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Are Commodity Prices Useful Leading Indicators of Inflation?

by Calista Cheung

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# Abstract

Commodity prices have increased dramatically and persistently over the past several years, followed by a sharp reversal in recent months. These large and persistent movements in commodity prices raise questions about their implications for global inflation. The process of globalization has motivated much debate over whether global factors have become more important in driving the inflation process. Since commodity prices respond to global demand and supply conditions, they are a potential channel through which foreign shocks could influence domestic inflation. The author assesses whether commodity prices can be used as effective leading indicators of inflation by evaluating their predictive content in seven major industrialized economies. She finds that, since the mid-1990s in those economies, commodity prices have provided significant signals for inflation. While short-term increases in commodity prices can signal inflationary pressures as early as the following quarter, the size of this link is relatively small and declines over time. The results suggest that monetary policy has generally accommodated the direct effects of short-term commodity price movements on total inflation. While indirect effects of short-term commodity price movements on core inflation have remained relatively muted, more persistent movements appear to influence inflation expectations and signal changes in both total and core inflation at horizons relevant for monetary policy. The results also suggest that commodity price movements may provide larger signals for inflation in the commodity-exporting countries examined than in the commodity-importing economies.

JEL classification: E3, E52, E58
Bank classification: Business fluctuations and cycles; Economic models; Inflation and prices; International topics; Transmission of monetary policy

Résumé

Les produits de base ont vu leurs prix augmenter considérablement et de manière persistante ces dernières années, puis chuter brusquement dans les récents mois. Les répercussions de telles fluctuations sur l’inflation mondiale suscitent des interrogations. Le processus de mondialisation a été la source de bien des débats visant à savoir si les facteurs internationaux jouent aujourd’hui un rôle accru dans l’évolution de l’inflation. Comme les cours des produits de base sont sensibles aux conditions de l’offre et de la demande mondiales, ils constituent un canal potentiel de transmission par lequel des chocs extérieurs pourraient influer sur les taux d’inflation nationaux. L’auteure s’attache à évaluer si les prix de ces produits sont de bons indicateurs avancés de l’inflation en appréciant leur pouvoir prédictif au sein de sept grandes économies industrialisées. Dans celles-ci, il apparaît que les cours des matières premières ont fourni depuis le milieu des années 1990 des signaux significatifs annonciateurs d'inflation. Si le renchérissement des produits de base à court terme peut annoncer l'émergence de tensions inflationnistes dès le trimestre suivant, le lien s'avère en revanche assez mince et s'atténue encore avec le temps. D'après les résultats, la politique monétaire n'a en règle générale pas cherché à faire contrepoids aux effets directs des variations de prix à court terme des matières premières sur l'inflation globale. L'incidence indirecte de ces fluctuations de court terme sur l'inflation fondamentale est restée relativement limitée, mais les mouvements plus durables semblent de nature à modifier les attentes d'inflation et à signaler des changements dans l'inflation tant globale que fondamentale, et ce, aux horizons pertinents pour la politique monétaire. Les résultats obtenus permettent également de penser que les cours des produits de base sont de meilleurs indicateurs avancés de l'inflation parmi les pays exportateurs de matières premières que parmi les pays importateurs.

Classification JEL : E3, E52, E58
Classification de la Banque : Cycles et fluctuations économiques; Modèles économiques; Inflation et prix; Questions internationales; Transmission de la politique monétaire

1 Introduction

Since the early 1990s, inflation levels and volatility have declined across many industrialized economies. At the same time, markets for globally traded goods and services have become increasingly integrated across national borders. This has prompted much debate over whether inflation may have become less sensitive to domestic factors, and more influenced by global economic conditions. Whether global activity variables have become more relevant determinants of domestic inflation has important policy implications, since an underestimation of their influence could lead to systematic prediction errors for inflation.

While monetary policy determines the level of inflation in the long run, global shocks may affect the short-run behaviour of inflation. Various recent studies have investigated the impact of foreign activity variables on inflation, with mixed conclusions. For example, Borio and Filardo (2007) and Ciccarelli and Mojon (2005) find evidence that global factors and foreign output gaps significantly affect inflation in many industrialized countries, while Dées et al. (2007) find a significant role for foreign inflation in driving the domestic inflation of several countries. The IMF (2006) also finds that increasing trade openness has significantly reduced the sensitivity of domestic inflation in industrial economies to their domestic output gaps.

In contrast, Ihrig et al. (2007) and Ball (2006) subject the results of some of the above studies to various robustness tests and conclude that global developments have had limited if any impact on inflation in industrialized countries. Ball (2006) also argues that the prices affected by globalization are relative prices, with no obvious consequences for overall price levels as long as central banks target inflation. However, Rogoff (2006) reasons that, when globalization generates changes in the terms of trade, optimal monetary policy may allow inflation to drift temporarily away from target. Furthermore, the presence of stickiness in nominal adjustments may allow relative price changes to affect inflation if they are unusually large (Ball and Mankiw 1995).

Few of these recent studies have examined explicitly the role of commodity prices, aside from oil, in influencing inflation. Real commodity prices have experienced dramatic and persistent increases in recent years, which have partly reversed very rapidly in recent months. To a large extent, the earlier price increases resulted from globalization, as the integration of emerging economies into world markets raised levels of global production, and hence the demand for commodity inputs. Since commodity prices are set on world markets, they respond to global demand and supply conditions, and are thus a potential channel through which foreign shocks could influence domestic inflation. Furthermore, because commodity prices respond more rapidly to demand and supply expectations than consumer prices, they may act as effective leading indicators of inflation.

This paper assesses whether commodity prices can be used as leading indicators of inflation by evaluating their predictive content in seven industrialized economies: Australia, Canada, the euro area, Japan, New Zealand, the United Kingdom, and the United States. We also investigate whether potential signals for inflation provided by commodity prices may differ between commodity-exporting countries and commodity-importing ones. We find that, since the mid-1990s, short-term changes in commodity prices have significant predictive power for future total inflation in the major industrialized economies considered, but that the size of this signal is relatively small and declines over time. More persistent changes in commodity prices appear to influence inflation expectations and provide stronger signals for both total and core inflation at horizons relevant for monetary policy. The results also suggest that commodity price movements may provide larger signals for inflation in the commodity-exporting countries examined than in the commodity-importing economies.

2 The Link Between Commodity Prices and Consumer Price Inflation

The link between commodity prices and consumer price inflation arises through several channels. Firstly, to the extent that rising commodity prices reflect accelerating global demand for final goods, they may feed domestic inflationary pressures, depending on the openness of the economy. Secondly, commodities are important inputs into production; therefore, if commodity price increases are sufficiently persistent to influence inflation expectations, agents may pass through rising input costs in the form of higher final-goods inflation. Because commodity prices are determined in continuous auction markets, they respond instantaneously to expectations about supply and demand, while consumer prices adjust more slowly. This permits commodity prices to give early warning of inflationary pressures, even when demand originates at the final-goods stage. Furthermore, because commodities are storable, inventory demand is influenced by expected future prices, and commodity prices thus contain a forward-looking element.[1] Lastly, since commodity prices respond quickly to general inflation pressures, investors can view them as an inflation hedge (most common for gold prices). If treated as financial assets, the prices of commodities can be effective leading indicators of inflation, since their rate of return should embed inflation expectations (Tkacz 2007).

1. This can also be seen from the close tracking of spot prices and futures prices in commodity markets.

It is worth distinguishing between the direct influence that commodity price movements may have on overall inflation, and the indirect effect. The direct effect arises because prices for commodities such as food and energy are included in the consumer price index (CPI), and therefore increases in these prices feed directly into total inflation. However, these are relative price changes that will not necessarily lead to higher generalized inflation unless they are accommodated by monetary policy. Meanwhile, the indirect effect from commodity price changes comes from their impact on inflation expectations, or "second-round effects," which may be observed in the responses of core inflation (which excludes food and energy prices).

