inflation dynamics. We construct two sub-indices based on weighted averages of the constituent series in each category and examine the response of each inflation series to IT adoption in terms of mean, persistence and volatility. In the same section, we also implement a common factor model analysis. Section 4 concludes the paper. The Appendix contains a description of the data along with some detailed empirical results at the sectoral level.

2. The data and preliminary analysis

We use national monthly indices in Canada for the overall consumer price index and its subcomponents. Of the 118 sectoral price indices available at various levels of aggregation, we focus on those at the most disaggregate level.[5] Table A1 in the Appendix presents the 50 sectors for which monthly price indices are available from September 1978 until May 2010, resulting in 381 observations for each series. The table also contains weights for each of the 50 items that together comprise approximately 75% of the CPI. There is, however, substantial variation in the weights allocated to each sector, ranging from 0.14–0.18% for 'fats and oils' to 5.36–7.75% for 'rented accommodation'. Also, the weights vary slightly over time.

Unless noted otherwise, inflation is calculated as the annualized monthly percentage change in the consumer price index (1200 times the log difference of the price indices), after seasonally adjusting the price indices using the Census X12-ARIMA method. Table A2 in the Appendix presents summary statistics (mean, 10-th and 90-th percentiles, and standard deviation)

[5] The selection of sectors was mainly governed by the availability of sufficiently long continuous data series for monthly price indices. For some sectors in which price indices are available at this level of disaggregation for only a short period, we retain the series at the next highest level of aggregation. The underlying data have been collected from *Statistics Canada* homepage (http://www.statcan.gc.ca/).

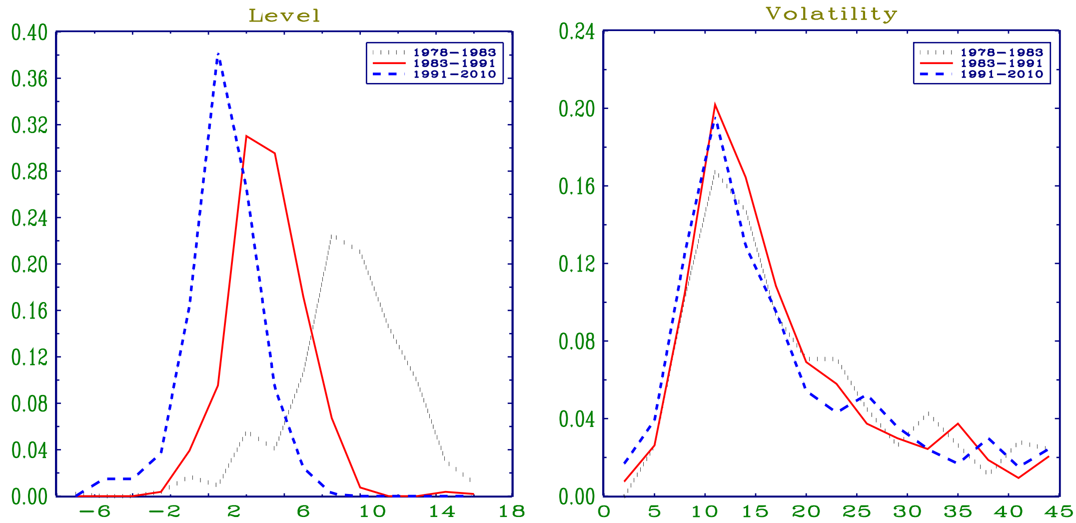

Fig. 2. Empirical densities of level and volatility of sectoral inflation rates over time.

on sectoral inflation for the full sample period and for three subsample periods, using 1983:M8 and 1991:M2 as breakpoints. September 1983 marks the end of the Great Inflation when the level and volatility of inflation declined significantly in Canada, and February 1991 is the official adoption date of inflation targeting in Canada.[6] Not surprisingly, Table A2 illustrates considerable variation in the mean and volatility of sectoral inflation. In the full sample period, for instance, the period average annualized inflation rates range from −0.75% for 'recreational equipment and services' to 8.63% for 'tobacco products'. Volatility, measured by standard deviation, also exhibits similar sectoral heterogeneity, varying between 2.13 ('rented accommodation') and 18.24 ('fuel oil'). Note that sectoral inflation is higher than the headline inflation rate in 25 out of 50 sectors but more volatile than headline inflation in the vast majority of sectors (44 out of 50 sectors). This is consistent with the empirical regularity established in the literature that disaggregated sectoral inflation series are on average more volatile than their aggregate counterpart.

Fig. 2 displays the empirical densities for the level and volatility of all sectoral inflation rates for the three subsample periods. As shown in the left panel, the distribution of the level of sectoral inflation rates clearly shifts to the left over time, while no such pattern can be seen in the distribution of sectoral inflation volatility displayed in the right panel. This strengthens our prior observation that the adoption of IT in Canada was associated with a marked reduction in the level but not in the volatility of headline inflation. Recall from Table 1 that the absence of a fall in headline inflation volatility after IT adoption was conjectured to be mainly driven by energy prices. Although informative, the low degree of disaggregation used in Table 1 masks further heterogeneity within each of those categories. Table A2 reveals that the absence of a fall in headline inflation volatility can be largely attributed to several highly volatile sectors, such as 'electricity', 'fuel oil and other fuels', 'gasoline', 'traveler accommodation', and 'tobacco products'. These sectors' price movements have become much more volatile since the late 1990s, probably due to sector specific shocks. In fact, once these five CPI items are dropped from our sample, we see that headline inflation volatility has actually decreased after IT adoption. In what follows, therefore, we carry out our analysis both with and without these five CPI items in order to ensure the robustness of our findings.

3. Price stickiness and the heterogeneous dynamics of sectoral inflation

In recent years, the heterogeneity in price stickiness across sectors has received an enormous amount of attention from theoretical and empirical researchers alike. On the theoretical side, macroeconomic models often predict that sticky prices have important implications for both monetary policy and the dynamics of the aggregate price level (e.g. Aoki, 2001) and link the larger welfare costs of inflation to the sectors with the stickier prices (e.g. Walsh, 2009). Recent empirical studies provide concrete evidence of sectoral heterogeneity in price stickiness (e.g. Bils and Klenow, 2004; Nakamura and Steinsson, 2010; Kehoe and Midrigan, 2010). While firms in sectors with more flexible prices are able to respond more quickly to changes in the current economic environment, firms in sticky price sectors may be more forward looking with a longer time horizon to reset prices (e.g. Bryan and Meyer, 2010; Millard and O'Grady, 2012). As such, there is good reason to believe that the varying speed of adjustment of prices across sectors may play an important role in explaining the heterogeneous responses to the monetary policy regime change. Given more forward-looking behavior in sticky price sectors and the

[6] The choice of break points is also supported by more formal econometric analysis based on Bai-Perron's multivariate break-point test method. The results from the Bai-Perron structural break tests are reported in Table 3.

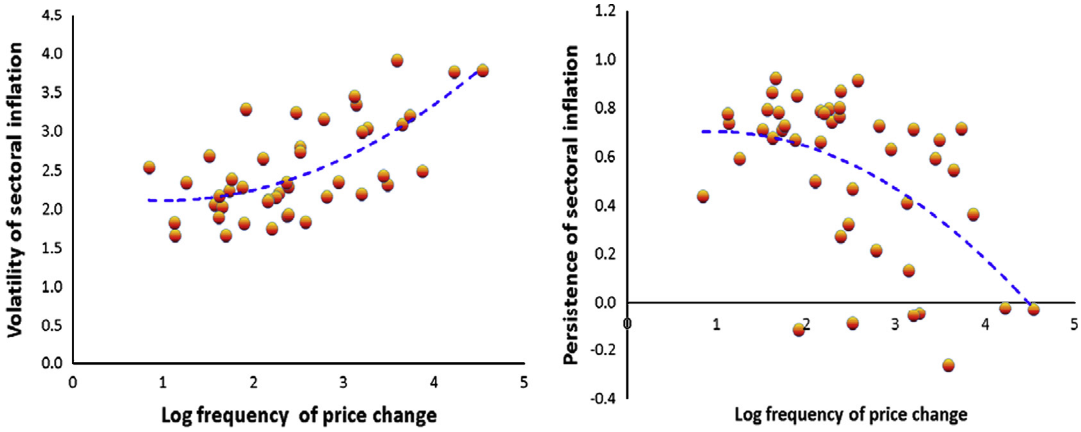

Fig. 3. Price flexibility (on the horizontal axis) and volatility (left) and persistence (right).

potential influence of IT on the formation of inflation expectations, it appears reasonable that sticky price sectors would be more responsive to the monetary regime change.

To examine this issue, we first construct two sub-indices, a sticky-price subindex of the CPI and a flexible-price subindex, following Bryan and Meyer (2010) who highlighted that prices changing at different speeds provide us differing information about the state of the economy. We then apply formal econometric techniques to investigate how the dynamic behavior of the sub-indices has changed after IT adoption. In order to better understand the observed dynamics, we also employ a common factor model that has become popular in macroeconomic modeling and policy analysis (e.g. Bernanke et al., 2005; Boivin et al., 2009). By decomposing the fluctuations in sectoral inflation into a common component that captures economy-wide macro shocks, such as monetary policy regime changes, and an idiosyncratic component that captures sector specific shocks, we assess how the regime change affected sectoral inflation in each of the price-stickiness categories.

3.1. Stickiness of Canadian sectoral prices

In the absence of price stickiness data for Canada, we utilize part of the extensive data set constructed by Nakamura and Steinsson (2008) for the US to categorize our sectors, in the belief that the variation across sectors for the US is a reasonable proxy for that in Canada due to the relatively high degree of integration between the two economies.[7] Using Table 17 of a supplement to their paper as a guide, where the correspondence between the entry-level items (ELI's) and major product groups is documented, we match the relevant ELI's to 45 of the 50 items in our study. We then use their data on the frequency of price changes and expenditure weights to calculate a measure of price flexibility for each of these 45 items based on the weighted mean of the frequency of price changes. Table A1 in the Appendix presents the resulting measure of price flexibility in terms of both frequency (in percent) and duration (in months) for the 45 CPI items. As anticipated, the frequency of price change exhibits a wide degree of variation across sectors, ranging from 2.5% per month for ‘passenger vehicle insurance premiums’ to 93.3% per month for ‘gasoline’. These frequency estimates imply durations of prices of between 0.4 months (gasoline) and 42.7 months (passenger vehicle insurance premiums). For about two-thirds of the CPI items under study, the price duration is less than a year.[8] In Fig. 3, we plot this frequency of price change against a couple of measures of sectoral inflation dynamics, volatility (on the left panel) and persistence (on the right panel). A visual inspection of the scatterplots reveals that sectors with a higher frequency of price changes have more volatile but less persistent sectoral inflation, in line with the prevailing view in the literature (e.g. Bils and Klenow, 2004; Boivin et al., 2009).

