CHAPTER 3

IS INFLATION BACK? COMMODITY PRICES AND INFLATION

This chapter examines the current commodity price boom and evaluates the risks that the associated relative price adjustment could ratchet up inflation, as during the 1970s. Despite some recent easing in commodity prices, many of the forces underlying the boom are still in place, and prices will likely remain at high levels by historical standards. Continuing inflation risks arise from the large increases in commodity prices that have not fed fully through the supply chain. Most vulnerable to risks of a ratcheting up in inflation are those economies with a high likelihood of second-round effects—where commodities account for a large share of final expenditure and where monetary policy has only limited credibility, where there are price pressures from other sources such as overheating, and where the macroeconomic policy response to rising inflation has been inadequate.

Could the large commodity price surge of the past year and a half signal an end to a decade or so of price stability and herald a return to the type of high inflation seen during the 1970s? This question continues to be widely debated, even as commodity prices have begun to ease since mid-July. In many economies, headline inflation rates remain at levels last seen 10 to 15 years ago, and core inflation is still rising, particularly in emerging and developing economies.

Although there is broad agreement that inflation risks have increased across the globe, the causes for concern differ among various analysts and policymakers. For some, the main concern is that the commodity price increases have been so broad-based, large, and rapid that perceptions of rising inflation could spill over into expectations for further prices increases, demands for higher wages, and thereby an increase in underlying inflation (second-round effects). Others focus on the fact that, in a number of emerging and developing economies, the pressures from surging commodity prices come on top of price pressures from economic overheating. This combination exacerbates the risks of second-round effects. The problem is particularly acute in commodity exporters for which the commodity price surge has been expansionary.

A third cause for concern is that the commodity price surge might not, in fact, be a pure supply shock but may instead be the consequence of global excess demand resulting from overly expansionary macroeconomic policies. As during the 1970s, soaring commodity prices may be an early indication that capacity is being overestimated in some countries. By mistakenly reading the price surges as entirely the result of sector-specific constraints, policymakers may amplify inflation pressures.

The chapter analyzes the commodity price boom and the implications for inflation prospects and risks. Specifically, it seeks to answer the following questions.

- Why are commodity prices so high, and will they stay high?
- What has been the impact of rising commodity prices on headline and core inflation across the globe? Which countries have been most affected? What are the risks of significant second-round effects, and what factors affect these risks?
- What should be the appropriate monetary policy response to rising commodity prices? Under what circumstances can inappropriate monetary policies in individual countries carry significant global implications?

The chapter concludes that the current commodity price boom has, broadly speaking, reflected the interaction of strong demand, low

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inventory and spare capacity levels, slow supply expansion in key sectors, and adverse supply shocks. Prospects for a slowing of global growth in 2008–09—partly in response to high commodity prices—and the resolution of weather-related supply constraints for key food crops have recently caused commodity prices to ease. However, some of the underlying forces behind the commodity price boom are still in place, notably strong growth in large emerging economies, low inventories, and supply constraints in key sectors. Barring an intense global downturn, these factors will likely limit the extent of further easing from recent price peaks and provide for continued price volatility.

Inflation risks will likely remain elevated for some time, even if commodity prices exert less direct inflation pressure than during the past year and a half, because the adjustment to the large increase in relative commodity prices is still in train. There have already been second-round effects in some economies, and some others remain at risk. Emerging and developing economies are generally more vulnerable to the main risk factors, including having a large share of commodities in final expenditure and having less-credible monetary management. Moreover, higher international prices, in particular for fuels, have not yet been fully passed through to domestic prices in many economies.

Notwithstanding the recent easing in commodity prices, a determined monetary policy response remains important in economies where inflation pressures were already elevated before the commodity price surge and where risks of second-round effects are high. Delaying the monetary policy response could lower the credibility of policymakers and thereby significantly worsen the inflation-output tradeoff. Other macroeconomic policies should be supportive, particularly if exchange-rate-related constraints limit the scope for monetary tightening.

The chapter is organized as follows. The next section examines the origins of and prospects for high commodity prices. The following section looks at the relationship between commodity price shocks and inflation at the country level, examining whether sustained increases in food and energy prices could reverse the recent "great moderation" in inflation across the globe. The analysis then focuses on the monetary policy implications of the commodity price shocks and the implications for global inflation dynamics. The summary and conclusions section also draws some policy implications.

Surging Commodity Prices: Origins and Prospects

Commodity prices surged during the past year and a half (Figure 3.1, top and middle panels). The oil price more than doubled between December 2006 and mid-July 2008, although some of these gains have been reversed since, and food prices rose by more than 50 percent during this period. These surges came on top of large price increases during 2003–06. Overall, cumulative commodity price increases since 2003 are broadly similar in magnitude to those recorded during the commodity price boom of the early 1970s (1971–74), the last major boom. More recent periods of sustained global growth—during the 1980s and the 1990s—were not accompanied by broad-based commodity price booms involving fuel and food commodities. This section compares the current commodity price boom to the early 1970s boom and then discusses current oil and food price developments and prospects.[1]

The Current Commodity Price Boom Compared with the 1970s

Three common factors seem to underlie both booms. First, the origins can be traced to strong global growth (Figure 3.1, bottom panel).[2] Prices for many commodities respond strongly

[1]Appendix 3.1 provides a more detailed overview of recent commodity market developments and prospects.

[2]Among others, Radetski (2006) noted that the beginning of each significant, broad commodity price boom during the postwar period (1950–52, 1972–74, and 2003

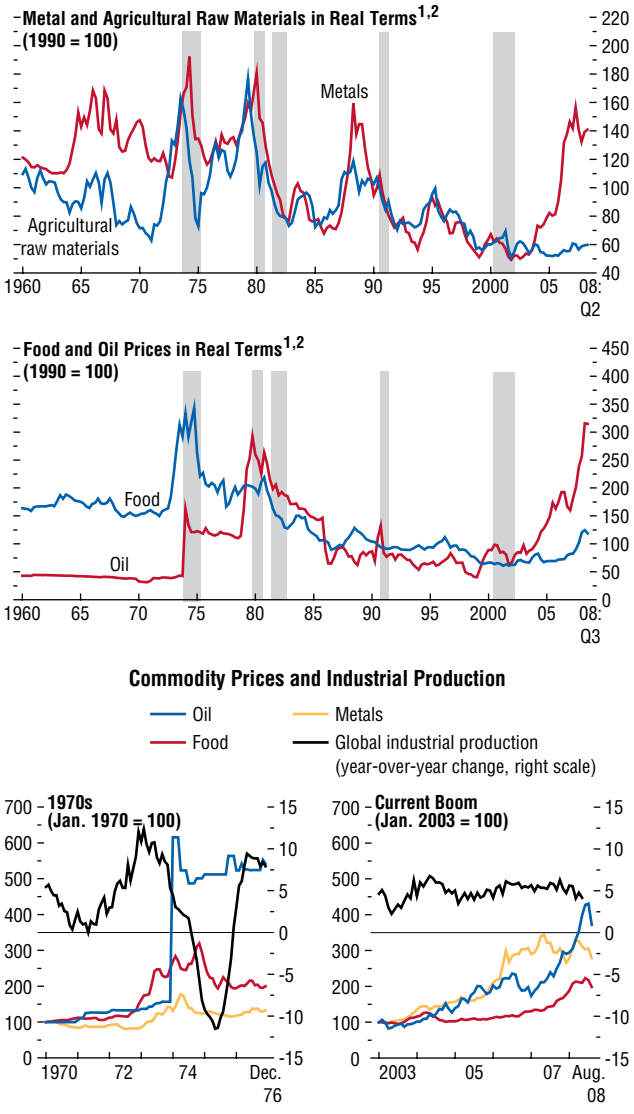
to changes in global growth or industrial activity. This reflects the role of commodities in global industrial activity—especially intermediate inputs in manufacturing such as metals and agricultural raw materials, but also oil—and, for other commodities such as food, the role of income as a determinant of demand.

The growth acceleration in emerging and developing economies during the past few years—driven by industrialization takeoff and strong per capita income increases from a low base—has likely altered the relationship between global activity and commodity prices during the current boom. The rotation in global growth toward these economies has catalyzed commodity demand because their growth has been relatively more commodity-intensive (Figure 3.2, top panel). The slowdown in the advanced economies has so far had less of an impact on commodity prices than during earlier downturns in these economies. That said, turning points in price cycles have historically been broadly synchronized with those in global economic activity.[3]

A second factor common to the 1970s boom and the current boom is that both started with lower-than-usual inventory and spare capacity levels (Figure 3.2, middle and bottom panels). In both booms, this lack of buffers amplified the price impetus from the pickup in commodity demand resulting from strong global growth.[4] The reasons for low inventory and spare capacity levels in the current boom vary across commodity sectors, but in general, there was underinvestment and slow supply growth during the late

Figure 3.1. Commodity Prices in Historical Context

The current commodity price boom shares many common features with the most recent major commodity price boom, during the early 1970s, including sharp increases in oil and food prices and an environment of strong global growth .



Source: IMF staff calculations.
[1]Deflated by U.S. consumer price index (CPI).
[2]Shading denotes periods of global recession (identified by a monthly index of global industrial production).

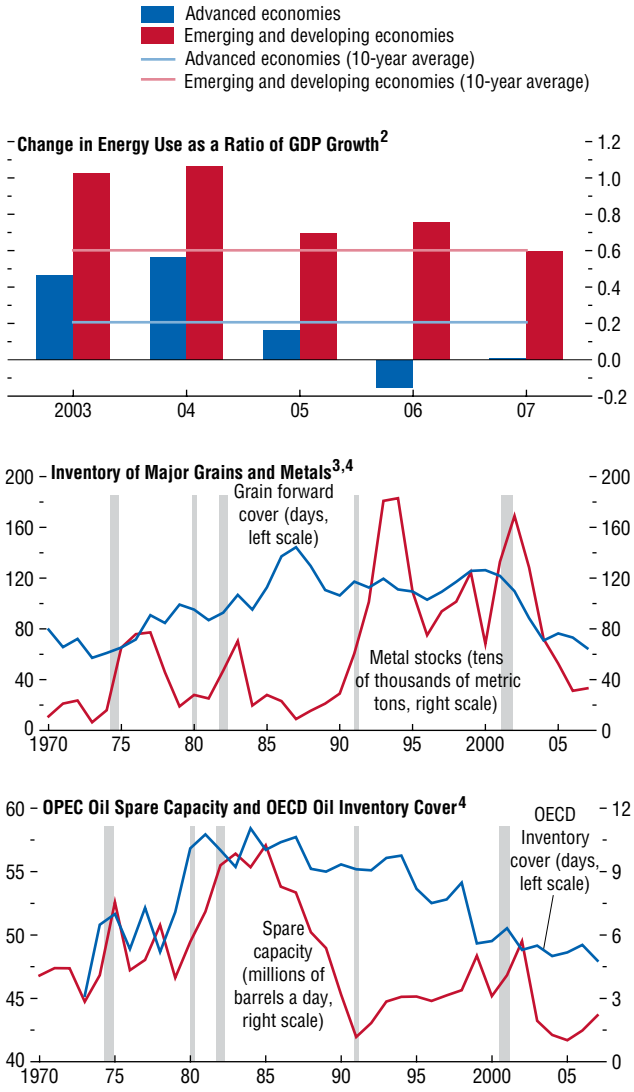
until now) coincided with an acceleration in economic growth and industrial production.

[3]See Box 5.2 in the April 2008 *World Economic Outlook*.

[4]The presence of such interaction between strong demand and low initial buffer levels is likely one of the factors that turn a cyclical price upswing into a price boom, because differences in global growth between expansions are too small to plausibly explain the large differences in commodity prices observed during global upswings. See, among others, Deaton and Laroque (1992) and Radetski (2006) on the mechanics of commodity price cycles.

Figure 3.2. Marginal Change in Energy Intensity, Commodity Inventories, and OPEC Oil Spare Capacity[1]

Strong commodity-intensive growth in emerging and developing economies was a major factor behind declining inventory levels and low OPEC oil spare capacity.



Sources: *British Petroleum Statistical Review of World Energy* (2008); International Energy Agency; U.S. Department of Agriculture; U.S. Department of Energy; and IMF staff calculations.

[1]OPEC is the Organization of Petroleum Exporting Countries.

[2]Primary energy in millions of barrels of oil equivalent per GDP (expressed in billions of 2005 U.S. dollars).

[3]Grains include corn, rice, and wheat; metals include copper, lead, and zinc.

[4]Shading denotes periods of global recession (identified by a monthly index of global industrial production).

1990s, following two decades of low commodity prices.

A third factor common to both booms has been that supply constraints put upward pressure on prices. The abrupt rise in oil prices in December 1973, together with the temporary reduction in oil production during the embargo by the Organization of Petroleum Exporting Countries (OPEC), has become the textbook case of a commodity supply shock. In the current boom, weather-related crop failures, for wheat in particular, have boosted food prices. Such shortfalls also propelled food prices during the earlier boom (Figure 3.3).

In the current boom, the supply-side constraints in commodity sectors other than agriculture were not the result of sharp, temporary supply reductions, but instead reflected protracted, inelastic supply responses in the face of higher demand and rising prices. In the oil market and, to a lesser extent, in some metals markets, "time-to-build" lags appear to have increased during the current cycle, as discussed below. In the face of rapidly growing demand, this slow capacity expansion has led to a perpetuation of low inventory and spare capacity levels, which have sustained the pressure on prices. This feature of the current boom has given rise to the notion of a "supercycle" in commodity prices—a period with secular trend increases in commodity prices because of the need for a substantial buildup in capacity.[5]

Speculation—the purchase of commodities intended for resale at a higher price rather than for commercial use—has been widely seen as a factor driving up commodity prices during both booms.[6] In the 1970s, speculative inventory holdings appear to have risen for some

[5]See Cuddington and Jerrett (2008) for a recent analysis. More generally, lags in the response of supply (as well as demand) to unexpected price changes can lead to price cycles (see, for example, Krautkraemer, 1998), with the length and amplitude of a cycle depending on differences between long- and short-term price elasticities and the lag structure as well as the magnitude of the initial unexpected change.

[6]See Harrison and Kreps (1978) or Feiger (1976) on definitions of speculation.

commodities, notably metals (see, for example, Cooper and others, 1975). In the current boom, however, inventory holdings of key commodities have generally remained low or have even declined, suggesting that prices have not been driven up by a speculative shift toward holdings of real assets, as in the earlier boom. Despite recent financial innovation in commodity markets, such as indexing, which has allowed investors to benefit from rising commodity prices without having to maintain physical inventory holdings, there is little discernible evidence that the buildup of related financial positions has systematically driven either prices for individual commodities or price formation more broadly (Box 3.1).

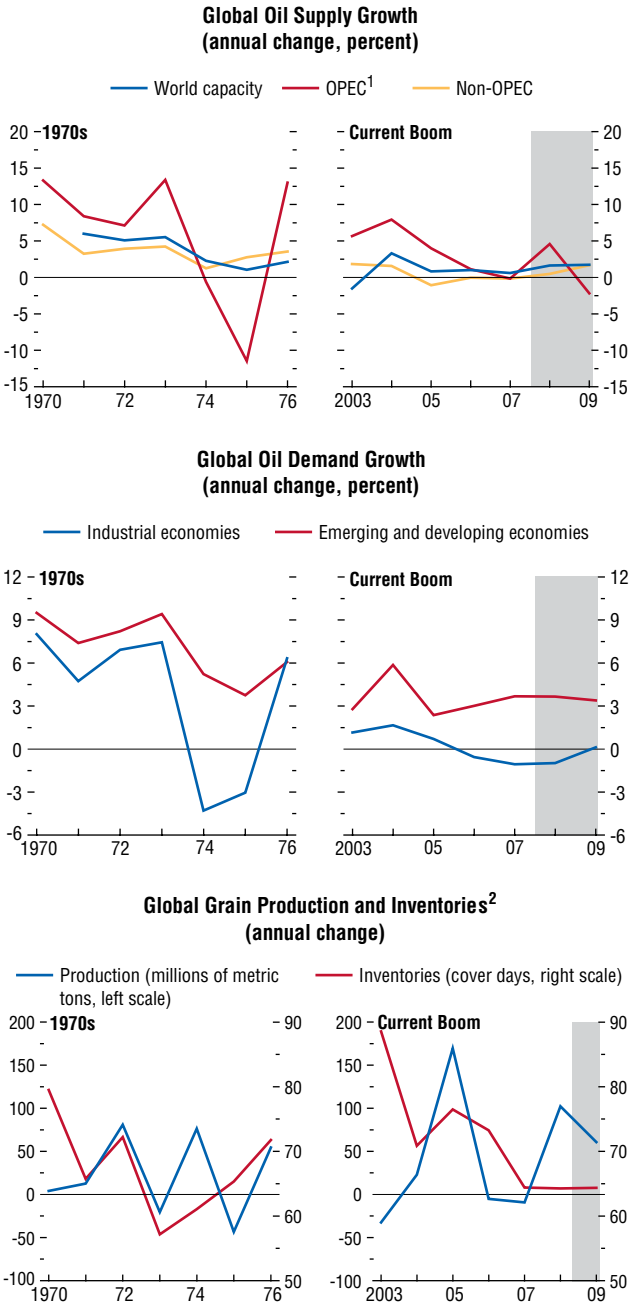
Nevertheless, financial factors and sentiment do play a role in commodity price formation. Financial variables such as interest rates affect commodity prices through their effects on physical demand and supply. Indeed, the recent decline in U.S. policy interest rates likely spurred commodity demand temporarily, as discussed below. Many commodity prices have traditionally been more flexible than either wages or prices for other goods, and therefore they tend to respond faster to such monetary policy impulses, with some scope for short-term price overshooting.[7] Moreover, because most commodities are storable, they are real assets, and their prices are thus affected not only by current market conditions but also by future expectations. In the short term, such expectations can be influenced by sentiment and investor behavior, which can amplify short-term price fluctuations, as in other asset markets.

Whether the current commodity price boom will continue depends on the extent to which the current alignment prevails: strong demand, low inventory and spare capacity levels, and supply constraints. There are indications that some elements of this constellation have started

[7]See Bordo (1980) on the commodity price response to monetary policy impulses, and Frankel (1986, 2006) and Akram (2008) on the effects of real interest rate changes on commodity prices.

Figure 3.3. Grain and Oil Demand, Production, and Inventories in Comparison

Strong demand and slow capacity expansion in key sectors, as well as supply disruptions for major crops, are aspects of both the current and the 1970s commodity price booms.



Sources: *British Petroleum Statistical Review of World Energy* (2008); U.S. Department of Agriculture; U.S. Department of Energy; and IMF staff estimates.
[1]Organization of Petroleum Exporting Countries.
[2]Grains include corn, rice, and wheat.

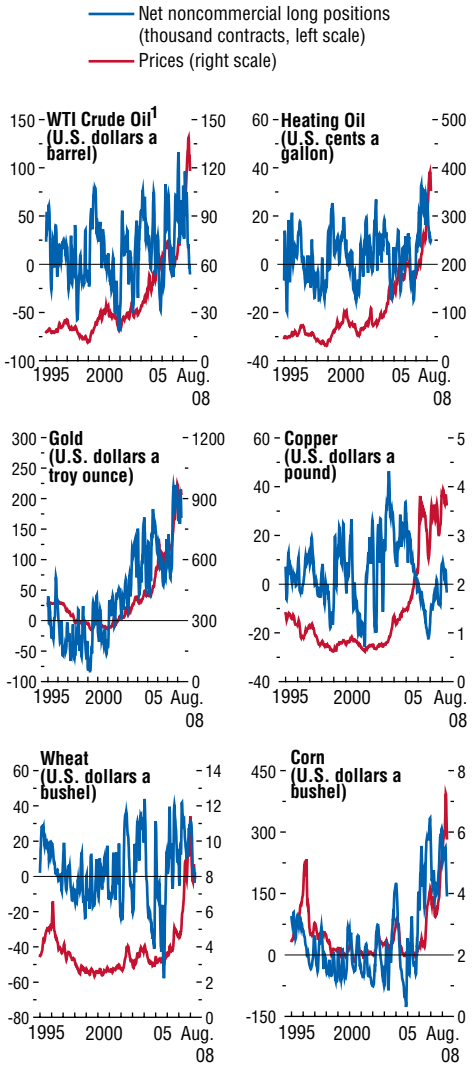
Box 3.1. Does Financial Investment Affect Commodity Price Behavior?

