FEATURE ARTICLE

The relationship between commodity and consumer prices in Mainland China and Hong Kong

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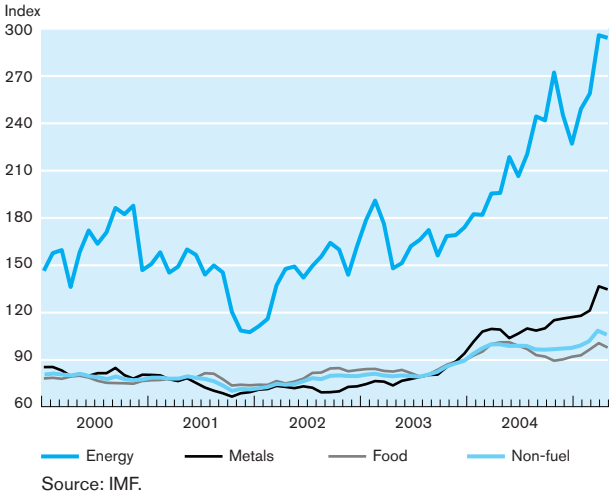
This paper examines the empirical relationship between changes in commodity prices and CPI inflation in Hong Kong and Mainland China, using a VAR (Vector autoregression) analysis, drawing comparisons with the US. It finds that changes in non-fuel commodity prices help to predict headline CPI inflation on the Mainland and in Hong Kong. Increases in non-fuel commodity prices are associated with a larger increase in CPI inflation in these economies than is typically found in empirical studies on industrialised economies. This could be due to a high degree of openness, a relatively large share of food prices in the CPI, and, for the Mainland, the size and commodity-intensity of its manufacturing sector.

Introduction

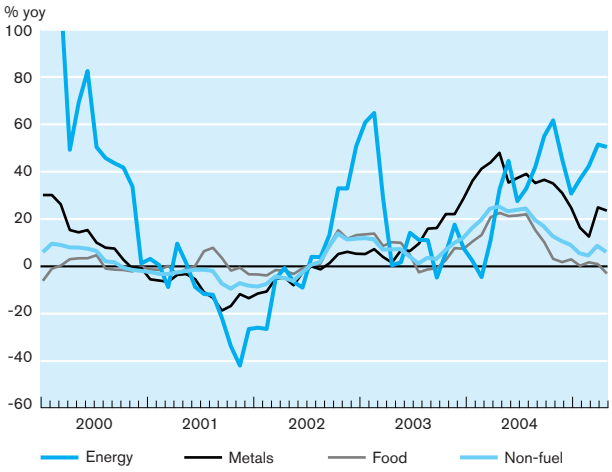
Since the second half of 2003, world prices for energy, metals and food have risen sharply (Charts 1 and 2). The simultaneous rise across many different commodity prices suggests that demand rather than supply shocks have played a key role in influencing prices, although, in the case of energy prices, geo-political concerns have also been important. This has re-opened the question about the relationship between commodity and consumer prices. This paper examines the empirical relationship between changes in commodity prices and consumer price inflation in Hong Kong and Mainland China, using a VAR analysis, and drawing comparisons with the US.

CHART 1
Global commodity prices



Source: IMF.

CHART 2
Commodity price inflation

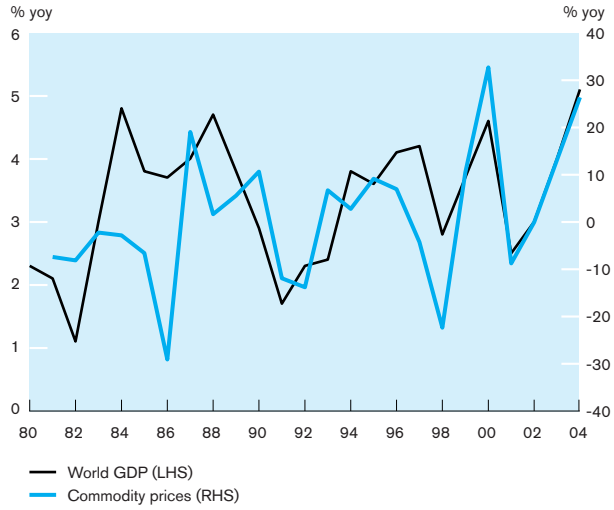


Source: IMF.

Changes in commodity prices can provide a timely indicator of future movements in CPI inflation, for several reasons. First, commodity prices are a sensitive leading indicator of changes in global demand conditions. As Chart 3 shows, there is a close relationship between changes in (energy and non-fuel) commodity prices and global GDP,

especially after 1990. [1] They are likely to respond earlier than consumer prices because they are more flexible, with prices for some commodities set frequently in auction markets. Consumer prices, on the other hand, tend to be sticky, reflecting wage contracts in labour markets (where nominal wages are set and fixed for a certain period) and the cost of changing prices in product markets ('menu costs').

CHART 3
Commodity prices and world GDP



Source: IMF.

The reliability of commodity prices as a signal of demand pressures depends on the relative importance of demand versus supply shocks in determining prices. In addition to being sensitive to changes in demand, commodity prices are subject to (idiosyncratic) supply shocks. For example, a bad harvest can lead to higher food prices with no read-across to demand conditions. Because supply shocks tend to be one-off in nature, they are likely to have only transient effects on inflation. The implication is that, sometimes, changes in commodity prices can provide misleading signals about underlying demand conditions and inflationary pressures.

