Commodity Special Feature: Market Developments and the Power of Prices

Primary commodity prices declined slightly between August 2023 and February 2024, driven by a decrease in oil prices. Supply growth in the Americas surprised on the upside, buffering the impact of geopolitical tensions in the Middle East. Food and beverage prices increased, driven by the impact of El Niño on tropical crops. Iron ore prices rebounded due to record steel production in China. Gold prices were supported by safe haven demand. This Special Feature analyzes price elasticities of commodity demand and supply in depth.

Commodity Market Developments

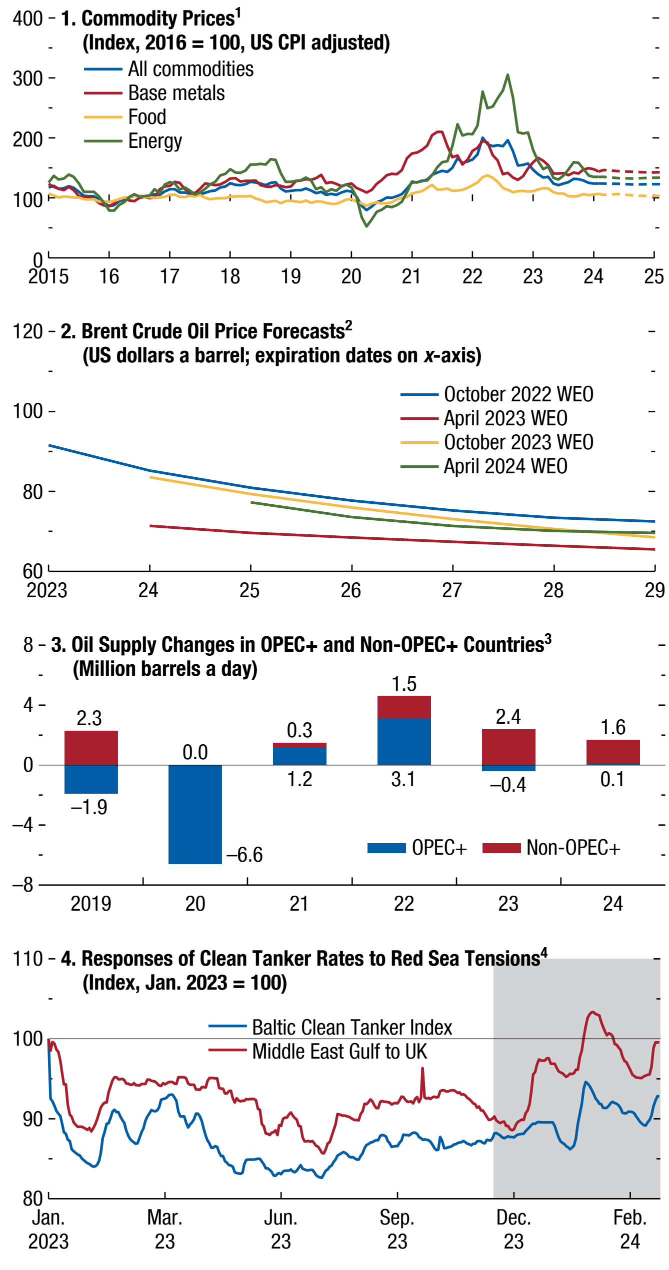
Oil prices decreased despite Middle East tensions. After breaking \$95 a barrel in late September, oil prices decreased by 4.2 percent between August 2023 and February 2024, when they stood at a monthly average of \$80.70. On the demand side, weaker expectations about global demand growth have contributed to downward price pressures. On the supply side, the implementation of output curbs by OPEC+ (Organization of the Petroleum Exporting Countries plus selected nonmember countries, including Russia) was more than offset by strong output growth in Iran and non-OPEC countries, led by the United States, Brazil, and Guyana (Figure 1.SF.1, panel 3).

Red Sea tensions have led to a 50 percent rise in global freight rates of oil product tankers. Among the main routes affected is the one from the Middle East to Europe (Figure 1SF.1, panel 4), for which prices increased by 200 percent from mid-November 2023 to mid-March 2024. The higher costs and the implied rerouting have only had a minor impact on crude oil prices. Russian oil, primarily exported to China and India, was mostly above the Group of Seven price cap since the second half of 2023, at a \$15–\$20 discount (based on Argus data).

