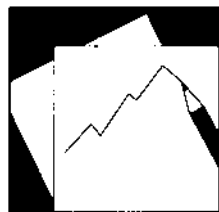


# Working Paper

---

INTERNATIONAL MONETARY FUND



# IMF Working Paper

---

## Inflation Dynamics in Asia: Causes, Changes, and Spillovers from China

*Carolina Osorio and D. Filiz Unsal*

**IMF Working Paper**

Asia and Pacific Department

**Inflation Dynamics in Asia: Causes, Changes, and Spillovers from China**

**Prepared by Carolina Osorio and D. Filiz Unsal<sup>1</sup>**

Authorized for distribution by Roberto Cardarelli

November 2011

**This Working Paper should not be reported as representing the views of the IMF.**

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

**Abstract**

The perception that Asia's inflation dynamics is driven by idiosyncratic supply shocks implies, as a corollary, that there is little scope for a policy reaction to a build-up of inflationary pressures. However, Asia's fast growth and integration over the last two decades suggest that the drivers of inflation may have changed, and that domestic demand pressures may now play a larger role than in the past. This paper presents a quantitative analysis of inflation dynamics in Asia using a Global VAR (GVAR) model, which explicitly incorporates the role of regional and global spillovers in driving Asia's inflation. Our results suggest that over the past two decades the main drivers of inflation in Asia have been monetary and supply shocks, but also that, in recent years, the contribution of these shocks has fallen, whereas demand-side pressures have started to emerge as an important contributor to inflation in Asia.

JEL Classification Numbers: C32, C35, E31, E52, F42

Keywords: Inflation, Global VAR (GVAR), Monetary Policy

Authors' E-mail Address: [cosoribu@gmail.com](mailto:cosoribu@gmail.com), [dunsal@imf.org](mailto:dunsal@imf.org)

---

<sup>1</sup> A part of this work was featured in October 2010 *Regional Economic Outlook* of the Asia and Pacific Department. We would like to thank Vivek Arora and Roberto Cardarelli for their invaluable guidance, and Yiqun Wu for excellent research assistance. We would like to also thank seminar participants at IMF's Asia and Pacific Department, Hong Kong Monetary Authority, Korea Development Institute, and Lingnan University. The usual disclaimer applies.

Contents

Page

I. Introduction .....[3](#)

II. Data and Methodology .....[5](#)

    A. GVAR Analysis .....[6](#)

    B. SVAR Analysis .....[7](#)

III. Empirical Results and Discussions .....[8](#)

    A. What Drives Inflation in Asia? .....[9](#)

    B. Has Inflation Dynamics Changed Over Time? .....[11](#)

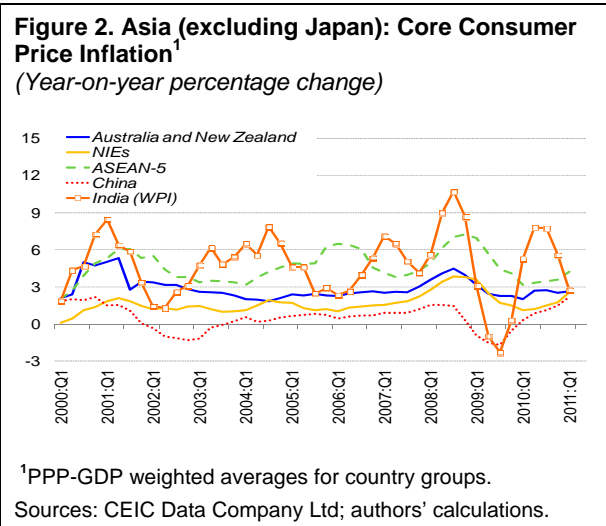
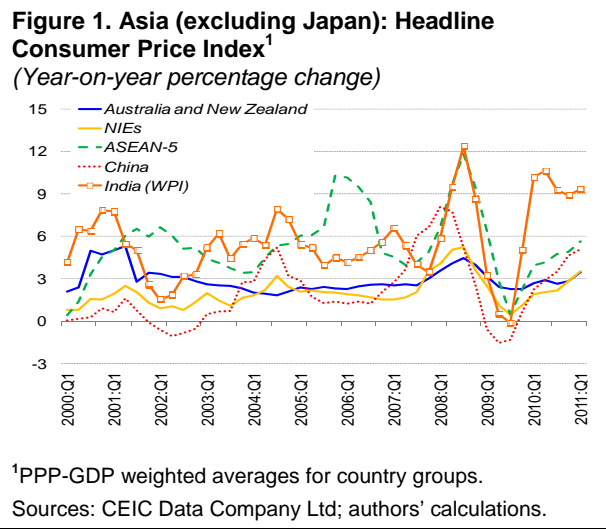
    C. Inflation Spillovers from China: Direct and Indirect Channels .....[13](#)

IV. Policy Implications and Concluding Remarks .....[18](#)

References.....[19](#)

## I. INTRODUCTION

Managing inflation pressures is traditionally one of the macroeconomic challenges Asian economies have been facing, particularly in recent years. Inflation, as measured by consumer price indices, gathered momentum throughout 2007 and accelerated sharply in the first half of 2008.<sup>2</sup> Inflationary pressures started receding towards the end of 2008 as a result of the global financial and economic crisis, but they have started to build up in some Asian countries as early as late 2009 (Figure 1). Inflation generally accelerated even further towards the end of October, owing mainly to still accommodative monetary conditions and higher oil and food prices. In fact, higher global commodity prices often tend to translate directly into higher headline inflation due to high weights these items have on the CPI baskets of a number of Asian economies (Figure 3).<sup>3</sup> However, core inflation has mostly been on the move as well, reflecting overheating and potentially second-round effects (Figure 2).<sup>4</sup>

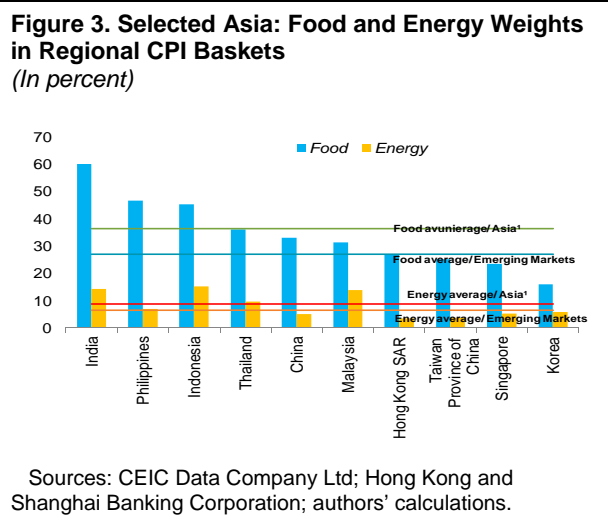


<sup>2</sup> By the end of 2007, headline inflation in emerging East Asia reached 5.3 percent, double the rate at the start of the year, and 6.9 percent by May 2008.