Next, we use this information on price flexibility to divide the 45 disaggregate CPI series into two groups—a sticky-price group and a flexible-price group. For each group, we compute a subindex based on the weighted averages of the constituent series.[9] Although it is not straightforward to draw a dividing line between the two groups as noted by Millard and O'Grady

[7] Nakamura and Steinsson (2008) document the frequency of price changes for non-shelter consumer prices for some 270 entry-level items for the period 1998–2005. As shown by Nakamura and Steinsson (2008), the frequency of price change can be transformed to the degree of price stickiness using the formula for implied duration, $d=-1/ln(1-f)$, where f denotes the frequency of price change. Throughout the paper, we stick to the frequency of price change as our measure of price flexibility.

[8] Here price stickiness is assumed to be exogenous, although we are well aware that the degree of price stickiness may vary across monetary policy regimes (e.g. Smets and Wouters, 2007; Kimura and Kurozumi, 2010). As is often documented in the literature (e.g. Kiley, 2000; Nakamura and Steinsson, 2008), for example, the degree of price stickiness is systematically related to the inflation regime via monetary regime change. Gagnon (2009), however, documents that frequency of price changes is not meaningfully correlated with inflation in a moderate inflation environment, say below 10%. Along this line, we maintain that the adoption of IT in Canada might not have exerted a significant impact on the degree of price stickiness, especially in terms of the order of price stickiness across sectors.

[9] The period average (1986–2007) sectoral weights are used to this end.

Table 2
Descriptive statistics of flexible- and sticky-price groups.

	Flexible price group	Sticky price group
Number of sectors included	24	21
Share of CPI basket (%)	30	29
Duration in months		
Average	4.7	18.8
Minimum	0.4	9.7
Maximum	8.9	42.7

(2012), a natural separating point would be the median value of price flexibility among the 45 CPI items. In our data, the median frequency of price change is 10.7% and the corresponding duration is 8.7 months. As there is a frequency value very close to the median, however, we use the duration of nine months as the threshold. Consequently, sectors in which price changes occur less often than every nine months are included in the sticky-price group, leading to 21 of the 45 sectors being included there.

Table A1 in the Appendix highlights the components of the sticky-price group in bold face. The sticky-price group includes manufacturing and service based sectors, such as footwear, clothing, education, and personal care services, whose prices are known to change less frequently. It should be noted that the five highly volatile CPI items, discussed as being responsible for the absence of a decline in headline inflation volatility under IT, all fall into the flexible-price group. As summarized in Table 2, on average, prices in the flexible-price group are changed approximately once every five months, whereas those in the sticky-price group are changed once every 19 months. The flexible-price group accounts for 30% of the full CPI basket and the sticky-price group accounts for 29%.[10]

3.2. Dynamics of sticky- and flexible-price inflation based on sub-indices

In this section, we focus on how the dynamic behavior of inflation differs across the two sub-indices we constructed. To begin with, we look at whether the regime change in monetary policy induces any structural shift in the dynamics of the two inflation measures. To this end, we employ a set of popular structural break tests developed by Bai and Perron (1998).[11] Table 3 reports the estimated dates for the structural breaks for three measures of inflation dynamics (level, persistence and volatility) for both sticky and flexible-price inflation as well as headline inflation. For the level of inflation, flexible-price inflation had only one break in 1984, while sticky-price inflation experienced two breaks, one in 1983 and the other in 1991, dates that coincide with the breaks in headline inflation. The timing of the first break accords well with the widely accepted timing of the end of the Great Inflation, while the second break corresponds to the official adoption of IT in Canada.[12] Given the absence of a break in the flexible-price series around 1991, it appears that the break in the headline inflation rate around the time of IT adoption was driven by the sticky-price group. This pattern also carries over to the cases of volatility and persistence, in which break points are detected around the timing of IT adoption for both headline inflation and sticky-price inflation, but not for flexible-price inflation.[13] To the extent that structural changes in the inflation dynamics may signal shifts in economic agents' perceptions of the policy target for inflation (e.g. Kozicki and Tinsley, 2001), the clear differential response between the sticky-price and flexible-price groups suggests that the impact of the monetary regime change was transmitted to headline inflation mainly through the sticky-price sectors.

Table 4 reports summary statistics on the dynamics of sticky-price and flexible-price inflation rates before and after IT adoption. The upper panel of Table 4 presents the results on the basis of the two sub-indices we constructed. The results are very similar to those outlined above, clearly demonstrating the difference between sticky-price and flexible-price inflation in terms of dynamics. In all sample periods, the level of sticky-price inflation is lower than flexible-price inflation, with lower volatility and higher persistence. Although the adoption of IT led to a substantial decline in mean inflation for both

[10] Although the main rationale behind our group divisions is qualitative rather than quantitative, the dividing line of nine months seems reasonable not only because it results in groups with a comparable number of subcomponents and with almost equal weights but also because it is not far off from the conventional textbook dividing line of 12 months. Nevertheless, we checked the robustness of our results with a couple of alternative cutoff points to find qualitatively similar results to our main findings.

[11] Following the guidelines from Bai and Perron in testing for structural breaks, the break is assumed not to occur during the initial 15% nor the final 15% of the sample period. The maximum number of breaks is set to five and the minimum regime size is set to 5% of the sample. Robust standard errors are based on a quadratic spectral kernel HAC estimator with AR(1) prewhitening filters. See note in Table 3 for further details.

[12] Another notable economic event that took place in Canada around 1991 was the introduction of the goods and services tax (GST). We do not believe, however, the structural breaks in 1991 are attributable to the introduction of GST, because it would have exerted upward pressure on mean inflation rather than the downward pressure evident in the data. As clearly stated in the lecture (October, 1998) of the Governor of the Bank of Canada, Gordon Thiessen, '[t]he key objectives of Canada's inflation targets … were to prevent inflation from accelerating in the short run in the face of the introduction of the new goods and services tax (GST) and a sharp rise in oil prices.' Moreover, GST was not applied uniformly across sectors and we observe structural breaks around 1991 in items that were exempt from GST (e.g. items #17, 37, and 39), while items that were subject to the tax (e.g. items #12, 15, 22 and 34), did not have a structural break.

[13] We follow much of the literature in estimating persistence of inflation as the sum of autoregressive coefficients (SARC) within a univariate autoregressive model. See Appendix C for further discussion on this.

Table 3
Structural break points for flexible- and sticky-price inflation.

Dynamics	Break	Headline	Flexible		Sticky
Level	1-st break	1983:06	1984:02	(1984:03)	1983:06
	2-nd break	1991:01	–	(–)	1991:01
Volatility	1-st break	1990:06	1983:10	(1985:05)	1990:09
Persistence	1-st break	1990:07	1983:06	(–)	1990:07
	2-nd break	1997:12	–	(–)	1996:04
	3-rd break	–	–	(–)	2001:04

Note: 'Flexible' and 'sticky' respectively represent flexible price and sticky price inflation series that are constructed based on the weighted averages of CPI components belonging to each category. Numbers inside parenthesis represent the case without five volatile items. Entries represent the occurrence of break points in the year and month estimated by the sequential procedure estimation method of Bai and Perron (1998). For the level of inflation, we use a pure structural change model, $\pi_t = \delta^{(j)} + \varepsilon_t$, while for the persistence of inflation we employ a partial structural change model of $y_t = x'_t\beta + z'_t\delta_j + u_t$ where $x_t = \{\pi_{t-1}, \ldots, \pi_{t-p}\}$ and $z_t = \{c, \pi_t\}$ such that the coefficient for inflation is allowed to shift. The lag length (p) is selected by the AIC rule. Refer to note in Table A3 in the Appendix. For volatility, we closely follow the approach suggested by McConnell and Perez-Quiros (2000).

Table 4
Dynamics of flexible- and sticky-price inflation.

	Flexible price inflation			Sticky price inflation		
	1978–1991	1983–1991	1991–2010	1978–1991	1983–1991	1991–2010
Composite indexes						
Mean inflation (%)	10.0 (8.3)	6.2 (5.3)	2.0 (1.9)	8.3	5.7	1.5
Volatility	6.85 (6.93)	7.07 (7.19)	9.48 (5.58)	3.28	4.72	2.13
Persistence (quarterly)	0.80 (0.83)	0.01 (0.33)	−0.08 (0.42)	0.88	0.65	0.33
Weighted average of individual series						
Mean inflation (%)	10.6 (8.7)	6.8 (5.6)	2.1 (1.6)	9.0	6.3	1.6
Volatility	20.28 (17.92)	20.30 (17.18)	21.61 (13.43)	10.87	9.96	6.67
Persistence (quarterly)	0.51 (0.53)	0.21 (0.22)	0.18 (0.30)	0.64	0.36	0.25

Note: Entries are based on the flexible- and sticky-price series constructed from weighted averages explained in Section 3.1. Mean inflation and volatility are based on the annualized monthly inflation rates and persistence is computed from quarterly inflation rates. Numbers inside parenthesis represent the corresponding values in the absence of five volatile items. Entries inside parentheses represent the case without five volatile sectors.

groups, its impact on volatility and persistence measures differed across the groups. Both volatility and persistence have fallen considerably after IT adoption for the sticky-price group, but the decline in mean inflation after IT adoption was not associated with a similar drop in volatility for the flexible-price group. The difference in the impact of IT adoption becomes much more significant when we focus our comparison on the pre-IT period beginning in 1983. Persistence, for example, has dropped from 0.65 to 0.33 for the sticky-price group, whereas it has declined only slightly from 0.01 to −0.08 in the flexible-price group, which already exhibited a very low degree of inertia even before the monetary regime change. This indicates that the observed reduction in persistence of overall inflation in Canada after IT adoption was likely driven by the sticky-price group. Given that inflation persistence is known to reflect long-run inflation expectations, our result suggests that the Bank of Canada effectively stabilized market expectations of inflation around the targeted level mainly through influencing inflation expectations in the sticky price sectors. The story remains much the same when we remove the five highly volatile CPI items, identified in Section 2, from the flexible-price basket. Without the five highly volatile items, however, the volatility of flexible-price inflation does fall in the post-IT period as predicted, while at the same time persistence increases to a level even higher than that for sticky-price inflation. Moreover, as shown in the lower panel of Table 4, when we look at mean, volatility and persistence based on weighted averages of those measures for the individual series that make up the sub-indices (as opposed to those measures for the sub-indices themselves), our finding on the differential impacts of monetary regime change on sticky and flexible inflation is unaltered.

The scatterplots in Fig. 4 present additional evidence at the sectoral level on the differential responses between the sticky-price and flexible-price sectors. In each scatterplot, circles (○) represent the 21 sectors belonging to the flexible-price group and diamonds (⋄) represent the 24 sectors in the sticky-price group respectively. As displayed in the top panel of Fig. 4, there is a clear positive relationship between volatility of sectoral inflation and the degree of price flexibility in both the sticky-price and flexible-price groups, confirming the conventional wisdom that inflation volatility is higher for sectors in which prices are adjusted more frequently. Although the slope of the fitted line appears to be flatter for the sticky-price group, the positive association can be seen in both groups regardless of monetary regime, indicating that IT adoption did not exert any qualitative impact on the relationship. However, a dramatically different picture is depicted in the middle panel of Fig. 4, where the relationship between the persistence of sectoral inflation and the degree of price flexibility is illustrated.

