Conference Draft

Has Asian emerging market monetary policy been too pro-cyclical when responding to swings in commodity prices?

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September 21, 2013

The views expressed are those of the authors and do not necessarily represent those of the Bank for International Settlements. The authors would like to thank Claudio Borio for insightful comments and Emese Kuruc for superb research assistance. This paper was prepared for the PBC-BIS Research Conference on 'Globalisation and Inflation Dynamics in Asia and the Pacific', 23-24 September 2013, Beijing, China.

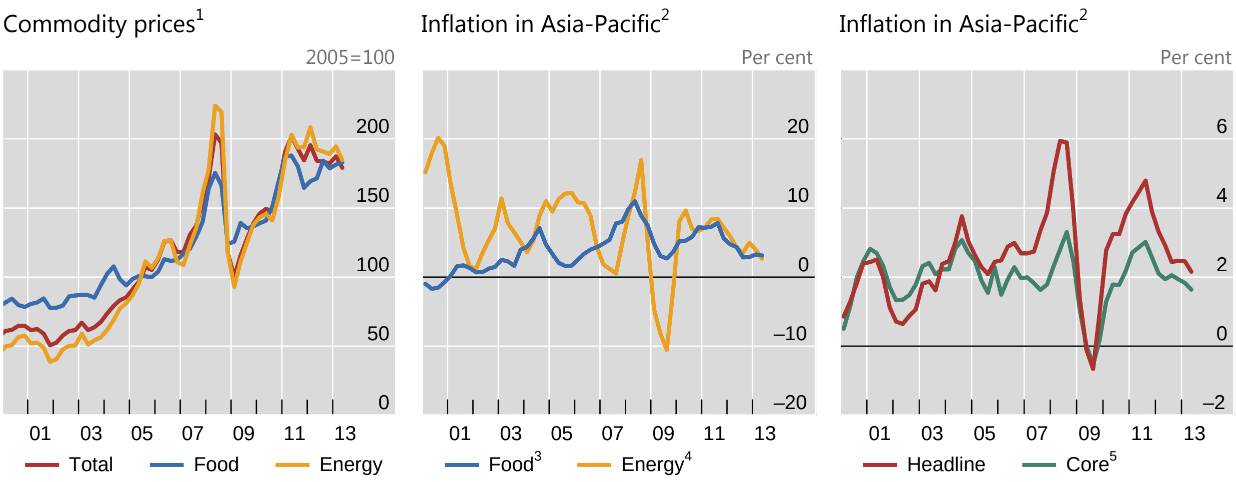
I. Introduction

In the past ten years, global commodity prices have experienced several pronounced swings, with some commodities reaching historically high price levels. Graph II.1 illustrates the wide swings in commodity prices and their correlation with Asian inflation trends. Such heightened volatility clearly has presented a challenge to policymakers. Moreover, the recent price gyrations raise questions as to whether the global economy will remain particularly prone to swings in the future and how central banks in particular should respond.

As we look forward, it is critical to understand the drivers of this recent behaviour if we are to fully understand the policy trade-offs facing central banks. We need to know if this new policy environment is a product of a series of one-off experiences or whether it reflects a permanent increase in volatility. Possibly more important is an understanding of the underlying sources of the shocks driving the volatility – for example, knowing whether they are primarily demand or supply shocks.

The conventional wisdom about commodity price fluctuations and monetary policy is that each country should respond only to those fluctuations that lead to second-round inflationary effects. Practically, this suggests that monetary authorities should focus on core inflation and look through the initial impact of commodity price fluctuations on headline inflation. This conventional wisdom was largely built upon experiences in the 1970s and 1980s when oil supply shocks led to wide swings in energy prices. The more generalised swing in commodity prices in recent years, however, raises questions about the general relevance of this conventional wisdom in today's more globalised world.

Inflation and commodity prices | Graph I.1



[1] Quarterly averages. [2] Year-on-year changes in consumer price index. Weighted averages based on 2005 GDP and PPP exchange rates of Australia, China, Hong Kong SAR, India, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand. Wholesale prices for India. [3] For Hong Kong SAR, Q4 2005–Q2 2013; for Indonesia, Q2 2000–Q2 2013; for Malaysia, Q1 2006–Q2 2013. [4] For Hong Kong SAR, Q4 2005–Q2 2013; for Indonesia, Q2 2000–Q2 2013; for Japan and Malaysia, Q1 2006–Q2 2013; for the Philippines, Q1 2007–Q2 2013. [5] For China and Malaysia, Q1 2006–Q2 2013; for Indonesia, Q2 2000–Q2 2013 for the Philippines, Q1 2007–Q2 2013.

Sources: IMF, *World Economic Outlook*; IMF, *International Financial Statistics*; national data.

To address these policy concerns, the paper first highlights global trends that help to explain the pronounced commodity price swings over the past decade. Section III presents statistical evidence supporting the case that global demand shocks have been a key driver of global commodity price swings and of domestic inflation dynamics in emerging market economies, especially in Asia. Section IV offers a new theoretical monetary policy model consistent with the empirical facts and supports the case that emerging market monetary policymakers should target headline inflation rather than core inflation. Section V concludes that emerging market central banks need to take an increasingly globe-centric view of the policy challenges associated with swings in commodity prices; as well, we offer suggestions for future research.

II. Understanding recent commodity price swings

What can we say about the changing nature of the economic and financial environment, with respect to the factors driving commodity prices? In this section, we highlight some of the arguments suggesting a fundamental change in the policy environment has been underway for a while. Despite some retreat during the international financial crises, the overall trend is toward greater economic and financial globalisation. The section then highlights the broad monetary policy challenges from a globe-centric, rather than a country-centric, perspective for emerging market central banks facing volatile commodity prices.

A changing economic and financial landscape

At the time of writing this paper, global food and energy prices movements have been moderate compared to those of recent years, albeit with isolated price spikes in certain segments due to idiosyncratic factors. For example, supply shocks have been related to low probability weather and geopolitical developments. Such developments appear transitory as they represent consequences of such things as a heat wave in China, monsoon-related crop damage in India and certain administrative measures taken in Indonesia.

But one can point to a number of fundamental forces indicating a more permanent change in the state of affairs. Two inter-related factors accounting for this change in correlation are the relative shift in economic gravity away from the advanced economies to the emerging market and developing economies, and the spread of financial globalisation, to which we now turn.

Shifting economic gravity The relative economic decline of the advanced economies and the corresponding increase in the importance of the emerging market and developing economies has been manifest in the past decade. By the end of 2012, emerging and developing economies accounted for over 25% of global output (Graph II.1). This shift has yielded important benefits. Per capita incomes in these economies and standards of living, for example, are rising at a much faster pace than imagined a few decades ago. However, these positive developments have had side-effects. One of them is the impact on commodity prices.

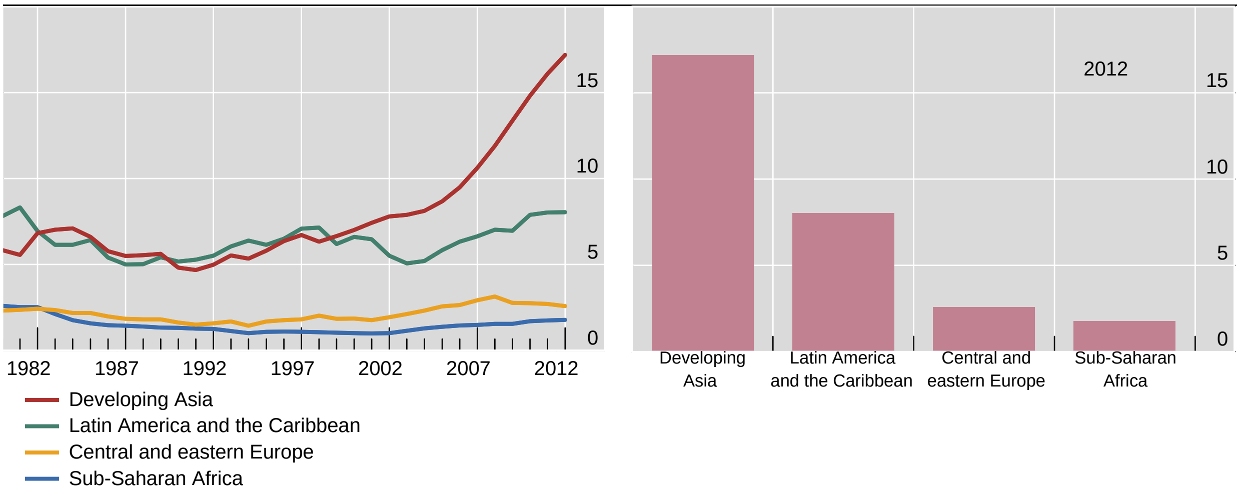
One way to conceptualise the policy environment is to consider commodity supply and demand curves. The global economic growth shifted global commodity demand out along an increasingly steeply sloped commodity supply curve. Two key arguments support this view (Inamura et al (2011) and G20 (2011)). First, a greater share of global demand is accounted for by emerging market economies. Second, emerging and developed economies tend to be more commodity-intensive than the advanced economies. The higher commodity intensity means that for every dollar of global output produced in the emerging and developed economies, relative to the advanced economies, there is a greater demand for commodities.[1]

[1] It is also the case that the international financial crisis has accelerated the shift of production of commodity-intensive products and demand from the advanced economies to the emerging market and developing economies. In addition, the increased demand for commodities by the emerging and developing economies, of course, could be offset eventually by greater efforts in exploration for new sources of commodities as well as the introduction of new technologies that are less-commodity intensive. The oil shale development in the United States in recent years demonstrates this potential. However, over "short" periods such as a decade, the supply inelasticity of commodities and the steady increase in global demand are likely to keep the average level of commodity prices high (Adams, 2009). This has and will continue to help commodity-producing Asian economies.

Rising share of global output outside the advanced economies

In per cent

Graph II.1



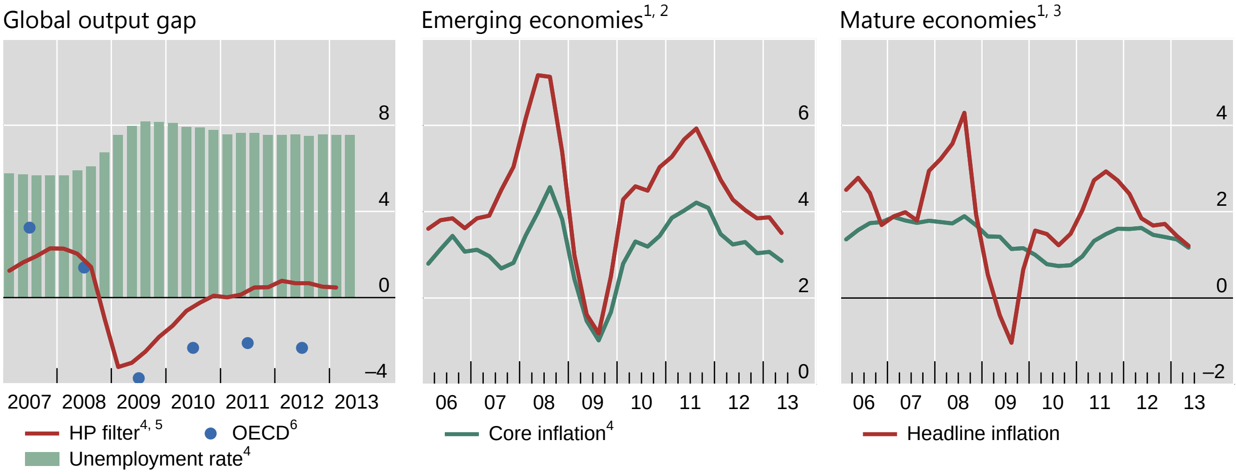
Source: IMF, *World Economic Outlook*.

In terms of volatility, emerging and developing economies however tend to be "higher beta" economies; that is, they are much more volatile than the advanced economies during global business cycles. This sensitivity helps to account for some of the volatility in commodity prices in recent years. It is useful to note that the string of financial crises affecting the advanced economies since mid-2007 has contributed to the volatility in demand for commodities. Demand for these commodities has been affected especially by the waves of global risk aversion. Spikes in global risk aversion have been found to drive capital flows to emerging and developing economies, which have significant impacts on financial stability conditions (see eg Forbes and Warnock (2011), Bruno and Shin (2012) and Rey (2013)).

The impact of the international financial crises on commodity markets also brings up a concern about the future. It is important to note that recent commodity price booms have ended primarily because of crises. This happened in late 2009 in the wake of the Lehman collapse and again in 2011-12 as the sovereign debt crisis in Europe intensified. These episodes have left us wondering what might have happened if these adverse international spillovers had not come along and acted as powerful headwinds against the commodity booms and inflation (Graph II.2).