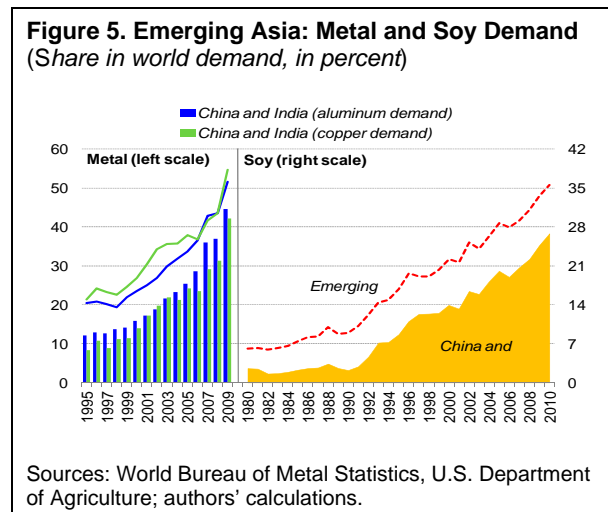
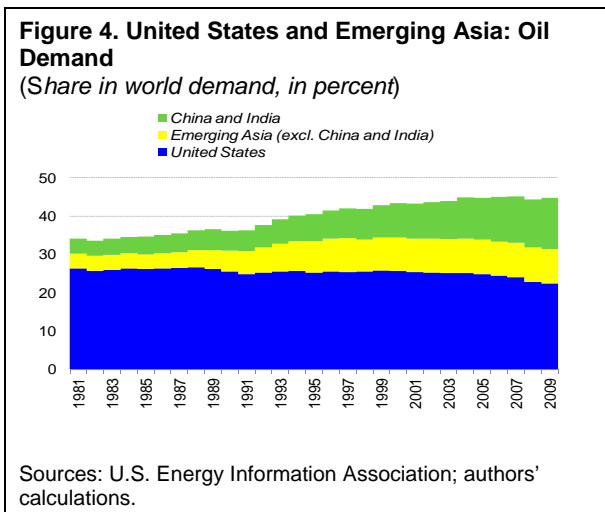
<sup>3</sup> The shares of food and energy in the average emerging Asian CPI basket are nearly 40 percent and 10 percent, respectively, both of which are higher than the average for emerging economies worldwide. In India and Indonesia, the CPI shares of food and energy are higher than the Asian average.

<sup>4</sup> Over the last decade, simple contemporaneous correlations between headline inflation and core inflation, on the one hand, and between core inflation and food and energy prices on the other hand, have been quite high (at 0.8 and 0.4, respectively). This suggests that changes in food and energy prices feed through quickly to core inflation, possibly through inflation expectations, wages, and other input costs.

Against this background, an important consideration for policymakers is what forces drive inflation dynamics across the region. In order to assess inflation prospects, and determine the appropriate monetary policy response, it is important to determine the extent to which inflation in Asia is driven by supply and demand pressures as well as the extent to which these pressures are caused by foreign versus domestic sources. Central banks in emerging Asia have been rather passive in episodes of rising inflation on the premise that inflationary pressures derive largely from temporary supply problems and/or from imported sources. It is implicit in these arguments that policymakers can clearly identify the forces that drive inflation, in terms of the nature and impact of shocks, or so called inflation dynamics.



However, identifying the relative contributions of different factors to inflation is complicated by the fact that these factors usually coexist. For example, the run-up in Asian inflation before the global crisis, to nearly 8 percent in 2008, coincided with both surging world commodity prices and strong Asian growth. Moreover, given the importance of regions' demand for the global commodity prices, and the region's integration with the world economy, it is important to consider also international trade and financial channels in the transmission of different shocks (Figure 4 and Figure 5). In fact, spillovers are likely to result from the multiple transmission mechanisms through which shocks can impact the local, regional, and global economy; these channels can be mapped into groups of common observed factors (such as commodity prices), unobserved global factors (e.g., technological progress spillovers), or specific national or regional factors emerging from trade relationships or financial linkages.



To determine the relative contributions of various factors to inflation it is thus necessary to conduct an empirical analysis which explicitly incorporates domestic, regional, and global factors, and their interactions, as this paper does. The analysis examines the relative impacts of supply shocks and demand shocks, as well as their origins in terms of foreign and domestic sources. Supply factors comprise commodity prices and producer prices, while demand factors comprise monetary shocks (to money supply, interest rates, and exchange rates) and output gaps.

This paper presents a two-step quantitative analysis of inflation dynamics in Asia. In the first stage, we identify the nature and origin of inflationary pressures for the economies of the Asia and Pacific region using the Global VAR (GVAR) framework proposed by Pesaran, Schuermann, and Weiner (2004); this model is estimated for 33 countries from 1986 to 2010 (first quarter). In the second stage, we examine the robustness of the GVAR results, as well as how the inflationary processes of Asian economies have changed over time. To this end we estimate a structural VAR (SVAR) for each country and two subsamples, 1986–99 and 2000–09.

Three main conclusions emerge from the empirical analysis. First, over the last two decades, the main driving forces of inflation in Asia have been supply shocks and monetary shocks, while demand pressures have played a relatively smaller role. However, the region's role in determining global commodity prices has been rising and, therefore, among ASEAN economies other than Indonesia, commodity prices play a particularly important role in driving inflation, perhaps owing to the openness of these economies and their dependence on oil and food imports. By contrast, in some of the higher-income economies (Australia, Hong Kong SAR, Japan, and New Zealand), output gaps tend to be more important. Across the region, while foreign factors sometimes play an important role, most shocks are domestically driven. Second, the relative roles of key inflation drivers appear to be changing over time. The role of supply shocks in driving inflation appears to have fallen slightly in recent years, while the role of output gaps has increased. The impact of monetary shocks on inflation in Asia has diminished, particularly in economies that have relatively clear monetary objectives and flexible exchange rate regimes (such as Indonesia, Korea, the Philippines, and Thailand). Third, demand-driven inflation spillovers from China to the region are both significant and large, directly from higher imported goods prices and indirectly through higher commodity prices.

The paper proceeds as follows. Section II describes the data set and the methodology. Section III presents the empirical results and discusses them. Section IV makes policy recommendations and concludes.

## **II. DATA AND METHODOLOGY**

This section presents the two-stage methodology to analyze inflation dynamics in Asia. In the first stage, the nature and origin of inflationary pressures across different economies and

regions are identified based on the Global VAR (GVAR) framework proposed by Pesaran, Schuermann, and Weiner (2004). In the second stage, we analyze the evolution of the inflation process over time across Asian economies by estimating a structural VAR for two sub-samples.

### A. GVAR Analysis

For each country, we include the output, consumer and producer price inflation, money supply, the nominal exchange rate, the short term interest rate, as endogenous variables. Global oil and food prices are assumed to be exogenous global factors for all countries except for China, India, and the United States. We use quarterly data, encompassing 1986:Q1 to 2010:Q1.