A second channel linking commodity and consumer prices is that commodities are part of firms' input and production costs. Shocks to commodity prices can be an early indicator of pipeline inflationary pressures, and can often be traced through the production chain from intermediate to final producer and consumer prices – a so-called 'stage of processing' channel. The impact of a given change in commodity prices will depend on the magnitude of the initial price shock, the share of that commodity in production costs, and any subsequent change in firms' profit margins.

A third channel is that some commodities, like gold and other precious metals, have been used in the past to hedge against unanticipated inflation. An increase in inflation expectations raised the demand and price of commodities, signalling a pick-up in inflationary pressures. The role of commodity price changes as a proxy for inflation expectations and as a signal of demand pressures are closely related since expectations about inflation are affected by – among other things – demand conditions.

Importantly, the pass-through from changes in commodity prices to CPI inflation will depend on expectations about the response of monetary policy to the initial commodity price shock. For example, a positive shock to commodity prices, which puts upward pressure on inflation, may lead to expectations of tighter monetary policy. This will tend to dampen the impact of the initial commodity price shock on inflation expectations, thereby limiting its effect on wages and other prices. In our empirical work, we attempt to control for the effects of changes in monetary policy, and monetary conditions more generally, which includes exchange rate movements, in quantifying the impact of commodity prices on CPI inflation.

[1] The lack of a clear leading relationship may reflect the averaging effects from the use of annual data. We also note that there appears to be a positive relationship between the two series, but, in the case of oil, some studies find a negative relationship between supply-induced oil price shocks and output, for example, Hamilton (2000).

Comparisons with the US

Previous work in this area has focused mainly on advanced economies. A number of US studies find that changes in commodity prices can help to predict both headline and core CPI inflation, but the size of the impact is fairly small {Blomberg and Harris (1995), Furlong and Ingenito (1996)}. Furthermore, the predictive power of commodity prices appears to have declined after the mid-1980s and, in some cases, sends perverse signals, with higher commodity prices apparently associated with lower future inflation {Blomberg and Harris (1995)}. This can be explained by a number of factors, including a decline in the commodity-intensity of US production; changes in the way monetary policy responds to commodity price changes; and less use of commodities as hedges against inflation because alternative financial instruments have been developed for this purpose.

This paper extends existing work by focusing on Hong Kong and the emerging market economy of Mainland China. There are a number of reasons why we might expect the relationship between commodity and consumer prices to be closer in these economies than in the US. First, they are highly open, and imports have a high weight in the consumer price index. On the Mainland, the degree of openness of the economy has increased dramatically as a result of economic reforms and restructuring since 1978.[2] Its share of world export markets has doubled, increasing the correlation between domestic and global business cycle fluctuations (the IMF estimates that the Mainland accounted for around one-third of global GDP growth between 2001 and 2003).[3] The link between changes in global commodity prices and domestic inflation can be expected to be tighter than in economies that are less synchronised with the global business cycle.

Secondly, in Hong Kong and the Mainland, food prices account for a larger share of the CPI than in the US. Seasonal and processed food, combined with meals taken outside the home, account for an estimated 40% to 50% of the CPI on the Mainland[4] and 27% in Hong Kong, compared with just 15% in the US. The importance of food in household budgets should mean that shocks to world food prices have a larger effect on CPI inflation in Hong Kong and the Mainland than in the US, other things being equal.[5]

Thirdly, for the Mainland, production is more commodity-intensive than in the US. So shocks to energy and metal prices should lead to higher production costs and, via a stage of processing channel, higher consumer prices. For Hong Kong, we might expect the impact of commodity price changes to have diminished because the share of manufacturing output in GDP has declined over the past two decades, from 24% to 4%, as production facilities have relocated to the low-cost areas of southern China.

In addition to structural factors, exchange rate and monetary policy arrangements play an important role in the pass-through from commodity price changes to CPI inflation. Since 1983, Hong Kong has operated a currency board system linked to the US dollar, with no capital controls. Mainland China operates a managed float against the US dollar, but with tight bands of fluctuation enforced by capital controls that effectively peg the renminbi to an exchange rate of around 8.3 against the US dollar. These exchange rate arrangements reduce the scope for independent monetary policy in both economies, especially in the case of Hong Kong because of the absence of capital controls.

[2] For further analysis, see "Intra-regional trade and the role of Mainland China", *HKMA Quarterly Bulletin*, December 2004.

[3] Based on *IMF World Economic Outlook* database, September 2004.

[4] Staff estimates based on household budget shares.

[5] The effect of price controls and liberalisation of commodity prices on the Mainland is discussed later.