Much of the research examining the usefulness of commodity prices as leading indicators of inflation was conducted over the late 1980s to the 1990s (for example, see Durand and Blondal 1988; Boughton and Branson 1991; Cody and Mills 1991; Blomberg and Harris 1995). This literature provided mixed results, likely because any relationship between commodity prices and general inflation would differ depending on the nature of a given shock and the response of monetary policy. To the extent that demand shocks are not idiosyncratic, a positive linkage would be expected between commodity prices and overall inflation.

Many of the studies over this period also concluded that, while commodity prices had significant explanatory power for short-run inflation before the mid-1980s, this link has since weakened over time (Furlong 1989; Blomberg and Harris 1995; Furlong and Ingenito 1996). There may be several reasons for this. First, monetary policy reactions may have changed the relationship between commodity prices and inflation since the 1980s. In particular, monetary policy responses to the oil-price shocks in the 1970s were quite different from those in the 1980s. In many OECD countries, monetary policy largely accommodated the oil-price hikes of the 1970s and likely fuelled higher inflation, whereas monetary policy responses to similar shocks in the 1980s were more restrictive. Furthermore, inflation targeting since the 1990s may have sufficiently anchored expectations such that inflationary pressures signalled by commodity prices are prevented from materializing in general inflation.[2] In addition, Fuhrer and Moore (1992) find that monetary policy that includes asset prices explicitly in the reaction function can cause the expected relationships to change signs, so that high commodity prices are associated with falling inflation.

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2. As Trehan (2005) suggests, commodity prices are sensitive to inflation expectations, and may have been dominated by volatile inflation expectations (which were themselves a reflection of the conduct of monetary policy) during the 1970s. Since then, a tighter anchoring of inflation expectations has led commodity prices to reflect developments in commodity markets, which may not necessarily influence inflation.

A second potential reason for the diminished inflation response to commodity price movements is that the commodity content of output in industrialized countries has declined, since final demand has shifted towards goods with low commodity intensity, such as services.[3] A third reason is that productivity gains may have reduced the effect of rising commodity prices on input costs, while lowering the prices of manufactured goods, thereby mitigating the impact on overall inflation. Finally, as asserted by Blanchard and Galí (2008), declining real-wage rigidities over time may have reduced the inflation response to adverse supply shocks.

There are also reasons to expect that the link between commodity price movements and inflation may differ between commodity exporters and commodity importers. For example, commodity price increases would generate opposite effects on the terms of trade of commodity importers versus commodity exporters, resulting in dampening income effects on the domestic economy of commodity importers, but stimulating effects for commodity exporters. Additionally, as Carney (2008) notes, the exchange rate of a major commodity exporter may respond to commodity price changes in an offsetting way that neutralizes the effect on domestic currency prices. Bloch, Dockery, and Sapsford (2006) find that exchange rate responses in Australia are indeed large enough to offset the inflationary impact of a commodity price boom, but they find that this is not the case for Canada.

3 Methodology

We follow the approach of Hamilton and Kim (2002) and Calza (2008) to assess the predictive content of commodity prices for future inflation, because of its simplicity and intuitive appeal. This methodology regresses future domestic inflation of country *i* on current and lagged values of domestic inflation, the domestic output gap ($ygap_{it}$), and the one-period change in the logged real commodity price variable ($\Delta^1 pc_{it}$):[4]

$$\pi_{\mathrm{it}}^{\mathrm{k}} = \alpha_i + \sum_{j=1}^{4} \beta_{ij} \pi_{i,t-j}^{1} + \eta_i ygap_{it} + \delta \Delta^1 pc_{it} + \varepsilon_{it} \, , \qquad (1)$$

where π_{it}^{k} is defined as the annualized cumulative rate of change in the consumer price index (P_{it}) over the next *k* quarters:

3. Hooker (2002), however, finds that such structural changes do not explain the change in relationship between oil prices and inflation.
4. A limitation of this approach is that data on output (used to construct the output gap) are frequently revised, while CPI data are not, rendering real-time output data potentially less informative. Although it would be useful to evaluate the equations using real-time data, we leave this for future research.

$$\pi_{it}^{k} = (\log P_{i,t+k} - \log P_{it}) * 4 / k ,$$

and

$$\Delta^{1} pc_t = (pc_t - pc_{t-1}) * 4 .$$

At the horizon k=1, equation (1) can be viewed simply as a traditional backward-looking Phillips curve augmented by global variables. The lagged domestic inflation variables can also be used as a proxy for inflation expectations.

Since commodities are also considered a financial asset, their rates of return may incorporate inflation expectations. Therefore, an alternative specification is also assessed that links the rate of return from holding the commodity over the previous k periods to realized inflation over the next k periods, as in Tkacz (2007):

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^{k} pc_t + \varepsilon_{it} , \quad (2)$$

where

$$\Delta^{k} pc_t = (pc_t - pc_{t-k}) * 4 / k .$$

The difference with this specification is that it would allow us to detect signals provided by more persistent changes in commodity prices (i.e., realized over several quarters).

Finally, panel seemingly unrelated regressions (SUR) are performed for the above equations, to control for potential contemporaneous cross-country correlation in the residuals, thus improving estimator efficiency. We also test for differences in the impact on inflation between commodity-exporting and commodity-importing economies by imposing restrictions of equal inflation responses among commodity exporters (Canada, Australia, and New Zealand), and among commodity importers (the euro area, Japan, the United Kingdom, and the United States).

4 Data

Quarterly data on CPI and core CPI (excluding food and energy) for the seven economies are examined over the period 1980Q1–2007Q4.[5] Table 1a shows the mean and standard deviations of the CPI and core CPI inflation series, and Table 1b the results of unit-root tests. These indicate

5. CPI data for the euro area are available beginning only in 1990. Prior to 1990, we proxy the series using a GDP-weighted average of the consumer price indexes of West Germany, France, and Italy.

that most countries' inflation rates are stationary or very close to stationary for most values of *k*.[6] With inflation targeting having been adopted by several countries (Australia, Canada, New Zealand, and the United Kingdom) in the early 1990s, it is likely that inflation dynamics have changed over time. Table 2 identifies the dates on which inflation targeting began for the seven economies considered. We therefore split the sample at 1994Q1 to reflect this broad change in monetary policy regime, and compare results over two subsamples: 1980Q1–1993Q4 and 1994Q1–2007Q4.

The domestic output-gap variables are derived from estimates of real output potential obtained by detrending individual countries' real GDP with a Hodrick-Prescott (HP) filter. This method is known to suffer from end-of-sample bias, which is problematic for practical purposes. To mitigate this problem, we use the real GDP forecasts obtained from the OECD *Economic Outlook* database to extend the output series to 2010Q4.[7] After applying the HP filter to the extended series, we drop the last 12 quarters.[8]

We consider a number of different constructions of the real commodity price variable ($\Delta^k pc_{it}$):

(i) The first uses the IMF index for total primary commodity prices (which is denominated in U.S. dollars), deflated by a world consumer price index obtained from the IMF:[9]

$$\Delta^k pc_{it} = \Delta^k pcus_t = (pcus_t - pcus_{t-k}) * 4 / k \ ,$$

where

$$pcus_t = (\log pcusnom_t - \log cpi\_world_t) \ .$$

(ii) It is also possible that inflation expectations are influenced only by the commodity price movements that consumers and producers face in their own domestic currency. In this case, only movements in the domestic-currency-denominated commodity prices would matter. As discussed earlier, exchange rate responses may often offset the inflationary pressures

6. The stationarity of inflation rates suggests that no long-term relationship between inflation and commodity prices exists.
7. The real output series are also extended at the beginning of the sample to 1971Q1 for application of the HP filter.
8. Alternatively, the output-gap series in the OECD *Economic Outlook* database (constructed using a production function approach) were also tested. These output-gap measures generally produced similar results but a worse equation fit, so we do not report the results.
9. Since the IMF's total commodity price index is available beginning only in 1992, a proxy is constructed from a weighted average of the IMF's non-fuel index and oil-price index. The weights used are the IMF's 2002–04 average world export shares.

signalled in commodity price movements. Therefore, an alternative construction is also tested, which assumes that the relevant variable for each country *i* is the real commodity price movement relative to the change in its real bilateral exchange rate over the same period:

$$\Delta^k pc_{it} = \Delta^k pcdom_{it} = \Delta^k pcus_t - \Delta^k rer_{it} ,$$

where $\Delta^k rer_{it}$ is defined as the *k*-period change in U.S. dollars per unit of domestic currency in country *i*, adjusted for the relative consumer price indexes. As a result, the impact of a real commodity price increase would be moderated by any appreciation of the real exchange rate, but magnified by any depreciation.

