2. Low Inflation in Asia: How Long Will It Last?

Introduction and Main Findings

Global growth in 2017 was the highest since 2011 and is expected to strengthen further in 2018–19, supported by broad-based momentum across countries and fiscal expansion in the United States. Headline inflation has been picking up with the upturn in oil prices since September, but core inflation remains surprisingly subdued, especially in advanced economies. Asia has been in a sweet spot of strong growth and benign inflation. While GDP growth forecasts for 2017–18 have been repeatedly revised up over the past two years, inflation forecasts have been kept constant or revised down (Figure 2.1). Core inflation remains below inflation targets in many Asian economies (Figure 2.2).

Motivated by these developments, this chapter aims to shed light on the following questions: Why has inflation been low in Asia recently, and how long will it last? What has been the role of import prices and global factors? How well anchored are inflation expectations? To what extent has inflation become less sensitive to economic slack? How do these drivers of inflation in Asia differ from those in other regions? Finally, what are the key implications for policymakers?

To address these questions, the chapter analyzes inflation dynamics relying on a variety of approaches, including estimation of augmented Phillips curves, principal component analysis to distinguish global factors from country-specific factors, and an analysis of trend inflation to shed light on how long low inflation is likely to persist.
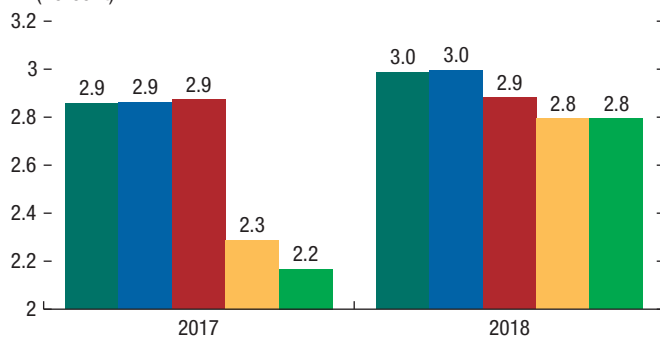
The main findings are as follows:

Figure 2.1. Growth and Inflation

**1. Asia: Real GDP Growth**
(Percent)
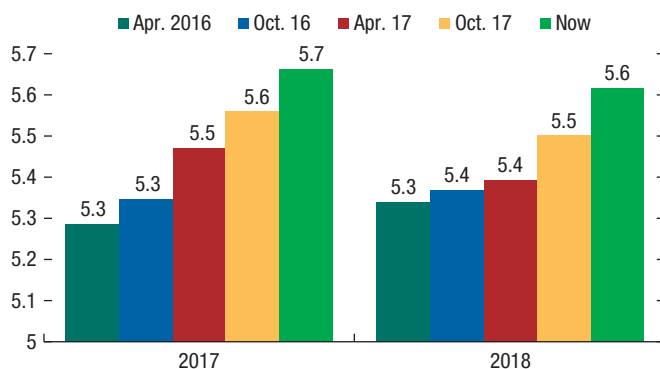
2. Asia: Inflation
(Percent)

Source: IMF, *World Economic Outlook*.

- *Recent low inflation has been driven mainly by temporary forces, including imported inflation.* The Phillips curve estimation indicates that weaker import prices, including low commodity prices, contributed to half of the undershooting of inflation targets in advanced Asia and most of the undershooting in emerging Asia in recent years. In addition, China seems to have played an important role in driving both global and regional inflation. More generally, an analysis looking at temporary and trend components suggests that temporary shocks have accounted for the bulk of the recent reduction in inflation.

Figure 2.2. 2017 Inflation Target versus Headline and Core Inflation
(Percent)
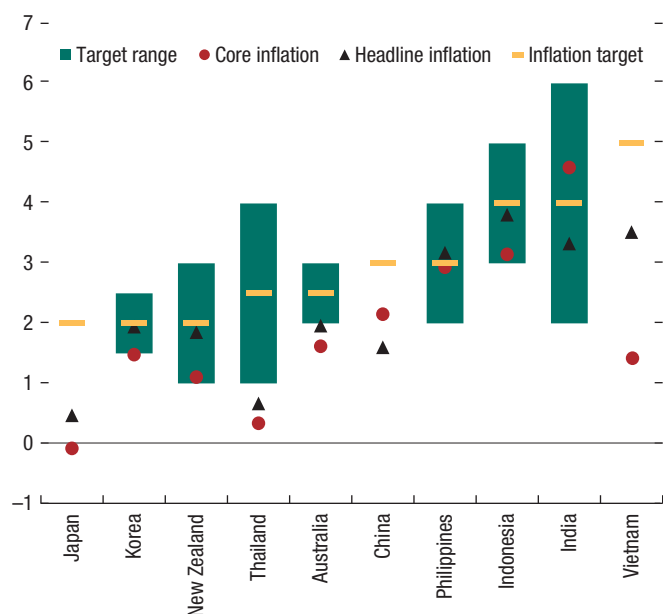
Sources: Haver Analytics; and IMF staff calculations.
Note: Australia and New Zealand are based on quarterly data as of the third quarter of 2017.

- *The inflation process has become more backward-looking.* While inflation expectations are generally relatively well anchored, especially in advanced Asia and in economies with inflation-targeting frameworks, the importance of expectations in driving inflation has declined in recent years, with past inflation playing a larger role.

- *The sensitivity of inflation to the unemployment gap has declined.* There seems to be a flattening of the Phillips curve compared with the 1990s in advanced Asia and a similar but more continuous flattening in emerging Asia. Outside Asia, the slope of the Phillips curve seems to have been more stable.

Looking forward, these findings suggest that inflation may well rise in Asia as commodity prices and other temporary factors reverse themselves (the April 2018 *World Economic Outlook* projects a near-term increase in commodity prices). Higher

inflation in the rest of the world and weaker currencies in the region could pose upside risks to inflation. If such risks materialize, higher inflation may well persist, given the stickiness of the inflation process. And given the relative flatness of the Phillips curve, the output costs of disinflating may be high.

The main policy implications of the findings are as follows:

- Central banks should be vigilant in responding to early signs of inflation pressure, including from global factors. A sudden increase in inflation may then persist, and disinflating may be costly if the sensitivity of inflation to the unemployment gap has declined.

- It will be important to strengthen monetary policy frameworks and improve central bank communications in order to both increase the role of expectations in driving inflation and to maintain expectations anchored to targets.

- To mitigate the role of imported inflation, exchange rates should be allowed to adjust more flexibly.

- In principle, the monetary policy response to commodity price shocks should be to accommodate first-round effects but not second-round effects.

The chapter first reviews recent inflation trends in Asia, followed by an examination of the structural drivers of inflation. It then analyzes the anchoring of inflation expectations and distinguishes global from country-specific factors in driving inflation. The chapter then presents an analysis of trend inflation and concludes with policy implications.

Recent Inflation Trends in Asia

Headline inflation declined sharply during 2012–15 across many advanced, emerging market, and developing economies in Asia (Figure 2.3). Disinflation was broad-based across sectors and inflation measures. The breakdown

Figure 2.3. Asia: Headline Inflation

1. Advanced Economies: Headline Inflation
(Percent)
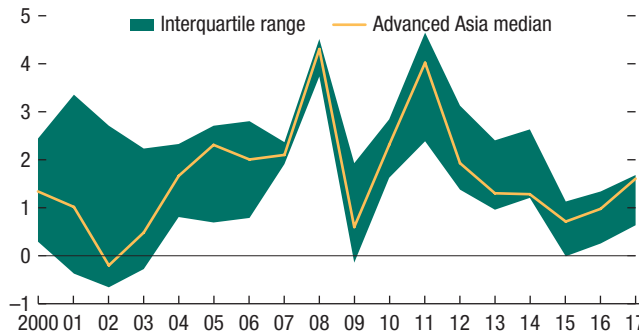
2. Emerging Market Economies: Headline Inflation
(Percent)
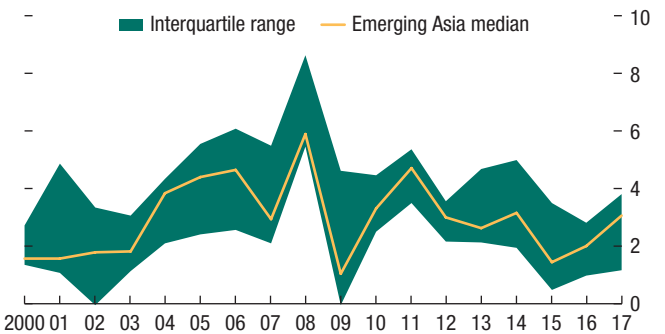
3. Low-Income Economies: Headline Inflation
(Percent)
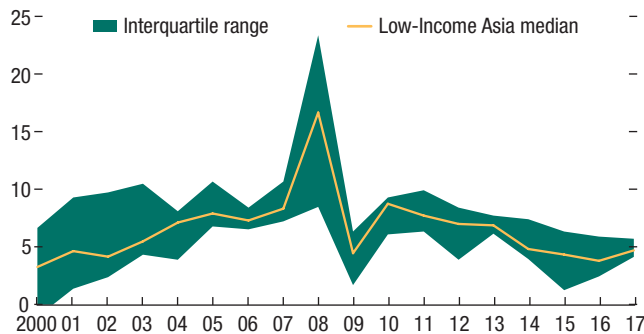
4. PCIs and Small States Economies: Headline Inflation
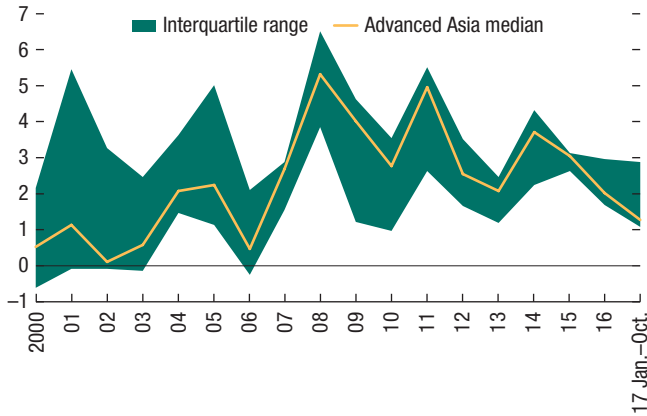(Percent)
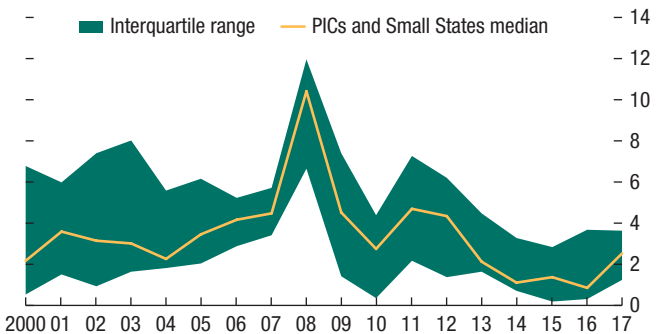
Sources: IMF, *World Economic Outlook*; and IMF staff calculations.
Note: PICs = Pacific island countries.

of inflation across expenditure categories shows that the decline in inflation in advanced and emerging market economies was widespread (Figure 2.4). On average, the decline in inflation was comparable across food, other goods, and services. While food inflation declined the most across advanced economies, it remained generally positive despite the decline in international food prices over the same period, suggesting a rather low pass-through from international to domestic food prices. Other goods inflation entered negative territory in several advanced Asian economies, reflecting the large decline in manufacturing producer prices (Figure 2.5). In turn, this may reflect a larger effect of lower commodity prices in manufacturing as well as an increase in excess manufacturing capacity. Core inflation—the change in the prices of goods and services excluding food and energy—also declined widely, as did wage inflation (Figure 2.5).

Headline inflation started to pick up in 2016, with the share of low-inflation economies dropping from its 2015 peak (Figure 2.6). Inflation is currently picking up in Australia, Japan, Korea, and some ASEAN economies (Figure 2.7). The recent pickup in headline inflation is primarily explained by other goods and services inflation, with the manufacturing producer price index (PPI) recovering strongly. The pickup is in line with other advanced economies and emerging markets (Figure 2.8), reflecting the recent increase in commodity prices (Figure 2.9). In China, however, the pickup in PPI inflation did not spill over to consumer price index (CPI) inflation (Box 2.1). While food prices are still declining, core inflation is edging up, and wage inflation is recovering. That said, the level of inflation is still low in many economies, with headline and core inflation below inflation targets in most economies (Figure 2.2).

Figure 2.4. Asia: Inflation by Sector

1. Advanced Economies: Food Inflation
(Percent)

Legend: Interquartile range — Advanced Asia median

2. Emerging Market Economies: Food Inflation
(Percent)

Legend: Interquartile range — Emerging Asia median
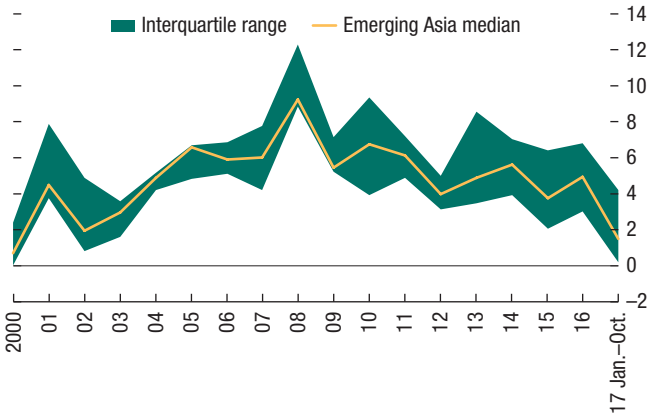
3. Advanced Economies: Other Goods Inflation
(Percent)

Legend: Interquartile range — Advanced Asia median
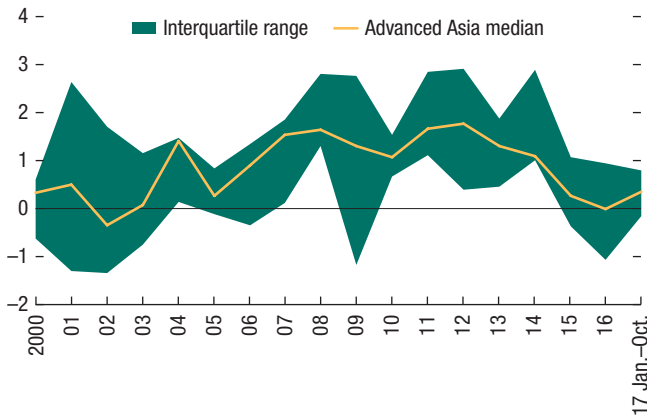
4. Emerging Market Economies: Other Goods Inflation
(Percent)