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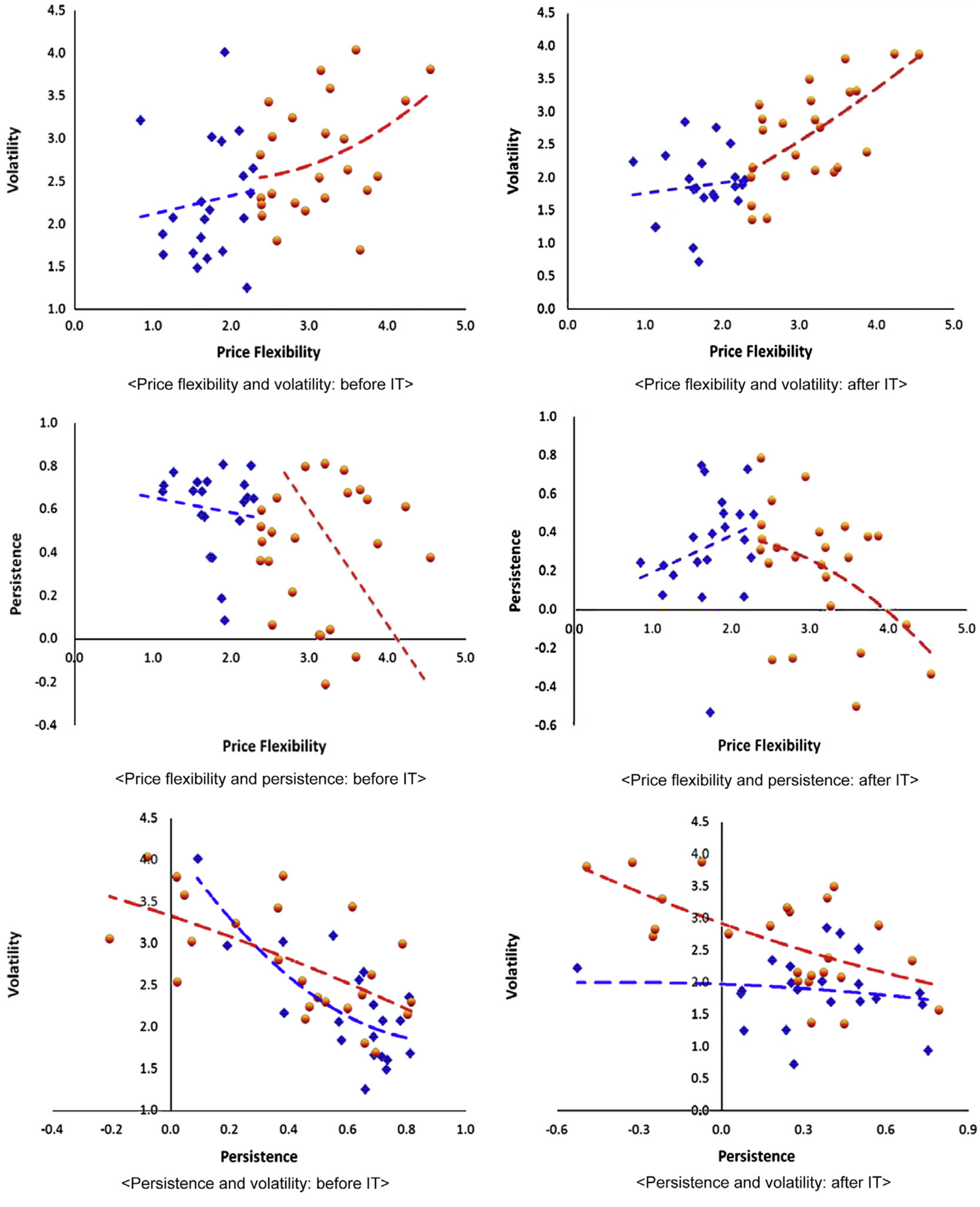

Fig. 4. Price flexibility (◇ for sticky and ○ for flexible) and inflation dynamics at the sectoral level.

Before IT adoption, persistence of sectoral inflation is inversely associated with the degree of price flexibility in both the sticky-price and the flexible-price groups, in line with the stylized fact that sectors with less frequent price adjustment tend to experience more persistent inflation. After IT adoption, the negative relationship still remains for the flexible-price group, but not for the sticky-price group, where inflation persistence is now positively associated with price flexibility. This unexpected positive relationship was possibly driven by a greater reduction in the persistence of the stickiest sectors within the sticky-price group, as these sectors responded most strongly to the monetary regime change. The difference between the two groups is also reflected in the relationship between persistence and volatility of sectoral inflation rates, as illustrated in the bottom panel of Fig. 4. In the flexible-price group, the conventional inverse association can be seen between persistence and volatility of inflation both before and after IT adoption. Relatively low levels of inflation persistence are associated with relatively high levels of inflation volatility. But, the inverse relationship disappears in the sticky-price group after IT adoption.

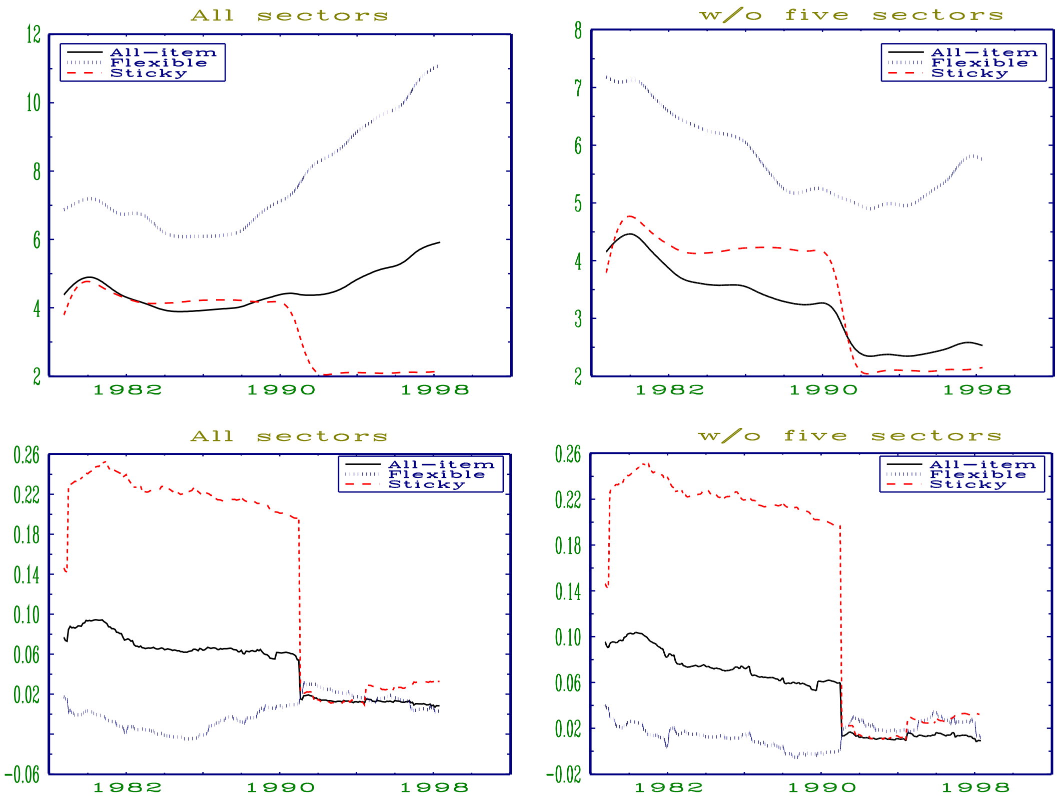

Fig. 5. Dynamics between flexible-price inflation and sticky price inflation (12-year rolling window). Panel B: Cross correlation of inflation by group.

Fig. 5 provides further evidence of differences in dynamic patterns between the sticky-price and flexible-price groups. The upper panel of Fig. 5 illustrates the volatility of the two inflation measures for a rolling window of 12 years.[14] We note that the volatility of sticky-price inflation fell sharply around 1991 when the new monetary policy regime came into operation. Such a structural change in the volatility measure, however, is not observed in flexible-price inflation regardless of the exclusion of the five volatile items. A similar picture is painted in the lower panel of Fig. 5, which portrays the cross-sector correlation of sectoral inflation in each group for the same rolling window of 12 years. As can be seen from the plots, the correlation of all 45 sectoral inflation sharply declined in the early 1990s when the Bank of Canada adopted IT, indicating a drastic change in the nature of comovement across sectoral inflation rates. The structural change, however, appears to be driven almost entirely by the sticky-price sectors. In contrast, the cross-correlation of the flexible-price group exhibits only a trivial change in the comovement of flexible sectoral inflation rates after IT adoption. The decline in the cross-sector correlation in the sticky-price group may reflect a fall in the sensitivity of sticky-price sectoral inflation to common aggregate shocks or an increase in responsiveness to sector-specific shocks. This issue is further investigated in the next section using a common factor model.

Taken together, our results in this section strongly suggest that the sticky-price sectors were much more responsive to the adoption of IT in Canada and that the structural change observed in headline inflation was driven by these sticky-price sectors.

3.3. *Common factor model analysis*

Another useful way to capture the dynamics of sectoral inflation is to utilize common factor model analysis which involves relating a large number of individual sectoral inflation series to a small number of estimated common factors. Use of such models is gaining popularity in the literature on pricing behavior (e.g. Bernanke et al., 2005; Boivin et al., 2009). The basic idea of a common factor model is to decompose the volatility of inflation into two components: one reflecting aggregate common shocks that affect all sectors, and the other reflecting idiosyncratic shocks that are specific to each sector. Within this framework, we can not only analyze how sectoral inflation rates react to common shocks, but assess the relative importance of aggregate shocks to sector specific shocks in explaining the fluctuations of sectoral inflation. An expanding empirical literature (e.g. Altissimo et al., 2009; Boivin et al., 2009) documents that the variance of sectoral inflation is

[14] 1991 therefore captures the subsample period of 1991–2002, and so on. Similar results are obtained using rolling windows of 10 and 15 years respectively.

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Table 5
Common share before and after IT adoption.

	1983–2010	1983–1991	1991–2010
All-sectors	0.096	0.143	0.023
Flexible sectors	0.022	0.018	0.014
Sticky sectors	0.174	0.268	0.034

attributable far more to sector-specific shocks than to common aggregate shocks.[15] By treating a monetary regime change as an economy-wide macroeconomic shock, we evaluate the impact of IT adoption on sectoral inflation in the sticky-price and flexible-price groups within the framework of a common factor model. Our initial intuition is that IT adoption would reduce the relative importance of the common component. This is because, once inflation expectations are anchored under IT, sectoral inflation would respond more sluggishly to aggregate shocks, as the public expects the associated inflationary pressure to eventually be dampened out by the central bank's action to offset the effects of exogenous disturbances.