(iii) Since commodity prices are extremely volatile and often subject to large sectoral shocks, their movements may not always reflect aggregate supply or demand conditions. However, common movements across commodity prices likely do reflect global demand pressures. Indeed, Borensztein et al. (2000) find that cycles tend to be correlated across different commodity prices, suggesting a role for common macroeconomic factors. If domestic inflation is truly influenced by global demand pressures, these would be best captured by extracting the common factor among movements in the disaggregate commodity prices. This is achieved via the method of principal-component analysis on *k*-period changes in the 52 IMF commodity price series. The common factor is taken to be the first principal component corresponding to the largest eigenvalue computed from the sample variance-covariance matrix containing the 52 series, both priced in U.S. dollars ($\Delta^k fus_t$) and adjusted for real exchange rate movements ($\Delta^k fdom_{it}$).

5 Results

5.1 Full sample: 1980Q1–2007Q4

Equations (1) and (2) are first estimated via ordinary least squares for future total and core inflation in each individual country *i* over the entire sample 1980Q1–2007Q4, at forecast horizons k = 1, 2, 4, and 8 quarters ahead.[10] Table 3b shows the results of including the one-quarter change in commodity prices in equation (1) for total inflation, while Table 3c reports the results of including the *k*-quarter change in commodity prices, as per equation (2). At $k = 1$, the latter results are the same as those obtained from estimating equation (1), but for $k > 1$ the

10. When $k > 1$, the error term ε_{it} is likely to be serially correlated and follow a MA(k-1) process, resulting in incorrect standard errors. This issue is addressed by using Newey-West heteroskedastic and autocorrelation consistent (HAC) standard errors, with a truncation lag of 3.

differences in results can be thought to reflect the effects of more *persistent* changes in commodity prices realized over several quarters. Tables 4b and 4c show the corresponding results for core inflation. For simplicity, the coefficients on lagged domestic inflation and the constant are not reported.

To determine whether any improvement in fit is achieved by including the commodity price variables, Tables 3a and 4a first report the results for equation (1) excluding any commodity price variables. These results suggest that domestic output gaps do possess significant information content for future headline and core inflation up to four quarters ahead, in most countries except the United States. These results do not change when the commodity price variables are included in the equation.

The four different commodity price variables, as described in section 4, were included one at a time into equations (1) and (2); we report only the specification that generated the highest adjusted-R^2 for each country. Chart 1 shows the common factor estimated across year-over-year movements in the 52 disaggregate U.S.-dollar commodity price movements. Movements in the common factor are highly corrrelated with those of the IMF total commodity price index, although they are substantially less volatile and account for only about 31 per cent of the total variance.[11]

The results, shown in Table 3b, suggest that, in most of the economies considered, a one-quarter change in real commodity prices is a significant and positive indicator for changes in total CPI in the following quarter, as well as for two quarters ahead in Japan and the euro area. Beyond two quarters ahead, one-quarter commodity price movements have little predictive value, suggesting only a short-term influence on inflation. In general, movements in the estimated common factor across commodity price movements (either in U.S. or domestic currency) tend to be more significant for total inflation than do movements in the commodity price index itself. The inflation responses signalled by commodity prices are small: a 1 percentage point rise in real commodity prices in a given quarter is associated with a 0.12 percentage point increase in total consumer prices the next quarter in the United States, and with only a 0.01 percentage point increase in Japan. Furthermore, incorporating the information content from commodity price movements appears to do little to improve the equation fit above that provided in the domestic output gap. Interestingly, results in Table 3c indicate that more persistent increases in commodity prices that accumulated over two to eight quarters appear to be associated with *negative* changes

11. Including the second principal component can explain an additional 12 per cent of the total variance, but this second factor was generally found to be insignificant in the equation estimations.

in future total inflation, most significantly for Australia, Canada, and New Zealand four to eight quarters ahead.[12] Although it is not clear why, the fact that all three countries are commodity exporters may indicate that exchange rate movements played a role in offsetting inflationary signals from commodity price movements. Alternatively, regime changes towards inflation targeting in the early 1990s may have changed the relationship between commodity prices and inflation in these countries, rendering full-sample estimates unreliable. Meanwhile, the results in Tables 4b and 4c indicate that commodity price changes provide limited use for signalling future core inflation in most countries at most forecast horizons.

5.2 Split-sample results

Given that the adoption of inflation targeting by many countries in the early 1990s has likely changed the inflation process in these countries, we split the sample at 1994Q1 to reveal whether relationships have changed since the shift in monetary policy regime. Table 5 reports the estimation results for total inflation over the 1980Q1–1993Q4 period, and Table 6 over the 1994Q1–2007Q4 period. Tables 7 and 8 show the corresponding results for core inflation.

We first compare the early and late sample results for total inflation. Over the early sample (Table 5b), results suggest that one-quarter commodity price changes provide the strongest positive signal for next-quarter changes in total CPI for most countries (except for the United Kingdom). Including the commodity price variables improves the adjusted-R^2 for most countries, with Canada and Japan enjoying the largest improvements. However, quarterly commodity price movements add limited value for predicting future inflation beyond one quarter ahead, except in Japan. Table 5c indicates that more persistent changes in commodity prices, accumulated over eight quarters, have significant predictive content for total inflation over the next eight quarters.

Since 1994, commodity price movements appear to have much stronger signalling power for future headline inflation relative to the preceding period. As Table 6b shows, one-quarter changes in commodity prices significantly and positively lead changes in total inflation in almost all economies considered, for most forecast horizons up to eight quarters ahead. This suggests that monetary policy has generally accommodated the direct effects of short-term commodity price movements on total inflation. Over the 1994Q1–2007Q4 period, changes in the estimated common factor across U.S.-dollar-priced commodities provide the strongest signal for future inflation in most economies. The signal offered by the commodity price common movement also appears to diminish over time. For example, for Canada, a 1 percentage point increase in the

12. In alternative specifications, dummy variables were inserted to account for the effect of a goods and services tax on inflation in Australia and Canada, but this did not change the results significantly.

common factor over one quarter signals a 0.21 percentage point increase in total CPI over the following quarter, but only a 0.06 percentage point cumulative increase in CPI over the next eight quarters. While this may be related to well-anchored inflation expectations, it appears that more persistent changes in commodity prices (accumulated over four to eight quarters) give early warning of larger inflation changes four to eight quarters ahead. Including the quarterly commodity price change improves the equation fit substantially relative to those that include only the domestic output gap, but including the more persistent commodity price changes generates even larger improvements.

The results for core inflation (Tables 7 and 8) are fairly similar between the early and late samples, and suggest that more persistent commodity price movements (i.e., those lasting eight quarters) tend to offer the most useful signal for future core inflation for the majority of the economies. Less persistent movements (over two to four quarters) are also found to lead future core inflation for a few economies. For Canada, commodity price movements have significant information content for future core inflation in the early sample, but not in the later sample. These results suggest that short-term commodity price movements have had relatively muted indirect effects on core inflation, but that more persistent commodity price movements do continue to influence inflation expectations.

