OVERVIEW

Motivation

Commodity markets are integral to the global economy. Developments in these markets have major effects on the global economy. In turn, changes in the global economy materially affect commodity markets. A deeper understanding of the determinants of the supply of and demand for commodities can help clarify the nature of commodity price movements and what drives them. Understanding those determinants would also help assess how commodity market developments, such as oil price shocks, affect commodity-exporting and commodity-importing countries. Such analysis is critical to the design of policy frameworks that facilitate the economic objectives of sustainable growth, inflation stability, poverty reduction, food security, and the mitigation of climate change.

Several major events since the beginning of the current decade highlight the complex and volatile relationship between commodity markets and economic activity. In 2020, the COVID-19 pandemic triggered a sharp fall in global demand for commodities—especially crude oil, which experienced its sharpest one-month price decline ever in April 2020. Prices subsequently rebounded, however, amid capacity constraints, supply bottlenecks, and a strong economic recovery. In 2022, the war in Ukraine led to further disruptions to commodity markets and more costly patterns of trade, with a major diversion of trade in energy as Ukraine was unable to export grains while some countries banned imports of Russian energy. The disruption also displayed how interrelated commodity markets are—high energy prices pushed up the production costs of other commodities (such as fertilizers), fueling a broad-based increase in commodity prices. The increase in prices had major economic and humanitarian impacts, especially for energy- and food-importing economies. In the longer term, the war may have accelerated the energy transition as countries seek to reduce their reliance on fossil fuels.

Shifts in commodity markets pose challenges for emerging market and developing economies (EMDEs). Commodities are critical sources of export and fiscal revenues for almost two-thirds of EMDEs, and more than half of the world's poor reside in commodity exporters (World Bank 2018a). The macroeconomic performance in commodity-exporting EMDEs and progress on poverty reduction in low-income countries (LICs) historically has varied in line with commodity price cycles. This is especially so for LICs that rely on a narrow set of commodities (Richaud et al. 2019).

Commodity price movements may present large terms-of-trade shocks for economies that rely heavily on exports of a few commodities. For example, for an oil exporter, a

fall in the price of oil causes a deterioration in the current account balance and puts downward pressure on its currency. Absorbing these shocks can be particularly challenging for economies with fixed exchange rates (Drechsel, McLeay, and Tenreyro 2019; Ha, Kose, and Ohnsorge 2019; World Bank 2020).

Commodity price cycles can lead to procyclical patterns in public spending. In other words, fiscal policy often amplifies the impact of the commodity price cycle on economic growth and increases the amplitude of cycles in economic activity (Mendes and Pennings 2020; Riera-Crichton, Végh, and Vuletin 2015).

Commodity price cycles have often created credit booms and busts in EMDEs, amplifying the macroeconomic effects. These usually involve international capital flows and the supply of domestic credit. Commodity booms have frequently encouraged a surge in capital inflows and a build-up of foreign currency debt by domestic borrowers that proved excessive when the bust arrived (Masson 2014). Strong growth in domestic credit, frequently denominated in foreign currency, has often exacerbated the accumulation of risky debt (Koh et al. 2020). Capital inflows can cause a simultaneous real appreciation of the domestic currency—whether through nominal currency appreciation or domestic inflation—that reduces the competitiveness of the non-tradeable sector and holds back economic diversification (Ostry et al. 2010). Often, surges in capital inflows and undue risk tolerance by lenders during price booms lay the groundwork for systemic financial crises when commodity prices decline. Capital flight adds to the damaging economic impact of a commodities bust.

Commodity price shocks can intensify global inflationary pressures. The oil price shocks of the mid-1970s triggered a global increase in inflation that was only brought under control in the 1980s after central banks imposed steep increases in interest rates. Food price inflation can be an especially difficult challenge for LICs because food constitutes a large share of consumption and food insecurity is pervasive. Following the COVID-19 pandemic, reduced incomes and lost wages, combined with higher domestic food prices and supply constraints, exacerbated undernourishment. The number of people facing hunger globally increased from 650 million in 2019 to 768 million in 2020, undoing most of the progress achieved over the past 15 years (FAO 2021).

Climate change and the transition to more climate-friendly sources of energy add another dimension to the uncertainties that roil commodity markets. Climate change and more frequent extreme weather events are likely to affect the production of all commodities. In what was perhaps a harbinger, in 2021 extreme weather disrupted the production of many commodities: droughts reduced hydroelectric generation in several countries including Brazil, China, and the United States; freezing weather and hurricanes disrupted crude oil and natural gas production in the United States; floods interrupted the production and transport of coal and some metals in Australia, and drought in Brazil reduced its coffee production to historic lows.

The energy transition—intended to minimize the worst impacts of climate change—will materially alter the production and consumption of commodities. Demand for fossil fuels is expected to be flat or decline over the next 30 years, while demand for

metals and minerals will be boosted by ramped up investment in renewable energy infrastructure. The effects on agriculture are less certain and depend on the evolution of demand for biofuels. The energy transition will also have major economic and geopolitical consequences. Fossil-fuel exporters may see a decline in export and fiscal revenues, while metal exporters could receive windfall revenues. Because metal reserves are much more geographically concentrated than other commodities, the global economy could be more at risk of supply disruptions. The energy transition could also lead to additional energy price volatility in the short run if investment in fossil fuels declines before there is sufficient alternative renewable energy capacity. Technological innovation is likely to generate inherently unpredictable shifts in commodity demand and supply. Thus, while the general nature of the energy transition may have a clear endpoint (that is, reduced reliance on fossil fuels), the speed at which it takes place and the implications for the demand for individual commodities are highly uncertain.

Main findings and policy challenges

This volume examines the channels by which developments in the global economy drive commodity markets, and how changes in commodity markets can affect commodity exporters and importers. The analysis in the following chapters encompasses four broad approaches. First, it studies the evolution of commodity markets over the past century and identifies similarities and differences among commodity groups. It shows that several factors—such as income and population growth, industrialization and urbanization, technology, and policy changes—frequently reappear as key drivers of supply, demand, and price movements both across commodity groups and over time. Second, it quantifies the relative importance of these drivers for different commodity groups using an econometric model and concludes that income elasticity plays a crucial role in driving the demand for industrial commodities over the long term. Third, it takes a detailed look at the nature and drivers of commodity price cycles. Fourth, it assesses the impact of commodity price fluctuations on commodity exporters and importers.

Main findings

The book offers a range of analytical findings:

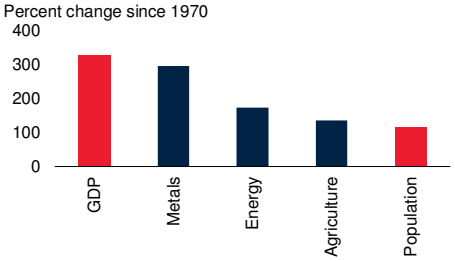
The quantity of commodities consumed has risen enormously over the past century, driven by population and income growth (figure 1). Demand for metals has risen ten-fold, energy six-fold, and food four-fold. The center of commodity demand has shifted over the past half-century from advanced economies toward EMDEs. China, in particular, has substantially increased its market share in both the production and consumption of commodities—especially energy and metals—over the past two decades.

The relative importance of commodities has shifted over time, as technological innovation created new uses for some materials and facilitated substitution among commodities. For example, crude oil products replaced coal in transport in the first half of the 20th century. Later, natural gas emerged as a major fuel for electricity generation and heating. More recently, renewable sources such as solar and wind energy have accounted for a growing share of global energy demand as the world shifts toward zero-

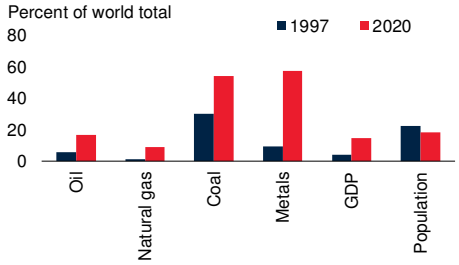
FIGURE 1 Overview

Global consumption of metal commodities has grown in line with GDP while consumption of agricultural commodities resembles population growth. China dominates the consumption of most industrial commodities. Production has likewise seen a huge increase, assisted by technological developments that have boosted productivity. Commodity exporters, particularly oil exporters, are reliant on these commodities for export and fiscal revenue.