Legend: Interquartile range — Emerging Asia median

5. Advanced Economies: Services Inflation
(Percent)

Legend: Interquartile range — Advanced Asia median
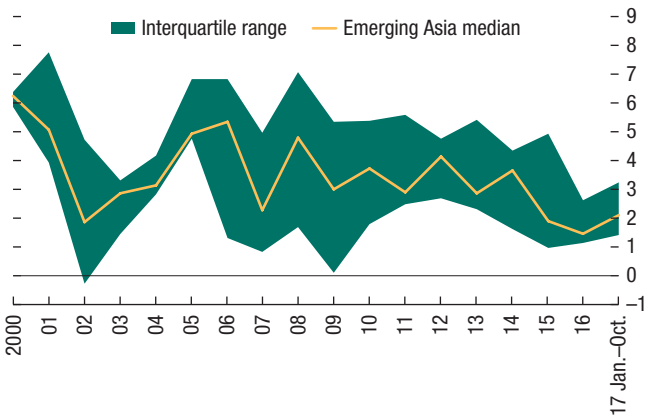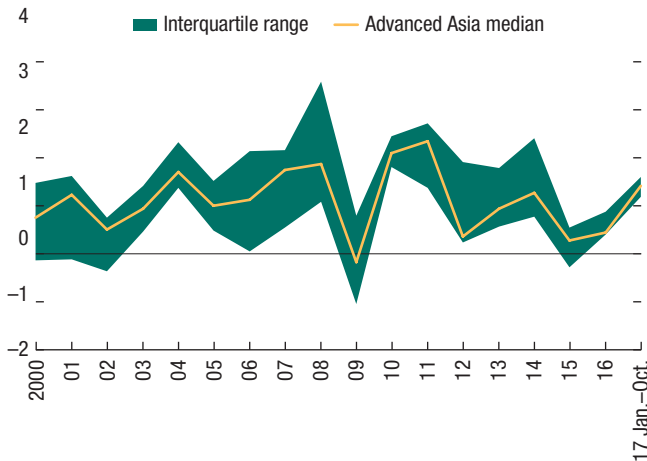
6. Emerging Market Economies: Services Inflation
(Percent)
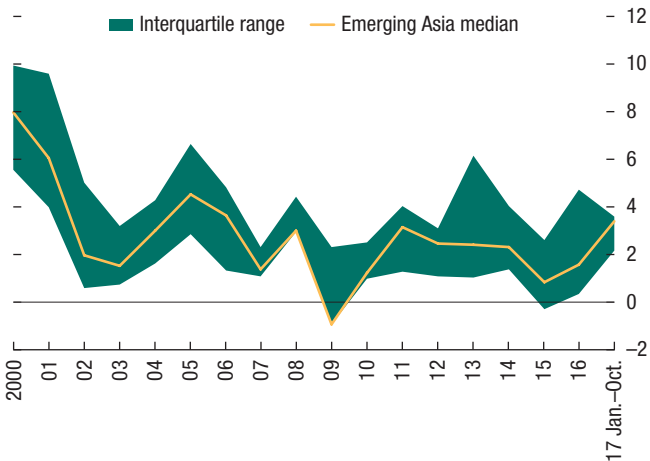
Legend: Interquartile range — Emerging Asia median

Sources: Haver Analytics; and IMF staff calculations.
Note: Some countries' data are only through August 31, 2017.

Figure 2.5. Asia: Other Inflation Measures

1. Advanced Economies: Core Inflation
(Percent)

Legend: Interquartile range — Advanced Asia median
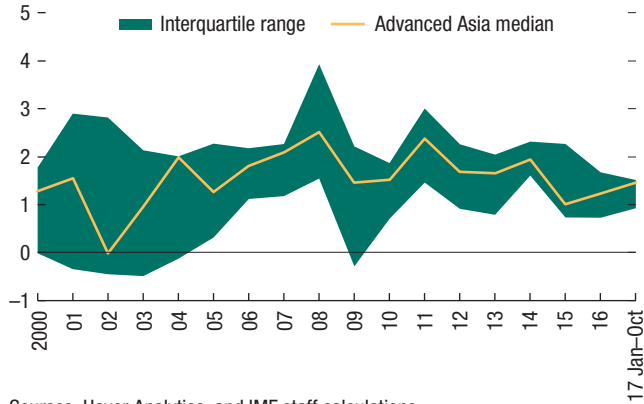
Sources: Haver Analytics; and IMF staff calculations.

2. Emerging Market Economies: Core Inflation
(Percent)

Legend: Interquartile range — Emerging Asia median
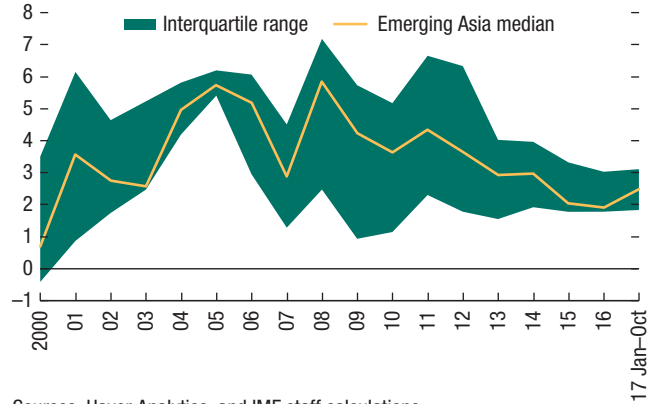
Sources: Haver Analytics; and IMF staff calculations.

3. Advanced Economies: Wage Inflation
(Percent change in nominal wages, year over year)
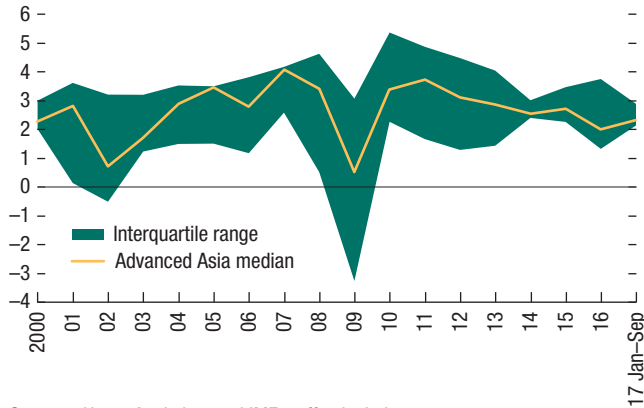
Legend: Interquartile range — Advanced Asia median

Sources: Haver Analytics; and IMF staff calculations.
Note: Some countries' data are only through August 31, 2017.

4. Emerging Market Economies: Wage Inflation
(Percent change in nominal wages, year over year)
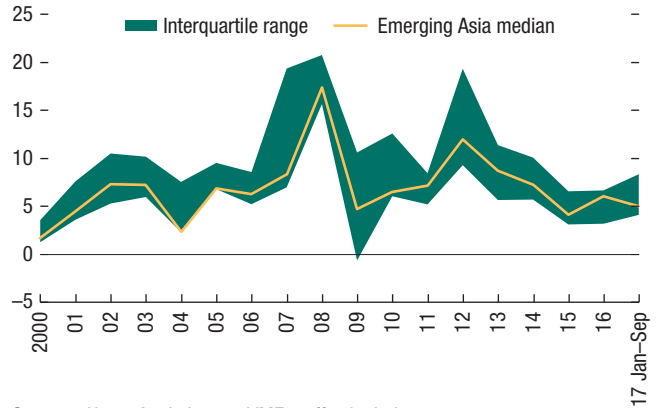
Legend: Interquartile range — Emerging Asia median

Sources: Haver Analytics; and IMF staff calculations.
Note: Some countries' data are only through August 31, 2017.

5. Advanced Economies: Manufacturing PPI
(Percent change)
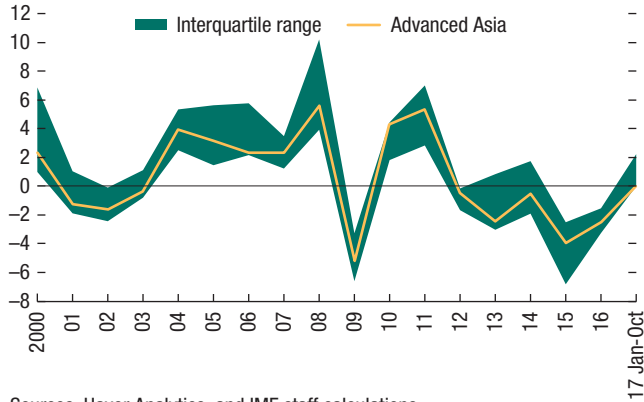
Legend: Interquartile range — Advanced Asia

Sources: Haver Analytics; and IMF staff calculations.
Note: Some countries' data are only through August 31, 2017.

6. Emerging Market Economies: Manufacturing PPI
(Percent change)
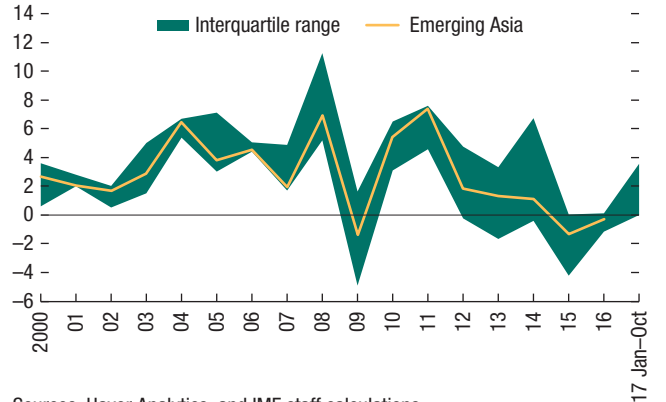
Legend: Interquartile range — Emerging Asia

Sources: Haver Analytics; and IMF staff calculations.
Note: Some countries' data are only through August 31, 2017.

**Figure 2.6. Share of Asian Countries with Low Inflation**
(Percent)

Below zero
Below 1 percent
Below 2 percent
Below 3 percent
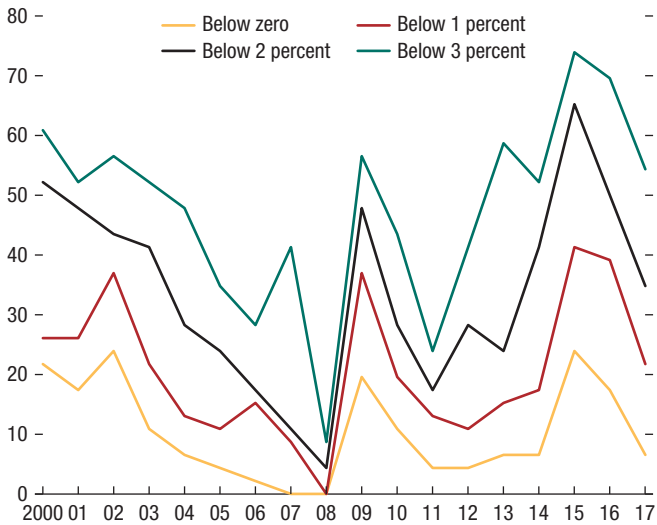
Sources: IMF, *World Economic Outlook*; and IMF staff calculations.

Figure 2.7. Headline Inflation - Selected Asian Countries
(Percent)

Asia
Australia
China
India
Japan
Korea
ASEAN-5
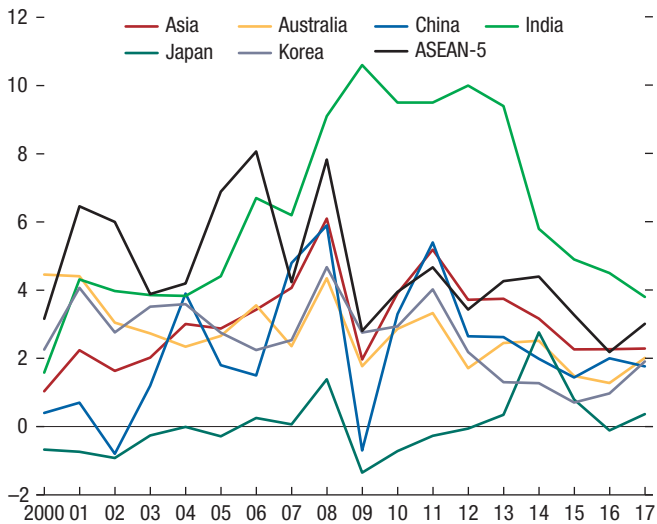
Sources: IMF, *World Economic Outlook*; and IMF staff calculations.
Note: ASEAN-5 = Indonesia, Malaysia, Phillipines, Singapore, and Thailand.

Structural Drivers of Inflation

To study inflation dynamics, this chapter follows the analytical framework in Chapter 3 of the April 2013 *World Economic Outlook*, Chapter 3 of the October 2016 *World Economic Outlook*, and Blanchard, Cerutti, and Summers (2015). It

Figure 2.8. Headline Inflation and Rest of the World

Advanced Economies: Headline Inflation
(Percent)

United States
Euro area
Advanced Asia median
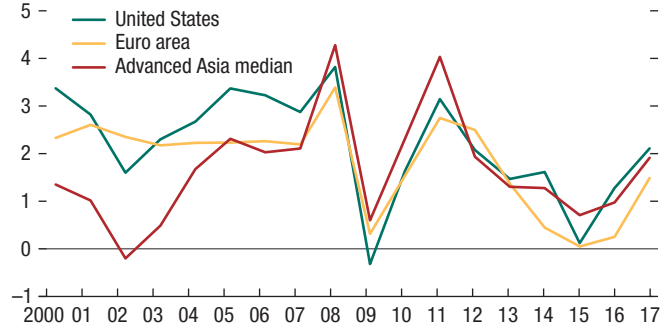
Emerging Markets: Headline Inflation
(Percent; median of the region)

Latin America and the Caribbean
Emerging Europe
Emerging Asia
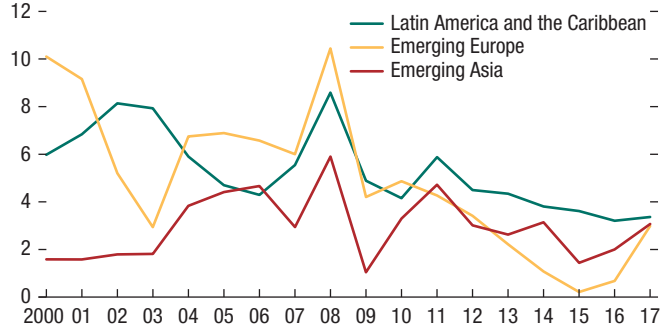
Sources: IMF, *World Economic Outlook*; and staff calculations.

Figure 2.9. Commodity Prices
(Percent change, year over year)

Total commodity prices
Fuel prices
Food prices
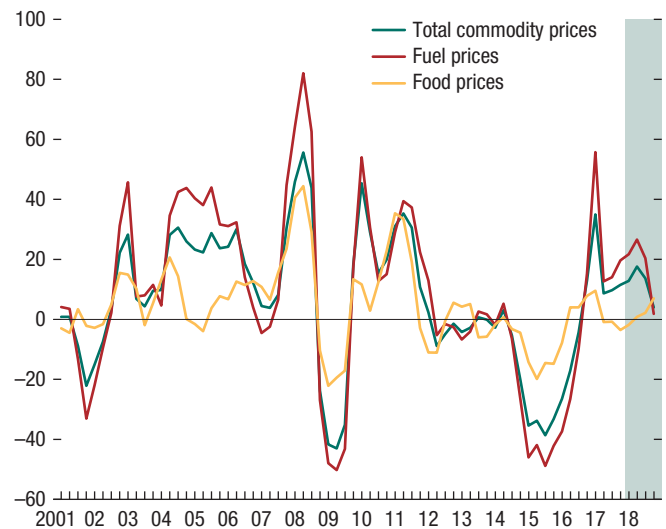
Source: IMF, *World Economic Outlook*.