The main advantage of the GVAR approach is that it explicitly accounts for trade and financial linkages among economies such that impacts of regional and global shocks on domestic economies, as well as for those of individual economies to conditions overseas could be considered. This “integrated” feature of GVAR allows for the identification of the sources of inflation as supply or demand factors, which can be either of domestic, regional or global origin.

The analysis is undertaken for all variables in the world economy simultaneously, by making use of generalized impulse response functions and forecast error variance decompositions (Koop, Pesaran, and Potter, 1996; Pesaran and Shin, 1998). This approach is an alternative to the orthogonalized impulse response function proposed by Sims (1980), which is traditional to the VAR literature. While orthogonalized impulse response functions rely on a set of orthogonalized shocks, generalized impulse response functions consider shocks to individual errors and integrate out the effects of other shocks based on historical distributions of all errors. Moreover, unlike orthogonalized impulse responses, the generalized framework does not require identification restrictions, and it does not depend on the ordering of endogenous variables.

The framework also allows for the construction and use of weakly exogenous country-specific foreign variables in the estimation of individual country models. Hence, trade linkages are exploited to allow for a coherent inclusion of national models into the GVAR, while dealing with the “curse of dimensionality problem” typically associated with large models.

A number of macroeconomic variables are modeled; let  $x_{it}$  denote the vector collecting these variables for country  $i = 0, 1, 2, \dots, N$ . Given the general nature of interdependencies that might exist in the world economy, all country-specific variables ( $x_{it}$ ) and observed global factors (such as oil prices) are treated endogenously. Denote the observed global and unobserved global factors by  $d_t$  and  $f_t$ , respectively. Then



$$x_{it} = \delta_{io} + \delta_{it}t + \Gamma_{id}d_t + \Gamma_{if}f_t + \xi_{it}$$

For  $i = 0, 1, 2, \dots, N$  and  $t = 1, 2, \dots, T$ , where  $\xi_{it}$  is a vector representing-country specific factors. On the other hand,  $\delta_{io}$  and  $\delta_{it}$  correspond to the coefficients of the deterministic intercept and time trend respectively. Note that, unit root and cointegration properties between variables can be accommodated by allowing for the global and idiosyncratic factors to have unit roots. Without unobserved common factors, the model for the  $i$ -th country decouples from the rest of the country models, and each country model can be estimated separately. But when unobserved common factors are included, the model is quite complex, particularly for large  $N$ .

An alternative strategy proposed by Pesaran (2006) is to proxy the unobserved global factor ( $f_t$ ) in terms of the cross-section averages of country-specific variables  $x_{it}$ , and the observed common effects ( $d_t$ ). After some algebraic manipulation, the model in equation (1) can be re-expressed as follows:

$$\phi_i(L, p_i)x_{it} = a_{io} + a_{it}t + T_i(L, q_i)d_t + \Lambda_i(L, q_i)x_{it}^* + u_{it} \quad (2)$$

$$\text{where } x_{it}^* = \sum_{i=1}^N w_{ij}x_{it} \text{ with } w_{ii} = 0.$$

The weight  $w_{ij}$  captures the importance of the  $j$ -th country for the  $i$ -th economy. Moreover, the use of country-specific weights allows us to specify a different model for each country (by attaching zero weights to missing variables from country  $j$ 's model).<sup>5</sup>

## B. SVAR Analysis

To examine the evolution of the importance of supply, demand and monetary policy factors for inflation dynamics in Asia, we estimate an SVAR model for two sub-samples 1986:Q1–1999:Q4 (before and during the Asian crisis) and the ‘post-Asian crisis’ period: 2000:Q1–2010:Q1. The SVAR framework allows for the identification of structural shocks through a Choleski decomposition. We employ a seven variables including GDP, consumer price and producer price inflation, the bilateral U.S. dollar exchange rate, real narrow money (or short-term interest rate), a food and oil commodity price index, and foreign (trade weighted) GDP. To ensure stationarity of variables we take their first differences.

---

<sup>5</sup> Before estimating the model we conduct unit root and cointegration tests, to identify and take account of long term relationships between macroeconomic variables for each country. We also test for weak exogeneity of  $x_{it}^*$  as well as for global observed factors (such as oil and food prices).

For the big economies of the region, China and India, we impose the following Wold ordering relating the reduced form ( $u_t$ ) and structural shocks ( $\varepsilon_t$ ) as follows:

$$\begin{bmatrix} u_t^y \\ u_t^{y^*} \\ u_t^{COM} \\ u_t^{ER} \\ u_t^{MP} \\ u_t^{PP} \\ u_t^{CP} \end{bmatrix} = \begin{bmatrix} S_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 & 0 & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 & 0 & 0 & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & 0 & 0 & 0 \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} & 0 & 0 \\ S_{71} & S_{72} & S_{73} & S_{74} & S_{75} & S_{76} & S_{77} & 0 \end{bmatrix} \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^{y^*} \\ \varepsilon_t^{COM} \\ \varepsilon_t^{ER} \\ \varepsilon_t^{MP} \\ \varepsilon_t^{PP} \\ \varepsilon_t^{CP} \end{bmatrix},$$

where upper-scripts ( $y, y^*, COM, ER, MP, PP, CP$ ) denote, domestic GDP, foreign GDP, commodity prices, exchange rate, monetary policy, producer and consumer price inflation respectively. This ordering implies that economic growth in China and India can have an impact on global commodity prices directly through their own demand effect or indirectly through their impact on global demand.

On the other hand, for the smaller economies, global demand and commodity prices are assumed to be exogenous, as it is commonly assumed in the literature. We hence used the following ordering:

$$\begin{bmatrix} u_t^{y^*} \\ u_t^{com} \\ u_t^{ER} \\ u_t^{MP} \\ u_t^y \\ u_t^{PP} \\ u_t^{CP} \end{bmatrix} = \begin{bmatrix} S_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 & 0 & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 & 0 & 0 & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & 0 & 0 & 0 \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} & 0 & 0 \\ S_{71} & S_{72} & S_{73} & S_{74} & S_{75} & S_{76} & S_{77} & 0 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{y^*} \\ \varepsilon_t^{com} \\ \varepsilon_t^{ER} \\ \varepsilon_t^{MP} \\ \varepsilon_t^y \\ \varepsilon_t^{PP} \\ \varepsilon_t^{CP} \end{bmatrix}$$