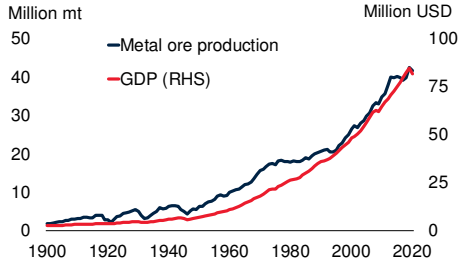
A. Commodity demand, GDP, and population



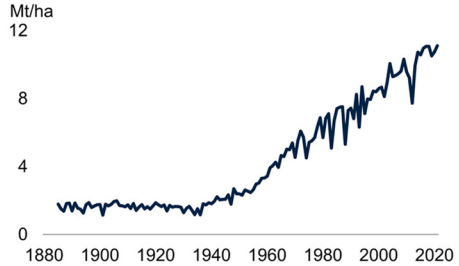
B. China's share of global consumption



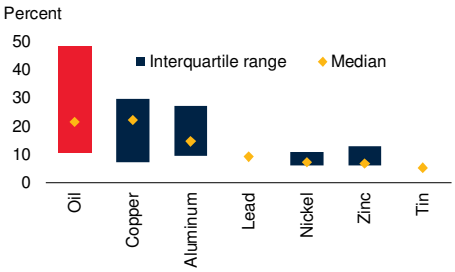
C. World metal ore production and GDP



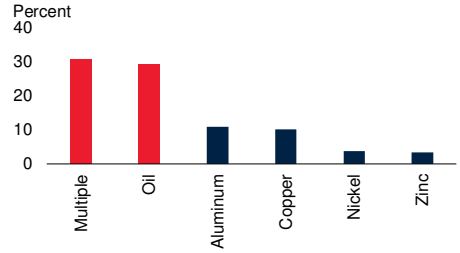
D. Maize yields, United States



E. Share of oil or metal exports in total exports, oil and metal exporters



F. Share of resource revenues in total government revenues, oil and metal exporters



Sources: BP Statistical Review; UN Comtrade; United States Department of Agriculture; World Bureau of Metals Statistics; World Bank.
A. Data show increase in global commodity consumption, GDP, and population between 1970 and 2019.
E.F. Charts show the median and interquartile range of the share of exports and share of fiscal revenues accounted for by resource sectors for EMDE exporters of that commodity. Oil includes 62 EMDEs, copper 14, aluminum 10, zinc 5, nickel 3, and lead and tin each have 1. Export data are from 2019 depending on availability.
E. Due to small sample size, lead and tin do not have an interquartile range.
F. "Multiple" exporters include exporters who export both oil and copper.

carbon energy. Among metals, aluminum's light weight, strength, and affordability have made it an attractive replacement for metals, such as steel, in such industries as packaging, auto manufacturing, and construction. Among agricultural commodities, substitution is common among some grains and especially different types of oilseeds. Shifts also have occurred on the demand side, including the ongoing increase in the consumption of animal products that require soybeans and maize for animal feed, and the increased use of biofuels that raises demand for maize, vegetable oils, and sugar cane.

Growth in China's demand for commodities is expected to slow, while other fast-growing EMDEs are likely to account for an increasing share of commodity demand. China's economic growth is projected to slow as its economy shifts from manufacturing and investment to services and domestic consumption. However, China's experience over the past half-century is unlikely to be repeated, unless a group of other EMDEs collectively (or India) replicate China's growth performance. As some EMDEs mature, broader slowdowns in global economic and population growth will also contribute to slower growth in overall commodity demand. At the same time, as the energy transition gathers speed, fossil fuels will increasingly be replaced by metals, while climate change and changing weather patterns are likely to affect the production of many commodities. Technological innovations will further affect commodity demand—perhaps through better and cheaper materials, new methods of extracting or consuming resources, and increased energy efficiency of consumption.

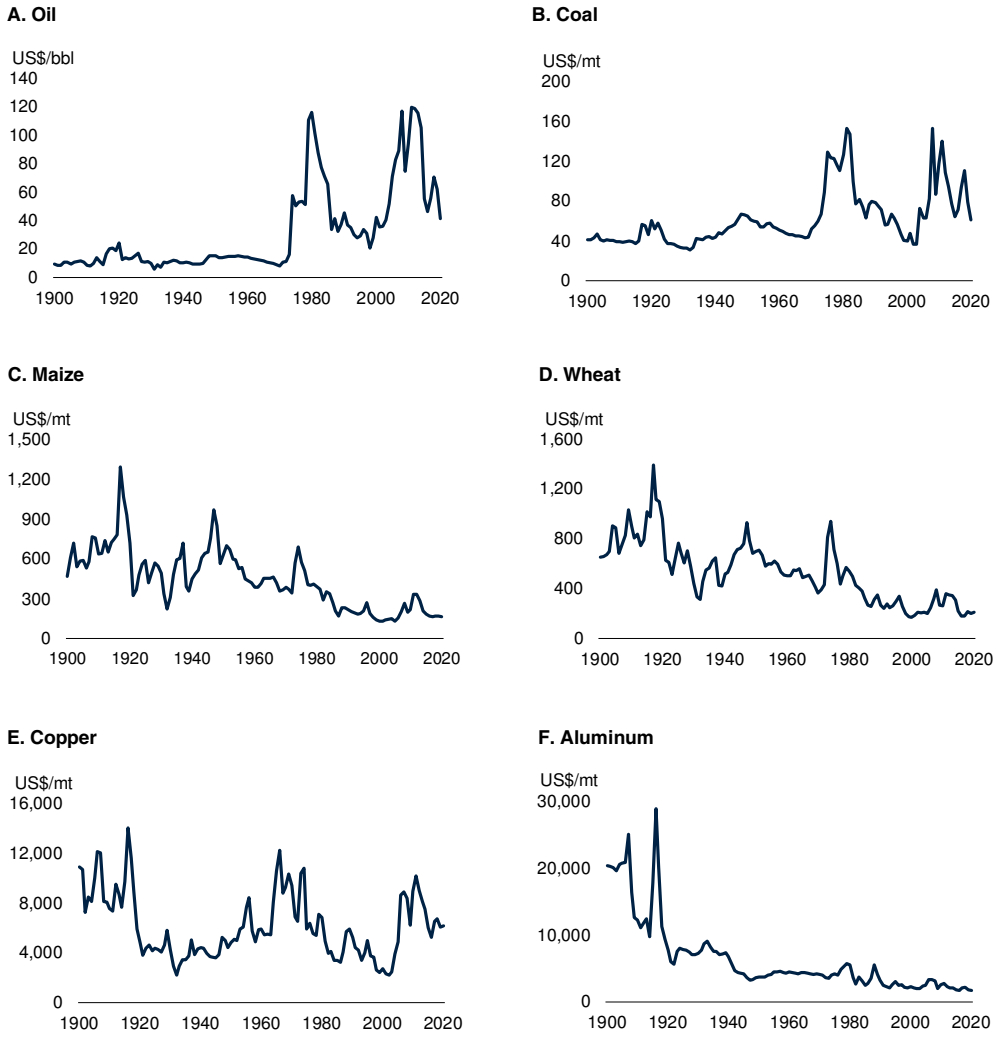
Commodity markets are heterogeneous in terms of their drivers, price behavior, and macroeconomic impact on EMDEs. Policy makers often treat commodities as homogenous, and as a result misinterpret the drivers of price changes and their impact, which can lead to inappropriate policy responses. To formulate appropriate policy, it is critical to understand differences among commodity markets.