Overall, the split-sample results suggest that commodity price movements, particularly persistent ones, have been more effective leading indicators of total inflation since 1994 relative to the 1980–93 period. Given monetary policy's tighter focus on inflation over the more recent sample, this result is likely related to other developments that may have affected inflation during those periods. As Chart 2 shows, the IMF commodity price index declined fairly steadily in real terms between 1980–93, with no large or sustained increases. Although high inflation levels at the beginning of the sample were largely related to the oil-price shock following the Iranian revolution in 1979, the sizable fluctuations in inflation that occurred up until the early 1990s appear to be mostly disconnected from commodity price movements. Furthermore, in the presence of downward nominal-wage rigidity, it is possible that commodity price declines may have smaller implications for inflation than commodity price increases. If so, the greater predictive power of commodity prices for total inflation in the later sample may reflect the direct effects of a large commodity price increase in recent years – which has been accommodated by monetary policy, and which has likely also influenced inflation expectations given its persistence.

5.3 Commodity exporters vs. commodity importers

Results of panel SUR estimations are reported in Table 9 for total inflation and in Table 10 for core inflation, at the forecast horizon of one quarter ahead. Given the disparate results found between the early and late samples in the previous section, the estimations are restricted to the more recent period, due to its greater relevance for the current policy environment. These estimations control for potential contemporaneous cross-country correlation in the residuals, allowing for greater estimator efficiency. Results are reported only with the commodity price variable that generated the highest adjusted-R^2, which was $\Delta^1 fdom_{it}$.

Various restrictions are tested, with column 1 of Tables 9 and 10 showing the results when coefficients are imposed to be equal across all seven economies. Under this restriction, we find that total inflation is significantly and positively influenced by the previous period's movements in domestic output gaps and commodity prices, whereas core inflation is negatively associated (although not significantly) with commodity price changes in the previous quarter.

Given that commodity price increases may have different implications for inflation in commodity-exporting countries (Australia, Canada, and New Zealand) compared with those in commodity-importing economies (the euro area, Japan, the United Kingdom, and the United States), we next restrict the inflation responses to be equal across commodity exporters (column 2 of Tables 9 and 10), and equal across commodity importers (column 3). The results suggest that real commodity price changes are positively associated with total inflation over the next quarter for commodity exporters, but less so for commodity importers. Commodity price changes appear to have a positive relationship with future core inflation for commodity exporters, but a negative assocation for commodity importers – these relationships, however, are not statistically significant.

The results for the commodity-importing economies considered appear to be consistent with a monetary policy that targets total inflation rather than core inflation. Under such a policy target, an increase in a relative price such as oil or food would lead to relative declines in core prices. Meanwhile, the results for commodity-exporting countries appear to be consistent with a monetary policy that operationally targets core inflation, given that commodity price changes are permitted to significantly influence total inflation but not core.[13] It is difficult to determine whether the larger positive coefficients on the commodity price variable for commodity

13. While the Bank of Canada uses core inflation (excluding the eight most volatile components) as an operational target for monetary policy, the Reserve Bank of Australia and the Reserve Bank of New Zealand officially target the average total inflation rate over the medium term.

exporters (relative to commodity importers) point to the stimulative income effects generated by commodity price increases, given that we would expect these effects to materialize over longer lags. However, the results suggest that the real exchange rate responses of commodity exporters are not sufficient to completely offset the inflationary signals in commodity price increases.

6 Conclusions

In the context of increasing globalization, there has been rising interest in understanding how global variables affect inflation. This paper examines the predictive content of commodity prices for total and core inflation in seven major industrialized economies. While several studies conclude that the link between commodity prices and inflation in industrialized countries diminished from the late 1980s to the early 1990s, this paper presents evidence that commodity prices have provided significant signals for total inflation in the major industrialized economies considered since the mid-1990s. While short-term commodity price increases can signal inflationary pressures as soon as the following quarter, the size of this link is relatively small and declines over time. The results suggest that monetary policy has generally accommodated the direct effects of short-term commodity price movements on total inflation. While the indirect effects of short-term commodity price movements on core inflation have remained relatively muted, more persistent movements appear to influence inflation expectations and signal changes in both total and core inflation at horizons relevant for monetary policy. The results also suggest that commodity price movements may provide larger signals for inflation in the commodity-exporting countries examined than in the commodity-importing economies.

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Table 1a
Summary Statistics for Inflation Rates

	π^1		π^2		π^4		π^8	
	Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**	**Mean**	**Std**
AUS	4.53	3.58	4.50	3.21	4.47	3.01	4.38	2.77
CAN	3.50	3.05	3.47	2.83	3.42	2.59	3.28	2.22
EA	3.47	2.38	3.44	2.28	3.39	2.18	3.27	1.97
JPN	1.08	2.05	1.04	1.67	1.00	1.46	0.92	1.26
NZL	5.16	.5.55	5.12	5.15	5.04	4.81	4.89	4.33
UK	3.68	3.08	3.63	2.77	3.56	2.54	3.42	2.21
US	3.53	2.24	3.50	1.91	3.45	1.69	3.31	1.27
	π^1_{core}		π^2_{core}		π^4_{core}		π^8_{core}	
	Mean	**Std**	**Mean**	**Std**	**Mean**	**Std**	**Mean**	**Std**
AUS	4.42	3.66	4.40	3.37	4.37	3.20	4.31	2.97
CAN	3.38	2.88	3.35	2.72	3.30	2.55	3.21	2.26
EA	3.39	2.28	3.36	2.23	3.30	2.15	3.22	1.99
JPN	1.22	1.71	1.20	1.58	1.16	1.47	1.12	1.35
NZL	5.23	5.72	5.17	5.43	5.10	5.13	4.98	4.71
UK	3.73	3.40	3.67	3.11	3.60	2.87	3.51	2.58
US	3.62	2.15	3.57	1.91	3.53	1.80	3.42	1.50

Note: EA stands for euro area.

Table 1b
Unit-Root Test Results

	π^1		π^2		π^4		π^8	
	ADF	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
AUS	-2.25 (0.19)	-5.54 (0.00)	-1.91 (0.33)	-2.74 (0.07)	-1.64 (0.46)	-1.72 (0.42)	-1.83 (0.36)	-1.48 (0.54)
CAN	-4.21 (0.00)	-3.85 (0.00)	-3.76 (0.00)	-2.69 (0.08)	-4.13 (0.00)	-3.81 (0.00)	-2.26 (0.19)	-4.22 (0.00)
EA	-2.51 (0.12)	-2.96 (0.04)	-4.21 (0.00)	-2.60 (0.10)	-3.37 (0.01)	-3.25 (0.02)	-3.00 (0.04)	-3.92 (0.00)
JPN	-3.51 (0.01)	-7.68 (0..00)	-2.84 (0.06)	-4.67 (0.00)	-2.53 (0.11)	-3.81 (0.00)	-2.57 (0.10)	-3.10 (0.03)
NZL	-2.79 (0.06)	-3.59 (0.01)	-1.53 (0.52)	-2.02 (0.28)	-0.95 (0.77)	-1.73 (0.41)	-1.11 (0.71)	-1.32 (0.62)
UK	-3.72 (0.01)	-5.32 (0..00)	-3.79 (0.00)	-3.95 (0.00)	-1.98 (0.30)	-3.38 (0.01)	-1.84 (0.36)	-3.73 (0.00)
US	-4.65 (0.00)	-6.54 (0.00)	-5.16 (0.00)	-3.65 (0.01)	-2.34 (0.16)	-4.43 (0.00)	-2.07 (0.26)	-4.84 (0.00)
	π^1_{core}		π^2_{core}		π^4_{core}		π^8_{core}	
	ADF	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
AUS	-3.47 (0.01)	-6.51 (0.00)	-2.33 (0.16)	-3.81 (0.00)	-2.17 (0.22)	-2.76 (0.07)	-2.01 (0.28)	-2.03 (0.27)
CAN	-3.69 (0.01)	-3.38 (0.01)	-2.84 (0.06)	-2.51 (0.12)	-3.61 (0.01)	-2.45 (0.13)	-3.55 (0.01)	-3.28 (0.02)
EA	-2.88 (0.05)	-2.81 (0.06)	-4.31 (0.00)	-2.94 (0.04)	-2.88 (0.05)	-3.18 (0.02)	-3.12 (0.03)	-3.82 (0.00)
JPN	-3.23 (0.02)	-4.01 (0.00)	-2.18 (0.21)	-2.80 (0.06)	-2.58 (0.10)	-2.58 (0.10)	-1.74 (0.41)	-2.06 (0.26)
NZL	-2.52 (0.11)	-3.02 (0.04)	-1.58 (0.49)	-1.91 (0.33)	-0.80 (0.82)	-1.58 (0.49)	-0.97 (0.76)	-1.34 (0.61)
UK	-4.84 (0.00)	-4.77 (0.00)	-5.67 (0.08)	-3.44 (0.01)	-1.52 (0.52)	-2.74 (0.07)	-1.33 (0.61)	-2.78 (0.06)
US	-2.50 (0.12)	-5.68 (0.00)	-6.70 (0.00)	-3.04 (0.03)	-3.41 (0.01)	-4.01 (0.00)	-4.66 (0.00)	-4.75 (0.00)

Notes: Test statistics are provided for augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit-root tests. Mackinnon (1996) one-sided *p*-values are shown in parentheses. EA stands for euro area.