Commodities have become an alternative asset class in recent years, with rapid growth in both open positions at futures exchanges and investments in commodity-indexed assets.[1] This financialization of commodity markets is often thought to have affected commodity price behavior, although views about the extent of influence vary widely among analysts. One perspective is that financialization of commodities is largely beneficial and improves market efficiency and price discovery. Another view is that recent commodity price surges are largely driven by speculators and herd behavior among investors looking for alternative asset classes. This box analyzes the potential impact of investment flows on commodity price behavior. Specifically, it considers whether the evidence supports the notion that speculation in commodity-related financial assets has driven the recent commodity price booms. To shed further light, it also considers how other aspects of price formation, such as price volatility and comovements, have been affected by increased financial flows.

How do financial factors affect price formation? Financial markets can affect commodity prices through two channels. First, certain financial variables—such as exchange rates and interest rates—can directly affect commodity supply and demand. For example, a weakening U.S. dollar and lower interest rates could raise demand and reduce production of commodities, thereby exerting price pressures.[2] Second, transactions by financial investors, including speculators, might influence price behavior. A prominent controversy in this area relates to whether the recent commodity price boom has been underpinned by the rapid rise in investment in commodity-indexed assets by investors seeking to diversify their portfolios.

Net Noncommercial Futures Positions and Prices

(Four-week moving averages)



Sources: Bloomberg Financial Markets; U.S. Commodities Futures Trading Comission; and IMF staff calculations.
[1]WTI is West Texas Intermediate crude oil.

The main author of this box is Kevin Cheng.

[1]For example, the open interest of crude oil futures traded in the New York Mercantile Exchange (NYMEX) has increased by 155 percent during 2003–08, with corresponding figures increasing by 63 percent for gold. Investment in commodity-related assets has increased from below $10 billion in 1997 to about $230 billion in the second quarter of 2008 (Barclays Capital, 2008).

[2]See, for example, Box 1.4 of the April 2008 *World Economic Outlook*.

Because the fair value of commodities is difficult to determine, the issue of whether such behavior has driven prices away from fundamentals has been addressed through indirect approaches. One approach is to examine whether changes in commodity financial positions lead to commodity price changes using time-series analysis ("Granger causality tests"). Many recent studies in this vein, including in the October 2008 *Global Financial Stability Report* (IMF, 2008d), have not found evidence of systematic causality between positions and prices in either direction.[3] Indeed, the direction of financial flows is often inconsistent with the direction of price movements. For example, while crude oil prices rose sharply in May and June 2008, net speculative positions declined (first figure).

A second approach is to examine whether recent inventory behavior is consistent with the hypothesis that the recent price trends have been mostly driven by speculation. The basic intuition is as follows: For speculation to have a persistent effect on commodity prices, it must be accompanied by increasing physical hoarding of the commodities to keep spot markets in balance because consumption would decline at the higher prices (see Krugman, 2008). Available data, however, suggest that, although inventories for some commodities increased somewhat in recent years, inventories for other commodities that had significant price appreciation declined or remained broadly stable (second figure, upper panel). In particular, although crude oil prices almost doubled during 2007–08, crude oil inventories among Organization for Economic Cooperation and Development (OECD) member countries remained flat during 2008. Overall, therefore, there is little evidence of a systematic inventory hoarding of commodities, although a caveat is that data on commodity inventories are poor and lack global coverage.

[3]See also Box 5.1 of the September 2006 *World Economic Outlook* or the *Interim Report on Crude Oil* by the Interagency Task Force on Commodity Markets (ITC, 2008).

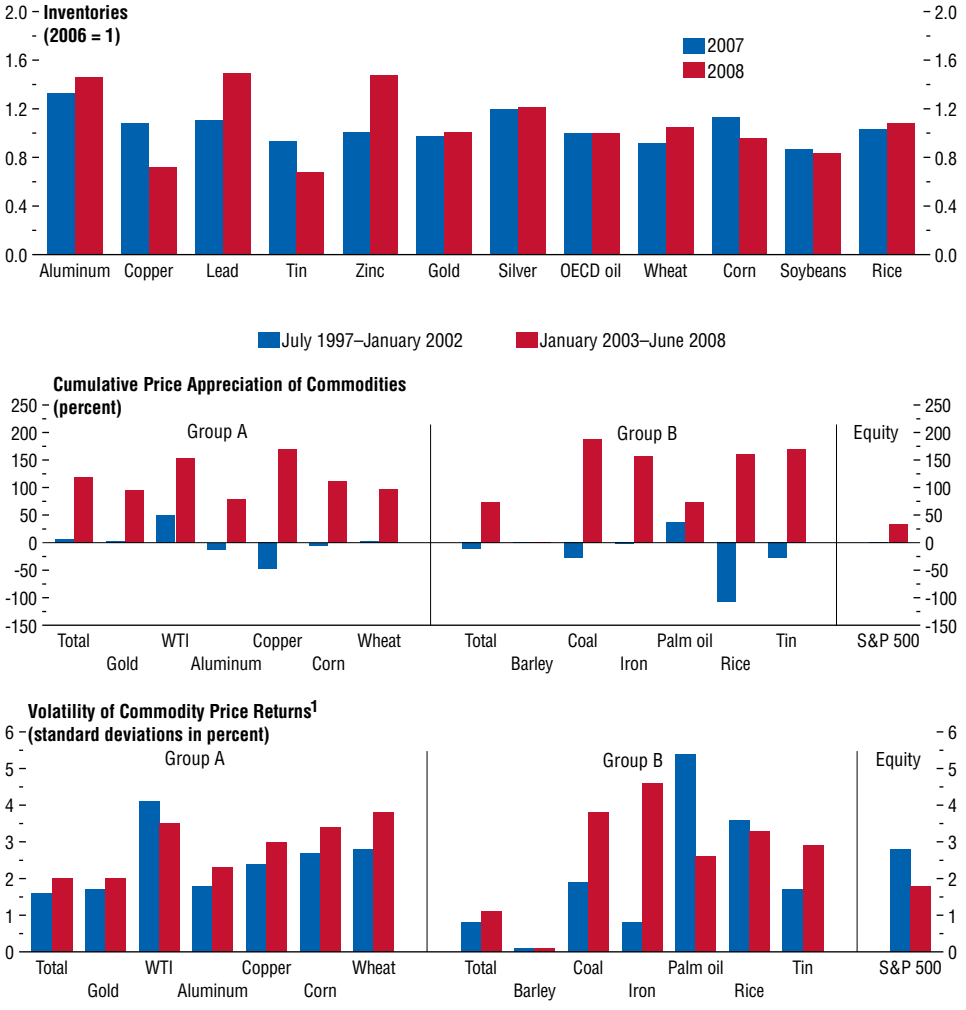
A third approach to assessing the impact of financial investment is to gauge the cross-sectional relationship between price formation and investor activities before and after the financialization of commodities. To shed further light, this box examines the relationship between financialization and price levels across markets. It also extends the analysis to two other aspects of price formation:

- *Volatility:* The impact of speculators on price volatility has long been a source of controversy among economists. Some noteworthy economists—including Adam Smith, John Stuart Mill, and Milton Friedman—have argued that speculators provide liquidity, facilitate price discovery, and improve intertemporal allocation of resources by buying low and selling high, thereby stabilizing prices. Others contend that market participants can often be "irrational," trading based on emotion, heuristics, and herd mentality, thereby increasing market volatility.
- *Price comovement:* Another hypothesis is that enhanced financialization of commodities can raise the degree to which commodity prices move together. The reason is that increased financial flows can amplify exposure of commodities to some common financial shocks, such as exchange rate and interest rate movements. Moreover, investors may lack familiarity with individual commodities, thereby leading them to allocate funds to commodities as a whole (the habitat/category theory). For example, investors can invest in commodities by buying a commodity index, which allocates funds across various commodities according to some specified weights, rather than by investing in specific commodities about which they may lack knowledge. Moreover, financialization of commodities can increase the correlation—either positive or negative—between commodity prices and other asset prices, such as equity prices, purely on account of overall financial market conditions.

To examine the possibility of a price impact, properties of weekly commodity price returns (weekly changes of price in logarithms) of

Box 3.1 *(continued)*

Inventories, Price Changes, and Volatility



Sources: Bloomberg Financial Markets; International Energy Agency; London Metal Exchange; U.S. Department of Agriculture; and IMF staff calculations.

[1]An *F*-test at the 5 percent significance level indicates that the standard deviations of the two periods are statistically different, except for rice.

50 commodities are examined before and after the takeoff in commodity investment. Because the recent commodity price and investment booms began roughly in 2003, the focus period is January 2003–June 2008, with the control period being July 1997–December 2002. To distinguish the extent of financialization, commodities are divided into two groups:

- *Group A:* These are commodities heavily traded in the financial markets. Specifically, a commodity is included in Group A if it is included in one of the four major commodity

indices.[4] A total Group A price index is computed based on the average weights of the underlying four commodity indices. Also, six individual commodities within the group are examined in greater detail: gold, WTI crude oil, aluminum, copper, corn, and wheat.

- *Group B:* This includes all the commodities in the IMF commodity index that are not included in Group A.[5] In addition to the total Group B price index calculation based on the IMF commodity weights, six of these are examined in greater detail: barley, coal, iron ore, palm oil, rice, and tin.

Price Level

Prices of Group A commodities rose by less than 6 percent between 1997 and 2002, but they increased by about 120 percent during 2003–08. Group B prices fell by about 12 percent during the first period, but rose by almost 75 percent during the second period (first figure, middle panel). Indeed, many commodities without significant futures markets—such as iron ore and rice—have experienced more price appreciation than those with sizable futures markets, such as gold and crude oil. Furthermore, a simple cross-sectional regression indicates an almost flat and slightly negative relationship between price changes and changes in the speculative net long positions[6] during 2003 (third figure, upper panel).

Price Volatility

To gauge if greater financial investment has destabilized markets by increasing price volatility, measures of price volatility (standard deviations) were computed for each commodity group before and after 2003 (second figure, lower panel). The results are mixed. First, price volatilities for most commodities in Group A were higher after 2003, with the notable exception of crude oil, which has significantly declined despite being heavily traded. Second, volatilities for most commodities in Group B have also risen, despite the fact that they are not heavily financially traded, which suggests that the volatility increases in Group A may reflect factors other than the financialization of commodities. Furthermore, a simple cross-sectional equation is estimated by regressing return volatilities on changes in open interests of commodity futures during 2003–08.[7] The results indicate a positive but weak relationship between return volatilities and the extent of financialization, suggesting that price volatility may be better linked to other variables, such as market tightness, stock levels, or geopolitical risks[8] (third figure, lower panel).

Price Comovement

To gauge if there has been an increase in comovement of commodity prices and stock prices, weekly returns of selected commodities were regressed on a constant and an "explanatory" variable—including a return of another commodity within the same group,

[4]The four commodity indices examined are the S&P Goldman Sachs Commodity index, Deutsche Bank Commodity Index, Dow Jones–AIG Commodity Index, and UBS Bloomberg Constant Maturity Commodity Index. Commodities included in Group A are Brent crude, natural gas, West Texas Intermediate (WTI) crude, gas oil, unleaded gasoline, heating oil, aluminum, copper, gold, lead, nickel, silver, zinc, cocoa, coffee, corn, cotton, lean hogs, beef, orange juice, soybean oil, soybeans, soybean meal, sugar, and wheat.

[5]These include bananas, barley, coal, fish, fish meal, groundnuts, hard logs, hard sawed wood, hides, iron ore, lamb, olive oil, palm oil, poultry, rapeseed oil, rice, rubber, shrimp, soft logs, soft sawed wood, sunflower oil, tea, tin, uranium, and wool.

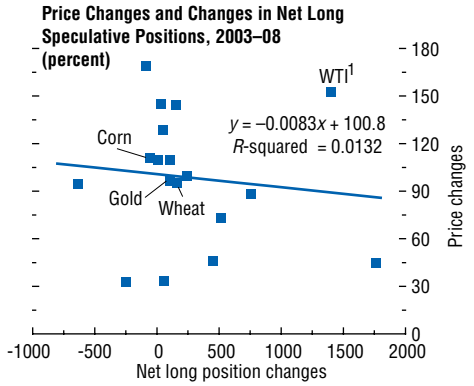
[6]Following the classification of futures positions by type of trader by the U.S. Commodity Futures Trading Commission (CFTC), net noncommercial futures positions are used as a measure of speculative positions in commodity futures markets. These positions are defined as the net of long and short positions of noncommercial traders.

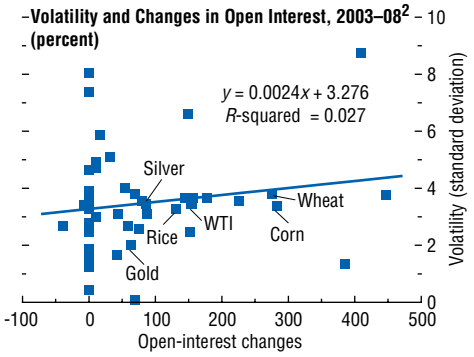
[7]An open interest—defined as the total number of options and/or futures contracts that are not closed or delivered on a particular day—is used as a proxy for the degree of financialization.

[8]Haigh, Hranaiova, and Overdahl (2007) also find no evidence that increased commodity hedge fund trading has raised price volatility.

Box 3.1 *(concluded)*

Financialization, Price Changes, and Volatility





Sources: Bloomberg Financial Markets; U.S. Commodities Futures Trading Commission; and IMF staff calculations.

[1]West Texas Intermediate crude oil.

[2]Sample size may vary among commodities because data on open interests for some commodities are not available before 2003. Commodities with no futures markets are shown as zero changes in open interests.

the return of the total group index (excluding the individual commodity under investigation), or the return of the S&P 500 stock market index. The extent of comovement is measured by the coefficient of determination or R^2. Intuitively, if comovements were primarily driven by commodity investment, especially indexing, the R^2 for Group A commodities should be higher than for Group B and should increase after 2003, as financialization accelerated.[9]

The results do suggest increasing price comovements among some of the more financialized commodities (table). Overall, Group A commodities demonstrate a higher comovement than those in Group B both before and after 2003. Moreover, on average, comovement among Group A commodities has increased to a greater extent than among Group B commodities. Most notably, the explanatory power of gold returns for other Group A returns has increased significantly, rising from about 2 percent during 1997–2002 to over 20 percent during 2003–08, suggesting that gold increasingly comoves with other commodities in Group A. However, the explanatory power of crude oil for other Group A commodities has declined significantly since 2003.[10] Finally, commodity returns in both groups do not seem closely related to stock returns in either period.[11]

In summary, although financialization may have led to increases in comovement between some commodities, particularly with respect to gold, no apparent systematic connection is found to either price volatility or price changes. These findings are consistent with recent studies in the area by the CFTC and others. Thus, there is little evidence to suggest that trading in futures markets has driven the price run-up or has destabilized the commodity markets during the first half of 2008.

[9]As a caveat, given the interlinkages among commodities (such as production-consumption substitution), it is possible that financialization could affect Group B indirectly through Group A, even though Group B commodities are not heavily traded. See, for example, Adrangi and Chatrath (2006) for more details.

[10]Using monthly data, however, WTI crude oil has a high explanatory power—over 30 percent—for other commodity returns in Group A, reflecting energy cost pass-through over a longer horizon.

[11]Büyükşahin, Haigh, and Robe (2008) also find that the relation between the returns on investable commodity and U.S. equity indices has not changed significantly in the past 15 years.

Comovement among Returns (*R*-squares in percent)[1]

	Group A													
	July 4, 1997–December 27, 2002							January 3, 2003–June 27, 2008[3]						
	Gold	WTI	Aluminum	Copper	Corn	Wheat	Group A	Gold	WTI	Aluminum	Copper	Corn	Wheat	Group A
WTI crude	0.9							6.6*						
Aluminum	0.8	2.1						23.4*	4.8					
Copper	2.9	1.6	43.4					19.5*	3.5	34.6				
Corn	1.1	0.1	0.2	0.0				3.4	0.1	1.6*	1.2			
Wheat	0.5	0.5	0.3	0.5	40.6			4.7	0.5	1.0	1.9	23.1		
Group A[2]	2.3	7.2	0.5	40.1	2.5	36.5		21.0*	0.9*	2.5*	28.1*	0.0*	17.6	
S&P 500	0.0	0.6	0.2	0.2	0.0	0.3	0.5	0.1	0.1	0.6	0.8	0.7	0.1	0.0
Average	**6.7**							**7.2**						

	Group B													
	July 4, 1997–December 27, 2002							January 3, 2003–June 27, 2008						
	Barley	Coal	Iron ore	Palm oil	Rice	Tin	Group B	Barley	Coal	Iron ore	Palm oil	Rice	Tin	Group B
Coal	0.0							0.0						
Iron ore	0.4	0.0						1.3	0.8					
Palm oil	2.0	0.2	0.1					0.2	0.0	0.2				
Rice	0.0	0.1	0.0	0.0				0.0	0.2	0.1	0.4			
Tin	0.1	0.2	0.1	0.1	0.4			0.5	0.4	0.3	0.0	0.2		
Group B[2]	0.4	56.3	0.0	17.4	0.1	0.4		0.6	73.1*	0.1	0.0*	1.1	0.2	
S&P 500	0.9	1.0	0.3	0.1	0.4	0.0	1.4	0.7	2.7	0.0	0.4	0.1	0.8	2.3
Average	**2.9**							**3.1**						

Sources: Bloomberg Financial Markets; and IMF staff calculations.

[1]A higher *R*-square indicates higher comovement. In bivariate regressions, *R*-squares are invariant to the choice of left- and right-hand-side variables. For example, regressing gold on WTI yields the same *R*-square as regressing WTI on gold.

[2]Excluding the commodity of the column under investigation.

[3]An asterisk indicates that there is a structural break between the two periods according to the Chow test at the 5 percent significance level.

to unwind. Prospects for slowing global growth in 2008–09, the resolution of weather-related supply constraints for key food crops, and increased oil supply have led to some easing of commodity prices since mid-July. However, inventories and spare capacity both remain low, growth momentum in the large emerging economies remains strong, and some supply constraints still exist, which, barring a more severe global downturn, will likely limit the extent of further easing and provide for continued price volatility.

Within this general outlook, prospects vary for individual commodities. Fundamentally, these cross-commodity variations reflect different characteristics (such as a commodity's storability or its relative position in the stages of production) and the fact that supply problems and inventory conditions tend to be commodity-specific. The role of common factors in short-term commodity price fluctuations is generally limited even during booms, as reflected in the wide differences in the magnitude and timing of price increases (Table 3.1). Against this backdrop, the chapter now turns to developments and prospects for the two commodity groups that are most relevant for the global inflation outlook: oil and food.

Will Slowing Growth Ease Oil Prices?

By mid-July 2008, oil prices had risen well above previous highs, to some 30 percent above the previous December 1979 record in

Table 3.1. Contributions of Common Factors to Commodity Price Fluctuations[1]
(In percent)

	1970–2008 (June)	Booms 1972–74	Booms 2003–08 (June)	"Great Moderation Period" 1984–2008 (June)	"Period with No Oil Shocks"[2] 1992–2002 (June)
Crude oil	1.6	1.9	3.6	2.6	3.2
Metals	37.9	29.6	34.5	27.7	63.7
Agricultural raw materials	23.9	1.3	21.8	13.0	12.5
Food	16.7	1.2	23.9	24.7	15.2
Meat	8.3	0.5	26.7	9.7	6.8
Cereals	18.9	1.7	11.9	22.8	12.4
Vegetable oils and protein meals	24.3	0.7	28.5	42.6	25.9
Other foods	7.8	3.0	24.5	6.9	5.2
Beverages	11.2	2.2	28.0	7.5	2.4

Sources: IMF, Primary Commodities database; and IMF staff calculations.
[1]Contributions are based on the first principal component of logarithmic changes of prices of 38 primary commodities in team terms (corrected for serial correlation and standardized).
[2]See Kilian (2008).

real terms, but have fallen since then. The rise in oil prices since early 2007 mirrored a noticeable tightening in market balances in a context of low buffer levels (low inventories, little spare capacity). OPEC production through most of 2007 was below 2006 levels, and non-OPEC production declined in the second half of 2007, while global oil demand continued to expand at a broadly unchanged pace. When oil market capacity is so tightly stretched, relatively small unexpected shifts in global supply (or demand) can have large price effects, given the generally very low short-term price responsiveness of oil demand.[8] During the past year and a half, the price impact of shifts in global demand has been reinforced by the decreased pass-through to domestic prices in emerging and developing economies, which further reduced the already low short-term price elasticity of global oil demand.[9] Other contributing factors include rising risks of supply disruptions in some major producers and geopolitical concerns.