The relationship between economic growth and commodity demand varies widely across countries, depending on their stage of economic development. At low levels of income, commodity demand rises rapidly with economic growth (that is, income elasticities of demand are high). But as incomes rise, demand growth starts to slow as basic infrastructure and energy needs are fulfilled. For advanced economies, demand has actually decreased at the highest levels of income in response to conservation efforts and efficiency gains. Aggregate income growth is more important for metals and energy demand than for food commodities, which more closely track population growth.

Real commodity prices follow different paths in the long term. Adjusted for inflation, prices of agricultural commodities have been on a long-term downward path, reflecting the spectacular increase in productivity and low income elasticity of demand for these commodities (figure 2). In contrast, real energy prices have risen since the early 20th century, as demand has increased in line with income and suppliers have been forced to turn to less accessible sources. The long-run trends in metal prices have been mixed, due to their high income elasticities of demand, while extraction processes have benefitted from technological improvements. Moreover, the cyclical components of energy and metal prices follow business and investment cycles more closely than agricultural prices.

FIGURE 2 Real prices of key commodities

Energy prices, which were broadly stable prior to 1970, have experienced two cycles, one associated with the oil crises of the 1970s and the other with the emergence of EMDEs (and China) in the 2000s. Most agricultural commodity prices have followed a long-term downward path, consistent with the fact that demand grows in line with population. The evolution of metal prices has been mixed, with significant volatility in copper—a reflection of its close link with industrial activity—and a downward trend for aluminum resulting from its relative abundance.



Sources: World Bank.
Note: Prices have been deflated by the US CPI; base year is 1990.

Global macroeconomic shocks have been the main source of short-term commodity price volatility over the past 25 years—particularly for metals. Global demand shocks have accounted for 50 percent of the variance of global commodity prices and global supply shocks accounted for 20 percent. In contrast, during 1970–96, supply shocks specific to particular commodity markets—such as the 1970s and 1980s oil price volatility—were the main source of variability in global commodity prices.

Among commodity exporters, oil exporters tend to be less diversified than metal and agricultural exporters. They depend much more on oil for export and fiscal revenue than other commodity exporters depend on agricultural products or metals. As a result, oil-exporting economies are quite vulnerable to fluctuations in oil prices. However, there are significant variations in the size, duration, and impact of price fluctuations across commodities. Moreover, price shocks have asymmetric impacts, with large price declines having a bigger impact on commodity exporters than do large price increases.

Policy frameworks that enable countercyclical macroeconomic responses have become increasingly common—and beneficial. This is particularly true during the past two decades when the number of commodity-exporting EMDEs with fiscal rules and inflation-targeting central banks increased (figure 3). These frameworks have helped moderate macroeconomic fluctuations and boost growth. Similarly, the use of sovereign wealth funds has helped countries diversify their national assets and may reduce the risks posed by the "resource curse," a term used to describe how resource-rich countries can perform more poorly than less-endowed developing economies.

Other policy tools have had mixed outcomes. Many countries use subsidies to mitigate the impact of price spikes on poorer households, particularly for food and energy. Trade interventions, such as export restrictions, have also been used to counter external shocks. At the international level, coordinated supply management efforts were used in many commodity markets over the past century to stabilize markets in response to short-term disruptions, or to raise or stabilize prices over the longer term. While there have been some successes when these tools had short-run and targeted objectives, their prolonged use often led to unintended consequences—subsidies are very costly, regressive, and can encourage excess consumption; trade policies can exacerbate price spikes; and commodity agreements have almost always failed, leading to major price volatility. The mixed impact of these tools reflects, in part, the difficulty faced by policy makers in determining whether price shocks are permanent or transitory. The next section examines the reasons why policy tools are needed and considers the best approach for policy makers to respond to different challenges.

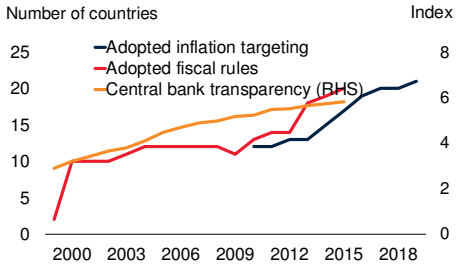
Policy challenges and responses

Policy tools should be tailored to the type of shock and the terms-of-trade effects faced by different types of commodity exporters and importers. For all economies, strong macroeconomic frameworks that provide counter-cyclical fiscal and monetary policies can help build buffers and allow authorities to better manage the negative economic effects of commodity price fluctuations. For longer-term trends, such as the energy

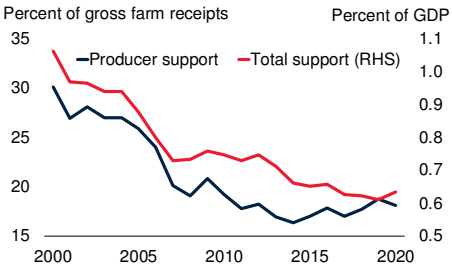
FIGURE 3 Policy improvements in recent years

There has been a marked improvement in policies in commodity exporters during the past two decades. A rising share of commodity-exporting EMDEs has adopted inflation targeting and fiscal rules, while central bank transparency has also improved. Both energy subsidies and agricultural subsidies (the latter among OECD countries) have been reduced. Historically, commodity markets have been subjected to supply management schemes. These have all ended (except oil), often followed by large price falls.

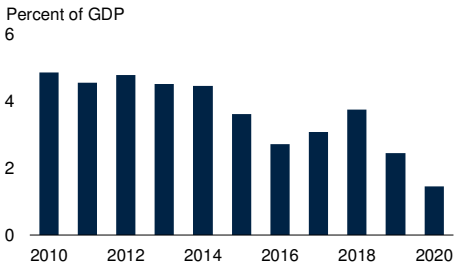
A. Commodity-exporting EMDEs with fiscal rules or inflation targeting



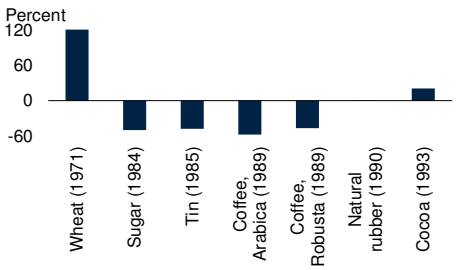
B. Agricultural subsidies



C. Energy subsidies



D. Change in price after agreements collapse



Sources: Cerutti, Claessensand, and Laeven (2021); Dincer, Eichengreen, and Geraats (2019); Ha, Kose, and Ohnsorge (2019); International Energy Agency; International Monetary Fund; Organisation for Economic Co-operation and Development; United States Department of Agriculture; World Bank.

A. An economy is considered to be implementing a fiscal rule if it has one or more fiscal rules on expenditures, revenues, balancing the budget, or limiting debt. Inflation targeting as classified in the International Monetary Fund's Annual Report of Exchange Arrangements and Exchange Restrictions.

B. Shows total support granted to the agricultural sector as percent of GDP. Producer support is measured at the farm gate level and comprises market price support, budgetary payments, and the cost of revenue foregone.

C. Sample includes 25 energy-exporting EMDEs and 14 energy-importing EMDEs.

D. The change is based on the three-year nominal average before and after the year of the collapse of the agreement. The year of collapse is noted in parentheses and is excluded from the comparison.

transition and climate change, policy makers in EMDEs can take steps now to prepare for and build resilience to potential shifts in commodity demand, even though the speed at which these shifts will occur is uncertain. In some countries, notably fossil fuel exporters, expected long-term trends require efforts to reduce their exposure to resource sectors over the medium to long term. For metals exporters, strong demand for certain metals arising from the energy transition may lead to windfall revenue, which will require policies to ensure that these revenues are used strategically and equitably.

Agricultural exporters are likely to experience differing effects of climate change and will need to build resilience to extreme weather shocks.