Table 2
Dates on which Inflation Targeting Began

Countries with inflation targets	**Date**
Australia	Sept. 1994
Canada	Feb. 1991
New Zealand	Mar. 1990
U.K.	Oct. 1992
Countries without inflation targets	
Euro area, Japan, U.S.	

Table 3
Predictive Content for Total Inflation, Full Sample (1980Q1–2007Q4)

a. Domestic Output Gap

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \varepsilon_{it}$$

	$ygap_t$	*Adj-R^2*
	k = 1	
Australia	0.54***	0.55
Canada	0.33***	0.57
Euro area	0.03	0.82
Japan	0.33**	0.32
New Zealand	0.77*	0.66
UK	0.34**	0.61
US	0.16	0.41
	k = 2	
Australia	0.55***	0.65
Canada	0.40***	0.64
Euro area	0.05	0.86
Japan	0.30**	0.44
New Zealand	0.61**	0.66
UK	0.41***	0.68
US	0.17	0.39
	k =4	
Australia	0.64***	0.64
Canada	0.49***	0.74
Euro area	0.04	0.84
Japan	0.20	0.47
New Zealand	0.45*	0.58
UK	0.62***	0.71
US	0.15	0.31
	k = 8	
Australia	0.40*	0.51
Canada	0.39***	0.75
Euro area	-0.03	0.82
Japan	0.06	0.38
New Zealand	0.26	0.56
UK	0.71***	0.71
US	0.02	0.23

b. Commodity Prices : 1-Q change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^{1} pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^1 pc_{it}$				*Adj-R^2*
		$\Delta^1 pcus_t$	*$\Delta^1 pcdom_{it}$*	*$\Delta^1 fus_t$*	*$\Delta^1 fdom_{it}$*	
			k = 1			
Australia	0.56***				0.20**	0.56
Canada	0.32***				0.14*	0.58
Euro area	0.04				0.09***	0.84
Japan	0.23		0.01***			0.36
New Zealand	0.75*				0.17*	0.65
UK	0.35***	-0.012				0.63
US	0.17			0.12**		0.43
			k = 2			
Australia	0.56***				0.09	0.64
Canada	0.39***				0.12	0.64
Euro area	0.06				0.06**	0.86
Japan	0.20		0.01***			0.51
New Zealand	0.6**			-0.31		0.67
UK	0.42***			-0.12**		0.69
US	0.17			0.07		0.40
			k = 4			
Australia	0.65***			-0.06		0.63
Canada	0.49***				0.04	0.74
Euro area	0.05				0.03	0.84
Japan	0.14		0.01***			0.51
New Zealand	0.52**			-0.29		0.59
UK	0.63***			-0.06		0.72
US	0.15			0.04		0.31
			k = 8			
Australia	0.39			-0.09		050
Canada	0.39***	-0.00				0.75
Euro area	-0.03		-0.00			0.82
Japan	-0.00				0.07***	0.41
New Zealand	0.31	-0.02				0.55
UK	0.72***				0.04	0.71
US	0.02			0.01		0.22

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^{k} pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^k pc_{it}$				*Adj-R^2*
		$\Delta^k pcus_t$	*$\Delta^k pcdom_{it}$*	*$\Delta^k fus_t$*	*$\Delta^k fdom_{it}$*	
			k = 1			
Australia	0.56***				0.20**	0.56
Canada	0.32***				0.14*	0.58
Euro area	0.04				0.09***	0.84
Japan	0.23		0.01***			0.36
New Zealand	0.75*				0.17*	0.65
UK	0.35***	-0.012				0.63
US	0.17			0.12**		0.43
			k = 2			
Australia	0.56***			-0.16		0.65
Canada	0.39***				0.07	0.63
Euro area	0.06				0.04	0.86
Japan	0.20				0.10***	0.47
New Zealand	0.72**	-0.04*				0.68
UK	0.44***			-0.11		0.69
US	0.17		-0.00			0.39
			k = 4			
Australia	0.59***				-0.23*	0.62
Canada	0.53***		-0.02**			0.76
Euro area	0.04		-0.00			0.84
Japan	0.13				0.08	0.48
New Zealand	0.68***	-0.05**				0.57
UK	0.63***	-0.00				0.71
US	0.16	-0.01				0.31
			k = 8			
Australia	0.27	-0.03**				0.41
Canada	0.43***		-0.03***			0.65
Euro area	-0.04				-0.10**	0.73
Japan	0.152		-0.01			0.34
New Zealand	0.51**	-0.04**				0.48
UK	0.74***	-0.01				0.67
US	0.06	-0.01				0.16

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 4
Predictive Content for Core Inflation, Full Sample (1980Q1–2007Q4)

a. Domestic Output Gap

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it}\pi_{i,t-j}^{1} + \eta ygap_{it} + \varepsilon_{it}$$

	$ygap_t$	Adj-R^2
	k = 1	
Australia	0.51**	0.63
Canada	0.31***	0.69
Euro area	0.07*	0.93
Japan	0.23**	0.61
New	0.63*	0.74
UK	0.25	0.63
US	0.13	0.79
	k = 2	
Australia	0.53***	0.70
Canada	0.43***	0.73
Euro area	0.16***	0.95
Japan	0.21**	0.71
New Zealand	0.45*	0.71
UK	0.36*	0.65
US	0.14	0.79
	k =4	
Australia	0.63***	0.66
Canada	0.53***	0.78
Euro area	0.14**	0.93
Japan	0.17	0.72
New Zealand	0.32	0.64
UK	0.56**	0.67
US	0.13	0.74
	k = 8	
Australia	0.40	0.49
Canada	0.50***	0.80
Euro area	0.11	0.89
Japan	0.08	0.67
New Zealand	0.18	0.55
UK	0.51*	0.60
US	0.11	0.64

b. Commodity Prices : 1-Q change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it}\pi_{i,t-j}^{1} + \eta ygap_{it} + \delta\Delta^1 pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^1 pc_{it}$				Adj-R^2
		$\Delta^1 pcus_t$	$\Delta^1 pcdom_{it}$	$\Delta^1 fus_t$	$\Delta^1 fdom_{it}$	
			k = 1			
Australia	0.52**				0.13*	0.63
Canada	0.29***		0.01			0.70
Euro area	0.08**				0.02	0.93
Japan	0.23**			0.02		0.61
New	0.72**			-0.30*		0.75
UK	0.28			-0.08		0.63
US	0.13			0.007		0.79
			k = 2			
Australia	0.53***				0.07	0.70
Canada	0.41***				0.12	0.74
Euro area	0.10**	-0.00				0.94
Japan	0.21**			0.02		0.71
New Zealand	0.54**			-0.33		0.73
UK	0.40*			-0.11*		0.66
US	0.14			0.01		0.79
			k = 4			
Australia	0.64***			-0.09		0.65
Canada	0.52***		0.004			0.78
Euro area	0.15**		0.00			0.92
Japan	0.17**	0.00				0.72
New Zealand	0.40*			-0.31		0.65
UK	0.59**			-0.10*		0.68
US	0.13		-0.00			0.74
			k = 8			
Australia	0.41	-0.01				0.49
Canada	0.50***	-0.00				0.80
Euro area	0.11		0.00			0.89
Japan	0.06				0.03*	0.67
New Zealand	0.26	-0.02				0.55
UK	0.50**				0.08	0.61
US	0.11		-0.00			0.64

