CHAPTER 3

The Nature and Drivers of Commodity Price Cycles

Alain Kabundi, Garima Vasishtha, and Hamza Zahid

Price cycles are regular occurrences in commodity markets, bringing with them major macroeconomic implications for both commodity exporters and importers. The impact of these cycles, however, depends significantly on whether they are transitory or permanent. This chapter investigates the features and drivers of commodity price cycles. Across commodities, transitory and permanent components are found to be equally important in explaining price cycles. At the group level, however, there are marked differences. The permanent component dominates agricultural prices, whereas the transitory component is more important for industrial commodity prices. Energy and metal prices generally move in line with global economic activity, and this tendency has strengthened in recent decades. Given the heterogeneity in the magnitude, duration, and drivers of price cycles, appropriate policy responses will depend on the specific terms-of-trade faced by each country and their export and import commodity mix.

Introduction

The recent commodity price upswing has once again brought to the fore the vulnerability of emerging market and developing economies (EMDEs) to large fluctuations in commodity prices. Such price fluctuations are common across commodity groups (figure 3.1). Macroeconomic performance in commodity exporters has historically varied closely in line with commodity price cycles. This is especially true for EMDEs that rely on a rather narrow set of commodities.

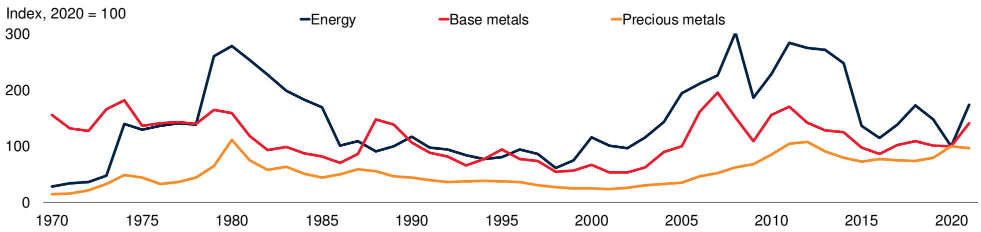
For policy makers, formulating the appropriate policy response depends on whether commodity price changes are expected to be permanent or temporary. To the extent that commodity price movements are temporary, they can be looked through, or smoothed by fiscal and monetary policies. For longer-lasting price shifts, however, structural changes may be needed. Understanding what is behind commodity price cycles is also critical for policy makers in both commodity exporters and importers. For example, the likely impact of commodity price movements and the appropriate policy response depend heavily on whether they were driven by global factors or commodity-specific factors, as well as whether they are predominantly demand- or supply-driven.

Shocks to commodity markets can have both permanent and transitory effects. Shocks with a transitory impact can originate from recessions, such as the 2007-09 global financial crisis and the 1997-98 Asian financial crisis (both of which impacted a wide range of commodities); trade tensions (such as in 2018-19 and of special relevance to metals and soybeans); and the bans on grain exports during 2007 and 2011 (World Bank 2018). They can also arise from adverse weather conditions, most common to agriculture, such as El Niño and La Niña episodes or drought-related production

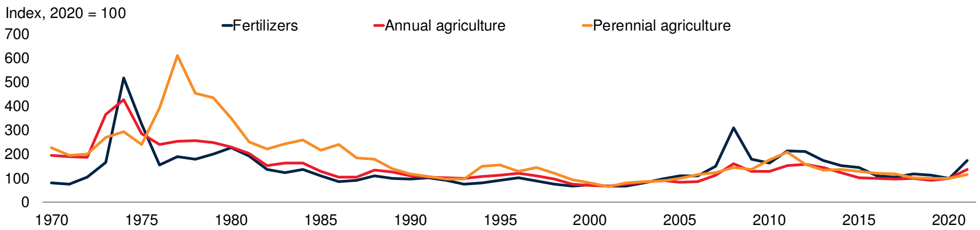
FIGURE 3.1 Real commodity price indexes

Price shocks and price cycles are regular occurrences in commodity markets. Movements in global commodity prices have often been associated with global business cycles as well as developments specific to commodity markets.

