CHAPTER 3

TARGET WHAT YOU CAN HIT: COMMODITY PRICE SWINGS AND MONETARY POLICY

This chapter examines the inflationary effects of commodity price movements and the appropriate monetary policy response. Commodity prices tend to have stronger and longer-lasting effects on inflation in economies with high food shares in the consumption basket and in economies with less firmly anchored inflation expectations. The chapter's analysis suggests that central banks in these economies should set and communicate monetary policy based on developments in underlying inflation rather than headline inflation, where underlying inflation means a measure that reflects the changes in inflation that are likely to be sustained over the medium term. Because shocks to commodity price inflation are typically beyond the control of policymakers, hard to predict, and often not sustained, central banks seeking to establish credibility are generally better off setting and communicating their monetary policy in terms of underlying inflation rather than headline inflation. A headline framework may be preferred, however, if economic agents place a much higher value on the stability of headline inflation than on the stability of output. Finally, in emerging and developing economies with excess demand pressures and inflation already above target, a food price shock is likely to have larger second-round effects and require a more aggressive policy response than in the absence of such preexisting demand pressures.

International food prices have risen to levels last seen during the 2003–08 commodity price surge. After falling during the Great Recession, world food prices surged again in late 2010 and are now around their mid-2008 peak (Figure 3.1). Oil and energy prices also rose in recent months on the back of increased demand and concerns about supply disruptions. The spot price of a barrel of Brent crude oil reached $110 in April 2011, compared with an average of $34 a barrel over the past 30 years.

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The significant volatility in commodity prices and the prospect that food and fuel prices may remain elevated for a sustained period are a significant challenge for monetary policymakers. One concern is that the recent rises in food and energy inflation may prove to be persistent, leading to expectations of rising inflation that could spill over into higher wage demands and underlying inflation.[1] Another concern is that attempting to stabilize inflation in the face of such high volatility could have significant economic costs. These concerns are most acute in economies where the share of food in the consumption basket is high and the effects of these shocks are largest.

How then should monetary policy respond to these risks? Standard advice, particularly in advanced economies, is to accommodate the first-round effects of food and energy price swings on the consumer price index (CPI) but not the second-round effects on other CPI components.[2] Because shocks to food and energy inflation are typically transitory, the standard advice amounts to a recommendation that central banks set and communicate their monetary policy in terms of underlying inflation. When commodity shocks are indeed largely transitory, this approach can deliver more stable headline CPI inflation over the medium term and lower output volatility than a framework that requires the central bank to stabilize headline inflation in the short term, which entails countering even the first-round effects of such shocks.

Central banks often operate in line with standard advice, but the details vary across countries. A number of central banks closely watch underly-

[1]For example, recent studies suggest that oil prices may trend higher for many years to come on the back of scarce supplies and rising demand from emerging market economies such as India and China. For a further discussion of these risks, see the October 2008 and April 2011 issues of the *World Economic Outlook* and Helbling and Roach (2011).

[2]The rationale for accommodating first-round effects rather than attempting to prevent them is that such an approach reduces output fluctuations.

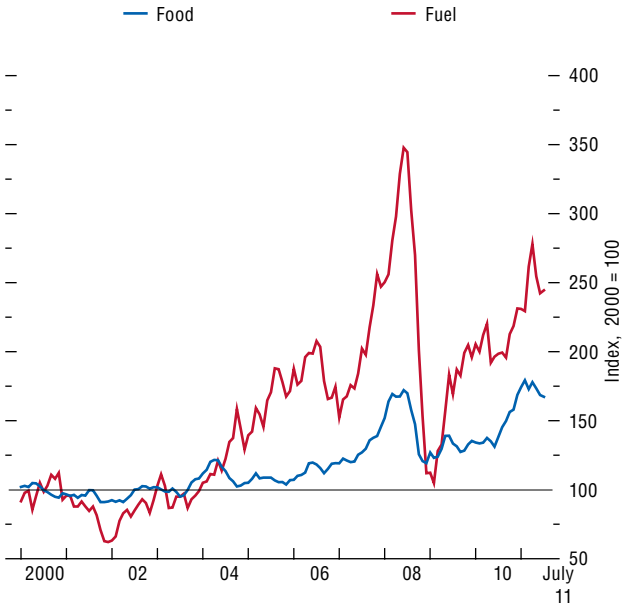
ing inflation measures that down-weight or exclude certain volatile components, notably food and energy prices.[3] Some central banks set their price stability goals in terms of a core inflation measure.[4] Most others target headline inflation but define their targets over the medium term and thus down-weight the influence of transitory shocks, such as those to food and energy prices.[5] In this respect, the effect is similar to using an underlying inflation measure as the target.

Overall, a variety of measures of inflation are used either as targets or as guides. In what follows, underlying inflation is measured simply by headline

Figure 3.1. World Commodity Prices, 2000–11

(In real terms, as deflated by U.S. consumer price index)

Food and fuel prices have risen dramatically since 2000. Food and fuel prices peaked in 2008 at levels 80 percent and 250 percent above the levels in 2000. Current prices are 75 percent and 150 percent above 2000 levels, and there are concerns that structural forces will push prices higher over coming years.



Sources: Haver Analytics; and IMF staff calculations.

[3]For example, the Bank of Japan, the U.S. Federal Reserve, and the Reserve Bank of Australia all pay close attention to measures of underlying inflation that are not directly affected by movements in commodity prices. In the case of the Bank of Japan, a closely watched indicator of price stability is the year-over-year rate of change in the CPI, excluding fresh food. In the case of the Federal Reserve, food and energy components are excluded from the core personal consumption expenditure inflation measure used to describe the outlook for inflation in monetary policy reports. The Reserve Bank of Australia monitors a wide range of measures of underlying inflation, including trimmed mean and weighted median measures that down-weight volatile prices.

[4]For example, the Bank of Thailand currently defines its target in terms of a core inflation measure that excludes fresh food and energy prices. In the past, especially during periods of transition, some central banks, including the Reserve Bank of Australia, the Czech National Bank, and the Reserve Bank of New Zealand (RBNZ), defined their targets in terms of a measure of core inflation. More recently, having achieved low inflation, some of these central banks have moved to a headline measure in their formal targets. This evolution is discussed in a speech by the deputy governor of the RBNZ: "As inflation expectations have subsided, it has been possible to assume a degree more flexibility in the regime, and the current PTA [Policy Targets Agreement] reflects that. Rather than detailed calculations of the impact of specific shocks, as embodied in the old underlying inflation measure, the PTA now explicitly acknowledges that outcomes will occasionally fall outside the target range for a variety of reasons, even when the Bank is 'constantly and diligently' striving to deliver price stability" (Sherwin, 1999).

[5]The experience of the RBNZ, with its "hard-edged" targets, shows why such "flexible" medium-term targeting is the general practice. As stated by the deputy governor of the RBNZ: "While clearly a useful device for communicating the strength of the Bank's resolve to a wider public audience, the portrayal of the inflation target as hard-edged also carried risks given the lags and uncertainties in monetary policy decision making. A 'strict' approach to inflation targeting encouraged a search for precision in calculating 'core' or underlying inflation measures for accountability purposes and may have encouraged a shortening of policy horizons as the direct price effects of the exchange rate became more important to the achievement of the target outcomes" (Sherwin, 1999).

inflation, excluding food and energy inflation—also commonly referred to as "core inflation." The reason is that, in practice, food and energy prices are less indicative of medium-term inflation pressures than are the price changes of other goods and services. That said, using this simple "exclusion" measure as an indicator for underlying inflation raises some problems. Because it places zero weight on food and fuel prices, core inflation can be a poor measure of the cost of living. In addition, some argue that food and energy price inflation does contain useful information about underlying inflation and, therefore, hints at the likely evolution of inflation pressure over the medium term. These issues are discussed below.

Given the variety of approaches to the implementation of monetary policy, the range of inflation measures now in use, and the size of recent commodity price shocks, it is timely to reconsider the policy advice. Thus, this chapter addresses the following key questions:

- What are the effects of international commodity price swings on inflation across a variety of economies? What economic factors influence these effects?
- What is the appropriate monetary policy response to commodity price shocks? In particular, how does the approach of targeting underlying inflation rather than headline inflation perform in terms of delivering macroeconomic stability in different types of economies? Should central banks respond to persistent commodity price shocks any differently than to one-time shocks?
- Finally, what are the implications for monetary policy in today's environment, with excess demand pressures in some emerging and developing economies and economic slack in advanced economies?

These are the main findings of the chapter:

- Food price shocks tend to have larger effects on headline inflation in emerging and developing economies than in advanced economies. On a related note, because medium-term inflation expectations are weakly anchored in many emerging and developing economies, food price shocks have larger effects on inflation expectations in these economies.
- The measure of inflation used to define a central bank's target matters because of its effect on the central bank's credibility. In economies with low initial monetary policy credibility and high food shares in the consumption basket, focusing on underlying inflation—that is, a measure that reflects the changes in inflation that are likely to be sustained over the medium term—rather than on headline inflation, makes it easier to build credibility. The reason is that it is harder to hit headline inflation targets when commodity prices are volatile. Higher credibility, in turn, leads to better-anchored inflation expectations and lower volatility of both output and headline inflation.
- The desirability of setting and communicating monetary policy based on a measure of underlying inflation depends on the relative importance of headline inflation and output to a country's welfare. A headline framework can lower the volatility of headline inflation, but at the cost of significantly higher volatility in output (and hence in household income).
- Finally, in economies where central bank credibility is still limited and the share of food in consumption is high (as in a number of emerging and developing economies), a food price shock is likely to have even larger second-round effects and require a more aggressive policy response when excess demand pressures are high and inflation is running above target. This assumes that the economic costs rise as the gap increases between actual inflation and the target. In contrast, in economies where the central bank's credibility is strong, where food accounts for a low share in consumption baskets, and where there is substantial economic slack (as in major advanced economies today), the monetary policy tightening required to stabilize inflation is more gradual.

The first section of this chapter establishes some stylized facts about the effects of international commodity price swings on inflation in different types of economies. The following section considers how the monetary policy responses most appropriate for dealing with these shocks might differ across economies. The analysis uses simulations from a small open economy model that focuses on the difference in economic stability between a monetary policy frame-

work based on underlying inflation (proxied by core inflation in the model) and one based on headline inflation.[6] The chapter then draws some policy conclusions and explores some practical considerations related to the definition of underlying inflation.

Commodity Price Swings and Inflation

This section examines the size and nature of the inflationary effects of international commodity price swings in different economies. It starts by reviewing recent developments in international commodity prices and then considers the various channels likely to affect how much international price movements pass through to domestic price movements. Finally, it looks at the overall pass-through from food prices to headline inflation. This discussion serves to explain the challenges commodity price shocks present for monetary policymakers and to identify what key characteristics of economies influence the size of these challenges. These characteristics become the building blocks for the model presented in the following section.

Swings in International Commodity Prices

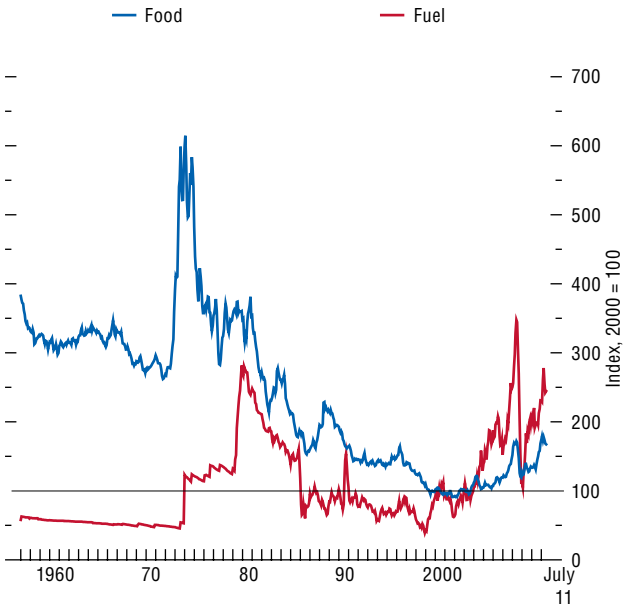
Figure 3.1 shows that food and fuel prices have been rising since 2000. World food prices are about 80 percent higher in real terms than in January 2000, and oil prices are 175 percent higher. On the other hand, from a longer perspective, food prices hit a historical low in 2000 (Figure 3.2) after declining for decades.[7] Clearly, the potential range of swings in commodity prices is large.

Another key characteristic of international food and energy price movements is that it is difficult to predict their direction and persistence. Figure 3.3 compares real food prices with forecasts of food prices based on futures market prices over the past

Figure 3.2. World Commodity Prices, 1957–2011

(In real terms, as deflated by U.S. consumer price index)

In a long-term historical context, 2000 was a low point for both food and fuel prices. Current fuel prices are at historical highs (at least in real U.S. dollar terms), but food prices are at or below levels that prevailed before the mid-1990s.



Sources: Haver Analytics; and IMF staff calculations.

[6]Numerous studies focus on the relative forecasting power of core versus headline inflation for future headline inflation (see, for example, Cogley, 2002; and OECD, 2005). However, because central banks tend to forecast inflation based on a wide range of economic indicators and modeling techniques rather than solely on headline or core inflation, this line of analysis is not pursued here.