### III. EMPIRICAL RESULTS AND DISCUSSIONS

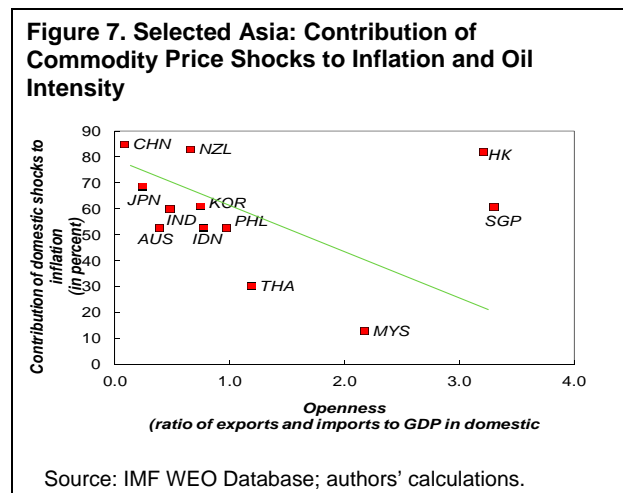
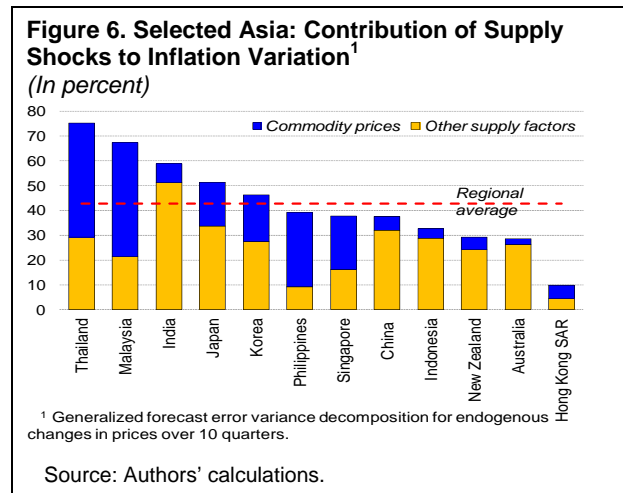
In this section, forecast error variance decomposition analysis is used to estimate the relative importance of different types of shocks for the inflation processes of Asian economies. We then test for a structural break in the data and apply SVAR to focus on the evolution of the relative role of factors in driving inflation in Asia. In the last part, we present results based on impulse response analysis. In the analysis that follows, *supply shocks* represent changes in production costs, proxied by producer price indexes, and in commodity prices; whereas *demand shocks* refer to changes in monetary variables (money supply, nominal interest rates, and nominal effective exchange rates), and in the output gap. *Domestic factors* make reference to the impact on domestic inflation of domestic supply and demand shocks,

*regional factors* to the impact of shocks in other Asian economies, and *global factors* to the impact of shocks in the 21 non-Asian economies of the model.

### A. What Drives Inflation in Asia?

The results from the empirical analysis suggest that supply shocks and monetary shocks account for most of the variation in Asia’s inflation during the last two decades. In particular:

- Supply shocks explain about 45 percent of the inflation fluctuations in Asia, of which about three-quarters reflect commodity price shocks (Figure 6). The contribution of commodity prices is particularly significant among ASEAN economies (except Indonesia), Japan, and Korea, which are among the largest oil importers in Asia. In general, commodity prices contribute more to inflation in economies that have higher oil intensity (defined as barrels of oil consumption divided by GDP in constant U.S. dollars) (Figure 7). The contribution of commodity prices to inflation is smaller for high-income commodity exporters (Australia and New Zealand), where they contribute less than 10 percent to the fluctuations in inflation. In these economies, higher commodity prices drive up the terms of trade, but this tends to be accompanied by exchange rate appreciation that mitigates the inflationary impact of higher food and fuel prices.

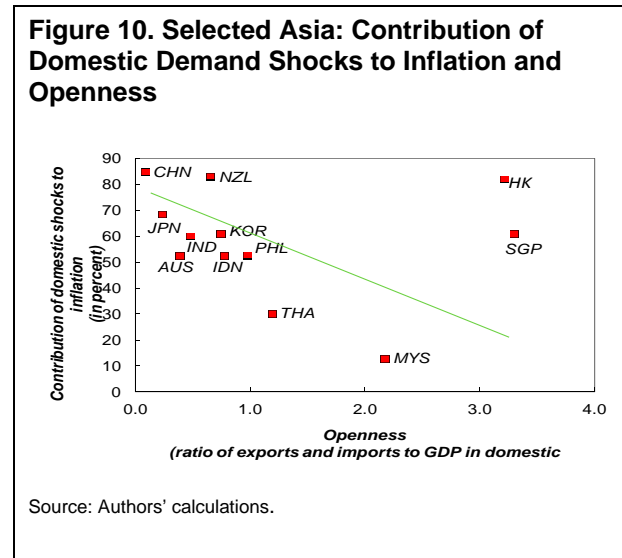
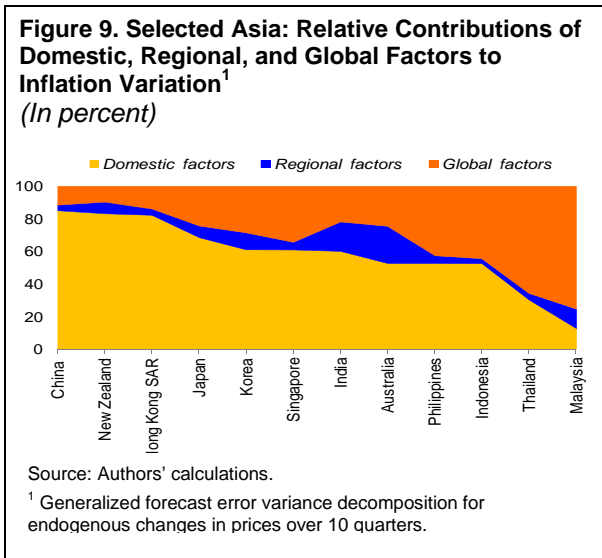
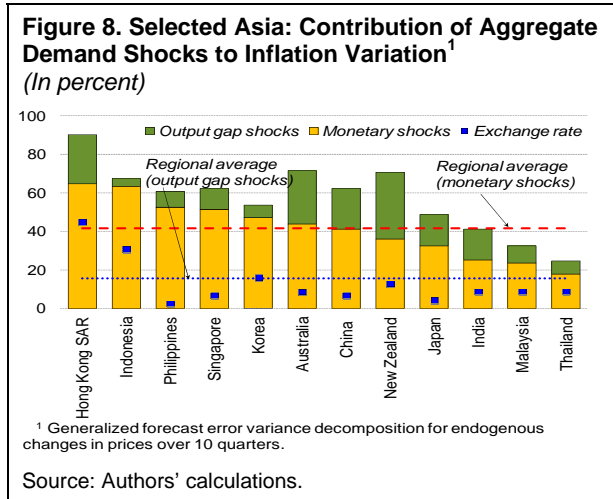


- Demand shocks explain 55 percent of fluctuations of inflation in Asia, of which nearly three-quarters reflects the impact of monetary shocks and one-quarter reflects the effect of output gaps. In particular, changes in money supply and interest rates explain about 25 percent of inflation fluctuations; changes in exchange rates explain about 15 percent, although they play a more important role in those economies (such as Indonesia and Korea) that experienced relatively large currency swings during the

sample period (Figure 8); and changes in the output gap account for about 15 percent of Asia's inflation fluctuations.