Financial globalisation and the financialisation of commodity markets Greater financial globalisation has raised the prospects that commodity markets have become much more volatile because of increasing activity in the commodity futures market. It is true that, over the past decade, there has been a fundamental transformation in commodity trading. There has been a shift from participants primarily interested in physical delivery to those interested in commodities as an asset class. Some have expressed the concern that the bets placed by the financial traders are not related to the underlying supply and demand conditions. There is a growing body of evidence to support this perspective, especially for commodities that are traded regularly on organised exchanges (eg Hong and Yogo (2010), Tang and Xiong (2010), Singleton (2011)).

Global output gaps and inflation Graph II.2



[1] Year-on-year changes in consumer prices, in per cent. [2] Weighted averages based on 2005 GDP and PPP exchange rates of Brazil, China, Chinese Taipei, the Czech Republic, Hong Kong SAR, Hungary, India, Indonesia, Korea, Malaysia, Mexico, the Philippines, Poland, Singapore, Slovakia, South Africa, Thailand and Turkey. Wholesale prices for India. [3] Weighted averages based on 2005 GDP and PPP exchange rates of Canada, Denmark, the euro area, Japan, Norway, Sweden, Switzerland, the United Kingdom and the United States. [4] For 2007, excluding the Philippines. [4] Major advanced and emerging economies. [5] Based on a world aggregate; trend calculated using Hodrick-Prescott filter with standard specification. [6] Aggregation of national output gaps.

Sources: IMF, *World Economic Outlook*; OECD, *Economic Outlook*; Datastream; national data.

Along with greater financial globalisation, financialisation is thought to have boosted asset return correlations across asset classes. Indeed, commodity prices in recent years have been rather sensitive to swings in generalised risk perceptions in markets. According to Lombardi and Ravazzolo (2013), since the early 2000s, correlations between commodity price returns and stock market returns have gone from around zero to above 0.4 by 2012. It is no wonder policymakers have become more sensitive to possible links between excessive speculation (and herding behaviour) and commodity prices.

But how much of the commodity price volatility is due to the financialisation of commodity markets? This is not an easy question to answer. Some evidence suggests that financialisation of commodity markets has increased the frothiness in some commodity prices, but the size and breadth of the impact has been limited (Kilian and Murphy (2012), Lombardi and Van Robays (2011)). Irwin and Sanders (2011) document that the activity of exchange-traded funds in commodity futures markets did not increase commodity price volatility. One additional piece of corroborating evidence for this view is that the volatility of commodity prices that are not actively traded on organised exchanges has been similar to the volatility of prices on organised exchanges where financial speculation is present. Hence, while some of the frothiness in commodity prices can be linked to the financialisation of commodity markets, a good share of the volatility likely is not.[2]

Overall, these economic and financial factors – the relative decline of the advanced economies, financial globalisation and the financialisation of commodity markets – help to explain why we have seen greater swings in a wide range of commodity prices in recent years and the correlation in cross-sectional EM inflation dynamics, especially in Asia (Graph II.3). The swings have been wider and more frequent than in the prior years. The nature of the trends suggests that these forces will continue to influence the policy environment going forward.

[2] This evidence would also suggest that this aspect of the commodity price issue has limited financial stability implications for central banks. Nonetheless, public calls for specific anti-speculation measures, such as financial transaction taxes, have been heard with increasing frequency in recent years.

Are EM monetary policy responses contributing to greater commodity price pro-cyclicality?

For policymakers, it is also important to consider the possibility that existing monetary policy frameworks have contributed to the amplitude of the boom-bust commodity cycles. It is possible that this is not because policymakers have changed their approach but rather that the traditional country-centric view of central banking is becoming less relevant as economies around the world are becoming more globalised economically and financially. Globalisation trends call for consideration of more globe-centric policy frameworks. In this section, we first review the country-centric and globe-centric views before addressing the empirical evidence and policy implications.

Country-centric versus globe-centric perspectives This section lays out two conceptual perspectives within which to frame the current policy debate about commodity prices. The first perspective is a country-centric one; the other a globe-centric one (Borio and Filardo (2007)). To highlight the different policy implications of the two perspectives, we sketch a simplified typology of the two views before turning to the policy implications.

First, consider the country-centric perspective. This is the traditional approach to policymaking. The organising principle is the national economy. In the case of inflation and financial stability issues arising from commodity price developments, excess demand and supply conditions are assessed at the country level, as would be the analysis of wages, capital formation etc. External price developments would be assessed by looking at import prices, assuming they are sufficient statistics to summarise the relevant regional and global factors.[3]

In contrast, the organising principle of the globe-centric perspective takes the global economy as the starting point of the analysis. In the case of commodity prices, the globe-centric perspective makes particular sense since most commodities are highly traded goods and have their benchmark prices determined in a global marketplace. In this perspective, the critical determinants of prices would be global excess supply and demand. Moreover, wages and capital formation would be influenced not only by domestic forces but also global ones.[4]

Monetary policy considerations

Relative price shifts associated with commodity prices, theory tells us, should have only transitory impacts on inflation dynamics. To get commodity prices to have longer-lasting impact on inflation dynamics, relative price shifts would have to influence the setting of monetary policy in a systematic way. This begs the question: is it possible that wide swings in global commodity prices have contributed to pro-cyclical monetary policy in emerging market economies?

The answer to this question depends, in an important sense, on the source of the shocks driving commodity prices. If a surge in commodity prices is driven by a supply shock, the lessons learned during the experiences of the 1970s and 1980s apply: central bankers must focus on the impact of the rise in commodity prices on inflation expectations. There have been numerous examples of central banks successfully looking through the gyrations of commodity price shocks, as long as the increase in prices did not appear to feed an increase in medium-term inflation expectations – the so-called second-round effects. This is consistent with a country-centric approach.[5]

[3] In addition, the country-centric perspective would assume limited cross-border substitutability of goods and very limited mobility of capital and labour. This is consistent with a closed-economy type of analysis found in most traditional macroeconomic textbooks.

[4] In the extreme, labour and capital would be assumed to be highly mobile across geographic boundaries so that global, or regional, developments play a larger role than local factors in pricing the efficient allocation of goods.

[5] One additional possibility is that low interest rates at the global level has increased commodity prices through a financial portfolio rebalancing channel, which at the country level would look like a cost-push shock.

However, as noted above, soaring global commodity prices in recent years do not appear to have been the result of a supply shock, but of a persistent global demand shock. In other words, the higher prices have been the result of a shift in global demand along a more steeply sloped aggregate supply curve. One tell-tale sign that it is mainly demand, and not supply, driving up commodity prices is that output grew robustly, even as prices of all types of commodities rose.[6] The globe-centric approach has much to offer in this situation.

A useful thought experiment. The following thought experiment highlights the nature of the policy trade-offs in this case of a positive global demand shock. We might imagine the existence of a hypothetical global monetary authority. This authority has the power to coordinate monetary policy actions across existing monetary jurisdictions. Asking the following question helps us to understand the implications of the globe-centric approach: how would this global monetary authority respond to commodity price booms and busts, and would this response deviate significantly from what we have seen?

In many respects, the policy prescription for the hypothetical global monetary authority is quite straightforward when the commodity price boom is driven by strong global aggregate demand. This hypothetical global monetary authority would tighten monetary policy by raising the average real policy rate sufficiently to counteract the underlying shift in aggregate demand. If calibrated correctly across jurisdictions, non-inflationary sustainable growth would be achieved and commodity price pressures would reverse. Indeed, if the global monetary authority was sufficiently credible and economic agents forward-looking, the prospect of a tightening of monetary policy might forestall the initiation of a commodity price boom in the first place.

So, how does the policy prescription for this hypothetical global monetary authority compare with the behaviour of central banks during the run-up in commodity prices in 2006–08 and in 2011? Graphs II.3 and II.4 illustrate that the actual responses stand in sharp contrast to theoretical considerations. Across EM Asia, and most jurisdictions around the globe, nominal rates were not raised sufficiently quickly, if at all, to boost real policy rates. In other words, global monetary policy became more, not less, accommodative during the commodity price booms and resulted in higher inflation (Graph II.5).[7]

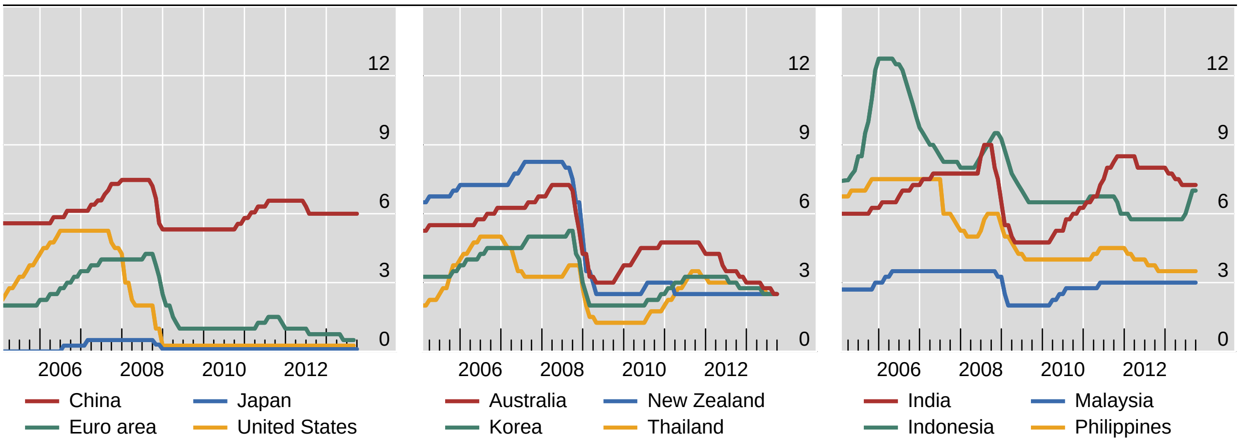
What might account for this discrepancy between theory and practice? One difficulty in operationalising this theoretical policy prescription at the national level is that a global demand shock looks in many respects like an external supply shock to national policymakers.[8] This would be particularly the case when an economy is a large net importer of commodities.

[6] Recent empirical evidence from Lee and Rhee (2012) finds some evidence in Asian economies that rising food prices tend to have a bigger impact on core inflation than energy prices. In addition, core inflation shows a tendency to move towards headline inflation rather than vice versa. This evidence provides support for the view that monetary authorities should put greater weight on headline inflation in emerging and developing economies than on core inflation in the conduct of monetary policy.

[7] Of course, if the commodity price increases represented a supply shock, this policy response would have been appropriate, based on the experience of the 1970s and 1980s.

[8] This may sound like pure semantics, but there is an important distinction in terms of communicating to the public the accurate conceptual framework being used by central banks; this may also be valuable for internal deliberations inside the central bank. Filardo (2012) discusses this policy challenge.

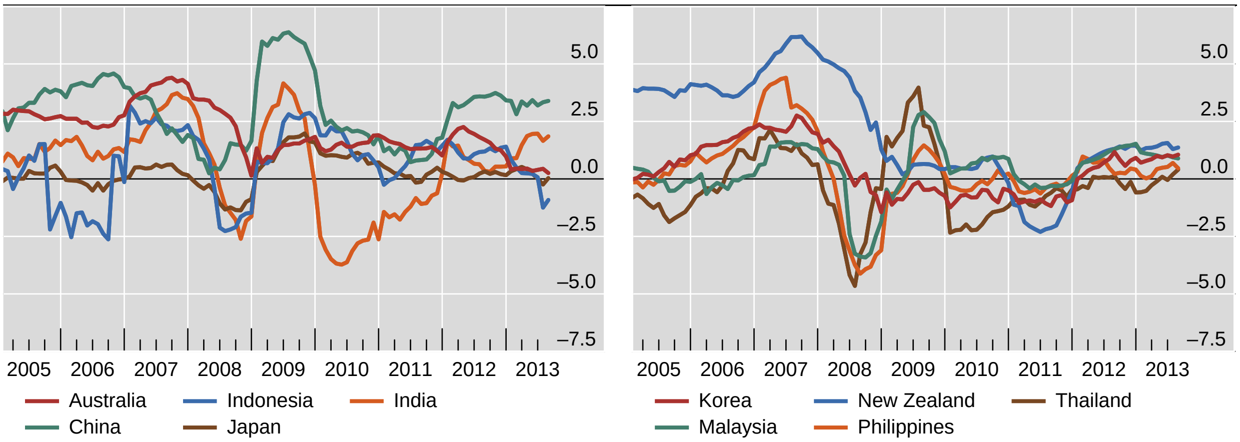
Nominal policy rates[1] Graph II.3



[1] In per cent. Policy target rates or their proxies. For Australia, RBA cash target rate; for China, benchmark one-year lending rate; for the euro area, ECB main refinancing rate; for India, repo rate; for Indonesia, one-month official discount rate; for Japan, target policy rate; for Korea, target for the overnight call rate; for Malaysia, overnight policy rate; for New Zealand, official cash daily rate; for the Philippines, overnight reverse repo rate; for Thailand, one day repo rate; for the United States, Federal Funds target rate.