[7]See Southgate (2007) for a discussion of the reasons behind the price declines.

decade. As prices started fluctuating substantially around 2005, the forecasts became more inaccurate and, most dramatically, missed the turning points in 2008 and 2009.[8]

From International to Domestic Commodity Prices

We now examine the pass-through from international commodity prices to domestic commodity prices. In particular, we estimate the effect of a 1 percent increase in international food prices (expressed in local currency) on domestic food prices.[9] Figure 3.4 shows the estimation results, which suggest that pass-through tends to be larger in emerging and developing economies than in advanced economies.[10] However, the size of the pass-through is relatively small. The median long-term pass-through of a 1 percent food price shock to domestic food prices is 0.18 percent in advanced economies and 0.34 percent in emerging and developing economies. There is even less pass-through—and little difference between advanced and emerging market economies—from oil prices to transportation prices.[11]

A number of factors help explain this incomplete pass-through. There is a significant local component in the production of food, including retail and distribution margins, excise taxes, and customs duties. Food and fuel subsidies may limit the degree of pass-through. In addition, there is generally significant domestic production of food, making domestic agricultural and weather conditions more influential than global market developments. Moreover, world

[8]In general, futures markets do not decisively beat a random walk forecast of commodity prices, as discussed by Roach (2011). For further discussion of the difficulties of forecasting commodity prices, see Groen and Pesenti (2011).

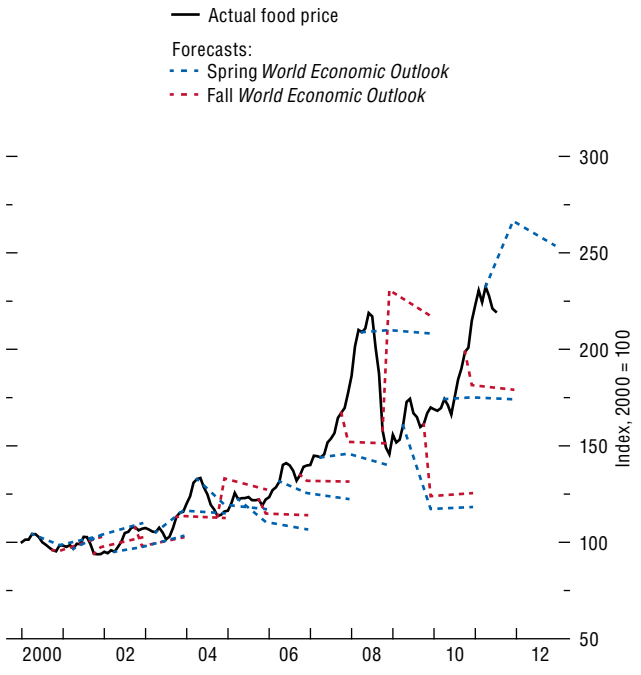
[9]See Appendix 3.1 for the countries included in the sample and Appendix 3.2 for details on the pass-through analysis.

[10]Throughout this chapter, advanced economies and emerging and developing economies are defined according to the classification in the Statistical Appendix. This classification does not separate emerging market economies from developing economies, but Appendix 3.1 shows the division between advanced and emerging and developing economies.

[11]We examine the pass-through of international oil prices to transportation prices rather than to domestic fuel prices, because only limited data are available for domestic fuel prices. The median pass-through of oil to transportation is 0.13 for advanced economies and 0.17 for emerging and developing economies.

Figure 3.3. Food Price Forecasts

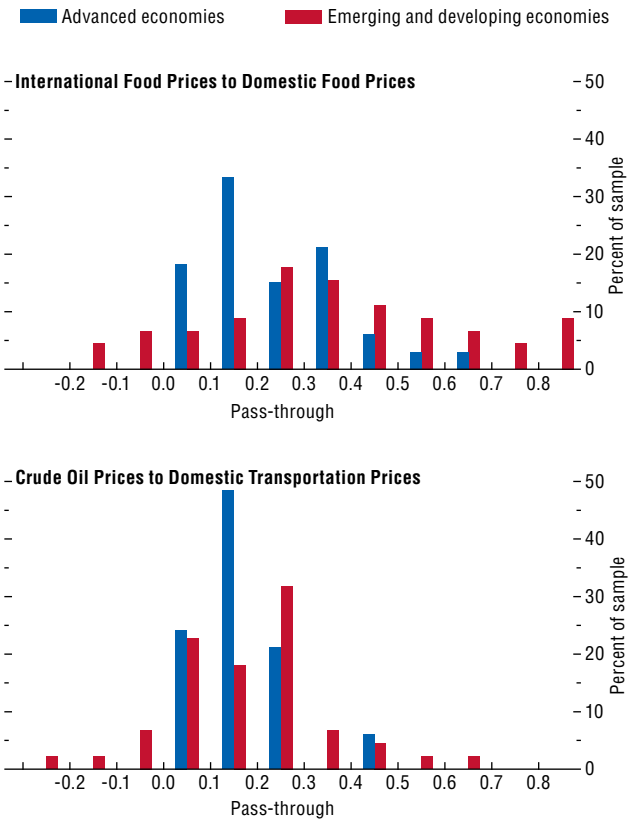
The history of forecasts demonstrates the difficulty of determining whether any given price movement is likely to be permanent or temporary. This is particularly evident in the performance of forecasts over the period of increased volatility during the past five years.



Source: IMF staff estimates.

Figure 3.4. Pass-through from World Inflation to Domestic Inflation

The pass-through of international food inflation to domestic food inflation is higher in emerging and developing economies than in advanced economies, and both are on average generally higher than the pass-through from crude oil inflation to domestic transportation inflation.



Sources: Haver Analytics; and IMF staff calculations.

Note: The pass-through from international to domestic inflation is estimated using country-by-country bivariate regressions. The pass-through is calculated as the sum of coefficients on the current value and 12 lags of the international variable divided by 1 minus the sum of coefficients on the 12 lags of the domestic variable.

commodity price indices do not necessarily reflect the consumption bundle in any given country. The world index includes, for example, wheat, barley, and rice in proportion to their value in international trade, but domestic consumption patterns vary across countries.

Focusing on more tightly defined consumer product categories, such as bread and bakery products, can help shed more light on the extent of pass-through when compositional effects are mitigated. Based on data for economies for which this more exact breakdown is available, Tables 3.1 and 3.2 show the pass-through of world crude oil prices to gasoline prices and the pass-through of world wheat prices to flour and bread. The higher pass-through for fuel is evident; however, even for such closely related food products as wheat, flour, and bread, the rate of pass-through is low.

Within the detailed pass-through results is evidence of price subsidies for certain commodities. For example, there is virtually no correlation between the gasoline price in Brazil and the world price, which reflects both the government's ownership of the largest national oil producer and the highly developed ethanol market. Similarly, government subsidies explain the lack of correlation between Indian flour and bread prices and world wheat prices. Subsidies generally transform a monetary policy challenge into a fiscal policy challenge. But because this chapter focuses on monetary policy and because such subsidies are generally outside the control of the monetary authorities, price subsidies are taken as a given.

One final note is that the results reveal a wide variation in effects across economies. The wide range in pass-through coefficients helps explain why, as Figure 3.5 shows, real domestic food price increases since 2000 have ranged from –15 percent to 70 percent despite the 80 percent increase in the real U.S. dollar world food price index over the same period. One reason real food prices have fallen over this period in some countries (for example, Bulgaria, Czech Republic, Ireland, Slovak Republic) is that their exchange rates appreciated against the U.S. dollar. Exchange rate effects can significantly influence how commodity price shocks affect a country, and Boxes 3.1 and 3.2 include further discussion of this.

Table 3.1. Gasoline Pass-through from Oil Prices

	Long-Term Pass-through
United States	0.65
India	0.56
Canada	0.49
France	0.46
South Africa	0.44
Russia	0.41
Japan	0.40
Italy	0.35
EU-27	0.34
United Kingdom	0.30
Germany	0.30
Korea	0.30
Mexico	0.06
Brazil	0.01
Average (median)	0.38

Source: IMF staff calculations.

EU-27: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, and United Kingdom.

For transportation prices, the effects of world oil prices are similarly diverse.

Influences on Pass-through from Domestic Commodity Prices to Overall Inflation

Two key factors are used to gauge the effect of domestic food and energy prices on overall CPI inflation: the share of these components in the consumption basket and the anchoring of inflation expectations. The higher the food share, the higher the direct effect on headline inflation. To the extent that food prices affect wage demands, higher pass-through to nonfood price inflation might be expected when the food share is higher. In countries with a poor track record of controlling inflation, food and fuel price shocks might also raise expectations of larger inflation in the future and might thereby raise pass-through when these expectations are reflected in prices.

Table 3.2. Flour and Bread Pass-through from Wheat Prices

	Long-Term Pass-through	
	Flour	Bread
South Africa		0.33
Brazil	0.32	0.28
Mexico	0.41	0.19
Canada	0.48	0.19
Russia	0.17	0.16
United States	0.22	0.15
Japan		0.13
Germany		0.11
Italy	0.26	0.10
India	–0.05	0.00
Average (median)	0.26	0.16

Source: IMF staff calculations.

Food share

The share of food in the CPI consumption basket is typically higher in emerging and developing economies than in advanced economies. For advanced economies in our sample, the median food share is 17 percent, whereas in emerging and developing economies, the median is 31 percent (Figure 3.6). Such a high food share implies that food price shocks will have a strong direct effect on headline inflation in these economies. These direct effects are shown in Figure 3.7: in 2008, food prices contributed about 5 percentage points to headline inflation in emerging and developing economies on average but only about 1 percentage point to advanced economy inflation. More recently, the contribution exceeded 2 percentage points for emerging and developing economies and about 0.5 percentage point for advanced economies. These averages also mask significant variations among economies—in some, food prices raised headline inflation by about 10 percentage points in 2008 and 5 percentage points in recent months. The contribution of transportation to headline inflation was more limited than that of food during 2003–08, possibly reflecting the minimal effect of world oil prices on transportation prices and the smaller share of fuel in consumer baskets.[12]

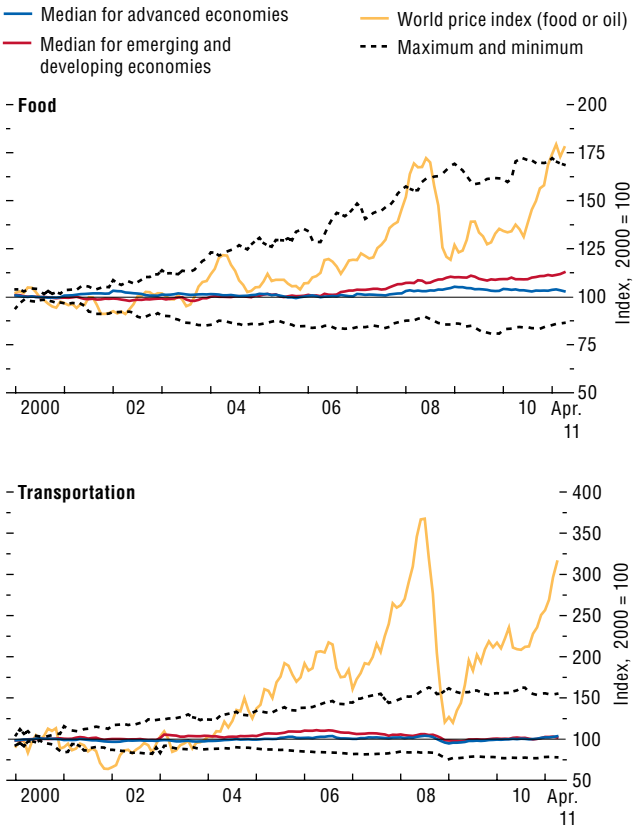
Inflation expectations

The overall effect of a food price shock on inflation, and the required policy response, are likely

[12]This analysis includes very few low-income countries (LICs). Box 3.1 investigates the experience of such countries in sub-Saharan Africa during the food price surge of 2007–08. Overall, it finds that the contribution of food prices to headline CPI inflation in LICs was similar to that of emerging and developing economies as reported here.

Figure 3.5. Variability of Real Domestic Prices

Domestic food and transportation prices have generally risen far less than world food and oil prices since 2000, with a wide range of country experiences. These divergences reflect the fact that domestic food and transportation baskets are different from the world commodity price indices and also reflect incomplete pass-through from commodity prices to domestic consumption items.



Sources: Haver Analytics; and IMF staff calculations.

to depend on how well inflation expectations are anchored. If monetary policy credibility is low, then medium-term inflation expectations are likely to be revised upward in response to incoming inflation news. By contrast, if the private sector believes that the central bank will stabilize inflation, then medium-term inflation expectations should respond little to incoming inflation news, thus requiring smaller adjustments in monetary policy.

The extent to which inflation expectations are anchored is estimated using the response of medium-term inflation expectations to an unexpected increase in inflation in the current period by means of statistical analysis. In particular, we estimate the average response of expectations of future inflation to an unexpected 1 standard deviation increase in inflation in the current year.[13] The inflation expectation data are based on surveys of professional forecasters conducted in 20 advanced and 18 emerging and developing economies over the past two decades, and the statistical approach is based on that of Levin, Natalucci, and Piger (2004) and the October 2008 *World Economic Outlook*. We also explore how the response differs between advanced and emerging and developing economies and across different monetary policy regimes.