Growing expectations that medium-term oi-market conditions will remain tight were likely an important factor in price increases during the past year. The pace of capacity expansion has been slow and has consistently fallen short of expectations in recent years, particularly outside OPEC (Figure 3.4, top panel).[10] A broad consensus has emerged that the buildup of production capacity needed to accommodate the anticipated robust expansion of emerging and developing economies will remain sluggish because of cyclical, technological and geological, and policy

[8]Short-term price elasticities of oil demand are generally believed to be low. The U.S. Department of Energy (Costello, 2006) considers them to be in the range of 0.01 to 0.04 (absolute values)—whereas income elasticities are much higher. Similarly, Hamilton (2008) reports elasticities of 0.03 to 0.07 (absolute values), and values ranging from 0.03 to 0.08 were reported in the September 2005 *World Economic Outlook*. As a result, income effects have dominated price effects in oil demand. In a simple demand model with exogenous supply that ignores nonlinearities from low inventories and intertemporal considerations, such price elasticities imply that a reduction in oil production of 0.5 million barrels a day—roughly the amount of the reduction in non-OPEC supply during the second half of 2007—should lead to prices that are 10–60 percent higher (the calculations are based on 2007 production data). If longer-term price elasticities are higher than short-term ones, prices will overshoot their long-term increase in response to a supply reduction.

[9]Oil consumers in many countries have been increasingly sheltered from rising world market prices. In a sample of 43 emerging and developing economies, fewer than half allowed full pass-through during 2007 (compared to three-quarters in 2006). See IMF (2008b).

[10]Capacity constraints in the downstream oil sectors, notably in refining, have also contributed to rising oil prices. However, the longer-term supply issues discussed here primarily relate to upstream investment, which is where the long-term constraints are most severe.

constraints.[11] In effect, the time-to-build lags noted above have lengthened, although the scope to eventually achieve such a buildup remains in place—as reflected in the broadly constant ratio of proven oil reserves to current production, a measure of the long-term scarcity of oil (Figure 3.4, middle panel). Even so, future capacity will be built at a much higher cost than in the past, because of the sharply rising extraction costs in marginal fields, which have a substantial permanent component (Figure 3.4, bottom panel).

Even relatively small downward revisions in the expected path of future supply expansion caused by increased pessimism can imply large increases in expected future prices, given the relatively low price elasticity of oil demand noted above.[12] Such expectations of higher prices must be reflected in higher spot prices today. Otherwise, producers would have incentives to leave oil reserves in the ground, and traders would have incentives to accumulate inventories, which could be sold later at higher prices. It is for this reason that some observers have referred to recent oil price increases as an "expected supply shock," that is, a response to tighter medium-term market conditions (see, for example, Clarida, 2007).

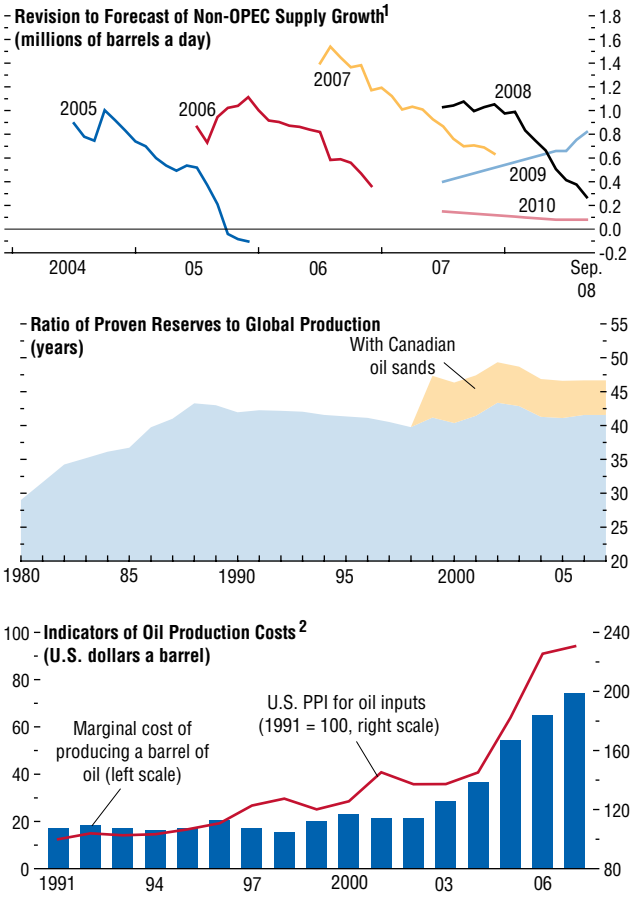
What about the role of financial factors? Speculation and commodity financial investment are frequently mentioned as factors in recent oil price increases. However, there is little clear evidence that these factors have any systematic price impact. Both investment inflows into energy and oil funds and the net futures market positions of noncommercial investors, for example, peaked in late 2007 and have since declined. Nevertheless, shifts in sentiment may well have some impact on short-term price dynamics, particularly given the lack of timely information about global market conditions. In addition, recent financial

[11]See Box 1.5 in the April 2008 *World Economic Outlook*.

[12]A more inelastic medium-term supply response because of longer time-to-build lags also implies that upward revisions to the expected path of global demand should have a larger impact on current spot prices.

Figure 3.4. Oil Supply Developments

Oil production, which has consistently fallen short of expectations over the past four years amid high production costs, has fostered concerns that tight market conditions will last for some time, despite adequate reserve levels.



Sources: Bloomberg Financial Markets; *British Petroleum Statistical Review of World Energy* (2008); Goldman Sachs Global, Inc. Equity Group; International Energy Agency; U.S. Bureau of Labor Statistics; U.S. Department of Energy; and IMF staff calculations.

[1]The forecast refers to a simple average from the Organization of Petroleum Exporting Countries (OPEC), the International Energy Agency, and the U.S. Energy Information Administration at the time of the forecast.

[2]Marginal cost is defined as the average of the highest-cost (or bottom quartile) producers, based on a survey of listed oil companies. The producer price index (PPI) for oil inputs refers to the unweighted average of drilling oil and gas wells, oil and gas operation support activities, and oil field machinery and equipment.

conditions likely exerted some upward pressure. Both U.S. dollar depreciation and the decline in real policy interest rates tend to push oil prices upward. The effects are primarily short-term, with scope for overshooting, but longer-term effects are possible through the effects on physical oil demand and supply.[13]

Oil prices have eased recently on (1) increased OPEC production (primarily in Saudi Arabia); (2) data signaling a continued decline in U.S. oil demand that seems to reflect a growing demand response to high prices and not just slowing income; (3) prospects for lower growth in other major advanced economies; and (4) less-supportive financial conditions, given the U.S. dollar rebound. Looking ahead, oil demand growth is likely to moderate with the slower global growth envisaged for the second half of 2008 and for 2009. If recent production increases are sustained, near-term market conditions will thus be less tight and will support a decrease in prices below recent peaks, with some scope for further downward adjustment if the global downturn intensifies or the demand response to high prices further strengthens in advanced economies. Nevertheless, supply constraints and continued strong growth in emerging economies are likely to keep prices both well above pre-boom levels and subject to continued volatility.

High Food Prices Reflect a Combination of Permanent and Temporary Factors

The food price boom that began around mid-2006 intensified during the first four months of 2008, driven largely by increases in the prices of six key food commodities: corn, wheat, rice, soybeans and related products, rapeseed oil, and palm oil. Together, these commodities account for over 80 percent of the rise in the IMF's food price index since early 2006, despite having a weight of only 40 percent.

The decline in global inventory levels for these food commodities over the past few years was important in setting the stage for the price surges. On the supply side, there was a decline in yield growth rates after the mid-1980s, attributable in part to declining relative prices and low investment rates (Figure 3.5, top panel). The high levels of protection in agriculture in advanced economies and the bias in public expenditures in developing economies toward subsidies (instead of investment in agricultural infrastructure and research) contributed to this trend.[14] On the demand side, there was a strong pickup in consumption, driven by rapid income growth in emerging and developing economies (Figure 3.5, middle panel).[15]

This analysis seeks to estimate the relative roles of a number of supply and demand factors in explaining the price increases of these six food commodities during 2006–08 (Figure 3.5, bottom panel). As a caveat, the exercise is based on simple partial equilibrium analysis and does not incorporate the price-driving effects of low inventories. Moreover, the uncertainty involved is considerable, given complex interactions across markets and time.[16]

- *Weather Shocks:* A series of weather-related supply shocks in 2006 and 2007, which occur less frequently than once a decade on average, severely reduced average wheat and rapeseed yields for two years. These include drought

[13]Effective U.S. dollar depreciation can exert upward pressure on commodity prices through a number of channels. The empirical analysis in Box 1.4 in the April 2008 *World Economic Outlook* suggests that a 1 percentage point depreciation raises oil prices (in U.S. dollars) by more than 1 percentage point. Lower short-term real interest rates reduce inventory holding costs and could induce shifts from money market instruments to commodities and other higher-yielding assets. See Bordo (1980), Frankel (1986, 2006), and Akram (2008).

[14]In the OECD countries, progress has been slow in reducing overall support during the past 20 years, with the average transfer to agricultural producers as a share of farm-gate prices falling from 37 percent to 30 percent in 2005. See World Bank (2007).

[15]The composition of demand has also changed toward protein-rich foods, feeds, and oils in line with consumption trends in developing economies.

[16]The methodology is described in more detail in Appendix 3.2. Unless otherwise stated, references are to crop years (with the 2007 crop year running from mid-2007 to mid-2008).

damage, particularly to wheat crops in Australia, eastern Europe, and northern Africa, which accounted for about 20 percent of the increase in wheat prices since 2006.[17] The impact of weather shocks is generally temporary; indeed, the wheat area planted for the 2008 crop year has risen sharply in response to high prices in the United States (Trostle, 2008).

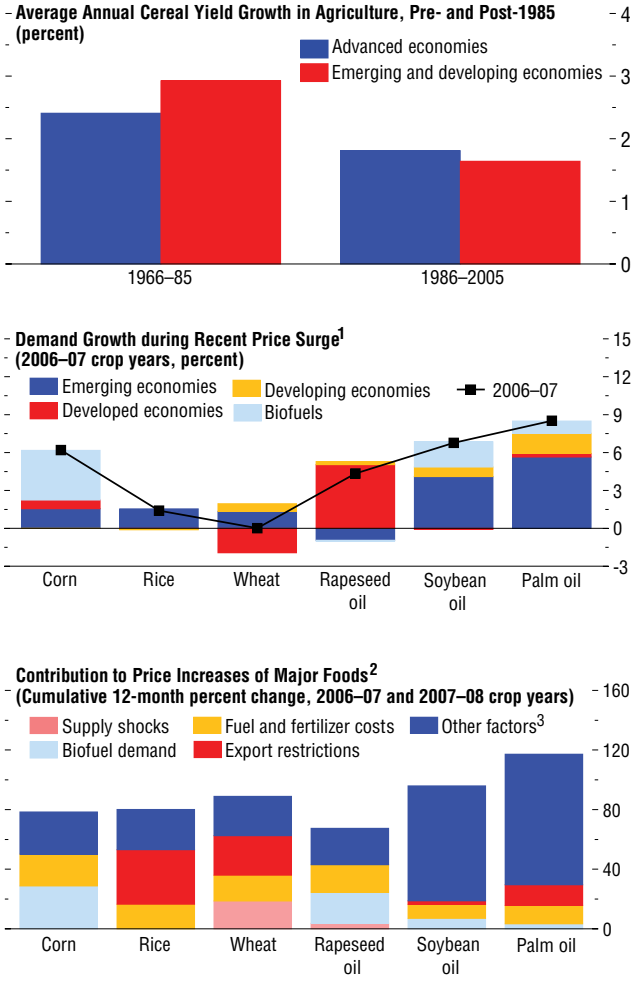
- *Biofuel Production:* Soaring demand from biofuel producers for corn and some vegetable oils was a second factor boosting food prices. Biofuel production expanded rapidly in response to rising fuel prices, as well as to ambitious biofuel mandates, government subsidies, and tariff protection in major advanced economies.

  In particular, corn-based ethanol production soared in the United States. Almost 30 percent of the U.S. corn crop was diverted toward the production of biofuels during 2006–07, and this share is projected to rise to 36 percent in 2008. Despite a strong production response, the additional demand pressure is estimated to account for some 25–45 percent of the rise in international corn prices during this period, given a range of plausible values for the price elasticity of demand. Looking ahead, demand pressures from ethanol will likely continue to exert a rising effect on food prices unless policies are changed.

  The price effect of biofuel production on rapeseed oil—the main biodiesel feedstock in Europe—has become less important over time. A reduction of EU subsidies amid a reexamination of biofuel policies and soaring vegetable oil prices rendered many biodiesel plants unprofitable, and demand for rapeseed oil for biodiesel use declined during 2007.[18] Moreover, rapeseed oil repre-

Figure 3.5. Price Trends of Major Foods

The recent price surge followed a period of declining yield growth in grains amid sluggish investment in agriculture. Recent demand growth, mostly from emerging economies, has shifted toward soybean oil and palm oil. In addition to biofuel growth, the price surge reflects a confluence of factors.



Sources: Food and Agriculture Organization; U.S. Department of Agriculture; World Bank (2007); and IMF staff calculations.
[1]Demand growth from biofuels is excluded from the calculation for country groups.
[2]See Appendix 3.2 for details on the calculations.
[3]Including spillovers and substitution effects.

[17]Indeed, without the bumper crops in soybeans, wheat, and corn in 2005, the price surge might well have occurred earlier.

[18]About 20 percent of global rapeseed oil demand is currently diverted toward biodiesel production. Use of soybean oil and palm oil for biodiesel production also grew in during this period but remained a very small fraction of total global use (an estimated 9 percent and 3 percent in 2006 and 2008, respectively).

Table 3.2. Selected Indicators of Spillovers across Major Food Commodity Prices

	Corn	Rice	Wheat	Soybean Oil	Rapeseed Oil	Palm Oil
Estimated percent price change resulting from a 1 percent increase in the price of foods used for biofuels[1]						
Corn	1.00	0.23	0.19	0.78	—	—
Rapeseed oil	—	—	0.62	1.19	1.00	—
Concordance statistic of cyclical comovement[2]						
With corn (Jan. 1957–May 2008)	100**	82**	61*	71**	74**	66**
With rapeseed oil (Jan. 1980–May 2008)	74**	76**	46	82**	100**	78**
Memorandum items (2007 crop year)						
Share of global production exported	13	6	18	29	10	72
Share of fuel and fertilizers in total production costs[3]	32	30	25	12	30	14

Sources: USDA (2008); Food and Agriculture Organization's online database, FAOSTAT; Fedepalma (2008); North Carolina Solar Center (2006); and IMF staff calculations (see Appendix 3.2 for details).

[1]Derived from composite estimate of elasticities of substitution.

[2]The concordance statistic measures the proportion of time that prices of two commodities are in the same phase, with a range between 0 and 100. A high value implies that their cycles are more synchronized, suggesting the two commodities are highly substitutable (Cashin, McDermott, and Scott, 1999). * = significance at the 10 percent level. ** = significance at the 5 percent level.

[3]Production costs for soybean oil and rapeseed oil refer to corresponding plant crop. Share of fuels used for transport not included.

sents only a small and declining share of the market for edible oils.

- *Pass-Through of Higher Energy Costs:* A third factor pertains to the pass-through of higher energy costs directly to food prices, estimated to have accounted for about 20 percent of the rise in the prices of the six commodities. Agricultural production costs have been pushed higher by an almost tripling of fertilizer prices and a doubling of fuel prices since mid-2006. This is particularly true for corn, rapeseed, and rice, which are particularly energy-intensive crops.
- *Trade Policy:* More-restrictive trade policies have been a fourth factor pushing up food prices. Growing concerns about the domestic impact of rising food prices led a number of major food-exporting countries to impose export restrictions starting in mid-2007. The restrictions had a particularly strong effect on rice prices—accounting for about half of the overall price increase according to IMF staff estimates—but they also affected the prices of wheat and, to a lesser extent, palm oil and soybean oil. These policies also led to some short-term price overshooting, as they reportedly triggered panic buying and inventory hoarding.[19] Many of these restrictions were subsequently removed, and some countries have released stocks. The removal of restrictions is likely to continue with more favorable harvests for rice and wheat.

Overall, the most important direct factor driving up food prices since 2006 has been rising energy costs, with trade restrictions following as a close second. However, the direct effects of these factors do not account for all of the observed increases in the prices of the affected crops. Mutually reinforcing indirect effects, which operate mainly through supply and demand substitution channels, have also contributed. Table 3.2 illustrates the spillover effects from the price increases for corn and rapeseed oil (which are inputs for biofuels), using demand and supply cross-price elasticities. The results suggest that these effects are particularly important in explaining price increases for soybeans and related products: a

[19]Such effects are common when international markets are segmented and the share of trade in total production is small, as it is the case for rice, but they are not considered in the estimates. See FAO (2008).

1 percent increase in corn prices, all else equal, raises soybean prices by about three-quarters of a percent, as farmers substitute acreage from soybeans to corn and consumers switch from corn to soybean meal.[20] If it were assumed that the increase in corn prices was unrelated to price rises for the other major foods, the indirect effects of higher corn prices would account for some 60 percent of the increase in soybean prices and about 20 percent of the increases in rice and wheat prices.

The resolution of weather-related supply disruptions in the current crop year and removal of export restrictions have already led to some easing of food prices. However, the pressure on food prices from high oil prices and further increases in biofuel production will likely remain, limiting the extent of the easing, and low inventories will continue to contribute to price volatility. Indeed, because of these more permanent factors, the duration of the present boom has already exceeded the length of the average food price boom by 12 months (Figure 3.6).

Commodity Price Shocks and Inflation

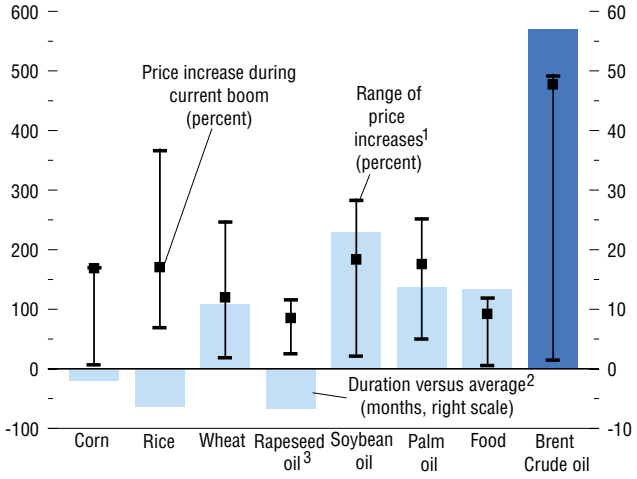
Can the large relative price adjustments implied by the recent commodity price surges be accommodated without ratcheting up underlying inflation? The main concern is that a lengthy period of high headline inflation following the commodity price surges may unhinge inflation expectations.[21] The broad context for such concern is the contrast in commodity price behavior during two key episodes in recent history. During the "great mod-

[20]Consumers in this case would be mostly meat and poultry producers, who use cornmeal and soymeal as animal feed.

[21]While relative price shifts do not generally lead to sustained changes in the overall price level, large and persistent temporary shocks, especially to the prices of essential commodities, may unhinge inflation expectations and spill over into underlying inflation. For a more formal discussion of the relationship between relative price changes and overall inflation, see Ball and Mankiw (1995) and Sims (2003).

Figure 3.6. Duration and Amplitude of Food and Crude Oil Price Cycles

The current boom is already longer than average for most foods and for crude oil. However, with the exception of crude oil and corn, the price increases are not exceptionally high.