Source: national data.

Real policy rates[1] Graph II.4



[1] In per cent. Policy target rates or their proxies minus average of year-on-year change in CPI and consensus inflation forecast for the year. Wholesale prices for India. For Australia, RBA cash target rate; for China, benchmark one-year lending rate; for the euro area, ECB main refinancing rate; for India, repo rate; for Indonesia, one-month official discount rate; for Japan, target policy rate; for Korea, target for the overnight call rate; for Malaysia, overnight policy rate; for New Zealand, official cash daily rate; for the Philippines, overnight reverse repo rate; for Thailand, one day repo rate; for the United States, Federal Funds target rate.

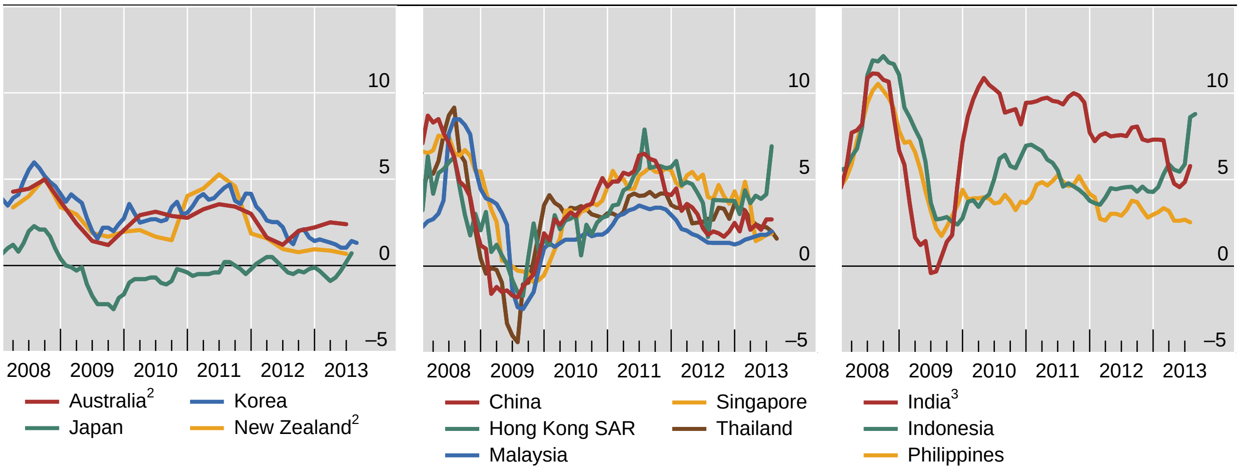
Sources: national data; BIS calculations

It is important to emphasise the distinction between reality and perception when thinking about commodity price shocks. When commodity prices rise and fall significantly, there is a temptation for national central banks, as well as others, to dwell on the external nature of the shock, both in terms of their internal discussions at the time of policy meetings and in terms of communication with the public. There is an underlying logic to categorising commodity price movements as external supply shocks from a country-centric point of view. In the case of a small, open economy, it might be difficult to see how the policy response alone would materially influence global demand. And, given that commodities are important inputs into production, the higher prices are contractionary from a comparative statics point of view.

However, from a general equilibrium perspective at a global level, the commodity prices are really driven by global demand shocks, not supply shocks. There is a growing consensus that this distinction is important from a policy point of view.

Consumer price inflation[1]

Graph II.5



[1] Annual percentage change. [2] Quarterly frequencies. [3] Wholesale prices.

Source: national data.

The misdiagnosis of the source of the shocks opens up the risk of applying the wrong medicine to the problem. If the shock is misdiagnosed as a supply shock, policymakers may find themselves heeding the monetary policy lessons of the 1970s and 1980s. The oil price experience in the 1970s and 1980s taught monetary policymakers a key lesson: it is important to take strong policy actions to prevent second-round inflation effects, but otherwise to ignore the gyrations on the price level. When this advice about first-round versus second-round effects was taken during the second oil crisis, central banks such as the Deutsche Bundesbank, the Bank of Japan and the Swiss National Bank achieved much better macroeconomic and financial outcomes.

As a result of a misdiagnosis, a monetary authority could find itself behind the curve because it has an incentive to wait until surging commodity prices push up inflation expectations. Of course, if all economies are more or less subject to the same incentives, this would lead to accommodative monetary policy at the global level and a surfeit of global liquidity which would, in turn, feed upward pressure on global commodity prices and spur more global demand expansion. In other words, global monetary policy settings would tend to be too accommodative during the upswing in commodity prices.

Traditionally, such liquidity expansion and economic overheating would conjure up images of upward inflation spirals which central banks focused on price stability would naturally combat. However, this empirical lead-lag relationship between credit growth and inflation has broken down in many economies that have achieved a high level of credibility for price stability. Recent studies of credit booms gone bad have taught us that credit booms often lead to credit busts and financial instability without a sharp deterioration in the short-term inflation picture. Indeed, these longer lags between excess liquidity provision by central banks and inflation have put a premium on complementing traditional monetary policy tools with macroprudential ones in order to curb the tendency for boom-bust credit and asset price cycles. This has also called for central banks to focus on policy horizons much longer than the conventional two-year one (Borio and Zhu (2008), Reinhart and Rogoff (2009)).

What is the empirical foundation of this perspective? The global trends support the case. The sheer size of emerging market economies as a share of global activity raises the possibility that correlated EM policy responses to commodity price swings are having a non-trivial feedback on global activity and hence commodity prices. If truly a reflection of global demand conditions, the policy responses may be feeding inflationary pressures. To assess the empirical relevance of this, we dig into the empirical record and explore the theoretical nature of the monetary transmission mechanism implied by misperceptions of global demands as country-centric supply shocks.

Insights from the literature on commodity prices and monetary policy

The literature on commodity prices and monetary policy has highlighted the trade-offs central banks face as a result of large swings in commodity prices. Large commodity price swings have been seen as complicating the ability of central banks to not only achieve price stability but also stabilise the real economy. Bernanke, Gertler and Watson (1997) argued, for example, that the US recessions of 1974 and 1982 were exacerbated by the Federal Reserve's reaction to oil price shocks.

For decades, much of the literature has supported the conventional wisdom that monetary authorities should ‘look through’ first-round relative price effects of commodity prices but to respond once second-round effects kick in. The IMF (2011) re-examined the issue in light of recent swings in commodity prices and largely affirmed the conventional wisdom of looking through commodity price shocks, ie targeting core inflation rather than headline inflation; this is consistent with theoretical findings going back to Aoki (2001). Coletti et al (2012) argue that price-level targeting worsens the trade-off between inflation and output stabilisation when compared to inflation targeting; they treat commodity price movements as cost-push shocks.

From the perspective of emerging market economies, gyrations in food prices have taken on greater prominence in the literature, leading to different arguments for putting more weight on headline versus core inflation in monetary policy frameworks. First, given the share food has in consumption baskets of emerging economies, the inflationary consequences of commodity price movements is much greater than in the advanced economies.[9] Second, rising food prices have significant social implications that policymakers confront; Catao and Chang (2010) examine the case of a small, open economy in which food has a large role in the utility function. In such a setting, they find support for targeting consumer prices rather than targeting producer prices when food price shocks are volatile. Credit constraints are also likely to affect consumers in emerging economies; Anand and Prasad (2012) argue that with incomplete markets and financial frictions, targeting headline inflation is optimal.

The papers above generally start their analysis from the assumption that commodity price movements are largely exogenous developments from a small, open economy’s perspective. Indeed, the exogenous nature of commodity price developments has been a longstanding assumption in macroeconomic models. For example, in his seminal paper, Hamilton (1984) argued that almost all post-WWII US recessions were preceded by exogenous oil supply-driven price increases. Early theoretical models featuring energy prices (see, for example, Kim and Loungani (1992)) were also built on the assumption that energy price shocks are exogenous to the rest of the economy. Whereas treating commodity prices as exogenous may be reasonable from a narrow small, open economy perspective, it is not tenable from a global perspective. As a consequence, what might look like an appropriate country-centric response may no longer be the best way to fully analyse the policy environment, especially if other economies are responding in a correlated fashion.

[9] Cutler et al (2005), for example, report evidence that the pass-through of commodity prices to consumer prices in Hong Kong and mainland China is higher compared to mature economies. Bank of Thailand (2011) also finds that the correlations between domestic price indices and international food prices have increased in the 2000s. Tang (2008) argues that monetary authorities in East Asia responded slowly to commodity price increases during the mid-2000s.

The broad-based surge in commodity prices of the 2000s spurred academic interest in demand, rather supply, shock implications of commodity price developments. Since the influential paper by Kilian (2009), a growing empirical literature has supported the contention that commodity price fluctuations in the past decade have been heavily influenced by demand-side developments, which are in turn associated with the growing importance of commodity-hungry emerging economies. This has spurred on interest in the state-contingent nature of the monetary policy response. Bodenstein, Guerrieri and Kilian (2012) employ a two-country DSGE model with endogenous oil production, and show that the optimal monetary policy response to an increase in the price of oil depends on the nature and the location of the shock that produced the price increase. Robust control issues associated with alternative shocks driving commodity price fluctuations have received less attention in the literature despite relevance for policymakers.

Finally, the literature has also drawn links between commodity price developments and monetary policy settings. This raises the issue of the extent to which monetary policy can itself influence commodity prices via its impact on demand. On this point, Barsky and Kilian (2002) reported evidence that high oil prices in the seventies and early eighties may have been caused by loose monetary policy rather than supply shocks; the link to monetary policy was also highlighted by global monetarists in the early 1980s (McKinnon (1982)). Anzuini, Lombardi and Pagano (2013) also find evidence that monetary policy can contribute to commodity price fluctuations by generating expectations of higher demand.

III. Commodity prices and EM inflation – empirical role of global supply and demand

In this section, we first examine the empirical evidence supporting the notion that recent commodity price developments have been driven significantly by global demand shocks. To do this, we begin by first identifying global supply and demand shocks from a small-scale global macroeconomic model using a Blanchard-Quah identification scheme.

Having estimated global demand and supply shocks using this procedure, we then explore to what extent these two types of global shocks influence domestic inflation dynamics. We do this systematically in steps. First, we separate movements in commodity prices into those components explained by global demand shocks and those by global supply shocks. Then we use these components to assess their empirical relevance in explaining domestic inflation dynamics, for both headline and core inflation. Finally, we explore the extent to which these components can help us explain whether headline inflation tends to converge to core inflation, or vice versa, in emerging market economies.

Estimating global demand and supply shocks

To identify global demand and supply shocks, we use the Blanchard-Quah approach. To operationalise this approach at a global level, we use a bivariate autoregression model of global output and inflation on data from 1974:Q1-2012:Q4. Graph III.1 illustrates the swings in the two series since 2000.

The empirical model. The particular regression design is the following:

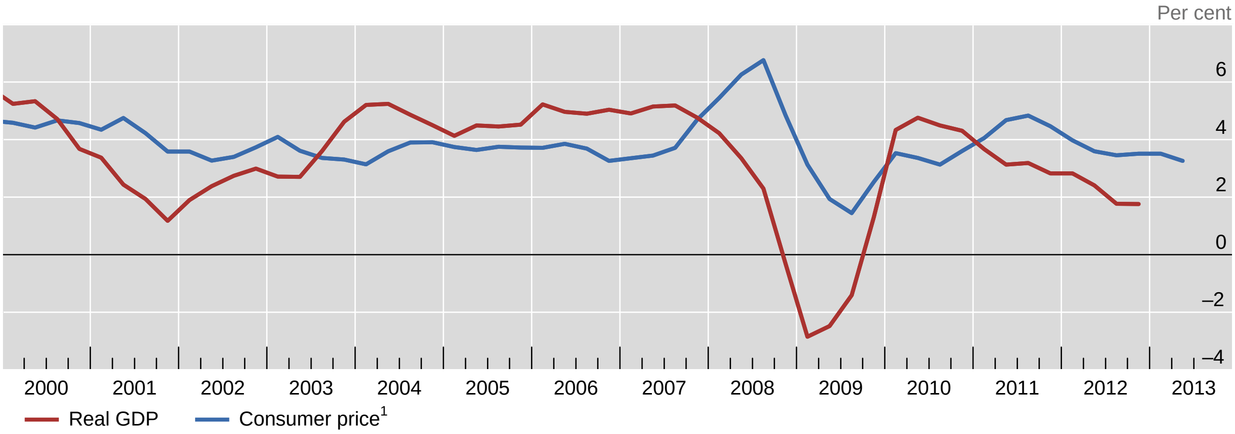
$$\begin{pmatrix} y_t^g \\ \pi_t^g \end{pmatrix} = \begin{pmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{pmatrix} \begin{pmatrix} \zeta_{d,t}^g \\ \zeta_{s,t}^g \end{pmatrix} \qquad \text{(III.1)}$$

imposing the constraint that $A_{12}(1) = 0$, where $y_t^g \; and \; \pi_t^g$ are measures of the global output gap and global inflation, respectively. This identification strategy is based on assumptions about the persistence of the shocks. Namely, demand shocks are transitory and supply shocks can have a permanent impact.