In terms of the geographic origins of shocks, the analysis suggests that inflation fluctuations in Asia are driven mainly by domestic factors.<sup>6</sup> In particular:

- More than 60 percent of inflation fluctuations in Asia have a domestic origin (Figure 9). The contribution of domestic factors is more pronounced for economies that have large domestic demand bases (China, India, and Indonesia) and for those that are more advanced (Japan, Korea, and New Zealand). On the other hand, domestic factors account for a lower share of inflation fluctuations in ASEAN economies such as Malaysia and Thailand, which are relatively more open and exposed to global inflationary shocks (Figure 10).

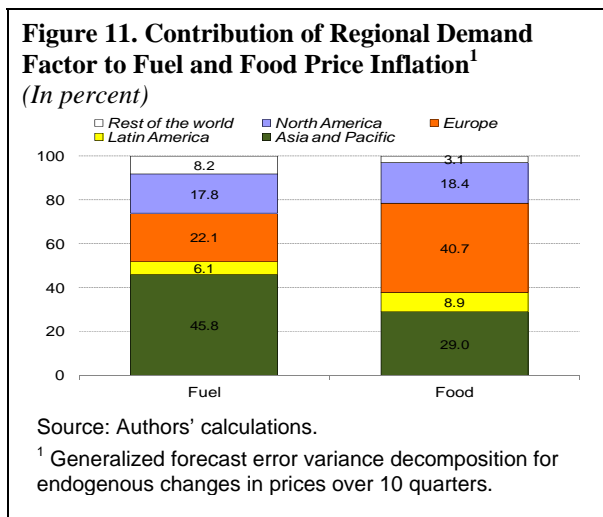


- Global factors account for about 30 percent of inflation in Asia, and regional factors account for slightly less than 10 percent. The contribution of regional factors may, however, be larger than this, if account is taken of the indirect impact of regional demand on domestic inflation via its impact on commodity prices. Indeed, demand

<sup>6</sup> See also Jongwanich and Park (2009).

from Asia explains about 45 percent of demand-driven changes in world fuel prices, and 30 percent of demand-driven fluctuations in food prices (Figure 11). Taking into account the indirect effect, the contribution of regional factors to Asia's inflation increases to about 20 percent.

- There are, however, variations in the importance of these various factors across economies. Among ASEAN economies other than Indonesia, commodity prices play a particularly important role in driving inflation, perhaps owing to the openness of these economies and their dependence on oil and food imports. By contrast, in some of the higher-income economies (Australia, Japan, and New Zealand), output gaps tend to be more important.



## B. Has Inflation Dynamics Changed Over Time?

Given changes in trade, financial, and policy structure of Asia within the last three decades, as well as global economy, it is imperative to allow for possibility of structural breaks in data. Note, however, that country-specific models within the GVAR framework are specified conditional on foreign variables, which implies that the methodology implicitly accommodates cobreaking (Hendry, 1996; and Mizon and Hendry, 1998). For that reason, the GVAR is more robust to the possibility of structural breaks as compared to standard VAR models or reduced-form single equation models (Dees and others, 2008; Cesa-Bianchi and others, 2011). In the context of cointegrated models, structural stability is relevant for both, the long-run and short-run coefficients, as well as error variances. To render the structural stability tests of the short-run coefficients invariant to exact identification of the long-run relations, we consider structural stability tests that are based on the residuals of the individual equations of the country-specific error correction models.<sup>7</sup>

The tests included in our analysis are Ploberger and Kramer's (1992) maximal OLS cumulative sum (CUSUM) statistic, denoted by *PK sup* and its mean square variant *PK msq*. The *PK sup* statistic is similar to the CUSUM test suggested by Brown et al. (1975), although the latter is based on recursive rather than OLS residuals; the parameter constancy against non-stationary alternatives proposed by Nyblom (1989), denoted by *NY*, as well as sequential

<sup>7</sup> It is well known that these residuals only depend on the rank of the cointegrating vectors and do not depend on the way the cointegrating relations are exactly identified.

Wald-type tests of a one-time structural change at an unknown change point. The latter include the Wald form of Quandt's (1960) likelihood ratio statistic (*QLR*), the mean Wald statistic (*MW*) of Hansen (1992) and Andrews and Ploberger (1994), and Wald statistic based on the exponential average (*APW*). The heteroskedasticity-robust version of the above tests is also presented, and denoted by *robust-NY*, *robust-QLR*, *robust-MW*, *robust-APW*. Table 1 below summarizes the results of the tests by variable. The critical values of the tests, computed under the null of parameter stability, are calculated using the bootstrap samples obtained from the solution of the GVAR (p) model.

With the PK tests, the null hypothesis of parameter stability is rejected at most in 13 out of 157 cases. According to the other three tests (*NY*, *QLR* and *APW*), the outcomes depend greatly on whether the heteroskedasticity-robust version of the test is used. The robust tests yield rejection rates which are slightly higher than those obtained with the *PK* tests, while the non-robust *NY*, *QLR* and *APW* tests, yield a much larger number of rejections. These results suggest that there is evidence of some structural instability, which is largely explained by error variances, rather than coefficient structural breaks. The problem of changing error variances is addressed by using bootstrapped means and confidence bounds rather than on point estimates for the impulse response and forecast error variance analyses.

**Table 1. Number of Rejections of the Null of Parameter Constancy per Variable Across the Country-Specific Models at 5 Percent Significance Level**

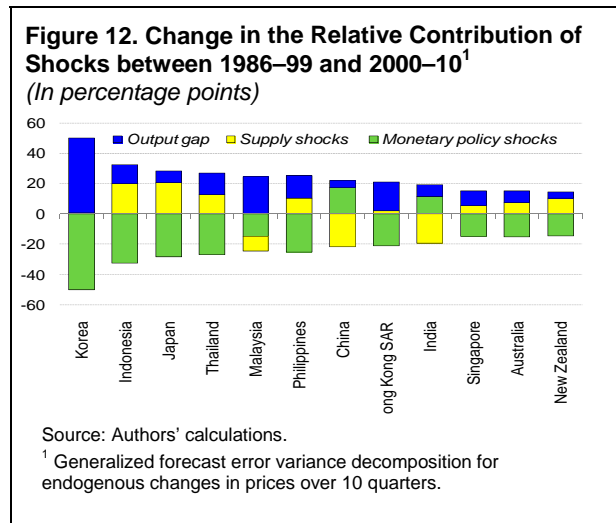
Test	Y	$\Delta CP$	M	EP-CP	IR	$\Delta PP$	Total	
							Number	(%)
<b>PK sup</b>	3	2	1	3	4	0	13	8.3
<b>PK msq</b>	3	2	0	2	2	2	11	7.0
<b>NY</b>	3	6	2	3	6	8	28	17.8
<b>robust - NY</b>	1	7	1	5	6	7	27	17.2
<b>QLR</b>	8	11	4	13	14	9	59	37.6
<b>robust - QLR</b>	5	6	0	2	5	4	22	14.0
<b>MW</b>	6	8	3	7	8	9	41	26.1
<b>robust - MW</b>	3	4	0	4	7	5	23	14.6
<b>APW</b>	9	9	4	14	14	10	60	38.2
<b>robust - APW</b>	4	4	0	3	6	4	21	13.4