Policies to manage the macroeconomic impact of commodity price fluctuations

Robust macroeconomic policy frameworks oriented toward longer-term sustainability offer the best protection against commodity price volatility (Borensztein et al. 1994; World Bank 2009). Key ingredients are strong fiscal frameworks that encourage countercyclical fiscal policy, notably by building fiscal space during booms to support spending during slumps; exchange rate flexibility linked to a monetary policy with credible low-inflation objectives; and a regulatory system for the financial sector that deters the accumulation of excessive risks, especially from capital inflows and foreign currency debt. In addition, policy makers may use financial market-based risk-management instruments offered on commodity markets such as futures and options contracts.

Fiscal policies. Swings in commodity-based fiscal revenues in EMDEs often lead to procyclical fiscal policies: spending rises when commodity prices are high and falls when commodity prices decrease (Arezki, Hamilton, and Kazimov 2011; Frankel, Végh, and Vuletin 2013; Ilzetzki and Végh 2008). This procyclicality, however, tends to be asymmetric between booms and slumps. Spending typically rises faster during a resource boom than it falls during a slump, reducing net public savings (Gill et al. 2014). A sustainable and stability-oriented fiscal framework would build buffers during the boom phase of a cycle to prepare for a later bust. Fiscal rules can help in this regard by dampening the observed procyclicality of government spending among commodity exporters. Sovereign wealth funds can also be used to invest commodity revenue windfalls, thereby generating revenue for future generations.

Monetary policies. For commodity exporters subject to terms-of-trade volatility, a flexible exchange rate regime can be superior to a fixed exchange rate. Flexible exchange rates can act as a mechanism of adjustment to commodity price shocks (Berg, Goncalves and Portillo 2016; Broda 2004; Céspedes and Velasco 2012). For example, during the 2014 oil-price plunge, oil exporters with a floating exchange rate had better macroeconomic outcomes than those with a fixed exchange rate (World Bank 2016). For a flexible exchange rate to work effectively, monetary policy has to provide a solid anchor to longer-term inflation expectations. Many central banks use flexible inflation targeting for this purpose, allowing inflation to vary in the short term but returning it to target over time. In contrast, for small open economies or countries with less developed financial markets, a fixed exchange rate regime can offer some advantages, especially if the central bank cannot commit credibly to an inflation target (Frankel 2017).

Macroprudential policies, capital flow management measures. Commodity price fluctuations often lead to substantial capital inflows, which can cause sharp movements in asset prices and credit markets and amplify business cycles in commodity-exporting countries (IMF 2012). Capital flows to developing countries tend to be procyclical (Kaminsky, Reinhart, and Végh 2004). Macroprudential policies can be used to address vulnerabilities that arise from excessive capital inflows. Such policies could include

requiring countercyclical capital buffers by financial institutions, restricting foreign currency borrowing, limiting loan-to-value ratios in housing finance, and limiting the accumulation of short-term debt. Capital controls can also be used to limit the financial risks arising from short-term capital flows.

Market-based mechanisms. Governments exposed to commodity price fluctuations can use market-based risk mechanisms such as futures and options contracts to limit their exposure to price movements. Such instruments, however, have their own shortcomings. They can be costly (especially if they involve exchange rate contracts in which the commodity in question is traded in a different currency) and they can be subjected to large interest rate risk if hedges are mismatched. These instruments also only apply to the short term (with the exception of crude oil, few futures contracts extend much more than a year) and so cannot be used to address long-term changes in prices. Other options include state-contingent debt instruments, such as commodity-linked bonds, which fluctuate in value in line with commodity price movements and can thereby help governments manage public debt, although in practice these novel instruments are hard to use (Benford, Best, and Joy 2016).

Structural policies to reduce vulnerability to commodity price fluctuations

Exposure to commodity market risks is most pronounced for countries that depend on a narrow range of resource-based exports. The underlying vulnerability can be addressed only over the longer run, via structural changes in the economy and through macroeconomic policies discussed above. Economic diversification reduces the risks of terms-of-trade shocks, but direct government intervention to achieve it is seldom successful and may go against the country's comparative advantages. A more promising way forward is to establish an environment that favors innovation and investment generally. Commodity exporters also face environmental risks, and for their future prosperity they must ensure that their resources are extracted in a sustainable way.

Commodity importers encounter a different set of risks. They are less subject to terms-of-trade volatility from commodity price shocks than exporters because commodity concentration is much less on the import side. However, importers may face risks of accessibility to resources that commodity exporters do not. This has become a more pressing issue during the energy transition because some countries may find it harder to obtain the metals needed for renewable energy infrastructure in a similar way that some countries today have difficulties accessing energy resources.

Economic diversification. The prospect of a long-term decline in demand for fossil fuels gives hydrocarbon exporters an especially strong motive to diversify their economies. In addition, for countries that rely heavily on commodities that may be subject to downward price trends, structural policies may be needed to facilitate adjustments to new economic environments. For example, low-income countries that depend on exports of agricultural products as a source of revenue may benefit from reforms that facilitate the expansion of other sectors of their economy. There is strong evidence that diversifying exports and government revenues away from commodities strengthens an

economy's long-term growth prospects and resilience to external shocks (Hesse 2008; Papageorgiou and Spatafora 2012; and World Bank 2018a).

Diversification can take different forms. Policies can support vertical integration—which, in the case of an oil producer could involve oil refining and petrochemicals. Governments could also encourage firms to diversify their output mix (horizontal diversification) with an emphasis on innovation and technological upgrading (Cherif and Hasanov 2014). Governments can also diversify their "national asset portfolios"—an economy's mix of natural resources, human and physical capital, and economic institutions (Gill et al. 2014; World Bank 2021; World Bank 2022). For example, reforms to enhance the economic value of the work force (human capital accumulation) can promote export diversification partly by promoting innovation and the development of new products (Giri, Quayyum, and Yin 2019). More generally, education is a key driver of long-term economic growth and poverty reduction and can help boost innovation as well as lead to stronger institutions (World Bank 2018b).

Wealth diversification. Sovereign wealth funds have been used successfully by several countries to diversify wealth and provide stable long-term foreign income. These funds allow countries to invest windfall revenues rather than spending them, diversifying the country's wealth. For energy exporters anticipating a decline in future demand, building a rainy-day fund while prices remain elevated becomes more pressing. For metal exporters that may benefit from future windfalls, creating frameworks and legislation to create sovereign wealth funds now can help preserve resource revenue for the future.

Resource security. The energy transition is expected to result in a sharp increase in demand for metals and minerals and will pose several challenges. First, policy makers must provide a conducive policy environment that ensures sufficient investment goes into metals production to avoid future shortfalls (Boer, Pescatori, and Stuermer 2021). Policy makers could remove obstacles that prevent businesses from rapidly increasing the production of a metal following the discovery of a reserve. Second, the resources required for the energy transition must be extracted in an equitable and environmentally friendly manner, while recycling rates will need to be stepped up (Hund et al. 2020). Third, to facilitate the smooth functioning of metal markets, greater availability of data and analysis is required, including robust forecasts of global supply and demand. The creation of an international institution focused on metals—similar to the International Energy Agency (which was established after the 1970 oil crises) and the Agricultural Marketing Information System (established after the 2010-11 food price spikes)—could provide a useful forum for cooperation.

Policies to moderate boom-bust cycles: use cautiously

Commodity price booms and busts often lead to calls for policy measures to protect producers or consumers. For example, governments often use subsidies or trade measures to try to moderate the effects of commodity price movements on consumers. At the international level, attempts to mitigate market volatility can take the form of agreements among producers to manage supplies in order to achieve price goals.

However, history suggests that these policies may be effective only for achieving limited, short-term objectives. Prolonged use of these schemes has generally led to undesirable consequences, and such tools should be used cautiously.

Domestic policy initiatives. Commodity price spikes can hurt households, particularly poorer households, which spend a large portion of their disposal income on food. Consumer subsidies are frequently used to protect households from destabilizing shocks, especially for food and energy. For example, the energy price spikes of 2021-22 led both advanced economies and EMDEs to announce fuel subsidies or tax breaks. Policy makers have also often turned to trade measures such as restrictions and bans on the export of agricultural products to boost domestic supply and dampen inflation in food prices.