We implement this by estimating the following equations and solving for demand and supply shocks $\zeta^g_{d,t}$ and $\zeta^g_{s,t}$. To this end, the equation III.1 is transformed in a standard way:

$$\begin{pmatrix} y^g_t \\ \pi^g_t \end{pmatrix} = \begin{pmatrix} B_{11}(L) & B_{12}(L) \\ B_{21}(L) & B_{22}(L) \end{pmatrix} \begin{pmatrix} e^g_{1,t} \\ e^g_{2,t} \end{pmatrix} \qquad \text{III.2}$$

Global real GDP and consumer price (Year-on-year changes) Graph III.1



[1] Quarterly averages.

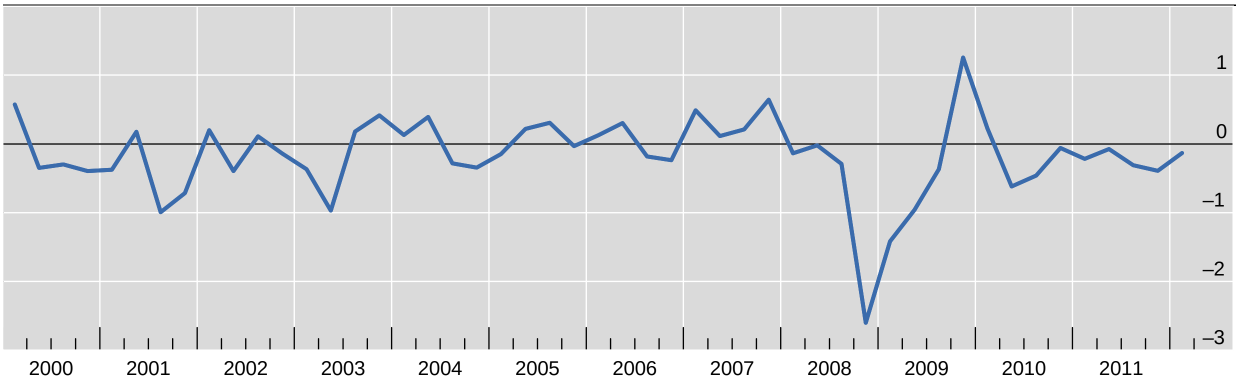
Sources: IMF, *International Financial Statistics*; Datastream; BIS calculations.

where $E(ee') = \Omega$ and $G = chol(B(1)\Omega B(1)')$ and $F = B(1)^{-1}G$. The global demand and supply shocks are computed as:

$$\begin{pmatrix} D_t \\ S_t \end{pmatrix} \equiv \begin{pmatrix} \zeta^g_{d,t} \\ \zeta^g_{s,t} \end{pmatrix} = F^{-1} \begin{pmatrix} e^g_{1,t} \\ e^g_{2,t} \end{pmatrix}. \qquad \text{III.3}$$

This Blanchard-Quah model and identification strategy yield global demand shocks, D_t. Graph III.2 plots the series from 2000-2012. The crisis and its immediate aftermath stand out. Starting in late 2008, demand shocks were persistently negative until one positive shock at the end of 2009, followed by smaller negative supply shocks. Prior to 2008, the demand shocks exhibited less amplitude in swings and were less correlated, but tended to be positive in the run-up to the crisis.

Estimated global demand shocks Graph III.2



Estimated model described in equations III.1-III.3.

Sources: IMF, International Financial Statistics; BIS calculations.

Attributing global commodity price inflation to global demand and supply shocks

Having identified the global demand and supply shocks, we can now use them to estimate the components of commodity price inflation attributed to demand and supply shocks, respectively:

$$\pi_t^{cp} = \alpha^{cp} + \sum_{k=0}^{4}\left(\beta_k^{cp} D_{t-k} + \theta_k^{cp} S_{t-k}\right) + \sum_{k=1}^{4}\gamma_k^{cp}\pi_{t-k}^{cp} + \varepsilon_t^{cp} \qquad \text{(III.4)}$$

where $\pi_t^{cp,d} \equiv \sum_{k=0}^{4}\hat{\beta}_k^{cp} D_{t-k}$ and $\pi_t^{cp,s} \equiv \sum_{k=0}^{4}\hat{\theta}_k^{cp} S_{t-k}$.[10]

Graph III.3 highlights the relative importance of global demand shocks in driving commodity price fluctuations. The coefficient estimates are presented in Annex Table A1. The red bars represent the demand component of commodity price inflation. They show that the demand component was typically negative in the early part of the 2000s, indicating that demand was acting as a headwind at the time. This component then turned around in the mid-2000s and was mainly positive. The most dramatic contributions for the demand component came at the depth of the international financial crisis when it was highly negative and persistent.[11]

Demand, supply and commodity price components[1] Graph III.3

[1] The components are estimated from the following regression: $\pi_t^{cp} = \alpha^{cp} + \sum_{k=0}^{4}(\beta_k^{cp} D_{t-k} + \theta_k^{cp} S_{t-k}) + \sum_{k=1}^{n4}\gamma_k^{cp}\pi_{t-k}^{cp} + \varepsilon_t^{cp}$ and defining $\pi_t^{cp,d} = \sum_{k=0}^{4}\beta_k^{cp} D_{t-k}$, $\pi_t^{cp,s} = \sum_{k=0}^{4}\theta_k^{cp} DS_{t-k}$, and $\pi_t^{cp,cp} = \sum_{k=1}^{n4}\gamma_k^{cp}\pi_{t-k}^{cp}$.

Sources: IMF, *International Financial Statistics*; Datastream; BIS calculations.

Pass-through of global commodity price inflation to domestic headline inflation

We now turn to the pass-through of commodity price inflation to domestic headline inflation and assess the relative contributions coming from the demand and supply components of commodity price inflation. The following equation is estimated for various economies:

$$\pi_t^{h} = \alpha + \sum_{k=0}^{4}\left(\beta_k^{h}\pi_{t-k}^{cp,d} + \theta_k^{h}\pi_{t-k}^{cp,s}\right) + \sum_{k=1}^{4}\gamma_k\pi_{t-k}^{h} + \varepsilon_t^{h} . \qquad \text{(III.5)}$$

Graph III.4 succinctly summarises the findings from equation III.5. The sum of the coefficients on the demand shocks are presented in the left-hand panel and on the supply shocks in the right-hand panel. What immediately becomes apparent is that the coefficients

[10] The statistical issue of generated regressors applies here. While the coefficient estimators in this case are theoretically unbiased, the estimator of the variance-covariance is biased and may lead to an overstating of significance levels. Establishing the power and size of the tests is left for future research.

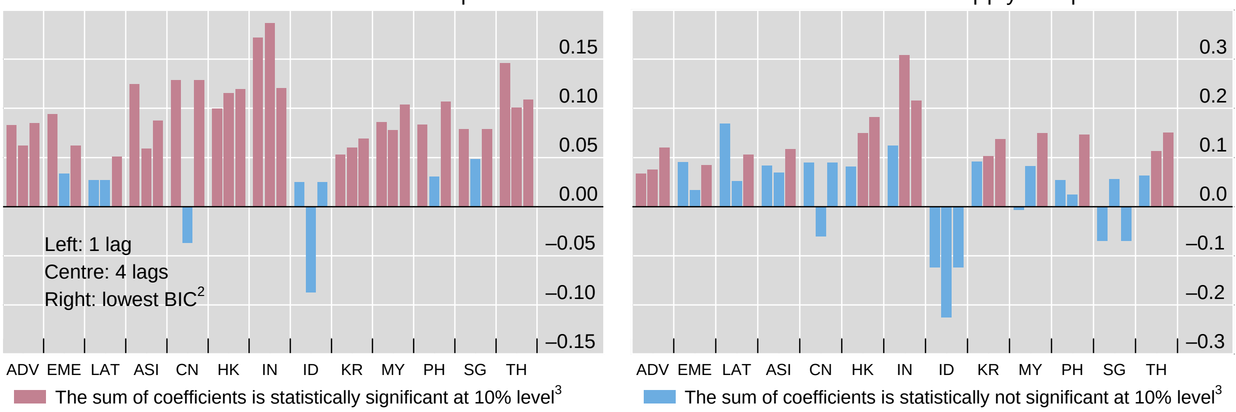
[11] See BIS (2010) for more detail on the international financial crisis impact on Asia and the Pacific economies.

on the demand shocks are generally positive and exceed those on the supply shocks. The sum of the coefficients is generally statistically significant, as indicated by the red bars.

In addition, the sum of the coefficients appears to be larger and more statistically significant that the average result for the emerging markets as a whole (designated by EME) or for Latin American economies (designated by LAT). The individual Asian emerging market economies exhibit a fair amount of diversity but headline inflation is much more sensitive to global demand side commodity price inflation than the global supply side commodity price inflation.

Pass-through of global commodity price inflation to domestic headline inflation[1] Graph III.4

Sum of the coefficients of the demand component | Sum of the coefficients of the supply component



ADV = Australia, Canada, the euro area, Japan, New Zealand, the United Kingdom and the United States; ASI = China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand; EME = Asia, Latin America, the Czech Republic, Hungary, Poland, Russia, South Africa and Turkey; LAT = Brazil, Chile, Colombia and Peru. CN = China; HK = Hong Kong SAR; ID = Indonesia; IN = India; KR = Korea; MY = Malaysia; PH = the Philippines; SG = Singapore; TH = Thailand.

[1] Regression estimation of equation: $\pi_t^h = \alpha + \sum_{k=0}^{n}(\beta_k^h \pi_{t-k}^{cp,d} + \theta_k^h \pi_{t-k}^{cp,s}) + \sum_{k=1}^{n} \gamma_k \pi_{t-k}^h + \varepsilon_t^h$. Q1 2000–Q1 2012. Wholesale prices for India. [2] 1-4 lags. [3] According to the Wald test.

Sources: IMF, *International Financial Statistics*; IMF, *World Economic Outlook*; CEIC; Datastream; national data; BIS calculations.

Pass-through of global commodity price inflation to domestic core inflation

In a similar way, we now estimate the influence of the components of commodity price inflation due to global demand and supply shocks on core inflation, economy-by-economy:

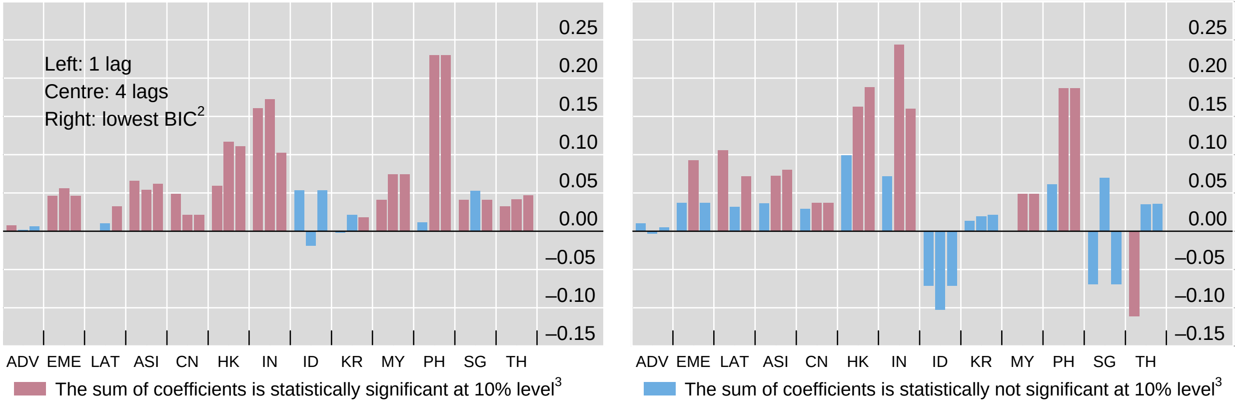
$$\pi_t^c = \alpha + \sum_{k=0}^{4}\left(\beta_k^c \pi_{t-k}^{cp,d} + \theta_k^c \pi_{t-k}^{cp,s}\right) + \sum_{k=1}^{4} \gamma_k \pi_{t-k}^c + \varepsilon_t^c \qquad \text{(III.6)}$$

The regression uses autoregressive lags as well as four lags of the demand- and supply-driven components. Statistical tests are used to assess the adequacy of the fit.