Given the results of the parameter constancy tests mentioned above, we assess the changes in the importance of the determinants of inflation in Asia across time, by estimating a Structural VAR (SVAR) model for each country for two sub-samples: (i) 1986–1999 (before and during the Asian crisis), and (ii) 2000-2009 (the ‘post-Asian crisis’ period). The results of the country specific SVAR models are broadly consistent with those of the GVAR— the

inflation variance decomposition estimates between the two methodologies differs by no more than 10 percent for all (Figure 12).<sup>8</sup>

The SVAR analysis for two sub-periods reveals that drivers of inflation processes in Asia have been changing over time. In particular:

- The role of output gaps in driving inflation has grown over time. In emerging Asia, the correlation between core inflation and the output gap rose to 0.7 over the past decade, from 0.2 in the previous two decades. On average in Asia over the last decade, output gaps explained about 20 percent of inflation fluctuations, from about 5 percent over the previous decade (Figure 12).
- By contrast, the contribution of monetary shocks to inflation has diminished over time, particularly in economies that have relatively clear monetary objectives and flexible exchange rate regimes such as Indonesia, Korea, the Philippines, and Thailand.



### C. Inflation Spillovers from China: Direct and Indirect Channels

Developments in economic activity and financial conditions of China are likely to exert significant effects on the business cycle of other Asian economies. Traditionally, effects of the China's state of the economy on the regional economies have been studied through trade linkages, since the China plays a profound role in regional trade. In fact, China accounts for about 50 percent of all trade flows in imported inputs and 30 percent of intermediate goods exports in Asia (Untergerberdoerster and others, 2011). However, direct trade linkages are only one of the important channels. There is another channel which works through the impact of China's business cycles on the commodity prices. As discussed before, the region's demand explain about 45 percent of the demand-driven shocks to oil and about 30 percent of demand-driven changes in food prices, about one-third of which come from China. The importance of China in driving commodity prices, together with the importance of commodity price shocks in explaining variations in Asian economies; imply that there are also indirect spillovers from China associated with commodity prices.<sup>9</sup>

<sup>8</sup> However, for all economies the results obtained under the two orderings are similar.

<sup>9</sup> It should be noted that demand pressures from China can drive commodity prices even if China does not have pricing power over international commodities.

The GVAR framework allows us to estimate these direct and indirect channels through which economic developments in China affect Asian economies' inflation. In particular, we study inflation spillovers of a demand shock from China, based on generalized impulse responses functions (GIRF) proposed in Koop and others (1996) and developed further in Pesaran and Shin (1998) for vector error-correcting models. To this aim, we present impacts of a shock to China's output on inflation in the region as well as on commodity prices, and identify direct and indirect inflation spillovers from China. The figures display the bootstrap estimates of the GIRFs and their associated 90 percent confidence bounds.

Figure 13 presents the GIRFs for a positive 1 percent shock to China's GDP.<sup>10</sup> The shock is accompanied by an increase in China's inflation by about 0.5 percent on impact, 0.7 percent on average per quarter in the first year, and 0.15 percent on average per quarter in the second year. The shock would have a significant effect also on other Asian economies inflation and on commodity prices.

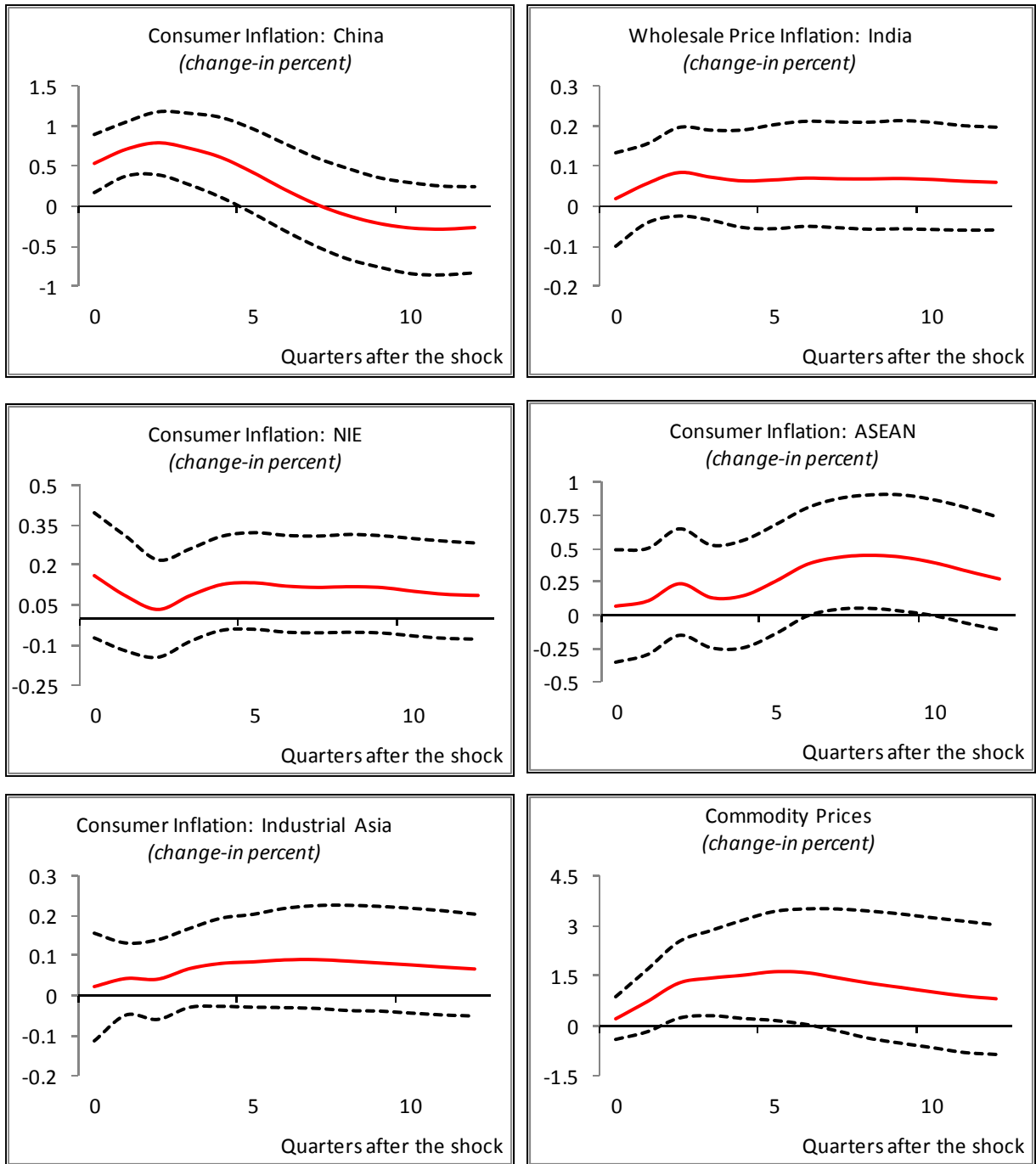
Although the effects of the demand shock in China on Asia's inflation are generally large, the transmission of the shock to inflation in the region takes place rather slowly. On impact, the region's inflation increase by 0.1 percent, but effects of the shock on inflation of Asian economies becomes more pronounced over the first two years, averaging about 0.2 percent increase in every quarter. This partly reflects high level of competitiveness product markets in the region, which limits producers' ability to transmit the changes in the input prices to the final consumer good prices right away. The overall cumulative impact of the shock on Asia's inflation on average after two years amounts to 1.3 percent, which is slightly lower than the cumulative impact of the shock on China's inflation (1.5 percent).