We follow the studies by Altissimo et al. (2009) and Reis and Watson (2010) to construct a factor model based on subaggregate prices without including other macroeconomic variables.[16] To be specific, we consider the following prototypical factor representation:

$$\pi_{it} = a_i + \lambda'_i F_t + e_{it}, \quad (1)$$

where π_{it} denotes the inflation rate in sector i in period t, a_i represents an individual fixed effect, F_t denotes common factors that capture common sources of variation in sectoral inflation driven by aggregate shocks, λ_i are factor loadings that measure the 'sensitivity' of inflation in sector i to F_t, and e_{it} is an idiosyncratic error associated with idiosyncratic sectoral events or measurement error.

We first assess the relative importance of common aggregate shocks that would include monetary regime changes. Table 5 reports the fraction of the variability of sectoral inflation associated with the common component (i.e. common component share) for three groups: all 45 sectors (henceforth, all-sectors), 21 sectors in the sticky-price group and 24 sectors in the flexible-price group. In each group, we look at the full sample period beginning in 1983 as well as two subsample periods split by the timing of IT adoption.[17]

In all cases under consideration, we note that only a small portion of the variation in sectoral inflation is explained by aggregate common shocks, confirming the growing body of evidence in the literature (e.g. Boivin et al., 2009; Maćkowiak et al., 2009). In all-sectors, for example, merely 9.6% of the sectoral inflation volatility is explained by the common component for the full sample period. What is more interesting is that the common component share has declined significantly after IT adoption. Before the monetary regime change, the common factor explained about 15% of the variance of sectoral inflation, which is very close to what Boivin et al. (2009) found in the US data. The common component share, however, dropped considerably in the post-IT period, to only 2.3%, implying that sector-specific shocks account for almost all of the variance in sectoral inflation under the IT regime. This sharp decline in the common component share is consistent not only with our prior intuition that IT adoption should reduce the importance of the common component but also with the finding by Ciccarelli and Mojon (2010) that the common factor has less impact in countries with a stronger commitment to price stability. An interpretation of the dramatic decline in the common component share is that sectoral inflation became less responsive to aggregate macro shocks as inflation expectations became better anchored under the new monetary regime.

More importantly, a clear difference exists between the sticky-price group and the flexible-price group both in the share of the common component and in the impact of IT adoption. The common component share is consistently higher in the sticky-price group regardless of the sample period under study. This implies that sectors where prices are adjusted less frequently tend to respond more strongly to common macro shocks, probably because they are more forward looking and hence more sensitive to aggregate macro shocks that generally persist longer.[18] The share of the common shock for the sticky-price group, however, fell significantly after IT adoption, from 26.8% to just 3.4%, indicating a strong response to the

[15] Using US price data, for example, Boivin et al. (2009) report that macroeconomic fluctuations explain on average just 15% of the variation in monthly individual prices, while most of the fluctuations in disaggregated prices reflect sector-specific shocks to which prices are adjusting quickly. Altissimo et al. (2009) report a similar result using euro area CPI data although they found the portion attributable to the common component to be a bit higher, about 30%. For a dissenting view, see Graeve and Walentin (2011).

[16] Reis and Watson (2010) show that this factor model is able to flexibly and parsimoniously account for the main features of the economic data. Like Altissimo et al. (2009), we found a single factor based on the 'minimum rule' proposed by Greenaway-McGrevy et al. (2010). A detailed discussion on our factor model is relegated to Appendix C.

[17] Here we focus on the pre-IT period starting in 1983 to compare the effect of IT adoption with a stable inflation environment. When the data span is extended to 1978, we find qualitatively similar results on the main conclusions of our paper but with some quantitative differences. For instance, common component share in the pre-IT period becomes larger when the Great Inflation period is included in our sample, probably due to a more homogeneous response of sectoral inflation in a higher inflation environment. For the subsample analysis, we estimate the common factor (F_t) for the full sample period and then apply the estimation results to each subsample period to compute the relevant statistics. This is because the estimated common factor (F_t) may vary over the sample period.

[18] According to Boivin et al. (2009), the factor loadings are informative about the price-setting behavior in various sectors such that sectors with more frequent price adjustments are likely to respond more strongly to macro shocks. This is also consistent with the prediction of Calvo-type sticky price

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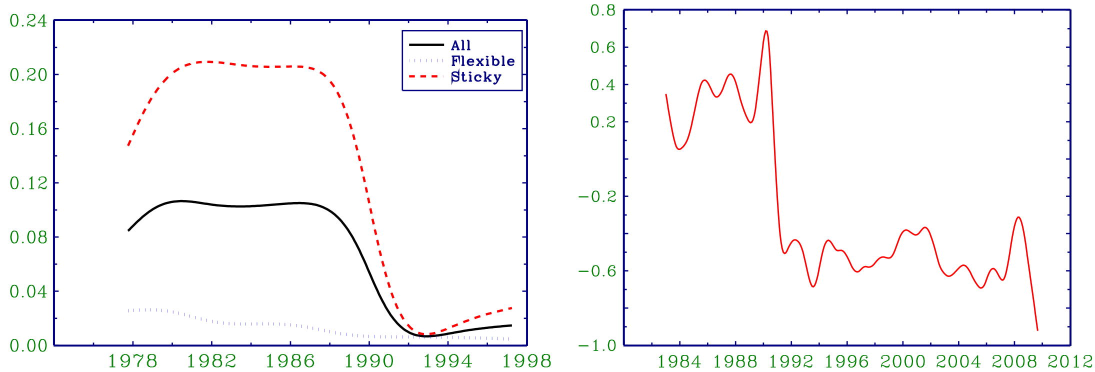

Fig. 6. Common component share (12-year rolling window) and estimated common factor ($\hat{F}_t$).

monetary regime change. That is, the influence of aggregate macro shocks on sticky-price sectoral inflation became much weaker after IT adoption. In the flexible-price group, in contrast, the sectoral inflation fluctuations are explained very little by common aggregate shocks and the share of common component hardly changed after IT adoption. Combined together, it can be deduced that sectoral inflation rates in the sticky-price group are responsible for the decreased share of common component in the headline inflation variability after IT adoption. This reinforces our primary claim that monetary regime change affected overall headline inflation mainly through the sticky-price sectors. In addition, our findings support the view of Bryan and Meyer (2010) that the Fed's success in bringing inflation under control in the early 1980s was achieved mainly by anchoring inflation expectations in the more forward-looking sticky-price sectors.[19]

To ensure the robustness of our results to the choice of subsample periods, we graph the dynamics of the common component share in Fig. 6. Specifically, we plot the shares of the common component for all-sectors (solid line), the sticky-price group (dashed line) and the flexible-price group (dotted line) for a 12-year rolling window. We find compelling evidence of structural change in the share of the common component in both the sticky-price group and all-sectors that coincides with the change in monetary policy behavior. No clear sign of a structural change in the common component share is found in the flexible-price group, however.

What then actually led to the sharp decline in the relative importance of common shocks in the sticky-price group after IT adoption? The decline in the share of the common component can arise either from a decline in the common component or from an increase in the idiosyncratic component or from both. Since monetary policy regime change is related to the common component, we here focus on a decline in the common component as a potential driving force. Given that the common component of sectoral inflation can be further decomposed into the common factor (F_t) in Eq. (1) and the factor loadings (λ_i) that capture the sensitivity of sectoral inflation to the common factor, any changes either in the common factor or in the sensitivity can lead to a change in the common component volatility. The right panel of Fig. 6 plots the evolution of the estimated common factor ($\hat{F}_t$). The series shows a noticeable drop in the early 1990s that coincides well with the timing of IT adoption. This kind of structural change in the common factor is often interpreted as being related to a new monetary policy regime (e.g. Boivin et al., 2009). But, since aggregate shocks other than those associated with monetary policy could also be responsible, we examine the relationship between the estimated common factor and several potential sources of macro economic shocks. Fig. 7 plots the estimated common factor with movements in labor productivity, government spending, exchange rates, oil prices and nonfuel commodity prices, that have been highlighted in the literature as factors affecting the dynamics of the common factor in sectoral inflation (e.g. Reis and Watson, 2010).[20] It is encouraging to notice that the dynamics implied by the common factor mimic remarkably well the dynamics observed in short-run interest rates, especially in the timing of the structural change around 1991. This strengthens our belief that the common factor dynamics were mainly driven by monetary policy and its regime change, and lends credence to the view of Boivin et al. (2009) that monetary policy regime change has played a crucial role in the dynamics of the Canadian sectoral inflation mainly through its influence on the common factor. For the other aggregate shocks under consideration, however, we fail to see any such synchronization with the estimated common factor movements.

Because the common factor is, by definition, *common* to every sector, it is unlikely to account for the sharp difference in the common component share between the sticky-price group and the flexible-price group. This leads us to look at a decline in the sensitivity (λ_i) to aggregate macro shocks as the possible culprit behind the drop in the common share. To investigate

(*footnote continued*)
models with heterogeneous price stickiness, such as the one developed by Carvalho (2006). Our empirical result, however, shows that sticky-price sectors have a higher sensitivity to aggregate macro shocks due to their more forward-looking feature.

[19] Bryan and Meyer (2010) contend that the volatility of flexible-price measures of US inflation has been relatively stable over time, while the volatility in sticky-price measures has diminished considerably since 1983 when inflation expectations in US were anchored substantially.

[20] The relevant data were retrieved from various sources, including the Bank of Canada (for interest rates), statistics Canada (for labor productivity and government expenditure ratio), and the international monetary fund's *international financial statistics* (IFS) (for oil prices, commodity prices and exchange rates).