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it}\pi_{i,t-j}^{1} + \eta ygap_{it} + \delta\Delta^k pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^k pc_{it}$				Adj-R^2
		$\Delta^k pcus_t$	$\Delta^k pcdom_{it}$	$\Delta^k fus_t$	$\Delta^k fdom_{it}$	
			k = 1			
Australia	0.52**				0.13*	0.63
Canada	0.29***		0.01			0.70
Euro area	0.08**				0.02	0.93
Japan	0.23**			0.02		0.61
New	0.72**			-0.30*		0.75
UK	0.28			-0.08		0.63
US	0.13			0.007		0.79
			k = 2			
Australia	0.54***			-0.15		0.70
Canada	0.41***		0.008			0.73
Euro area	0.09*			-0.02		0.94
Japan	0.23**				-0.02	0.71
New Zealand	0.57**	-0.04				0.73
UK	0.47**			-0.21**		0.67
US	0.14			0.01		0.79
			k = 4			
Australia	0.58***				-0.21	0.65
Canada	0.57***			-0.18**		0.80
Euro area	0.15**	0.00				0.93
Japan	0.17**			0.04		0.72
New Zealand	0.54**	-0.05**				0.63
UK	0.53**				0.15	0.68
US	0.13		-0.01			0.74
			k = 8			
Australia	0.28	-0.04**				0.44
Canada	0.52***		-0.02*			0.73
Euro area	0.11				-0.04	0.85
Japan	0.12		-0.01			0.66
New Zealand	0.38				0.48	0.49
UK	0.57**	-0.02				0.59
US	0.14		-0.01			0.68

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 5
Predictive Content for Total Inflation, Early Sample (1980Q1–1993Q4)

a. Domestic Output Gap

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \varepsilon_{it}$$

	$ygap_t$	$Adj\text{-}R^2$
	***k* = 1**	
Australia	0.39**	0.53
Canada	0.37***	0.66
Euro area	-0.02	0.85
Japan	0.46*	0.16
New Zealand	1.16**	0.59
UK	0.33**	0.37
US	0.14	0.41
	***k* = 2**	
Australia	0.42**	0.61
Canada	0.47***	0.71
Euro area	0.01	0.85
Japan	0.43**	0.27
New Zealand	0.96***	0.57
UK	0.38**	0.44
US	0.16	0.37
	***k* =4**	
Australia	0.55**	0.59
Canada	0.57***	0.81
Euro area	-0.03	0.82
Japan	0.28	0.25
New Zealand	0.77***	0.42
UK	0.61***	0.49
US	0.16	0.27
	***k* = 8**	
Australia	0.34	0.35
Canada	0.46***	0.78
Euro area	-0.06	0.77
Japan	0.24	0.10
New Zealand	0.65**	0.36
UK	0.73***	0.61
US	0.06	0.11

b. Commodity Prices: 1-Q change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^1 pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^1 pc_{it}$				$Adj\text{-}R^2$
		$\Delta^1 pcus_t$	$\Delta^1 pcdom_{it}$	$\Delta^1 fus_t$	$\Delta^1 fdom_{it}$	
			***k* = 1**			
Australia	0.47***				0.30***	0.57
Canada	0.35***		0.03***			0.73
Euro area	0.01				0.13**	0.87
Japan	0.37**		0.02***			0.37
New Zealand	1.08**				0.36***	0.61
UK	0.33**	-0.02				0.38
US	0.20			0.22**		0.46
			***k* = 2**			
Australia	0.45**				0.13	0.62
Canada	0.44***			0.26**		0.77
Euro area	0.03				0.07	0.86
Japan	0.36***		0.02***			0.56
New Zealand	0.99***			-0.43		0.60
UK	0.40***			-0.17**		0.46
US	0.19			0.12		0.39
			***k* = 4**			
Australia	0.54**			-0.10		0.59
Canada	0.57***				0.12	0.82
Euro area	-0.02				0.05	0.82
Japan	0.25*				0.16***	0.49
New Zealand	0.87***	-0.05*				0.47
UK	0.63***				0.08	0.50
US	0.18			0.07		0.27
			***k* = 8**			
Australia	0.33	-0.01				0.34
Canada	0.45***			0.10*		0.79
Euro area	-0.08	-0.00				0.77
Japan	0.22*				0.14***	0.34
New Zealand	0.71***	-0.03				0.38
UK	0.75***	0.10**				0.64
US	0.08			0.09*		0.14

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^k pc_{it} + \varepsilon_{it}$$

	$ygap_t$	$\Delta^k pc_{it}$				$Adj\text{-}R^2$
		$\Delta^k pcus_t$	$\Delta^k pcdom_{it}$	$\Delta^k fus_t$	$\Delta^k fdom_{it}$	
			***k* = 1**			
Australia	0.47***				0.30***	0.57
Canada	0.35***		0.03***			0.73
Euro area	0.01				0.13**	0.87
Japan	0.37**		0.02***			0.37
New Zealand	1.08**				0.36***	0.61
UK	0.33**	-0.02				0.38
US	0.20			0.22**		0.46
			***k* = 2**			
Australia	0.42**	-0.03***				0.65
Canada	0.45***			0.27*		0.74
Euro area	-0.04	-0.01*				0.86
Japan	0.43***				0.26***	0.58
New Zealand	0.97***	-0.07				0.63
UK	0.44***			-0.20*		0.45
US	0.14		-0.01			0.36
			***k* = 4**			
Australia	0.58**	-0.02				0.59
Canada	0.57***				0.05	0.81
Euro area	0.00			0.13		0.83
Japan	0.25**				0.32***	0.57
New Zealand	0.83***	-0.10				0.45
UK	0.62***		0.01			0.49
US	0.14			0.22		0.32
			***k* = 8**			
Australia	0.19				1.67***	0.45
Canada	0.35***				0.49	0.66
Euro area	-0.05**			0.17		0.60
Japan	0.20**				0.48***	0.48
New Zealand	0.52**				1.19**	0.41
UK	0.80***				0.25**	0.76
US	-0.14			0.60***		0.34

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 6
Predictive Content for Total Inflation, Late Sample (1994Q1–2007Q4)

a. Domestic Output Gap

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\varepsilon_{it}$$

	$ygap_t$	$Adj\text{-}R^2$
	***k* = 1**	
Australia	1.46	0.14
Canada	0.47**	0.04
Euro area	0.35**	0.22
Japan	0.58**	0.14
New Zealand	0.24	0.10
UK	0.22	0.08
US	0.35**	0.16
	***k* = 2**	
Australia	1.35**	0.26
Canada	0.41**	0.08
Euro area	0.31**	0.31
Japan	0.50*	0.22
New Zealand	0.33	0.11
UK	0.40	0.20
US	0.37**	0.14
	***k* =4**	
Australia	1.07**	0.18
Canada	0.38***	0.16
Euro area	0.34**	0.22
Japan	0.41*	0.21
New Zealand	0.32	0.05
UK	0.38	0.33
US	0.31**	0.07
	***k* = 8**	
Australia	0.53	0.04
Canada	0.27**	0.11
Euro area	0.18*	0.08
Japan	0.19	0.01
New Zealand	-0.08	0.00
UK	-0.19	0.25
US	0.09	0.00

b. Commodity Prices: 1-Q change

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\delta\Delta^{1}pc_{it}+\varepsilon_{it}$$