As might be expected, the influence of commodity price inflation on core inflation is generally smaller than in the case of headline inflation. Graph III.5 is designed in an analogous way to that of Graph III.4. A similar pattern emerges: the global demand component of commodity price inflation appears to be more often statistically significant and with a somewhat larger sum of coefficients than the global supply component of commodity price inflation.

Pass-through of global commodity price inflation to domestic core inflation[1] Graph III.5

Sum of the coefficients of the demand component | Sum of the coefficients of the supply component



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[1] Regression estimation of equation: $\pi_t^c = \alpha + \sum_{k=0}^{n}(\beta_k^c \pi_{t-k}^{cp,d} + \theta_k^c \pi_{t-k}^{cp,s}) + \sum_{k=1}^{n} \gamma_k \pi_{t-k}^c + \varepsilon_t^c$. Q1 2000–Q1 2012; for China and Malaysia, Q1 2006–Q1 2012; for Indonesia, Q3 2000–Q1 2012; for the Philippines, Q1 2007–Q1 2012. Wholesale prices for India. [2] 1-4 lags. [3] According to the Wald test.

Sources: IMF, *International Financial Statistics*; IMF, *World Economic Outlook*; CEIC; Datastream; national data; BIS calculations.

Does core inflation revert to headline: global demand versus supply shocks?

To investigate whether the reversion of headline inflation to core inflation has different features depending on the source of commodity price changes, we extend the framework of Cecchetti and Moessner (2008) and Lee and Rhee (2013). We first look at regressions that do not distinguish between global demand and supply influences. These regressions are of the following form:

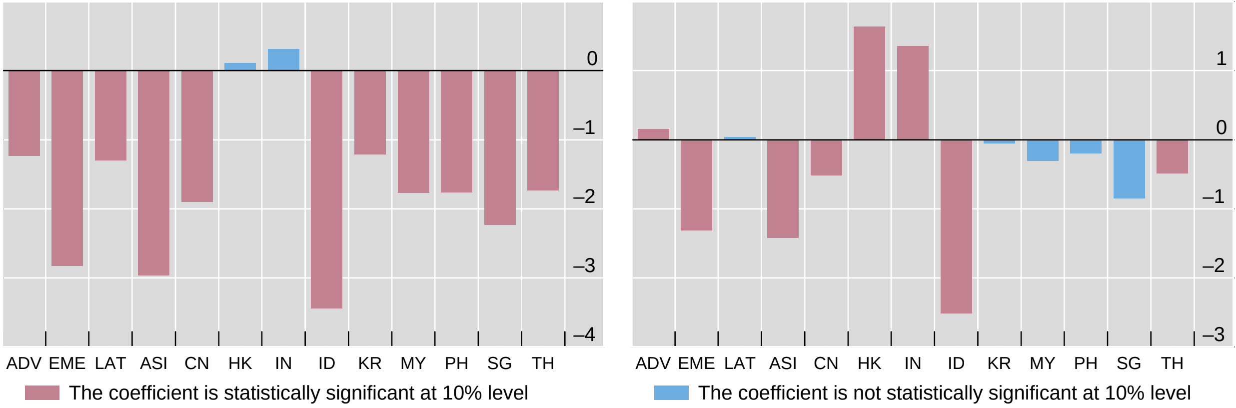
$$\begin{aligned} \pi_{t+k}^h - \pi_t^h &= \alpha + \beta_h \left(\pi_t^h - \pi_t^c\right) + \xi_t^h \\ \pi_{t+k}^c - \pi_t^c &= \alpha + \beta_c \left(\pi_t^h - \pi_t^c\right) + \xi_t^c \end{aligned} \qquad \text{(III.7)}$$

These regressions can capture the general tendency of headline and core inflation to converge over time. If $\beta_h > 0$, then headline inflation being above core inflation would tend to lead to further increases in headline inflation in the future; if $\beta_h < 0$, then headline inflation would tend to converge to core inflation. A similar logic applies to the second equation.

On balance, the evidence suggests that headline inflation tends to converge to core inflation rather than vice versa. This should not be a particular surprise given the proven abilities of most Asia-Pacific economies to maintain price stability during the period under investigation. The results found in Graph III.6 illustrate that $\beta_h < 0$ consistently in the headline equation and β_c is less consistently signed in the core equation.

Reversion of headline to core and of core to headline inflation — Graph III.6

Headline inflation[1] — Core inflation[2]



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Note: Q1 2000–Q1 2012; for the emerging regions, Q1 2007–Q1 2012; for China and Malaysia, Q1 2006–Q1 2012; for Indonesia, Q3 2000–Q1 2012; for the Philippines, Q1 2007–Q1 2012. Wholesale prices for India.

[1] Regression estimation of equation: $\pi^h_{t+k} - \pi^h_t = \alpha + \beta_h\left(\pi^h_t - \pi^c_t\right) + \xi^h_t$, where k = 4. [2] Regression estimation of equation: $\pi^c_{t+k} - \pi^c_t = \alpha + \beta_c\left(\pi^h_t - \pi^c_t\right) + \xi^c_t$, where k = 4.

Sources: IMF, *International Financial Statistics*; IMF, *World Economic Outlook*; CEIC; Datastream; national data; BIS calculations.

We now turn to the hypothesis that global demand shocks have led to a weaker anchor for inflation expectations in the emerging market economies and hence a weaker tendency for headline inflation to revert to core inflation when global demand is driving commodity price inflation compared to when supply is. The regression design to address this question is:

$$\pi^h_{t+k} - \pi^h_t = \alpha + \beta_D \pi^{h-c}_{d,t} + \beta_S \pi^{h-c}_{s,t} + \beta_E \pi^{h-c}_{\kappa,t} + \xi_t$$

$$\pi^c_{t+k} - \pi^c_t = \alpha + \beta_D \pi^{h-c}_{d,t} + \beta_S \pi^{h-c}_{s,t} + \beta_E \pi^{h-c}_{\kappa,t} + \xi_t$$

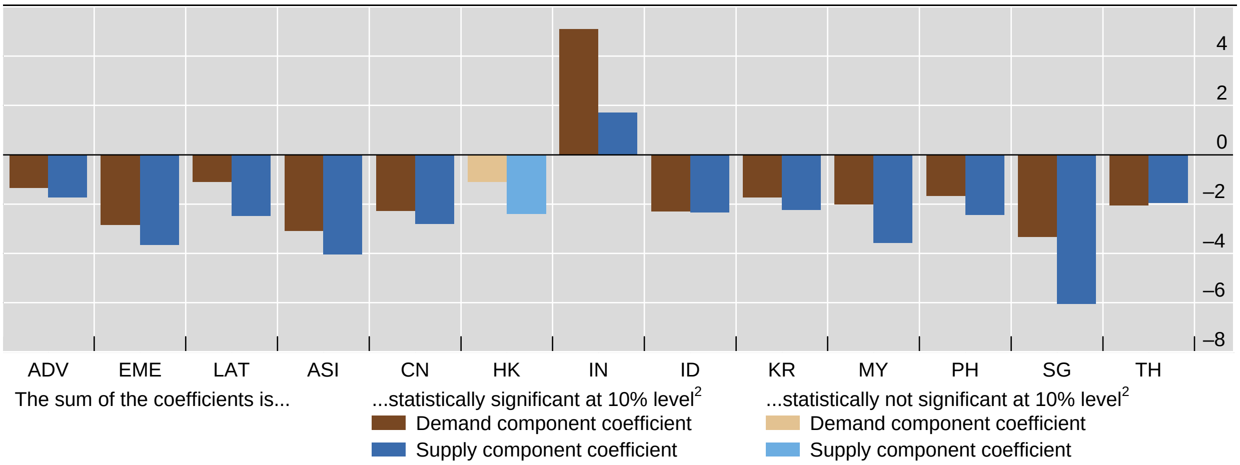
where $\left(\pi^{h-c}_{d,t}, \pi^{h-c}_{s,t}, \pi^{h-c}_{\kappa,t}\right)$ are estimated from $\pi^h_t - \pi^c_t = a + \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i} + \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i} + \kappa_t$, and

defining $\pi^{h-c}_{d,t} \equiv \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i}$, $\pi^{h-c}_{s,t} \equiv \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i}$ and $\pi^{h-c}_{\kappa,t} \equiv \kappa_t$.

We find evidence that the inflation anchor in emerging markets, especially in Asia, has been less well anchored when commodity prices are driven by global demand shocks than by global supply shocks. This is inferred from the tendency of headline inflation to revert to core inflation more weakly in the presence of demand shocks versus supply shocks. Specifically, Graph III.7 shows that while demand and supply components of commodity price movements are correlated with the future direction of headline inflation in a statistically significant way, the coefficient estimates are mostly negative. This implies that there is tendency for headline inflation to revert to core inflation as deviations arise. However, note that the coefficients on the global demand component are generally smaller than those on the global supply component; this indicates less mean reversion with demand-driven shocks to commodity price inflation than with supply-driven shocks. Graph III.8 shows mixed evidence that core reverts to headline.

Reversion conditional on nature of global shocks – impact on headline inflation[1]

Graph III.7



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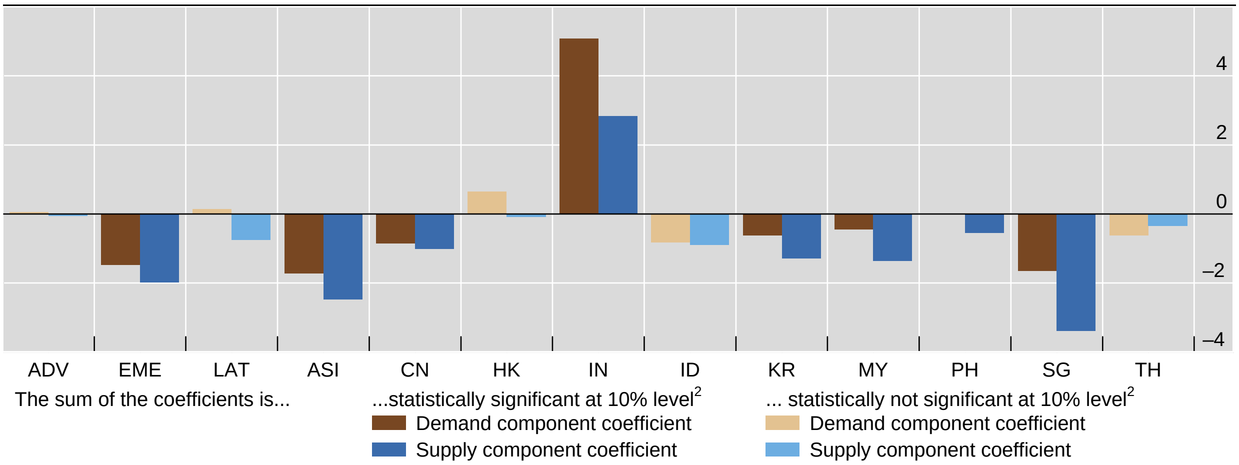
[1] Regression estimation of equation: $\pi^{h}_{t+4} - \pi^{h}_{t} = \alpha + \beta_D \pi^{h-c}_{d,t} + \beta_S \pi^{h-c}_{s,t} + \beta_E \pi^{h-c}_{\kappa,t} + \xi_t$ where $(\pi^{h-c}_{d,t}, \pi^{h-c}_{s,t}, \pi^{h-c}_{\kappa,t})$ are estimated from the following regression: $\pi^{h}_{t} - \pi^{c}_{t} = \alpha + \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i} + \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i} + \kappa_t$ and defining $\pi^{h-c}_{d,t} = \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i}$, $\pi^{h-c}_{s,t} = \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i}$ and $\pi^{h-c}_{\kappa,t} = \kappa_t$. Q1 2000–Q1 2012; for the emerging regions, Q1 2007–Q1 2012; for China and Malaysia, Q1 2006–Q1 2012; for Indonesia, Q3 2000–Q1 2012; for the Philippines, Q1 2007–Q1 2012. Wholesale prices for India. [2] According to the Wald test; where sum of the three components has been tested.

Sources: IMF, *International Financial Statistics*; IMF, *World Economic Outlook*; CEIC; Datastream; national data; BIS calculations.

Reversion conditional on nature of global shocks – impact on core inflation[1]

Graph III.8



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[1] Regression estimation of equation: $\pi^{c}_{t+4} - \pi^{c}_{t} = \alpha + \beta_D \pi^{h-c}_{d,t} + \beta_S \pi^{h-c}_{s,t} + \beta_E \pi^{h-c}_{\kappa,t} + \xi_t$ where $(\pi^{h-c}_{d,t}, \pi^{h-c}_{s,t}, \pi^{h-c}_{\kappa,t})$ are estimated from the following regression: $\pi^{h}_{t} - \pi^{c}_{t} = \alpha + \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i} + \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i} + \kappa_t$ and defining $\pi^{h-c}_{d,t} = \sum_{i=1}^{4} \theta_{d,i} \pi^{cp,d}_{t-i}$, $\pi^{h-c}_{s,t} = \sum_{i=1}^{4} \theta_{s,i} \pi^{cp,s}_{t-i}$ and $\pi^{h-c}_{\kappa,t} = \kappa_t$. Q1 2000–Q1 2012; for the emerging regions, Q1 2007–Q1 2012; for China and Malaysia, Q1 2006–Q1 2012; for Indonesia, Q3 2000–Q1 2012; for the Philippines, Q1 2007–Q1 2012. Wholesale prices for India. [2] According to the Wald test; where sum of the three components has been tested.