A key result is that expectations are generally less well anchored in emerging and developing economies than in advanced economies. On average, in emerging and developing economies, a 1 standard deviation shock to current-year inflation expectations, equal to 1.8 percentage points, has a substantial effect on medium-term inflation expectations. As Figure 3.8 illustrates, even as far as five years into the future, inflation is still expected to rise by 0.3 percentage point in response to such a shock. By contrast, in advanced economies, a 1 standard deviation shock to current-year inflation expectations, equal to 0.6 percentage point, has a negligible effect on medium-term inflation expectations (0.04 percentage point), suggesting a higher degree of policy credibility.[14]

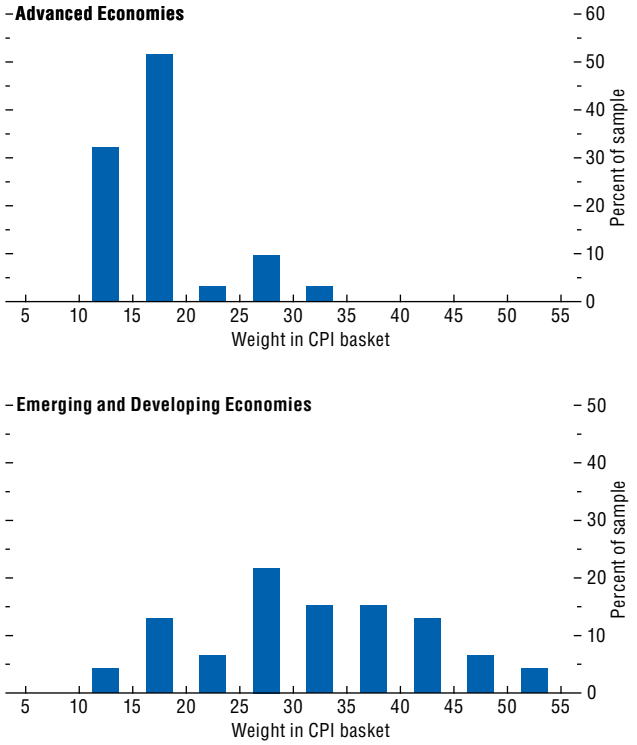
[13]See Appendix 3.2 for details on estimates of inflation expectations.

[14]These results imply that medium-term expectations change 2.5 times more in emerging and developing economies than

Not all emerging and developing economies, however, have weakly anchored inflation expectations. Inflation expectations appear to be well anchored in emerging and developing economies in which the central bank has an explicit inflation target (see Figure 3.8). In particular, in emerging and developing economies that use an inflation-targeting framework, expectations of inflation two or more years in the future respond little to current-year inflation surprises.[15] In these economies, after a 1 standard deviation shock equal to 1.3 percentage points, inflation expectations five years out rise by only 0.07 percentage point, which is statistically indistinguishable from the response estimated for advanced economies. By contrast, where there is no inflation-targeting framework, inflation expectations as far as five years out rise by 0.5 percentage point following a 1 standard deviation surprise in current-year inflation.[16] However, as discussed in the October 2008 issue of the *World Economic Outlook,* the apparent benefits of inflation targeting may reflect the general quality of domestic monetary management and institutions in economies that adopt such a framework rather than the particular benefits of inflation targeting.

Figure 3.6. Share of Food in the Consumption Basket

Emerging and developing economies tend to have a much higher share of food in their consumption baskets. The median CPI weight in advanced economies is 17 percent, whereas the median weight for emerging and developing economies is 31 percent.



Source: Haver Analytics.
Note: CPI = consumer price index.

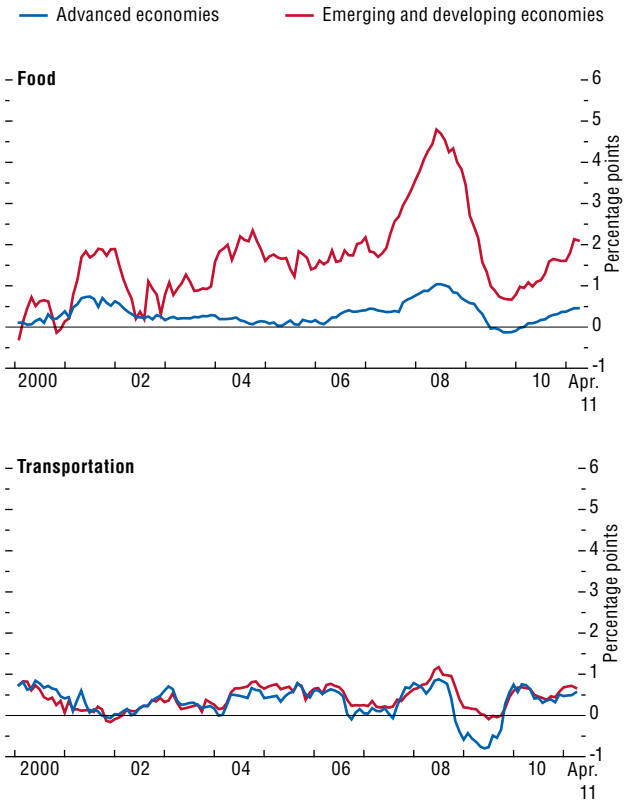
in advanced economies following a given inflation surprise—(0.3/1.8) divided by (0.04/0.6).

[15]For the purposes of the analysis, an inflation-targeting framework is identified based on the definition in Roger (2010), which includes four main elements: (1) an explicit central bank mandate to pursue price stability as the primary objective of monetary policy and a high degree of operational autonomy; (2) explicit quantitative targets for inflation; (3) central bank accountability for performance in achieving the inflation objective, mainly through high-transparency requirements for policy strategy and implementation; and (4) a policy approach based on a forward-looking assessment of inflation pressures, taking into account a wide array of information.

[16]Most of these economies have pegged exchange rates, which reduces their ability to respond to shocks to domestic inflation. However, additional analysis suggests that inflation expectations are just as weakly anchored in emerging and developing economies that do not have an inflation-targeting framework and have floating exchange rates (according to the de facto classification compiled by Ilzetzki, Reinhart, and Rogoff, 2008). Thus, the association between inflation targeting and the anchoring of expectations is not driven by the exchange rate regime.

Figure 3.7. Contribution of Food and Transportation to Headline Inflation

Rising food prices raised overall inflation more in emerging and developing economies than in advanced economies. There is little evidence of transportation prices adding appreciably to headline inflation.



Sources: Haver Analytics; and IMF staff calculations.

From Food Prices to Headline Inflation

Given the preceding discussion, pass-through from food to headline inflation might be expected to be higher where the share of food in consumption is larger and inflation expectations are less well anchored. This is indeed what we find. An estimation of the effect of food prices on headline inflation is shown in Figure 3.9.[17] The figure also includes, for reference, the median pass-through from international food prices to domestic food prices as calculated earlier in Figure 3.4.

The pass-through is much higher in emerging and developing economies, where the food share is typically higher and inflation expectations are less well anchored than in advanced economies. When combined with the fact that the pass-through from international to domestic food prices is higher in emerging market economies, it highlights that the effects of commodity prices on those economies are much larger than for advanced economies.

Overall, the preceding discussion has highlighted the following key characteristics of the data, which will inform the model-based analysis in the next section:

- Distinguishing between one-time and persistent commodity price shocks is difficult.
- Food has a high share in the consumption baskets of emerging and developing economies.
- Inflation expectations are well anchored in advanced economies and in inflation-targeting emerging and developing economies.
- Inflation expectations are less well anchored in some emerging and developing economies without inflation-targeting regimes.
- The pass-through from food prices to headline inflation is higher on average in emerging and developing economies than in advanced economies.

Monetary Policy and Food Price Shocks: A Simulation-Based Perspective

This section explores the appropriate monetary policy response to international food price shocks using a macroeconomic model that focuses on the role of

[17]These parameters are imprecisely estimated, and there is a wide dispersion among individual country results. Consequently, only the median is reported.

monetary policy credibility and the food share in consumption baskets. For simplicity, energy price shocks are not included. The model assesses the implications of defining the central bank's inflation goal in terms of headline inflation versus a measure of underlying inflation. This measure is not directly affected by temporary food price shocks and here is called "core inflation."[18]

Monetary Policy Credibility and Food Price Shocks

The analysis focuses on a small open economy that takes international commodity prices as given. The structure of the model is relatively standard and in line with the recent "New Keynesian" macroeconomic literature. It consists of three equations: an aggregate supply schedule (expectations-augmented Phillips curve); an intertemporal aggregate demand (IS) equation; and an exchange rate–real interest rate parity equation.[19] Within this three-equation bloc the model shares results commonly found in the New Keynesian literature. In particular, regardless of the food share in the consumption basket, the central bank is fairly well able to simultaneously stabilize both core inflation and the output gap—although at the cost of a volatile nominal interest rate.

A distinguishing feature of the model is the introduction of an endogenous credibility formation process, as in Alichi and others (2009).[20] The cred-

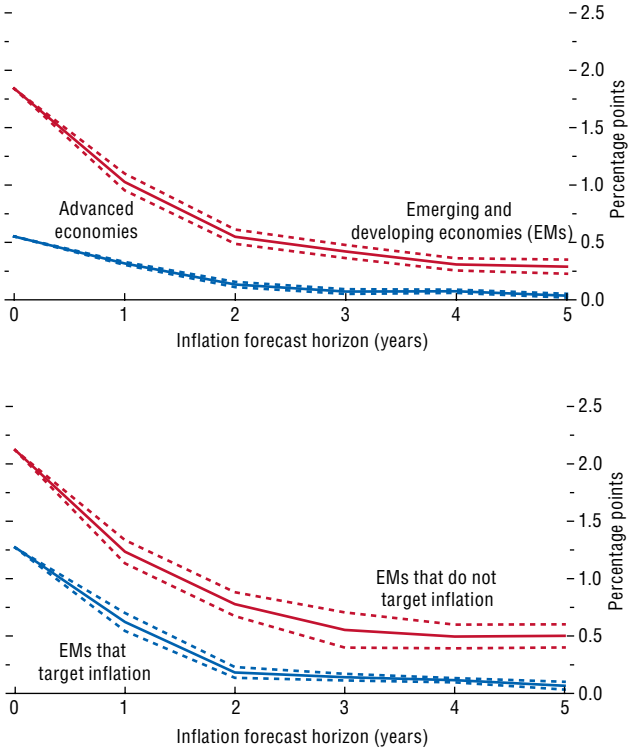
[18]As implied above, within the context of this model, there is no distinction between core inflation and underlying inflation. The key feature of the food component is that it is subject to exogenous shocks that are largely beyond the control of domestic policymakers and that the core measure is not directly affected by these shocks. In practice, this food component might apply more to items such as fresh fruit and vegetables than to restaurant meals and other prepared meals, which largely reflect more slowly moving rental and labor costs. The core measure could also be constructed as a trimmed mean rather than an exclusion-based measure. Such practical matters are discussed in the final section of this chapter.

[19]The Phillips curve links current core inflation to past and expected core inflation, the output gap, and the real exchange rate change. The IS equation relates output gap growth to the real interest rate and the real exchange rate. Finally, the uncovered interest parity links exchange rate depreciation to the domestic and world interest rate differential.

[20]The monetary policy literature is divided over the credibility problem: the monetary authority either is fully credible, and the central bank is able to manage the private sector's expectations, or it is not credible at all. The latter case corresponds to "discretion," which means that the central bank conducts policy while taking the private sector's expectations as given (see Woodford, 2003). The approach here seeks a middle ground between those two extremes.

Figure 3.8. Response of Inflation Expectations to Inflation Surprises

Inflation surprises generally have larger effects on medium-term inflation expectations in emerging and developing economies than in advanced economies. However, in emerging and developing economies with an inflation-targeting framework, inflation expectations are well anchored.

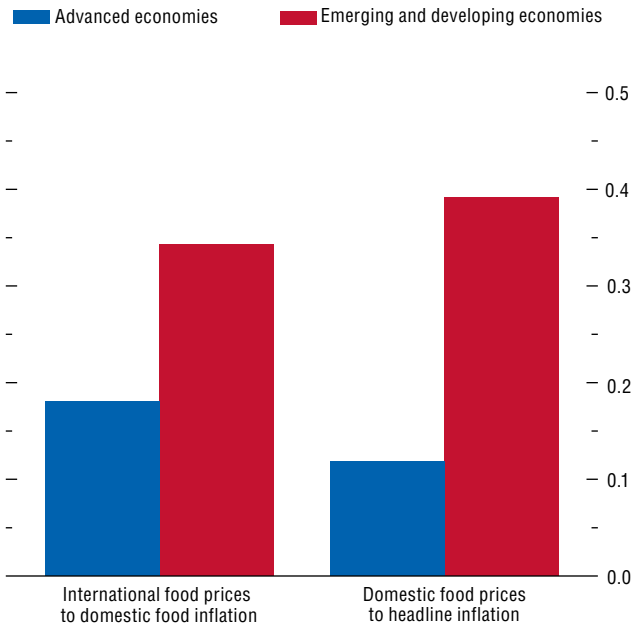


Sources: Consensus Economics; and IMF staff estimates.

Note: This figure shows expectations of inflation in the current year and one to five years ahead as percentage point responses to a 1 standard deviation shock to current-year inflation and the estimated effect of a 1 standard deviation unexpected change in domestic consumer price index inflation based on private sector inflation expectations surveyed by Consensus Economics, 1990–2010 spring and fall vintages. Unexpected change occurs in year $t = 0$. Solid line indicates point estimates; dashed lines indicate 1 standard error bands.

Figure 3.9. Pass-through from International to Domestic Food Price Inflation

The pass-through from international food price inflation to domestic food price inflation and from domestic food price inflation to headline inflation is higher in emerging and developing economies than in advanced economies.