	$ygap_t$	$\Delta^1 pc_{it}$				$Adj\text{-}R^2$
		$\Delta^1 pcus_t$	$\Delta^1 pcdom_{it}$	$\Delta^1 fus_t$	$\Delta^1 fdom_{it}$	
			***k* = 1**			
Australia	1.41*				0.25	0.20
Canada	0.45*				0.21**	0.09
Euro area	0.39***			0.18***		0.36
Japan	0.52*		0.01			0.14
New Zealand	0.17			0.13		0.11
UK	0.26				-0.06	0.09
US	0.34*			0.24***		0.27
			***k* = 2**			
Australia	1.31**				0.21*	0.33
Canada	0.39**				0.20***	0.20
Euro area	0.34***			0.14***		0.44
Japan	0.41		0.01***			0.27
New Zealand	0.28			0.10		0.11
UK	0.39	0.00				0.19
US		0.36**		0.21***		0.29
			***k* = 4**			
Australia	1.04**				0.17*	0.24
Canada	0.39***			0.17***		0.35
Euro area	0.37**			0.14***		0.42
Japan	0.40*			0.07		0.22
New Zealand	0.21			0.22**		0.19
UK	0.38	0.01				0.38
US	0.31**			0.18***		0.24
			***k* = 8**			
Australia	0.48		0.01			0.07
Canada	0.27**				0.06**	0.15
Euro area	0.24***			0.12***		0.39
Japan	0.11				0.06	0.05
New Zealand	-0.17			0.23***		0.26
UK	-0.09			0.08**		0.32
US	0.11			0.12**		0.11

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\delta\Delta^{k}pc_{it}+\varepsilon_{it}$$

	$ygap_t$	$\Delta^k pc_{it}$				$Adj\text{-}R^2$
		$\Delta^k pcus_t$	$\Delta^k pcdom_{it}$	$\Delta^k fus_t$	$\Delta^k fdom_{it}$	
			***k* = 1**			
Australia	1.41*				0.25	0.20
Canada	0.45*				0.21**	0.09
Euro area	0.39***			0.18***		0.36
Japan	0.52*		0.01			0.14
New Zealand	0.17			0.13		0.11
UK	0.26				-0.06	0.09
US	0.34*			0.24***		0.27
			***k* = 2**			
Australia	1.34**				0.24*	0.31
Canada	0.39**			0.20**		0.17
Euro area	0.33***			0.14**		0.41
Japan	0.44		0.01			0.23
New Zealand	0.20			0.20		0.16
UK	0.37	0.01				0.23
US	0.40**			0.23**		0.26
			***k* = 4**			
Australia	1.06***	0.03**				0.29
Canada	0.35***	0.01				0.20
Euro area	0.34***			0.20***		0.44
Japan	0.26				0.14	0.25
New Zealand	0.05			0.46***		0.34
UK	0.32			0.18***		0.51
US	0.40**			0.32***		0.34
			***k* = 8**			
Australia	0.94***				0.69***	0.35
Canada	0.30**			0.07		0.12
Euro area	0.29***			0.20***		0.32
Japan	0.15			0.10		0.02
New Zealand	-0.16			0.46***		0.36
UK	-0.10			0.30***		0.74
US	0.24**			0.30***		0.27

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 7
Predictive Content for Core Inflation, Early Sample (1980Q1–1993Q4)

a. Domestic Output Gap

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\varepsilon_{it}$$

	$ygap_t$	$Adj\text{-}R^2$
	k = 1	
Australia	0.46**	0.60
Canada	0.37***	0.60
Euro area	0.03	0.88
Japan	0.31*	0.20
New Zealand	0.97**	0.66
UK	0.41*	0.36
US	0.14	0.63
	k = 2	
Australia	0.49**	0.67
Canada	0.50***	0.67
Euro area	0.06	0.89
Japan	0.27**	0.31
New Zealand	0.74**	0.60
UK	0.57**	0.38
US	0.15	0.64
	k =4	
Australia	0.60**	0.61
Canada	0.62***	0.75
Euro area	0.09	0.87
Japan	0.22**	0.30
New Zealand	0.63**	0.47
UK	0.83***	0.47
US	0.12	0.54
	k = 8	
Australia	0.37	0.35
Canada	0.54***	0.74
Euro area	0.01	0.82
Japan	0.14	0.13
New Zealand	0.61**	0.34
UK	0.78***	0.47
US	0.10	0.34

b. Commodity Prices: 1-Q change

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\delta\Delta^{1}pc_{it}+\varepsilon_{it}$$

	$ygap_t$	$\Delta^1 pc_{it}$				$Adj\text{-}R^2$
		$\Delta^1 pcus_t$	$\Delta^1 pcdom_{it}$	$\Delta^1 fus_t$	$\Delta^1 fdom_{it}$	
			k = 1			
Australia	0.50**				0.22**	0.62
Canada	0.33***		0.02			0.63
Euro area	0.077		0.01***			0.89
Japan	0.31**		0.01			0.20
New Zealand	1.04**			-0.48*		0.68
UK	0.44**		0.01			0.37
US	0.14			0.03		0.63
			k = 2			
Australia	0.52**				0.15*	0.67
Canada	0.45***		0.03**			0.75
Euro area	0.08				0.03	0.89
Japan	0.27**		0.00			0.30
New Zealand	0.81***			-0.51		0.64
UK	0.60**		0.02			0.40
US	0.16			0.05		0.64
			k = 4			
Australia	0.59**			-0.10		0.61
Canada	0.60***		0.01*			0.77
Euro area	0.11		0.00			0.87
Japan	0.22**				0.04	0.32
New Zealand	0.77***	-0.05				0.52
UK	0.83***				0.16*	0.51
US	0.12			0.03		0.54
			k = 8			
Australia	0.36	-0.01				0.34
Canada	0.53***				0.10	0.75
Euro area	0.01			-0.01		0.81
Japan	0.14				0.07***	0.23
New Zealand	0.71**	-0.04				0.37
UK	0.79***				0.17***	0.54
US	0.10			0.05		0.35

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k}=\alpha_i+\sum_{j=1}^{4}\beta_{it}\pi_{i,t-j}^{1}+\eta ygap_{it}+\delta\Delta^{k}pc_{it}+\varepsilon_{it}$$

	$ygap_t$	$\Delta^k pc_{it}$				$Adj\text{-}R^2$
		$\Delta^k pcus_t$	$\Delta^k pcdom_{it}$	$\Delta^k fus_t$	$\Delta^k fdom_{it}$	
			k = 1			
Australia	0.50**				0.22**	0.62
Canada	0.33***		0.02			0.63
Euro area	0.077		0.01***			0.89
Japan	0.31**		0.01			0.20
New Zealand	1.08**	-0.04*				0.68
UK	0.44**		0.01			0.37
US	0.14			0.03		0.63
			k = 2			
Australia	0.47**			-0.29*		0.68
Canada	0.47***		0.04**			0.75
Euro area	0.04			-0.04		0.89
Japan	0.28**				0.04	0.31
New Zealand	0.80***	-0.07				0.65
UK	0.68**			-0.29*		0.41
US	0.17			0.11		0.65
			k = 4			
Australia	0.62**	-0.01				0.61
Canada	0.62***		0.03			0.77
Euro area	0.11	0.01				0.87
Japan	0.20**				0.12**	0.41
New Zealand	0.73***	-0.10				0.50
UK	0.82***				0.38**	0.57
US	0.12			0.10*		0.55
			k = 8			
Australia	0.18				1.94***	0.51
Canada	0.42***				0.43	0.62
Euro area	0.04	0.02**				0.70
Japan	0.01				0.33***	0.47
New Zealand	0.42**				1.72***	0.46
UK	0.78***			0.64**		0.68
US	-0.00			0.29***		0.26