Sources: IMF, *International Financial Statistics*; IMF, *World Economic Outlook*; CEIC; Datastream; national data; BIS calculations.

Overall, this section has documented the important role that global demand shocks play in determining EM domestic inflation dynamics. We have found that global demand shocks are correlated with swings in commodity prices and the global demand-driven component of commodity price inflation is an important factor accounting for emerging market economy inflation dynamics.

IV. Global commodity prices swings and domestic inflation dynamics – a misperceptions modelling perspective

This section explores the question: how might the monetary policy transmission channel from global commodity price swings to EM domestic inflation dynamics be modelled? And, what are the implications for EM central bank monetary policy frameworks going forward in a more globalised world.

To this end, we specify a simple two-country monetary policy model in which commodity prices evolve endogenously and also play an important role influencing inflation dynamics. This is solved for the optimal monetary policy response given the array of possible shocks. The novel use of this model is to simulate the consequences of a central bank observing an increase in commodity prices due to buoyant global demand, but treating this as a commodity supply shock. This model demonstrates how misperceptions can lead a monetary authority to unwittingly induce pro-cyclical monetary policy. In terms of monetary policy implications, the potential for such misperceptions argues for EM central banks putting more weight on headline inflation rather than core inflation in monetary policy frameworks oriented toward price stability. This model also supports the case for greater regional and global cooperation as the global economy becomes increasingly integrated economically and financially.

Simple monetary policy model

For each economy $i \in \{EM, ROW\}$, the following equations describe the macroeconomic setting.

Macroeconomic block – output and inflation

The macro block comprises four equations describing the dynamics of output, core inflation, headline inflation and global commodity price inflation. The output equation takes forward-looking specification and the coefficients may differ across economies:

IS curve: $$y_{i,t} = -\beta_i r_{i,t} + \theta_i y_{i,t-1} + (1-\theta_i)Ey_{i,t+1} - \kappa_i \pi_t^{cp} + \varepsilon_{i,t}^{y} \qquad \text{(IV.1)}$$

Output (y) is determined by the real interest rate (r), past and expected output, global commodity price inflation (π^{cp}) and an error term (ε). Global commodity price inflation adversely affects output in a manner consistent with a supply shock.

Inflation dynamics take on a dynamic Phillips curve specification in which the difference between headline and core inflation is highlighted.

Core inflation: $$\pi_{i,t}^{c} = \tilde{\pi}_{i,t-1}^{c*} + \zeta_i E\pi_{i,t+1}^{c} + \gamma_i y_{i,t-1} + \alpha_i(\pi_{i,t-1}^{c} - \pi_{i,t-1}^{h}) + \varepsilon_{i,t}^{\pi^c} \qquad \text{(IV.2)}$$

$$= (1-\mu_i)\pi_{i,t-1}^{c} + \zeta_i E\pi_{i,t+1}^{c} + \gamma_i y_{i,t-1} + \alpha_i(\pi_{i,t-1}^{c} - \pi_{i,t-1}^{h}) + \varepsilon_{i,t}^{\pi^h};$$

$$where\ \tilde{\pi}_{i,t-1}^{c*} = \mu_i \pi_i^{*} + (1-\mu_i)\pi_{i,t-1}^{c}\ and\ \pi_i^{*} = 0$$

In this equation, core inflation is a function of backward and forward-looking inflation as well as the output gap, the gap between core inflation and headline inflation and an error term. The backward-looking component of core inflation is adjusted to take into account the strength of the anchoring of long-run inflation. In this case, the long-run inflation target is zero and μ calibrates the strength of this anchor.

Headline inflation: $\pi_{i,t}^{h} = \pi_{i,t}^{c} + \tau\pi_{i,t-1}^{h} + \iota_i\pi_t^{cp} + \varepsilon_{i,t}^{\pi^h}$ (IV.3)

Global commodity price inflation is by definition taken as a common variable that influences both economies. It is assumed to be driven by global demand and idiosyncratic supply shocks:

Global commodity price inflation: $\pi_t^{cp} = \phi\pi_{t-1}^{cp} + \omega_{EM} y_{EM,t} + \omega_{ROW} y_{ROW,t} + \varepsilon_t^{\pi^{cp}}$ (IV.4)

This specification allows the coefficients on country-specific output to differ. A larger weight on EM reflects the greater commodity-intensity of emerging market economies per unit of output. In other words, a given unit of output in EM has a larger demand impact on commodities than a similarly sized increase for ROW. Implicitly, the contemporaneous output terms capture the impact of the central banks' reaction function.

For completeness, the error terms $(\varepsilon_{i,t}^{y}, \varepsilon_{i,t}^{\pi^c}, \varepsilon_{i,t}^{\pi^h}, \varepsilon_t^{\pi^{cp}})$ are assumed to be i.i.d. normally distributed random variables with constant variances.

Monetary policy block

Monetary policy is assumed to follow a Taylor-type rule assuming policy rate inertia:

$$r_t = R_t - \pi_t^h = \lambda\pi_t^c + \delta y_t + \eta r_{t-1} \qquad \text{(IV.5)}$$

In each economy, the monetary authority sets the interest rate so as to minimise the losses associated with the variance of output, inflation and the volatility of interest rate changes. In particular, the central bank's decision problem is a conventional one. The loss function for each central bank is $L_i = \text{var}(\pi_i) + \nu_y \text{var}(y_i) + \nu_r \text{var}(r_i - r_{i,-1})$, where the preference parameters are assumed (without loss of generality) to be the same. The decision for each central bank is:

$$\underset{\{\lambda_i,\delta_i,\eta_i\}}{Min} \; L_i = \text{var}(\pi_i) + \nu_y \text{var}(y_i) + \nu_r \text{var}(r_i - r_{i,-1}) \qquad \text{(IV.6)}$$

subject to the equations (IV.1) to (IV.4). The resulting dynamic two-country model is the baseline model for the simulations.[12]

Results

In this section, we first present the baseline results from the model under the assumption of complete information. We then compare the impulse response from the baseline model with the impulse responses from a model in which the EM monetary authority misinterprets an increase in commodity prices as a global commodity supply shock instead of global demand shock. We highlight how this misdiagnosis leads to (ex post) pro-cyclical monetary policies relative to the baseline.

Baseline results

In Graph IV.1, we report the response of commodity prices, inflation, output and the interest rate to a demand shock (blue line) and a commodity supply shock (red line). Starting from the left panel, we report the responses of commodity prices to the two different shocks: the responses are quite similar. Also the impact of the two shocks on the dynamic responses of headline inflation are similar, although the degree of pass-through differs somewhat. The

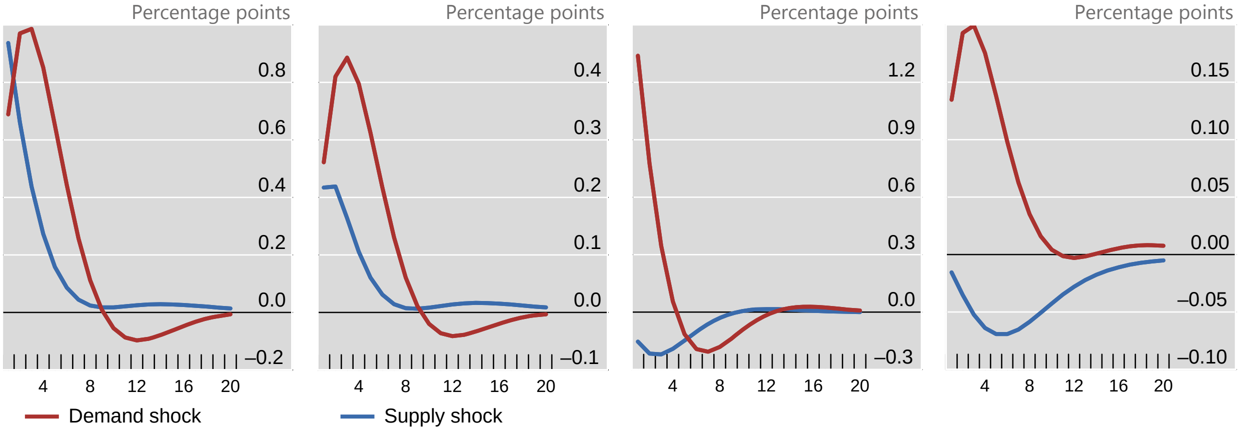
[12] The model is solved using Dynare by iterating over IV.6 for each economy. The calibrated parameters in the baseline model are list in Table A2 in the Appendix.

responses of output to the shocks however are quite different: the demand shock has an expansionary impact, whereas a commodity supply shock has a contractionary one. As a consequence, it is not surprising that the optimal monetary policy responses differ as well: in the presence of a commodity supply shock, the central bank accommodates the decline in output, whereas it tightens in the presence of a demand shock.

Response to demand and supply shocks[1]

Baseline[2]

Graph IV.1



[1] Responses of selected variables to a unit shock to global demand and to commodity supply. [2] Calibrated parameters as in Table A2.

Source: authors' calculations.

This indicates the importance of correctly identifying the source of shocks in the formulation of monetary policy. However it should be noted that distinguishing the source of the shocks may not be straightforward, for example, by merely observing the behaviour of commodity prices or inflation. Because the responses of commodity prices (and headline inflation) to the two types of shocks are similar, the only way to pin them down in this setting is to look at output dynamics. However, data on output is noisy, subject to significant revision and only available after a delay. All these considerations highlight the risk of ex post policy mistakes due to the misdiagnosis of the source of shocks.

Policy experiments and robustness analysis

In this section, we are interested in three policy issues of relevance to emerging market economies, and address them by considering alternative model specifications. In particular, we examine the implications of rising EM output sensitivity to commodity price movements, of the possible weakening of the EM inflation anchor, and of the monetary policy option to focus on headline rather than core inflation as a means to stabilise the economy. These simulations also shed light on the model's implications cross-sectionally, ie how different EM economies compare with others.

1. Increasing the commodity price inflation sensitivity of output

In Graph IV.2 we report instead a situation in which the EM economy is assumed to be more commodity-intensive. In terms of the parameter settings, κ_{EM} is increased from .05 to .25. This corresponds to an increase in the sensitivity of EM output to global commodity price inflation.

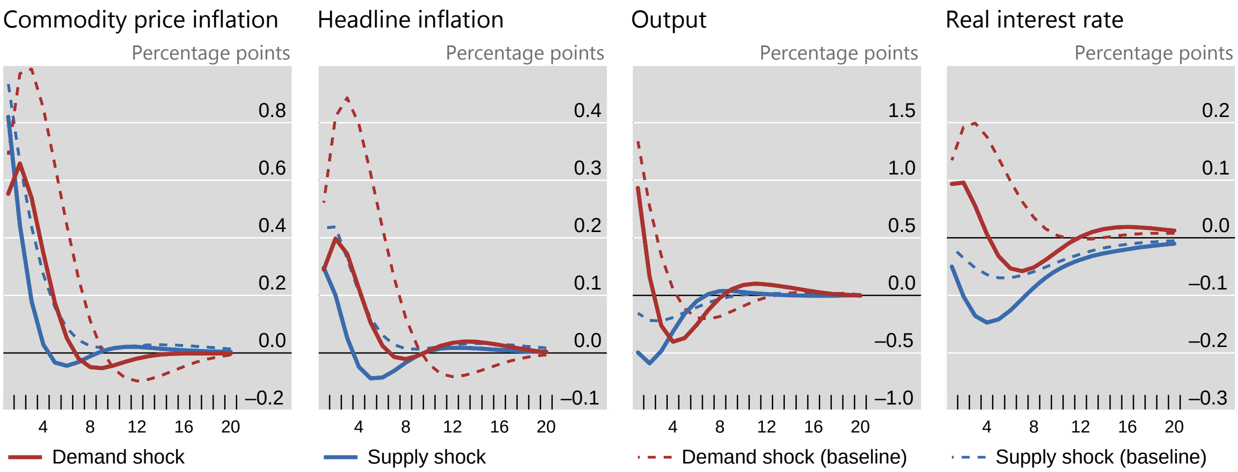
Higher commodity prices for either global demand or commodity supply shock simulations have a stronger negative impact on output than in the baseline, indicated by the downward shift in the solid blue and red lines relative to the dashed lines in the centre-right panel. This translates into less inflationary pressure via the Philips curve and less tight monetary policy via the Taylor-type rule.