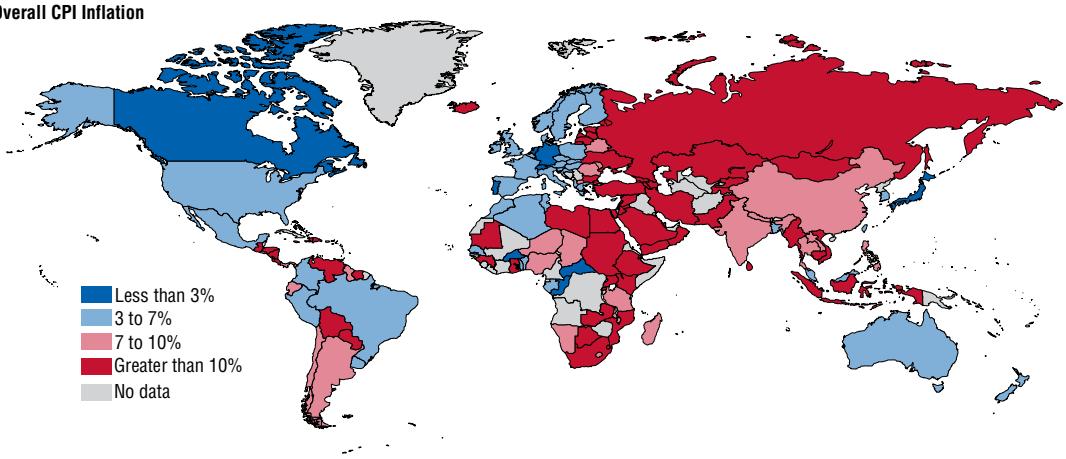
Source: IMF staff calculations.
[1]Range of price increases during past trough-to-peak phases between January 1957 and June 2008.
[2]Months price is rising within the cycle compared with the average of past cycles.
[3]Rapeseed oil price series starts in January 1980.

Figure 3.7. Inflation around the World[1]

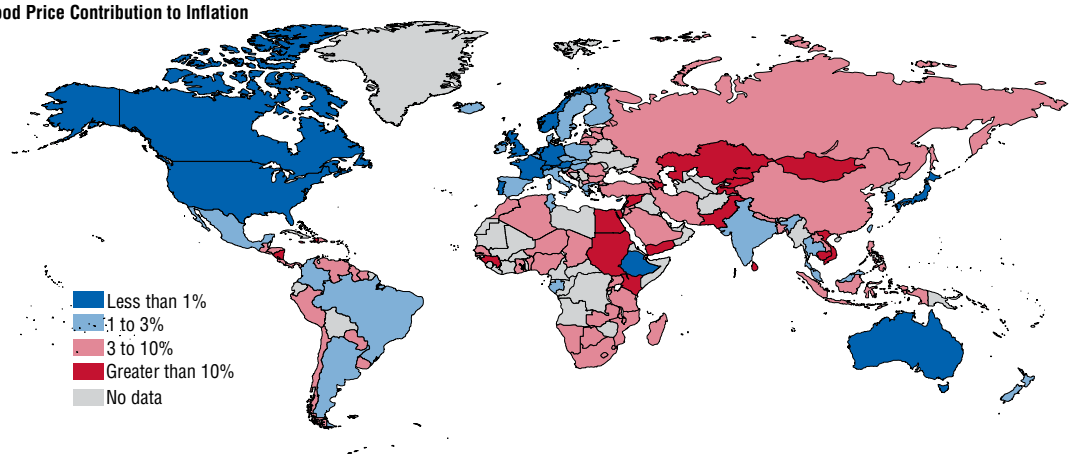
(2008:Q2-over-2007:Q2 percent change)

Headline inflation has risen, especially in emerging and developing economies, where the role of food prices is particularly significant. The contribution of energy prices is smaller in comparison, with stronger effects in advanced economies.

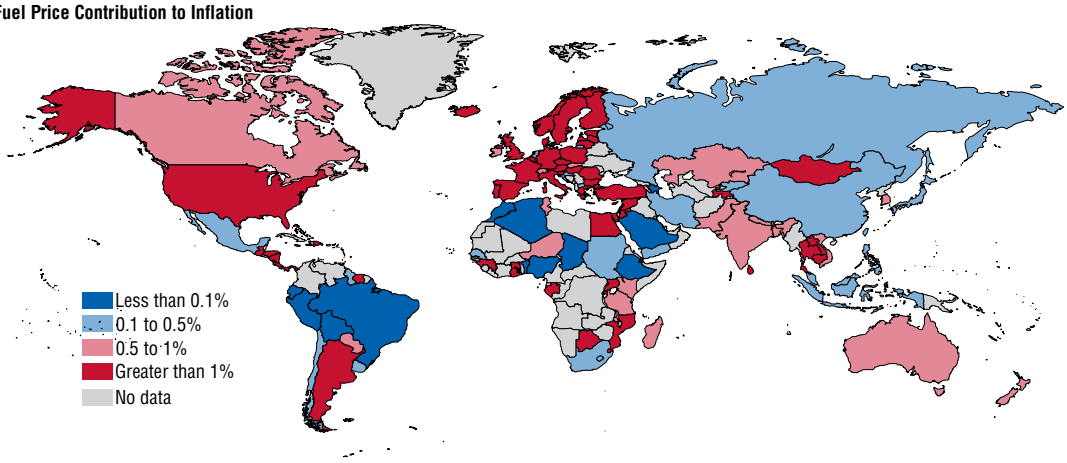
Overall CPI Inflation



Food Price Contribution to Inflation



Fuel Price Contribution to Inflation



Source: IMF staff calculations.

[1]Food and fuel price contributions are calculated as, respectively, food and fuel inflation multiplied by the corresponding weight in the consumer price index (CPI).

eration"—the long period of low and falling inflation rates from the 1990s until recently—changes in commodity prices were relatively modest and temporary, whereas during the "great inflation"—the 1970s—these shocks were large and persistent, as they have been in the present period.[22]

Concerns about second-round effects remain relevant despite the recent easing of international commodity prices, because domestic price pressures will likely persist for some time as a result of the continuing feed-through of past commodity price increases and lingering overheating pressures in many emerging economies. This section examines the links between commodity prices and inflation over time and across a broad sample of economies. It highlights how the risks to the inflation outlook are linked to the credibility of monetary policy—its ability to effectively anchor expectations—to the magnitude and persistence of the commodity price shocks, and to structural factors.

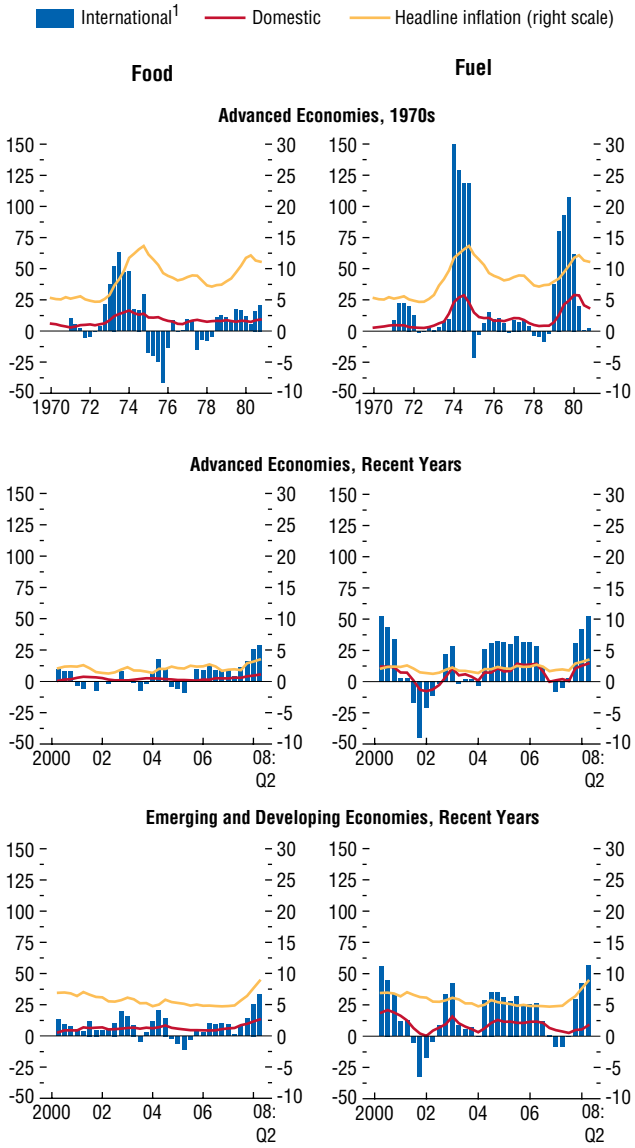
Turning first to current events, the dramatic rise in headline inflation in recent months owes much to commodity price increases over the past year and a half, with food prices playing a particularly important role in emerging and developing economies (Figure 3.7). In comparison, the contribution of energy prices has been moderate, with stronger effects in advanced economies. Indeed, domestic food prices have accelerated primarily in emerging and developing economies, while energy

[22]There is a growing literature on the sources of the "great moderation." For example, Gerlach and others (forthcoming) attribute the "great moderation" primarily to improved monetary policies. The role of globalization is less clear. Falling manufactured goods prices, driven by rapid productivity gains from integration of large underutilized labor forces in emerging and developing economies, helped to make the process of reducing inflation less costly than it would otherwise have been. However, recently strong growth in demand for commodities has added to price pressures. The observed flattening of the Phillips curve (documented in Chapter 3 of the April 2006 *World Economic Outlook*) may be related to global competition but may also reflect better monetary management.

Figure 3.8. Changes in International and Domestic Commodity Prices and Headline Inflation

(Year-over-year changes, in percent)

Large changes in commodity prices characterized the 1970s, when inflation reigned in advanced economies. In comparison, recent price fluctuations have been modest, although in recent months domestic food prices have accelerated in emerging and developing economies, and domestic energy prices have surged in advanced economies, while inflation has picked up around the world.



Sources: IMF Primary Commodity Prices database; and IMF staff calculations.
[1]International food and fuel prices are converted into local currencies. Food and fuel price indices in the 1970s include a narrower set of commodities for data availability reasons.

prices surged mainly in advanced economies (Figure 3.8).[23] To date, however, underlying or core inflation has remained broadly stable in advanced economies, although it has risen significantly in the rest of the world, as discussed in Chapter 1 (see Figure 1.3).[24] Inflation expectations have also begun to mount, especially in emerging economies, where wages have been on the rise amid generally tight labor markets.

What factors might affect the extent of transmission, or pass-through, from international commodity prices into domestic food and fuel retail prices? First, because domestic prices are denominated in local currencies, whereas world prices are typically denominated in dollars, exchange rate movements can amplify or mitigate the domestic impact of changes in world prices.[25] Second, many economies levy taxes or grant subsidies on certain commodities, especially fuels, which, again, may amplify or mitigate the transmission (Box 3.2).[26] Third, the extent to which the domestic economy is integrated with international commodity markets is important, because in more isolated markets, domestic supply conditions may dominate the role of world price changes (for example, for certain crops). Fourth, the cost structure of domestic production plays a very important role in the extent and timing of the pass-through to retail prices, because labor, transportation, and retailing costs account for a large part of the final price of many food items, especially in advanced economies, and the costs associated with the commodities themselves may be moderate in comparison.[27]

Changes in domestic prices of food and fuel may influence overall inflation both directly and indirectly. The direct (first-round) effects on headline inflation are determined by the weights of these commodities in the consumption basket. Although these effects are large in many—especially poor—economies, they eventually dwindle once international price changes are passed through, unless underlying, or core, inflation is affected.[28] Such indirect (second-round) effects on core inflation depend on the

[23]There are substantial differences across countries in the way food and fuel prices are treated in consumer price indices, especially across emerging and developing economies. The food baskets used to measure food inflation vary from country to country, with some countries including beverages and tobacco alongside food items, and other countries using narrower definitions including fresh but not processed foods. The measurement issues are even more acute in the case of fuel prices: definitions of the fuel component of the consumer price index (CPI) range from gasoline prices to prices for household utilities.

[24]Measuring core inflation is difficult. In theory, core inflation is defined as the underlying, or persistent, part of inflation that provides an indication of future inflation, although precise definitions vary (see, for example, Eckstein, 1981; and Bryan and Cecchetti, 1994). In practice, core inflation is commonly measured using the CPI that excludes food and energy prices, or their most volatile components, but these measures differ across countries. The variation in measurements of core inflation tends to be especially significant among emerging and developing economies, for which inferences about the underlying inflation need to be made with caution.

[25]De Gregorio, Landerretche, and Neilson (2007) argue that past oil shocks were often accompanied by depreciations that may have amplified their pass-through into domestic prices, whereas depreciations have been less common in the past few years, and many economies have, in fact, experienced appreciations that may have softened the pass-through.

[26]A number of emerging and developing economies rely on energy subsidies to limit the domestic consequences of international energy price shocks. However, the associated fiscal costs may be large, especially at times of significant pressures from international prices (see IMF, 2008b). Indeed, escalating fiscal costs have recently forced a number of countries to roll back some of these subsidies. Furthermore, the associated fiscal expansion and financing requirements for ensuing government deficits may themselves lead to inflation (Sargent and Wallace, 1985).

[27]Movements in domestic labor and transportation costs may vary and may either offset or reinforce pressures from commodity price changes. For example, labor costs in advanced economies followed a declining trend during the past couple of decades, in part due to increased access to the global pool of labor (see Jaumotte and Tytell, 2007). This may have helped offset higher energy and material costs in recent years.

[28]In fact, these effects are rarely immediate, because commodity price shocks may take considerable time to propagate through to final retail prices. For example, Rigobon (2008) estimates that oil price shocks typically take 9 to 12 months to pass through, and food price shocks can take up to 30 months.

Box 3.2. Fiscal Responses to Recent Commodity Price Increases: An Assessment

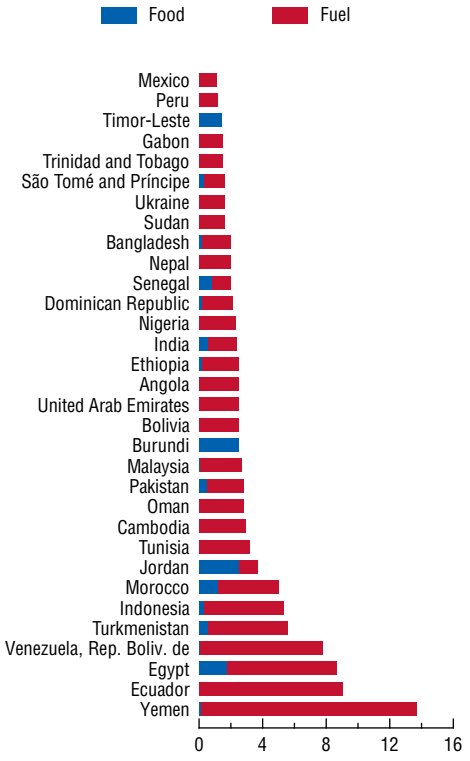
The boom in prices for food and energy has led to a wide range of fiscal responses across the globe aimed at mitigating the domestic impact. This box summarizes these responses and discusses their effectiveness in alleviating the impact of commodity price increases on the poor and their macroeconomic implications more broadly.

A recent IMF survey collected information on the fiscal responses of 161 countries to international price increases (IMF, 2008b). Among the survey's findings were these:

- Expenditure measures are more prominent in the case of fuels, whereas revenue measures dominate for food. More than one-quarter of the surveyed countries increased fuel subsidies, and about one-fifth reduced fuel taxes. Fuel subsidies reached high levels in many countries this year, exceeding 5 percent of GDP in Ecuador, Egypt, Turkmenistan, República Bolivariana de Venezuela, and Republic of Yemen. The picture is almost the opposite for food, with more than half the countries reducing food taxes and less than one-fifth increasing food subsidies.
- Exporting countries have used both tax and regulatory measures to contain increases in domestic food prices. These measures have included increases in export taxes, the introduction of export quotas, and even the imposition of an outright ban on certain exports. Notably, export bans and export taxes were imposed by key exporters of major cereals, including Argentina, China, India, Kazakhstan, Ukraine, and Vietnam. However, more recently a few major exporters have started to relax some export restrictions. Vietnam and Kazakhstan recently allowed export bans to expire on rice and wheat, respectively, and Ukraine has increased quotas on wheat exports.
- About a quarter of the surveyed countries recently increased financing for more targeted transfer programs, and 15 countries increased public sector wages and pensions partly in response to the price increases.

Universal Subsidies, 2008[1]

(Percent of GDP)



Source: IMF Fiscal Survey.
[1]For countries where only the food or the fuel subsidy is displayed, data for the other type of subsidy are not available.

The total fiscal cost of these measures has been substantial; the median annualized increase in fiscal cost across the surveyed countries during 2007–08 was 0.7 percent of GDP. For about a quarter of the countries, the fiscal costs exceeded 1 percent of GDP, with higher food and fuel universal subsidies accounting for the bulk of this increase. By 2008, the combined fiscal cost of these universal subsidies had become a major fiscal burden in many countries, particularly for fuel subsidies. For example, these subsidies now account for

The main author of this box is David Coady.

Box 3.2 *(concluded)*

at least 5 percent of GDP in 7 countries and at least 2 percent in another 17 countries (figure).

These measures are adopted, in part, because increases in the prices of food and fuel are seen to be particularly damaging to the poor. In general, the burden of food price increases tends to be highly regressive, but the burden of fuel price increases depends on the type of fuel. Indeed, recent IMF studies[1] found that a doubling of rice prices results in a 12 percent decrease in real incomes for the poorest income quintile, compared with a 5 percent decrease for the richest quintile. In contrast, whereas a doubling of all fuel prices results in approximately a 10 percent decrease in income for all income groups, the impact of increases in gasoline prices is roughly proportional, but the impact of increases in kerosene prices is highly regressive.

Universal price subsidies are a fiscally costly approach to protecting the welfare of poor households. This is because a high proportion of the benefits from low food and fuel prices accrue to higher-income groups, reflecting the higher shares of these groups in total consumption. For example, IMF studies found that about 64 percent of a subsidy for rice went to the top three income quintiles (IMF, 2008b); the corresponding shares for kerosene and gasoline subsidies were 55 percent and 92 percent, respectively (Coady and others, 2006). Switching to better-targeted mitigation measures can substantially reduce the associated costs while more effectively assisting the most affected segments of the population.

Furthermore, incomplete pass-through of international to domestic commodity prices distorts incentives for domestic consumers and producers and ultimately reinforces global price pressures. More specifically, reduced taxes and increased subsidies dilute the impact of higher international commodity prices on demand, and the imposition of export taxes and quotas reduces the gains to exporters from higher prices and therefore obstructs the supply response that would, in time, help bring prices down. The financing requirements implied by the high fiscal costs of subsidies will eventually either cause their reversal or lead to higher taxes—and therefore higher prices—for other goods and services. They could also feed into more general inflation pressures if the ensuing deficits are monetized or if they cause an excessive accumulation of government debt. For these reasons, the broad-brush fiscal intervention ongoing in a wide range of countries is not a viable substitute for an appropriate monetary policy response to help maintain macroeconomic stability in the face of commodity price fluctuations.

[1]IMF (2008a) analyzes the case of Senegal, and Coady and others (2006) provide evidence for Bolivia, Ghana, Jordan, Mali, and Sri Lanka.

extent to which expectations of future inflation get unhinged and higher wage demands are set in motion.[29] This is partly linked to the relative magnitudes of demand and supply effects associated with commodity price shifts. On the one hand, higher food and energy prices raise costs and may lower productivity—a negative supply effect that puts upward pressure on inflation. On the other hand, they may cause expenditure switching from other goods and services—a negative demand effect that pushes inflation down. Although the supply effect tends to

[29]In the past, the risk of a wage-price spiral was exacerbated in many countries by wage indexation, with wages indexed to past inflation, which introduced an additional source of inflation persistence. However, indexation systems have been redesigned over the past decades, weakening the inflation effects. This said, the role of indexation is difficult to quantity given differences in wage-setting practices across countries. In some countries—especially where labor markets are already tight—transfer revenue indexation can indirectly affect wage negotiations and increase inflation risks. In addition, in a number of countries, public sector wages are adjusted in response to increases in food and energy prices, which may contribute to a wage-price spiral.

dominate, the balance between the two effects is subject to some uncertainty, especially in net commodity importers. In net commodity exporters, a commodity price boom typically raises aggregate demand and intensifies inflation pressures, although exchange rate adjustments could mitigate this effect.

What factors influence the vulnerability of economies to inflation risks associated with commodity price shifts? Broadly, these could be grouped into structural and policy-related factors. A key structural factor is the intensity of use. Indeed, energy intensity—measured as energy consumption per unit of real GDP—has fallen by about 40 percent in advanced economies since the 1970s. In comparison, emerging and especially developing economies are considerably more energy-intensive (Figure 3.9).[30] The difference between these two groups is even more dramatic when it comes to food consumption. Food represents over one-third of household consumption in emerging and developing economies, with the share ranging from just over 10 percent to almost 80 percent in some developing economies. In contrast, in advanced economies food amounts to only one-tenth of household consumption (half of what it was in the 1970s), and the share of raw material costs in total costs is considerably lower.