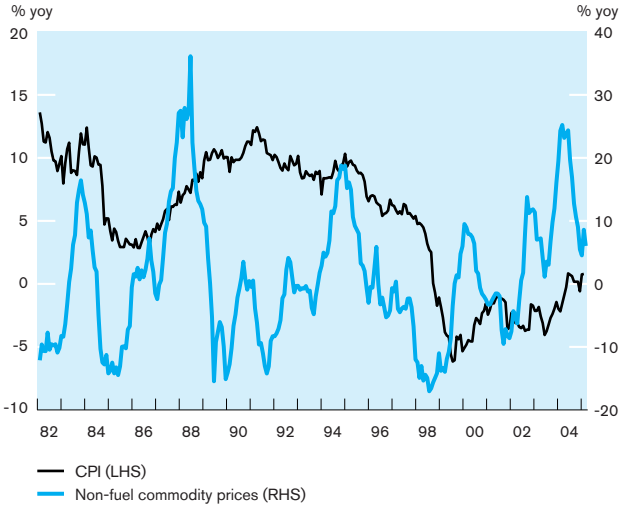
However, the effect on price pass-through is ambiguous. On the one hand, domestic monetary policy is geared towards maintaining a fixed exchange rate vis-a-vis the US rather than domestic price stability. On the other, it could be argued that these arrangements may help to anchor inflation expectations following a commodity price shock, reflecting expectations that the US monetary authorities are unlikely to accommodate such shocks to domestic economic conditions . The overall effect on inflation in Hong Kong and the Mainland will depend on the appropriateness of the US monetary stance to domestic economic conditions. How all of these influences on pass-through play out is an empirical issue, and the subject of the rest of this paper.

Bivariate VAR

Charts 4 and 5 suggest there may be a lead relationship between changes in non-fuel commodity prices and CPI inflation in Hong Kong and the Mainland. For Hong Kong, the relationship was not close between the mid-1980s and mid-1990s, but it strengthened in the second half of the 1990s, despite the declining share of the manufacturing sector. For the Mainland, the opposite is true. The relationship was close in the late-1980s and early 1990s, but weakened in the second half of the 1990s.

CHART 4

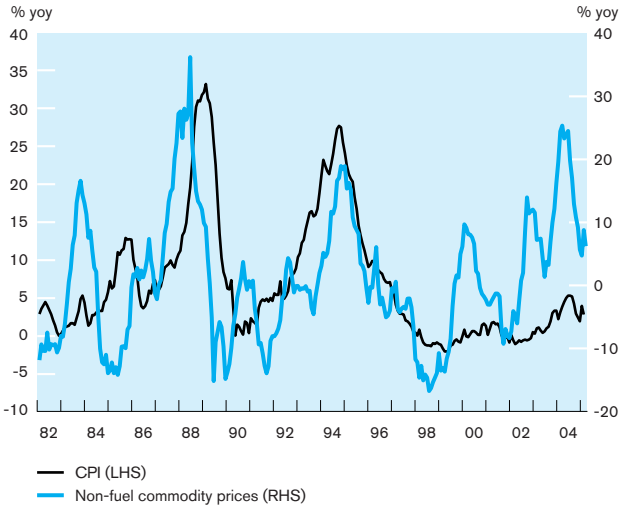
Commodity and CPI inflation in Hong Kong



Sources: Census & Statistics Department and IMF.

CHART 5

Commodity and CPI inflation in Mainland China



Sources: CEIC, IMF and staff estimates.

In formally investigating this relationship, we estimate a bivariate VAR (Vector autoregression) model and test whether commodity prices help to predict CPI inflation (in addition to using past values of CPI inflation), using pair-wise Granger-causality tests. ADF tests suggest that changes in commodity prices and the CPI are both stationary[6], so we estimate a VAR in first differences with 12 lags because we are using monthly data, as shown:

$$\pi_t^{cpi} = \alpha + \sum_{i=1}^{12} \beta_i \pi_{t-i}^{cpi} + \sum_{i=1}^{12} \sigma_i \pi_{t-i}^{commodity} + \varepsilon_i \qquad \text{Equation (1)}$$

For each regression, we use one of the four different world commodity price indices, covering energy (mainly oil), non-fuel, metals and food commodities (components of non-fuel commodities), and one of two measures of consumer price inflation, headline and core CPI. World commodity price data are from the IMF and are in US dollars. The sample period for the US is from January 1981 to November 2004; for the Mainland, the period starts in September 1988, due to data limitations (discussed later); and for Hong Kong, it is from November 1983, when the Currency Board system was established.

[6] Some US studies find a relationship between the level of commodity prices and CPI inflation. However, unit root tests suggest that commodity and headline consumer prices in Mainland China, Hong Kong and the US are non-stationary and are not co-integrated, so we proceed to model the relationship using first differences.

Before looking at the results, it is useful to explain why we may be interested in core inflation as well as headline inflation. Measures of core inflation attempt to estimate the underlying rate of inflation, often by excluding volatile price components, such as food and energy prices. Because food and energy prices are closely correlated with world commodity prices, stripping them out may weaken the estimated relationship between commodity and consumer price changes, unless other consumer prices more generally are affected by changes in commodity prices. As monetary policy-makers are interested in the issue of whether commodity price shocks lead to more generalised inflationary pressures, there is a case for focusing on core, instead of headline, measures of CPI inflation. For example, the US Fed is often interpreted as responding to movements in the personal consumption expenditure deflator excluding food and energy, instead of headline inflation measures.

Table 1 shows the results of Granger-causality tests for the predictive power of commodity price changes for CPI inflation in Mainland China, Hong Kong and the US.

The key points are:

- Energy prices are not significant in predicting headline CPI inflation in Mainland China or Hong Kong, but they are significant for the US at standard significance levels. These results are consistent with the relative importance of petrol prices in household budgets. In Hong Kong, petrol prices account for only 0.7% of the CPI, compared with 3.3% in the US, while on the Mainland, government price controls in the past have limited the pass-through of crude oil price changes to retail prices.[7]

- By contrast, changes in non-fuel commodity prices are significant in predicting headline CPI inflation in Mainland China and Hong Kong, but not in the US.[8] This is consistent with a high share of food in household budgets in Asian economies. For the Mainland, changes in metal prices have a higher level of significance than food prices, which can be explained by the size and commodity-intensity of its manufacturing sector.