Figure 2.10. Inflation Drivers

Interquartile range — Emerging Asia Median

1. Advanced Asia: Inflation Expectations
   (Percent)

2. Emerging Asia: Inflation Expectations
   (Percent)

3. Advanced Asia: Unemployment Gap
   (Percent)

4. Emerging Asia: Unemployment Gap

5. Advanced Asia: Relative Import Price
   (Percent)

6. Emerging Asia: Relative Import Price
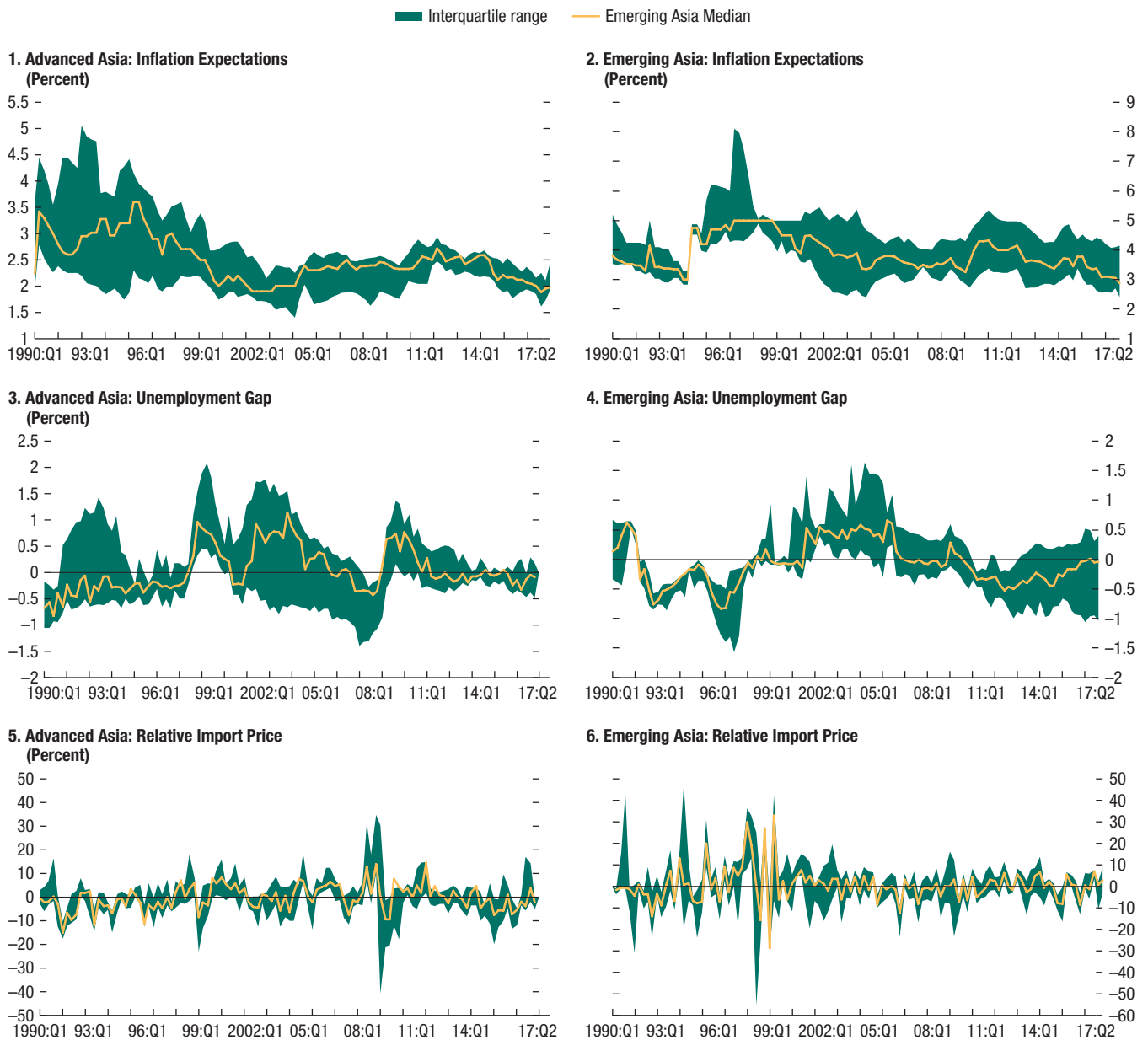
Source: IMF staff estimates.

builds on the hybrid new Keynesian Phillips curve of Fuhrer (1995) and Galí and Gertler (1999) and relates domestic inflation to inflation expectations, cyclical unemployment, and imported inflation.

Figure 2.10 shows the evolution of the underlying variables. Inflation expectations came down substantially in the 1990s for both advanced and emerging Asia and have been on a declining trend

since 2011. There was some slack in labor markets in the aftermath of the global financial crisis, but unemployment gaps seem to be closing in recent periods, with some slack still remaining in China, India, Korea, Malaysia, and Singapore.

The main findings from the estimates of Phillips curve parameters are discussed below (see Annex 2.1 for details).

Figure 2.11. Estimated Coefficient on Inflation Expectations
(Percent)

1.

2.

Source: IMF staff estimates.

Figure 2.12. Expectations Coefficient versus Average Headline Inflation

1. Expectations Coefficient versus Average Headline Inflation (excluding Japan)

2. Expectations Coefficient versus Average Headline Inflation (Japan)
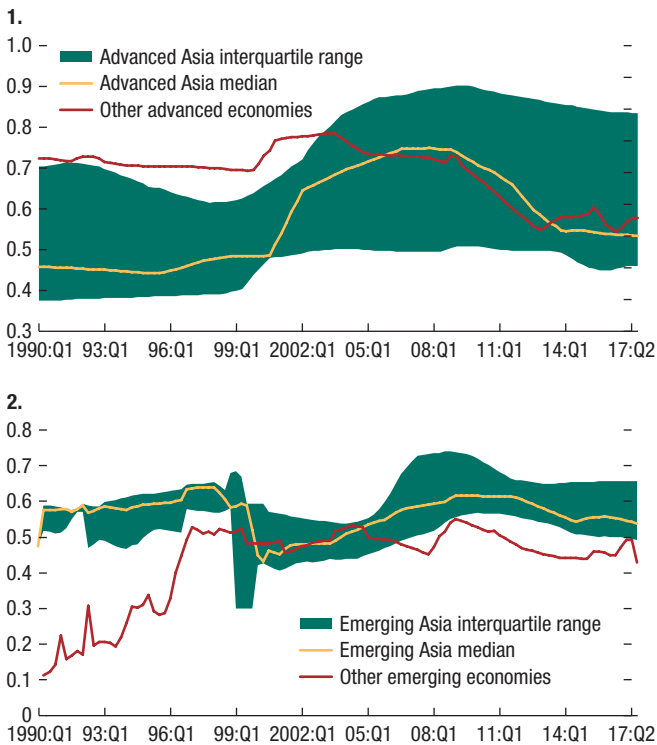
Source: IMF staff estimates.

First, the inflation process in Asia has become more sticky, or backward-looking, since the global financial crisis. The estimated coefficient on inflation expectations has declined in both advanced economies and emerging markets back to levels of the early 2000s, suggesting that inflation is being driven more by past inflation than by expectations about future inflation (Figure 2.11).

- In advanced Asia, the role of long-term inflation expectations was less important than in other advanced economies but has gradually caught up. Since the global financial crisis, the coefficient has declined in line with other advanced economies, a finding similar to that of Chapter 3 of the October 2016 *World Economic Outlook.* The decline could reflect the difficulty of central banks in reaching inflation targets when faced with negative inflation shocks. As a result, the inflation process has become more backward-looking,

as opposed to following expectations. Indeed, after 2007, the expectations coefficient was lower in economies with lower inflation (Figure 2.12). A lower coefficient on expectations implies that the effects of cyclical unemployment, import prices, and shocks on inflation have become relatively more persistent in the recent period.

- The role of inflation expectations in driving inflation in emerging Asia has generally been more important than it has been in other emerging markets and, as a result, inflation shocks have been less persistent. This could be related to the fact that Asia has a higher share of inflation-targeting countries, and the fact that the inflation expectations coefficient tends to increase after the adoption of inflation targeting (Figure 2.13). There has

Figure 2.13. Share of Inflation-Targeting Countries and Expectations Coefficient

1. Share of Inflation-Targeting Countries
   (Percent)

2. Expectations Coefficient: before and after Inflation Targeting
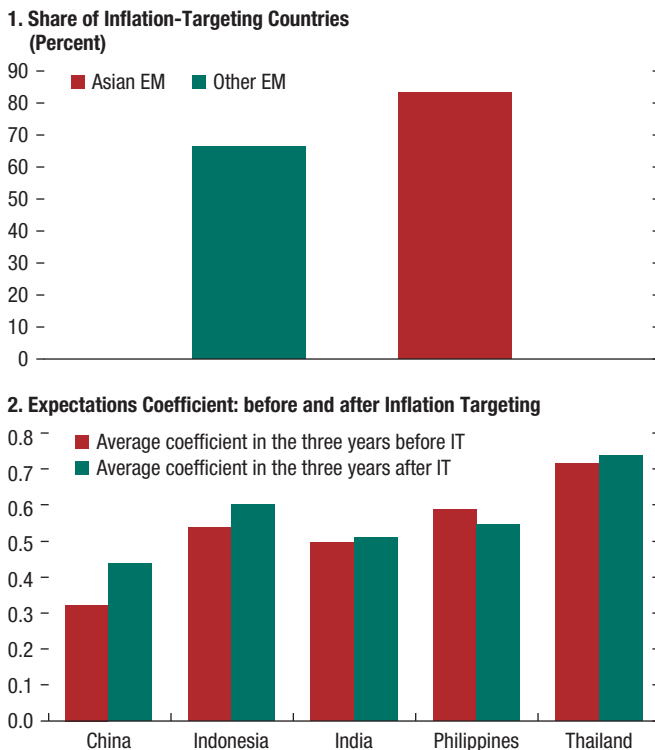
Source: IMF staff estimates.
Note: EM = emerging market; IT = inflation targeting.

Figure 2.14. Estimated Coefficient on Cyclical Unemployment

Source: IMF staff estimates.
Note: EM = emerging market.

been some decline in the coefficient since the global financial crisis, but less than in other countries and with a longer lag compared with advanced economies. This finding suggests that inflation may be more driven by inflation expectations in emerging Asia than in other emerging markets.

Second, the slope of the Phillips curve, which measures the sensitivity of inflation to domestic labor market slack, is estimated to have declined in Asia (Figure 2.14).

- In Asian advanced economies, inflation in the 1990s was more sensitive to labor market slack than in other advanced economies, with median coefficients of about 1 and 0.2, respectively. The slope declined compared with the 1990s from 1 to about 0.6, but has remained broadly stable since 2004. This

contrasts with other advanced economies, where it has remained stable since the 1990s.

- In Asian emerging markets, the slope has been declining steadily, mirroring the developments in emerging Europe, while Latin American emerging markets did not see such a flattening of the Phillips curve. The flattening has been significant and prevalent across most Asian emerging markets.

- This result is robust to alternative measures of the nonaccelerating inflation rate of unemployment (NAIRU) to measures of slack based on capacity utilization rather than unemployment, and to some (but not all) estimates of slack based on the output gap.

Third, the coefficient on imported inflation remained broadly constant in both advanced economies and emerging markets (Figure 2.15). In Asian advanced economies, it has been lower than

Figure 2.15. Estimated Coefficient on Relative Import Prices
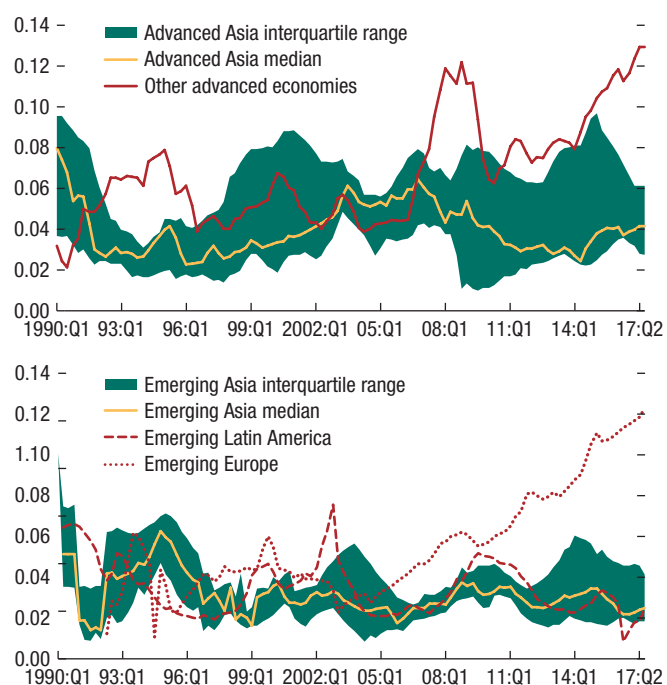
Source: IMF staff estimates.

in other advanced economies. In Asian emerging markets, it has been broadly in line with Latin American emerging markets but lower than in European emerging markets.

Putting together the sensitivity of inflation to these factors and their changes over time, the analysis shows that imported inflation has been the most important driver of inflation deviations from targets in recent years (Figure 2.16):[1]

- In advanced economies, while cyclical unemployment was the main driver of deviations before the global financial crisis, import prices accounted for about half of the undershooting since 2013.

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[1]Inflation targets are proxied by the average of 10-year-ahead inflation expectations during 2000–07. The decomposition of inflation dynamics is conducted in a way similar to that in Chapter 3 of the October 2016 *World Economic Outlook* and Yellen (2015). The contribution of each explanatory variable is obtained by setting its value to zero and comparing the model's prediction with that when all explanatory variables are set at their historical values. The contribution of import prices to inflation is further decomposed into the contribution of import prices in US dollars and variations in the domestic exchange rate vis-à-vis the US dollar.

- In emerging markets, the undershooting of inflation targets since 2014 is mainly accounted for by import prices. Unlike in advanced economies, cyclical unemployment has also been behind the inflation undershooting in emerging markets.

- Starting in 2016 and 2017, inflation expectations also started to contribute to the undershooting of inflation compared with targets, accounting for 35 percent of the undershooting in advanced Asia and 40 percent of the undershooting in emerging Asia in the first two quarters of 2017.

- The depreciation of Asian currencies in 2015 following China-induced volatility contributed in a positive way to inflation in both advanced and emerging Asia.

There is, however, a large share of unexplained factors driving inflation undershooting in Asia, especially in advanced economies. These could reflect the mismeasurement of labor market slack by headline unemployment rates, the fact that expectations of actual price setters may have dropped more than those of professional forecasters (Coibion and Gorodnichenko 2015), or technical constraints on monetary policy in the form of the zero lower bound. There also seems to be large cross-country heterogeneity in the drivers (Figure 2.16).

Overall, the analysis shows that low inflation in Asia has been driven mainly by sluggish import prices and inflation expectations being below targets. In addition, while the Phillips curve fits the inflation data in Asia, it seems to have flattened, meaning that the sensitivity of inflation to economic slack has declined.