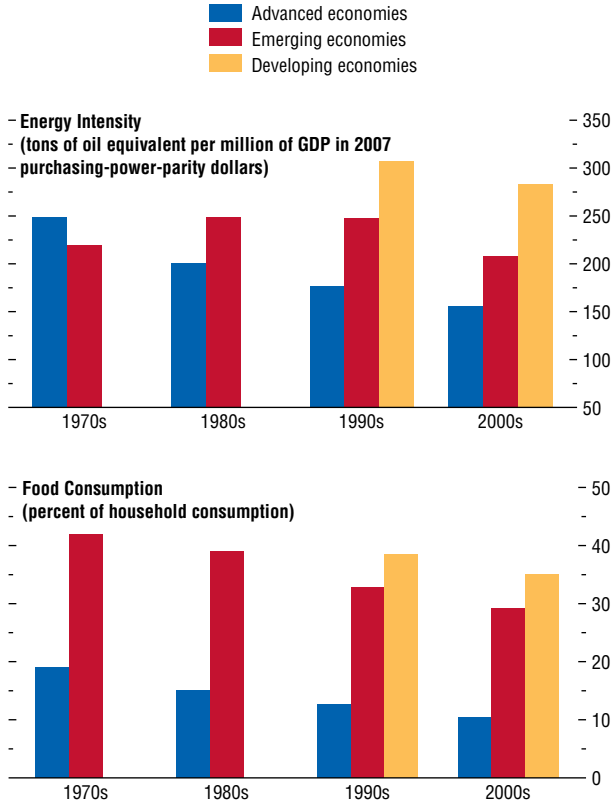
Among the policy-related factors that affect economies' vulnerability to the inflationary impact of a commodity price shock, the credibility of monetary policy stands out. The quality of monetary management—approximated by an index of central bank autonomy[31]—has improved around the world, but it remains lower in emerging and especially developing economies than in advanced economies (Figure 3.10). More than 80 percent of emerging and developing economies maintain heavily managed exchange rate regimes, in sharp con-

[30]Energy intensity in emerging and developing economies is even higher when GDP is evaluated at market exchange rates.

[31]This index captures the ability of a central bank to pursue independent monetary policy and is based on Arnone and others (2007).

Figure 3.9. The Relative Importance of Food and Energy

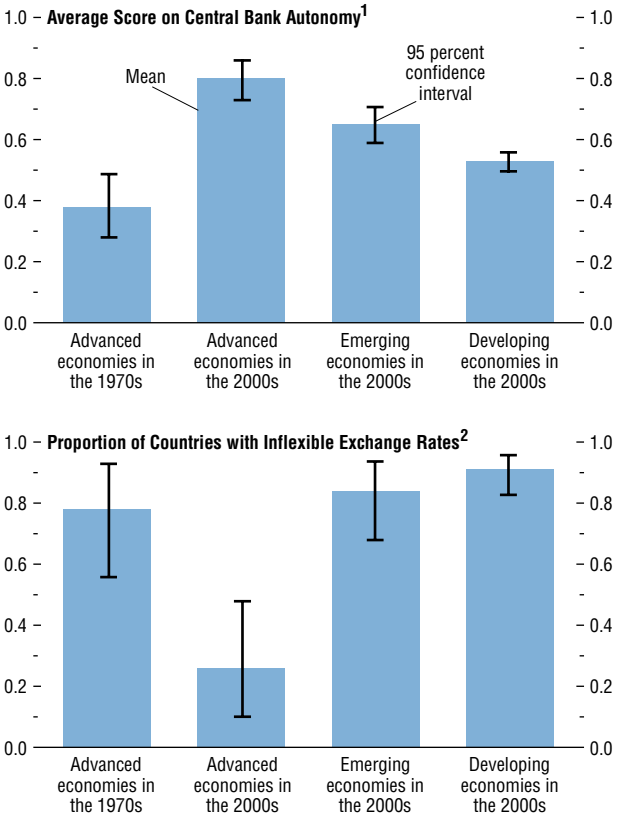
Although the relative economic importance of energy and food consumption has broadly followed a declining trend, emerging and developing economies are both more energy-intensive and more dependent on food consumption than advanced economies.



Sources: *British Petroleum Statistical Review of World Energy* (2008); UN National Accounts; U.S. Department of Agriculture; and IMF staff calculations.

Figure 3.10. Monetary and Exchange Rate Policies

Although the quality of monetary management has improved around the world, advanced economies score better in this area than emerging and developing economies, the majority of which continue to maintain inflexible exchange rate regimes.



Sources: Arnone and others (2007); Reinhart and Rogoff (2004, updated); and IMF staff calculations.

[1]The score for the 1970s is constructed using the methodology of Arnone and others (2007) for a somewhat narrower set of indicators.

[2]Inflexible exchange rate regimes include all de jure and de facto exchange rate pegs and bands and exclude currency unions.

trast to advanced economies, where exchange rates are now overwhelmingly floating.[32] Although pegged exchange rates have helped many emerging and developing economies anchor inflation expectations in the past, they do constrain monetary policy responses, particularly when advanced and nonadvanced economies face very different cyclical conditions. The dissonance between the buoyant activity levels and easy policy stances that now characterize a range of emerging and developing economies is striking and reminiscent of the situation faced by advanced economies during the great inflation of the 1970s.

To assess the potential for second-round effects from changes in food and fuel prices and to relate them to the structural and policy characteristics of different economies, two related econometric exercises were conducted. The first one links core inflation to changes in prices of food and fuel, controlling for changes in the output gap (the Phillips curve).[33] It is based on country-by-country estimations over a relatively extended time period and allows a comparison between current developments and those at the time of the great inflation in the 1970s. The second exercise directly links changes in expected inflation to changes in actual headline inflation and disaggregates the latter into core inflation and changes in domestic inflation rates for food and fuel.[34] This exercise is based on a

[32]This comparison is based on an updated classification of exchange rate regimes of Reinhart and Rogoff (2004). Inflexible exchange rate regimes include all de jure and de facto exchange rate pegs and bands and exclude currency unions. See also Ilzetzki, Reinhart, and Rogoff (forthcoming).

[33]See Blanchard and Galí (2007) for an analysis of oil price pass-through across industrialized economies. De Gregorio, Landerretche, and Neilson (2007) undertake a similar study for a sample of industrial and some emerging and developing economies. Both studies find that the pass-through from oil price changes to overall inflation has declined over time.

[34]Inflation expectations are typically measured in one of two ways. The first is based on surveys of consumers or professional forecasters, and the second is based on the difference in yields between conventional and inflation-linked bonds (see Soderlind and Svensson, 1997; Fung, Mitnick, and Remolona, 1999; and Shen and Corning, 2001).

panel of advanced and emerging economies and allows a comparison of performance depending on structural and policy characteristics of these economies over recent years.

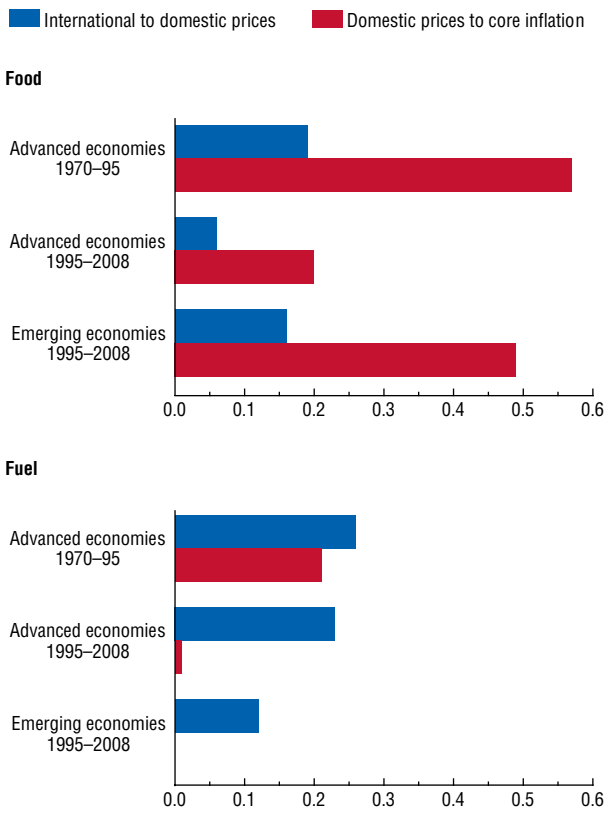
The first set of estimations shows that the pass-through from international to domestic food prices and from domestic food prices into core inflation in emerging economies is comparable to that seen in advanced economies in the 1970s and much higher than the pass-through observed in advanced economies more recently (Figure 3.11).[35] In emerging economies, about one-half of the shock to domestic food prices ultimately makes its way through to core inflation, whereas in advanced economies, less than one-quarter passes through. These findings are in line with the high share of food in consumption and the relative importance of material costs in production across emerging economies and underscore these economies' sensitivity to food price developments.

Turning to fuel prices, the pass-through from international to domestic prices is substantially lower in emerging than in advanced economies. The pass-through from domestic prices to core inflation has recently been markedly lower than

Figure 3.11. Commodity Price Pass-Through[1]

(Full long-term response to a 1 percentage point change in commodity price inflation, in percentage points)

The recent food price pass-through in emerging economies resembles that seen in advanced economies in the 1970s, whereas the fuel price pass-through has been markedly lower. The recent pass-through to core inflation has been moderate for both food and fuel prices in advanced economies.



Source: IMF staff calculations.

[1]Weighted averages of country-by-country estimates using quarterly data. The pass-through from international to domestic prices is estimated using bivariate regressions. The pass-through from domestic commodity prices to core inflation is estimated using Phillips curve equations with domestic prices net of any influences other than international prices and their own lags. In both estimations, the full long-term pass-through is calculated as the sum of coefficients on the current value and the four lags of the independent variable divided by 1 minus the sum of coefficients on the four lags of the dependent variable.

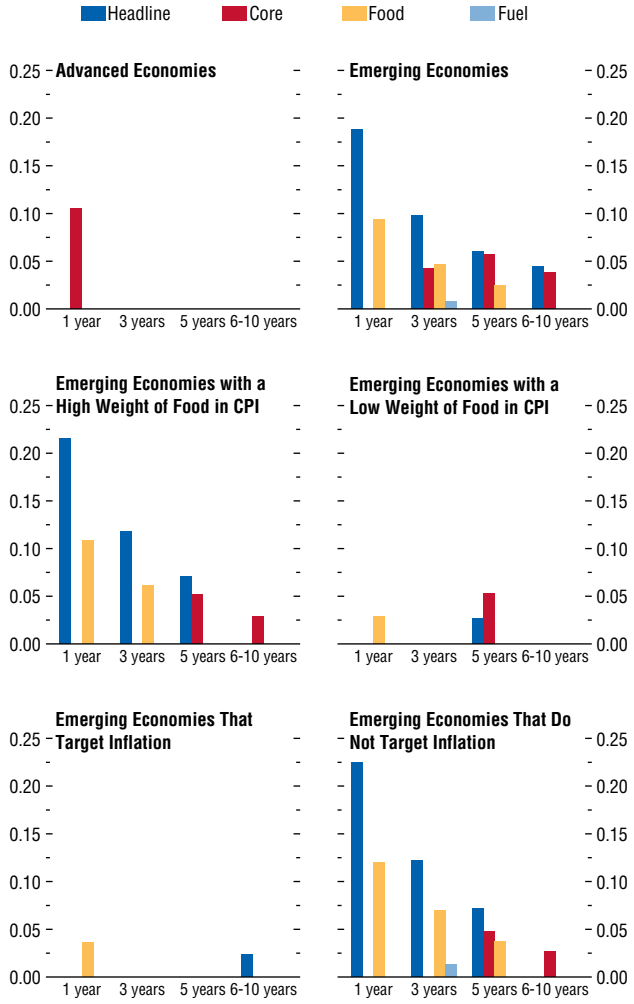
Both of these measures have shortcomings: survey-based measures may reflect subjective and sometimes unfounded perceptions about inflation, while bond-based measures may reflect liquidity and inflation volatility premiums, as well as institutional features of specific bond markets. In this study, expected inflation is measured using inflation forecasts published by Consensus Economics, because bond-based measures are not available for a sufficiently broad set of countries. See Goretti and Laxton (2005) and Levin, Natalucci, and Piger (2004) for similar analyses.

[35]The sample consists of 25 emerging and 21 advanced economies (9 for the 1970–95 period). In order to limit contamination of the estimates by endogenous factors, the pass-through from domestic commodity prices to core inflation is estimated using only the variation in domestic prices that is due to changes in international prices as well as lagged effects of domestic price developments. It must be mentioned that the estimates vary considerably across countries, reflecting in part differences in data quality, measurement of inflation, and sample periods, especially across emerging economies. The estimated pass-through captures the full long-term pass-through and does not reflect any differences in the time path of the inflation responses. Appendix 3.3 provides a detailed description of this exercise.

Figure 3.12. Changes in Expected Inflation in Response to Changes in Actual Inflation[1]

(Expected inflation 1, 3, 5, and 6–10 years ahead; percentage point responses to a 1 percentage point change in actual inflation)

Inflation expectations appear significantly better anchored in advanced economies than in emerging economies, especially those with a high share of food in the CPI. In emerging economies, inflation targeting seems to have recently been more effective than alternative monetary policy frameworks in anchoring expectations.



Sources: Consensus Forecasts; and IMF staff calculations.

[1]Based on statistically significant coefficients from panel regressions with fixed effects, using semiannual data since 2003. The measure of core inflation is net of food and fuel inflation.

during the 1970s, when over 20 percent of the price shock reached core inflation. The low pass-through coefficients may reflect a combination of factors, including declining energy intensity, widespread fuel subsidies and controls in emerging economies, and high fuel taxes in many advanced economies.[36]

The econometric analysis of the relationship between changes in expected and actual inflation suggests that differences in structural and policy vulnerabilities shape expectations across economies (Figure 3.12).[37] In advanced economies, expectations appear to be well anchored: long-term inflation forecasts do not react to actual inflation. Expectations are generally less well anchored in emerging economies, where expected inflation continues to be influenced by actual inflation even at long forecast horizons. Thus, when headline inflation increases by 1 percentage point, inflation expected in the following year rises by nearly 0.2 percentage point on average. Even as far as six to ten years into the future, inflation is still expected to rise by about 0.05 percentage point. In these economies, expectations also respond strongly to changes in domestic food price inflation, whereas energy price inflation does not appear to exert significant effects, likely reflecting the relative shares of food and energy in consumption. In economies where food accounts for a large share of household consumption, there is a particularly sizable increase in expected inflation in response to changes in actual headline and food price inflation.

[36]In addition, comovement between food and energy prices could make the two effects hard to disentangle. Indeed, energy price changes contribute significantly to the dynamics of food prices, as pointed out in the preceding section. Furthermore, measurement issues in domestic food and especially fuel prices noted above could attenuate the estimated pass-through coefficients.

[37]The estimations are based on a panel of semiannual observations beginning in 2003. The sample includes 14 advanced and 21 emerging economies. In order to disentangle the effects of core inflation from those of changes in commodity prices, only the variation in core inflation that is not due to changes in food and fuel prices is used in the analysis. More information on this exercise is provided in Appendix 3.3.

The transmission of commodity price shocks into expected inflation appears to depend crucially on the conduct of monetary policy. Specifically, inflation targeting appears to have been quite effective in anchoring inflation expectations: beyond the one-year horizon, expectations respond very little to changes in actual inflation. In contrast, non-inflation-targeting countries—many of which formally or informally target nominal exchange rates—seem less successful in anchoring expectations. This said, the apparent benefits of inflation targeting may reflect in part the general quality of domestic monetary management in these countries and their levels of development more broadly (but even so, achieving the targets has recently become more difficult).[38] In addition, other country-specific factors—such as the extent of labor market flexibility and the conduct of fiscal policy—may also influence the response of expectations to actual inflation.

Will the recent food and energy price surges lead to a sustained increase in inflation rates across the globe? The findings of this analysis may give reason to be optimistic, particularly for the advanced economies and emerging economies that have adopted inflation targeting. At the current juncture, inflation risks are also diminished by the economic slowdown, especially in advanced economies, although overheating pressures linger in many emerging and developing economies. That said, empirical relationships based on past data may not provide reliable guidance for the future, even if one assumes that monetary policy credibility will continue to improve and that global integration and competition will continue to rise. Recent commodity-market-related shocks have been larger and more persistent than they were over the sample period used for the estimations, and for this reason, actual future pass-through may surprise on the upside, unless the global slowdown intensifies.[39] The risks of such surprises are intimately linked to expectations of future inflation and the ability of monetary policies to anchor them effectively, as discussed in the following section.

[38]Inflation targeting in emerging economies is discussed in Chapter 4 of the September 2005 *World Economic Outlook*. In a more recent study, Mishkin and Schmidt-Hebbel (2007) suggest that inflation targeting helps countries to lower inflation, to strengthen monetary policy and, in particular, to reduce inflationary effects of oil price shocks.

Monetary Policy Responses to Commodity Price Shocks

Monetary policy mistakes can have serious consequences in the presence of permanent commodity price shocks, as demonstrated by the great inflation of the 1970s in the advanced economies. Given already increasing inflation and easy monetary conditions, the appropriate response at that time to the oil price shock—an adverse supply shock—would have been to tighten. Instead, the inflation surge was exacerbated by a continued easing of the monetary policy stance, which further increased inflation expectations and eroded policy credibility. Since that experience, central banks have been very aware that monetary policy should not accommodate second-round effects of adverse supply shocks.[40]

It is well established that the appropriate response of monetary policy to supply shocks depends on the cyclical position of an economy and the degree of policy credibility. For example, with a high degree of capacity utilization and low policy credibility, dangers of pass-through into core inflation are relatively high. This has implications for the appropri-

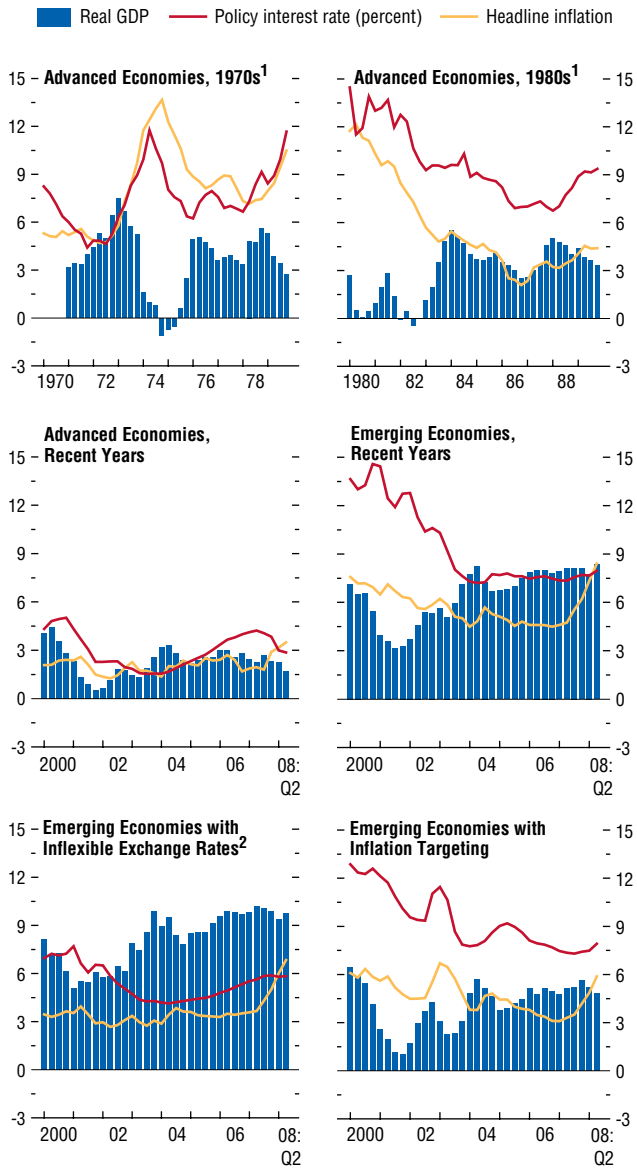
[39]In addition, although the flexibility of domestic labor markets will in all probability continue to improve, the anti-inflationary role of the global labor market may eventually weaken, as labor markets in emerging and developing countries mature and their wages catch up to advanced economy levels.

[40]Many economists have noted the substantial decline in the volatility of important macroeconomic variables since the 1980s, including, for example, Bernanke (2004) and King (2005). Kumhof and Laxton (2007) estimate that about one-half of the higher output variability in the 1970s and early 1980s relative to 1995–2007 can be attributed to inefficient monetary policy and one-half to larger supply and demand shocks.