TABLE 1

Do changes in commodity prices help to predict CPI inflation?

	Mainland China	Hong Kong		United States	
	Headline	Headline	Core	Headline	Core
Energy	X	X	X	√√√	X
Non-fuel	√	√√√	X	X	X
Of which:					
Metals	√√	X	√	X	X
Food	√	√√	X	X	X

√√√ indicates significance at 1%, √√ at 5% and √ at 10%.
Based on pair-wise Granger-causality tests.
Sample period: 1/1981-11/2004 for the US, from 11/1983 for Hong Kong, and from 9/1988 for Mainland China.

[7] See "Pump priming", *The Economist*, 2 October 2004.

[8] A number of US studies find that non-oil commodity prices have significant predictive power for US CPI inflation. These are based on earlier sample periods, and they tend to find that the relationship is weaker and, in some cases, perverse after the mid-1980s, when our sample starts {for example, Blomberg and Harris (1995)}. Also, these studies use different variables to measure commodity price movements (although they are likely to be highly correlated with our measures).

- The relationship between changes in commodity prices and core CPI inflation in the US and Hong Kong is not precisely determined (they are significant predictors at a 20% level). This finding is robust to extending the model to include other conditioning variables; therefore, the rest of this paper focuses on headline measures of CPI inflation.

Multivariate VAR

In line with other studies, we include a number of additional variables in the VAR, shown in equation (1), to allow for the channels through which commodity prices can affect consumer prices. These are changes in global output, domestic interest rates and own nominal effective exchange rate.[9]

For monetary policy changes, the control variable for Hong Kong and the US is the change in the federal funds target rate (FFTR). For Hong Kong, this reflects the currency board arrangements, which mean that domestic short-term interest rates are closely tied to the FFTR. For the Mainland, it is less appropriate to use the FFTR, even though the renminbi is effectively pegged to the US dollar because of the existence of capital controls, which allow the monetary authorities some control over domestic interest rates. Instead, we use the one-year deposit rate to proxy the policy rate. A drawback with this measure is that it may not be a good measure of changes in monetary conditions, because it is not closely linked with market interest rates, and does not pick up changes in credit controls.[10] Nevertheless, increases in the one-year deposit rate broadly coincide with past announcements of monetary tightening in January 1989 and January 1993 (16 austerity measures) and the ensuing growth slowdown (although this is not the case for the most recent tightening episode, which began in June 2003) (see charts in Annex A).

The results for Hong Kong and the US, shown in Table 2, are similar to those from the bivariate VAR. Non-fuel commodity prices are significant for Hong Kong, while energy prices are significant for the US, but not vice versa. The finding that energy prices remain significant for the US when changes in output, interest rates and exchange rates are included is consistent with other studies {(Blomberg and Harris (1995)}. Indeed, Blomberg and Harris find that including interest rates in the model causes the sign of the effect of commodity prices on inflation to switch from being (perversely) negative to positive.

TABLE 2

Do changes in commodity prices help to predict headline CPI inflation, controlling for output and monetary conditions?

	Mainland China	Hong Kong	United States
Energy	X	X	√√√
Non-fuel	X	√	X
Of which:			
Metals	X	X	X
Food	X	√√	X

√√√ indicates significance at 1%, √√ at 5% and √ at 10%.
Based on pair-wise Granger-causality tests.
Sample period: 1/1981-11/2004 for the US, from 11/1983 for Hong Kong, and from 9/1988 for Mainland China.

[9] We do not control separately for movements in the US dollar exchange rate. Some commodities, like oil, are priced in US dollars and are, therefore, influenced by movements in the US dollar exchange rate (as commodity producers seek to stabilise their revenues in domestic currency terms). However, we assume that the pass-through from commodity prices to consumer prices will be similar, whether the change arises from US dollar fluctuations or changes in global growth.

[10] An alternative would be to use the growth of monetary or credit aggregates, which we explore later in the paper.

For the Mainland, the initial finding regarding the significance of non-fuel commodity prices in predicting inflation is not robust to extending the VAR to include more conditioning variables. This lack of robustness is confirmed by experimenting with the VAR by dropping some of the variables, which gives mixed results for the significance of non-fuel commodity prices. However, the insignificance of energy prices is robust to changing the model in this way.

The pair-wise Granger-causality results reported above test for a direct effect from changes in commodity prices on CPI inflation. However, there may be indirect effects, which operate through other variables in the system. We test for indirect channels using pair-wise Granger-causality tests at two levels. First, whether commodity prices have significant predictive power for any of the other variables in the model and, second, additionally, whether these variables, in turn, have significant predictive power for CPI inflation.[11]

The results are shown in Table 3. In the case of Mainland China and Hong Kong, there is evidence of indirect effects for energy prices, through growth and the exchange rate on the Mainland and, through growth and changes in the FFTR in Hong Kong. The same is true for changes in metal prices. By contrast, in the US, there is no evidence of indirect effects for either energy or non-fuel commodity price changes.