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 8
Predictive Content for Core Inflation, Late Sample (1994Q1–2007Q4)

a. Domestic Output Gap

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \varepsilon_{it}$$

	ygap$_t$	***Adj-R***^{2}
	k = 1	
Australia	0.88	0.12
Canada	0.06	0.06
Euro area	0.16**	0.48
Japan	0.32	0.28
New Zealand	0.21	0.13
UK	-0.06	0.16
US	0.14**	0.45
	k = 2	
Australia	0.83	0.22
Canada	0.07	0.00
Euro area	0.19***	0.56
Japan	0.30	0.37
New Zealand	0.23	0.11
UK	0.03	0.22
US	0.17**	0.41
	k =4	
Australia	0.70	0.13
Canada	0.09	0.00
Euro area	0.24***	0.51
Japan	0.29	0.32
New Zealand	0.15	0.03
UK	0.17	0.27
US	0.22***	0.43
	k = 8	
Australia	0.51	0.04
Canada	0.29***	0.30
Euro area	0.34***	0.53
Japan	0.17	0.17
New Zealand	-0.10	0.00
UK	0.15	0.14
US	0.18***	0.37

b. Commodity Prices: 1-Q change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^1 pc_{it} + \varepsilon_{it}$$

	ygap$_t$	$\Delta^1 pc_{it}$				***Adj-R***^{2}
		$\Delta^1 pcus_t$	$\Delta^1 pcdom_{it}$	$\Delta^1 fus_t$	$\Delta^1 fdom_{it}$	
			k = 1			
Australia	0.84				0.19	0.14
Canada	0.05				0.05	0.06
Euro area	0.17***		-0.00			0.51
Japan	0.32	-0.00				0.27
New Zealand	0.16			0.08		0.12
UK	-0.03				-0.08*	0.18
US	0.14**	0.00				0.45
			k = 2			
Australia	0.80				0.17	0.27
Canada	0.10	-0.01				0.00
Euro area	0.20***		-0.004*			0.59
Japan	0.30		0.00			0.36
New Zealand	0.19			0.06		0.10
UK	0.04		-0.00			0.23
US	0.17**	0.00				0.40
			k = 4			
Australia	0.67				0.17*	0.20
Canada	0.11	0.00				0.00
Euro area	0.25***		-0.00			0.52
Japan	0.28		0.00			0.31
New Zealand	0.06			0.16*		0.14
UK	0.16				0.01	0.25
US	0.22***	0.00				0.41
			k = 8			
Australia	0.47		0.01			0.06
Canada	0.30***			-0.03		0.32
Euro area	0.33***			0.04*		0.59
Japan	0.14				0.03	0.18
New Zealand	-0.18			0.17**		0.20
UK	0.16				0.07*	0.25
US	0.18***	0.00				0.37

c. Commodity Prices: *k*-quarter change

$$\pi_{it}^{k} = \alpha_i + \sum_{j=1}^{4} \beta_{it} \pi_{i,t-j}^{1} + \eta ygap_{it} + \delta \Delta^k pc_{it} + \varepsilon_{it}$$

	ygap$_t$	$\Delta^k pc_{it}$				***Adj-R***^{2}
		$\Delta^k pcus_t$	$\Delta^k pcdom_{it}$	$\Delta^k fus_t$	$\Delta^k fdom_{it}$	
			k = 1			
Australia	0.84				0.19	0.14
Canada	0.05				0.05	0.06
Euro area	0.17***		-0.00			0.51
Japan	0.32	-0.00				0.27
New Zealand	0.16			0.08		0.12
UK	-0.03				-0.08*	0.18
US	0.14**	0.00				0.45
			k = 2			
Australia	0.82				0.24*	0.28
Canada	0.14	-0.01*				0.02
Euro area	0.20***		-0.00			0.58
Japan	0.32			-0.04		0.36
New Zealand	0.11			0.17*		0.16
UK	0.03	-0.00				0.21
US	0.17**			-0.01		0.40
			k = 4			
Australia	0.81**		0.03**			0.23
Canada	0.15	-0.01				0.00
Euro area	0.23***	0.00				0.52
Japan	0.31*	-0.01				0.33
New Zealand	-0.00	0.03**				0.24
UK	0.09			0.17***		0.45
US	0.21***	0.00				0.42
			k = 8			
Australia	0.92**				0.66***	0.33
Canada	0.26***		0.01			0.30
Euro area	0.33***	0.01***				0.71
Japan	0.30*		-0.02			0.22
New Zealand	-0.16			0.31***		0.24
UK	0.28***				0.29***	0.72
US	0.18***			0.01		0.36

***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively, based on Newey-West HAC standard errors.

Table 9
Panel SUR Estimations for Total Inflation 1 Q Ahead, 1994Q1–2007Q4

Variable	All	Commodity exporters	Commodity importers
C	1.47***	2.03***	1.13***
$\boldsymbol{\Delta\pi_{t-1}}$	0.09*	-0.04	0.10
$\boldsymbol{\Delta\pi_{t-2}}$	0.07	0.08	0.07
$\boldsymbol{\Delta\pi_{t-3}}$	0.10*	0.06	0.18**
$\boldsymbol{\Delta\pi_{t-4}}$	-0.08	-0.09	-0.06
$ygap_t$	0.21***	0.28***	0.23***
$\Delta^1 fdom_{it}$	0.07***	0.19***	0.03
$Adj\text{-}R^2$	0.359		
Fixed effects:			
Australia	0.69	0.50	
Canada	0.05	-0.37	
Euro area	0.20		0.37
Japan	-1.49		-1.07
New Zealand	0.11	-0.23	
UK	-0.16		0.02
US	0.60		0.69

***, **, and * denote statistical significance at 1%, 5%, and 10% critical levels, respectively.
Note: *t*-statistics are shown in parentheses.

Table 10
Panel SUR Estimations for Core Inflation 1 Q Ahead, 1991Q4–2007Q4

Variable	All	Commodity exporters	Commodity importers
C	0.80***	1.22***	0.50***
$\boldsymbol{\Delta core_{t-1}}$	0.26***	0.20**	0.33***
$\boldsymbol{\Delta core_{t-2}}$	0.18***	0.06	0.26***
$\boldsymbol{\Delta core_{t-3}}$	0.04	0.23	0.00
$\boldsymbol{\Delta core_{t-4}}$	0.00	-0.03	0.03
$ygap_t$	0.11***	0.14**	0.11***
$\Delta^1 fdom_{it}$	-0.01	0.06	-0.01
$Adj\text{-}R^2$	0.56	0.11	0.69
Fixed effects:			
Australia	0.41	0.32	
Canada	0.01	-0.19	
Euro area	0.11		0.17
Japan	-0.79		-0.47
New Zealand	0.06	-0.13	
UK	-0.15		-0.05
US	0.36		0.34

***, **, and * denote statistical significance at 1%, 5%, and 10% critical levels, respectively.
Note: *t*-statistics are shown in parentheses.

Chart 1
Movemements in Commodity Price Index vs. Common Factor

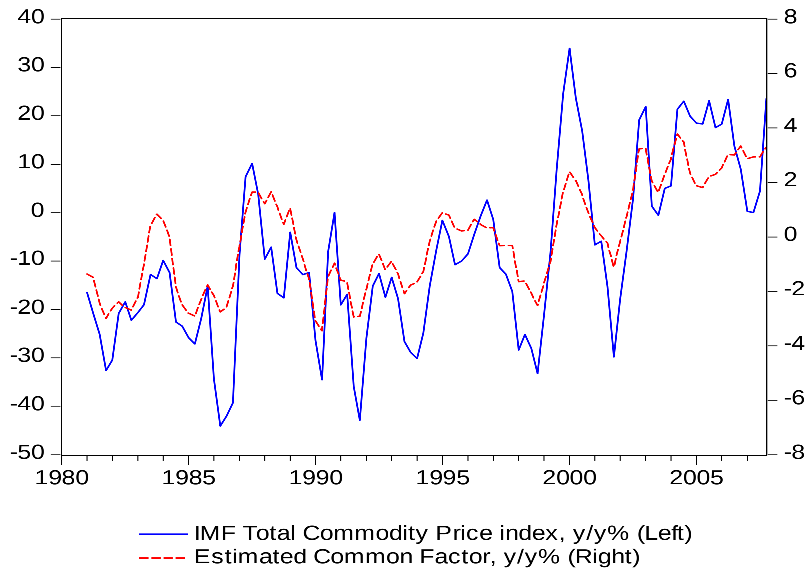

Chart 2
Inflation in Industrialized Economies vs. Real Commodity Prices