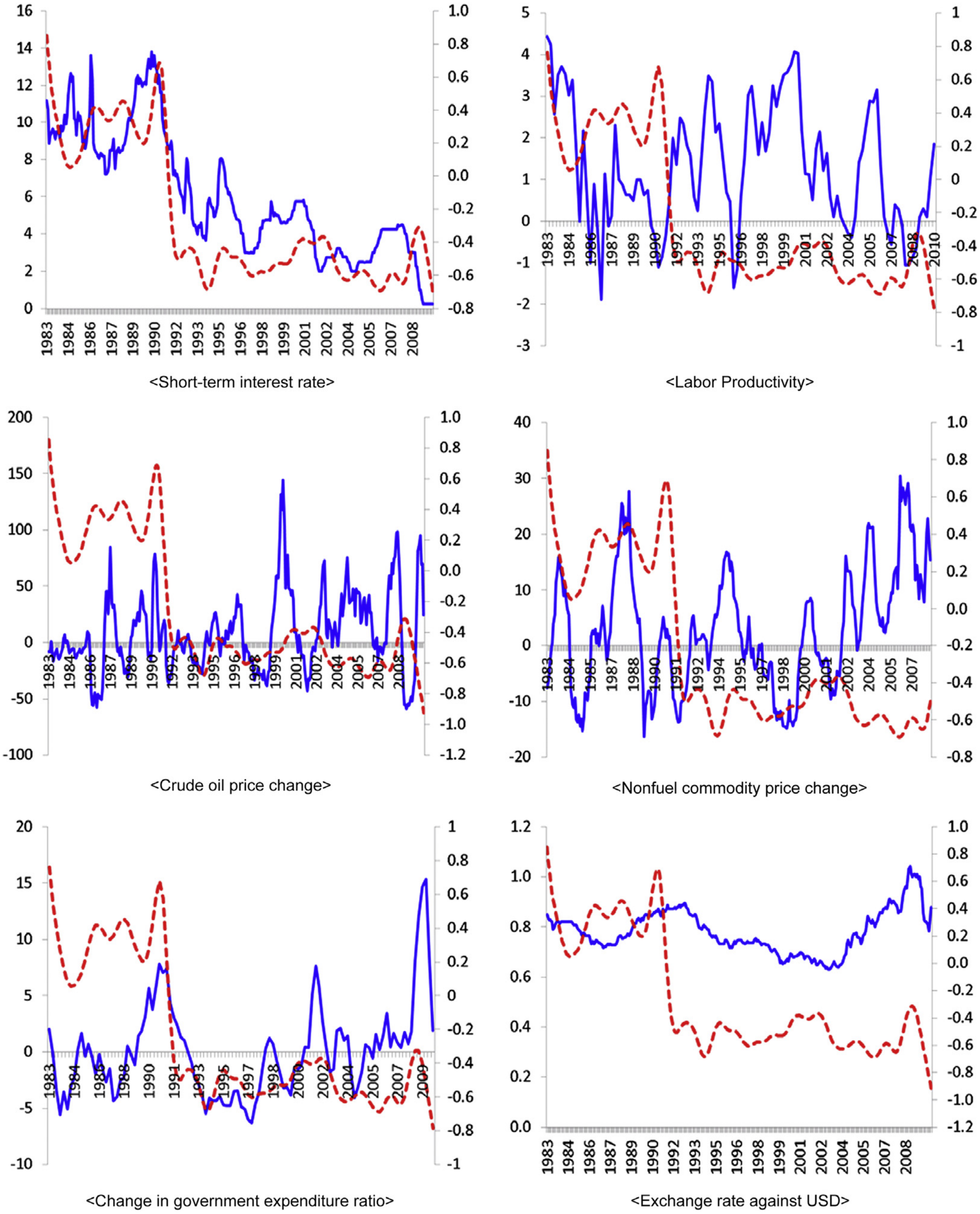

Fig. 7. Common factor (dotted line) and aggregate shocks (solid line).

this, we implement a basic regression analysis, relating sectoral inflation rates to the estimated common factor augmented with a time-dummy for IT adoption.[21] We estimate

$$\pi_{it} = \alpha_i + \lambda_{1i}\hat{F}_t + \lambda_{2i}\hat{F}_t D_t + \epsilon_{ij}, \tag{2}$$

where π_{it} represents the sectoral inflation rate for sector i in time t, $\hat{F}_t$ denotes the common factor estimated from the full sample and D_t is a time dummy variable which takes the value of one for $t > 1991:\mathrm{M1}$. This specification allows us to assess the impact of IT adoption on the sensitivity to the common factor (F_t). The parameter of interest is λ_{2i} which measures the change in the sensitivity of sectoral inflation to the common factor (F_t) associated with the adoption of IT. Using the

[21] Given the time-varying property of λ_i, a common factor model with time-varying factor loadings suggested by Del Negro and Otrok (2008) looks quite promising for our analysis. We do not pursue it here, however, because our focus lies on the change between two subsamples rather than on developments over the entire sample.

Table 6
Sensitivity of sectoral inflation to common factor (F_t).

	$\hat{\lambda}_{1,GM}$	$\hat{\lambda}_{2,GM}$
All-sectors	0.321[a] (0.001)	0.030[a] (0.002)
Flexible sectors	0.168[a] (0.001)	0.104[a] (0.002)
Sticky sectors	0.497[a] (0.003)	−0.054[a] (0.006)

Note: Regression equation is $\pi_{it} = \alpha_i + \lambda_{1i}\hat{F}_t + \lambda_{2i}\hat{F}_t h_t + \epsilon_{ij}$, where $\hat{F}_t$ denotes the estimated common factor from the full sample and h_t is a time dummy variable which takes the value of one for $t > 1991 : M1$. $\hat{\lambda}_{k,GM} = (1/N)\sum_{i=1}^{N} \lambda_{k,i}$ where $k = 1, 2$. $\sqrt{N}(\hat{\lambda}_{2,GM} - \lambda_2) \rightarrow^d N(0, \Sigma)$ where $\Sigma = (1/N)\sum(\hat{\lambda}_{2i} - (1/N)\sum\hat{\lambda}_{2i})^2$.

[a] Indicates statistical significance at the 1% error levels.

properties of the group-mean estimator, $\hat{\lambda}_{2,GM} = (1/N)\sum_{i=1}^{N} \lambda_{2,i}$, statistical significance of the parameter of interest can be tested based on its sampling distribution of $\sqrt{N}(\hat{\lambda}_{2,GM} - \lambda_2) \rightarrow^d N(0, \Sigma)$ where $\Sigma = (1/N)\sum(\hat{\lambda}_{2i} - (1/N)\sum\hat{\lambda}_{2i})^2$.

Table 6 presents the regression results for both the sticky-price group and the flexible-price group, along with all-sectors. We first note a significantly larger coefficient for $\hat{\lambda}_{1i}$ in the sticky-price group compared to the flexible-price group, confirming our initial belief that sectoral inflation in the sticky-price group is more responsive to the common factor. Moreover, $\hat{\lambda}_{2i}$ takes an expected negative sign for the sticky-price group and is statistically significant. This indicates that the sensitivity of sectoral inflation to the common factor has indeed decreased after IT adoption in the sticky-price group. Given that the persistence in sectoral inflation is largely propagated by the persistence in the common component, the weaker responses to the common factor can explain the lower persistence in sticky-price inflation after IT adoption. In the flexible-price group, however, $\hat{\lambda}_{2i}$ is statistically significant but with a positive sign as in all-sectors, suggesting an increased sensitivity to the common factor after IT adoption. This elevated sensitivity to the common factor in the flexible-price group might have been offset by a comparable increase in the idiosyncratic component principally driven by the aforementioned five highly volatile sectors, leading to little change in the share of the common component.

To sum, our results in the current section strongly suggest that IT adoption in Canada has affected headline inflation mainly through the sticky price sectors in which sectoral inflation became much less responsive to common aggregate shocks under the IT regime. The reduced persistence in headline inflation after IT adoption can be explained by the drastic fall in the importance of common shocks for the sticky price sectors, as these shocks are inherently more persistent.

4. Concluding remarks

In this study, we assess how a monetary policy regime change affects the behavior of headline inflation by focusing on the differential impact across sectors. Our study builds upon a couple of important strands in the empirical literature on inflation dynamics. One strand of the literature has provided pervasive evidence of structural changes in many macroeconomic series, including inflation, after changes in the monetary policy regime. In another, a growing consensus has emerged on the importance of disaggregate analysis in the study of inflation dynamics. Using disaggregate price data for Canada, we examined the impact of the adoption of IT on sectoral inflation dynamics. Our aims were to assess the subaggregate inflation responses to the adoption of IT and to identify the sectors of the economy that were more sensitive to the change in the monetary regime. We found substantial heterogeneity in the responses of sectoral inflation rates, with a pronounced difference in the responses between the sectors in which prices are adjusted infrequently and the sectors with greater price flexibility. The influence of the policy regime change is felt predominantly in the sticky-price sectors of the economy, where firms are more forward looking and hence more responsive to changes affecting inflation expectations. By decomposing the fluctuations in sectoral inflation into a common and a sector-specific component, we also found that one common factor explained about 10% of the variance of sectoral inflation. More importantly, the common component share has declined dramatically after IT adoption, mainly driven by sectoral inflation in the sticky price sectors. Given that the common factor captures aggregate shocks, such as a monetary regime change, and that the dynamics implied by the common factor mimic very closely the dynamics of short-run interest rates, we share the view of Boivin et al. (2009) that monetary policy regime change is likely responsible for the change in the dynamics of sectoral inflation.

Knowledge about the sources of the heterogeneity observed between the sticky-price and flexible-price sectors can be used to guide policymakers when formulating their communication policy, which is an essential tool for effective management of inflation expectations. For countries considering a change to their monetary policy framework, our findings suggest that their ability to predict the impact of the new regime and successfully design a transition to that regime could be enhanced by taking into account the sectoral composition of their economy. For example, if a country is thinking about specifying a numerical target for inflation and its headline inflation rate gives substantial weight to sectors with greater price flexibility, it may need to consider a wider range than normal for its target. This may be a particularly important issue for less-developed countries in which primary resources, whose prices are usually more flexible and thus more volatile, often constitute a larger share of the economy.

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While this study unveils several interesting findings, as with any analysis of this kind, it leaves many questions for future research. One potentially fruitful avenue to pursue concerns further exploration of the role of price stickiness in relation to the so-called exchange-rate pass-through (ERPT). Another path might be to examine additional potential sources of the heterogeneity in the responsiveness across the sectors within each price-stickiness category, such as the share of imported content in the goods produced, or the breakdown between durable goods, non-durable goods and services. The current study leaves no doubt that a change in the framework governing macroeconomic policy affects various sectors of the economy differently, opening up many interesting related questions.

Table A1
Data description.