The undershooting of inflation targets due to import prices seems to be linked to manufacturing slack in China. Figure 2.17 shows the averages, medians, and the interquartile range of the coefficients from country-level regressions of the import price contribution in Figure 2.16 on manufacturing slack in China, Japan, and the United States. Changes in import prices depend

Figure 2.16. Contributions to Inflation Deviation from Targets

1. Contribution to Inflation Deviation from Targets:
Advanced Asia Average
(Percent)
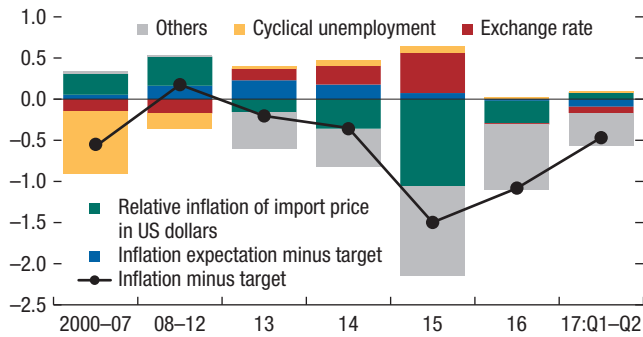
Source: IMF staff estimates.

2. Contribution to Inflation Deviation from Targets:
Emerging Asia Average
(Percent)
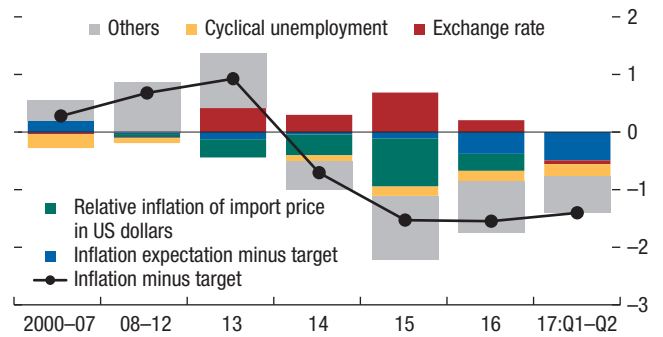
Source: IMF staff estimates.

3. Advanced Asia: 2016 Cross-Country Distribution
(Percent)
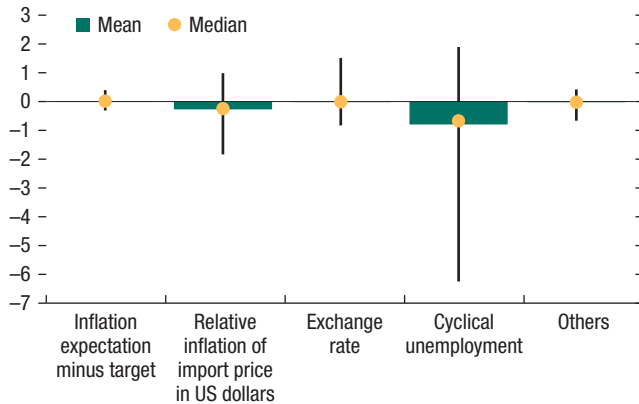
Source: IMF staff estimates.

4. Emerging Asia: 2016 Cross-Country Distribution
(Percent)
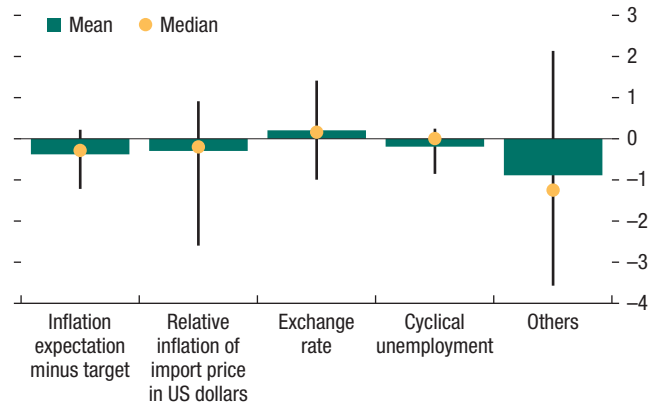
Source: IMF staff estimates.

on the degree of excess supply or demand in globally integrated markets for tradable goods and services. This in turn is related to the rising slack in tradables sectors in large economies and systemic trading partners. Using estimates of manufacturing slack,[2] it seems that the import price contribution to inflation in Asia is particularly strongly related to slack in China (Figure 2.17).

To the extent that growth in China in 2018 and 2019 is expected to be stronger than envisaged in the October 2017 *Regional Economic Outlook*

Update: Asia and Pacific, this could put upward pressure on inflation in the region.

The next section explores why the Phillips curve may have flattened—that is, why inflation may be becoming less sensitive to the unemployment gap. The analysis then examines whether inflation expectations in Asia are becoming unanchored— while the role of expectations in driving inflation has weakened over time, their contribution to inflation undershooting has increased recently. If expectations are becoming unanchored, as some analysts have suggested, this would imply a risk of continued undershooting of targets.

[2]Estimates of slack for the industrial sector of each economy are obtained through an extended multivariate filter that includes information on GDP, consumer price inflation, PPI inflation, and industrial production.

Figure 2.17. Correlations of Manufacturing Slack in China, Japan, and the United Sates with Import Price Contribution to Inflation in Other Countries

1. Advanced Asia: Correlation of Import Price Contribution to Inflation with Manufacturing Slack in China, Japan, and the United States

2. Emerging Asia: Correlation of Import Price Contribution to Inflation with Manufacturing Slack in China, Japan, and the United States

Source: IMF staff estimates.

Figure 2.18. Phillips curve, Automation, and Global Value Chains

1. Advanced Asia: Phillips Curve and Automation

$$\pi_t = -1.865^{***} + Pinv \times 3.173^{***}$$
$$(0.686) \qquad (0.832)$$
Time and country fixed effects
$R^2 = 0.647$

Higher automation

2. Emerging Asia: Phillips Curve and Integration into Global Value Chains

$$\pi_t = 1.077^{***} + Foreign\ VA \times (-0.0267^{***})$$
$$(0.134) \qquad (0.00483)$$
Time and country fixed effects
$R^2 = 0.66$

Higher GVC integration

Source: IMF staff estimates.
Note: Excludes China and India. The Phillips curve slope estimates for these two countries are less reliable given difficulties in measuring the unemployment gap in countries with large informal sector (India) and state-owned enterprises (China). GVC = global value chain.

Why Is Inflation Becoming Less Sensitive to the Unemployment Gap?

Inflation can become less responsive to labor market slack when the ability of workers to bid up their wages is weakened. Workers' bargaining power is affected by institutional factors, such as union density and collective bargaining agreements, labor laws, and employment regulations.[3] There could also be structural factors at play, such as aging,[4] technological

progress, global integration, and the rise of the service economy.

In Asia, there appears to be a link between the flattening of the Phillips curve and automation (in advanced economies) and between inflation and integration in global value chains (GVCs) (in emerging market economies) (Figure 2.18). To the extent that automation substitutes, or threatens to substitute, for some low- or middle-skilled workers with routine job tasks (Autor and Dorn 2013; Goos, Manning, and Salomons 2014), it could weaken the power of such workers to bid up their wages. It could also weaken their unionization. Workers' bargaining power can also be influenced by exposure to international competition. This may arise through trade and through firms' participation in global supply chains. The threat

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[3]For example, the global decline in trade union membership and the rise of nonregular or nonunionized employment since the 1990s resulted in a collective decline in bargaining power, which may have further undercut leverage for wage increases.

[4]With an aging workforce, job security takes on more importance than wage increases, especially where wages are seniority based.

of production facilities' relocating to economies where labor costs are lower would weaken the ability of workers to bargain for higher wages and weaken the effectiveness of labor unions.

A scatter plot of indicators of automation and GVCs shows some correlation with the slope of the Phillips curve in Asia. Automation is measured by the price of investment goods relative to the consumer price deflator (see Chapter 2 of the October 2017 *World Economic Outlook*). A decline in the cost of capital relative to labor can lower the cost of automating routine tasks. GVC integration is measured through backward linkages—the share of foreign value added in a country's exports—as shown in the Organisation for Economic Co-operation and Development's Trade in Value-Added database. Figure 2.18 shows the scatter plots of annual averages of slope coefficients by country (based on quarterly estimates) and the fitted lines from panel regressions on automation and GVC integration with country and time fixed effects. There is a statistically significant link between the flattening of the Phillips curve and automation in advanced Asia and between the flattening of the Phillips curve and GVC integration in emerging Asia (Figure 2.18).

These findings are in line with those in Chapter 3 of the April 2017 *World Economic Outlook* that show that technological progress, reflected in the steep decline in the relative price of investment goods, along with varying exposure to routine-based occupations, explained about half of the overall decline in the labor shares of income in advanced economies. In emerging markets, the

labor-share evolution was driven by the forces of global integration, particularly the expansion of GVCs, which contributed to raising the overall capital intensity in production.

In general, the Phillips curve appears to have flattened more when Asia experienced a rapid increase in GVC integration and automation. Now that these factors have stabilized, one would expect the slope of the Phillips curve to normalize.

The next section turns to the role of inflation expectations and the risks that they may be becoming unanchored.

How Well Anchored Are Inflation Expectations?

Medium-term inflation expectations in Asia have been on a declining trend since 2011 (Figure 2.10) and have started to contribute to the undershooting of inflation relative to targets more recently (Figure 2.16). This section investigates the risks that inflation expectations may be becoming unanchored by (1) computing the fraction of time that expectations are within inflation targets; and (2) examining the response of expectations to inflation shocks. Box 2.2 examines policy efforts in Japan to break the "deflation mindset."

Time within the Target

As a first step, Table 2.1 shows the number of quarters in which inflation expectations, measured

Table 2.1 Percent of Time Expectations are within Inflation Targeting Range, Inflation Targeting start till 2017

Country	Start of Inflation Targeting	Most Recent Target Band	Expectation Horizon (years)					
			0	1	2	3	4	5
Australia	1993	2–3	54	70	76	82	86	88
China	2005	2–4	40	79	92	92	100	96
Indonesia	2001	2.5–4.5	47	54	40	35	54	50
India	2016	2–6	100	100	100	100	100	100
Japan	2013	1–3	25	65	80	80	80	90
Korea	1998	1.5–2.5	48	86	90	90	80	78
New Zealand	1990*	1–3	73	91	100	100	100	100
Philippines	2002**	2–4	85	88	73	58	45	35
Thailand	2000	1–4	50	72	83	83	86	89

Source: IMF staff calculations.

*Evaluation begins at 1995 due to availability of inflation expectations data.

**Evaluation begins at 2008 due to availability of inflation expectations data.

Table 2.2. Percent of Time Expectations are within Inflation Targeting Range, 2013–17

Country	Start of Inflation Targeting	Most Recent Target Band	Expectation Horizon (years)					
			0	1	2	3	4	5
Australia	1993	2–3	70	100	100	100	100	100
China	2005	2–4	45	75	100	100	100	100
Indonesia	2001	2.5–4.5	50	65	35	10	25	20
India	2016	2–6	100	100	100	100	100	100
Japan	2013	1–3	25	65	80	80	80	90
Korea	1998	1.5–2.5	20	75	80	60	60	80
New Zealand	1990*	1–3	70	100	100	100	100	100
Philippines	2002**	2–4	70	95	75	65	60	60
Thailand	2000	1–4	50	90	100	100	100	100

Source: IMF staff calculations.
*Evaluation begins at 1995 due to availability of inflation expectations data.
**Evaluation begins at 2008 due to availability of inflation expectations data.

Table 2.3. Average Absolute Deviation from Target (from Beginning of Inflation Targeting until 2017)

Country	Start of Inflation Targeting	Most Recent Point Target	Expectation Horizon (years)					
			0	1	2	3	4	5
Australia	1993	1.5	0.7	0.5	0.4	0.3	0.2	0.2
China	2005	3	1.3	0.6	0.6	0.5	0.3	0.4
Indonesia	2001	3.5	1.7	1.1	1.2	1.1	0.9	1.0
India	2016	4	0.9	1.0	1.2	1.0	0.9	0.9
Japan	2000	2	1.4	0.7	0.6	0.9	0.6	0.6
Korea	1998	2	0.7	0.4	0.3	0.3	0.4	0.4
New Zealand	1990*	2	0.8	0.4	0.3	0.3	0.3	0.3
Philippines	2002**	3	0.5	0.4	0.7	0.9	1.0	1.1
Thailand	2000	2.5	1.4	0.9	1.0	1.0	1.0	0.9

Source: IMF staff calculations.
*Evaluation begins at 1995 due to availability of inflation expectations data.
**Evaluation begins at 2008 due to availability of inflation expectations data.

by Consensus Forecasts for different time horizons, are within the target range, divided by the number of quarters since the inflation target was adopted.[5]

The degree of anchoring of inflation expectations to the target varies with the time horizon. Inflation expectations for the current year in most Asian economies are not well anchored. This is because short-term inflation expectations are usually close to actual inflation, which may differ from the target. In contrast, one-year-ahead to five-year-ahead inflation expectations are better anchored to inflation targets, except in Indonesia and the Philippines, where they tend to overshoot. More generally, the anchoring of inflation expectations around targets improved during the past five years (Table 2.2), except in Indonesia and Korea.

Table 2.3 assesses how far inflation expectations are from the inflation targets in terms of average

absolute deviation. Indonesia tends to overshoot the targets the most, and Thailand has started to undershoot more recently. While India tends to have relatively high inflation expectations, they fall within its ±2 percent target range. All economies improved their performance in the past five years, except Indonesia (Table 2.4).

Response to Shocks

The second step is to examine how inflation expectations respond to shocks. Chapter 3 of the October 2016 *World Economic Outlook* and Levin, Natalucci, and Piger (2004) relate changes in inflation expectations to inflation surprises in the following way:

$$\Delta\pi^e_{t+h} = \beta^h\pi^{news}_t + \varepsilon_{t+h} \qquad (2.1)$$

in which π^e_{t+h} is the first difference in inflation expectations h periods ahead; and π^{news}_t is a measure of inflation shocks, defined as the

[5]When the central bank has only a point target, the target range is defined as the point target ±1 percent.

Table 2.4. Average Absolute Deviation from Target, 2013–17

Country	Start of Inflation Targeting	Most Recent Point Target	Expectation Horizon (years)					
			0	1	2	3	4	5
Australia	1993	1.5	0.4	0.2	0.2	0.1	0.1	0.1
China	2005	3	1.0	0.7	0.5	0.5	0.4	0.4
Indonesia	2001	3.5	1.3	1.0	1.0	1.3	1.3	1.4
India	2016	4	0.9	1.0	1.2	1.0	0.9	0.9
Japan	2000	2	1.4	0.7	0.6	0.9	0.6	0.6
Korea	1998	2	1.1	0.3	0.2	0.5	0.4	0.3
New Zealand	1990*	2	0.7	0.2	0.2	0.2	0.2	0.1
Philippines	2002**	3	0.6	0.4	0.6	0.7	0.7	0.8
Thailand	2000	2.5	1.4	0.7	0.5	0.6	0.6	0.4

Source: IMF staff calculations.

*Evaluation begins at 1995 due to availability of inflation expectations data.

**Evaluation begins at 2008 due to availability of inflation expectations data.

difference between actual inflation and short-term inflation expectations (for example, expectations for the current year's inflation from the previous year).