While subsidies may be an effective tool to temporarily moderate the impact of shocks, they can have adverse effects if they remain in place for too long. Subsidies are very expensive and can erode fiscal space, diverting funds from potentially more productive spending in other sectors such as infrastructure, health, and education (Guenette 2020). Often, subsidies benefit wealthier households more than poorer households and, as a result, encourage excess consumption. In addition, trade policies that seem appropriate at the country level can have significant negative global consequences when applied simultaneously by many countries. For example, the combined use of trade restrictions during the 2010–11 food price spike amplified the increase in world prices and tipped millions of people into poverty, even though each country's policies dampened domestic price movements (Laborde, Lakatos, and Martin 2018; World Bank 2019). Instead of subsidies, policy makers should use social welfare policies where feasible to protect the most vulnerable households. These policies could include targeted safety-net interventions such as cash transfers, food and in-kind transfers, school feeding programs, and public works programs (World Bank 2019).

International policy initiatives. Coordinated supply management efforts have been implemented in numerous commodity markets over the past century. The Organization of the Petroleum Exporting Countries (OPEC) is a well-known arrangement to coordinate supply and one of the longer-lived. Supply management schemes may appear attractive as a permanent facility to mitigate boom-bust cycles of commodity prices by controlling production. Indeed, internationally negotiated supply management schemes have often had the goal of long-term price stabilization. Experience has shown, however, that high and stable prices encourage new producers to enter the market and consumers to reduce their consumption. These market pressures often lead to the eventual collapse of such supply management schemes. At their worst, these mechanisms exacerbate commodity price cycles and harm producers by encouraging consumers to switch to alternatives, which may lead to a permanent reduction in demand for the commodity.

Synopsis

The remainder of this introductory chapter summarizes the main messages of the subsequent chapters in this volume. For each chapter, the main theme, contributions to

the literature, and analytical findings are presented. These summaries are followed by a discussion of future research directions.

Chapter 1: The Evolution of Commodity Markets Over the Past Century

Commodity markets have undergone massive changes over the past century. Dramatic increases in productivity have led to a declining trend in commodity prices relative to manufactured goods and services. Technical innovations have affected patterns of consumption as well as production. Innovations in transportation have reduced costs and widened the opportunities for international trade in commodities, while innovations in communication have facilitated the development of price benchmarks and greater integration of commodity markets. The growing role of EMDEs in the global economy has shifted the location of demand, especially for energy and metals. In chapter 1, Baffes, Koh, and Nagle review developments during the past century for three key commodity groups: energy, metals, and agriculture.

Contribution. The chapter examines demand trends, technological progress, price fluctuations, and policy interventions. It makes three contributions to the literature. *First*, it analyzes all three main commodity markets—energy, metals (including precious metals), and agriculture—and highlights differences and similarities among commodity markets. *Second*, the discussion takes a longer-term perspective, including events and developments earlier in the 20th Century, such as World War I and the Great Depression, as well as recent events in the 21st Century, such as the COVID-19 pandemic and the war in Ukraine. *Third*, in addition to price movements, it discusses three key aspects of commodity markets—preferences and demand shifts, technological progress, and policies. It also considers how the energy transition will affect commodity markets in the future.

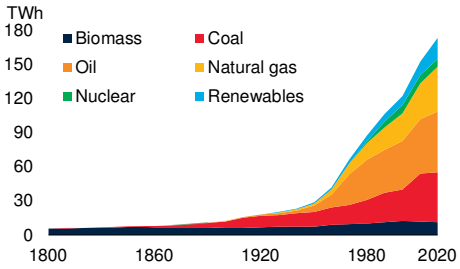
Main findings. Four major themes emerge (figure 4). *First*, commodity demand (and production) has increased enormously over the past century. The largest increases have been for energy and metals as population and per capita income have grown and technological change has encouraged the use of industrial commodities. Demand growth over the period has shifted from advanced economies toward EMDEs. There has also been significant substitution across groups of commodities. For example: in ocean shipping, oil replaced coal; in the package and container industry, aluminum and plastics replaced tin; more recently, biofuels (an agricultural product) have been used as a substitute for fossil fuel in gasoline. These changes mimic earlier historical shifts—such as steamers replacing sailing ships, then diesel-powered ships replacing steamers; road vehicles and trains replacing animal power, and cotton and synthetic fibers substituting for wool and silk in clothing.

Second, technological advances have encouraged consumption by creating new products and new uses for commodities. They have also reduced the use of raw materials by improving efficiency in consumption and production. In addition, they have facilitated the discovery and development of new reserves and new commodities. Spectacular advances in agriculture took place after the development of hybrid varieties in the 1930s

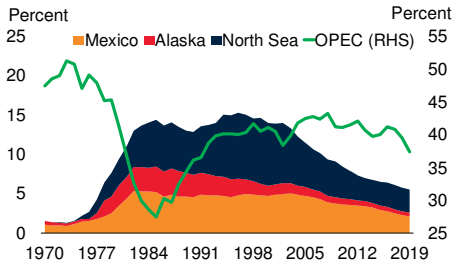
FIGURE 4 Evolution of commodity markets over the past century

The structure of energy markets has changed significantly over the past two centuries, with gradual transitions as new fuels have emerged. Periods of high prices have periodically led to the emergence of new producers, often via new discoveries or new technologies, such as the Middle East after the Second World War, and the North Sea, Mexico, and Alaska in the 1970s. Technology has also played a big role in the composition of production and consumption of commodities. For example, maize productivity increased almost 10-fold during 1930-2020. Consumption of edible oils in particular has seen a massive increase, due to its many uses, including in food, animal feed, consumer products, and biofuels.

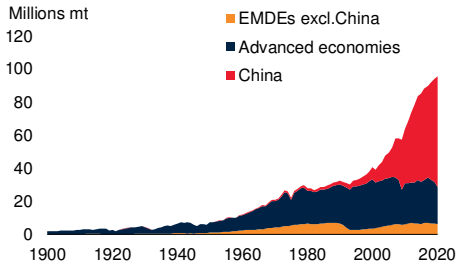
A. Level of global energy consumption, by source



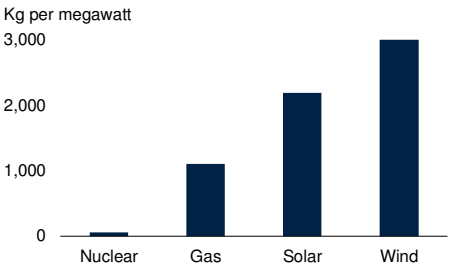
B. Global oil production, 1970-2019



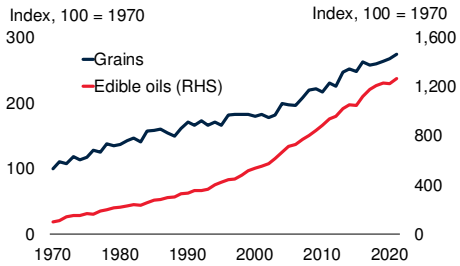
C. Metal demand since 1900



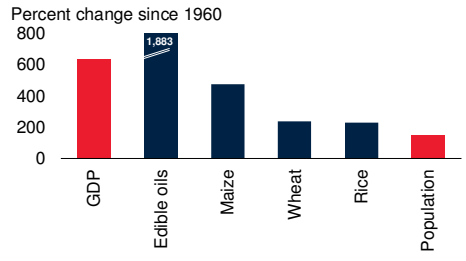
D. Copper use in electricity generation



E. Grains and edible oils production



F. Output, population, and food consumption growth



Sources: BP Statistical Review; Copper Alliance; Energy Information Administration; United States Department of Agriculture; World Bank.