TABLE 3
Indirect effects

	Mainland China	Hong Kong	United States
Energy	√ via growth and exchange rate	√ via growth and interest rate	X
Non-fuel	√ via growth	√ via interest rate	X
Of which:			
Metals	√ via growth and exchange rate	√ via growth and interest rate	X
Food	X	X	X

Based on pair-wise Granger-causality tests.
Sample period: 1/1981-11/2004 for the US, from 11/1983 for Hong Kong, and from 9/1988 for Mainland China.

[11] Rodriguez and Sanchez (2004) test for indirect effects by running a likelihood ratio test on whether oil prices are significant in all other equations in the VAR except their own. However, it could turn out that oil prices have predictive power for the other variables in the system but that these variables, in turn, have no predictive power for consumer price inflation. The likelihood ratio test would suggest that there are indirect effects present, whereas our method of testing would suggest otherwise.

Impulse responses

Table 4 shows the (accumulated) impact on headline CPI inflation of a 1% increase in energy, non-fuel, metals and food prices after two years, based on impulse responses from the multivariate VAR.[12] An asterisk indicates whether the impulse responses are significantly different from zero based on the estimated standard error bands.

In terms of rules of thumb:

- The impact of a 1% increase in energy prices after two years is similar in all three economies, varying between 0.03 (US) and 0.07 (Mainland China) percentage points;
- A 1% increase in non-fuel commodity prices has a substantially larger impact in Hong Kong, increasing headline CPI inflation by 0.50 percentage points after two years, compared with 0.08 percentage points on the Mainland and 0.03 percentage points in the US;
- Within non-fuel commodities, shocks to food prices have larger effects on CPI inflation than shocks to metal prices in both Asian economies. A 1% increase in food prices raises headline CPI inflation by 0.17 percentage points on the Mainland, and by 0.35 percentage points in Hong Kong, after two years, but has a negligible impact in the US. The degree of pass-through in Hong Kong is similar to the budget share of food in the consumption basket while, for the Mainland, it is lower. The latter is consistent with the existence of price controls on the Mainland over the period, which have de-linked domestic food prices from international commodity prices.

Is the relationship robust?

This section examines the stability of the models estimated above. The impulse responses derived from splitting the sample period are shown in Table 5. There is clear evidence of instability in the relationship between changes in commodity and CPI inflation in Mainland China and – to a lesser extent – in Hong Kong. This contrasts with the remarkable stability of the relationship in the US.

For the Mainland, the estimated pass-through of changes in non-fuel commodity prices in each sub-period is larger than for the whole sample period. The estimated effect is very high during the 1980s, but halves after 1997. The decline in the impact of international prices on domestic prices seems at odds with a gradual liberalisation of commodity prices on the Mainland, which can be expected to increase the correlation between domestic and international prices (although, as already noted, the estimates for the 1980s look implausibly large). For Hong Kong, the impact of changes in non-fuel

TABLE 4

Effect of a 1% increase in commodity prices on headline CPI inflation, controlling for output and monetary conditions

(percentage point)	Mainland China		Hong Kong		United States	
	1 year	2 years	1 year	2 years	1 year	2 years
Energy	0.04	0.07	0.02	0.05	0.02*	0.03*
Non-fuel	0.12	0.08	0.27*	0.50*	0.02	0.03
Of which:						
Metals	-0.03	-0.12	0.11*	0.21*	0.02	0.03
Food	0.16	0.17	0.21*	0.35*	-0.01	-0.03

Accumulated effect. *indicates that impulse response is significantly different from zero based on the estimated standard error bands. Sample period: 1/1981-11/2004 for the US, from 11/ 1983 for Hong Kong, and from 9/1988 for Mainland China.

[12] Identification of the shocks was achieved by a Cholesky decomposition, with the variables ordered as follows: changes in commodity prices, changes in exchange rate, growth, changes in interest rates, CPI inflation.

TABLE 5

Effect of a 1% increase in commodity prices on headline CPI inflation after 2 years, controlling for output and monetary conditions

(percentage point)	Mainland China		Hong Kong		United States	
	88-96	97-04	83-92	93-04	81-92	93-04
Energy	0.24	-0.03	0.03	0.13	0.02	0.03*
Non-fuel	0.70	0.38	0.27	0.43	0.05	0.06
Of which:						
Metals	0.43	0.33	0.15	0.19	0.03	0.03
Food	1.00	0.16	0.35*	0.41	0.00	0.01

Accumulated effect. *indicates that impulse response is significantly different from zero based on the estimated standard error bands. Sample period: 1/1981-11/2004 for the US, from 11/1983 for Hong Kong, and from 9/1988 for Mainland China.

commodity prices on CPI inflation looks too large, and is higher during the 1990s than the 1980s. The latter is difficult to square with the steady decline in the share of the manufacturing sector in the economy.

Instability of results for Mainland China

To further illustrate the instability of the Mainland regressions, we run a rolling regression of CPI inflation on changes in commodity prices using a five-year window.[13] Charts 6 and 7 show the sum of the coefficients on the lags of changes in commodity prices and provide a visual assessment of the stability of the relationship over time, with less volatility indicating a more stable relationship. There is a clear break in the relationship for energy and non-fuel commodity prices during the mid-to-late 1990s, probably reflecting a combination of factors.