The coefficient β^h reflects the degree of anchoring in h-years-ahead inflation expectations, or what is often referred to as "shock anchoring" (Ball and Mazumder 2011). When monetary policy is credible, the value of β^h should be close to zero at sufficiently long horizons. In other words, inflation shocks should not lead to changes in medium-term expectations when agents believe the central bank is able to counteract short-term shocks and bring inflation back to target over the medium term.

Equation (2.1) is estimated using ordinary least squares with quarterly data from the first quarter of 1995 to the third quarter of 2017 from the Consensus Forecasts for seven advanced economies (Australia, Hong Kong SAR, Japan, Korea, New Zealand, Singapore, Taiwan Province of China) and six emerging markets (China, India, Indonesia, Malaysia, Philippines, Thailand).
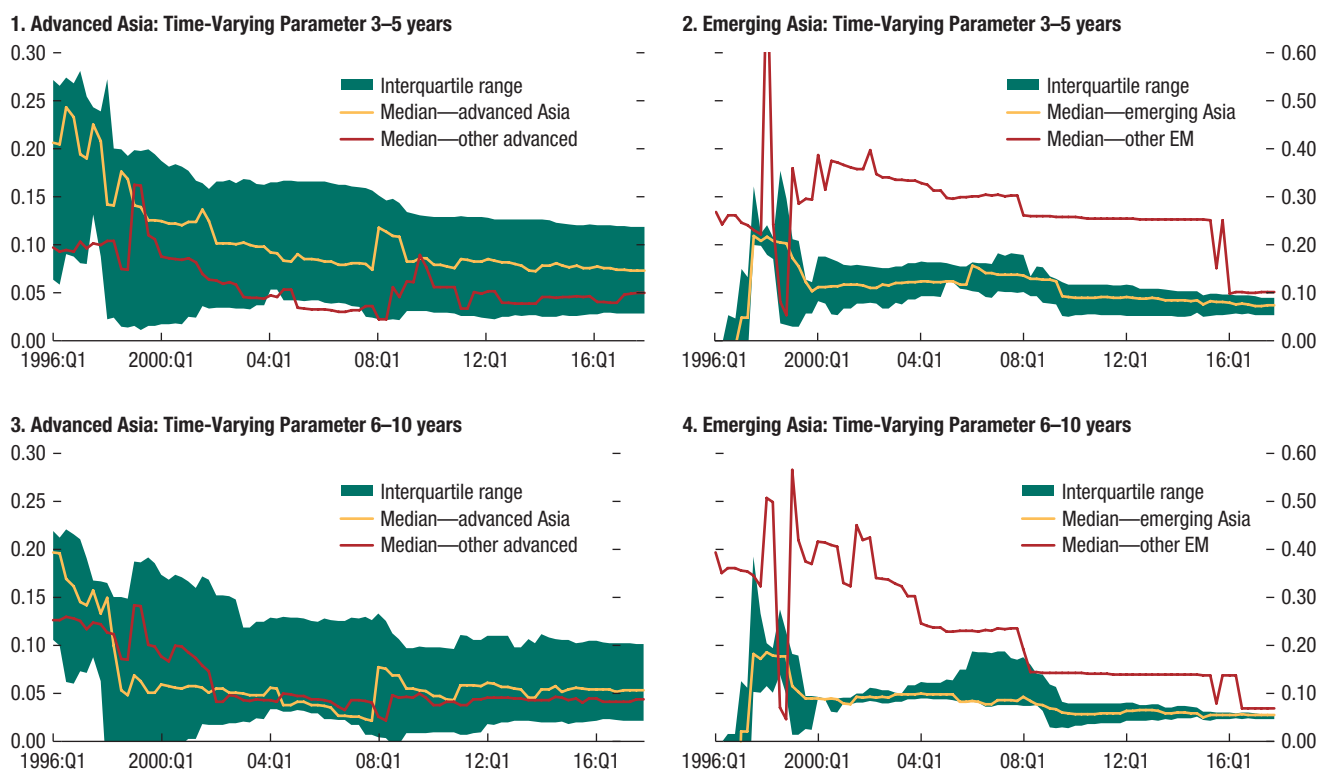
Inflation expectations seem to be better anchored in advanced than in emerging Asia. Figure 2.19 exhibits the sensitivity of inflation expectations to inflation surprises at horizons of 1, 2, 3, 5, 7, and 10 years ahead. In general, the longer the horizon, the less-sensitive inflation expectations are to inflation surprises. Emerging markets in Asia seem to be, on average, more sensitive to inflation shocks than advanced economies in Asia,

Figure 2.19. Sensitivity of Expectations to Inflation Surprises

Advanced Asia: Sensitivity of Expectations to Inflation Surprises

Emerging Asia: Sensitivity of Expectations to Inflation Surprises
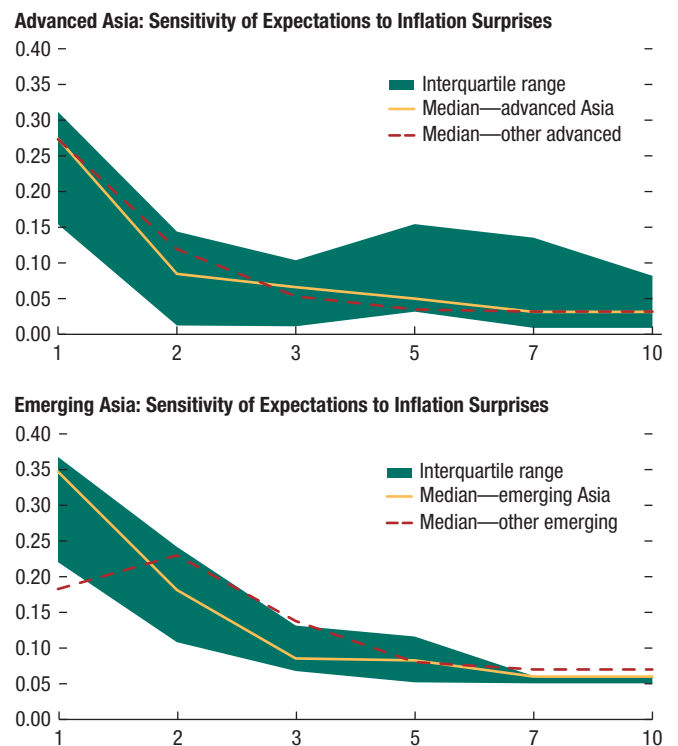
Source: IMF staff estimates.

especially over shorter horizons. For example, a 1 percentage point increase in inflation results in a 0.32 percentage point increase in inflation expectations one year ahead in emerging markets, and a somewhat smaller 0.26 percentage point increase in advanced economies.

Figure 2.20. Sensitivity of Expectations to Inflation Surprises with Time-Varying Parameters

1. Advanced Asia: Time-Varying Parameter 3–5 years

2. Emerging Asia: Time-Varying Parameter 3–5 years

3. Advanced Asia: Time-Varying Parameter 6–10 years

4. Emerging Asia: Time-Varying Parameter 6–10 years

Source: IMF staff estimates.
Note: EM = emerging market.

Inflation expectations have become better anchored over time for both advanced and emerging Asia. Figure 2.20 compares the evolution of the sensitivity of inflation expectations to inflation surprises in both advanced economies and emerging markets for the medium term (3–5 years ahead) and long term (6–10 years ahead), estimating equation (2.1) but allowing the parameters to change over time.[6]

Adopting inflation targeting also seems to help anchor inflation expectations (Figure 2.21). Equation (2.1) is estimated before and after the adoption of the inflation-targeting framework in six economies in the region: New Zealand (March 1990), Australia (July 1993), Korea (January 1998), the Philippines (January 2002), Thailand (May 2002), and Indonesia (July 2005). The sensitivity of inflation expectations to inflation shocks after adopting inflation targeting is smaller
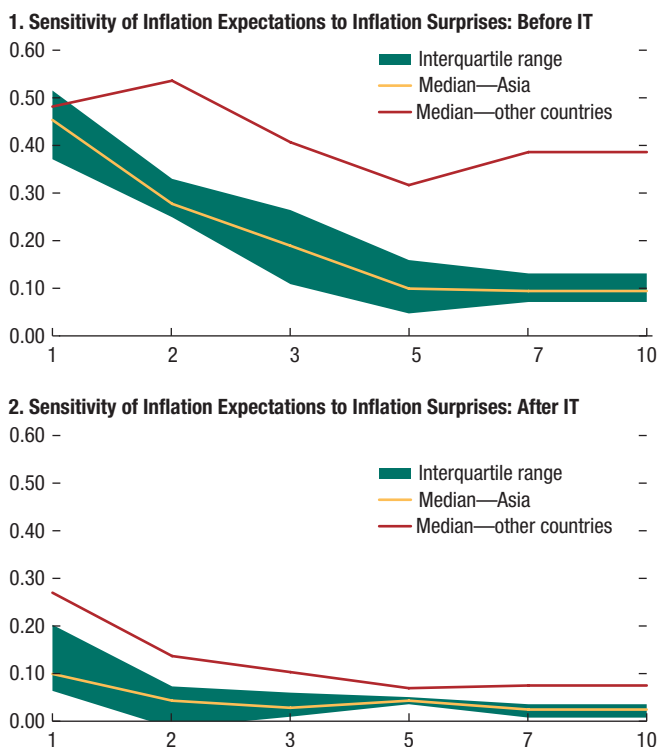
than before adopting inflation targeting, as is the distribution of inflation outcomes. This suggests that adopting an inflation-targeting framework helps to better anchor inflation expectations. This is in line with Brito, Carrière-Swallow, and Gruss (2018), who provide evidence that the adoption of inflation targeting indeed anchors inflation expectations when adoption is accompanied by increased central bank transparency.

Overall, while there is some evidence that inflation expectations have been coming down recently, there is no strong evidence that inflation expectations are becoming unanchored—that is, expectations are generally relatively well anchored to targets.

The estimation of Phillips curves suggested that low inflation in Asia is mostly explained by import prices. This finding is explored further in the next section, which performs principal component

[6]The estimation is done with a Kalman filter.

Figure 2.21. Sensitivity of Expectations to Inflation Surprises and Inflation Targeting

1. Sensitivity of Inflation Expectations to Inflation Surprises: Before IT

Interquartile range
Median—Asia
Median—other countries

2. Sensitivity of Inflation Expectations to Inflation Surprises: After IT

Interquartile range
Median—Asia
Median—other countries

Source: IMF staff estimates.
Note: IT = inflation targeting.

analyses to uncover the importance of global factors in driving inflation.

Global Factors

To gauge the role of global factors in driving inflation dynamics, a latent factor model is applied to cross-country data on inflation over the past 15 years (see Annex 2.2 for details). Three global factors explain 56 percent of the variance in headline inflation in the full cross-country panel sample (Figure 2.22). The first common factor explains 33 percent of the total variance, with the second and third common factors explaining 15 percent and 8 percent, respectively. In many economies, more than 50 percent of the variation in inflation is explained by common factors (Figure 2.23). Advanced Asia seems to be broadly in line with advanced economies in other regions

in terms of factor loadings (Figure 2.24), as are low-income economies and small states. Emerging Asia seems more responsive to Factor 1 than Latin America.

While the common factors are statistical constructs, they can be associated with economic variables that theory suggests might influence global inflation. Factor 1 fits well with the behavior of global commodity prices, especially fuel prices (Figure 2.22). The fit is especially strong after 2006, when there were large swings in the prices of food and fuel. Factor 2 seems to reflect the "great moderation" in inflation brought about by globalization, the rise of e-commerce, transition from central planning in eastern Europe, the aftermath of the emerging market crises in the 1990s, and the wider adoption of inflation-targeting frameworks (Figure 2.22). Factor 3 seems to be associated with the movements in the nominal effective exchange rate of the US dollar.
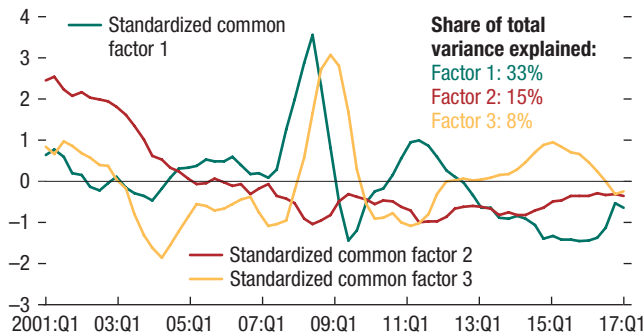
This is consistent with the fact that the US dollar is the numeraire for international trade, and its movements tend to be passed through to local prices (Figure 2.22). The fit is particularly strong when the sample includes low-income economies, while the correlation for the advanced economy and emerging market sample seems to have broken down in 2014. This could reflect the fact that many low-income economies have dollar pegs, so dollar movements have a more pronounced impact on their inflation.

As suggested separately above, China seems to be playing a role in driving inflation at the global level. The correlation of PPI inflation in China with Factor 1 is 0.34, suggesting that China could affect global inflation indirectly via its impact on commodity prices. The correlation of Factor 3 in the advanced economy and emerging market sample with Chinese PPI is 0.59, and it increased to 0.91 in the post-2014 period, as the correlation with the US dollar broke down. This indicates that PPI in China could be playing a larger role in driving inflation in advanced and emerging market economies than the US dollar, especially recently (Figure 2.22).