Source: IMF staff calculations.
Note: Estimates of pass-through from international to domestic food price inflation are from Figure 3.4. Estimates of the pass-through from domestic food prices to headline inflation are obtained by regressing headline inflation on lags of itself and current and lagged values of domestic food price inflation. To control for endogeneity, domestic food price inflation is instrumented by inflation in the international food price index expressed in domestic currency. The reported result is the median of country-by-country regressions.

ibility of monetary policy depends on the evolving track record of inflation relative to a long-term target. More precisely, it is assumed that a low-inflation target is announced once and for all by the central bank and is thereafter held constant. The central bank builds credibility over time by consistently attaining an inflation rate close to the targeted rate. The idea is that, in the long term, if monetary policy consistently holds inflation to the target rate, private sector inflation expectations become anchored to the inflation target.[21] Therefore, higher inflation volatility can complicate the task of establishing credibility, because it generally results in missing the target. To make the model more realistic, inflation that is above the target is assumed to imply a higher loss of credibility than inflation that is below the target; moreover, when inflation is way off target (a big miss), the effects are assumed to be disproportionately larger than for a small miss.

How does credibility affect the rest of the economy? An imperfect level of credibility substantially amplifies the trade-off between outlook and inflation that central banks face. In the model we assume that this amplification can happen in at least three different ways: (1) inflation expectations become more backward-looking and less well anchored (which increases inflation's persistence and makes it more difficult to stabilize inflation once it is off target);[22] (2) inflation expectations gain an upward bias; and (3) the pass-through from food to core inflation rises. This last channel captures the idea that cost-push inflation pressures stemming from the wage-bargaining process are stronger when central bank credibility is low. In other words, the lower the credibility, the higher the second-round effects. Most important, this introduces a clear trade-off between stabilizing core inflation and stabilizing the output gap. With full credibility, second-round effects disappear and inflation expectations are

[21]However, the credibility stock is also assumed to gradually rise over time, capturing the transitional process of building credibility typical of many economies. Starting from a relatively low initial credibility stock allows us to study how this convergence process can be hampered by commodity price shocks.

[22]The inflation bias and its importance when there is a lack of central bank credibility have been documented in various studies, such as Pasaogullari and Tsonev (2008), who examine the experience of the United Kingdom in the 1980s and 1990s.

entirely forward-looking, implying that even a highly persistent increase in food prices has little effect on expectations. By contrast, if credibility is low, even a one-time rise in food prices can de-anchor inflation expectations and induce strong second-round effects on core inflation. Restraining inflation then requires substantial monetary policy tightening (see Alichi and others, 2009).

The analysis also distinguishes between three stylized economy types. The key features that distinguish these economies are the degree of policy credibility and the share of food in households' consumption baskets. In the first economy, the share of food in the CPI is assumed to be 30 percent—in line with the average for emerging and developing economies—and the degree of policy credibility is low. In the second, the share of food in the CPI is still high, but the degree of policy credibility is also high. Finally, in the third economy, the share of food in the CPI is low (set at 10 percent), and the degree of policy credibility is high.[23] These can be considered, respectively, as an emerging and developing economy, a high-credibility emerging and developing economy, and a high-credibility advanced economy, but the emphasis is on the food share and credibility rather than on the stage of development.

For a given credibility level, the pass-through from food prices to core inflation is proportional to the food share. This implies that a high-food-share economy faces stronger second-round effects (and, hence, a worse policy trade-off) than one where the food share is low. In addition, to capture the fact that the wage-bargaining process is more affected by changes in food inflation in emerging market economies, the weight on relative food price inflation in driving inflation dynamics is assumed to be relatively high.

The model determines the optimal monetary policy response—through changes in the short-term interest rate—given the central bank's policy objectives. These relate to the variances of inflation, the output gap, and changes in short-term interest rates. The model postulates that the central bank sets interest rates to minimize variability along all three dimensions.[24] With food price shocks, a policy trade-off arises because substantial movements in the policy rate may be required to stabilize inflation and the output gap. Moreover, second-round effects—in the Phillips curve, from domestic food inflation to core inflation—generate a policy trade-off between the output gap and core inflation. The central bank's policy preferences determine how it trades off gains from reducing inflation against the costs of lower output and higher interest rate volatility.

Food Price Shocks with Core or Headline Inflation Targets

We consider two policy frameworks: one in which the target of monetary policy and the credibility formation process are based on headline inflation, and one in which they are based on core inflation. Each framework has two elements: the measure of inflation targeted by the central bank and the measure of inflation the private sector uses to evaluate the central bank's track record relative to the target—its credibility. Under a headline framework, the public evaluates the performance of the central bank based on how close headline inflation is to the target. Under a core framework, the public evaluates the performance of the central bank based on how close underlying inflation is to the target. The choice of the framework has important consequences for conducting monetary policy and the resilience of the policy framework to various shocks. For example, keeping core inflation at the target would imply no loss of credibility under the core framework, even if headline inflation were to rise above core inflation. Missing the headline inflation target in the headline

[23]A 10 percent food share was chosen rather than the 17 percent estimated for the advanced economies in the empirical section to accentuate the differences between the two groups. There is also, logically, a fourth kind of economy to consider: one with a low food share in the CPI and a low degree of credibility. As a practical matter, the evidence from the previous section suggests that this kind of economy is rare, and it is excluded.

[24]Formally, the central bank minimizes a loss function consisting of the weighted sum of the squared deviations of inflation from target, the squared output gap, and the square of the change in the short-term nominal interest rate. The weights in the loss function reflect the central bank's preferences regarding the stabilization of these three variables. In the baseline, the weights on inflation and output stabilization are equal (set to 1) and four times larger than the weight on interest rate stabilization (set to 0.25). We also test the robustness of the results to alternative weights, as discussed in the text.

framework comes with a loss of credibility and thus a worsening output-inflation trade-off.

Through its effect on credibility, the choice of the framework eventually may affect the way expectations are formed.[25] More precisely, a low level of credibility implies that private sector expectations are barely managed by the monetary authority. At the extreme of no credibility, monetary policy has no effect on private sector expectations. At the other extreme, policy announcements by a perfectly credible monetary authority have a substantial effect on private sector expectations.

The next paragraphs compare how these two frameworks perform in the three different types of economies following a shock to international food prices.

Stylized emerging and developing economy

We first consider a high-food-share (30 percent), low-credibility economy that is hit by a one-time international food price shock.[26] To abstract from cyclical factors, inflation is set initially at its target level, and the output gap is set to zero. We relax these assumptions later. The shock is assumed to raise international food inflation by 5 percentage points. The simulation is conducted twice, first assuming that the policy framework is defined in terms of headline inflation and then assuming it is defined in terms of core inflation.

Under the headline framework, the central bank loses policy credibility in the short term because the shock's direct effect raises headline inflation above the target (Figure 3.10). In response, to stabilize headline inflation, the central bank tightens policy, thus raising real interest rates and causing a real appreciation of the currency.[27] This policy tightening directly reduces the domestic price of imported food by raising the value of the domestic currency, and also restrains inflation by causing an output contraction. In addition, with the initial loss of policy credibility, inflation expectations become de-anchored and more backward-looking. Restoring policy credibility and reducing inflation expectations then require a sustained output slump with headline inflation a little below normal (inflation undershooting).

By contrast, under the core framework, the output cost of keeping core inflation close to its target is lower. In the short term, headline inflation rises by about the same amount as in the headline framework. However, with the central bank's mandate specified in terms of core inflation—which rises by less than headline inflation on impact—policy credibility is much less affected. The effects of this are significant. The enhanced policy credibility keeps inflation expectations better anchored and implies less need for policy tightening and output contraction. Consequently, both core and headline inflation are more stable under the core framework than under the headline framework. When combined with the smaller output loss, this implies that the core framework delivers superior macroeconomic stability. Nonetheless, if the central bank also cares about output gap stabilization, it must accept some second-round effects on core inflation.

The striking finding that targeting core inflation can deliver more stability in terms of both output and headline inflation than targeting headline inflation is robust to alternative weighting of policy priorities between inflation and output stabilization. This result is illustrated in Figure 3.11, which shows the policy frontier with respect to output gap and headline inflation volatility.[28] The core framework shifts the frontier toward zero. This implies that, over certain ranges, it is possible to simultaneously

[25]There are elements of this idea in the Central Bank of Egypt's (CBE's) recent decision to publish a core inflation measure. As the CBE *Annual Report* 2009/2010 explains (p. A), "By timely communicating the core inflation measure, the CBE aims to improve understanding of inflation dynamics. This is expected to reduce the pass-through of temporary price shocks to inflation expectations and, in turn, minimize the variability in inflation." Similarly, the RBNZ has stated, "…the initial move to inflation targets arose from a wish to influence inflationary expectations by stating clearly the Government's commitments" (Sherwin, 1999).

[26]International commodity prices have historically been well modeled as random walks, with changes that are unpredictable and not systematically followed by further changes in the same direction.

[27]The result—the real exchange rate appreciates in response to a rise in the price of imports (food)—is similar to the case of the "worst sufferer" economy modeled by Catão and Chang (2010), in which a rise in food or other commodity prices entails a terms-of-trade deterioration and a concomitant real exchange rate appreciation. See Box 3.2 for a further discussion of the implications of commodity price shocks for the comovement of the terms of trade and the real exchange rate in different types of economies.

[28]See Figure 3.11 for details on the policy frontier calculations.

achieve lower headline inflation volatility and lower output volatility by adopting a core framework.

A key element underlying the better performance of the core framework is that the temporary shock to headline inflation is not taken as a signal of central bank failure, and thus credibility and inflation expectations are not negatively affected. Focusing on core inflation here protects the central bank's credibility from the effects of international commodity price shocks that are, broadly speaking, beyond the control of domestic policymakers.[29]

The headline framework can deliver the lowest levels of headline inflation volatility—at the cost of significantly higher output volatility. In an economy in which headline inflation is much more important than output in determining overall welfare, it may be optimal to choose a headline framework.[30] We return to the implications of these findings, particularly for countries with a high food share in consumption, in the final section of this chapter.

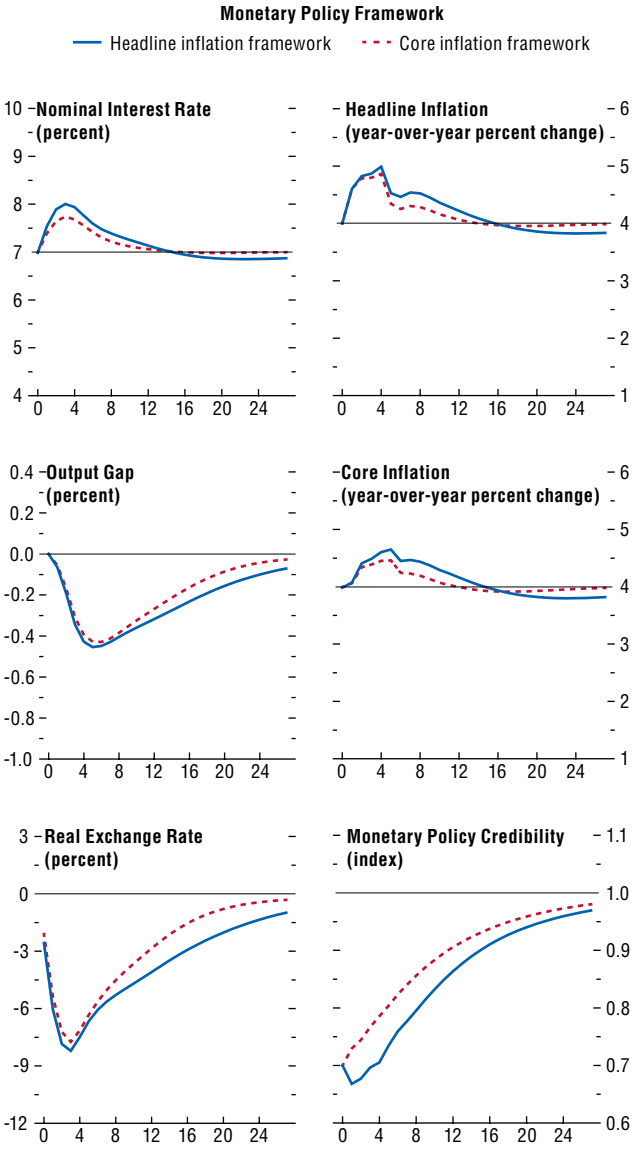
Stylized emerging and developing economy with high policy credibility

The case of an economy with a high food share but also high policy credibility illustrates the benefits of high credibility for emerging and developing economies. As the analysis above suggests, some emerging and developing economies have better-anchored inflation expectations than others.

As Figure 3.12 shows, in this case, with better-anchored inflation expectations, the degree of monetary policy tightening needed is smaller than in the previous case. Moreover, high credibility substantially reduces second-round effects, which is particularly important for economies with a high

Figure 3.10. Response to a Food Price Shock in a Stylized Emerging and Developing Economy

In emerging and developing economies with a high food share in the consumption basket and low monetary policy credibility, targeting core inflation after a one-time food price increase helps to stabilize both output and headline inflation.



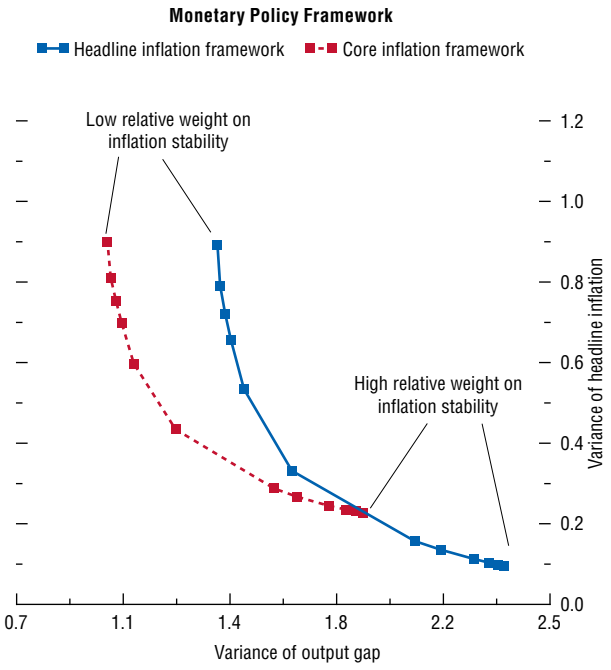
Source: IMF staff estimates.
Note: The time period is quarters. The food price shock occurs at $t = 0$.