Futures markets suggest that oil prices will slide by 2.5 percent year over year to average \$78.60 per barrel in 2024 and will continue to fall to \$67.50 in 2029. Risks to this price outlook are balanced. Upside price risks could arise from an escalation

The contributors of this Special Feature are Christian Bogmans, Andrea Pescatori (Team Lead), Ervin Prifti, and Martin Stuermer, with research assistance from Wenchuan Dong, Joseph Moussa, and Tianchu Qi. The consultant was Ivan Petrella. This Special Feature is based on Bogmans and others (2024).

Figure 1.SF.1. Commodity Market Developments



Sources: Bloomberg, L.P.; Haver Analytics; IMF, Primary Commodity Price System; International Energy Agency (IEA); Refinitiv Datastream; and IMF staff calculations.
[1]Last actual consumer price index (CPI) value is applied to the forecast.
[2]Forecasts are based on the *World Economic Outlook* (WEO).
[3]OPEC+ represents the member countries of the Organization of the Petroleum Exporting Countries plus some other oil-producing countries. Data are from the IEA.
[4]Lines represent logs of rates, which are normalized to January 2023. Shaded area represents the time since the first ship was seized by the Houthi rebels.

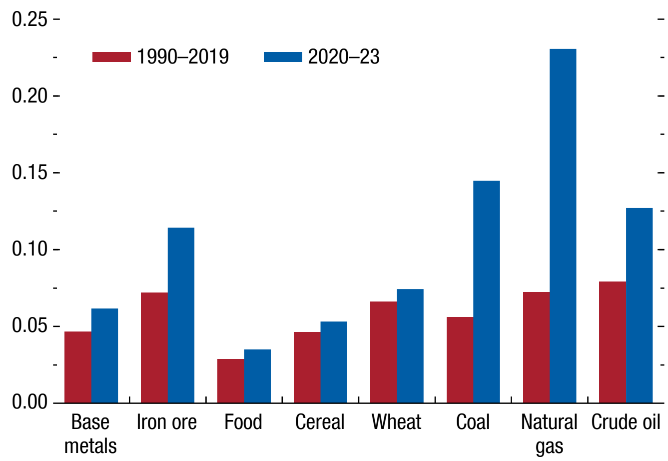
of the Middle East conflict and attacks on Russian oil infrastructure. Downside risks could arise from a slowdown in Chinese oil demand and strong non-OPEC supply growth, possibly coupled with a rise in OPEC+ oil supply to regain market share. The outlook for demand growth is highly uncertain.

Natural gas prices continued to decline amid ample supplies. Title Transfer Facility (TTF) trading hub prices in Europe fell 24.4 percent from August 2023 to $8.10 a million British thermal units (MMBtu) in February 2024—within the upper range of historical prices. Mild weather, low industrial demand in Europe, and ample liquefied natural gas (LNG) supplies have led to high gas storage levels and lower prices (see also Albrizio and others 2022, 2023). Asian prices for LNG declined by 24.9 percent. US Henry Hub prices decreased by 32.3 percent. Futures markets suggest that TTF prices will average $9.45 in 2024, decreasing to $8.73 in 2029. Henry Hub prices may rise from an average of $2.66 per MMBtu in 2024 to $3.63 in 2029, as US export capacity is expected to almost double from 11.4 billion cubic feet a day (bcf/d) to 21.1 bcf/d until 2027, according to the US Energy Information Administration. Risks around this outlook are balanced.

Metals prices rebounded. After declining during the summer, the IMF's base metals price index rose by 4.7 percent from August 2023 to February 2024. Iron ore prices increased by 14.9 percent due to record steel production in China. Uranium prices rose by 75.3 percent to their highest level since 2007 due to supply disruptions from major producers, a potential ban on Russian exports, and better prospects for nuclear power production to combat climate change. Geopolitical tensions and expectations of monetary policy easing raised gold prices by 5.5 percent.