Figure 3.13. Activity, Interest Rates, and Inflation

(Percent change from one year earlier unless otherwise noted)

Low or negative real interest rates were a feature of the inflationary period in the 1970s in advanced economies, in contrast to the period of stabilization that followed in the 1980s. Recently, real interest rates have turned negative in emerging economies—especially those with inflexible exchange rates—alongside substantially more buoyant activity than in advanced economies.



Source: IMF staff calculations.

[1]For data availability reasons, money market rates are used in place of policy rates for a number of countries.

[2]Inflexible exchange rate regimes include all de jure and de facto exchange rate pegs, bands, and crawling pegs or bands that are narrower than ±2 percent. See Reinhart and Rogoff (2004) and Ilzetzki, Reinhart, and Rogoff (forthcoming).

ate monetary policy responses to the recent surges in food and energy prices. As discussed in Chapter 1, many emerging economies have been showing signs of overheating, along with easing monetary conditions. Short-term nominal interest rates are below nominal income growth—partly because expansionary U.S. monetary conditions have been imported along with exchange rate constraints on monetary policy, as noted above (Figure 3.13). At the same time, monetary policy credibility in these countries is more fragile. To bring inflation under control and avoid a boom-bust cycle, monetary conditions will have to tighten in affected countries. As outlined in Box 3.3, this would also have some moderating influence on commodity demand at the global level and on international commodity prices.

Monetary Policy Credibility and Inflation Dynamics

Simulations based on models with endogenous credibility and capacity constraints can provide useful guidance for using monetary policy to respond to adverse supply shocks in the face of different degrees of policy credibility, different cyclical positions, and different levels of initial inflation. The analysis is based on a small open economy macroeconomic model in which inflation behavior and inflation expectations depend on the credibility of monetary policy. Credibility is determined endogenously and depends on the evolving track record of inflation relative to the long-run target.[41] This, in turn, affects the extent of second-round effects of supply shocks in the model, because the extent to which inflation shocks feed into expectations depends on current and past inflation. With full credibility, inflation expectations are entirely forward-looking, implying that a permanent increase in commodity prices has little effect on expectations. If credibility is low, however, expectations depend mostly on cur-

[41]See Alichi and others (forthcoming) for a description of the model and its properties.

rent and past inflation, and they are affected by shocks to current inflation.

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 deviations from the inflation target, output gaps, and short-term variability in interest rates.

The model postulates that the central bank sets interest rates to minimize variability along all three dimensions. With adverse supply shocks, the difficulties in setting policies arise because inflation and output initially move in opposite directions and because monetary policy tightening reduces both output and inflation in the short term. The central bank's policy preferences determine how it trades off gains from reducing inflation against the costs of lower output.

Supply Shocks and Policy Credibility

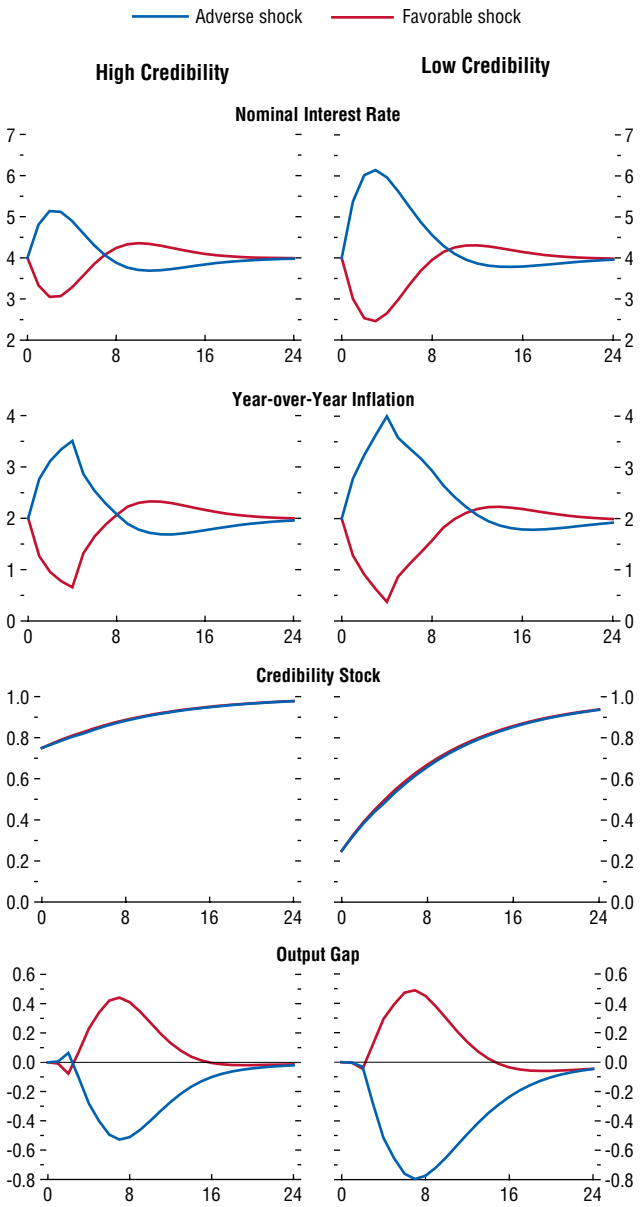
In a first simulation, the supply shocks hit the model economy when inflation is at the target rate of 2 percent and the initial level of the output gap is zero.[42] With high initial credibility—reflecting conditions prevailing in advanced economies—inflation rises to more than 3 percent following the inflationary supply shock (Figure 3.14, left panels). The optimal policy response brings inflation back to the target within eight quarters—which is in line with conventional estimates of the lags involved in the transmission of monetary policy. The interest rate has to rise temporarily to a peak of about 5 percent—about 1 percentage point above the neutral rate of 4 percent assumed in the model. In the low-credibility case, the general picture is roughly similar, although inflation rises by more, and the interest rate increase required to bring inflation back to target is proportionally higher (Figure 3.14, right panels).

[42]The experiments are based on supply shocks that either permanently increase or decrease the price of commodities. The output gap is defined so that a positive value is excess demand and associated with inflation pressures.

Figure 3.14. Stylized Advanced Economy with Adverse and Favorable Supply Shocks

(Percent; quarters on the x-axis)

Adverse and favorable supply shocks are broadly symmetric in their impact on inflation and output and monetary policy implications if credibility is high.



Source: IMF staff calculations.

Box 3.3. Monetary Policy Regimes and Commodity Prices

Policymakers around the world have recently shown much concern about heightened inflation pressures, with sharp spikes in oil and food prices starting to feed into headline and even core inflation in a large number of countries. The question is whether monetary policy arrangements, specifically the dollar standard that has many countries pegging their currencies to the U.S. dollar (formally or informally through heavily managed exchange rates) can be held partly accountable for this development. And, if yes, what would be the impact of adopting alternative approaches?

Under current monetary policy arrangements, the United States exports its monetary policy stance to a significant proportion of the global economy, when other countries either peg their exchange rates or intervene in foreign exchange markets. But the world is currently facing highly asymmetric shocks, with the United States and the euro area being slowed by financial strains and terms-of-trade losses and much of the rest of the world continuing to expand at historically high rates. A monetary policy that is appropriate for the United States, namely, relatively low nominal and real interest rates, is therefore highly inappropriate elsewhere.

This box seeks to answer two questions. First, if the most significant exchange rate pegs continue for the time being, is it in the best interests of the United States to take into account the effects of its monetary policy on the world economy? Second, given current circumstances, what difference would it make to the behavior of the world economy and of individual economies if the countries that now peg to the dollar moved to more flexible exchange rate regimes?

Monetary Policy and Core Inflation

This attempt to answer these questions involves illustrative dynamic simulations that use the Bank of Canada's version of the Global Economy Model (BoC-GEM).[1] This is a five-region dynamic stochastic general equilibrium model that separately specifies each region's monetary policy regime as either a peg to the U.S. dollar or as an inflation-targeting regime.[2] The latter is characterized by an interest rate reaction function whereby nominal interest rates are raised when inflation accelerates. These characterizations of monetary policies are not intended to be an accurate depiction of policies but rather a useful stylized representation that can help shed light on the issues. A critical feature of BoC-GEM for this investigation is its assumption of significant nominal rigidities in manufacturing and services but no nominal rigidities in the oil and commodity sectors.[3] This implies that if monetary policy is solely concerned with domestic stabilization of price and output volatility, it should not attempt to pursue a strict short-run target that includes oil and commodity inflation, but should instead focus on stabilizing "core inflation" in the remaining sectors, which is therefore our baseline assumption. Finally, given that reduced spare capacity and low supply elasticities appear to have been major factors behind the recent volatility of oil and food prices, the model introduces factor adjustment costs that limit the short-term supply response in these sectors. As a result, following a positive shock that raises global demand, there will first be a spike in prices and only later a significant output response.

The baseline simulation is shown as the black lines in the figure. In the initial period, the United States lowers its interest rate by 2.5 percentage points in response to a contractionary

The main authors of this box are Michael Kumhof, Douglas Laxton, and Dirk Muir.

[1]See Lalonde and Muir (2007).

[2]The regions are United States (21.2% of world GDP using purchasing-power-parity (PPP) weights), emerging Asia (24.8%), commodity exporters (15.2%), Canada (1.8%), and remaining countries (37.0%). The simulations do not address the issue of transitions from one monetary regime to another. They also do not address aspects of monetary policy other than the pure timing of interest rate changes such as questions of portfolio preferences for reserve assets in different currencies or questions of financial system regulation and control of credit expansion.

[3]The commodity sector includes but is not limited to food production.

shock to consumption and investment demand and elevated concern about financial sector stability. This monetary intervention dampens the effects of the demand shock, with output falling up to 1.2 percent below potential in the year following the shock.

At the same time, demand in emerging Asia (EA) and a group of oil-exporting countries (GOEC) continues to grow rapidly.[4] Using exchange rate pegs, these regions' interest rates cannot be raised in a countercyclical fashion, and instead they fall almost one for one with U.S. rates.[5] Together with the highly inflationary effects of the shocks, this leads to sharply lower real interest rates that amplify rather than dampen the output effects of the shocks. GDP in these regions therefore expands sharply, by 4.5 percent for EA and 2.8 percent for GOEC, while inflation, both headline and core, increases by about 4.5 and 2.0 percentage points, respectively. This additional demand originates in regions representing only about 20 percent of world GDP,[6] but because growth is very commodity-intensive in EA and GOEC, this exerts strong upward pressure on international oil and commodity prices, which rise by 14 percent and 5.3 percent, respectively. This in turn accounts for the moderate increase shown in U.S. headline inflation of 0.4 percentage point in the initial period, despite the U.S. slowdown. The reason is that these highly flexible prices immediately pass through into headline inflation. Core inflation does fall with demand, but after about a year, it picks up as some oil and commodity inflation feeds through.

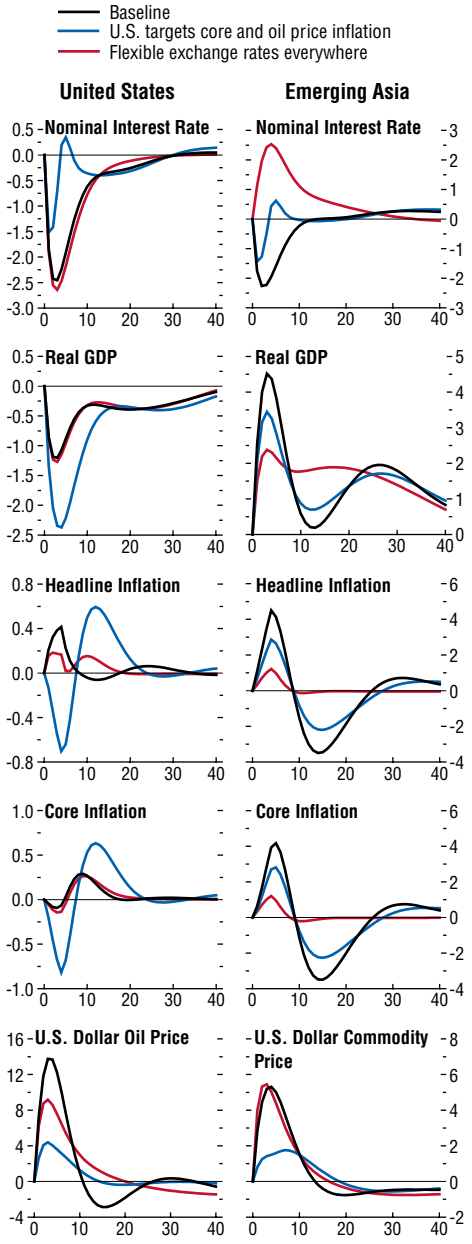
The dynamics of inflation in the baseline are almost entirely due to the underlying demand shocks and their amplification by monetary policy, rather than to the initial large spikes in oil and commodity prices that are due to supply-

[4]The figure only shows simulation results for EA; results for GOEC are very similar.

[5]The small observed difference is due to a foreign exchange risk premium that is increasing each region's net foreign liability position.

[6]World GDP expands by about 1.4 percent.

Adjustment Scenarios[1]



Source: IMF staff calculations.

[1]Plots show deviations from control. Nominal interest rate and inflation are in percentage points. Real GDP and prices are in percent. Quarters on the x-axis.

Box 3.3 *(concluded)*

side rigidities.[7] When the underlying shocks are to demand, flexible commodity prices therefore constitute a bellwether for underlying imbalances and overheating, rather than representing a problem in and of themselves. The situation would be very different, of course, if the underlying shocks were shocks to supply, an issue that is not addressed here.

Should the United States Account for the Global Impact of Its Monetary Policy?

The U.S. Federal Reserve could in principle take account of the effects of its monetary policy on inflation in the rest of the world. But, because targeting a measure of overall world inflation is not a realistic option for an institution with a mandate for domestic price and output stability, we consider a scenario in which the Fed, in addition to responding to domestic core inflation, also responds to oil price inflation. The corresponding simulations are shown as the blue lines in the figure. Monetary policy now is much less accommodative, with nominal interest rates dropping initially by around 1.5 percentage points instead of 2.5 percentage points. They then quickly rise to 0.3 percentage point above the neutral rate in response to upward pressure on oil prices.

Relative to the baseline, under this policy rule, the U.S. output gap deteriorates by 1.2 percentage points, with a cumulative 10-year difference in output losses of 3 percent. On the other hand, a less-accommodative U.S. monetary policy significantly mitigates the boom-and-bust cycle in EA and GOEC, with a 1 percent reduction in excess demand in the first year. The impact on world oil prices is large, with the peak increase reduced from 14 percent to 4 percent. A U.S. focus on oil price inflation is not only contractionary at home, but it also induces much greater volatility in inflation, with the benefit again accruing to EA and GOEC, whose inflation volatility falls by about a third. Adopting a more global measure of inflation, while of significant benefit to EA and GOEC, is therefore highly undesirable for the United States. But these regions have a far more powerful option at their disposal to help themselves without requiring sacrifices from others—the move from fixed to flexible exchange rates.

What Are the Benefits of Flexible Exchange Rate Regimes?

The red lines in the figure illustrate a scenario in which EA and GOEC also follow an inflation-targeting regime with flexible exchange rates, which causes them to sharply increase nominal interest rates in response to their demand shocks. This roughly halves the output expansion in these regions, with inflation rates only one-quarter of their baseline values. The effect on U.S. output, through reduced demand for U.S. exports, is less than 0.05 percent in the first year and virtually zero thereafter; the same is true for U.S. core inflation. But initial U.S. headline inflation rises by only half as much as under an exchange rate peg, principally because lower demand outside the United States causes the oil price to rise much less strongly, by 9 percent instead of 14 percent.

This provides the answer to the second of our questions: Under current circumstances, flexible exchange rates would indeed make a large difference for countries now pegging to the dollar, with beneficial effects for output and inflation stabilization, including the stabilization of oil and commodity prices.

[7]This requires a simulation, not shown here, that eliminates supply-side rigidities in energy and commodities. The only major resulting difference is that the maximum increase in real oil prices is 3.5 percent instead of 14 percent and the maximum increase in commodity prices is 4 percent instead of 5.3 percent.

A positive disinflationary shock has roughly symmetric implications for the inflation rate and for the other key variables. Thus, there is a transitory decline in inflation, which allows the central bank to lower the interest rate temporarily.

Supply Shocks and Existing Inflation Pressures

In a second simulation, the same shock hits an economy where there are excess demand pressures and inflation is already significantly above target. Initial inflation is assumed to be at 8 percent, which is above the long-run target of 3 percent—similar to the inflation pressures from overheating faced today by some emerging economies. With initial inflation above target and with low policy credibility, an adverse supply shock will have larger second-round effects on inflation (Figure 3.15, right panels). As expected, an aggressive immediate interest rate response is needed to bring inflation back to target, with rates rising to 14 percent, an increase substantially larger than the increase in inflation. Interest rates also need to remain higher for longer, and the negative output gap is longer-lived. Thus, even if policy responds appropriately, an inflationary supply shock in conjunction with low credibility results in a period of stagflation. By way of comparison, if credibility is higher, inflation can be brought back to target with a less aggressive interest rate response and a lower output cost (Figure 3.15, left panels). In contrast, in the case of a favorable, disinflationary supply shock, it is optimal to reduce inflation over a shorter time period than otherwise, as the more rapid gains from credibility lower the output costs of reducing inflation.

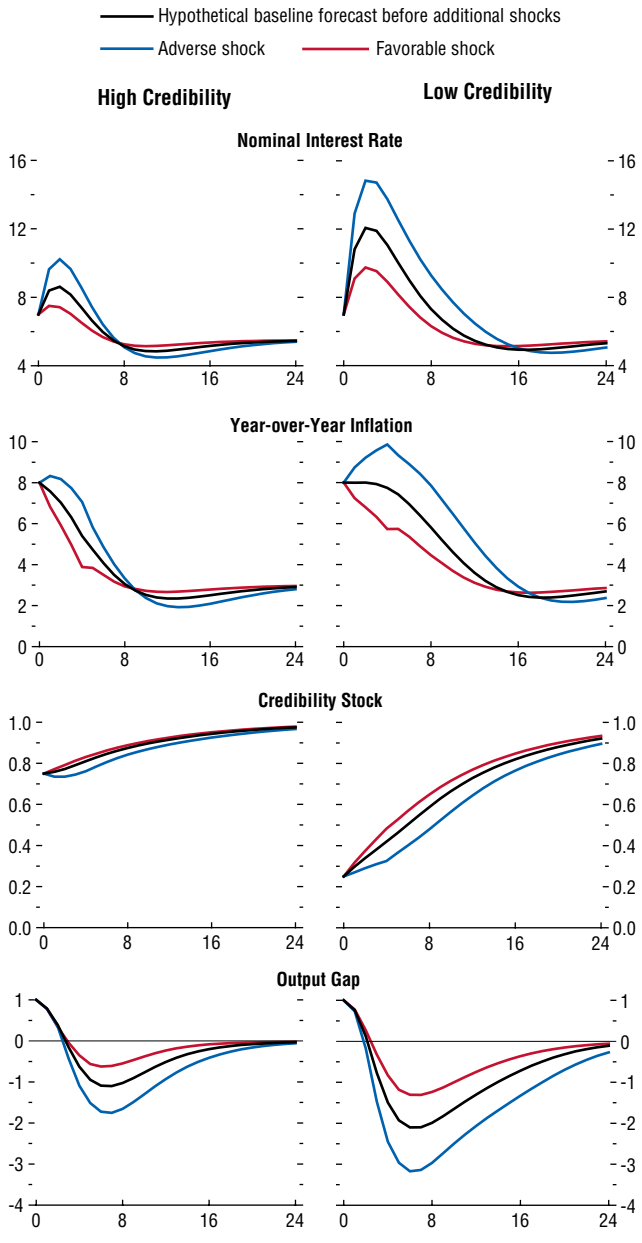
Supply Shocks with Delayed Monetary Policy Responses

In a final simulation, monetary policy is assumed to fall behind the curve. Specifically, optimal policy is overruled for two quarters by a decision to hold interest rates constant in the face of an inflationary supply shock. In the case of on-target initial inflation and high policy credibility, the picture does not change materially from the path under the optimal responses discussed above (Figure 3.16, left panels). The delay does mean, however, that the interest rate has to rise by more than otherwise. In contrast,

Figure 3.15. Stylized More-Vulnerable Emerging Market Economy with Adverse and Favorable Supply Shocks

(Percent; quarters on the x-axis)

The symmetry between adverse and favorable supply shocks disappears if monetary policy credibility is low and initial inflation is already above target. A more aggressive immediate interest rate response is needed to bring inflation back to target after an adverse supply shock.