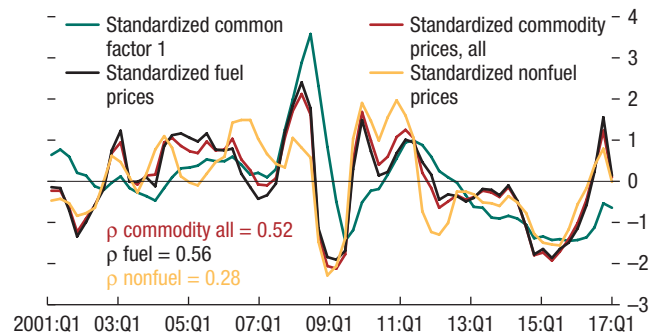## Figure 2.22. Common Factors Driving Inflation

1. Three Latent Common Factors
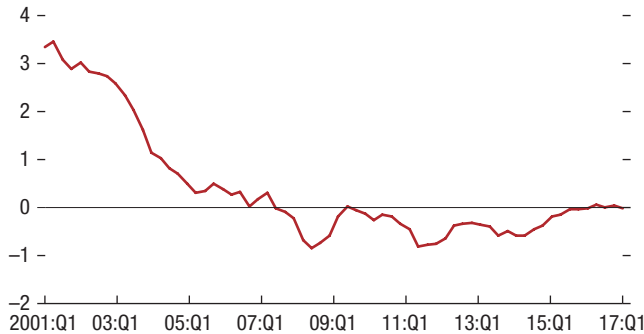**(Percent; year over year, seasonally adjusted)**

Standardized common factor 1

Share of total variance explained:
Factor 1: 33%
Factor 2: 15%
Factor 3: 8%

Standardized common factor 2
Standardized common factor 3

2. Factor 1 and Commodity Prices
(Percent; year over year; seasonally adjusted)

Standardized common factor 1
Standardized fuel prices

Standardized commodity prices, all
Standardized nonfuel prices

ρ commodity all = 0.52
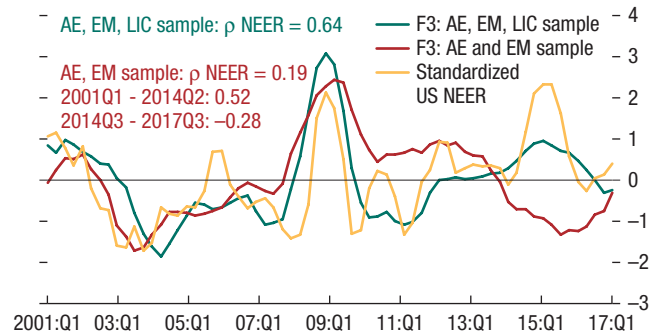ρ fuel = 0.56
ρ nonfuel = 0.28

3. Factor 2: Great Inflation Moderation
(Percent; year over year, seasonally adjusted)

4. Factor 3
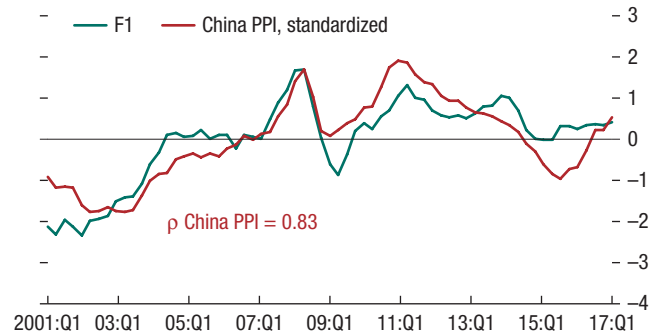**(Percent; year over year; seasonally adjusted)**

AE, EM, LIC sample: ρ NEER = 0.64

AE, EM sample: ρ NEER = 0.19
2001Q1 - 2014Q2: 0.52
2014Q3 - 2017Q3: −0.28

F3: AE, EM, LIC sample
F3: AE and EM sample
Standardized US NEER

5. Factor 3
(Percent; year over year, seasonally adjusted)

AE, EM, LIC sample: ρ NEER = −0.06
AE, EM sample: ρ NEER = 0.58
2001Q1 - 2014Q2: 0.58
2014Q3 - 2017Q3: 0.91

F3: AE, EM, LIC sample
F3: AE and EM sample
Standardized China PPI
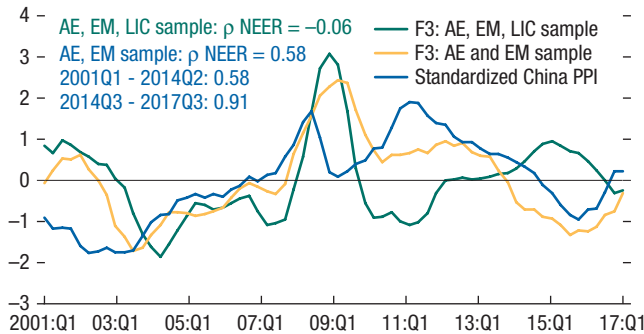
6. Residual PCA: Factor 1 and China PPI
(Percent; year over year, seasonally adjusted)

F1
China PPI, standardized

ρ China PPI = 0.83

Source: IMF staff estimates.
Note: AE = advanced economy; EM = emerging market economy; LIC = low-income country; NEER = nominal effective exchange rate; PCA = principal components analysis, PPI = producer price index.

China also plays a significant role in driving inflation at the regional level. After extracting the global factors, a second principal component analysis on residuals for Asian economies is estimated. The first common regional factor explains 50 percent of the residual variation in inflation and has a correlation with Chinese PPI of 0.83 (Figure 2.22).

To summarize, global factors seem to be playing a large role in Asia, implying that low inflation in the region may not last once global commodity prices recover. But to understand the outlook for inflation better, the next section presents an analysis of trend inflation, which aims to uncover the importance of temporary and permanent shocks in explaining inflation dynamics.

Figure 2.23. Variability of Inflation Explained by Common Factors

1. Advanced Asia: Variability of Inflation Explained by Common Factors
(Percent)

2. Emerging Asia: Variability of Inflation Explained by Common Factors
(Percent)

3. Developing Asia: Variability of Inflation Explained by Common Factors
(Percent)

4. Small States Asia: Variability of Inflation Explained by Common Factors
(Percent)
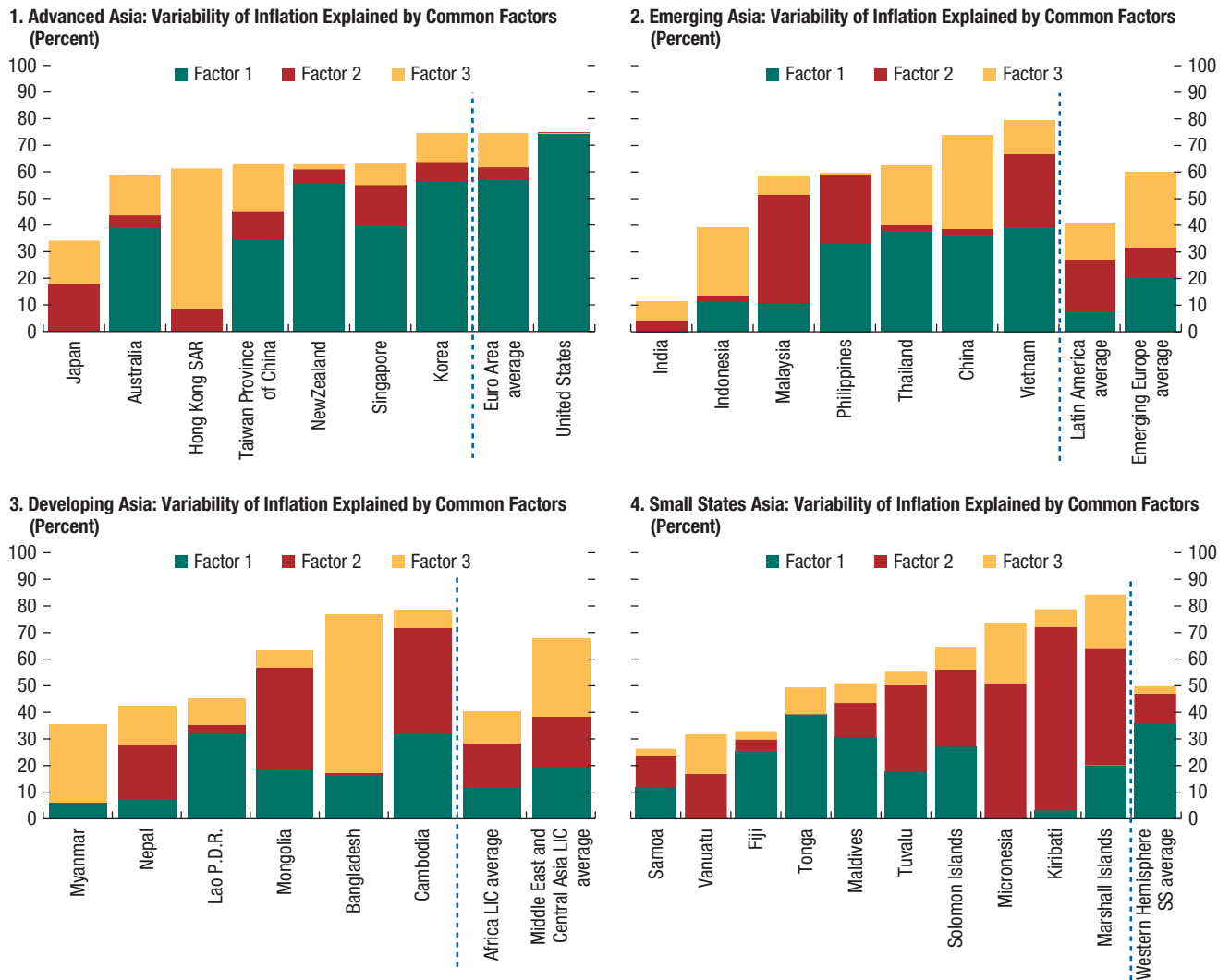
Source: IMF staff estimates.
Note: LIC = low-income country; SS = small state.

Trend Inflation[7]

Univariate time series models have been relatively more successful than more structural models in forecasting inflation (Stock and Watson 2007). In these models, inflation is represented as the sum of a permanent component (that is, the trend) and a temporary component.

Trend inflation has been declining. In both advanced and emerging Asia, trend inflation came down substantially over the 1990s, and there was another decrease, although milder, after 2011.

The decomposition shows a concentration of transitory disinflationary shocks in the region over the past few years (Figure 2.25). The recent bout of low inflation in Asia seems to have been driven by temporary forces, with the transitory component of inflation predominantly negative for most economies since 2014. Going forward, positive transitory shocks could lift inflation more quickly than expected. In addition, nonlinearities
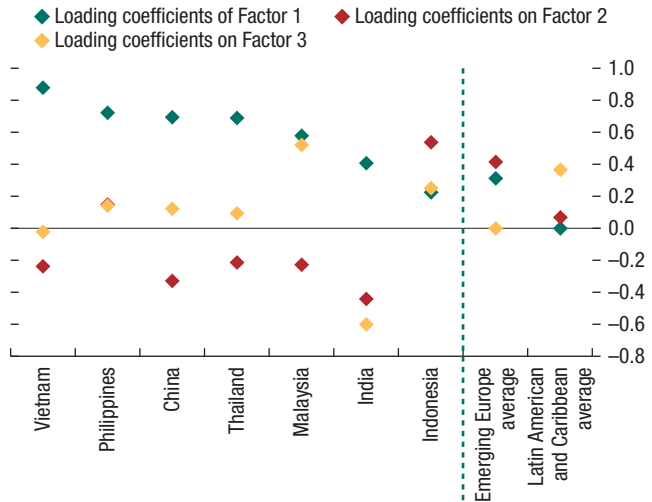
[7]See Annex 2.3 for details.

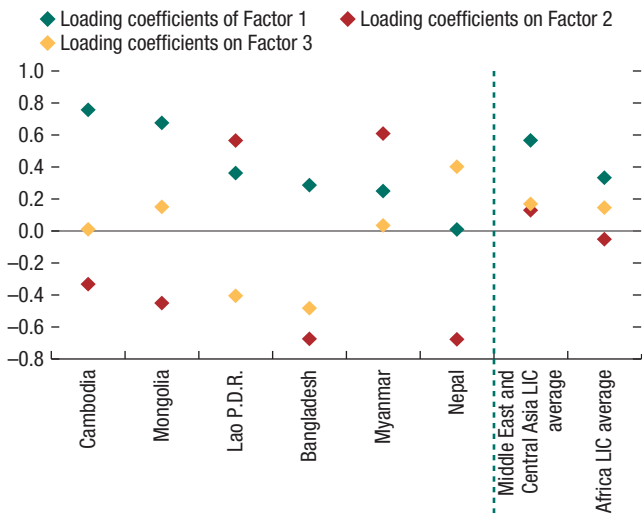**Figure 2.24. Importance of Common Factors across Countries**

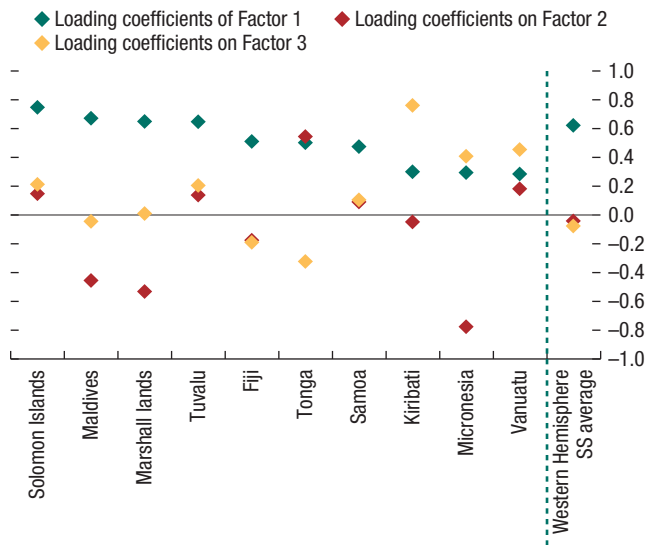**1. Advanced Asia: Loading Coefficients of Factors 1, 2, and 3**
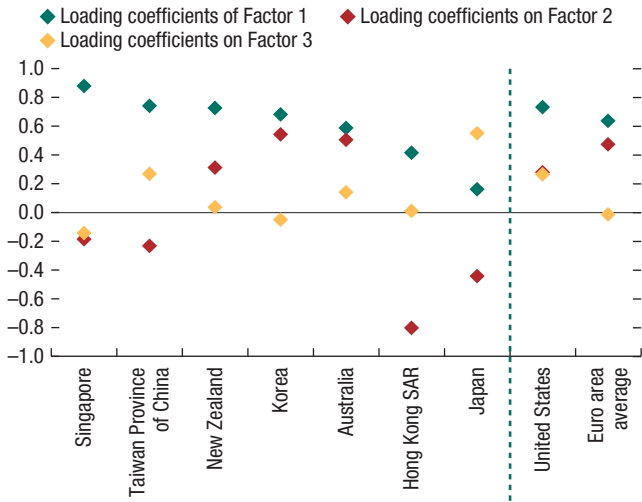
2. Emerging Asia: Loading Coefficients of Factors 1, 2, and 3

3. Developing Asia: Loading Coefficients of Factors 1, 2, and 3

4. Small States Asia: Loading Coefficients of Factors 1, 2, and 3

Source: IMF staff estimates.
Note: LIC = low-income country; SS = small state.

of the Phillips curve could lead to a jump in inflation at higher inflation levels.[8]

[8]For example, Guimaraes and Papi (2016) find that inflation becomes more sensitive to the output gap at higher inflation levels.