Agricultural commodity prices rebounded. Between August 2023 and February 2024, the IMF's food and beverages price index gained 6.0 percent, masking heterogeneity. Prices for cereals and vegetable oils continued to decline, by 7.2 percent and 10.9 percent, respectively, on the back of abundant global supplies. Concerns related to El Niño put upward pressure on the prices of certain tropical crops, including cocoa (64.2 percent) and coffee (18.2 percent). Coffee prices, especially those for Robusta, experienced upward price pressure from tensions in the Red Sea, which led some consumer countries to switch from Asian to Brazilian imports. Rubber prices jumped 39.8 percent as global output declined in 2023 following the outbreak of a novel leaf disease in Asia. Seafood prices surged 25.9 percent as demand outstripped supply growth, partly because of stricter environmental legislation in some countries. Risks to the price outlook are balanced. Upside risks stem from further trade disruptions in the Black Sea and new food export restrictions. Larger-than-expected harvests constitute the most important downside risk.

Figure 1.SF.2. Volatility of Commodity Prices
(Standard deviation of log differences)



Sources: IMF Primary Commodity Price System; and IMF staff calculations.
Note: Volatility is the standard deviation of log differences in monthly prices over the respective periods. Base metals, food, cereal, coal, and natural gas are price indices. The crude oil price refers to the IMF average petroleum spot price.

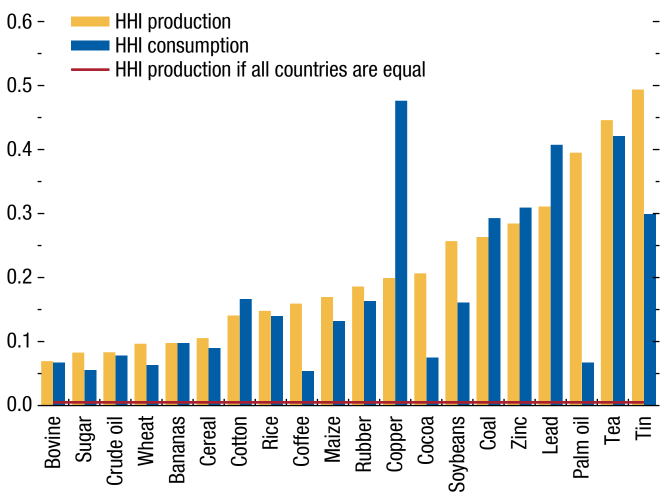
The Power of Prices: How Fast Do Commodity Markets Adjust to Shocks?

The pandemic, the war in Ukraine, and the conflict in Gaza and Israel generated shocks that led to a surge in commodity price volatility (Figure 1.SF.2). This volatility destabilized inflation, and made fiscal and monetary policy more difficult, especially for low-income and commodity-exporting countries.

Geoeconomic fragmentation and climate change could lead to more commodity market turbulences. The resulting price volatility could crucially hinge on the price elasticities of demand and supply. The lower those elasticities, the more prices react to unexpected changes in supply and demand (see Albrizio and others 2022, 2023).

It is therefore essential to understand to what extent commodity supply and demand are slow to react. Is demand more price sensitive than supply?

Figure 1.SF.3. Herfindahl Index by Commodity, 2021



Sources: Bems and others 2023; Food and Agriculture Organization; International Energy Agency; International Historical Statistics; Stuermer 2017; World Bureau of Metal Statistics; and IMF staff calculations.
Note: For each commodity, the Herfindahl-Hirschman index (HHI) is calculated by summing the squares of each country's share in global production (consumption). The HHI ranges between indicating perfectly equal production across the 195 countries in our sample and 1 (indicating perfect inequality).

Do the quantities supplied and demanded adjust more strongly over the long term? Are the elasticities different across energy, agricultural, and mineral commodities? What policies make commodity supply and demand more reactive?

This Special Feature presents a consistently identified and estimated set of price elasticities of demand and supply for a broad range of commodities.[1] Based on a granular instrumental variable approach (Gabaix and Koijen, forthcoming), an annual cross-country data set on agricultural goods, energy, and metals from 1960 to 2021 is employed.[2]

[1]This feature is based on Bogmans and others (2024). It fills a gap in the literature because surveys such as Dahl (2020) and Fally and Sayre (2018) mix estimates based on different methodologies. This is a major pitfall when models include several commodities (see, for example, Fally and Sayre 2018 and Bolhuis, Chen, and Kett 2023). The estimates are often based on correlations and suffer from biases (Roberts and Schlenker 2013). This feature also contributes to the literature estimating elasticities using vector autoregressive models (see Kilian 2022, Baumeister and Hamilton 2022, and Kilian and Zhou 2023).