[29]This would be equally applicable to a country that is self-sufficient in food. In this case, however, food prices would be subject to domestic weather shocks rather than international food price shocks. The conclusions are the same: a central bank will be better able to preserve its credibility in the face of food price shocks if that credibility is built on core rather than headline inflation.

[30]Numerous studies in the literature assume equal weights placed on inflation and output in the loss function, including Gilchrist and Saito (2006). By contrast, in Figure 3.11, a weight on inflation that is approximately six times as large as that placed on output is required for the headline inflation framework to be preferable to the core inflation framework.

Figure 3.11. Inflation-Output Policy Frontier

In emerging and developing economies with a high food share and low monetary policy credibility, targeting core inflation after a one-time food inflation shock helps to stabilize both output and headline inflation. Only when the relative weight on inflation is very high is it preferable to target headline inflation.



Source: IMF staff estimates.

Note: The policy frontier is traced out by varying the weights attached to the three target variables in the central bank's loss function—namely, variances in inflation, the output gap, and policy rate changes. In particular, we normalize the weight on the variance of the output gap to 1 and fix the weight on the policy rate at 0.25. The points on the frontier are then computed by changing the weight on inflation variance from zero to 500. In this model these weights correspond to a society's preference for output volatility or inflation volatility.

food share.[31] Overall, higher credibility contributes to more stable economic outcomes, because expectations are better-anchored and policy responses to shocks can be more measured—reducing the resultant output fluctuations.

The core inflation framework still achieves greater output stabilization than the headline framework. As with the first simulation, the policy frontier shifts toward zero (although both frontiers are closer to zero as a result of the higher level of credibility).

In both cases, optimal policy requires that some second-round effects be allowed. Core inflation rises slightly above the target under both frameworks, but it then undershoots under the headline framework because the real exchange rate, after the initial appreciation, takes longer to normalize.

Stylized advanced economy

Finally, we consider how the results change for an economy with a low food share—set at 10 percent of the CPI rather than 30 percent as in the previous simulations—as well as higher initial policy credibility (as introduced in the second simulation).

Figure 3.13 shows that, for this type of economy, the difference between the two frameworks in terms of macroeconomic stability following food price shocks is negligible. In particular, with the small food share and with well-anchored inflation expectations, the effect of the international food shock is far smaller than in the other simulations.

Persistent Shocks

The above analysis considers the response to food price shocks under the assumption that they are known to be one-time occurrences. However, as discussed in the introduction, there are concerns that shocks may be becoming more persistent. This section therefore explores the effect of a larger, more persistent food price shock.[32] Figure 3.14 shows the response of a high-food-share, low-credibility

[31]Recall that the pass-through from food inflation to core inflation is proportional to the food share and the credibility gap.

[32]The initial size of the shock is the same as for the one-time shocks considered above. However, for this experiment, prices continue to increase after the initial shock, although at a declining rate. More formally, we consider a shock with an autoregressive parameter of 0.5, such that the first period increase is 5 percent-

economy to a persistent international food price shock and shows that the response is stronger than to the one-time shock. With a persistent shock, the central bank anticipates further food price increases down the road and increases the interest rate by more to minimize a potential loss of credibility. This, in turn, mitigates the effect of expected future pass-through from food to core inflation, dampening the surge of expected inflation. This interaction between credibility losses and second-round effects is less relevant when the shock is known to be purely temporary: with no expectation of further food price shocks, pass-through from food to core inflation is not relevant. This logic also can be seen in the reaction of the credibility index. In the case of a temporary shock, credibility is allowed to drop in the first period, given that no further inflation pressures are expected. In the case of persistent shocks, the central bank is more concerned about losing credibility because of the difficulty of regaining it in the face of continued inflation pressure from food prices. That is, if one anticipates further price shocks in the future, it is more important to preserve credibility than if no further price shocks are expected.

Commodity Price Shocks and Cyclical Conditions

How does the appropriate monetary policy response to a persistent food price shock differ for advanced economies with substantial economic slack and for emerging and developing economies with excess demand pressures and relatively low initial real interest rates?[33]

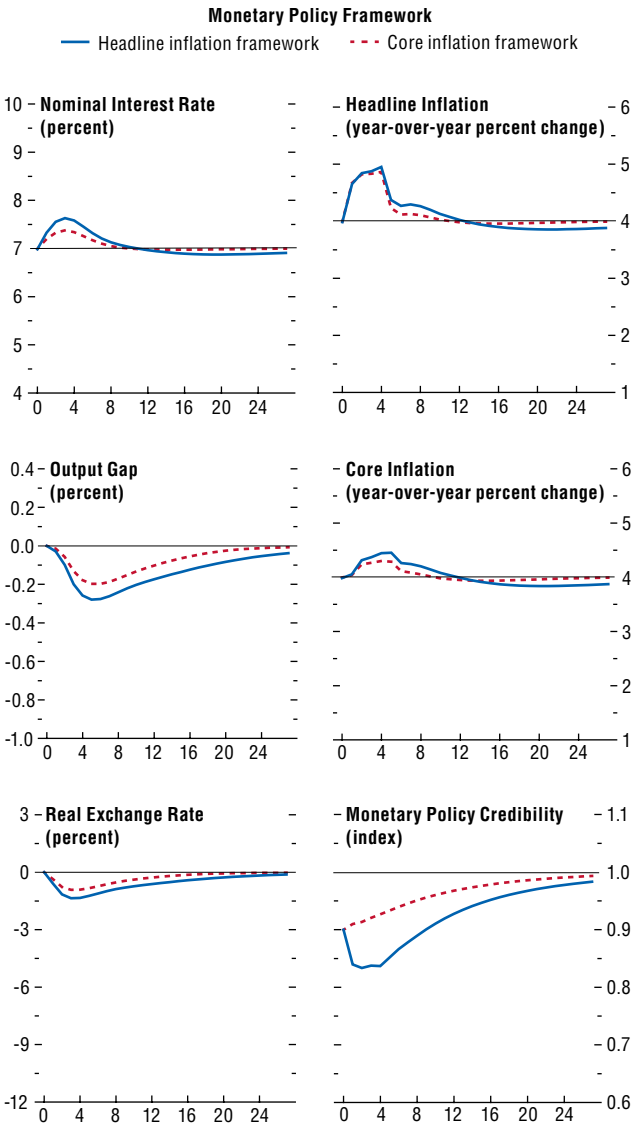
In Figure 3.15, the contrast between the two types of economies is dramatic. The different outcomes are driven mainly by two elements: the change in inflation for a given change in the output gap is increasing with the size of the output gap (that is, the slope of the Phillips curve is increasing in the output gap), and the additional loss of credibility is higher the greater the miss. Hence, in the emerging and developing model economy, policy credibility

age points, the second period increase is 2.5 percentage points, the third period increase is 1.25 percentage points, and so on.

[33]For the purposes of this exercise, we assume central banks are using a headline framework, but the main conclusions are similar for a core framework.

Figure 3.12. Response to a Food Price Shock in a Stylized High-Credibility Emerging and Developing Economy

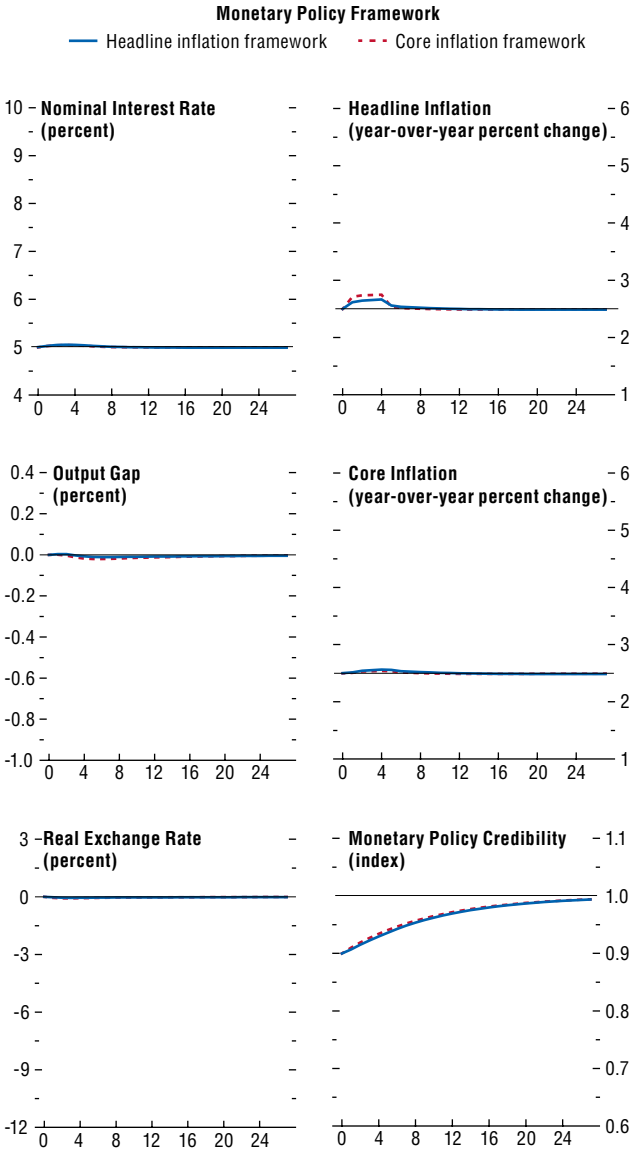
In economies with a high food share in consumption and high monetary policy credibility, less monetary policy tightening is needed after a one-time food price shock. Targeting core inflation still achieves greater output stabilization, but there is now a slightly greater increase in headline inflation in the short term.



Source: IMF staff estimates.
Note: The time period is quarters. The food price shock occurs at $t = 0$.

Figure 3.13. Response to a Food Price Shock in a Stylized Advanced Economy

In economies with a small food share in consumption and with well-anchored inflation expectations, the impact of the international one-time food price shock is far smaller than in emerging and developing economies. The difference between targeting core and headline inflation in terms of delivering macroeconomic stability is also smaller.



Source: IMF staff estimates.
Note: The time period is quarters. The food price shock occurs at $t = 0$.

is already negatively affected by preexisting excess demand pressures and above-target inflation. The persistent food price shock exacerbates this credibility loss. A rapid rise in interest rates to well above normal is then required to restore policy credibility and re-anchor inflation expectations. By contrast, for the advanced model economy, the disinflationary effect of economic slack dominates the small inflationary effect of the food price shock. With medium-term expectations well anchored and thus small pass-through to core inflation, the required policy adjustment involves only a gradual withdrawal of monetary policy stimulus.

Policy Implications for Responding to Commodity Price Shocks

This section outlines some key policy implications of the chapter's analysis and some practical considerations about how to measure underlying inflation.

First, changes in commodity prices are likely to have a stronger and longer-lasting effect on inflation in emerging and developing economies than in advanced economies. There are three main reasons for this: in emerging and developing economies (1) the pass-through from international commodity prices is higher, (2) food and energy consumption shares tend to be higher, and (3) medium-term inflation expectations are less well anchored.

Second, the simulations show that central banks in economies with low credibility and high food shares in consumption may be able to better preserve and build monetary policy credibility by setting and communicating monetary policy in terms of underlying inflation (taken to be core inflation in our model) rather than headline inflation. Basing the policy objective on a measure of inflation that is inherently more stable and less subject to large and unpredictable international commodity price shocks is thus preferable. The higher policy credibility in turn allows the central bank to stabilize inflation (both headline and core) with less monetary policy tightening and a smaller associated output loss.

For these economies, the choice between focusing on core or headline inflation depends on the relative welfare gains from stabilizing headline inflation versus stabilizing output. It is sometimes suggested that,

with high food shares in the consumption basket, the economic costs of volatility in food prices and headline inflation are high, and that it is therefore more appropriate to tie monetary policy closely to headline inflation targets. However, lowering the volatility of headline inflation means increasing the volatility of output and unemployment, and the economic costs of unemployment can also be very high in these economies. Although assessing the social and economic factors involved in ranking such priorities is beyond the scope of this chapter, the analysis does illustrate that there are significant trade-offs involved.