It is useful to note that κ_{EM} in the model acts as cost-push channel of influence. Despite this role, with a global demand shock and high commodity price sensitivity, the monetary policy prescription is tighter, not looser, monetary policy. With a supply shock, the commodity sensitivity of output reinforces the importance of an easing of monetary policy by reducing the real policy rate; given the rise in inflation, this tends to support the conventional wisdom of looking through supply shocks with little adjustment of nominal policy rates.

Response to demand and supply shocks[1]

Higher commodity intensity

Graph IV.2



[1] Responses of selected variables to a unit shock to global demand and to commodity supply.

Source: authors' calculations.

2. Weakening the inflation anchor

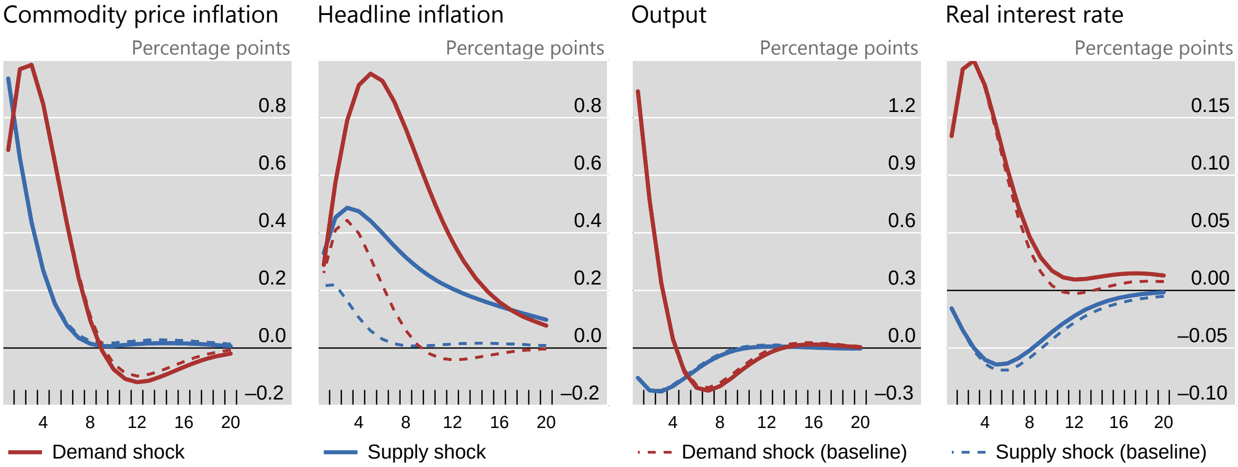
As seen in Graph II.2, EM core and headline inflation have exhibited a high correlation during the more pronounced commodity price swings in recent years. This raises concern that the EM inflation anchor has become weaker. To investigate the implications of a weaker anchor in our model, Graph IV.3 reports the impulse responses in the case where core inflation is more sensitive to transitory shocks.

In terms of model parameters, μ_{EM} is reduced from 0.55 to 0.25 and ζ_{EM} from 0.5 to 0.1. The reduction in μ implies that core inflation is more persistent (equation IV.2), and the change in ζ implies more sensitivity to past rather than expected changes in core inflation. Taken together, these changes imply a greater pro-cyclicality of core inflation dynamics. In this case, the impact of the demand and commodity price inflation shocks on headline inflation is larger and more persistent than that found in the baseline; despite this, the optimal policy response does not change substantially.

Response to demand and supply shocks[1]

Weakly anchored inflation expectations

Graph IV.3



[1] Responses of selected variables to a unit shock to global demand and to commodity supply.

Source: authors' calculations.

3. Changing the target in the policy rule from core to headline inflation

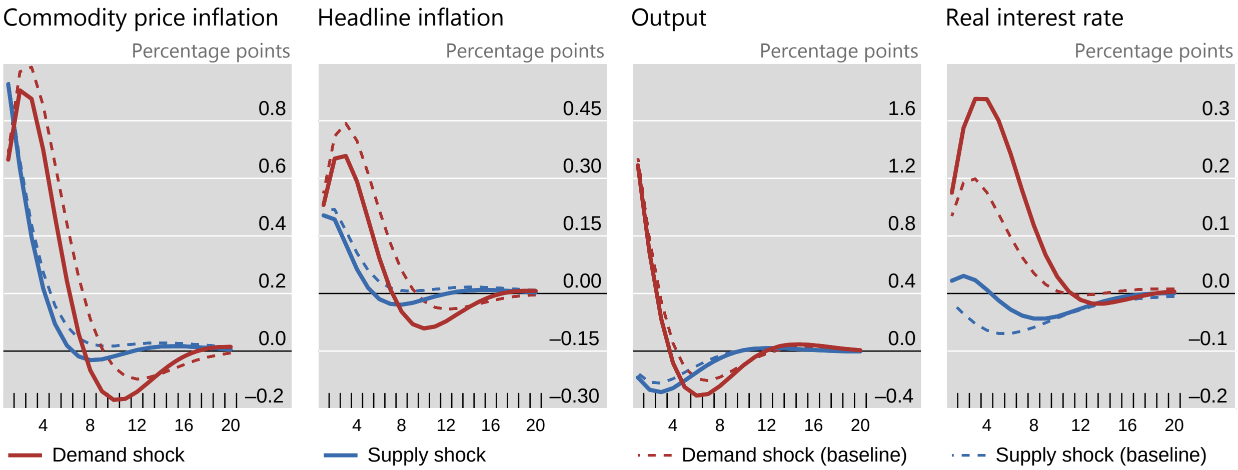
In Graph IV.4, we change the EM Taylor-type policy rule in Equation IV.5 to react to headline inflation rather than core inflation. This provides insights into the policy trade-offs of this policy option in this model.

In this case, the initial policy reaction to a commodity supply shock is quite different from the one in the baseline. In the case of the global demand shock (solid red line), the adjustment in the real policy rate is stronger and more hump-shaped than in the baseline. The resulting impact on headline inflation is evident: there is a more muted initial response for headline inflation and a modest overshoot on the downside after about eight quarters. Output also overshoots on the downside relative to the baseline case.

Response to demand and supply shocks[1]

Headline inflation in the policy rule

Graph IV.4



[1] Responses of selected variables to a unit shock to global demand and to commodity supply.

Source: authors' calculations.

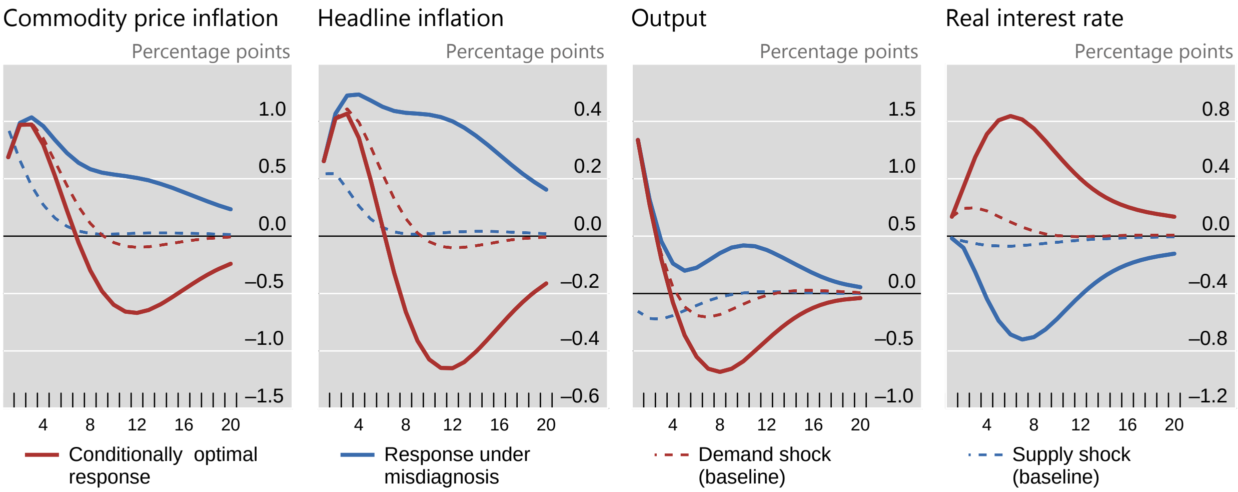
Accounting for misdiagnosis risk - misdiagnosing a global demand shock as an external supply shock

Armed with these simulation results, we now turn our attention to the implications of central bank misperceptions. The scenario we have in mind is one in which the monetary authority mistakenly interprets a change in commodity price inflation due to a global demand shock as a commodity supply shock. In the baseline, it is assumed the monetary authority correctly diagnoses the source of the shocks. In the misdiagnosis case, we assume the monetary authority does not realise its mistake throughout the entire simulation.[13]

Results of this counterfactual simulation are found in Graph IV.5. In the right panel, the blue line represents the response under misdiagnosis. Initially, the blue line coincides with the optimal response to a commodity supply shock. This policy mistake is pro-cyclical, stimulating more output and inflation than otherwise. In the second period and afterwards, the policy rate response reflects both the implied inherent persistence of a policy response to the initial commodity supply shock as seen in the baseline case and also the consequences of the policy error. This explains why the blue line deviates from the dashed blue line (ie from the baseline) across the simulation horizon.

Response to a policy misdiagnosis[1]

Policy rule with core inflation — Graph IV. 5



[1] Cumulated response to a sequence of policy mistakes (blue line) and path needed to correct such series of mistakes (red line). The dashed lines show responses of selected variables to a unit shock to global demand and to commodity supply, baseline scenario.

Source: authors' calculations.

The red line in the right-hand panel, in contrast, represents the policy rate that would be optimal at any point in time, had the monetary authority realised the policy error. The gap between the blue and red lines measures the extent of endogenous pro-cyclicality at each point in time. In other words, at each point in time, if the monetary authority recognised it had misdiagnosed the source of the shocks, it would jump from the blue line to the red line (note that at the time of such a jump and a cessation of policy ex post policy mistakes, the optimal trajectories thereafter would not move along the rest of the red line but would follow a different trajectory which is not shown).

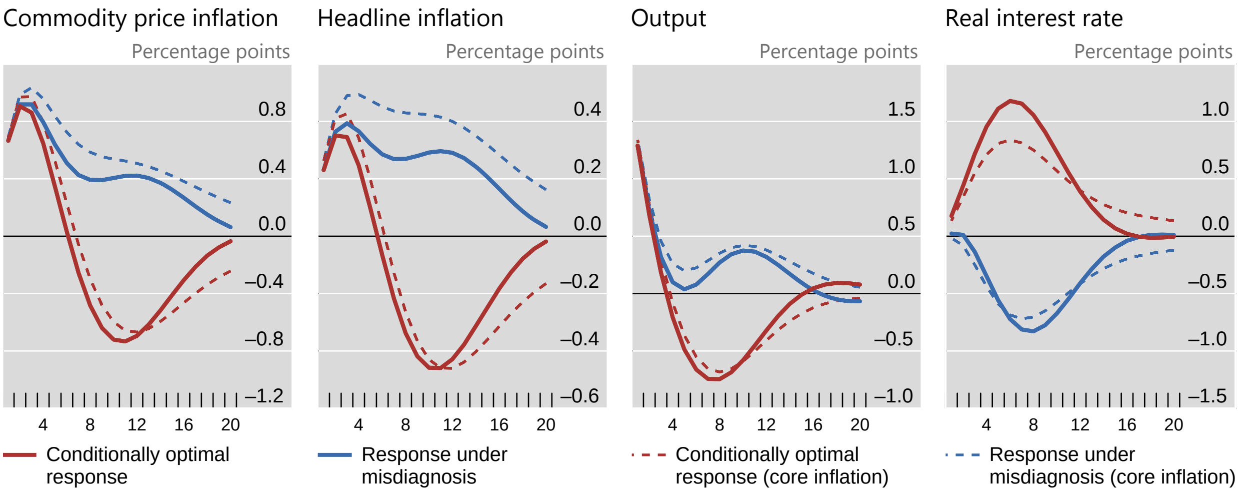
[13] In this model we assume that the monetary authorities' follow the implied policy response assuming a supply shock. In future research, we will explore this problem in an environment where the monetary authorities take account of possible misperceptions and optimally learn from the way the economy evolves.

The consequences of the misdiagnosis of the shock on headline inflation and output are reported, respectively, in the second and third panels. The additional stimulus due to the misdiagnosis does indeed stimulate the economy, and results in much higher and persistent inflation. The excessively accommodative monetary policy also feeds back and fuels commodity price inflation (far left panel), thereby elongating the swing in commodity prices.