Item no.	Item	Weights			Price adjustment	
		1986	1996	2007	Freq. (%)	Duration
1	Overall	100.00	100.00	100.00	–	–
2	Fresh or frozen beef	1.27	0.88	0.72	26.0	3.3
3	Fresh or frozen pork	0.35	0.34	0.24	23.0	3.8
4	Fresh or frozen poultry meat	0.53	0.67	0.63	16.0	5.7
5	Fish	0.39	0.29	0.25	16.5	5.5
6	Fresh milk	0.97	0.74	0.56	32.6	2.5
7	Butter	0.16	0.12	0.11	24.3	3.6
8	Eggs	0.20	0.18	0.14	47.6	1.5
9	**Bakery and cereal products (excl. infant food)**	1.65	2.04	1.84	9.8	9.7
10	Fruit, fruit preparations and nuts	1.29	1.40	1.27	24.4	3.6
11	Vegetables and vegetable preparations	1.52	1.25	1.23	36.0	2.2
12	Sugar and confectionery	–	0.43	0.42	6.8	14.3
13	Fats and oils	0.18	0.19	0.14	10.8	8.7
14	Coffee and tea	0.26	0.25	0.18	12.3	7.6
15	Non-alcoholic beverages	0.43	0.50	0.73	11.8	8.0
16	**Food purchased from restaurants**	–	4.98	5.15	5.4	18.0
17	Rented accommodation	7.75	7.17	5.36	–	–
18	Replacement cost	1.32	2.68	3.27	–	–
19	Property taxes (including special charges)	2.83	3.55	3.31	–	–
20	Homeowners' home and mortgage insurance	0.73	1.05	1.15	–	–
21	Homeowners' maintenance and repairs	–	1.69	1.51	–	–
22	Electricity	1.89	2.65	2.51	38.1	2.1
23	Water	0.33	0.39	0.51	10.7	8.8
24	Fuel oil and other fuels	0.40	0.58	0.42	68.0	0.9
25	Communications	1.57	2.79	2.95	31.1	2.7
26	**Household chemical products**	0.83	0.73	0.51	9.4	10.1
27	**Paper, plastic and foil supplies**	0.87	0.79	0.59	8.6	11.1
28	**Furniture and household textiles**	–	1.89	1.99	5.6	17.3
29	**Household equipment**	1.96	1.64	1.64	6.6	14.6
30	**Children's clothing (including infants)**	0.76	0.45	0.45	4.5	21.6
31	**Footwear**	1.11	0.93	0.88	3.5	28.1
32	**Clothing material, notions and services**	–	–	0.34	3.1	31.9
33	Purchase and leasing of passenger vehicles	–	7.02	7.60	18.9	4.8
34	Gasoline	3.09	3.93	4.92	93.3	0.4
35	**Passenger vehicle insurance premiums**	2.14	3.35	2.96	8.2	11.8
36	**City bus and subway transportation**	0.49	0.46	0.43	2.3	42.7
37	Medicinal and pharmaceutical products	0.50	0.76	0.92	13.1	7.1
38	**Personal care supplies and equipment**	1.62	1.55	1.27	4.8	20.5
39	**Personal care services**	0.98	0.95	0.99	3.1	32.1
40	**Recreational equipment and services (excl. vehicles)**	1.71	2.06	1.76	5.2	18.7
41	**Purchase and operation of recreational vehicles**	0.91	1.07	1.43	8.6	11.1
42	**Home entertainment equipment, parts and services**	1.39	1.56	1.19	9.0	10.6
43	Traveler accommodation	0.97	0.99	1.15	41.7	1.9
44	Cablevision and satellite services (incl. pay TV)	0.49	0.74	1.08	12.4	7.6
45	**Education**	1.30	1.92	2.67	6.5	14.9
46	**Reading material and other printed material (excl. textbooks)**	–	0.75	0.60	5.0	19.3
47	**Alcoholic beverages served in licensed establishments**	1.40	0.58	0.55	5.0	19.5
48	Beer purchased from stores	1.04	0.65	0.56	10.6	8.9
49	**Wine purchased from stores**	0.58	0.32	0.28	5.8	16.9
50	Liquor purchased from stores	0.79	0.33	0.27	10.8	8.8
51	Tobacco products and smokers' supplies	2.10	1.66	1.35	22.6	3.9

Note: Bold-faced items represent the sticky-price sectors in which prices are adjusted less frequently.

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Table A2
Summary statistics of national sectoral inflation.

Item no.	Full sample			1978:M9–1983:M8			1983:M9–1991:M2			1991:M3–2010:M5		
	Mean	[10%, 90%]	S.D.	Mean	[10%, 90%]	S.D.	Mean	[10%, 90%]	S.D.	Mean	[10%, 90%]	S.D.
1	3.6	[−1.2, 9.0]	4.3	9.4	[3.0, 14.8]	4.1	4.5	[1.8, 6.6]	3.2	1.8	[−2.1, 5.5]	3.3
2	3.4	[−17.4, 27.3]	21.0	7.2	[−38.3, 49.9]	36.1	4.1	[−17.5, 29.5]	19.5	2.3	[−14.4, 17.8]	15.9
3	2.7	[−29.1, 32.4]	28.7	6.5	[−54.3, 71.3]	44.9	5.4	[−26.7, 36.8]	26.0	1.0	[−24.0, 29.2]	24.0
4	3.7	[−20.3, 29.9]	23.7	7.5	[−26.3, 32.3]	25.7	4.8	[−32.1, 37.6]	34.6	2.3	[−19.3, 21.6]	17.0
5	3.8	[−6.2, 13.5]	8.8	10.3	[−2.1, 22.5]	9.5	4.8	[−4.5, 13.8]	8.8	1.8	[−7.1, 11.1]	7.6
6	3.6	[−4.2, 12.0]	10.2	9.5	[−7.6, 25.2]	14.0	3.6	[−6.6, 11.8]	9.4	2.0	[−3.5, 7.0]	8.7
7	3.8	[−6.7, 14.2]	9.1	11.0	[−3.8, 21.6]	10.1	2.7	[−6.9, 12.5]	8.2	2.3	[−7.6, 11.4]	8.3
8	3.2	[−10.9, 17.8]	12.1	6.8	[−9.3, 21.1]	13.0	2.0	[−17.0, 17.8]	13.7	2.6	[−9.2, 15.2]	10.9
9	4.3	[−5.0, 14.8]	9.1	11.6	[−4.0, 22.0]	14.4	3.7	[−3.8, 13.1]	6.6	2.7	[−5.5, 9.7]	7.3
10	3.1	[−19.4, 29.3]	20.0	9.0	[−22.1, 32.1]	21.5	5.4	[−22.3, 30.9]	23.0	0.7	[−19.2, 23.9]	18.0
11	4.2	[−53.8, 64.7]	50.7	10.4	[−82.4, 87.5]	57.0	3.5	[−64.1, 68.8]	58.8	2.7	[−44.9, 58.4]	45.4
12	4.1	[−19.8, 28.0]	26.9	12.0	[−57.4, 60.3]	55.6	2.5	[−21.5, 24.6]	19.8	2.8	[−15.9, 20.6]	16.0
13	3.2	[−7.9, 14.2]	10.0	3.9	[−7.7, 13.5]	8.2	3.6	[−10.4, 17.8]	13.6	2.9	[−7.6, 12.6]	8.7
14	1.4	[−12.4, 14.2]	16.5	0.5	[−11.2, 8.1]	10.6	0.8	[−12.2, 14.9]	15.3	1.8	[−14.0, 14.1]	18.1
15	2.7	[−25.3, 32.1]	25.9	8.8	[−23.9, 42.3]	31.0	3.2	[−32.6, 31.6]	29.5	0.7	[−24.2, 26.1]	22.6
16	4.0	[0.0, 8.0]	5.3	8.8	[2.3, 13.3]	5.0	5.4	[1.9, 7.6]	8.3	2.3	[0.0, 4.5]	2.1
17	2.9	[1.1, 6.1]	2.4	6.5	[2.6, 9.3]	2.7	4.1	[1.9, 6.0]	1.5	1.5	[0.0, 2.7]	0.9
18	3.6	[−2.6, 9.7]	6.0	4.8	[−5.2, 13.1]	7.7	5.3	[−5.6, 14.2]	7.9	2.7	[−1.7, 7.1]	3.9
19	4.2	[1.2, 7.1]	7.1	6.8	[0.0, 8.6]	13.7	6.2	[2.5, 7.4]	4.5	2.8	[0.0, 5.5]	5.0
20	5.4	[−3.0, 14.3]	9.4	8.4	[−5.3, 20.8]	11.3	5.4	[−5.0, 15.5]	9.2	4.3	[−1.6, 11.1]	7.2
21	3.4	[−10.4, 15.1]	12.9	9.1	[−2.1, 20.6]	9.6	3.4	[−8.7, 13.0]	12.8	2.0	[−13.1, 14.4]	13.4
22	4.3	[−5.2, 12.2]	22.2	9.0	[2.5, 13.2]	5.5	5.6	[1.7, 7.4]	11.1	2.6	[−9.2, 13.9]	27.3
23	5.8	[1.2, 11.1]	6.8	9.4	[0.0, 19.7]	10.1	6.1	[0.0, 11.1]	7.9	4.8	[1.3, 9.0]	4.8
24	6.7	[−33.3, 48.1]	43.8	19.9	[0.0, 50.3]	31.4	3.8	[−23.6, 29.7]	33.8	5.0	[−41.7, 54.4]	48.9
25	2.1	[−4.2, 7.2]	11.4	7.9	[−5.7, 15.1]	20.2	−0.2	[−11.3, 5.8]	9.9	1.5	[−4.0, 4.8]	8.1
26	2.9	[−6.3, 12.8]	8.7	11.6	[0.0, 21.3]	10.7	3.1	[−5.2, 10.3]	8.2	0.6	[−7.4, 7.7]	6.7
27	3.6	[−5.5, 13.3]	8.4	10.7	[0.0, 19.5]	8.0	3.3	[−7.2, 13.0]	8.5	1.9	[−6.0, 9.5]	7.5
28	2.2	[−7.2, 12.6]	9.5	7.2	[−5.4, 17.2]	8.8	3.7	[−6.5, 13.1]	8.8	0.3	[−8.5, 9.7]	9.3
29	1.3	[−6.1, 9.3]	6.2	7.5	[0.0, 13.6]	5.4	2.4	[−2.9, 8.6]	5.0	−0.7	[−7.2, 5.9]	5.6
30	1.6	[−15.2, 16.8]	14.8	7.2	[1.7, 14.9]	5.3	3.8	[−5.6, 11.1]	9.8	−0.7	[−23.8, 20.1]	17.4
31	2.3	[−9.7, 15.1]	10.5	8.5	[−1.9, 17.3]	8.0	4.0	[−3.4, 12.1]	9.9	0.0	[−13.5, 14.2]	10.5
32	3.8	[−1.4, 9.2]	5.3	8.5	[2.2, 13.1]	5.2	4.9	[0.0, 8.0]	6.8	2.1	[−2.4, 5.8]	3.5
33	2.7	[−8.4, 13.3]	10.5	8.5	[−2.2, 20.7]	8.7	3.5	[−5.2, 13.0]	10.5	1.0	[−9.8, 10.1]	10.5
34	5.8	[−41.1, 52.4]	44.6	18.6	[−27.2, 54.7]	45.5	2.8	[−29.6, 32.1]	30.3	3.8	[−47.3, 64.9]	48.5
35	6.3	[−4.1, 16.7]	14.3	12.3	[−5.4, 27.2]	22.2	5.7	[−4.1, 17.2]	10.8	5.0	[−4.1, 12.5]	12.6
36	5.7	[0.0, 12.0]	12.7	10.1	[−14.5, 26.6]	25.2	6.8	[2.9, 11.5]	5.4	4.3	[0.0, 6.8]	9.6
37	4.2	[−2.4, 11.4]	6.3	11.6	[5.0, 17.2]	6.1	7.2	[2.0, 10.9]	5.9	1.2	[−3.5, 5.7]	4.0
38	2.4	[−7.3, 11.7]	7.9	9.1	[3.3, 14.4]	4.5	3.2	[−5.5, 9.9]	8.5	0.5	[−8.4, 9.6]	7.4
39	4.0	[0.0, 8.1]	6.2	8.4	[2.7, 15.8]	6.6	5.8	[1.9, 7.5]	9.0	2.2	[−1.1, 5.1]	3.5
40	−0.8	[−9.2, 6.3]	7.7	6.9	[0.0, 13.8]	7.9	3.0	[−2.6, 6.3]	5.1	−4.2	[−11.1, 1.8]	6.4
41	4.1	[−4.5, 11.1]	8.2	10.1	[−5.7, 17.7]	13.1	5.2	[0.0, 10.8]	5.5	2.1	[−5.5, 7.9]	6.5
42	−0.7	[−6.5, 4.4]	5.8	3.3	[−1.1, 7.5]	3.5	0.7	[−7.6, 4.6]	6.7	−2.2	[−7.8, 2.4]	5.3
43	3.1	[−19.7, 21.5]	24.6	12.2	[0.0, 21.3]	11.0	4.8	[−12.8, 18.0]	20.8	0.2	[−26.3, 22.4]	27.8
44	5.4	[−3.5, 13.8]	15.5	7.6	[−3.6, 9.1]	20.7	5.7	[0.0, 13.8]	11.8	4.7	[−3.8, 13.8]	15.3
45	6.1	[2.7, 10.3]	9.8	8.8	[0.0, 17.5]	19.7	6.6	[3.0, 9.4]	8.3	5.2	[2.4, 8.5]	5.8
46	4.9	[−1.6, 11.9]	8.8	10.8	[0.0, 21.9]	9.7	7.0	[0.0, 11.5]	11.2	2.5	[−3.1, 8.6]	6.3
47	4.6	[0.0, 10.3]	6.7	10.7	[2.5, 16.1]	6.4	7.1	[1.7, 9.8]	10.0	2.1	[0.0, 4.3]	2.6
48	5.0	[−4.4, 15.7]	10.5	12.9	[−5.0, 28.0]	16.7	6.6	[−2.2, 17.3]	9.1	2.4	[−5.4, 11.2]	7.5
49	4.1	[−3.7, 12.6]	10.9	12.3	[−13.8, 21.8]	20.7	5.7	[−4.4, 14.2]	9.2	1.3	[−3.7, 7.1]	5.5
50	3.4	[−2.4, 9.5]	6.9	9.4	[0.0, 20.0]	9.3	5.4	[0.0, 10.0]	8.3	1.2	[−2.5, 5.5]	3.9
51	7.8	[−4.7, 22.2]	31.6	11.4	[−4.8, 26.4]	12.8	13.0	[−2.7, 27.3]	24.4	3.8	[−6.5, 15.6]	33.3