Setting and communicating monetary policy in terms of underlying inflation are likely to require significant effort on the part of the central bank. The importance of effective communication is evident in the sustained and ultimately successful efforts of the initial cohort of inflation-targeting central banks in this regard. The central banks in Australia, Canada, and New Zealand established their inflation-targeting frameworks in terms of a core inflation measure or with a prominent short-term role for core inflation and undertook sustained efforts to explain what they were doing to the public.[34] When inflation was successfully brought down and the policy was highly credible, these central banks moved to targeting headline inflation.[35]

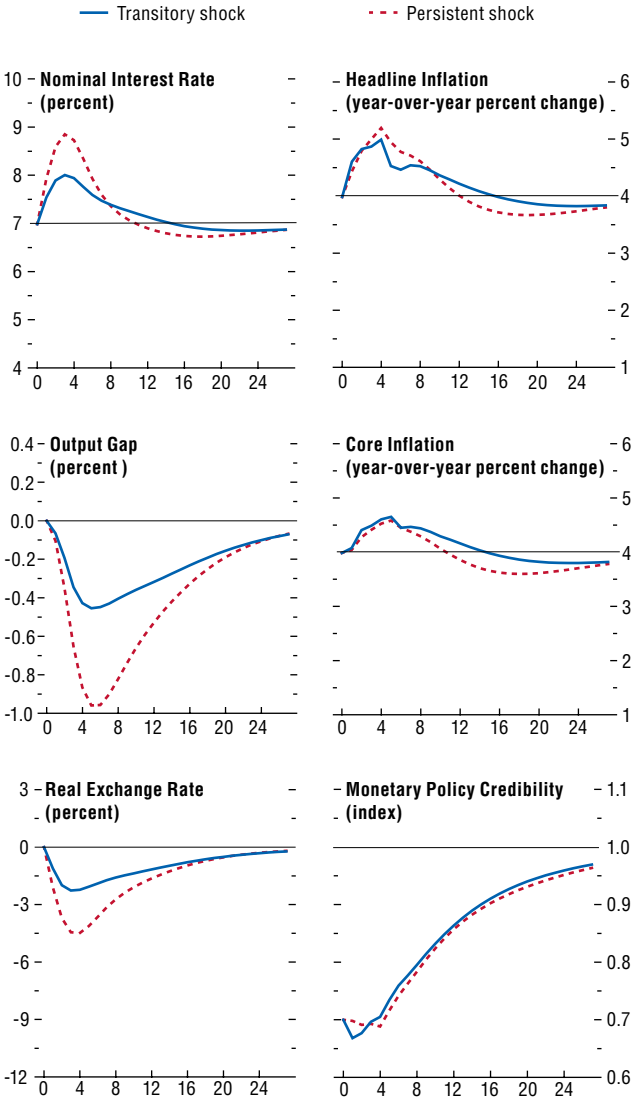
In the absence of an effective communication strategy, however, simply changing the operating target to a measure of underlying inflation, such as core inflation, could be counterproductive. For example, policy credibility could suffer and economic outcomes could deteriorate if the central bank's performance continued to be evaluated based on the volatility of headline inflation when it is tar-

[34]For example, in the case of Australia, in 1999 Glenn Stevens, the assistant governor (and now governor) of the Reserve Bank of Australia observed that "One important presentational change that we did make was a progressive upgrading of the quality and quantity of our published material on the economy. Financial markets and the media began to take much more notice of the quarterly pieces we put out. The extent of this change has been quite substantial. In early 1992, these documents were typically 4 or 5 pages in length. By the middle of 1994, they had grown to 15–16 pages. In more recent years, *Semi-Annual Statements* have on occasion approached 50 pages, and exceeded 20,000 words" (Stevens, 1999).

[35]Recall the discussion of this in footnote 4.

Figure 3.14. One-Time versus Persistent Food Price Shocks

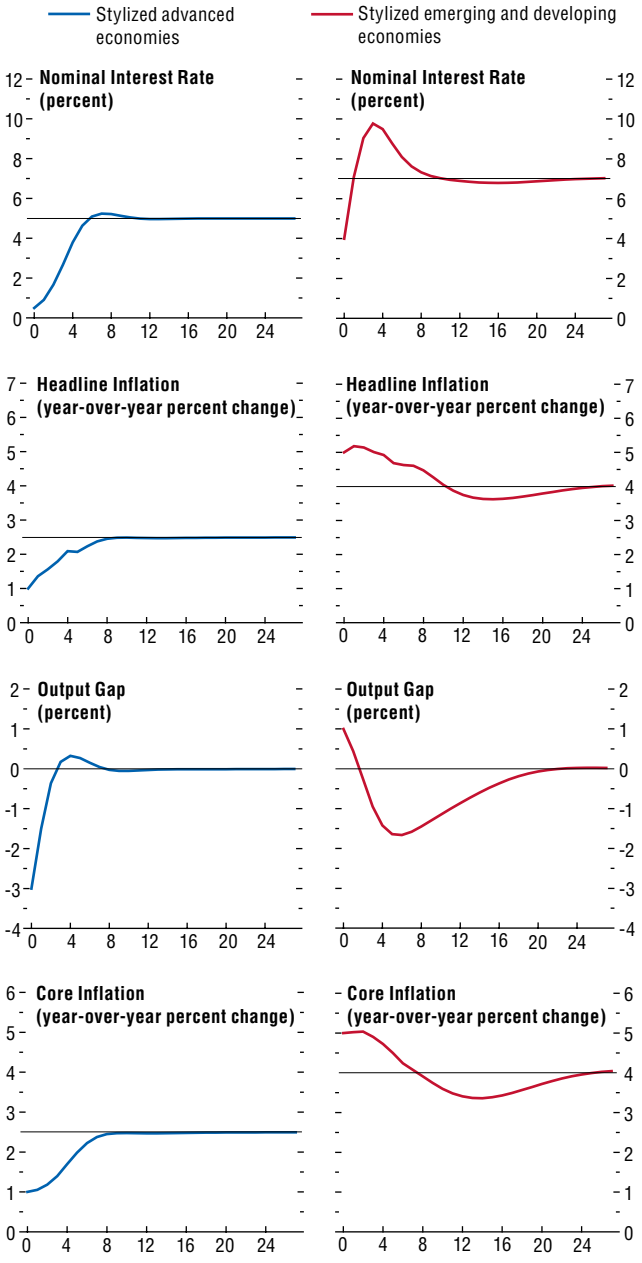
In economies with low monetary policy credibility and a high food share, the central bank facing a persistent shock increases the interest rate by more (relative to a one-time shock) to minimize losses in credibility.



Source: IMF staff estimates.
Note: The time period is quarters. The food price shock occurs at $t = 0$.

Figure 3.15. Response to a Food Price Shock amid Current Cyclical Conditions

In emerging and developing economies with a high food share in consumption, low monetary policy credibility, and initial inflation already above target, aggressive monetary policy tightening is required after a food price shock (right column). By contrast, in advanced economies with well-anchored inflation expectations and economic slack, a gradual unwinding of monetary policy stimulus is required (left column).



Source: IMF staff estimates.
Note: The time period is quarters. The food price shock occurs at $t = 0$.

geting core inflation. Any policy transition must be built on a firm foundation that includes effectively demonstrating the relevance of the chosen measure of underlying inflation.

Another important element in establishing a regime is the precise definition of the inflation target. As noted, a common criticism of exclusion-based core inflation measures is that they ignore the effects of food and fuel prices, which can undermine the credibility of the target in the eyes of the public. Additional credibility problems can arise if the average rate of inflation varies depending on which measure is used. In that respect, one of the key findings of this analysis is that the target measure of inflation should be resilient to transitory shocks from commodity prices, but an exclusion-based measure of inflation is not the only such target. For example, trimmed-mean or median measures of inflation do not automatically exclude food and fuel prices but still provide a less volatile and more robust measure of overall inflation trends than headline measures.[36] Such measures have tended to have the same average rates of inflation as headline measures over the long term.[37]

In practice, there is no perfect measure of underlying inflation, and different measures may be appropriate depending on the country and circumstances. Many central banks have chosen to target a headline inflation forecast and clarify what that forecast assumes for food and fuel prices. At least with respect to commodity price shocks, this is akin to targeting a measure of underlying inflation. The use of forecasts also allows for more flexibility than does a framework tied closely to current inflation, because the central bank can monitor a wide range of indicators of underlying inflation and place varying weights on these indicators as circumstances change. One drawback to using forecasts is that it is

[36]See Bryan and Cecchetti (1993) for a discussion of these measures.

[37]See Brischetto and Richards (2007) for a discussion of the long-term performance of trimmed-mean measures in Australia, the euro area, Japan, and the United States. It is possible to calculate asymmetric trims if the long-term averages do diverge (see, for example, Roger, 1997). However, as Brischetto and Richards argue, asymmetric trims may be harder to explain to the public and this may complicate the establishment of a targeting regime based upon them.

difficult to monitor the central bank's performance, because tomorrow never comes, which only increases the importance of a strong communications policy. (Other aspects of forecast targeting, such as the optimal time horizon, must also be carefully considered, but these are beyond the scope of this chapter.)[38]

Finally, the simulations related to the current global environment underscore the policy advice implied by the cyclical positions alone. In emerging and developing economies with excess demand pressures, inflation already above target, and a high share of food in consumption baskets, tighter monetary conditions can help mitigate the negative effects of potential future food price shocks and the associated loss of monetary policy credibility. In contrast, in advanced economies with substantial economic slack, well-anchored inflation expectations, and a low share of food in consumption, there is ample room for monetary policy to accommodate any future commodity price shocks with little loss of credibility.

[38]A related question regards the appropriate level for the inflation target when there are permanent shifts in the relative prices of commodities such as food and fuel. In such cases, targeting headline inflation implies a different long-term level for core inflation, and vice versa. If, for some reason, annual growth of 2 percent in the CPI index were deemed appropriate, the central bank could communicate an equivalent target for underlying inflation. However, a discussion of the appropriate level for an inflation target is beyond the scope of this chapter.

Appendix 3.1. Economies in the Data Set

Advanced Economies	Emerging and Developing Economies
Australia	Albania
Austria	Argentina
Belgium	Bahrain
Canada	Bosnia and Herzegovina
Czech Republic	Botswana
Denmark	Brazil
Estonia	Bulgaria
Finland	Chile
France	Colombia
Germany	Croatia
Greece	Ecuador
Hong Kong SAR	Egypt
Iceland	Hungary
Ireland	India
Israel	Jordan
Italy	Kazakhstan
Japan	Kuwait
Korea	Latvia
Netherlands	Lebanon
New Zealand	Lithuania
Norway	Former Yugoslav Republic of Macedonia
Portugal	Macao SAR
Singapore	Malaysia
Slovak Republic	Mauritius
Slovenia	Mexico
Spain	Montenegro
Sweden	Nigeria
Switzerland	Oman
Taiwan Province of China	Pakistan
United Kingdom	Peru
United States	Philippines
	Poland
	Qatar
	Romania
	Russia
	Saudi Arabia
	Serbia
	South Africa
	Thailand
	Tunisia
	Turkey
	Uganda
	Ukraine
	United Arab Emirates
	Uruguay
	Venezuela
	West Bank and Gaza

Appendix 3.2. Technical Appendix

Simulation Model Details

Headline inflation π_t^H is the weighted average of domestic food inflation π_t^F and core inflation π_t.

$$\pi_t^H = (1 - \omega_F)\pi_t + \omega_F \pi_t^F. \tag{3.1}$$

The parameter ω_F represents the share of food in the consumption basket.

A Phillips curve relates current core inflation to past and expected core inflation, previous period output gap x_{t-1}, the change in the real exchange rate change, ΔRER, and a term related to second-round effects from food to core inflation:

$$\pi_t = \alpha\pi_{w,t} + (1 - \alpha)\pi_{b,t-1} + g(x_{t-1}) + \beta_e \Delta RER_t + (1 + \delta - S_t)\omega_F(\pi_{t-1}^F - \pi_{t-1}). \tag{3.2}$$

The function $g(x)$ is increasing and convex in its argument, S is the credibility stock bounded between zero and 1, and α and δ are parameters.[39] The variables π_w and π_b represent the forward- and backward-looking terms of the Phillips curve, which are defined as follows:

$$\pi_{w,t} = S_t\pi_{b,t+4} + (1 - S_t)(\pi_{b,t-1} + bias_t) \tag{3.3}$$

$$\pi_{b,t} = \sum_{i=0}^{4} \frac{\pi_{t-1}}{4}. \tag{3.4}$$

The lower the current credibility stock, S_t, the higher the importance of past inflation and the inflation bias term (*bias*) associated with imperfect credibility. The current stock of credibility has the following law of motion:

$$S_t = \vartheta S_{t-1} + (1 - \vartheta)\sigma_t \tag{3.5}$$

$$\sigma_t = \frac{(m_{h,t} - \pi_t^{tg})^2}{(m_{h,t} - \pi_t^{tg})^2 + (m_{l,t} - \pi_t^{tg})^2}. \tag{3.6}$$

The credibility signal σ_t is bounded between zero and 1, and the parameter ϑ ($0 < \vartheta < 1$) governs the rate at which credibility converges to σ_t. The variables m_h and m_l represent the inflation rates prevailing in the high- and low-inflation regimes, as perceived by the private sector. The variable π_t^{tg}

[39]The parameter δ is set to zero and 0.25 for the high- and low-credibility cases, respectively.

represents the inflation measure for which the central bank is held accountable. The closer π_t^{tg} is to the high-inflation level, the greater the loss in credibility. The perceived inflation rates prevailing in the high- and low-inflation regimes are as follows:

$$m_{h,t} = \alpha_h \pi_{t-1}^{tg} + (1 - \alpha_h)\pi^{high} \quad (3.7)$$

$$m_{l,t} = \alpha_l \pi_{t-1}^{tg} + (1 - \alpha_l)\pi^{low} \quad . \quad (3.8)$$

We interpret π^{low} as the (constant) target chosen by the central bank, and we assume $\pi^{high} \gg \pi^{low}$ such that we can focus on cases where $\pi_t^{tg} \leq m_{h,t}$ at all times. The lowest level of credibility occurs when $m_{h,t} = \pi_t^{tg}$, implying that credibility, S_t, declines to zero at rate ϑ.