A. Renewables includes hydro-electric, solar, wind, geothermal, biomass, wave and tidal.

B. North Sea includes Norway and the United Kingdom.

C. Total metal consumption includes copper, aluminum, tin, lead, and zinc.

D. Chart shows the amount of copper required to generate one megawatt of electricity using different generation methods.

F. Edible oils includes coconut, olive, palm, palm kernel, rapeseed, soybean, and sunflower seed oil. The base year is the average of1964-65.

and again after the Green Revolution of the 1960s and 1970s. The development of communications and information technology has also had major effects on the structure of commodity markets. A notable feature of increased technical sophistication is the expansion of futures and options markets, and related hedging techniques.

Third, innovation in commodity markets has often occurred in response to periods of high prices. For example, in the case of metals, technological improvements in aluminum and policy interventions in the tin market made aluminum the dominant commodity in packaging. Episodes of production restraint by OPEC stimulated the development of new sources of oil. The oil price shocks of the 1970s encouraged the development of off-shore oil in the North Sea and Mexico. High oil prices in the 2000s likewise spurred the development of shale oil production technology.

Fourth, a variety of interventions have been used to mitigate commodity market volatility. Interventions have taken different forms, including subsidies, production quotas, trade measures, and internationally coordinated supply management schemes. Government intervention has been most prominent in agriculture. Policies have had large effects on commodity markets, but they have also had unintended consequences. Although supply schemes led to higher prices for a while, they also encouraged production by competitors outside of the agreement and stockpiling by consumers, which eventually resulted in increased downward pressures on prices.

Chapter 2: Commodity Demand: Drivers, Outlook, and Implications

Understanding the causes of variations in the long-term growth in commodity demand is critically important to the economic prospects of commodity-exporting EMDEs. Knowing how the key drivers—such as population growth, income growth, technology, and policies—shape long-term trends is a first step in making projections of future commodity demand growth. In chapter 2, Baffes and Nagle investigate the drivers of commodity demand over the past 50 years by looking at historical determinants, their evolution, and long-term prospects. They also discuss implications for policy makers.

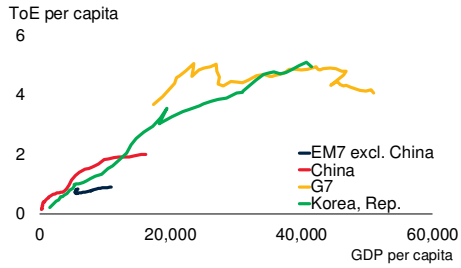
Contribution. The chapter documents the channels through which population, income, technology, and policies affect commodity demand. It examines these relationships quantitatively by estimating income elasticities of demand for energy, metals, and agriculture, and uses these elasticities to build scenarios of future commodity demand, based on expectations for future population and income growth. The chapter makes two contributions to the literature. *First*, by estimating income elasticities of demand at the group level (for example, for aggregate metal demand, rather than for individual metals such as aluminum) it accounts for long-term substitution among commodities. While a few studies have done this for energy, none have used a common framework to compare income elasticities across commodity groups. *Second*, the methodology provides estimates of income-varying elasticities of demand, thus enabling an analysis of how commodity demand changes at different stages of economic development.

Main findings. The chapter offers three main findings (figure 5). *First*, population and income growth are the two primary drivers of aggregate commodity demand in the long

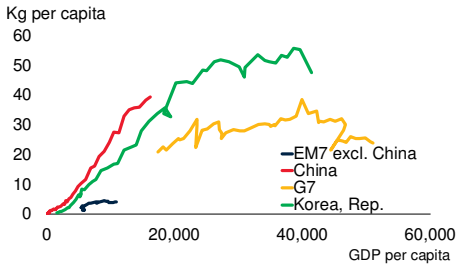
FIGURE 5 Commodity demand

The relationship between income per capita and commodity consumption per capita shows signs of plateauing for most commodities as income rises. Although income elasticities decline as income increases across all commodity groups, the elasticities differ markedly at low-income levels: high for metals and low for food commodities, with energy in between. The energy transition will change the consumption landscape of some commodities, with an expected shift from energy to metals.

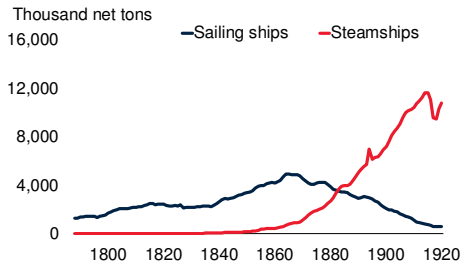
A. Energy consumption



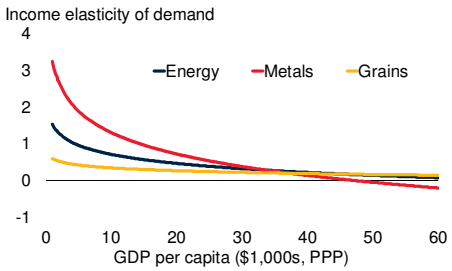
B. Metals consumption



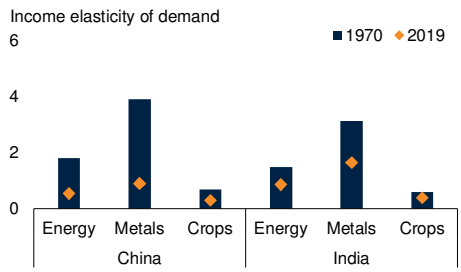
C. Shipping capacity in the United Kingdom



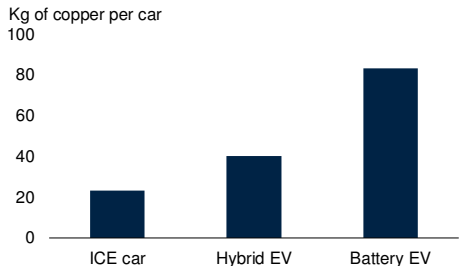
D. Aggregate elasticity estimates



E. Income elasticity of demand for commodities, China and India



F. Copper use in autos



Sources: BP Statistical Review; World Bureau of Metal Statistics; World Bank.

A.B. GDP per capita in constant 2010 U.S. dollars. Lines show the evolution of income and commodity consumption per capita over the period 1965-2019. Each data point represents one country or group for one year. EM7 excl. China includes Brazil, India, Indonesia, Mexico, Russia, and Turkey. ToE stands for tonnes of energy.

C. Denotes ocean transport capacity of ships registered in the U.K.

D.E. Income elasticities calculated using elasticity coefficients in Chapter 2.

F. Bars indicate the amount of copper used in different types of vehicles. ICE stands for internal combustion engine. EV stands for electric vehicle.

run. Whereas income is a key driver of growth for metals and energy, it is less important for food commodities, which tend to be driven more by population growth. Other factors—including relative prices, technology, substitutions from one commodity group to another, and government policies—are also important drivers of commodity demand growth. These factors can lead to changes in the intensity of commodity demand for a given level of per capita income, as well as to changes in the relative importance of individual commodities.

Second, per capita income elasticities of demand vary significantly among commodity groups. Base metals exhibit the highest income elasticity of demand, followed by energy. Food has the lowest income elasticity. Indeed, growth in metals consumption over the past 50 years has closely tracked growth in income, whereas growth in food consumption, particularly for grains, has more closely followed population growth. Income elasticities vary with per capita income levels as well. At low levels of income, demand elasticities are high (in some cases well above unity) but as per capita income levels rise, they fall, reflecting shifts in consumption patterns toward goods with high value-added content, and toward services. At high income levels, elasticities may go to zero, or even turn negative.

Third, overall commodity demand is likely to continue to increase in the years ahead, but at a slower rate than over the past two decades. This is due to slower population and income growth, as well as economic changes, such as China's shift toward a more service and consumer-based economy. Additionally, demand for individual commodities could be affected by transformative substitutions because of innovations and policy-driven initiatives to mitigate climate change. The energy transition is likely to induce large and potentially permanent changes in the demand for commodities. A shift to low-carbon sources of energy is expected to raise demand for metals used for clean energy (such as copper) and substantially reduce the consumption of fossil fuels.