Note: Bold-faced items represent the sticky-price sectors. Entries are the annualized monthly inflation rates. [10%, 90%] represent the 10-percentile and 90-percentile values of sectoral inflation during each sample period respectively.

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Appendix A. Data description and summary statistics

See Tables A1-A3.

Appendix B. Persistence of sectoral inflation

The idea that inflation persistence is affected by macroeconomic policy regimes, including IT, is well established in the literature (e.g. Cecchetti et al., 2007). Given that IT purports to anchor long-run inflation expectations which are known to

Table A3
Persistence estimates of sectoral inflation.

Item no.	Full sample			1978:M9–1991:M2			1991:M3–2010:M5		
	MUB	[90% band]	Idiosyncratic	MUB	[90% band]	Idiosyncratic	MUB	[90% band]	Idiosyncratic
1	0.95	[0.85, 1.02]	Common: 0.89	0.93	[0.80, 1.04]	Common: 0.75	0.26	[−0.15, 0.62]	Common: 0.26
2	0.02	[−0.37, 0.39]	0.02	0.13	[−0.29, 0.53]	0.00	0.06	[−0.25, 0.36]	0.08
3	0.18	[−0.14, 0.50]	0.03	0.08	[−0.29, 0.41]	0.03	0.26	[0.07, 0.44]	−0.27
4	0.23	[0.09, 0.37]	−0.37	0.25	[0.03, 0.47]	−0.38	−0.21	[−0.65, 0.23]	−0.40
5	0.82	[0.61, 0.96]	0.44	0.52	[0.30, 0.72]	0.34	0.31	[0.07, 0.53]	0.32
6	0.72	[0.56, 0.86]	0.30	0.82	[0.54, 1.05]	0.24	0.30	[0.12, 0.47]	−0.58
7	0.78	[0.60, 0.91]	0.33	0.94	[0.72, 1.13]	0.31	0.35	[0.18, 0.52]	−0.13
8	0.40	[0.16, 0.63]	0.32	0.53	[0.24, 0.79]	0.18	0.41	[0.24, 0.58]	−0.03
9	0.83	[0.64, 0.94]	0.46	0.70	[0.53, 0.84]	0.33	0.53	[0.36, 0.69]	0.14
10	−0.03	[−0.28, 0.22]	−0.06	−0.13	[−0.59, 0.28]	−0.06	0.19	[0.01, 0.37]	−0.14
11	−0.24	[−0.52, 0.05]	−0.53	−0.02	[−0.43, 0.37]	−0.55	−0.46	[−0.87, −0.05]	−0.62
12	−0.10	[−0.31, 0.12]	0.45	0.13	[−0.16, 0.41]	0.36	0.46	[0.29, 0.62]	0.09
13	0.30	[0.06, 0.52]	0.49	0.50	[0.28, 0.71]	0.28	0.40	[0.20, 0.58]	0.43
14	0.50	[0.31, 0.67]	0.65	0.66	[0.29, 0.88]	0.72	0.60	[0.46, 0.73]	0.68
15	0.34	[0.20, 0.47]	−0.37	0.41	[0.18, 0.62]	−0.31	0.27	[0.10, 0.44]	−0.45
16	0.83	[0.70, 0.93]	0.49	0.84	[0.59, 1.01]	0.50	0.27	[0.15, 0.40]	−0.06
17	0.98	[0.93, 1.02]	0.78	0.93	[0.81, 1.04]	0.82	0.83	[0.69, 0.94]	0.71
18	0.77	[0.65, 0.88]	0.77	0.91	[0.76, 1.05]	0.79	0.77	[0.63, 0.88]	0.84
19	0.82	[0.68, 0.92]	0.42	0.36	[−0.02, 0.69]	−0.05	0.69	[0.55, 0.81]	−0.05
20	0.70	[0.53, 0.86]	0.51	0.75	[0.51, 0.89]	0.33	0.84	[0.59, 1.04]	0.43
21	0.57	[0.33, 0.79]	−0.36	0.71	[0.29, 1.02]	−0.11	0.06	[−0.13, 0.25]	−0.30
22	0.61	[0.39, 0.81]	−0.47	0.80	[0.53, 1.00]	0.34	−0.17	[−0.53, 0.16]	−1.85
23	0.84	[0.67, 0.95]	0.09	0.58	[0.37, 0.76]	−0.02	0.87	[0.70, 1.00]	0.59
24	0.01	[−0.35, 0.35]	0.30	0.70	[0.47, 0.87]	0.27	−0.05	[−0.34, 0.22]	0.37
25	0.64	[0.44, 0.83]	0.18	0.94	[0.70, 1.20]	0.27	0.46	[0.29, 0.63]	−0.09
26	0.87	[0.71, 0.97]	0.08	0.94	[0.72, 1.16]	0.43	0.30	[0.11, 0.48]	−0.09
27	0.69	[0.55, 0.82]	0.51	0.81	[0.61, 0.92]	0.54	0.39	[0.19, 0.58]	0.60
28	0.82	[0.58, 0.99]	−0.74	0.42	[0.20, 0.64]	−0.28	−0.48	[−0.98, 0.00]	−0.19
29	0.92	[0.79, 1.03]	0.05	0.93	[0.73, 1.12]	0.50	0.70	[0.28, 1.00]	−0.08
30	0.82	[0.59, 0.97]	−0.35	0.81	[0.53, 1.01]	−0.32	0.61	[0.10, 0.97]	−0.80
31	0.64	[0.45, 0.82]	0.24	0.88	[0.66, 1.07]	0.48	0.47	[−0.20, 0.96]	−1.44
32	0.79	[0.64, 0.92]	0.10	0.82	[0.56, 1.05]	−0.37	0.48	[−0.11, 0.87]	−0.63
33	0.69	[0.50, 0.84]	0.47	0.92	[0.67, 1.21]	0.37	0.81	[0.55, 1.01]	0.45
34	0.00	[−0.26, 0.23]	−0.10	0.42	[0.20, 0.64]	−0.09	−0.30	[−0.64, 0.03]	−0.13
35	0.53	[0.35, 0.70]	0.46	0.68	[0.36, 0.87]	0.45	0.54	[0.33, 0.74]	0.52
36	0.48	[0.26, 0.68]	−0.14	0.55	[0.09, 0.82]	−0.10	0.29	[0.01, 0.56]	0.37
37	0.96	[0.88, 1.03]	0.44	0.73	[0.53, 0.88]	0.09	0.38	[0.11, 0.63]	0.07
38	0.87	[0.71, 0.96]	0.25	0.82	[0.61, 0.96]	−0.45	0.33	[−0.06, 0.67]	−0.22
39	0.85	[0.69, 0.93]	0.54	0.79	[0.51, 0.99]	0.93	0.13	[−0.22, 0.46]	0.00
40	0.97	[0.89, 1.05]	0.51	0.62	[0.42, 0.80]	−0.06	0.83	[0.60, 1.02]	0.41
41	0.87	[0.69, 0.98]	−0.18	0.70	[0.51, 0.86]	−0.53	0.13	[−0.25, 0.49]	0.09
42	0.86	[0.68, 0.99]	0.45	0.78	[0.50, 0.97]	0.34	0.86	[0.58, 1.14]	0.41
43	0.82	[0.59, 0.97]	−0.22	0.80	[0.49, 1.05]	−0.40	0.46	[0.16, 0.74]	−0.47
44	−0.08	[−0.23, 0.06]	−0.32	0.09	[−0.15, 0.34]	−0.15	−0.25	[−0.42,−0.07]	−0.51
45	0.76	[0.55, 0.90]	−0.05	0.22	[0.00, 0.43]	−0.56	0.65	[0.39, 0.86]	0.19
46	0.73	[0.56, 0.88]	0.26	0.79	[0.53, 0.97]	0.00	0.12	[−0.21, 0.44]	0.15
47	0.92	[0.81, 1.00]	0.22	0.70	[0.41, 0.85]	−0.15	0.85	[0.64, 1.02]	0.17
48	0.87	[0.72, 0.96]	0.12	0.40	[0.18, 0.61]	−0.14	0.34	[0.16, 0.52]	−0.22
49	0.82	[0.62, 0.93]	−0.05	0.42	[0.21, 0.61]	−0.03	0.47	[0.18, 0.72]	0.15
50	0.95	[0.82, 1.07]	0.26	0.78	[0.41, 1.10]	0.30	0.47	[0.30, 0.63]	−0.20
51	0.43	[0.31, 0.55]	0.09	0.04	[−0.19, 0.26]	−0.07	0.42	[0.29, 0.56]	0.11

Note: Bold-faced items represent the sticky-price sectors. MUB (median unbiased) estimates are for the sum of AR coefficient in the AR(p) model where the lag length (p) is selected using the BIC. Both MUB and the 90% confidence bands are estimated with Hansen's (1999) grid bootstrap. The table reports Hansen's (1999) mean unbiased estimator of the sum of autoregressive coefficients ρ and the bootstrapped 90% confidence bands based on 101 grid points and 999 replications. The lag order is chosen according to the BIC.