---

<sup>10</sup> The shock is about 3 standard errors in magnitude, which causes 1 percent increase in GDP on impact, and 2.5 percent on average within two years.

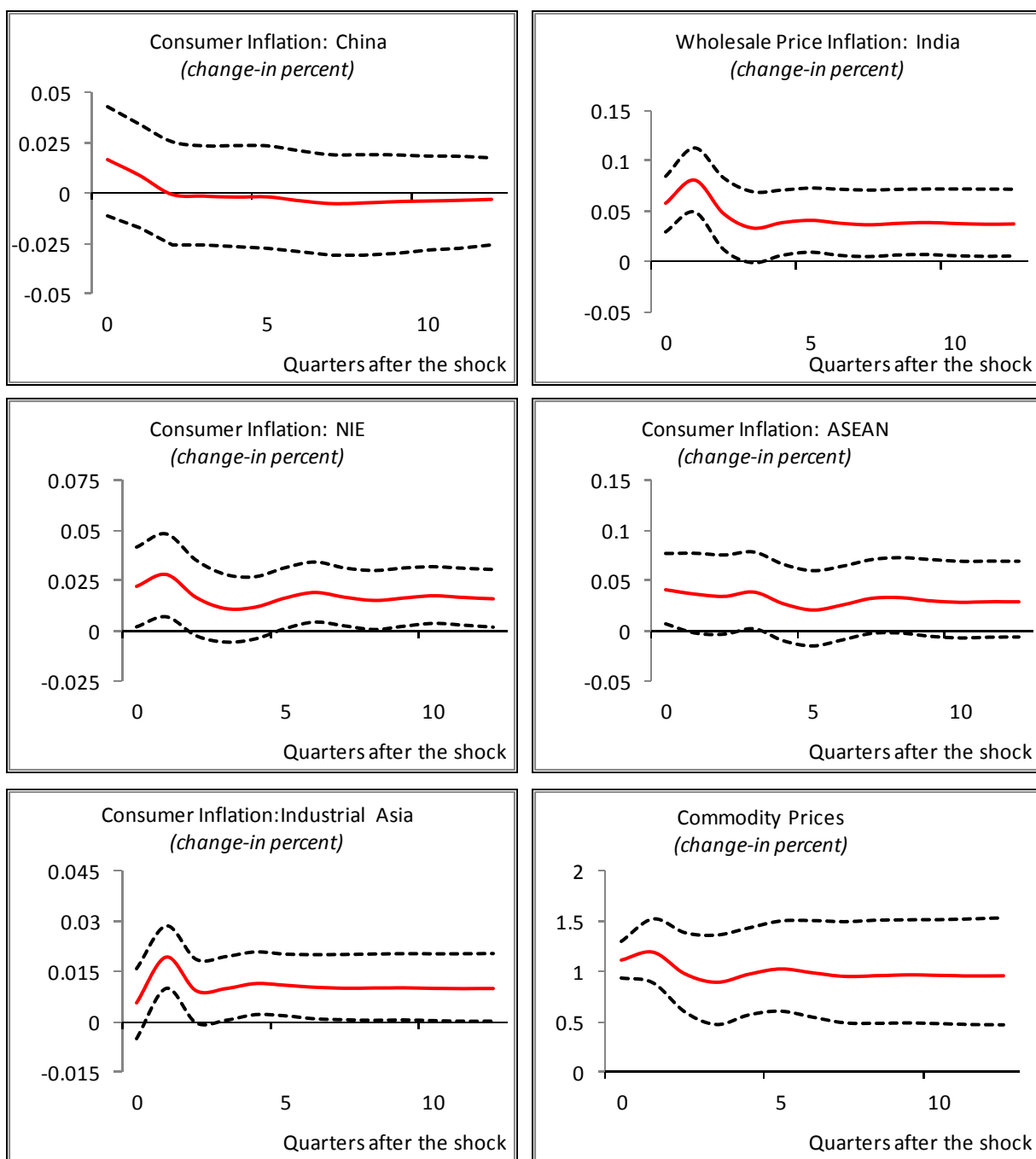


**Figure 13: Generalized Impulse Responses of 1 percent Positive Shock to China's GDP**  
*(Bootstrap mean estimates with 90 percent bootstrap error bounds)*



Source: Authors' calculations.

**Figure 14: Generalized Impulse Responses of a 1 percent Shock to Commodity Prices**  
*(Bootstrap mean estimates with 90 percent bootstrap error bounds)*

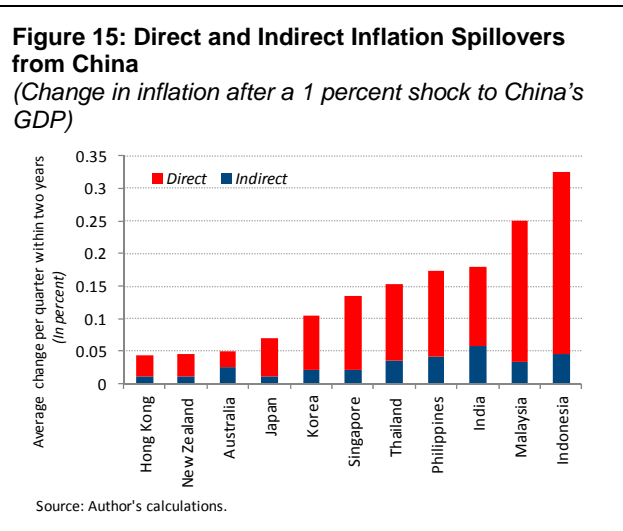


Source: Authors' calculations.