Chapter 3: The Nature and Drivers of Commodity Price Cycles

During the past half-century, there have been several episodes of synchronized commodity price booms and busts. Commodities in energy, metals, and agricultural markets experienced synchronized surges in prices in the 1970s and again in the 2000s. Fluctuations in commodity prices are common across commodity groups and have become more synchronized over time.

For EMDE commodity exporters, large fluctuations in commodity prices can pose significant policy challenges because macroeconomic performance has historically varied closely with commodity price cycles. This is especially true for EMDEs that rely on a narrow set of commodities for export and fiscal revenue. For policy makers, formulating the appropriate policy response depends on whether commodity price changes are expected to be permanent or temporary. To the extent that commodity price movements are temporary, they can be absorbed or smoothed by fiscal and monetary policies. For longer-lasting price shifts, however, structural changes may be needed. Understanding what is behind commodity price cycles is also critical for policy makers

because the appropriate policy response depends on whether the changes in price were driven by global or commodity-specific factors, as well as whether they are predominantly demand or supply driven. In this chapter, Kabundi, Vasishtha, and Zahid investigate the nature and size of transitory and permanent components of commodity price cycles and the main drivers of common cycles in commodity prices.

Contribution. This chapter adds to the existing price-cycle literature in two ways. *First*, whereas the existing literature analyzes price movements in the context of either supercycles or cyclical-versus-trend behavior, the analysis in this chapter focuses on business cycles and medium-term cycles, in line with the macroeconomic literature. Specifically, it separates the transitory component into two parts: the traditional two-to-eight-year cycle, which is associated with economic activity; and the medium-term cycle with a duration of eight to 20 years. The contribution of these components has been studied extensively in the macroeconomic literature and, in the case of commodities, for metals. The medium-term cycle has not been studied as much in the literature but has received attention lately.

Second, the chapter examines both global and commodity-specific cycles for a large number of commodities, as well as the underlying drivers of these cycles. In contrast, earlier literature either focused on a small set of commodities (examining commodity demand and supply rather than aggregate demand and supply) or simply documented the existence of co-movement without identifying the underlying drivers. This chapter also provides an in-depth analysis of price cycles in key commodities since 1970 and compares the rebound in commodity prices after the COVID-19-induced global recession in 2020 with price recoveries after earlier recessions and slowdowns.

Main findings. The chapter offers three main findings (figure 6). *First*, the long-term, or "permanent," component of commodity cycles accounts for nearly half of price variability, on average, across all commodities. The permanent component dominates agricultural prices and has a downward trend, while the transitory component is larger for industrial commodities. The analysis identifies three medium-term cycles. The first (from the early 1970s to mid-1980s) and third (from the early 2000s to 2020 onwards) exhibited similar duration and involved all commodities, while the smaller second cycle (spanning the 1990s) was mostly applicable to metals and less so to agriculture.

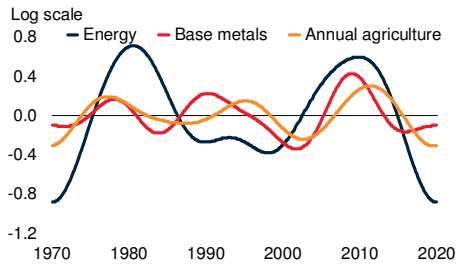
Second, the chapter finds that global macroeconomic shocks have been the main source of short-term commodity price volatility over the past 25 years—particularly for metals. Global demand shocks have accounted for 50 percent of the variance in global commodity prices, and global supply shocks accounted for 20 percent. In contrast, during 1970–96, supply shocks specific to particular commodity markets—such as the oil shocks of the 1970s—were the main source of variability in global commodity prices. These results suggest that developments specific to commodity markets may have played a diminishing role over time in driving commodity price volatility.

Third, using an event study, the chapter finds that the shock to commodity prices caused by the COVID-19 pandemic varied compared with previous recessions. The collapse in

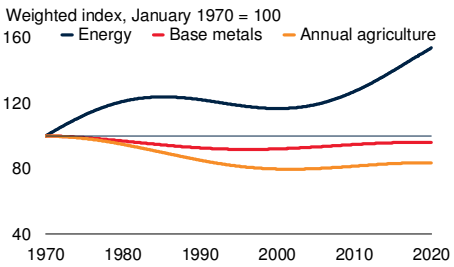
FIGURE 6 Evolution of commodity price cycles

Industrial commodity prices went through two large medium-term cycles in the 1970s and 2000s. Over the long term, energy prices are on an upward trend, and agricultural prices are on a downward trend. The response of industrial commodities to the recession triggered by COVID-19 has been larger than in previous recessions. Over time, the importance of global shocks for commodity prices has risen, while that of commodity-specific shocks has decreased.

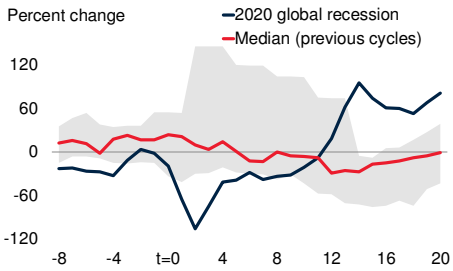
A. Medium term component, energy and metals



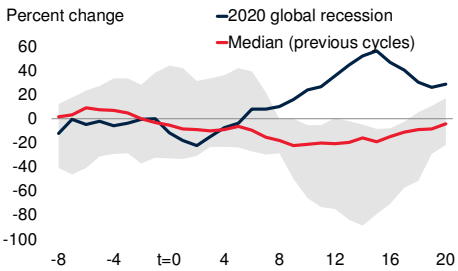
B. Permanent component, energy and metals



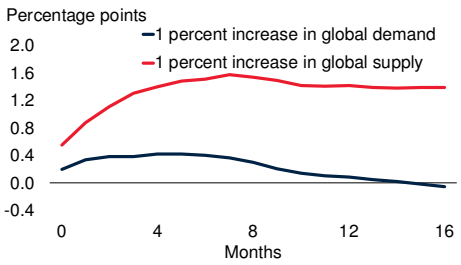
C. Energy



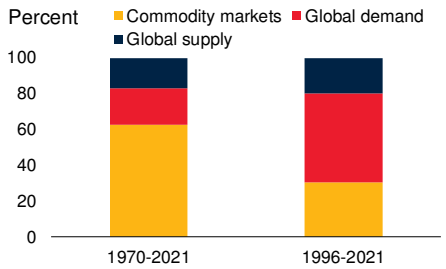
D. Base metals



E. Response of global commodity prices to 1 percent increase in global demand and supply



F. Drivers of global commodity price shocks



Sources: Baffes and Kabundi (2021); World Bank.

A.B. Charts show the medium-term cycle component (8-10 years frequency) and permanent component (above 20 years frequency) of the commodity price indexes. Decomposed using a frequency domain approach (see Baffes and Kabundi 2021 for more details).

C.D. The horizontal axis represent months, where t=0 denotes the peak of global industrial production before global recessions and downturns. The vertical axis measures the percent change in the commodity price series from a year earlier. The blue line shows the trajectory of the current commodity cycle around the COVID-19 recession, while the red line is the median of previous cycles around a global recession or downturn (Kose, Sugawara, and Terrones 2020). Gray shaded areas represent the range of observed values in previous cycles. Data from January 1970 to October 2021.

E. Cumulative median response of global commodity price growth to a 1 standard deviation (about 1 percent) increase in global demand and global supply.

F. Contribution of global demand, supply, and commodity market shocks to variance of month-on-month growth in commodity prices, based on samples covering 1970-2021 and 1996-2021.

energy prices in early 2020 was steeper than during any other global recession in the past five decades, and the subsequent recovery was likewise the steepest. For metals and agriculture, the fall in prices was not unusual by historical standards, but their recovery was much larger compared to recoveries from previous recessions.