A. Energy and metals



B. Agriculture and fertilizers



Source: World Bank.
Note: Indexes have been deflated by the U.S. CPI. Last observation is 2021.

shortfalls (such as for grains in 1995 and coffee in 1975 and 1985). Transitory shocks can also result from accidents (for example, the 2019 Vale accident in Brazil, which disrupted iron ore supplies); conflicts (for example, the first Gulf War, when Iraq/Kuwait oil production was halted); and terrorist attacks (for example, the attack on Saudi oil facilities in 2019, which halted oil exports temporarily) (World Bank 2019).

Shocks with a permanent impact can arise from technological changes. For example, the emergence of shale technology in the natural gas and oil industries rendered the United States a net energy exporter in 2019 for the first time since 1952 (EIA 2020). The biotechnology shock of the 1990s increased crop productivity by more than 20 percent (Klümper and Qaim 2014). Policy shocks can also have long-lasting impacts on commodity prices. Examples include government efforts to encourage biofuel production, which caused global land use to shift from food to biofuel production (Rulli et al. 2016); interventions in agricultural markets by most OECD countries, which have been shown to exert long-term downward pressures on food prices (Aksoy and Beghin 2004); and OPEC's decisions to manage oil supplies (Kaufmann et al. 2004).

Shocks, especially those related to energy markets, often trigger additional shocks. For example, the COVID-19 oil demand shock, which caused an estimated 10 percent decline in oil consumption during 2020, triggered a policy-driven supply shock of similar magnitude by the OPEC-plus group when it cut oil production by 9.7 mb/d in

April 2020. The oil price increases of the mid-2000s (driven by EMDE demand, OPEC supply cuts, and geopolitical concerns) rendered shale technology profitable, pushed up the costs of food production, and triggered biofuel policies. Following the oil price collapse of 2014, food production costs declined, but production of shale (through innovation and cost reduction) and biofuels (diverted from food commodities) appear to have a permanent character.

Against this backdrop, this chapter investigates the behavior of commodity price cycles, their duration, and their main drivers. Specifically, it answers the following questions:

- How large are the transitory and permanent components of commodity price cycles?
- What have been the main drivers of common cycles in commodity prices?

This chapter adds to the literature in two important 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- and medium-term cycles, in line with the macroeconomic literature. Specifically, it separates the transitory component into two parts: (i) the traditional 2-to-8-year cycle, which is associated with economic activity; and (ii) the medium-term cycle with a duration of 8 to 20 years. The first has been studied extensively in the macroeconomic literature and, in the case of commodities, for metals markets, while the second has only recently begun to receive significant attention in the literature.[1]

Second, using a cutting-edge econometric approach, this chapter examines both global and commodity-specific cycles for a large number of commodities as well as their underlying drivers. This contrasts with earlier literature that either focuses on a small set of commodities (examining commodity demand and supply rather than aggregate demand and supply) or simply documents the existence of comovement 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 the price recoveries following past recessions and slowdowns.

Main findings. This chapter offers three main findings.

First, the permanent component accounts for 47 percent of commodity price variability, on average, across all commodities. The remainder is accounted for by the transitory component: the medium-term and business cycle components account for 33 percent and 17 percent, respectively, while short-term fluctuations account for only 4 percent of commodity price variability. These shares, however, mask heterogeneity. The permanent

[1] For short-term cycles, see Davutyan and Roberts (1994); Labys, Lesourd, and Badillo (1998); and Roberts (2009). For medium-term cycles, see Marañon and Kumral (2019); McGregor, Spinola, and Verspagen (2018); and Ojeda-Joya, Jaulin-Mendez, and Bustos-Pelaez (2019).

component dominates for agricultural commodity prices while the transitory component is more relevant for industrial commodities. This is consistent with studies that find business- and investment-driven cycles more important for industrial commodities (Marañon and Kumral 2019; Roberts 2009).

Second, the analysis identifies three medium-term cycles: the first (from the early 1970s to mid-1980s) and the third (from the early 2000s to 2020 onward) exhibit similar duration and involve all commodities, while the smaller second cycle (spanning the 1990s) is mostly applicable to metals and (less so) agricultural commodities. The permanent component differs across commodities as well, with an upward trend for most industrial commodities and downward trend for agricultural commodities. Commodities subjected to policy interventions exhibit persistent price deviations from their respective linear trends. Non-linearities in the permanent component, which coincide with the two post-World War II supercycles, are dominant in prices of commodities where investment is irreversible such as energy, metals, and tree crops, but not in prices of annual agricultural crops where there is greater flexibility on investment allocation and input use.[2]

Third, the chapter finds that when considering cyclical and shorter-run movements, global macroeconomic shocks have been the main source of 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 for 20 percent. In contrast, during 1970-96, supply shocks specific to particular commodity markets—such as the 1970s and 1980s oil price shocks—were the main source of variability in global commodity prices. These results suggest that the role played by developments specific to commodity markets in driving commodity price volatility may have diminished over time.