All economies in the region are not equally exposed to the inflation spillovers from China. The impact of the shock is stronger on inflation in ASEAN countries and India, where inflation increases 0.2 and 0.3 percent every quarter in the first and the second year after the shock. Inflation rises by about 2 percent in ASEAN and 1.5 percent in India after two years in cumulative terms. In the region’s developed economies such as Japan, Australia, and New Zealand, the spillovers are more limited with only 0.05 percent average increase in inflation per quarter within two years. NIE’s are also somewhat shielded from the shock with an average of 0.1 percent increase in inflation in each quarter, and about a 1 percent cumulative increase in inflation after two years.

The demand shock in China has also a statistically significant impact on commodity prices. Commodity prices increase by about 0.7 percent on impact after the shock (Figure 13). In the first and the second year, the shock brings 4 and 3.5 percent increase in commodity prices in cumulative terms. This increase in commodity prices, however, also causes higher inflation in other Asian economies. In fact, the GIRFs results of a positive 1 percent shock to commodity prices, on average, brings about 0.05 percent increase in inflation in the region on impact, with a cumulative of 0.1 percent increase after a year, and 0.15 percent increase after two years (Figure 14). The impact is more pronounced for ASEAN economies (about 0.25 percent on average), which extensively import commodities, except from Malaysia. In advanced economies in Asia—Japan, Australia and New Zealand—the impact of the shock on inflation is lower at about 0.01 percent increase per quarter.

We calculate the direct and indirect spillovers by subtracting the indirect effect brought by the rise in commodity prices from the total impact. Figure 15 represents the results. About 20 percent of the spillovers from an inflationary demand shock in China within two years are due to higher commodity prices. Moreover, indirect impacts transmit faster to inflation in Asian economies than the direct impacts—in the first year after the shock, about 35 percent of the spillovers are caused by movements in commodity prices. Given the increasing impact of China on world commodity prices, indirect spillovers are likely to amplify going forward, rendering a more decisive policy response in the region to limit the increase in inflation.



#### **IV. POLICY IMPLICATIONS AND CONCLUDING REMARKS**

This paper aims to look at the drivers of inflation in Asia and how they have changed over time. Given the economic influence of China on regional economies and its impact in determining commodity prices, the paper also analyzes direct and indirect inflation spillovers from China.

We find that inflation dynamics across Asia, including in China and India, are mainly driven by domestic supply shocks. However, the contribution of demand factors has risen in recent years. Looking ahead, if the influence of demand factors on inflation continues to grow, policymakers will need to give increasing priority to managing inflation relative to promoting growth. The contribution of monetary shocks to inflation has diminished over time, perhaps reflecting the improvements in monetary frameworks in many countries. These improvements have included greater clarity and transparency with respect to monetary objectives and instruments as well as greater exchange rate flexibility. Additional moves in this direction may help to further reduce the level and volatility of inflation across the region.

Developments in Asia seem also to have a growing influence on global commodity prices, which is consistent with the high and rising share of Asia as a source of demand for key commodities. As this share grows over time, policymakers will need to pay increasing attention not only to the influence of global commodity prices on domestic prices, and indeed domestic economic conditions, but also to the implications of domestic conditions for global prices. Being the largest commodity importer in the region, this is particularly important for China. Indeed, our analysis reveals that an inflationary shock in China has a significant and large impact on commodity prices, which in turn feeds rather quickly into inflation of other Asian economies. Combined with the direct effects through changes in import prices, economies in the region are exposed to notable inflation spillovers from China.

## REFERENCES

- Andrews D. W. K. and W. Ploberger, 1994, "Optimal Tests when a Nuisance Parameter is Present Only under the Alternative," *Econometrica*, Vol. 62, pp. 1383–1414.
- Cesa-Bianchi, A., M. H. Pesaran, A. Rebucci and T. Xu, 2011, "China's Emergence in the World Economy and Business Cycles in Latin America," IZA Discussion Paper No. 5889.
- Dées, S., M. H. Pesaran, L. V. Smith and R. P. Smith, 2008, "Identification of New Keynesian Phillips Curves from a Global Perspective," IZA Discussion Paper No. 3298.
- Hansen B. E., 1992, "Tests for Parameter Instability in Regressions with I (1) Processes," *Journal of Business and Economic Statistics*, Vol. 10, pp. 321–36.
- Hendry D.F., 1996, "A Theory of Co-breaking," mimeo, Nuffield College, University of Oxford.
- Hendry D. F and G. E. Mizon, 1998, "Exogeneity, causality, and Co-breaking in Economic Policy Analysis of a Small Econometric Model of Money in the UK," *Empirical Economics*, Vol. 23, pp. 267–94.
- Hossain, A., 2009, *Central Banking and Monetary Policy in the Asia-Pacific* (London: Edward Elgar).
- Jongwanich, J., and D. Park, 2009, "Inflation in Developing Asia," *Journal of Asian Economics*, Vol. 20, pp. 507–18.
- Koop G., M. H. Pesaran, and S. M. Potter, 1996, "Impulse Response Analysis in Nonlinear Multivariate Models," *Journal of Econometrics*, Vol. 74, No. 1, pp. 119–47.
- Nyblom J., 1989, "Testing for the Constancy of Parameters Over Time," *Journal of the American Statistical Association*, Vol. 84, pp. 223–30.
- Pesaran, M. H., 2006, "Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure," *Econometrica*, Vol. 74, pp. 967–1012.
- Pesaran, M. H., T. Schuermann, and S. M. Weiner, 2004, "Modeling Regional Interdependencies Using a Global Error-Correcting Macroeconomic Model," *Journal of Business and Economic Statistics*, Vol. 22, pp. 129–62.
- Pesaran, M. H. and Y. Shin, 1998, "Generalized Impulse Response Analysis in Linear multivariate models," *Economics Letters*, Elsevier, Vol. 58, No. 1, pp. 17–29.

- Ploberger, W. and W. Kramer, 1992, "The CUSUM test with OLS residuals," *Econometrica*, Vol. 60, pp. 271–86.
- Quandt, R., 1960, "Tests of the Hypothesis that a Linear Regression System Obeys Two Separate Regimes," *Journal of the American Statistical Association*, Vol. 55, pp. 324–30.
- Sims, C., 1980, "Macroeconomics and Reality," *Econometrica*, Vol. 48.
- Tang, H.C., 2008, "Commodity Prices and Monetary Policy in Emerging Asia," ADB Working Paper Series on Regional Economic Integration, No. 23 (Manila: Asian Development Bank).
- Unteroberdoerster, O., A. Mohommad, and J. Vichyanond, 2011, "Implications of Asia's Regional Supply Chain for Rebalancing Growth," Chapter 3, *Regional Economic Outlook: Asia and Pacific* (Washington: International Monetary Fund, April).