First, as the Mainland moved from a command economy to a more market-based one, the sample period includes major reforms to both consumer prices and commodity prices. Key reforms are listed in Annex B. There were major price reforms in 1992, when most prices of consumer goods were liberalised and controls on service prices were largely removed. Many sequential reforms were made to oil, metals and food prices making them

CHART 6

Effect of changes in non-fuel commodity prices on CPI inflation in Mainland China

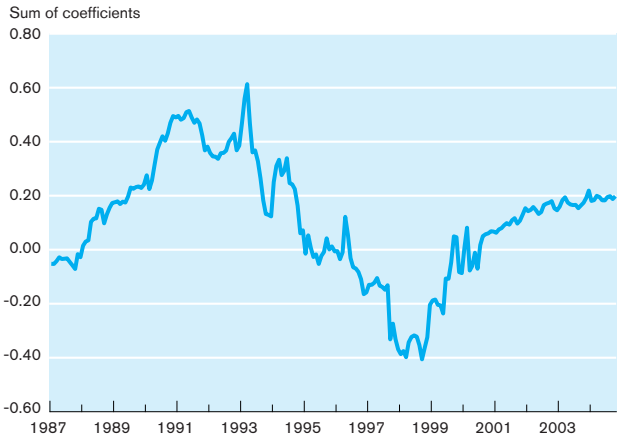
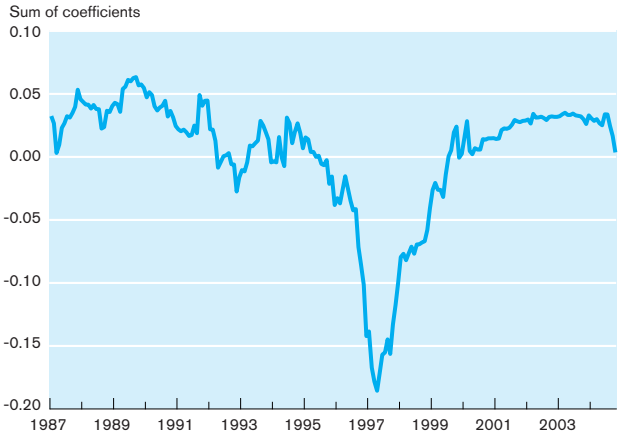


CHART 7

Effect of changes in energy prices on CPI inflation in Mainland China



[13] Note that with 12 lags, we were unable to do this in a multivariate context because of an insufficient number of observations. Also, this is a partial test of stability because the coefficients on the CPI terms contribute to the stability of the system as a whole.

more market-determined. In addition, the dual exchange rate system was unified in 1994, and the renminbi was devalued by one-third against the US dollar, which would have had a significant impact on the price of commodity imports.

Secondly, economic reforms begun in 1978 have gradually shifted the Mainland economy from a so-called 'shortage' to a 'surplus' economy, in which there is excess supply in certain sectors. Oversupply in the metals sector could explain why we find reverse causality between metals and consumer prices after 1993, with consumer prices tending to predict metal prices, rather than the other way around. In a situation of oversupply, producers lose pricing power and may have to wait until general prices rise to enable them to push through increases. In a market economy, oversupply in certain sectors would cause firms to exit the industry, thereby reducing supply, however, on the Mainland, most steel products (85%) are still produced by State-Owned Enterprises.

Thirdly, as already suggested, it is difficult to control for monetary policy tightening on the Mainland. We attempt to do this by including the one-year deposit rate. However, this does not capture administrative credit controls, which are not directly observed and they vary in intensity during tightening episodes, and, may not be closely linked to market interest rates.

To minimise the problem of structural breaks, it is sensible to focus on results after 1997. We compare the results using the one-year deposit rate and M2 growth, which potentially provides a better control variable for changes in monetary conditions on the Mainland because it includes the effect of administrative tightening measures. The results in Table 6 show that the effect of changes in energy prices on inflation is perversely signed and economically not significant (this is confirmed by the impulse response plots). For non-fuel commodities, the effect is significant and large. The impulse response is similar, whether we use the one-year deposit rate or M2 growth, with a 1% rise associated with a 0.4 to 0.5 percentage point rise in consumer price inflation after two years – similar to the estimate for Hong Kong. One caveat to these results is that the Granger causality tests suggest that energy and non-fuel commodity prices have not been significant predictors of consumer price inflation since 1997.

Hong Kong – excluding rental prices

For Hong Kong, we re-run the results using the CPI, excluding rents, which account for 27% of the index. We do this for two reasons. First, to test whether the high pass-through from commodity prices to CPI inflation, estimated to be 0.5 percentage points, reflects a high correlation between Hong Kong asset (housing) prices and global growth. This causes the rental component of the CPI to rise sharply during global upturns pushing up the correlation between global commodity prices and CPI inflation. The second reason is to check whether the exceptional decline in residential housing prices in Hong Kong between 1997 and 2003 has distorted the estimated relationship between commodity and consumer prices.

TABLE 6

Effect of changes in commodity prices on headline CPI inflation in Mainland China, controlling for output and monetary conditions, Jan 1997 to Nov 2004

	Energy		Non-fuel	
	Using 1-year deposit	Using M2 growth	Using 1-year deposit	Using M2 growth
12 months	0.03	-0.02	0.17	0.21
24 months	-0.03	-0.04	0.38	0.53

Accumulated effect.