# Conclusions and Policy Implications

Inflation in Asia largely followed the global pattern of a sharp decline during 2012–15 followed by an uptick more recently. The analysis in this chapter suggests that this reflects Asian economies' exposure to commodity price cycles and global competition, with inflation fluctuations mainly being driven by prices of imported goods. As
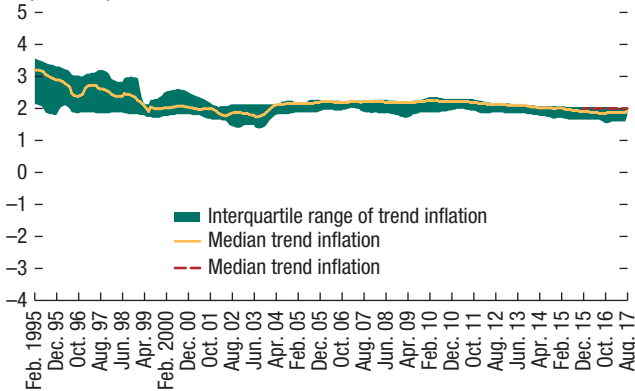
Figure 2.25. Trend and Transitory Inflation
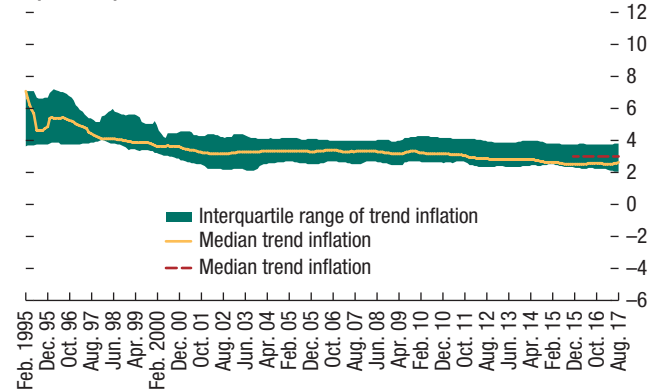
1. Advanced Asia: Transitory Inflation
(Percent)
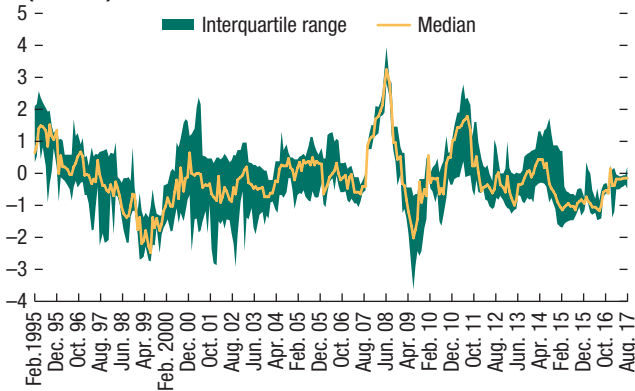
2. Emerging Asia: Transitory Inflation
(Percent)
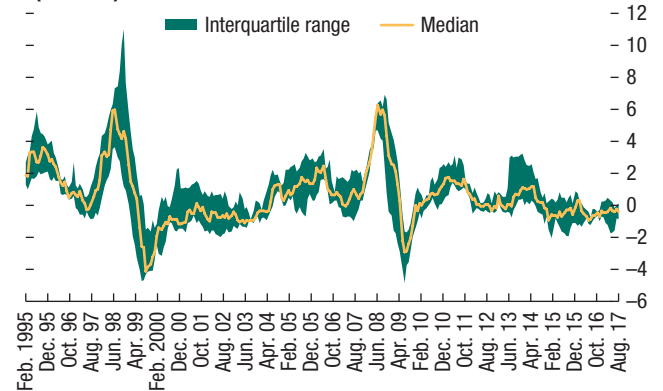
3. Advanced Asia: Trend Inflation
(Percent)

4. Emerging Asia: Trend Inflation
(Percent)

Source: IMF staff estimates.

inflation in the United States and commodity prices rise, Asia is likely to see rising inflation.

The inflation process has also become more backward-looking since the global financial crisis. This implies a risk that inflation shocks can lead inflation to deviate persistently from targets, undermining their credibility, and suggests benefits from pursuing a clear, well-communicated policy reaction function. The analysis in the chapter also suggests room for Asian emerging markets to further strengthen their monetary policy frameworks. There is evidence that inflation expectations are better anchored in Asian economies that adopted inflation-targeting frameworks. Finally, the chapter provides some

evidence that Phillips curves in Asia have flattened, implying a higher real cost for reducing inflation.

These findings mean that central banks should be vigilant about imported inflation when setting their policy reaction function to avoid sustained deviations from inflation targets. With more backward-looking inflation and a flatter Phillips curve, the costs of disinflating could be larger than in the past, as a central bank would need to induce a larger change in domestic demand to bring inflation back to target (Figure 2.26).

Higher exchange rate flexibility will better insulate domestic inflation from imported inflation. Inflation is likely to increase in the United States, as output will rise above potential following a sizable fiscal expansion. In that context, an

appreciation of Asian currencies vis-à-vis the US dollar will help Asian economies preserve monetary policy autonomy and keep higher inflation pressure coming from the United States under control.

In the case of a commodity price shock,[9] the appropriate response is to accommodate the first-round effects on the CPI but not the second-round effects on other CPI components. This will lower output volatility, as shown in Chapter 3 of the September 2011 *World Economic Outlook.* Since commodity price shocks are typically temporary, this suggests that central banks should consider underlying as well as headline inflation in their monetary policymaking.

Having said that, in economies where central bank credibility is limited and the share of commodity prices in the CPI is high, a commodity price shock is likely to have larger second-round effects and require a more aggressive policy response when excess demand pressures are high and inflation is running above target.

Figure 2.26. Slope of Phillips Curve and Disinflation
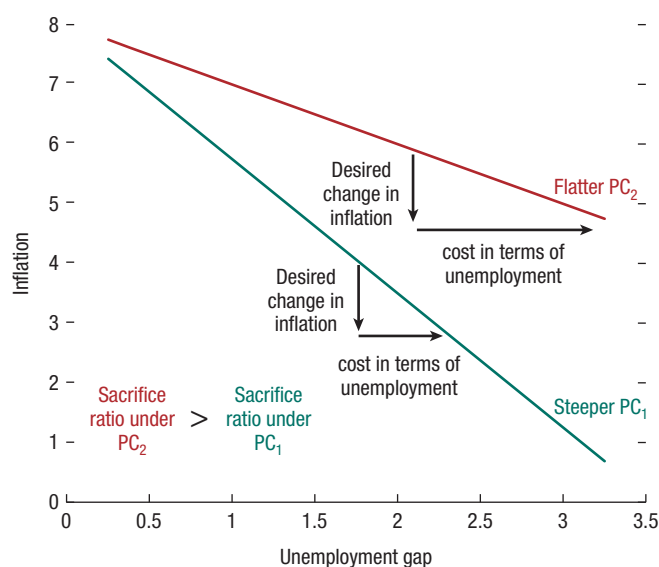
Source: IMF staff estimates.
Note: PC = Phillips curve.

[9]A commodity price shock could be seen as a special case of imported inflation; however, from an analytical point of view, they are different because commodity price shocks entail changes in terms of trade.

Box 2.1. The Disconnect between the Consumer and Producer Price Indices in China: Where Are Price Pressures Coming From?

In 2017, Chinese producer prices soared while consumer prices remained subdued. Rather than a puzzle, this disconnect stems from (1) an expansion in domestic infrastructure and real estate investment, and (2) the rebound in advanced economies' demand, both of which are behind the acceleration in Chinese growth since late 2016. Supply restrictions in selected industries in China did not play a lead role in the broad-based reflation of producer prices. Going forward, while the global environment will remain supportive of Chinese producer prices, a less favorable outlook for domestic investment and less stringent supply restrictions will lead to a gradual unwinding of producer price pressures.

Producer price index (PPI) and consumer price index (CPI) inflation diverged markedly in 2017 (Figure 2.1.1). The disconnect between producer and consumer prices is not new, and has been particularly noticeable since 2012, when the PPI fell into deflation territory for 54 consecutive months, while the CPI hovered around 2 percent. The declining PPI could reflect a variety of factors, including excess capacity in some sectors, global developments (PPIs have followed a similar pattern in several Asian economies), and, more recently, falling commodity prices. The two price indices have grown further apart as PPI inflation rebounded since November 2016 and remained above 5 percent.

The contemporaneous disconnect between the CPI and PPI is not surprising given the modest overlap in representative baskets (Figures 2.1.2 and 2.1.3).[1] Final consumption goods behave similarly across the CPI

Figure 2.1.1. Consumer Price Index and Producer Price Index Inflation
(Percent)

Sources: Haver Analytics.
Note: CPI = consumer price index; PPI = producer price index.

Figure 2.1.2. Consumer Price Index Decomposition
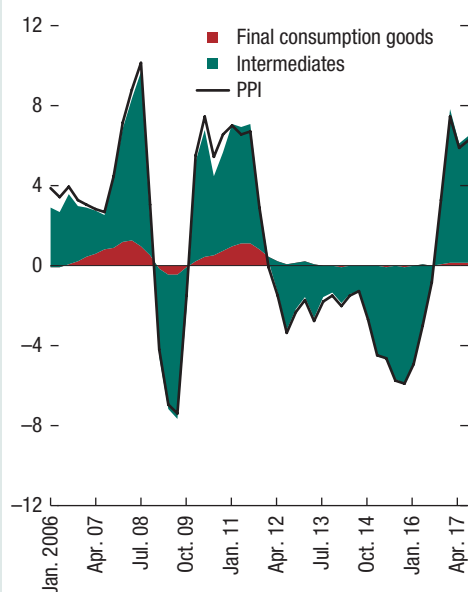*(Percent)*
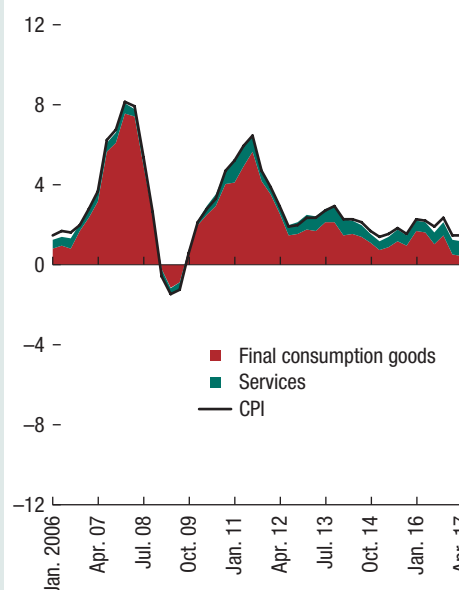
Sources: Haver Analytics; and IMF staff estimates.
Note: CPI = consumer price index.

This box was prepared by Rui Mano.
[1]China does not publish the composition of its CPI and PPI baskets. The figures rely on regression-estimated weights.
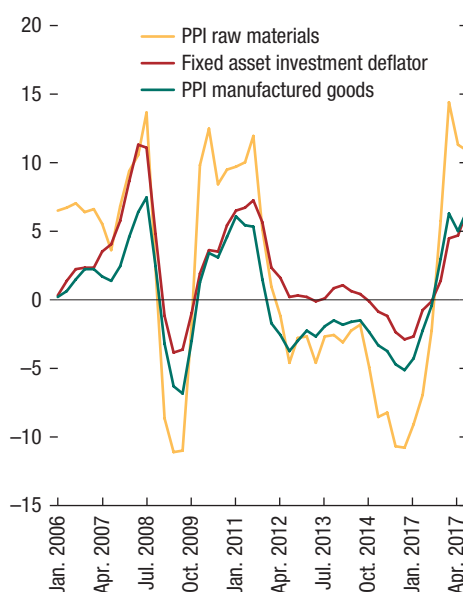
Box 2.1 *(continued)*

Figure 2.1.3. Producer Price Index Decomposition
(Percent)

Sources: Haver Analytics; and IMF staff estimates.
Note: PPI = producer price index.

Figure 2.1.4. Producer Price Index and Investment Deflator
(Percent)

Source: Haver Analytics.
Note: CPI = consumer price index; PPI = producer price index.

and PPI, but they make up three-quarters of the CPI basket and only one-quarter of the PPI basket.[2] Thus, while final consumption goods drive CPI, in the case of PPI it is the price of intermediates that plays the leading role.

So where are price pressures on intermediate goods coming from? An overall consumption demand shock cannot be the driver behind PPI developments, given muted consumer prices. Moreover, if the price of final consumption is not rising in response to higher prices of intermediate goods, then it means either that (1) the margins of producers of final goods are being squeezed, something that does not seem to be happening at present in China, or (2) upstream price pressures are showing up elsewhere.

China's investment demand may partly explain the rise in producer prices of intermediate goods (Figure 2.1.4). Since early 2016 and through 2017, the government has propped up the real estate market and infrastructure investment to support growth. Prices for fixed asset investment, a high-frequency measure of Chinese investment, co-move with PPI inflation of raw materials and intermediate manufacturing goods. This points to an investment demand shock as one of the drivers behind PPI inflation.

In addition, a spike in foreign demand since late 2016 also seems to have played a role. Global trade rebounded strongly in 2017, led by final demand in advanced economies. China's real exports of goods surged in response, as did their prices (Figure 2.1.5). Intermediate manufacturing goods are an important Chinese export, and thus their prices co-move strongly with overall goods export prices. Therefore, the demand shock in advanced economies seems to be another key factor behind PPI inflation.

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[2]The Chinese PPI is composed of goods for final consumption and intermediates. Within intermediates there are three categories: mining and quarrying goods, raw materials, and intermediate manufacturing goods.
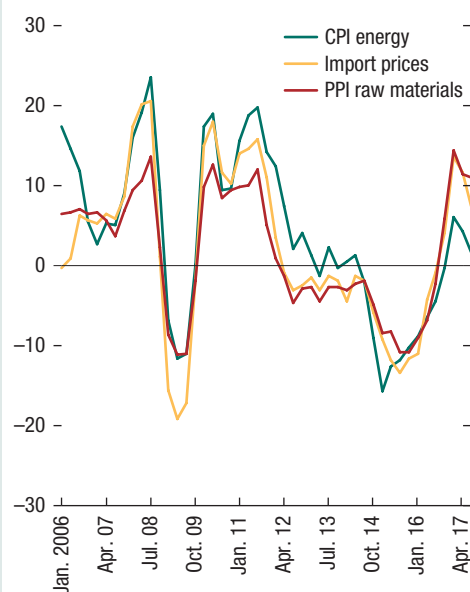
Box 2.1 *(continued)*

Figure 2.1.5. Producer Price Index and Export Prices
(Percent)

— Export prices
— PPI intermediates manufactured goods
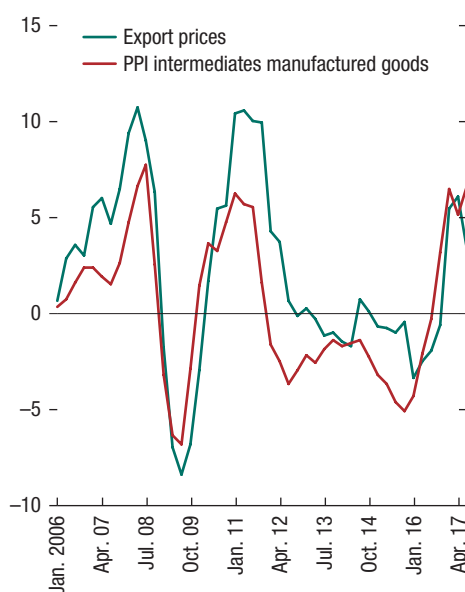
Source: Haver Analytics.
Note: PPI = producer price index.

Figure 2.1.6. Producer Price Index, Consumer Price Index, and Import Price Inflation
(Percent)

— CPI energy
— Import prices
— PPI raw materials

Source: Haver Analytics.
Note: CPI = consumer price index; PPI = producer price index.

In turn, higher domestic investment and foreign demand led to surging imports of raw materials, which further supported PPI inflation (Figure 2.1.6). China depends on imports of raw materials to satisfy its investment demand and as the input into its manufacturing exports. It is thus not surprising that the price pressures in investment and intermediate manufacturing goods for export translate into higher prices for raw materials and overall import prices.[3] The energy component of the CPI is also tightly linked with prices of raw materials, but its weight is small, and thus this link is not discernible in the headline CPI numbers.

Supply-side adjustments in selected Chinese upstream industries magnified the PPI inflation rebound but did not play a lead role. China started a campaign in 2016 to shut down overcapacity in the steel and coal industries. This may have played a marginal role in supporting PPI inflation but cannot explain the broad-based reflation that is more consistent with the investment and foreign-demand shocks. Moreover, actual production of steel throughout the period increased. And while coal production declined in 2016, it was on the rise in 2017 until the government initiated an intensified crackdown on polluting industries ahead of the 2017–18 winter. This latest campaign may have also contributed to sustaining price pressures, although it is hard to assess its ultimate effects because the authorities suspended production of intermediate goods while also suspending construction projects that demand the same input.