To assess the relative merits of core versus headline inflation targeting in this misdiagnosis case, we repeat the simulation exercise using the optimal policy rate path indicated in Graph IV.5 which reflects the policy rule with headline inflation. Despite some similarities in shapes, the response patterns with the headline inflation rule in Graph IV.6 deviate less persistently than those from the core inflation rule (dashed lines). Headline inflation nonetheless settles down quite slowly over the simulation horizon.

Response to a policy misdiagnosis[1]

Policy rule with headline inflation — Graph IV.6



[1] Cumulated response to a sequence of policy mistakes (blue line) and path needed to correct such series of mistakes (red line).

Source: authors' calculations.

In this case, the welfare implications of switching from a core inflation targeting Taylor-type rule to a headline inflation targeting Taylor-type rule are not obvious. Output and inflation deviations appear smaller with the headline rule but this in accompanied by a more volatile policy rate. To answer the welfare question, therefore, we now turn to a more formal evaluation of the relative benefits of the two policy strategies. In Table 1, we report the welfare losses associated with the use of core and headline inflation in the policy rule by simulating the model for 40 periods and calculating the associated variances of output, inflation and change in the policy rate; the loss function is described in equation IV.6.

There are two cases to consider in this evaluation for each of the two types of policy rules – one for core inflation and one for headline inflation. The first case is associated with the correct identification of the shocks as in the baseline simulations; the welfare loss results are shown in the first row of Table 1. The second case is associated with the misdiagnosis of the shocks and the results are in the second row of the table.

In the case in which monetary authorities are able to correctly identify the shocks hitting the economy, core inflation targeting yields somewhat lower losses on average. However, in the case in which policymakers are prone to misdiagnose the true nature of the shocks, the benefits of headline inflation targeting are relatively large when compared to core inflation targeting.

Welfare losses

Table 1

Assumption about shock identification	Core MP rule	Headline MP rule
Correct identification	5.78	6.67
Misdiagnosis	32.29	26.98

Source: authors' calculations.

This table is instructive with respect to the possible welfare losses associated with misdiagnosing the source of the shock. In practice, it is difficult, if not impossible, to correctly identify supply and demand shocks with complete confidence. One way to think about these losses in a probabilistic sense is to look at the expected losses associated with the probability that a policymaker might attach to the misdiagnosis risk.

To capture the inherent uncertainty in this decision-making problem, Columns 1 and 2 of Table 2 report the expected welfare losses for both core and headline inflation targeting as a function of the hypothetical probability of misdiagnosing a shock. For example, if a policymaker believes there is a 50% chance of misdiagnosis and believes the model is a good representation of the policy environment, the policymaker would see an expected loss of 19.03 when using a core inflation targeting rule and 16.82 when using a headline inflation rule. Given the simulation results in Table 1, it turns out that the balance shifts in favour of headline targeting starting from the relatively low probability of misdiagnosing risk at 20%. In other words, one has to be more than 80% sure that commodity price fluctuations are indeed due to global commodity supply shocks and not global demand shocks to prefer the core inflation targeting rule.

Welfare loss differentials

Table 2

Probability of correct identification	Core (1)	Headline (2)	More aggressive (3)
100%	5.78	6.67	9.09
90%	8.42	8.70	10.88
80%	11.08	10.73	12.66
70%	13.73	12.76	14.45
60%	16.38	14.79	16.24
50%	19.03	16.82	18.03
40%	21.68	18.85	19.81
30%	24.33	20.88	21.60
20%	26.98	22.92	23.39
10%	29.63	24.95	25.17
0%	32.29	26.98	26.96

Source: authors' calculations.

Additional inflation hawkishness to mitigate consequences of misdiagnosis risk

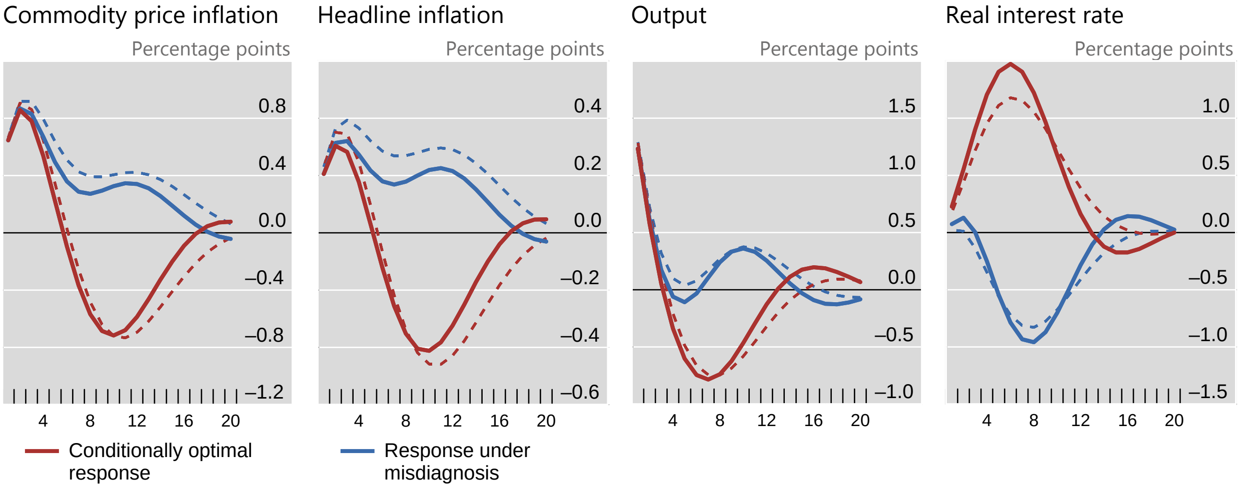
The result that headline inflation targeting largely dominates the core inflation targeting rule owing to misdiagnosis risk raises the question of whether further hawkishness with respect to headline inflation would be on net beneficial. To highlight this trade-off, we boost the response coefficient on headline inflation in the Taylor-type rules by 0.3 percentage points. The third column in Table 2 reports the welfare losses. At all probabilities, the more hawkish rule generates greater losses; the rule is also associated with a lower threshold probability of

60% determining whether to favour the core or headline inflation targeting rule. The consequences of the hawkish rule for the impulse responses are found in Graph IV.7. This illustrates that greater control of headline inflation comes at the cost of greater variability in output and greater policy rate volatility.

Response to a policy misdiagnosis in the inflation hawk case[1]

Boosting response coefficient on headline inflation in Taylor-type rule

Graph IV.7



[1] Cumulated response to a sequence of policy mistakes (blue line) and path needed to correct such series of mistakes (red line). The dashed lines show responses to a policy misdiagnosis (policy rule with headline inflation).

Source: authors' calculations.

V. Policy implications and conclusions

This paper offers new evidence on the role of global demand and supply factors in driving global commodity prices and, in turn, the influence of these factors on domestic inflation dynamics in Asian emerging market economies. We have found global demand shocks play an important role in emerging market monetary transmission mechanisms and therefore have implications for the design of monetary policy frameworks in emerging market economies such as those in Asia. We have explored the policy trade-offs within the framework of a stylised monetary policy model, investigating the implied welfare losses from misdiagnosing the source of commodity price fluctuations, and building the case for putting greater weight on headline versus core inflation in economies subject to misdiagnosis risk.

The results in this paper turn the conventional wisdom about how to respond to commodity price developments on its head. The conventional wisdom that came out of the experiences of 1970s and 1980s suggested that central banks should 'look through' commodity price increases. This prescription in our model leads to poor macroeconomic outturns when there is uncertainty on the source of the shocks hitting the economies.

In this respect, our experiment has also underscored the importance for central banks of identifying the source of commodity price fluctuations in pursuit of price stability. Some have suggested that small, open economies cannot influence global economic conditions and therefore should treat global commodity price increases as an external supply shock. This country-centric perspective, however, ignores the global dimension and potential feedbacks of the problem. If all emerging market economies respond in the same way to global commodity prices as external supply shocks, the aggregate response will matter.

All this points to the conclusion that even small, open emerging market economies cannot afford to adopt a country-centric perspective in an increasingly globalised world. The collective actions have implications that spill over geographic borders and include feedbacks from the others which, when taken together, lead to suboptimal outcomes. In this respect, efforts in Asia to promote regional cooperation and information sharing are positive trends.

Beyond explicit monetary policy coordination, central banks can adopt various practices to mitigate the risk of monetary policy pro-cyclicality with respect to commodity price swings. As highlighted in the policy simulations, greater focus on headline inflation targeting versus core inflation targeting would produce better outturns when there is misdiagnosis risk associated with commodity price movements. Of course, this is a second best outcome. The first best is based on an accurate assessment of both the nature of the shocks and the cross-border spillovers of policy actions.

Finally, to the extent that global forces are playing a more dominant role today and will continue to do so in the future, central banks have a role in ensuring that the public fully understands the changing nature of the monetary policy environment. This could be a communication challenge vis-à-vis commodity prices. It would require tearing down the conventional wisdom built up over the decades that 'looking through' commodity price movements is the appropriate policy approach.

As for future research, the model in this paper frames the policy issue solely in terms of price stability and the challenge for monetary policy. The model is mute with respect to financial stability concerns, which are well known in low inflation environments. Well anchored inflation expectations and easy monetary conditions could lead to unsustainable increases in asset prices and excessive risk-taking behaviour. In practice, monetary authorities would need to focus not only on the inflation risks but also on the boom-bust risks which may be much more difficult to identify and track. More research is needed to understand this aspect of the monetary transmission mechanism as well as the effectiveness of alternative macroeconomic policy tools, not least being the range of fiscal, macroprudential and capital flow management tools currently being used to address the implications of commodity price movements. In particular, a critical open question is the extent to which these alternative macroeconomic tools are effective substitutes for or complements to conventional monetary policy tools.

In addition, this paper has largely ignored the exchange rate and the commodity composition of output issues. To be sure, commodity price movements are correlated with exchange rate pressures. However, we believe these considerations are of second-order importance, but that has to be established. With respect to the commodity composition of output, the monetary policy trade-offs facing net exporters and net importers of commodities will certainly differ. Our conjecture is that net commodity exporters are likely to face less of a trade-off from the risk of misdiagnosing a global demand driven commodity price shock. This is owing to the likelihood that rising commodity prices will boost domestic aggregate demand and call for a response from the monetary authority in the same direction as in the case of a global increase in demand.

One additional issue that requires additional modelling attention is the game-theoretic challenges associated with global commodity price shocks and domestic monetary policymaking. As Taylor (2013) has emphasised, non-cooperative policymaking equilibria may be more complex in a globalised economy where policy spillovers are not fully internalised. Misdiagnosis risks as characterised in this paper would correspond to policymakers inadvertently choosing policy reaction functions on the interior of the feasible policy space rather than at the frontier. If sufficiently far from the frontier, the gains from monetary policy cooperation may be sufficiently large to call for a change in the current international institutional arrangements. In addition, there is the issue of whether incentives exist for a small, open economy to deviate from a cooperative equilibrium if all others cooperate; such a first mover advantage to deviating could make such an equilibrium unstable, and therefore create a need for mechanisms that foster greater international cooperation to address the policy spillover problem.

Annex

Regression results – global commodity price inflation — Table A1

	Coefficient	t-statistic
α^{cp}	8.67	3.66
β_0^{cp}	22.54	11.16
β_1^{cp}	9.34	2.55
β_2^{cp}	7.29	2.19
β_3^{cp}	–1.44	–0.48
β_4^{cp}	–2.86	–1.31
θ_0^{cp}	–1.93	–1.74
θ_1^{cp}	–6.38	–5.33
θ_2^{cp}	–5.36	–3.60
θ_3^{cp}	–1.18	–0.81
θ_4^{cp}	0.09	0.07
γ_1^{cp}	–0.04	–0.27
γ_2^{cp}	–0.45	–3.12
γ_3^{cp}	–0.07	–0.48
γ_4^{cp}	0.36	2.62
R^2	0.88	

Regression estimation of equation estimated from Q1 2000 to Q1 2012: $\pi_t^{cp} = \alpha^{cp} + \sum_{k=0}^{4}\left(\beta_k^{cp} D_{t-k} + \theta_k^{cp} S_{t-k}\right) + \sum_{k=1}^{4}\gamma_k^{cp}\pi_{t-k}^{cp} + \varepsilon_t^{cp}$.

Source: author's calculations.

Calibrated parameters — Table A2

Equation	Parameter	EM	ROW
IS	β	0.10	0.10
	θ	0.50	0.50
	κ	0.05	0.02
PC	μ	0.55	0.55
	ζ	0.50	0.50
	γ	0.02	0.04
	α	–0.01	–0.01
Headline inflation	τ	0.34	0.12
	ι	0.25	0.05
Taylor rule	λ	0.01	0.03
	δ	0.10	0.09
	φ	0.85	0.90
Commodity prices	ϖ	0.35	0.15
	ϕ	0.80	
Loss function	ν_y	3.00	3.00
	ν_r	5.00	5.00

Source: author's calculations.

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