Table 7 compares the effect of commodity prices on consumer prices with and without rental prices. The impact of a 1% increase in non-fuel commodity prices on CPI inflation after two years is smaller by one-fifth if rents are excluded, at around 0.4 percentage points. This suggests that the correlation between commodity prices and headline CPI inflation, in part, reflects a co-movement of Hong Kong asset prices and global growth. The relationship is more stable between the 1980s and 1990s, when rents are excluded. Specifically, changes in commodity prices are associated with a larger increase in future CPI inflation during the 1980s, of 0.4 percentage points compared with the previous estimate of 0.3 percentage points. One explanation for this difference is that shocks to Hong Kong housing prices and, therefore, the rental component of the CPI, were more idiosyncratic in nature during the 1980s, rather than reflecting global factors. That would tend to lower the correlation between Hong Kong housing prices and rents, and world commodity prices.

On the energy price effects, the results are similar whether rents are included or excluded. As before there is a larger impact during the 1990s (compared with a zero impact in the 1980s), but it is economically small at 0.1 percentage points and, after rounding, is similar to the estimated effect over the whole of the sample period.

Non-linearity

As a final stability check, we investigate whether the relationship between commodity and consumer prices may be non-linear in these three economies. A number of recent papers have investigated whether oil prices have non-linear effects on real output in the US and European economies {Hamilton (2000) and Rodriguez and Sanchez (2004) for recent studies}. Hamilton shows that a linear regression of US output on lagged oil prices exhibits instability over time, and argues that this may be due to a mis-specification of the true underlying relationship, which is non-linear, but stable. He tests a number of alternative non-linear specifications, and finds evidence that increases in oil prices may be more important to output than decreases, especially if the increase follows a period of stable oil prices.[14] He notes that it is not possible to choose between the many alternative non-linear forms with any certainty, but that many transformations boil down to taking account of exogenous increases in oil prices only, such as war-induced supply disruptions.

While Hamilton's work is mainly focused on the output effects of energy price changes, the same factors may work to influence the impact of commodity price shocks on CPI inflation. We follow one of the approaches taken by Hamilton, which is to estimate a GARCH (Generalised autoregressive

TABLE 7

Effect of a 1% increase in commodity prices on Hong Kong CPI inflation, controlling for output and monetary conditions

(percentage points)	Headline CCPI		CCPI excluding rents			
	1 year	2 years	1 year	2 years	83-92	93-04
Energy	0.02	0.05	0.02	0.05	-0.03	0.13 *
Non-fuel	0.27 *	0.50 *	0.22 *	0.41 *	0.40 *	0.38
Of which:						
Metals	0.11 *	0.21 *	0.12 *	0.23 *	0.23	0.30
Food	0.21 *	0.35 *	0.11	0.22	0.57	0.24

Accumulated effect. *indicates that impulse response is significantly different from zero based on the estimated standard error bands. Sample period: 11/1983-11/2004.

[14] As the author notes, the asymmetry could explain why researchers have difficulty finding significant negative effects of oil on output because there is a greater incidence of (less important) price falls after 1980.

conditional heteroscedasticity) model for energy price changes and use the conditional variance to derive a scaled energy price series. The transformation serves to dampen the pass-through of changes in energy prices onto CPI inflation, if they follow a period of energy price volatility. We test separately for asymmetric effects, by setting the scaled energy price variable to zero if it has a negative value. In other words, we hypothesise that only increases in energy prices matter for future CPI inflation.[15] We investigate non-linearity in non-fuel commodity prices in a similar way.

Table 8 shows the results from Granger-causality tests for the non-linear specifications and compares these with the results in the linear case. There is evidence of non-linearity in the direct effect of energy price changes on CPI inflation in the US and the Mainland. The scaled energy price variable that allows for asymmetries is a significant predictor of CPI inflation in both economies. For Hong Kong, there is evidence of non-linear effects from changes in non-fuel commodity prices, but only for food prices, and no evidence of asymmetries. We include

TABLE 8

Do changes in commodity prices help to predict CPI inflation?

	Linear	Non-linear	Non-linear (with asymmetry)	Evidence of indirect channels
Energy prices				
Mainland	X	X	√	√ (via growth and exchange rate)
Hong Kong	X	X	X	√ (via growth and interest rates)
US	√√√	√√√	√√	X
Non-fuel prices				
Mainland	X	X	X	√ (via growth, inerest rate and exchange rate)
Hong Kong	√	√√	X	√ (via interest rates)
US	X	X	√	√ (via interest rates)
Metal prices				
Mainland	X	X	X	√ (via growth and exchange rate)
Hong Kong	X	X	X	√ (via growth and interest rates)
US	X	X	X	√ (via interest rates)
Food prices				
Mainland	X	X	X	√ (via growth and exchange rate)
Hong Kong	√√√	√√	X	X
US	X	X	X	X

√√√ indicates significance at 1%, √√ at 5% and √ at 10%. Based on pair-wise Granger-causality tests.

Sample period: 1/1981-11/2004 for the US, from 11/1983 for Hong Kong, and from 9/1988 for Mainland China.

[15] The volatility adjusted oil price is given by oil prices divided by the square root of the conditional variance term from the GARCH model (Hamilton, 2000 pp 23). Hamilton uses real oil prices but we use nominal prices because we are interested in the relationship between commodity prices and CPI inflation rather than growth.

both the linear and non-linear scaled commodity price variables in the multivariate VAR to see which specification dominates in the predictive tests. For the US, both the linear and non-linear energy price terms are significant while, for the Mainland, the linear specification is preferred. For Hong Kong, there is no clear preference (both non-fuel commodity price terms are insignificant). In summary, these results suggest evidence of non-linear effects in the pass-through from changes in commodity prices onto CPI inflation, but pinning down the precise form of these is beyond the scope of this paper. Finally, as before, we find evidence of indirect effects through other variables in the system in the non-linear model.