[2]Online Annex 1.1 provides data descriptions and the methodology. Data sources are World Bank (2024), IEA (2024), FAO (2023), Bems and others (2023), and Schwerhoff and Stuermer (2020), among others. The online annex is available at www.imf.org/en/Publications/WEO.

Commodity Shocks

The methodology uses idiosyncratic changes in commodity production and consumption in individual countries to estimate average global price elasticities. This works only if these shocks are large enough to affect global prices, which, in turn, manifests as high market concentration.

Most commodity markets are in fact highly concentrated in their production and consumption, as elevated Herfindahl-Hirschman indices (HHIs) in Figure 1.SF.3 show. For example, for palm oil the production HHI is 0.4, roughly 80 times higher than the value of the HHI if all 195 countries in the world had the same market share (red line). This means that an idiosyncratic shock in palm oil production most likely affects palm oil prices globally.

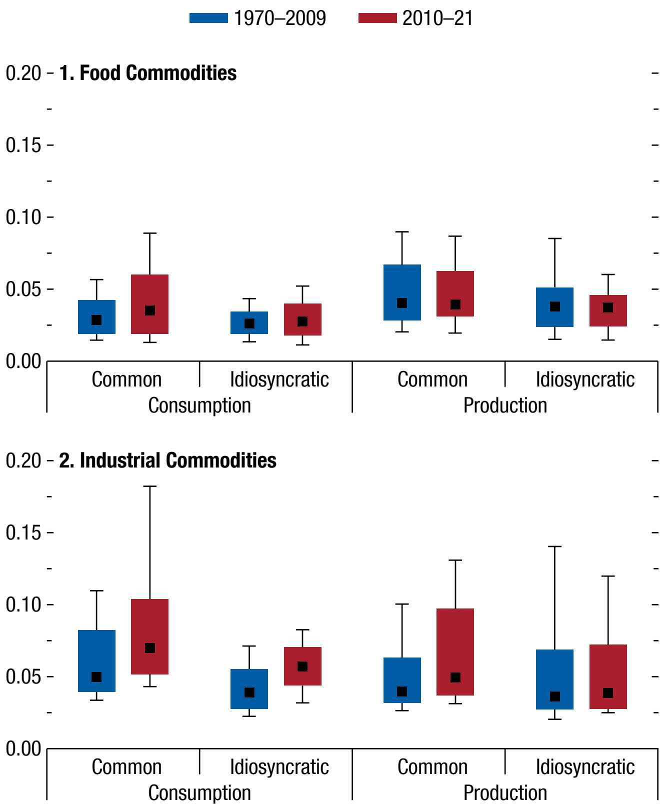
Figure 1.SF.4 shows that these country-specific idiosyncratic shocks are a substantial driver of fluctuations in global commodity production and consumption. Still, common factors are, on average, the stronger driver. One explanation is global supply chains. For example, shocks to shipping can manifest as a common factor across countries on the supply side. In line with this explanation, common factors have increased particularly in their role in the output of industrial commodities over the past decade. Common factors have also gained significance in the consumption of both food and industrial commodities (see also Jacks and Stuermer 2021). More synchronized global business cycles may offer an explanation (de Soyres and Gaillard 2020).

For food commodities idiosyncratic shocks in production are bigger than those in consumption. This is not the case for industrial commodities. Agricultural production can be affected more by idiosyncratic country-specific shocks such as droughts, flooding, or pests that can affect local yields.

Commodities Are Mostly Inelastic

In terms of supply elasticities, results show that metals, especially copper and zinc, tend to have the lowest elasticities, while agricultural commodities have the highest (see Figure 1.SF.5). For example, copper and zinc have a supply elasticity close to zero. In contrast, the results for cereals show a supply elasticity of about 0.6, implying that a 10 percent increase in prices raises output by 6 percent within a year. This is in line with the fact that crop switching, or the application of more fertilizer is possible within a year, whereas the

Figure 1.SF.4. Common versus Idiosyncratic Factors in Commodity Demand and Supply



Sources: Bems and others 2023; Food and Agriculture Organization; Stuermer 2017; World Bureau of Metal Statistics; and IMF staff calculations.
Note: The *y*-axis shows the standard deviation of the common and idiosyncratic components of the country-specific residuals. The residuals are obtained from panel regressions using countries' commodity consumption or production as dependent variables and time fixed effects as controls. Whiskers indicate the 10th and 90th percentiles; the bars show the 25th and the 75th percentiles; black markers indicate the median.

expansion and opening of mines is subject to longer lead times.