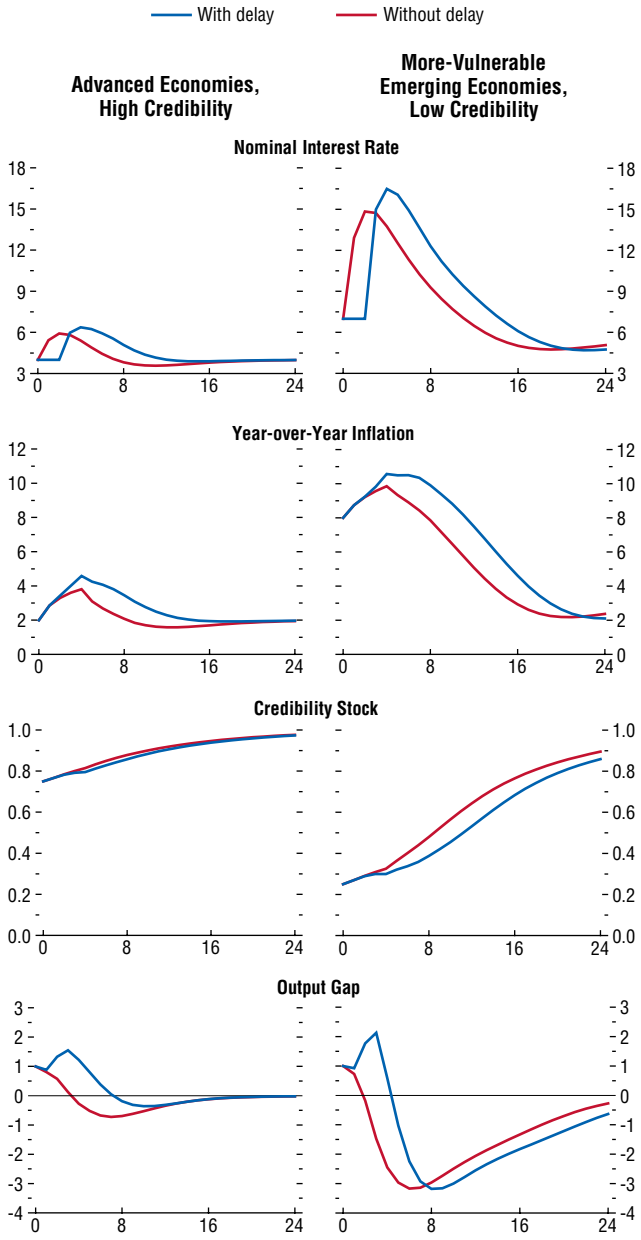


Source: IMF staff calculations.

Figure 3.16. Potential Costs of Delaying Interest Rate Hikes

(Percent; quarters on the x-axis)

Delaying the monetary policy response to adverse supply shocks implies that interest rates have to rise more in the end to bring inflation back to target, with possible disruptions to credibility building.



Source: IMF staff calculations.

in the case of excessive initial inflation and low credibility, the delay in raising interest rates in response to an adverse supply shock causes inflation to ratchet upward and to remain persistently higher than the long-term target. The damage to credibility means that significantly larger interest rate increases and a more prolonged negative output gap are needed to bring inflation back to target.[43] At the same time, the time horizon for inflation stabilization lengthens, which increases the risks of possible future adverse supply shocks.

If the adverse supply shock resulted in an *upward trend* in commodity prices rather than a *one-time* permanent increase in prices, the monetary policy challenges associated with low credibility and existing inflation pressures would increase further. Simulations (not reported) that consider a more persistent rise in commodity prices show that such shocks would require even more aggressive monetary policy responses. The costs from falling behind the curve would be even greater with such a supply shock.

To sum up, the simulation results underline the overarching importance of monetary policy credibility. When credibility is low, the short-run inflation-output trade-off is worse, which implies that the policy interest rate must increase more vigorously in response to adverse supply shocks with second-round effects. Inappropriate actions or delays can quickly undermine credibility and make achieving price stability more difficult.

Summary and Conclusions

The world economy has experienced the broadest and most sustained commodity price boom since the early 1970s. The boom has largely been driven by the interaction of strong global growth, a lack of sector-specific spare

[43]Historical experience supports this result. For example, in the United States and Canada in the early 1980s, short-term interest rates rose well above 20 percent, following the adoption of anti-inflation policies by the U.S. Federal Reserve and the Bank of Canada.

capacity and low inventories from the onset of the boom, and slow supply responses. In addition, commodity-specific factors have contributed to the recent surge in food prices, including demand related to biofuel production, supply disruptions for major crops, and trade restrictions. Cross-commodity price linkages have reinforced the price momentum, with rising energy prices spilling into food prices. In contrast, the increasing role of commodities as alternative financial assets has had little, if any, discernible systematic impact on prices, although shifts in market sentiment can affect short-term price dynamics, and financial variables such as interest rates can affect prices through their effects on physical demand and supply.

Recent developments suggest that some of the factors driving the current boom appear to be unwinding. Prospects of slowing global growth in 2008–09—partly in response to high commodity prices—the resolution of weather-related supply constraints for key food crops this year, and increased oil supply have already led to some easing of commodity prices. However, supply constraints and low inventories are likely to remain in place for some time, and the momentum of demand growth in large emerging economies remains robust. The extent of any further easing of prices will depend on the evolving balance between supply factors and global growth, with considerable scope for price volatility.

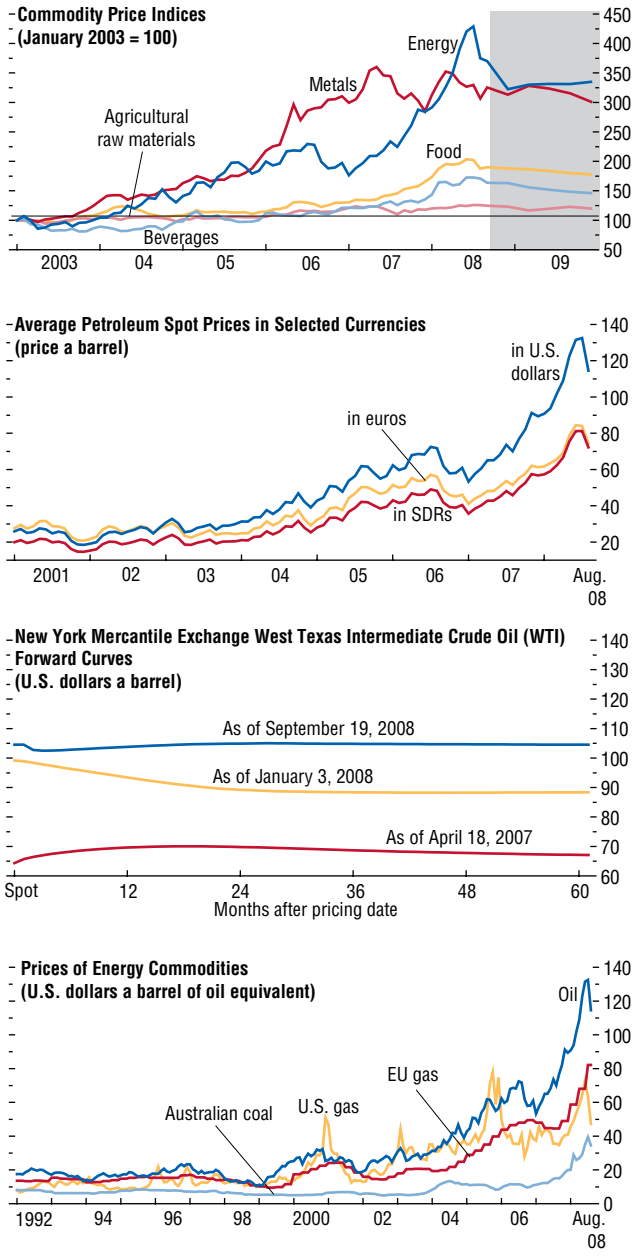
Barring a sharp drop in commodity prices, inflation risks will remain elevated for some time. The adjustment to the earlier commodity price surge is still in train in many economies, and the challenge remains to accommodate these relative price changes without second-round effects, that is, without spillovers into underlying inflation.

The chapter's empirical findings on the pass-through from food and fuel prices to core inflation and inflation expectations suggest that the risks of second-round effects depend importantly on the credibility of monetary policy and its ability to anchor expectations and the weight of commodities—especially food—in final expenditure. Emerging and developing economies score lower along these dimensions, and a number of them are thus at greater risk, notwithstanding some offset from generally more flexible labor markets. Such risk concerns are corroborated by the recent increases in core as well as headline inflation in some of these economies. Although inflation risks are diminishing in advanced economies owing to the deflationary impact of the financial turmoil, these countries may not be immune to inflation risks. Because the recent commodity price shocks have been larger and more persistent than they were during the period used in the analysis, the actual pass-through may surprise on the upside, unless the global slowdown intensifies.

There are growing signs that monetary policy has not yet responded adequately to the risks of rising inflation in some emerging and developing economies. Real policy interest rates in many of these economies are low, even in the face of strong growth rates, recent increases in core inflation, and relatively higher risks of second-round effects from recent commodity price increases. In some countries, this partly reflects exchange-rate-related constraints on monetary policy, which resulted in some economies having imported the expansionary U.S. monetary policy stance. In turn, monetary policies that are insufficiently tight to contain strong domestic demand may recently have put some additional pressure on international commodity prices.

As the chapter's simulation results highlight, delays in responding to rising inflation can erode monetary policy credibility, particularly if inflation expectations are not well anchored—which the chapter suggests remains the case for many emerging economies. As a result, more aggressive monetary policy responses may ultimately be needed to bring inflation back to target, at a higher cost in terms of output than would have been involved in a timely monetary policy response. Such dynamics are generally reinforced by higher initial inflation levels or inflation pressure from tightening capacity constraints. At the same time, even with a timely response, the time needed to reduce inflation

Figure 3.17. Commodity and Petroleum Prices



Sources: Bloomberg Financial Markets; and IMF staff estimates.

is likely to be longer with low policy credibility, making an economy more vulnerable to future adverse supply shocks. This highlights the importance of an adequate monetary policy response to the rising inflation seen in the wake of recent commodity price surges, especially where current inflation is already high ("above" target) for other reasons, notably overheating, and where policy credibility is low.

Appendix 3.1. Recent Commodity Market Developments

The main author of this appendix is Valerie Mercer-Blackman, with contributions from To-Nhu Dao and Nese Erbil.

Commodity prices rose by 33 percent during the first six months of 2008, led by soaring fuel prices, before softening in the third quarter of the year. Oil prices continued to rise rapidly over most of this period, and they remain at high levels by historical standards, notwithstanding some recent declines. Food prices surged in the first quarter of 2008, led by wheat and rice, but stabilized thereafter, as prices of these two grains started to decline. Prices of agricultural raw materials and beverages increased only moderately overall, whereas base metals prices broadly stabilized (Figure 3.17, top panel).

Fuel Prices Leading the Surge

Oil prices reached an all-time record high (in both nominal and real terms) of $143 a barrel on July 11, and then declined to just over $100 by mid-September.[44] Oil prices in euros also reached record highs, although the rise was 24 percentage points less than in dollar terms during the first six months of 2008 (Figure 3.17, second panel).

Despite rising slightly from their lows in late 2007 in terms of forward cover, OECD stocks

[44]Unless otherwise stated, oil prices refer to the IMF's Average Petroleum Spot Price, which is a simple average of the prices for the West Texas Intermediate, Dated Brent, and Dubai Fateh grades.

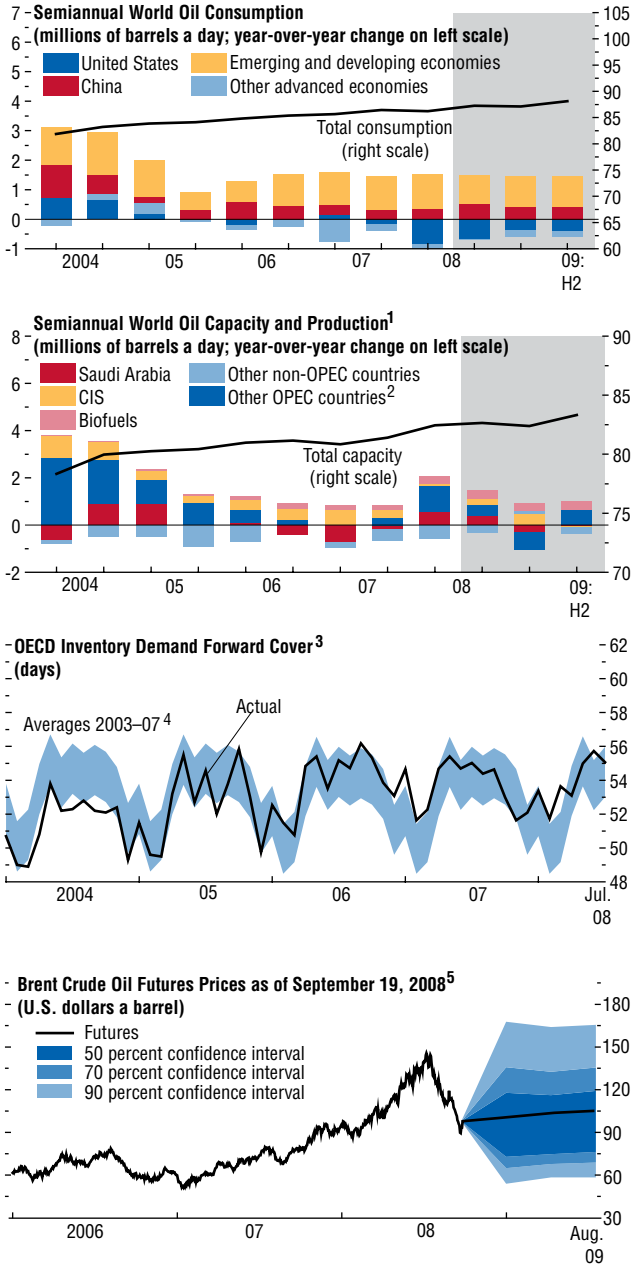
remained at relatively low levels in the first half of 2008. Reflecting this and the recent easing of broad market conditions (see below), the futures price curve moved from backwardation in the first quarter to a very mild contango in recent weeks, a constellation that provides incentives for further near-term inventory buildup (Figure 3.17, third panel). Nevertheless, shifts of the futures curve have dominated movements along the curve in terms of magnitudes, particularly in mid-September, when broad financial market volatility spilled into oil markets.

Diesel prices have risen much faster than gasoline prices, reflecting strong demand growth for this product relative to global refining capacity. Consequently, refining margins for diesel have generally been much higher than for gasoline, although gasoline crack spreads temporarily shot up in mid-September on hurricane-related temporary refining outages. Prices of other fuel products have followed crude oil prices, albeit with a lag (Figure 3.17, bottom panel). Coal prices, in particular, rose by 70 percent during the first six months of 2008, the largest increase among all energy products. This reflected short-term factors (such as supply disruptions early in the year), bottlenecks in major shipping ports, and the gradual substitution from coal in power generation away from more expensive fuel oil.

World oil consumption moderated slightly after seven consecutive years of rising prices, rising by roughly 0.7 million barrels a day (mbd) during the first half of 2008 (year over year), compared with 1 mbd during 2005–07. Consumption in OECD member countries declined by 1.0 mbd during this period, primarily in the United States, but rose by 1.5 mbd in non-OECD countries, led by China, the Middle East, and Latin America (Table 3.3, and Figure 3.18, top panel). Across different products, demand for transportation fuels (gasoline and diesel) has grown the most, driven by increased vehicle ownership in emerging and developing economies amid continued fuel subsidies and price controls.[45] However,

[45]In many economies that have limited the fuel price pass-through, the fiscal burden from fuel subsidies has

Figure 3.18. World Oil Market Balances and Oil Futures Price



Sources: Bloomberg Financial Markets; International Energy Agency; U.S. Energy Information Agency; and IMF staff estimates.

[1]CIS is the Commonwealth of Independent States. OPEC is the Organization of Petroleum Exporting Countries.

[2]Includes OPEC natural gas liquids.

[3]OECD is the Organization for Economic Cooperation and Development.

[4]Band is based on averages for each calendar month during 2003–07 and a 40 percent confidence interval based on deviations during this period.

[5]From futures options.

Table 3.3. Global Oil Demand and Production by Region

(Millions of barrels a day)

							Year-over-Year Percent Change					
			2008	2007		2008			2008	2007		2008
	2006	2007	Proj.	H1	H2	H1	2006	2007	Proj.	H1	H2	H1
Demand												
OECD	49.6	49.2	48.4	49.0	49.3	48.1	–0.5	–0.8	–1.3	-1.0	–0.6	–1.9
North America	25.4	25.5	24.8	25.5	25.5	24.8	–0.6	0.5	–2.6	1.1	–0.2	–3.4
Of which:												
United States	21.0	21.0	20.3	21.1	22.0	20.2	–0.5	0.0	–3.5	0.8	0.8	3.9
Europe	15.7	15.3	15.2	15.1	15.5	15.0	0.1	–2.4	–0.4	–3.6	–1.2	–0.4
Pacific	8.5	8.3	8.4	8.4	8.3	8.5	–1.4	–1.6	1.1	–2.4	–0.8	0.9
Non-OECD	35.5	36.9	38.3	36.6	37.1	38.2	4.0	3.8	3.8	3.7	3.9	4.0
Of which:												
China	7.2	7.5	8.0	7.5	7.6	7.9	7.8	4.6	5.6	4.8	4.3	4.9
Other Asia	9.0	9.3	9.5	9.3	9.2	9.6	2.3	2.8	2.4	2.2	3.5	3.6
Former Soviet Union	4.1	4.1	4.2	4.0	4.2	4.1	3.4	1.7	2.5	2.1	1.3	2.2
Middle East	6.2	6.5	6.9	6.5	6.6	6.8	4.0	4.7	5.9	5.5	4.0	6.0
Africa	3.0	3.1	3.1	3.1	3.1	3.2	0.9	3.9	1.7	3.0	4.7	2.2
Latin America	5.3	5.6	5.9	5.5	5.7	5.8	4.6	5.2	4.3	4.8	5.7	4.7
World	85.1	86.1	86.8	85.7	86.5	86.2	1.3	1.1	0.8	1.0	1.3	0.7
Production												
OPEC (Current composition)[1]	36.3	35.9		35.5	36.4	37.2	0.8	–0.9		–2.1	0.2	4.7
Of which:												
Saudi Arabia	10.4	10.0		9.9	10.1	10.4	–1.5	–4.4		–7.0	–1.8	5.6
Nigeria	2.5	2.3		2.3	2.4	2.1	–5.2	–4.8		–4.4	–5.1	–8.2
Venezuela	2.8	2.6		2.6	2.6	2.6	–5.8	–7.8		–9.6	–5.9	–0.7
Iraq	1.9	2.1		2.0	2.2	2.4	4.9	9.9		5.3	14.3	23.9
Non-OPEC	49.2	49.6	49.9	49.8	49.4	49.7	1.1	0.9	0.6	1.6	0.1	–0.2
Of which:												
North America	14.3	14.2	14.1	14.1	14.1	14.2	0.6	0.4	–1.6	–0.3	–0.4	1.0
North Sea	4.8	4.6	4.3	4.7	4.5	4.4	–7.6	–5.0	–6.6	–5.6	–4.4	–5.5
Russia	9.8	10.1	10.0	10.1	10.1	10.0	2.2	2.4	–0.5	3.2	1.6	–0.8
Other former Soviet Union	2.4	2.7	2.9	2.7	2.7	2.9	11.1	12.0	8.4	16.9	7.5	6.5
Other non-OPEC	17.9	17.9	18.6	18.3	18.0	18.3	2.3	0.4	3.5	2.3	–0.2	–0.4
World	85.5	85.6		85.4	85.8	86.9	1.0	0.1		0.0	0.2	1.9
Net Demand[2]	–0.4	0.5		0.3	0.7	–0.7						

Sources: International Energy Agency, *Oil Market Report* (September 2008); and IMF staff calculations.

[1]Includes Angola (subject to quotas since January 2007) and Ecuador (rejoined OPEC in November 2007, after having suspended its membership from December 1992 to October 2007).