Conclusions

Changes in non-fuel commodity prices help to predict headline CPI inflation on the Mainland and in Hong Kong. A 1% increase in non-fuel commodity prices is associated with a 0.5 percentage point and a 0.4 to 0.5 percentage point increase in headline CPI inflation in Hong Kong and Mainland China, respectively, after two years.

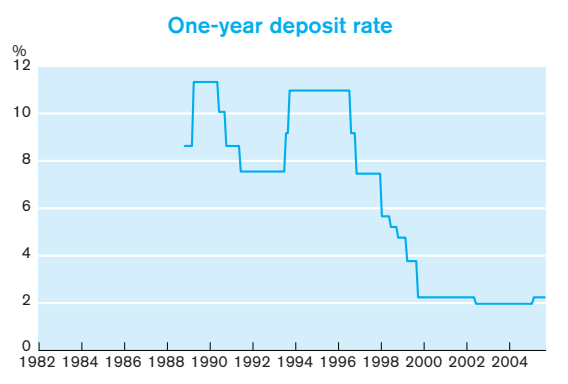
The estimates are larger than those for the US, which can be explained by the degree of openness of these economies, the relatively large share of food prices in the consumer price index, and the size and commodity-intensity of manufacturing on the Mainland. In addition, the results for Hong Kong appear to be picking up a correlation between domestic asset prices and global growth. Ignoring rents, the estimated pass-through from changes in non-fuel commodity prices to CPI inflation is lower by one-fifth, at 0.4 percentage points.

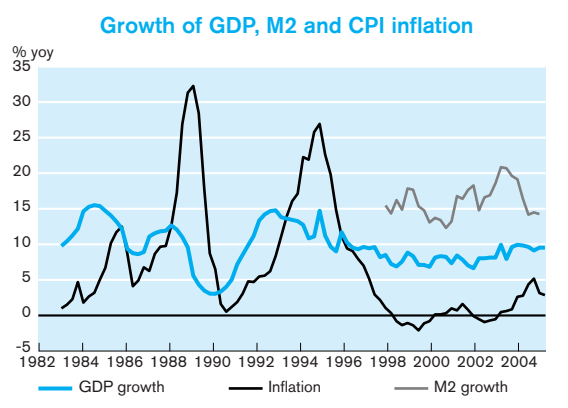
Energy prices are not significant predictors of headline CPI inflation in either Asian economy, in contrast to our findings for the US. This is consistent with a low share of petrol in the CPI basket in Hong Kong, and government controls on petrol prices on the Mainland that have limited the pass-through of oil price shocks.

There are two caveats to the above worth highlighting. First, the results for the Mainland are based on a post-1997 sample period to reduce the problem of structural breaks in the relationship between commodity and consumer prices. They may not be robust to extending the sample period forward, especially as structural changes in that economy are on-going. Secondly, there is some evidence that the effect of changes in commodity prices on consumer prices may be non-linear.

ANNEX A

Change in the one-year deposit rate and business cycles in Mainland China





ANNEX B

Announcements of policy tightening and key price reforms[16] in Mainland China

Date of reform	Measures
Macroeconomic control measures	
End-1988	Government implements tightening measures to reduce inflation.
June 1993	Sixteen austerity measures introduced to bring down inflation.
September 2003	Macroeconomic control measures introduced to reduce money and credit growth and investment.
Steel prices	
1985	Multi-tier price system introduced, covering floating prices, quality-premium prices (higher price for better quality), and temporary prices, resulting in the same product selling for different prices.
1990	Government increases temporary price of steel products.
1 Feb 1991 onwards	Temporary prices abolished. Efforts to unify different prices on the same product and allow market forces to play a larger role in price determination.
1 Jan 1993 onwards	Steel prices liberalised.
1994	Price intervention reintroduced on 10 steel products as part of "16 austerity measures".
1994	State Owned Enterprises produce 85% of steel. Price of flat steel and long steel determined by world prices, but depressed by macro economic control measures to reduce inflation, with steel prices falling below cost.
Grain products	
1989	Government increases procurement prices by 26.9%.
1 May 1991	Government raises procurement and urban selling prices to reduce the cost of subsidies following a poor harvest and falls in grain prices.
1992	Restrictions on food prices, including grain, relaxed.
1994	Government raises procurement and selling prices following high general inflation and increase in grain exports.
1996	Government increases procurement and selling prices towards market prices. By the end of 1996, procurement and market prices fully integrated.
1997	Grain prices fall due to over-supply.
Energy prices	
1981	Prior to 1980, government set energy prices at low levels and subsidised energy producers. In 1981, two-tier pricing introduced. Any output beyond the government-set quota can be sold at prices close to world level.
March 1988	Reforms to allow integration of up-and-downstream activities into independent oil companies, with formation of oligopoly of four oil and gas state-owned enterprises.
1990 - 1991	Government raises crude oil prices.
1994	Dual price system abolished and oil prices raised.
June 1998	Domestic oil prices pegged to Singapore prices, with a one-month lag.

[16] We are grateful to Liu Yun (PBoC) for providing this summary.

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