A distinction exists between perennial crops such as coffee, palm oil, and cocoa, on one hand, and annual crops like soybeans on the other. Perennial crops are characterized by smaller short-term supply elasticities compared with those for annual crops. It takes an extended period for new trees to produce fruit: typically, two years for palm oil and five years for cocoa. The supply elasticities of energy commodities tend to be between those for mineral and agricultural commodities.

Elasticities on the demand side are determined less by commodity groups. Instead, commodity-specific characteristics seem to play a larger role. This is in line with several mechanisms that allow for demand-side adjustment across all commodities: substitution by other commodities, more efficient use, and substitution of other products for downstream products.

For agricultural goods, rice is atypical, showing a price elasticity of demand close to zero, probably reflecting that only about 10 percent of output is internationally traded. Rice prices are also typically subsidized in Asia. Elasticities for tea, cotton, and wheat are above 0.4. For crude oil and coal, the results show demand elasticities below 0.2, in line with the difficulties of switching fuels over the short term because of technical constraints. Finally, copper and zinc have demand elasticities close to zero, whereas those for lead and tin are between 0.2 and 0.3. The former metals are essential for electrical appliances and steel production, respectively. Lead and tin are easier to substitute.

Supply and Demand Become More Responsive over Time

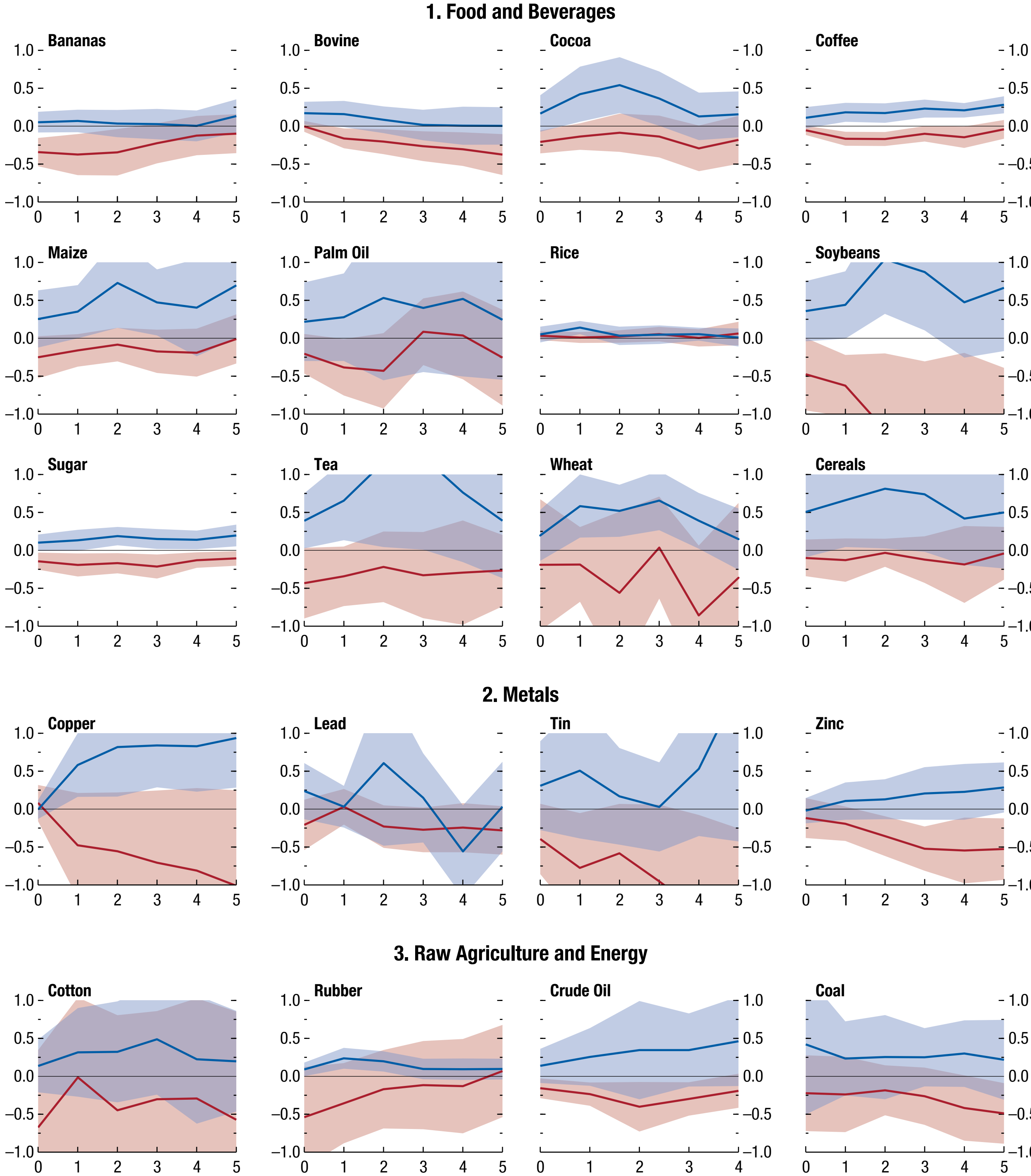
Commodity supply and demand become more responsive over time as markets adjust to shocks (Figure 1.SF.5). However, long-term multipliers show notable differences across commodities at different horizons. Results for most agricultural commodities indicate that supply responses are flat over a five-year horizon. Elasticities for perennial crops like coffee, cocoa, and rubber still show a statistically significant strong peak about two to three years after a shock. For most metals and energy, supply elasticities are upward sloping, but only the one for copper is statistically significant. On the demand side, results are generally not very precisely estimated. Metals show the largest increases in the multipliers over longer horizons. At the same time, for most agricultural commodities, the demand multipliers do not become larger.