Chapter 4: Causes and Consequences of Industrial Commodity Price Shocks

In chapter 4, Kabundi, Nagle, Ohnsorge, and Yamazaki build on the analysis in chapter 3 by focusing on shocks to the prices of energy and metals. The chapter examines the importance of energy and metals for the global economy and for EMDEs; it looks at the drivers of swings in energy and metals prices over the past seven decades, and it discusses the implications of such price swings for economic activity in EMDEs.

Contribution. While the literature on the impact of oil price shocks is extensive, the literature on the impact of metal price shocks is scarce. This chapter adds to the relevant literature in several ways. *First*, it compares the structure of global energy and metals markets, including the extent to which producers of energy and metal commodities rely on commodities for export and fiscal revenue and for overall economic activity. *Second*, through comparable estimates for multiple commodities, the chapter allows a cross-commodity comparison that previous studies have not offered. In particular, it illustrates how different market structures have different implications for the behavior and impact of individual commodity markets.

Third, the chapter joins a few recent econometric studies in cross-checking the identified drivers of swings in metal prices against historical narratives. The approach used expands on previous studies by using monthly data, adding aluminum and nickel to the sample, and explicitly comparing results for metal prices with those for oil prices in a consistent framework. *Fourth*, based on a local projections model, the chapter presents estimates of how output in metal exporters and importers responds to metal price shocks.

Main findings. The chapter offers several findings (figure 7). *First*, metal exporters are much less dependent on metal sectors than oil exporters are on oil sectors. Global metal production and consumption are considerably more concentrated geographically than oil production. China, in particular, is the single largest consumer and producer of all refined base metals. It accounts for roughly 50 percent of global consumption of metals, while it consumes just 15 percent of global crude oil output.

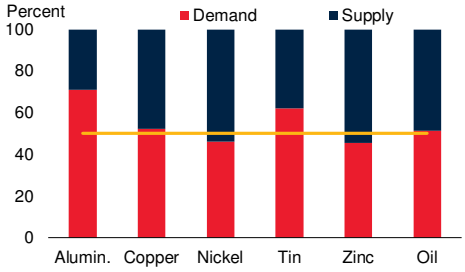
Second, except for nickel and zinc, demand shocks are the largest source of variability for almost all commodity prices, including oil. Collapses in demand during global recessions were the main drivers of sharp declines in energy and metal prices, and subsequent economic recoveries caused rebounds in commodity prices.

Third, both oil and metal price shocks appear to have asymmetric impacts on output growth in energy and metal exporters: Price increases have been associated with small, temporary accelerations in output growth; price declines have been associated with more

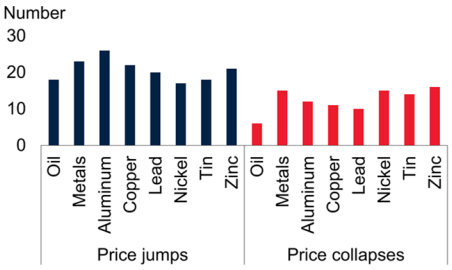
FIGURE 7 Causes and consequences of industrial commodity price shocks

Industrial commodity price shocks are common, driven by demand and supply shocks in almost equal measure (except for aluminum). Oil and metal price shocks have asymmetric effects on economic activity in energy and metal producers: price increases are associated with small, temporary growth accelerations; price collapses are associated with pronounced and lasting slowdowns.

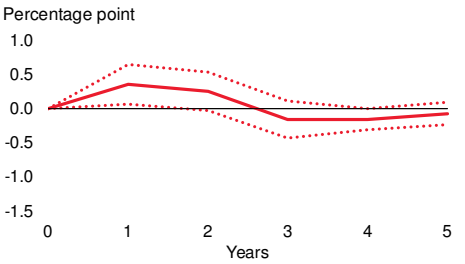
A. Forecast error variance decomposition of metal and oil prices



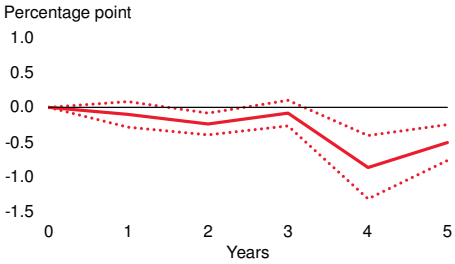
B. Number of large commodity price shocks



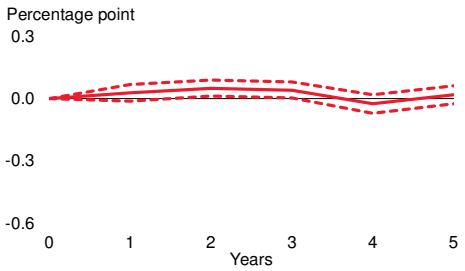
C. EMDE energy exporters: Impact of 10 percentage point higher oil price growth



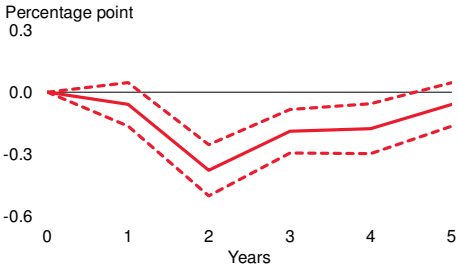
D. EMDE energy exporters: Impact of 10 percentage point lower oil price growth



E. EMDE metal exporters: Impact of 10 percentage point higher metal price growth



F. EMDE metal exporters: Impact of 10 percentage point lower metal price growth



Source: World Bank.

B. Large commodity price shocks are defined as price increases or decreases of one standard deviation over a six-month period.

C.-F. Cumulative impulse responses of output growth for 153 EMDEs, of which 34 are energy exporters and 28 are metal exporters, from a local projection estimation. Dependent variable is output growth after 10 percentage point change in oil or metal price growth. Solid lines are coefficient estimates and dotted lines are 95 percent confidence bands based on heteroscedasticity consistent standard errors and Driscoll-Kraay standard errors. Estimation accounts for asymmetric effects of price increases and price declines.

pronounced or longer-lasting growth slowdowns. Output growth among oil and copper exporters, in particular, declined significantly for several years following a fall in oil or copper prices. In contrast, there is no evidence of statistically significant output gains or losses in aluminum exporters after increases or decreases in prices. Among commodity importers, changes in metal or oil prices had negligible effects on output, reflecting the relatively low proportion of these industrial materials in the total inputs to their GDP.

Future research directions

The study suggests several avenues for further research.

Implication of the energy transition. The analysis in this book focuses on the main energy, metals, and agricultural commodities. However, the ongoing transition from fossil fuels to zero-carbon sources of energy will increasingly require the use of commodities such as rare earth and precious metals. Gaining a deeper knowledge of the structure of the respective markets (as is done for base metals in Chapter 4), as well as price behavior and drivers (along the lines of Chapter 3), will enhance our understanding of the energy transition in terms of resource requirements, substitutability among commodities, and price drivers.

Broadening the econometric analysis. Chapter 3 focused mostly on the business cycle component of prices. However, for some commodities, longer-term trends and super cycles account for a significant part of price behavior, while for others short-term price movements are important. Further research could analyze these components in greater detail; it could also examine the drivers of price movements as well as the correlation among prices at various time frequencies. Chapter 4 focuses on the sources and consequences of shocks to the prices of energy and metals. Future research could include agricultural commodities and fertilizers (an important input to the production of food). Results from such analysis, if complemented by the drivers of domestic food price inflation, would help shed light on the causes and consequences of food insecurity.

Deepening the policy discussion. The policy conclusions outlined in this volume reflect the implications of its analysis and econometric results. However, the policy issues relevant to commodity markets, especially for EMDEs, are complex, with far-reaching implications. Further research could focus on the relative importance of different policy frameworks for different types of commodity exporters to go beyond "one size fits all" recommendations. It could also investigate in more detail the potential for risk-sharing among commodity exporters—covering issues such as exchange rate management of commodity-exporting EMDEs; commodity price linked debt, energy subsidies, agricultural trade policies, and the role of sovereign wealth funds.

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