The choice of the framework boils down to the choice of π_t^{tg}. In the case of the core framework, we have $\pi_t^{tg} = \sum_{i=0}^{4} \frac{\pi_{t-1}}{4}$, while in the case of the headline framework we have $\pi_t^{tg} = \sum_{i=0}^{4} \frac{\pi_{t-1}^{H}}{4}$.

The output gap is governed by an intertemporal aggregate demand (IS) equation that links the output gap to the previous period real rate, r_{t-1}, and the current real exchange rate, *RER*. An uncovered interest parity equation relates the nominal policy rate, R_t, to the expected depreciation of the nominal exchange rate, e_t. All φs are positive parameters. Asterisks indicate values for the rest of the world.

$$x_t = \varphi_1 x_{t-1} + \varphi_2 E_t x_{t+1} - \varphi_r (r_{t-1} - r) + \varphi_e (RER_t - RER), \quad (3.9)$$

$$R_t = R_t^* + \varphi_u (E_t e_{t+1} - e_t). \quad (3.10)$$

Finally, other equations that close the model are the definitions of the inflation bias, the real exchange rate, and the real rate, which is

$$r_t = R_t - E_t \pi_{t+1}^{H}. \quad (3.11)$$

The domestic food price is

$$\pi_t^F = 0.6\pi_t + 0.4(\pi_t^{*F} + \Delta e_t), \quad (3.12)$$

where π_t^{*F} is the international food-inflation process, which is taken as exogenous:

$$\pi_t^{*F} = \rho \pi_{t-1}^{*F} + \varepsilon_t. \quad (3.13)$$

In the calibration, we set the persistence parameter, ρ, equal to zero and 0.5 for temporary and persistent shocks, respectively.

Analysis of Pass-through from International Food Prices to Domestic Food Prices

The pass-through analysis is based on a country-by-country regression of monthly domestic food price inflation on current and 12 lags of monthly international commodity price inflation (converted to domestic currency), controlling for 12 lags of domestic food price inflation. The economies included in the database are listed in Appendix 3.1. The regression is run on the inflation rates because, despite long-term trends in the price levels, there is no evidence of a long-term relationship between the world food price index and domestic CPI food baskets. (Likely reasons for this are discussed in the section "From International to Domestic Commodity Prices.") In particular, the estimated equation is as follows:

$$\pi_t^{dom} = \sum_{j=1}^{12} \beta_j \pi_{t-j}^{dom} + \sum_{k=0}^{12} \gamma_k \pi_{t-k}^{int} + \varepsilon_{i,t}, \quad (3.14)$$

where π_t^{dom} denotes domestic food inflation in month *t*, and π_{t-k}^{int} denotes international food inflation in month *t*. The long-term pass-through coefficient is computed as the sum of the coefficients on international food price inflation (γ_k) divided by 1 minus the sum of the coefficients on lagged domestic food inflation (β_j). An analogous equation is estimated to investigate the pass-through from international oil prices to domestic transportation prices. The sample includes 31 advanced economies and 47 emerging and developing economies over the period 2000–11. The long-term coefficients are generally statistically significant.

Analysis of Inflation Expectations

The change in future inflation expectations is the dependent variable on the left side of equation 3.15, and the explanatory variable on the right side is the unexpected change in current-year inflation, defined as the revision of expectations for inflation in year

t made between spring and fall of year *t*. Thus, the equation estimated is

$$\Delta E_{it}\pi_{i,t+N} = \alpha + \beta\Delta E_{it}\pi_{it} + \mu_i + \lambda_t + \nu_{i,t}, \quad (3.15)$$

where the subscript *i* denotes the *i*th country, the subscript *t* denotes the *t*th year, and $\Delta E_{it}\pi_{i,t+N}$ denotes the revision of expectations for inflation in year *t*+*N*. The approach includes a full set of country dummies (μ_i) and a full set of time dummies (λ_t) to take account of global shocks such as oil prices and the global business cycle. The estimation results are similar without controlling for global shocks, suggesting that inflation expectations are anchored roughly equally following global and domestic inflation shocks. The data on inflation expectations come from *Consensus Economics* and are based on surveys of professional forecasters published twice yearly in the spring (March/April) and fall (September/October) from 1990 to 2010. An alternative measure of inflation expectations is based on the difference in yields between conventional and inflation-linked bonds (see, for example, Söderlind and Svensson, 1997). However, such yield-based estimates are not widely available for the economies considered in this chapter.

Additional analysis suggests that the response of medium-term expectations is similar for positive and negative inflation surprises. In particular, allowing positive and negative inflation surprises to have different effects by estimating an augmented equation,

$$\Delta E_{it}\pi_{i,t+N} = \alpha + \beta\Delta E_{it}\pi_{it} + \gamma\Delta Positive_{it} + \mu_i + \lambda_t + \nu_{i,t}, \quad (3.16)$$

where the term $\gamma\Delta Positive_{it}$ denotes a *positive* inflation surprise, yields an estimate of coefficient γ that is statistically indistinguishable from zero.

Box 3.1. Inflation in Sub-Saharan Africa during the 2008 Commodity Price Surge

This box focuses on the experience of 31 sub-Saharan African (SSA) economies during the food and fuel price surge of 2008 to highlight potential challenges for policymakers when facing such shocks. We start by considering these economies' broad macroeconomic environment and inflation experience during this period. Drawing on *IMF Staff Reports,* we then examine broad policy responses that help explain the experience of these economies during this price surge. Finally, we summarize the experience of the median SSA economy.

Although in most economies inflation increased during this period, experience varied widely and largely reflected differences in the policy mix rather than the effects of the food price shock itself. These results point to the importance of the policy stance in maintaining stable inflation in low-income countries facing external shocks. We also find that, although food inflation increased considerably for the median African country—accounting for most of the increase in headline inflation—domestic food prices were partially shielded from international prices due to sizable real currency appreciation, differences in food baskets, and the incomplete tradability of food. Spillovers from food and fuel to nonfood, nonfuel inflation were also somewhat limited, suggesting moderate second-round effects.

Structure of Sub-Saharan Economies

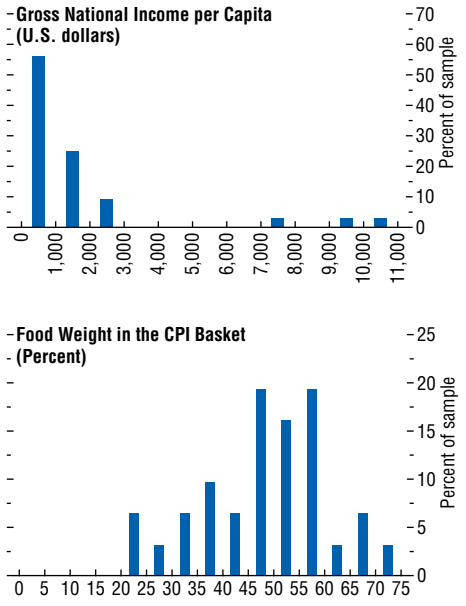
The majority of SSA economies have low income levels. The median gross national annual income in our sample was $950 per capita during 2001–05, much less than the median country in the world ($5,200). Because households in these economies tend to be poor, they spend a larger fraction of their income on food—about 50 percent—than do households in middle- and high-income countries (about 30 and 15 percent, respectively). There are, however, considerable variations in both income per capita and the share of expenditure allocated to food (Figure 3.1.1), with some countries (Botswana, Gabon, South Africa) in the middle-income category.

Economic performance in SSA economies is particularly vulnerable to changes in the external environment. The region's trade consists primarily of commodities, with many economies specializing in one or two commodities. As net importers of food and fuel, all economies are exposed to large fluctuations in their terms of trade. In addition, access to international capital markets is limited, although countries such as Nigeria, South Africa, and Zambia experience large movements in private capital flows. In addition, most countries rely on official flows, such as grants and concessional loans, and remittances to finance sizable current account deficits.

Although SSA economies have often been subject to episodes of high inflation associated with economic and political instability, the region generally succeeded in stabilizing and reducing inflation during the first half of the 2000s. During this period, fiscal dominance—subordination of monetary policy to fiscal needs—subsided and growth accelerated. The median inflation rate in the region stood at 6

The main authors of this box are Rafael Portillo and Felipe Zanna.

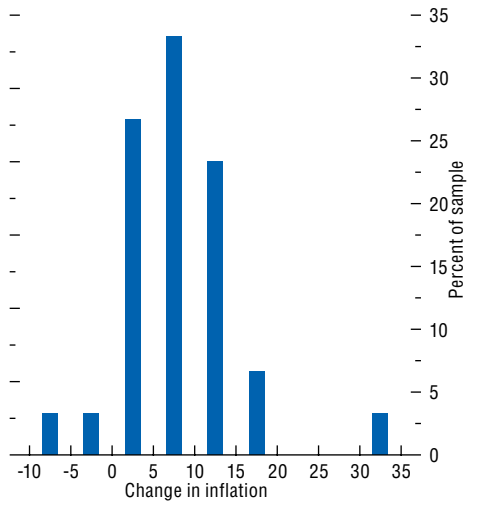
Figure 3.1.1. Income and Food Share in Sub-Saharan Africa



Sources: Haver Analytics; and IMF staff calculations.
Note: CPI = consumer price index.

Box 3.1 *(continued)*

Figure 3.1.2. Changes in Inflation in Sub-Saharan Africa, 2007–08



Sources: Haver Analytics; and IMF staff calculations.

percent by mid-2007, compared with 15 percent in 2000. Low inflation was achieved using a variety of monetary and exchange rate policies. About one-third of SSA economies (half our sample) operate hard pegs, of which most are in the CFA franc area. The rest have flexible exchange rate arrangements, ranging from soft pegs to fully floating arrangements. In the latter, central bank intervention in foreign exchange markets is common. Most countries with managed floats target monetary aggregates, although with considerable flexibility, and some can be considered to be practicing "inflation targeting light." In particular, although they target inflation, they do not have the institutional framework to formally adopt inflation targeting.[1]

[1]See Carare and Stone (2003). South Africa is a full-fledged inflation targeter, and Ghana is formally transitioning to inflation targeting.

Inflation during the 2008 Food Price Surge

Although inflation in SSA economies generally increased during the 2008 commodity price surge, there was a broad range of experience. Figure 3.1.2 illustrates this range using a histogram of the change in inflation in SSA economies between September 2007 and September 2008.

The variation in food and nonfood inflation was associated with a number of policy variables and economic features. In particular, as Table 3.1.1 shows, economies that reduced taxes on food or introduced export bans or quotas experienced smaller increases in food prices. The relationship between these policies and nonfood inflation was less clear. In addition, economies with lower income levels faced larger increases in food inflation, possibly because they could not afford the fiscal measures that would have offset the short-term effects of world food prices on domestic food prices.

The case of Madagascar illustrates the role of policy. Rice is the most important item in the food basket in Madagascar (15 percent of total consumption, and 55 to 70 percent of the daily caloric intake of households). As international prices increased in 2008, domestic prices—measured in U.S. dollars—stayed broadly constant (Figure 3.1.3). The government intervened actively in the rice market, imposing a suspension of rice exports in April and lowering value-added taxes on rice in the second half of the year, at an estimated budgetary cost of 0.3 percent of GDP.[2] In addition, the gap between domestic production and consumption in 2008 was closed by means of imports at preferential prices.

IMF Staff Reports shed light on these factors. These reports suggest that the policy responses and outcomes fall into three broad categories:

- Economies where increases in food and fuel inflation account for most of the inflation dynamics: Economies in this group include most of the CFA franc area countries that are not oil exporters (Benin, Burkina Faso, Cape Verde, Central African Republic, Comoros, Guinea-Bissau, Mali, Togo) as well as some with managed floats (Uganda, Mozambique). In these countries

[2]See IMF (2008).

Box 3.1 *(continued)*

Table 3.1.1. Variations in Inflation: Sub-Saharan Africa

Index of Measures Implemented	Correlation with Food Inflation	Changes in Macroeconomic Variables	Correlation with Food Inflation
Reduction in Taxes	–0.32	Government spending (% of GDP)	–0.29
Reduction in Import Tariffs	0.07	Base money growth	–0.05
Subsidies	–0.09	Broad money growth	0.06
Transfers	0.09	Credit growth	0.45
Export Bans/Quotas	–0.34	Current account (% of GDP)	–0.12
Price Controls	–0.03	Reserves accumulation	0.11
Structural Features		**Fuel prices**	0.13
Food Weight	–0.15		
Degree of Openness	–0.12		
Gross National Income per Capita	–0.53		

Source: IMF staff calculations.

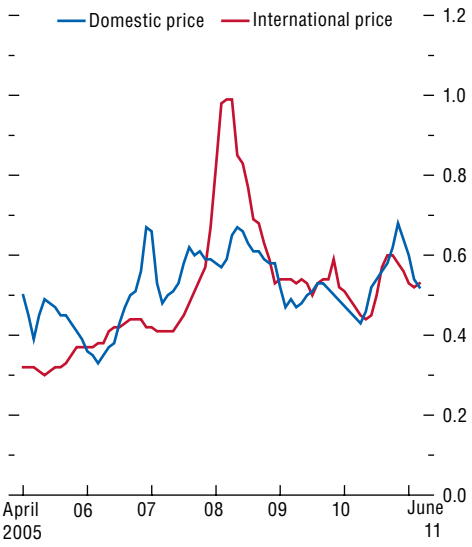
nonfood, nonfuel inflation did not increase, partly because inflation expectations were better anchored. (Uganda has a track record of low inflation, while historically fixed parity with the euro has kept inflation low in the CFA franc area.) In some CFA franc countries, monetary policy tightened endogenously as these countries faced pressures on the balance of payments—partly due to their status as food importers—and lost reserves during this period. Note that, in spite of the solid anchor, CFA franc countries experienced very large increases in food and fuel inflation, consistent with large pass-through of international prices to domestic prices. The policy response in Uganda and Mozambique was different, however: money targets were relaxed and interest rates stayed broadly constant.