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be reflected in inflation persistence, credible IT may bring about a reduction in persistence as inflation become less responsive to aggregate macro shocks. The empirical evidence generally suggests that the persistence of overall inflation is greatly reduced following IT adoption (e.g. Altissimo et al., 2006; Benati, 2008; Levin and Piger, 2004). Such a decline in persistence under an IT regime is often attributed to a quick transition of inflation expectations formation after the establishment of a clearly defined nominal anchor (e.g. Erceg and Levin, 2003; Orphanides and Williams, 2005). Adoption of IT is often linked to lower persistence of overall inflation, but not necessarily in all sectors. Indeed, a growing literature at the disaggregate level, including Bilke (2005) and Altissimo et al. (2009), uncovers the presence of widely different degrees of inflation inertia across sectors.

To evaluate the extent to which IT exerts a measurable influence on inflation persistence, we measure the reduced-form (intrinsic) persistence of each inflation series using the sum of autoregressive coefficients (SARC) in the AR(p) representation of

$$\pi_t = \alpha + \rho\pi_{t-1} + \sum_{k=1}^{p-1} \zeta_k \Delta\pi_{t-k} + \varepsilon_t,$$

where ρ denotes the SARC and the lag length (p) is selected using BIC with a maximum lag length of 8. To deal with the well-known downward small sample bias embedded in the OLS estimation of ρ, we follow common practice in the previous studies (e.g. Benati, 2008; Clark, 2006) and employ Hansen's (1999) ‘grid bootstrap’ based median-unbiased (MUB) estimator. In the current study we use *quarterly* data, which were computed by averaging the three non-overlapping monthly indices as in Stock and Watson (2007). When month-to-month inflation rates are used, we notice that the SARC estimates take large negative values in many sectors as noted by Benati (2008) in UK inflation rates, especially in the post-IT period, making comparison of inflation persistence based on SARC difficult. Table A3 presents MUB estimates of ρ by sector for both the full sample and the two subsample periods, along with the 90% confidence intervals.

Appendix C. Common factor model

In the following factor model:

$$\pi_{it} = a_i + C_{it} + e_{it} = a_i + \lambda'_i F_t + e_{it},$$

where π_{it} denotes the inflation rate in sector i in period t, a_i represents an individual fixed effect, C_{it} is the common component, and e_{it} is an idiosyncratic error associated with idiosyncratic sectoral events or measurement error. The common component (C_{it}) is the product of F_t and λ_i, where the former is the $r \times 1$ vector of common factors (F_t) that captures common sources of variation in sectoral inflation driven by aggregate shocks, and the latter are factor loadings that measure the ‘sensitivity’ of inflation in sector i to the common shocks. In this model, sectoral inflation may exhibit different dynamics due either to different idiosyncratic shocks (e_{it}) or to different responses to common aggregate shocks captured by factor loadings (λ_i). Before estimation, each sectoral inflation rate is demeaned to remove individual fixed effects and is further standardized by dividing by its sample standard deviation to deal with cross sectional heteroskedasticity. The demeaning process is important in controlling for potential sources of heterogeneity across sectors. As emphasized by Huynh et al. (2011), common factor analysis could yield misleading outcomes if sector specific heterogeneity is not properly taken care of. Consequently, demeaned standardized inflation rates ($\tilde{\pi}_{it} = (\pi_{it} - \mu_i)/\sigma_{\pi_{it}}$) are used to estimate the model based on the principal component method. The number of common factors (r) is selected using a ‘minimum rule’ proposed by Greenaway-McGrevy et al. (2010) who show that the rule can get around an overestimation problem. In our case, the rule suggests one common factor ($r=1$).

References

Altissimo, F., Bilke, L., Levin, A., Mathä, T., Mojon, B., 2006. Sectoral and aggregate inflation dynamics in the Euro area. Journal of the European Economic Association 4, 585–593.
Altissimo, F., Mojon, B., Zaffaroni, P., 2009. Can aggregation explain the persistence of inflation? Journal of Monetary Economics 56, 231–241.
Amano, R., Murchison, S., 2005. Factor-Market Structure, Shifting Inflation Targets, and the New Keynesian Phillips Curve. Working Paper, Bank of Canada.
Aoki, K., 2001. Optimal monetary policy responses to relative-price changes. Journal of Monetary Economics 48, 55–80.
Bai, J., Perron, P., 1998. Estimating and testing linear models with multiple structural changes. Econometrica 66 (1), 47–78.
Benati, L., 2008. Investigating inflation persistence across monetary regimes. Quarterly Journal of Economics 123 (3), 1005–1060.
Bernanke, B.S., Boivin, J., Eliasz, P., 2005. Measuring the effects of monetary policy: a factor-augmented vector autoregressive (FAVAR) approach. Quarterly Journal of Economics 120 (1), 387–422.
Bilke, L., 2005. Break in the Mean and Persistence of Inflation—A Sectoral Analysis of French CPI. ECB Working Paper No. 463, European Central Bank.
Bils, M., Klenow, P.J., 2004. Some evidence on the importance of sticky prices. Journal of Political Economy 112, 947–985.
Boivin, J., Giannoni, M.P., 2006. Has monetary policy become more effective? Review of Economics and Statistics 88 (3), 445–462.
Boivin, J., Giannoni, M.P., Mihov, I., 2009. Sticky prices and monetary policy: evidence from disaggregated US data. American Economic Review 99 (1), 350–384.
Bryan, M.F., Cecchetti, S.G., 1994. Measuring core inflation. In: Mankiw, N.G. (Ed.), National Bureau of Economic Research Studies in Business Cycles, vol. 29. , The University of Chicago Press, pp. 195–215.
Bryan, M.F., Meyer, B., 2010. Are some prices in the CPI more forward looking than others? We think so, Federal Reserve Bank of Cleveland Economic Commentary No. 2010/2.
Carvalho, C., 2006. Heterogeneity in Price Stickiness and the Real Effects of Monetary Shocks. Frontiers of Macroeconomics 2, available at http://www.bepress.com/bejm/frontiers/vol2/iss1/art1.
Carvalho, C., Nechio, F., 2011. Aggregation and the PPP puzzle in a sticky-price model. American Economic Review 101, 2391–2424.

Cecchetti, S.G., Hooper, P., Kasman, B.C., Schoenholtz, K.L., Watson, M.W., 2007. Understanding the Evolving Inflation Process, US Monetary Policy Forum 2007.
Choi, C.Y., 2010. Reconsidering the relationship between inflation and relative price variability. Journal of Money, Credit and Banking 42, 769–798.
Ciccarelli, M., Mojon, M., 2010. Global inflation. Review of Economics and Statistics 92 (3), 524–535.
Clark, T.E., 2001. Comparing measures of core inflation. Economic Review, Federal Reserve Bank of Kansas City, 5–31.
Clark, T.E., 2006. Disaggregate evidence on the persistence of consumer price inflation. Journal of Applied Econometrics 21 (5), 563–587.
Del Negro, M., Otrok, C., 2008. Dynamic Factor Models with Time-varying Parameters: Measuring Changes in International Business Cycles. Staff Reports No. 326, Federal Reserve Bank of New York.
Erceg, C.J., Levin, A.T., 2003. Imperfect credibility and inflation persistence. Journal of Monetary Economics 50 (4), 915–944.
Gagnon, E., 2009. Price setting during low and high inflation: evidence from Mexico. Quarterly Journal of Economics, 1221–1263.
Graeve, F.D., Walentin, K., 2011. Stylized (Arte) Facts on Sectoral Inflation. Working Paper 254, Sveriges Riksbank.
Greenaway-McGrevy, R., Han, C., Sul, D., 2010. The role of standardization in the estimation of common factors. University of Texas at Dallas, Mimeo.
Hansen, B., 1999. The grid bootstrap and the autoregressive model. Review of Economics and Statistics 81 (4), 594–607.
Huynh, K.P., Jacho-Chavez, D.T., Petrunia, R.J., Voia, M., 2011. Functional principal component analysis of density families with categorical and continuous data on Canadian entrant manufacturing firms. Journal of the American Statistical Association 106, 858–878.
Kehoe, P.J., Midrigan, V., 2010. Prices are Sticky After All. Staff Report 413, Research Department, Federal Reserve Bank of Minneapolis.
Kimura, T., Kurozumi, T., 2010. Endogenous nominal rigidities and monetary policy. Journal of Monetary Economics 57, 1038–1048.
Kiley, M.T., 2000. Price stickiness and business cycle persistence. Journal of Money, Credit, and Banking 32 (1), 28–53.
Kozicki, S., Tinsley, P.A., 2001. Term structure views of monetary policy under alternative models of agent expectations. Journal of Economic Dynamics and Control 25, 149–184.
Levin, A.T., Piger, J.M., 2004. Is Inflation Persistence Intrinsic in Industrial Economies? ECB Working Paper No. 334, European Central Bank.
Longworth, D., 2002. Inflation and the Macroeconomy: Changes from the 1980s to the 1990s. Bank of Canada Review.
Maćkowiak, B., Moench, E., Wiederholt, M., 2009. Sectoral price data and models of price setting. Journal of Monetary Economics 56, S78–S99.
McConnell, M., Perez-Quiros, G., 2000. Output fluctuations in the United States: what has changed since the early 1980s?. American Economic Review 90 (5), 1464–1476.
Millard, S., O'Grady, T., 2012. What do Sticky and Flexible Prices Tell Us? Working Paper No. 457, Bank of England.
Nakamura, E., Steinsson, J., 2008. Five facts about prices: a reevaluation of menu cost models. Quarterly Journal of Economics 123, 1415–1464.
Nakamura, E., Steinsson, J., 2010. Monetary Non-neutrality in a Multi-sector Menu Cost Model. Quarterly Journal of Economics 125 (3), 961–1013.
Orphanides, A., Williams, J.C., 2005. The decline of activist stabilization policy: natural rate misperceptions, learning, and expectations. Journal of Economic Dynamics and Control 29 (11), 1927–1950.
Reis, R., Watson, M.W., 2010. Relative goods' prices, pure inflation, and the Phillips correlation. American Economic Journal: Macroeconomics 2, 128–157.
Smets, F., Wouters, R., 2007. Shocks and frictions in US business cycles: a Bayesian DSGE approach. American Economic Review 97, 586–606.
Stock, J.H., Watson, M.W., 2007. Why has US inflation become harder to forecast? Journal of Money, Credit and Banking 39 (1), 3–33.
Walsh, C.E., 2009. Inflation targeting: what have we learned?. International Finance 12 (2), 195–233.

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