[2]Net demand is the difference between demand and production. It includes a statistical difference. A positive value indicates a tightening of market balances.

gasoline consumption in the United States fell by 1.7 percent in the first half of 2008—the first drop in at least 15 years—and has continued to fall to date, according to preliminary data, reflecting constrained incomes amid weakening economic activity and, increasingly, a demand response to one of the sharpest pickups in gasoline prices in recent U.S. history.

Oil production increased by 1.6 mbd during the first half of 2008, as OPEC production increased by 1.7 mbd (year over year), partly on account of the organization's September 2007 decision to raise output as of November 2007.

been increasing. Indeed, major product importers such as the Islamic Republic of Iran, Malaysia, and Pakistan have increased domestic prices by about 20 percent in response to this rising burden.

Within OPEC, production increases in Saudi Arabia (thereby risinig above the September 2007 production quota), a pickup in Iranian exports, and production recovery in Iraq more than offset output losses in Nigeria (from continued attacks on production facilities) and sluggish Venezuelan output. In contrast, non-OPEC crude oil supply fell by 0.1 mbd, reflecting mostly unexpected falls in Russian output and field declines in the North Sea and Mexico. In addition, liquid fuel supply has benefited from important increases in OPEC natural gas liquids (NGLs, not subject to quotas) and biofuels, which contributed one-quarter of the net increase in supply during the first half of 2008 (Figure 3.18, second panel).

In the near term, oil market conditions may ease further. On an annual basis, the International Energy Agency (IEA) forecasts global demand growth at 0.8 mbd in 2008 and 0.7 mbd in 2009, down from 1.1 mbd in 2007. Non-OPEC supply is expected to pick up by 1.2 mbd during the second half of 2008 (compared to the same period in the previous year), before decreasing again gradually in 2009. The completion of a host of new projects, particularly in Saudi Arabia, should temporarily lift OPEC spare capacity levels. The easing may not be long-lasting, however. In its recent *Medium-Term Oil Market Report*, the IEA expects OPEC spare capacity (as a share of global consumption) to fall to below 2008 levels by 2012, as OECD demand recovers in the outer years and supply growth trends remain limited (partially because of increased field decline rates).

With the moderate easing of market conditions—at least through end-2009—but with inventories and spare capacity still low, prices are expected to remain high, albeit below recent peaks. Oil futures options prices suggest a much wider range of uncertainty about price prospects than in recent years. As shown in the fan chart (Figure 3.18, bottom panel), the 90 percent confidence interval for end-2008 oil prices ranges from about $60 a barrel to more than $165 a barrel, a much wider range than typically observed.

Rising Food Prices Driven by Prices of Major Crops

Grain and vegetable oil prices picked up sharply during the first half of 2008 amid trade restrictions and tight supplies, leading to a 23 percent increase in the IMF's food price index during the first six months of 2008. Wheat prices reached record-high nominal levels in early March of this year following poor, drought-related crops in 2006 and 2007 but have declined since, as more favorable weather conditions led to a bumper crop this year. Rice prices began to rise in late 2007, as consumers in developing economies switched from high-priced wheat and corn toward cheaper rice. Price increases accelerated in early 2008, when major exporters started to impose trade bans (Figure 3.19, top panel).[46]

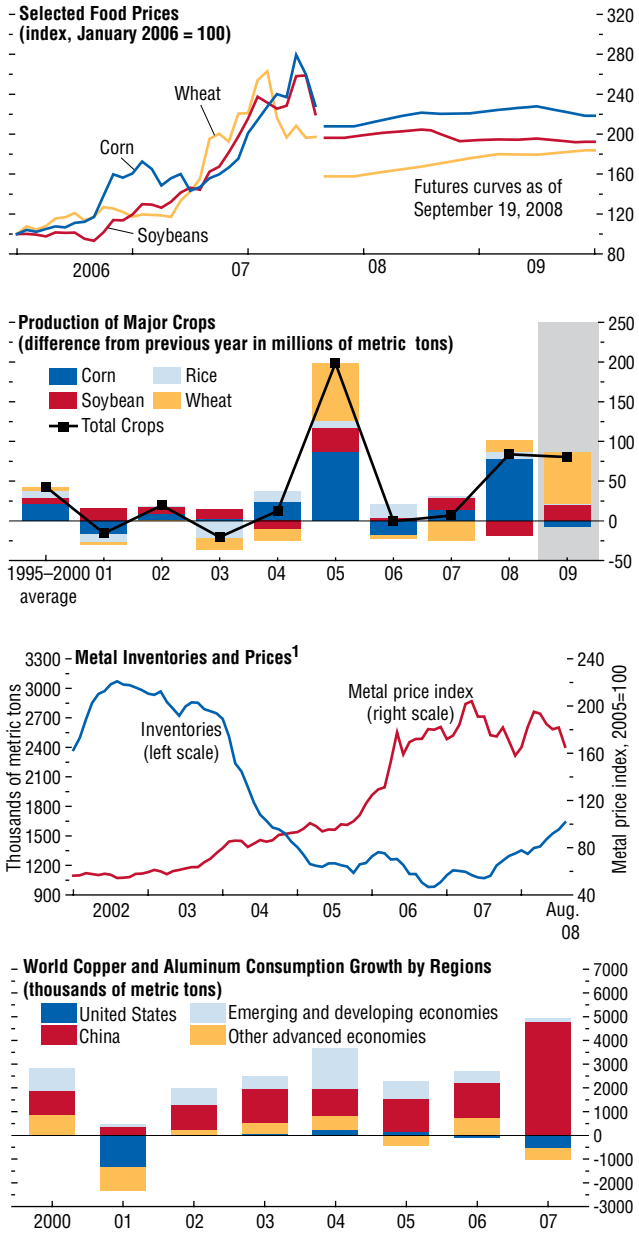
Corn and soybean prices have remained high so far in 2008, with a short-lived spike in June when floods in the U.S. Midwest (the largest producing region in the world) led to fears of crop damage. Other agricultural product prices have also risen, although much more gradually, partly because supplies and inventory levels have so far remained more comfortable. Meat and poultry prices have risen due to higher animal feed costs. Food prices are expected to remain high, given continued demand pressures, particularly for corn-based ethanol. As limited acreage moves from corn to wheat and soybeans on the margin in response to relative price movements, corn production is expected to fall slightly in 2009 from 2008 (Figure 3.19, second panel). Moreover, high oil prices will affect agricultural production costs more broadly in the coming years, in particular through the effect on higher fertilizer prices.

Metal Prices Stabilized

Divergent trends in fundamentals explain the widely varying performance of base metal

[46]Rice is mostly consumed domestically, and the share of global trade to consumption is very small (with large importers receiving the bulk of rice from only one or two producers).

Figure 3.19. Developments in Food and Metal Markets



Sources: Bloomberg Financial Markets; World Bureau of Metal Statistics; and IMF staff calculations.

[1]Inventories refer to the sum of global stocks of copper, aluminum, tin, zinc, nickel, and lead monitored by the London Metal Exchange. Price refers to a composite index of these metals.

markets through 2008 to date. Iron ore[47] prices increased by 66 percent, and copper and aluminum prices rebounded by 17 percent and 21 percent, respectively, but zinc and nickel prices declined sharply. While demand for copper and aluminum, which are more widely traded than the other metals, has weakened, supply in key producers (Chile, China, and South Africa) has been adversely affected by disruptive power shortages. In contrast, zinc and nickel inventory levels at the London Metals Exchange have recovered in the face of declining demand and rising production (Figure 3.19, third panel).

Looking ahead, base metal prices should ease in 2008 and 2009, as demand growth is expected to weaken with slowing global industrial production and the end of the Olympic Games construction run-up in China (Figure 3.19, bottom panel). However, continued supply-side problems will likely provide for tight copper and aluminum market balances for some time.

Appendix 3.2. Accounting for Food Price Increases, 2006–08

The main author of this appendix is Valerie Mercer-Blackman, with contributions from Stephen Tokarick.

This section describes the methodology used in estimating the impact of the various demand and supply factors on the prices of the six key commodities discussed in the main text (as shown in Figure 3.5, third panel). For tractability, the analysis is based on simple partial equilibrium approaches.

The amount of weather-related supply shortfalls, q_i^{sh}, was determined by the deviation of global production from trend, based on annual crop data since 1990.[48] The percent change in

[47]Iron ore prices are determined by annual contracts among producers and steel makers. The April 2008 increase largely reflected soaring mining costs over the previous year and strong demand.

[48]Typically, shortfalls (negative deviations) were the result of lower yields, not reductions in planted acreage,

Table 3.4. Elasticity Estimates Used for Price Calculations

	Own-Price-Demand Elasticity	Own-Price-Supply Elasticity	Cross-Price Elasticity of Supply with Wheat	Cross-Price Elasticity of Demand with Soybeans[1]
Corn	–0.21 to –0.43	0.50	–0.08 to –00.1	0.36 to 0.54
Rice	–0.38	0.32	. . .	. . .
Wheat	–0.3	0.48	. . .	. . .
Soybeans/soybean oil	–0.31 to –0.48	0.23	–0.03	. . .
Rapeseed oil	–1.2	0.58	–0.62 to –0.8	0.57
Palm oil	–0.47	0.21	. . .	. . .

[1] Soybeans are important substitutes for corn on the supply and demand sides. The cross-supply of corn and soybeans estimates range between –0.27 and –0.3.

the global price of commodity i, as a result of the supply shortfall q_i^{sh} was calculated as

$$p_i = \%\Delta P_i = \varepsilon_i^m * q_i^{sh} = \sum_c w_c[(\varepsilon_{i,c}^D * (C_{i,c}/M_{i,c}) - \varepsilon_i^S * (Q_{i,c}/M_{i,c}))] * q_i^{sh}, \quad (1)$$

where ε_i^m, the global import demand elasticity of commodity i, is a weighted average of the import elasticities of demand of the main importing countries (where w_c is the import weight of country c). This depends on the elasticities of demand ($\varepsilon_{i,c}^D$), and supply ($\varepsilon_{i,c}^S$) of country c, respectively. $M_{i,c}$ is total imports, $C_{i,c}$ is total consumption, and $Q_{i,c}$ is total production of the commodity i in country c.

The price impact of higher energy prices was calculated using the contribution of fuel and fertilizers to the production cost of each food commodity, as reported by the U.S. Department of Agriculture (USDA). For the 2007 and 2008 crop years, the costs were estimated based on the IMF commodity price projections, assuming that other costs grow at trend. The corresponding cost shares for palm oil and rapeseed oil are based on Fedepalma (2008) and North Carolina Solar Center (2006) estimates, respectively. The calculations assume full pass-through of higher costs to prices and a similar cost structure in crop production across the globe.

The price impact of increased biofuel demand was calculated for food items for which more than 1 percent of the crop was used as biofuel feedstock (which excluded wheat).[49] The expansion of demand attributed to biofuels is then expressed as the percentage difference between the growth in total demand for the crop (d_i) and demand growth excluding biofuels (denoted as d_i^b).[50] The price impact (in percent) was then calculated as

$$\%\Delta P_i = (d_i - d_i^b) * (1/\varepsilon_i^D), \quad (2)$$

where ε_i^D is the own-price elasticity of demand for the crop. A range of elasticity estimates from various sources were used (Table 3.4). Moreover, because a by-product of corn-based ethanol is distiller's dried grains with solubles (DDGS), which is used for animal feed (about 30 percent of every bushel of corn used in production), this additional supply was deducted from the demand for biofuel use.

To measure the impact of trade restrictions, a slightly modified version of the trade model in Tokarick (2003) was used. Supply and demand are modeled as constant elasticity functions, using elasticities from Gardiner, Roningen, and Liu (1989). Data on commodity trade values were taken from the UN COMTRADE database. Production value data were estimated using

including for wheat and rapeseed oil, thereby corroborating the approach.

[49] The shares of biofuel feedstocks were calculated using USDA data (adjusting the share of each crop used for industrial purposes) and IEA data on biofuel production.

[50] This definition takes into account two competing aspects. On the one hand, it is demand change, not demand levels, that has the greatest impact on prices. On the other hand, it avoids measuring the change from such a low base (given that biofuels are a small share of total demand), which would exaggerate the impact of demand growth for biofuel use on price.

volume data from the USDA's FAS database and IMF price indices.

These direct effects, which can be considered initial shocks, together explain about half of the total price increase of these foods during the period considered (2006 and 2007 crop years). It would be impossible to account fully for the indirect effects of the shocks. However, it is possible to get a sense of the relative magnitude of the cross-effects due to supply and demand substitution and comovements. Two indicators are considered (see Table 3.2):

- *For substitution across commodities:* Assuming symmetry and no second-order effects, the impact of a price increase in commodity j, ΔP_j, on commodity price i, ΔP_i, is given by

$$\frac{\Delta P_i}{P_i} = \frac{\varepsilon_{i,j}}{\varepsilon_i} * \left(\frac{\Delta P_j}{P_j}\right), \qquad (3)$$

  where $\varepsilon_{i,j}$ is the cross-price elasticity of supply (demand) between commodities i and j, and ε_j is the own-price elasticity of supply (demand) of commodity j, assuming commodities i and j are substitutes in production (consumption).
- *Comovement across time:* This was determined using the concordance statistic. The statistic was estimated for all commodity price pairs using monthly data from January 1957 to May 2008 (starting in 1980 for rapeseed oil), using the methodology of Cashin, McDermott, and Scott (1999). The concordance statistic between commodities i and j, defined as the proportion of time two commodities are on the same phase of the cycle, is denoted as

$$C_{i,j} = T^{-1}\left\{\sum_{t=1}^{T}(S_{i,t} * S_{j,t}) + \sum_{t=1}^{T}(1 - S_{i,t})\ (1 - S_{j,t})\right\}, \quad (4)$$

  where $S_{i,t}$ is a binary random variable taking the value unity when the price of commodity i, P_i is in a boom phase and zero when it is in a slump phase. The same definition applies to S_j. T is the sample size and $C_{ij} \varepsilon\{0,1\}$ measures the proportion of time the two series are in the same phase.

The elasticity estimates used in the calculation are weighted, global composites of individual country elasticities taken from Gardiner, Roningen, and Liu (1989). Plausible elasticity ranges for soybean oil and European rapeseed oil were also taken from the FAPRI/GOLD model estimates in Westhoff and Young (2000) and Arnade, Kelch, and Leetmaa (2002). Estimates and ranges used are shown in Table 3.4.

Appendix 3.3. Estimating Inflationary Effects of Commodity Price Shocks

The main author of this Appendix is Irina Tytell.

This section outlines the methodology behind the two econometric exercises discussed in the main text and in Figures 3.11 and 3.12.

Commodity Price Pass-Through

The pass-through coefficients shown in Figure 3.11 are obtained using quarterly data for 25 emerging economies and 21 advanced economies (9 for the 1970–95 period). First, the pass-through from international to domestic prices of food and fuel is estimated using country-by-country bivariate regressions of the following form:

$$\pi_t^{domestic} = \alpha + \sum_{i=1}^{4}\beta_i \pi_{t-i}^{domestic} + \sum_{i=0}^{4}\delta \pi_{t-i}^{world} + \varepsilon_t. \qquad (1)$$

In these equations π stands for the annualized quarter-over-quarter log difference (in percent) in, respectively, food or fuel prices (the equations also include seasonal dummies). The reported pass-through coefficients reflect the full long-term pass-through from international to domestic prices:

$$price\ pass\text{-}through = \frac{\sum_{i=0}^{4}\delta_i}{1 - \sum_{i=1}^{4}\beta_i}. \qquad (2)$$

Second, the pass-through from domestic food and fuel prices to core inflation is estimated

using the following generalized Phillips curve equations for each country:[51]

$$\pi_t = \alpha + \sum_{i=1}^{4}\beta_i\pi_{t-i} + \sum_{i=0}^{4}\gamma_i(y_{t-i} - y^*_{t-i}) + \sum_{i=0}^{4}\phi_i\pi^{food}_{t-i} + \sum_{i=0}^{4}\varphi_i\pi^{fuel}_{t-i} + \varepsilon_t \quad (3)$$

$$\textit{food price pass-through} = \frac{\sum_{i=0}^{4}\phi_i}{1 - \sum_{i=1}^{4}\beta_i}.$$

$$\textit{food price pass-through} = \frac{\sum_{i=0}^{4}\varphi_i}{1 - \sum_{i=1}^{4}\beta_i}$$

As above, π stands for the annualized quarter-over-quarter log difference (in percent) in core, food, and fuel prices, while y and y^* denote the annualized quarter-over-quarter log difference (in percent) in, respectively, real and potential GDP (the equations also include seasonal dummies).[52] In order to limit contamination of the estimates by endogenous factors, the pass-through from domestic commodity prices to core inflation is estimated using predicted values of domestic food and fuel inflation from the first-stage bivariate regressions. In this way, domestic food and fuel prices reflect only the variation that is due to changes in international prices and lagged effects of domestic price developments, rather than movements in labor, transportation, and retailing costs that may have common origins with overall inflation.

The resulting pass-through coefficients are aggregated across countries using weighted averages, with weights inversely proportional to the standard errors of the corresponding country-specific coefficients.[53] Given considerable variation across individual—especially emerging—economies that reflects in part differences in data quality, measurement of inflation, and sample periods, this approach is designed to give more weight to more precisely estimated pass-through coefficients.

Expectations and Actual Inflation

The responses of expectations to actual inflation shown in Figure 3.12 are based on a semiannual panel data set for 14 advanced and 21 emerging economies that covers the period starting in 2003. The exercise links changes in expected inflation to changes in actual headline inflation and disaggregates the latter into core inflation and changes in domestic inflation rates for food and fuel:[54]

$$\begin{aligned}\Delta\pi^{expected}_{i,t} &= \lambda_i + \theta\Delta\pi^{headline}_{i,t} + \varepsilon_{i,t} \\ &= \mu_i + \alpha\Delta\pi^{core}_{i,t} + \beta\Delta\pi^{food}_{i,t} \\ &\quad + \gamma\Delta\pi^{fuel}_{i,t} + \nu_{i,t}\ .\end{aligned} \quad (4)$$

In these equations, $\Delta\pi$ denotes first differences in expected inflation at various horizons (1, 3, 5, and 6–10 years ahead) and actual inflation (headline, as well as its core, food, and fuel components) in percentage points. The data on inflation expectations are obtained from Consensus Economics and are based on surveys of professional forecasters published twice yearly in March/April and September/October. To correspond to these frequencies, the data on actual inflation refer to the first and third quarters of each year and are measured in year-over-year terms. To better disentangle the impact of food and fuel from core inflation, a residual from a regression of core on food and fuel inflation (in first differences) is used in place of actual core inflation. The equations also include country-

[51]This approach is similar to the one used by De Gregorio, Landerretche, and Neilson (2007) to estimate pass-through from the world oil price to domestic inflation. See also Blanchard and Galí (2007).

[52]Core inflation is based on the CPI excluding food and energy prices. OECD data on potential GDP are used for OECD countries, and the Hodrick-Prescott filtered trend is employed to estimate potential GDP for non-OECD countries.

[53]In dynamic models, aggregating country-by-country estimates is preferable to aggregating the underlying data or using pooled panel regressions, as shown by Pesaran and Smith (1995).

[54]See Goretti and Laxton (2005) and Levin, Natalucci, and Piger (2004) for similar analyses, although without the disaggregation of headline inflation into core, food, and fuel components.

and year-fixed effects. The reported results include only the coefficients that are statistically significant at the 10 percent level.

The sample of emerging economies is further split by the weight of food in the consumer price index (CPI) and by the type of monetary policy regime.[55] Countries are grouped into those with high (low) food weights if the weight of food in their CPI is above (below) 25 percent. By this definition, Chile, China, Colombia, Hong Kong SAR, India, Indonesia, Peru, Romania, Russia, Taiwan POC, Turkey, and Ukraine have a high weight of food in the CPI; Brazil, Czech Republic, Hungary, Korea, Mexico, Poland, Singapore, Slovak Republic, and Thailand have a low food weight. With respect to the type of monetary policy regime, inflation targeters are defined as countries that introduced this regime prior to the beginning of the sample period and excludes more recent inflation targeters. Therefore, Brazil, Chile, Colombia, Czech Republic, Hungary, Korea, Mexico, Peru, Poland, and Thailand are classified as inflation targeters, whereas China, Hong Kong SAR, India, Indonesia, Romania, Russia, Singapore, Slovak Republic, Taiwan POC, Turkey, and Ukraine are classified as non-inflation-targeters.

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[55]It is worth noting that the two splits overlap: inflation targeters tend to have relatively low food weights.

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