- Economies with expansionary macroeconomic policies: These economies experienced high or accelerating inflation during both 2007 and 2008, partly because of rising food inflation but also because of aggregate demand pressures and a loose policy mix. In some cases (Angola, Gabon, Nigeria), the aggregate demand pressures reflected an expansionary fiscal policy driven by higher oil revenues. In others (Kenya, Nigeria, Rwanda, Tanzania), the aggregate demand expansion reflected a combination of higher aid-financed government spending with unsterilized accumulation of reserves.[3] Many of these economies had higher public wage bills. With the exception of Angola and, to a lesser extent, Nigeria, fuel prices were also increasing, suggesting possible fuel-driven inflation pressures.
- Economies that monetize debt: These are the countries with the highest inflation increases (about 20 to 30 percent), reflecting generalized price pressures—that is, very large increases in both food and nonfood prices. Unlike the previous group, the inflationary spike resulted from the complete subordination of monetary policy to

[3]This policy combination is often referred to as "spending but not absorbing" the aid (see Berg and others, 2010).

Figure 3.1.3. Rice Price, Madagascar

(U.S. dollars a kilogram)



Source: IMF staff calculations.

Box 3.1 *(continued)*

fiscal needs during this period. The Democratic Republic of Congo and Ethiopia fall into this category.

In sum, the cross-country experience suggests that, although all economies faced the same international commodity price shock, the policy stance helped shape the specific outcomes.

Inflation in the Median SSA Economy

Having discussed the variation across economies, we now summarize the experience of the median SSA economy during the 2008 commodity price surge. Given the large weight of food in consumer expenditures, a hefty increase in domestic food prices was to be expected in low-income countries (first-round effects). Nonfood inflation could also be expected to rise sharply due to higher fuel prices and potential spillovers from food to nonfood prices (second-round effects).

The experience of the median SSA economy provides evidence of first-round effects. In particular, as Table 3.1.2 shows, by September 2008—the month prices increased the most—food inflation had increased by 9.4 percentage points (from 6.4 percent to 15.8 percent) relative to the previous year. The increase, although large, was considerably smaller than the increase over the same period in the inflation rate in U.S. dollars of an index of internationally traded food commodities (29.3 percent). Two factors account for this large discrepancy. First, the median SSA economy experienced a nominal exchange rate appreciation of 9.3 percentage points against the U.S. dollar. This reduced, by one-third, the local currency equivalent of international food inflation—that is, "imported" food inflation. Second, because baskets are different and the law of one price does not hold perfectly for all commodities, slightly less than half the increase in imported food inflation was passed through to domestic food prices. As discussed above in the case of Madagascar, government intervention is one reason for incomplete pass-through in this region.[4]

Table 3.1.2. Food Inflation Dynamics
(percentage points, median sub-Saharan African economy, 2007–08)

	September 2007	September 2008
Domestic Inflation	6.4	15.8
International Inflation	7.3	36.6
Nominal Exchange Rate Depreciation	–6.0	–15.3
Imported Inflation	1.3	21.3
Change in Domestic Relative Price	0.2	3.7
Change in International Relative Price	4.6	31.6
Real Exchange Rate Depreciation	–5.4	–18.9
Change in Imported Relative Price	–0.7	12.7

Source: IMF staff calculations.

Table 3.1.2 also looks at changes in the domestic relative price of food for the median African economy—that is, it adjusts for headline inflation. We observe a broadly similar pattern, except that pass-through from international prices is now smaller. Just as the nominal appreciation helped dampen the effect on domestic food inflation, the real appreciation in 2008 also helped reduce the effect on the domestic relative price of food. Note that the real appreciation is consistent both with an improved external environment and with recent work on the macroeconomic adjustment to imported food prices—which emphasizes appreciation of the CPI-based real exchange rate in countries where the share of food in consumption is large.[5]

As Table 3.1.3 indicates, most of the increase in inflation observed during this period is the result of higher food prices. However, nonfood prices also increased by 2.9 percentage points. To assess whether the increase in nonfood prices reflects fuel prices or second-round effects of higher food prices, we estimate the direct and indirect effects of higher fuel prices on nonfood prices. The direct effect is given by the share of fuel in nonfood consumption expenditure—which we calibrate at 3 to 4 percent—whereas the indirect effect is given by the share of fuel in nonfood production—which we calibrate at 5 to 6 percent.[6] Because fuel prices in the median economy increased by 20 percent during this period, our calibration suggests that nonfood prices should have increased by 1.6 to 2 percentage points, which accounts for most of the 2.9 percentage point

[4]Relative to 2008, the spike in commodity prices that started in 2010 and peaked in April 2011 appears, thus far, to have had a smaller effect on inflation.

[5]See Catão and Chang (2010).

[6]The calibration is based on the input-output tables for Uganda and the share of fuel in production in economies that do not produce oil.

Box 3.1 *(continued)*

Table 3.1.3. Inflation Dynamics

(percentage points, median sub-Saharan African economy, 2007–08)

	September 2007	September 2008
Food Inflation	6.4	15.8
Nonfood Inflation	4.9	7.8
Headline Inflation	6.2	12.1

Source: IMF staff calculations.
Note: median food weight = 0.51.

increase observed during this period. In sum, there appears to be little evidence of large second-round effects from food inflation to nonfood inflation.

An analysis by exchange rate regime finds a similar pattern but with interesting differences. Starting from a low base in mid-2007 (1.7 percent inflation), economies with hard pegs experienced larger increases in inflation (10 percent), mostly on account of food. Managed floats, on the other hand, experienced smaller increases in inflation (6 percent), but starting from a higher base (8 percent). Note that the increase in inflation in hard pegs occurred despite a larger nominal appreciation vis-à-vis the U.S. dollar (9 percent versus 3.4 percent in managed floats), because these economies' exchange rates are fixed to the euro. The larger increase in inflation therefore reflects a larger pass-through of international prices.

What accounts for the relative stability of nonfood inflation? As Table 3.1.4 indicates, the macroeconomic environment was broadly neutral during this period. There was a small increase in government spending. On the monetary front, there was a small increase in the growth rate of monetary aggregates; money targets were missed in eight countries for which there are data; and nominal interest rates stayed constant—all of which is broadly consistent with an accommodation of first-round effects.

Table 3.1.4. Macroeconomic Environment: Sub-Saharan Africa

(percent unless noted otherwise)

Macroeconomic Variables	Government Spending (% of GDP)	Base Money Growth	Broad Money Growth	Credit Growth	Current Account (% of GDP)	Reserves Accumulation (% of GDP)	Policy Rates
Median Change	0.3	1.0	1.0	3.8	–2.2	–0.9	0.6

Source: IMF staff calculations.

Box 3.2. Food Price Swings and Monetary Policy in Open Economies

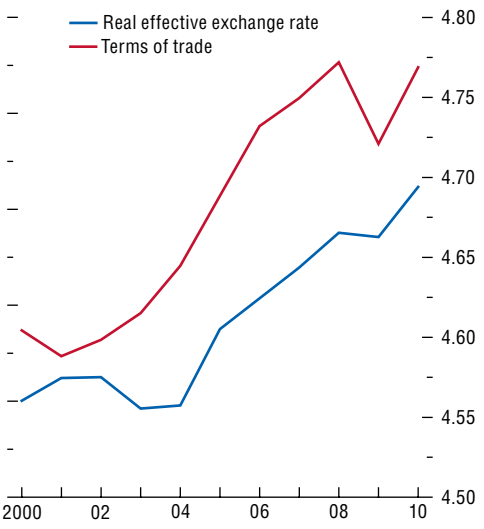
This box examines the trade-offs facing monetary policymakers in small open economies following swings in world food inflation. The discussion focuses on emerging and developing economies where the share of food in the consumption basket is not only sizable in absolute terms but also is larger than that of the country's main trading partners. This implies that rises in global food inflation tend to increase domestic inflation as well as appreciate the real exchange rate. As monetary policymakers formulate their response to these developments, they need to keep in mind the important trade-offs between stabilizing inflation, consumption, and output.[1]

This box argues that these trade-offs depend on three main factors: first, whether the country is a net food exporter or importer; second, whether the country is more or less financially integrated with the rest of the world; and third, whether the country has some market power in its export markets. The conclusion is that monetary policy trade-offs are particularly acute for net food importers, but much less so if they are highly integrated with world capital markets or have some market power in their export markets.

Food Exporters

Net food exporters, facing a rise in world food prices, will also experience a terms-of-trade improvement. This tends to raise output and consumption. Given the high food consumption share, consumer price index (CPI) inflation will also rise and by more than in trading partners, thus inducing a real exchange rate appreciation. Therefore, the terms of trade and the real effective exchange rate will tend to move in the same direction (Figure 3.2.1). In this case, the central bank can help stabilize both inflation and the output gap by tightening monetary policy. This is because monetary policy tightening induces nominal exchange rate appreciation, helping stabilize both food prices in domestic currency and domestic food output.[2] If, however, there are significant real wage rigidities, wage costs may rise in tandem with (or even overreact to) food price inflation, putting pressure on costs, and trade-offs between output and inflation stabilization will arise.[3]

Figure 3.2.1. Net Commodity Exporters, 2000–10
(Percent)



Source: IMF staff calculations.

Food Importers

By contrast, for net food importers facing a rise in world food prices, stabilizing the domestic inflation rate poses a starker trade-off. Take, for example, the case of a country that exports tourism services and imports most of its food—the latter being an important input for the production of its

This box was prepared by Luis Catão and is based largely on Catão and Chang (2010).

[1]The analysis assumes that monetary policy can influence real economic activity and the real exchange rate due to price and wage rigidities. Theoretically, if prices and wages were fully flexible, goods and factor markets integrated and fully competitive, and capital markets frictionless, monetary policy intervention would have no real effects.

[2]Such a circumstance, in which the inflation and output stabilization objectives do not conflict with each other, has been labeled "divine coincidence" by Blanchard and Galí (2007).

[3]It has been argued, however, that such real wage rigidities are less prevalent in emerging and developing economies than in advanced economies.

Box 3.2 *(continued)*

services. Here, a rise in world food prices entails a worsening of the terms of trade and pushes up costs, thereby reducing disposable income and adversely affecting domestic output and consumption. At the same time, given the high food consumption share, the world food price rise implies higher CPI inflation. Unlike in the case of net food exporters, the terms of trade and the real exchange rate will tend to move in opposite directions, as illustrated in Figure 3.2.2. Monetary tightening aimed at stabilizing inflation will tend to appreciate the nominal exchange rate. Although this may help reduce domestic cost pressures, it will also tend to further appreciate the real exchange rate, decreasing competitiveness and dampening output beyond the deterioration in the country's terms of trade. Overall, in these economies, there is no divine coincidence, and policymakers must face the trade-off between stabilizing inflation and economic activity.[4]

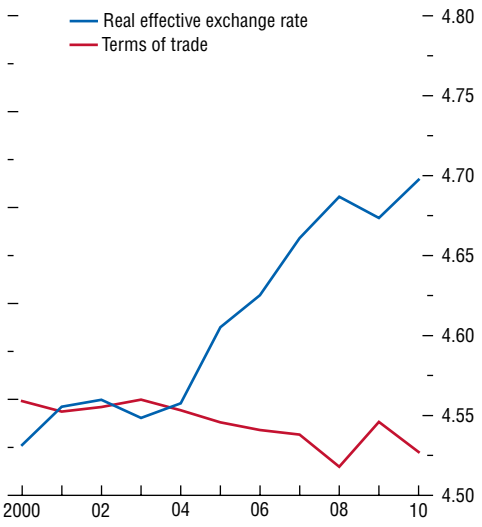
At the same time, for net food importers, the negative effects on economic activity from monetary policy tightening in response to food price increases can be mitigated by three factors: the positive effect of the ensuing currency appreciation on output by dampening imported input costs, a "terms-of-trade externality" effect resulting from the same nominal appreciation, and international financial integration.

The first cost-reducing effect is straightforward.

The second is more subtle: a rise in interest rates and the ensuing currency appreciation can improve an economy's terms of trade if it has strong market power in its export markets. An example of this would be an economy that produces a relatively unique service, such as tourism, for which foreign demand is relatively insensitive to the price. Here, as a consequence of the nominal appreciation induced by monetary policy tightening, the foreign currency price of the economy's exports rises, implying a positive effect on the terms of trade (terms-of-trade externality), which will cushion the initial fall in output and consumption.

[4]These economies also correspond to the "worst sufferer" case modeled in Catão and Chang (2010).

Figure 3.2.2. Net Commodity Importers, 2000–10
(Percent)



Source: IMF staff calculations.

The third factor is the degree of capital market integration: the more able the economy is to borrow abroad to smooth the shock, the less the fall in domestic consumption, and so the smaller the effect of monetary policy tightening on consumption and, ultimately, on domestic demand. Conversely, the greater the international capital market imperfections facing this economy, and the smaller its market power over what it produces and exports, the stronger the case for some accommodation of the food price shock. This prevents an overly tight monetary policy from exacerbating the adverse effects of the food price shock on the terms of trade and hence on output.[5] One way to achieve this in practice is to place a higher weight on the output gap in the monetary policy reaction function in these types of economies.

[5]See Frankel (2011) for a discussion of alternative monetary policy rules for small open economies with incomplete capital markets.

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