[3]Some of the increase in commodity prices cannot be attributed solely to international and Chinese demand; markets such as that for crude oil are also heavily influenced by supply constraints.

Box 2.2. Japan's Elusive Quest for Inflation

The Japanese economy has experienced low inflation for more than two and a half decades. Annual consumer price index (CPI) inflation averaged 0.2 percent between 1993 and 2017 (Figure 2.2.1), and the GDP deflator contracted by an average of 0.3 percent a year during the same period. While efforts to reflate the economy intensified under Abenomics, breaking the deflation mindset and reanchoring inflation expectations at the 2 percent inflation target have proved difficult. This box sheds light on the following questions: Why did Japan fall into a deflation trap? What were the policy responses before and after the introduction of Abenomics? What are the policy constraints and prospects for successfully reflating the economy?

Falling into the Deflation Trap

A multitude of factors contributed to Japan's transition into deflation in the 1990s. From the demand side, the economy was hit by several shocks. The collapse of the asset price bubble in the early 1990s led to deleveraging by households, banks, and businesses, causing the real economy to slow, unemployment to rise, and inflation to fall (Figure 2.2.1). The 1997–98 Asian crisis further weakened demand, and high levels of nonperforming loans resulted in a banking crisis that finally pushed the economy into deflation in 1998–99. Supply-side factors likely added to the effect of demand shocks, exacerbating deflation pressure. In particular, the government began to deregulate the labor market in the mid-1990s and early 2000s, leading to a sharp rise in the share of nonregular workers. The consequent decline in labor's bargaining power contributed to downward pressure on prices by lowering unit labor costs (Figure 2.2.2). Moreover, the aging and shrinking of Japan's labor force—which intensified in the 1990s—had an adverse impact on potential growth and fiscal sustainability, negatively affecting permanent income and potentially boosting precautionary savings (Anderson, Botman, and Hunt 2014; Liu and Westelius 2017).

Figure 2.2.1. Japan: CPI Inflation and Unemployment Rate, 1989–2017
(Percent)
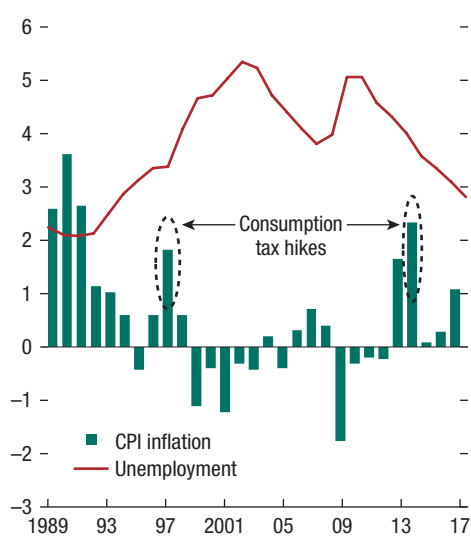
Source: Haver Analytics.
CPI = consumer price index.

Figure 2.2.2. Japan: Inflation and Unit Labor Cost Growth, 1980–2017
(Percent)

Sources: Haver Analytics; and IMF staff calculations.
Note: yoy = year over year.
[1]Detrended by Hodrick-Prescott filter.

This box was prepared by Niklas Johan Westelius.

Box 2.2 *(continued)*

Policy Response and the Emergence of the Deflation Mindset

The policy response to the economic slowdown in the 1990s may also have played a role in Japan's deflation experience. As several observers have pointed out, the monetary policy response was "too little, too late" and fiscal policy proved ineffective in stimulating growth (Bernanke and Gertler 1999; Ito and Mishkin 2006; Kuttner and Posen 2002). In fact, the Bank of Japan only gradually lowered the policy rate, and it was not until 1999 that it adopted its "zero interest rate policy," and later on, in 2001, switched to quantitative easing. In hindsight, the exit from quantitative easing and the increase in the policy rate from zero that started in early 2006 was probably premature. Fiscal policy did remain broadly accommodative throughout the period of deflation, but periodic attempts at consolidation led to stop-and-go policy implementation that reduced the effectiveness of fiscal policy. In short, the lack of sustained follow-through by fiscal and monetary policy—and the associated uncertainty—likely significantly reduced policy effectiveness. Once the inflation outlook finally did improve in 2006–07, reflation prospects were again shattered when the global financial crisis hit in 2008 and CPI inflation fell back into negative territory.
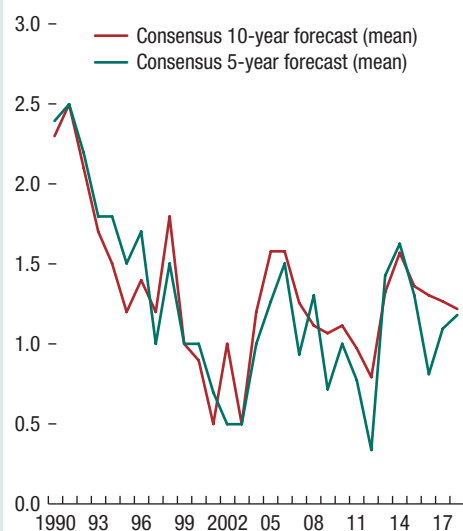
Importantly, the prolonged period of low inflation resulted in a gradual decline in inflation expectations and the emergence of the so-called deflation mindset (Figure 2.2.3). After two and a half decades of depressed inflation and deflation, a generation of Japanese has grown up in an environment of infrequent price increases. With the nominal interest rate at the zero lower bound, this has significantly constrained the Bank of Japan's ability to lower the real interest rate and generate demand-driven inflation. Moreover, low inflation expectations have contributed to less ambitious wage demands by unions, and firms have become reluctant to adjust prices in response to economic conditions (Watanabe and Watanabe 2018).

Abenomics: From Shock Therapy to Sustained Accommodation

In early 2013, the Japanese authorities shifted gears to decisively lift the economy out of deflation, boost growth, and address public debt sustainability. To break the deflation mindset and push down the entire yield curve, the Bank of Japan announced an explicit inflation target of 2 percent and significantly ramped up its Japanese government bond (JGB) purchases. These actions were also complemented by flexible fiscal policy and a commitment to implementing needed structural reforms. The initial impact appeared favorable as CPI inflation reached 1.6 percent in 2013, and inflation expectations started to gradually rise.

Figure 2.2.3. Japan: Long-term Inflation Expectations, 1990–2018
(Percent)

Source: Consensus Economics.

With a sharp drop in energy prices, however, the slowdown in global growth, and the implementation of the 2014 consumption tax hike, Japanese inflation began to drop again. The Bank of Japan provided additional stimulus by boosting JGB purchases in October 2014 and implementing a negative interest rate on excess marginal reserves in early 2016. By mid-2016, however, it was clear that these efforts had not yielded the desired result. Moreover, concerns were emerging that the Bank of Japan would run out of JGBs to purchase and that the flattening of the yield curve could significantly impair financial intermediation by further depressing profitability (Figure 2.2.4).
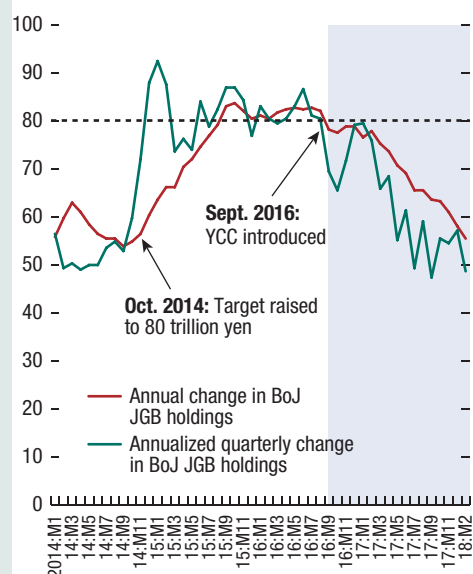
Box 2.2 *(continued)*

Figure 2.2.4. Japan: Annual Change in Bank of Japan Japanese Government Bond Holdings, 2014–17
(Trillions of Yen)

Source: Haver Analytics.
Note: BoJ = Bank of Japan; JBG = Japanese government bond; YCC = yield curve control.

To address these concerns, the Bank of Japan introduced its yield curve control framework in September 2016. This framework is composed of two main commitments: (1) to keep expanding the monetary base until inflation overshoots its target in a stable manner; and (2) appropriately shaping the entire yield curve to achieve price stability while considering financial conditions. So far, the framework appears to have worked relatively well (IMF 2017c). By deemphasizing quantities in favor of a yield target, the Bank of Japan has been able to reduce JGB purchases and thus alleviate some concerns over policy sustainability (Figure 2.2.4). Moreover, increased long-term yields have helped alleviate pressures on institutional investors (for example, pension funds and insurers).

Looking Forward: The High-Pressure Economy and Prospects for Reflation

In the context of an improving global environment, the Japanese economy has now experienced eight consecutive quarters of above-potential growth, the unemployment rate is at its lowest level since 1993, and CPI headline inflation reached 1.1 percent in March 2018. Nevertheless, core inflation remains stubbornly, and crucially low, long-run inflation expectations have yet to display convincing signs of moving toward the 2 percent target. Moreover, wage growth remains very low, particularly for regular workers, and anecdotal evidence suggests that firms are reluctant to pass higher labor costs on to prices—instead resorting to labor rationing and investment in labor-saving technologies.

Thus far in 2018 the Bank of Japan has been taking a patient approach, with the view that labor shortages will build enough pressure in the economy to force firms to increase prices at a higher rate. Nonetheless, with inflation expectations remaining slow to adjust, this process may take time, and at some point, the monetary policy cost-benefit trade-off may change. In addition, since other major central banks are beginning to normalize policy, market speculation is growing as to whether and when the Bank of Japan will follow suit. It is therefore imperative to take advantage of the current favorable macroeconomic environment to implement a comprehensive policy package that exploits complementarities between labor market reforms and coordinated income and demand policies, so that the Japanese deflation mind-set can be durably unwound.

Annex 2.1. New Keynesian Phillips Curve

The new Keynesian Phillips curve relates domestic inflation to inflation expectations, cyclical unemployment, and imported inflation as follows:

$$\pi_t = \alpha_t \pi_{t+10}^e + (1 - \alpha_t)\hat{\pi}_{t-1} + \beta_t u_t^c + \gamma_t \pi_t^m + \varepsilon_t, \tag{A2.1.1}$$

in which π_t is headline consumer price inflation; π_{t+10}^e is inflation expectations 10 years ahead;[1] $\hat{\pi}_{t-1}$ is the moving average of inflation in the previous four quarters; u_t^c is cyclical unemployment, estimated as the deviation of the unemployment rate from the rate consistent with stable inflation, or the nonaccelerating inflation rate of unemployment; π_t^m is inflation in the relative price of imports (the import-price deflator relative to the GDP deflator); and ε_t is the impact of other factors, including measurement error and supply shocks in addition to those controlled for by relative import price inflation.

The coefficient α_t captures the degree to which inflation is driven by long-term inflation expectations as opposed to lagged inflation; β_t denotes the slope of the Phillips curve (that is, the sensitivity of inflation to cyclical unemployment); and γ_t captures the impact of imported inflation.

Equation (A2.1.1) is estimated at the country level for 44 advanced and emerging market economies, including 13 Asian economies, using quarterly data for the first quarter of 1990 to the second quarter of 2017. The estimation method is maximum likelihood based on a constrained nonlinear Kalman filter that allows for time variation in the regression coefficients. Allowing time variation is important to capture structural changes.

[1]When such measures are not available, five-year *World Economic Outlook* forecasts of headline inflation are used.

Annex 2.2. Common Factors

To gauge the role of global factors in driving inflation dynamics, and following the approach in Chapter 1 of the May 2015 *Regional Economic Outlook: Asia and Pacific*, a latent-factor model is applied to the inflation rates of 136 advanced, emerging market, and low-income economies from the first quarter of 2001 to the third quarter of 2017 in order to identify the global common drivers of inflation and their importance for individual economies:

$$
\begin{bmatrix} \pi_{1,t} \\ \pi_{2,t} \\ \vdots \\ \pi_{N,t} \end{bmatrix} - \begin{bmatrix} \bar{\pi}_{1,t} \\ \bar{\pi}_{2,t} \\ \vdots \\ \bar{\pi}_{N,t} \end{bmatrix} = \begin{bmatrix} \beta_{1,1} & \beta_{1,2} & \cdots & \beta_{1,K} \\ \beta_{2,1} & \beta_{2,2} & \cdots & \beta_{2,K} \\ \vdots & \vdots & \ddots & \vdots \\ \beta_{N,1} & \beta_{N,2} & \cdots & \beta_{N,K} \end{bmatrix} \begin{bmatrix} f_{1,t} \\ f_{2,t} \\ \vdots \\ f_{K,t} \end{bmatrix} + \begin{bmatrix} e_{1,t} \\ e_{2,t} \\ \vdots \\ e_{N,t} \end{bmatrix}
$$

$$
\text{(A2.2.1)}
$$

$$
\pi_t - \bar{\pi}_t = \beta f_t + e_t \qquad \text{(A2.2.2)}
$$

Each economy's demeaned total inflation $(\pi_t - \bar{\pi}_t)$ can be decomposed into a common component (βf_t) and an idiosyncratic component (e_t); f is a $(K \times 1)$ vector of latent (unobserved) factors; and β is an $(N \times K)$ matrix, representing the loading coefficients or weight of each common factor in each country's inflation. Inflation is measured as the year-over-year percent change in the headline consumer price index, and the model is estimated with principal component analysis.

The importance of each common factor is country-specific, depending on the estimated value of the loading coefficients, which are assumed to be constant over the entire period and loaded contemporaneously. A higher loading factor means that the country's inflation is affected more strongly by that factor. Cross-country differences in inflation reflect not only country-specific factors but also different sensitivity to global factors (that is, different loading factors).

Annex 2.3. Trend Inflation

Chan, Clark, and Koop (2016) decompose inflation, π_t, into trend, π_t^*, and a deviation from trend, c_t, components in an unobserved-components framework (Stock and Watson 2007):

$$\pi_t = \pi_t^* + c_t \qquad (A2.3.1)$$

The two components of inflation are identified by assuming that

$$\lim_{j \to \infty} E_t\left[\pi_{t+j}\right] = E_t\left[\pi_{t+j}^*\right] = \pi_t^* \qquad (A2.3.2)$$

and

$$\lim_{j \to \infty} E_t\left[c_{t+j}\right] = 0 \qquad (A2.3.3)$$

By construction, the permanent component or "trend" in inflation, π_t^*, reflects the most likely inflation rate to be observed once transitory influences on inflation die off.

Trend inflation is estimated within an unobserved component and stochastic volatility model with data on headline inflation for six advanced economies (Australia, Hong Kong SAR, Japan, Korea, New Zealand, Taiwan Province of China) and six emerging markets (China, India, Indonesia, Malaysia, Philippines, Thailand). A crucial element in the analysis is the use of survey measures of long-term inflation expectations (6–10 years ahead) from the Consensus Forecasts as additional information to improve the estimation (Chan, Clark, and Koop 2016; Garcia and Poon, forthcoming).

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