Demand and supply for agricultural goods seem generally more responsive to shocks than those for minerals and energy commodities. This is consistent with the smaller price volatility observed for agricultural goods, compared with that for metals and energy commodities (Figure 1.SF.2). Agricultural commodities also see the least increase in their responsiveness after a couple of years, whereas mineral commodities become more responsive.

Conclusions and Policy Implications

This Special Feature estimated a broad set of supply and demand elasticities for commodities based on a consistent identification methodology and a unique data set. The results show that commodity demand

Figure 1.SF.5. Cumulative Supply and Demand Responses to a 1 Percent Price Increase
(Percent)



Sources: Food and Agriculture Organization; World Bureau of Metal Statistics; and IMF staff calculations.
Note: Impulse response functions (IRFs) show the change in the quantity supplied (blue line) or demanded (red line) as a result of a 1 percent increase in prices as a function of time measured in years. IRFs are based on a combination of local projections and the granular instrumental variable approach (Gabaix and Koijen, forthcoming). Figure shows 90 percent confidence intervals.

and supply are generally price inelastic, but that differences exist. The supply of agricultural perennial crops is more inelastic than that of annual crops. This may explain why wheat prices, which spiked at the start of the war in Ukraine, have now come down below prewar levels. Demand elasticities may have also played a role, since within cereals, cross-elasticities of demand allow for substitution. Supply and demand of mineral commodities are particularly inelastic. Those for energy commodities are between those for agricultural commodities and those for metals. At the same time, supply and demand become more elastic for mineral and energy commodities over time.

Countries exposed to commodity markets with relatively low elasticities, especially metals, could build fiscal buffers and monetary policy space to prepare for the larger impact of possible shocks. As elasticities ultimately reflect adjustments made by final consumers and producers, replacing energy and agricultural subsidies with targeted transfers would help increase the demand and supply elasticities of many commodities and could reduce their price volatility. International trade can also play a prominent role in smoothing out commodity shocks and buffer against their economic impact (see Albrizio and others 2022, 2023; and Alvarez and others 2023). This will be even more relevant in the context of increasing geopolitical tensions and trade fragmentation as well as in the case of critical minerals for the energy transition.