The chapter proceeds as follows. The first section examines the key features of commodity price cycles, including decomposing cycles into their transitory and permanent components. The second section looks at the main drivers of commodity price cycles. Box 3.1 provides an analysis of previous commodity price cycles for six major commodities: crude oil, coal, aluminum, copper, maize, and coffee. Box 3.2 estimates the comovement between commodity prices and compares the COVID-19-driven fall and recovery in commodity prices with previous recessions.

Explaining commodity price variability: Transitory versus permanent components[3]

Data and methodology: To decompose commodity price movements into transitory and permanent components, a novel frequency domain approach is used that has thus

[2] Annual agricultural commodities, often termed crop commodities, are produced on an annual basis, and as such, land (and other factors of production) can change each crop year, depending on demand and supply conditions. They include cotton, maize, rice, soybeans, and wheat.

[3] This section draws heavily on World Bank (2020a).

BOX 3.1 Evolution of commodity cycles

Since 1970, slumps in the prices of industrial commodities have been associated mainly with declines in global economic growth, geopolitical events affecting supply, and the emergence of new producers. In contrast, slumps in the prices of agricultural commodities have been associated mostly with commodity-specific supply and policy shocks and less so with aggregate demand shocks. This box summarizes how various shocks affected the prices of two energy commodities (oil and coal), two base metals (aluminum and copper), and two agricultural commodities (coffee and maize).

Introduction

To illustrate commodity price cycles, six major commodities are examined in detail—coal, crude oil, aluminum, copper, coffee, and maize. These commodities are the most traded in their respective commodity groups. Price booms and slumps are identified for each commodity using standard techniques to date business cycles (World Bank 2022).[a] A boom for each commodity is defined as a trough-to-peak rise in commodity prices and a slump as a peak-to-trough decline. Price troughs and their causes are the focus of this box.

Coal

Coal prices have gone through eight troughs since 1970. The troughs can mainly be attributed to global recessions and slowdowns, policy-driven changes in China's growth model, and the emergence of new producers.

Global recessions. The global financial crisis of 2007-09 and the resulting global recession led to a sharp fall in coal prices. Prices bounced back rapidly in 2010-11 as the global economy recovered, with China driving the increase in demand. In 2020, the COVID-19 pandemic and the associated global recession caused a drop in demand for coal, with its price falling by nearly 30 percent between January and August. While demand subsequently rebounded in 2021 alongside the economic recovery, production was slower to recover, with weather events, including flooding in China and Indonesia, causing disruptions (World Bank 2021).

Policy-driven changes in China's growth model. The coal market changed significantly in the 2000s as rapid economic growth in China led to a surge in demand for coal, both for power generation and for metallurgical uses. To meet the surging demand, China rapidly increased its domestic production as well as its imports of coal. These developments slowed and went into reverse in the 2010s, as China's growth moderated and government policy shifted from a focus on

a. Specifically, the procedure applied is a widely used algorithm for dating business cycles, and largely follows Harding and Pagan (2002) and Cashin, McDermott, and Scott (2002).

BOX 3.1 Evolution of commodity cycles *(continued)*

investment and manufacturing toward less energy-intensive consumption and services. This contributed to a steady decline in prices from 2011-15, with prices reaching a trough by end-2015.

Emergence of new producers. After increasing steadily through the 1970s, real coal prices declined through much of the 1980s and 1990s. The fall in prices through the 1980s in part reflected the emergence of additional coal producers, particularly China and Indonesia. By the 1990s, China had overtaken the United States as the world's largest coal producer, and by 2020, China accounted for about 50 percent of global coal production.

Crude oil

Oil prices (represented by the unweighted average of Brent, Dubai, and West Texas Intermediate prices, in real terms) have experienced eleven troughs since 1970 (figure B3.1.1). The troughs were associated primarily with global recessions and Organization of the Petroleum Exporting Countries (OPEC)'s decisions/agreements.

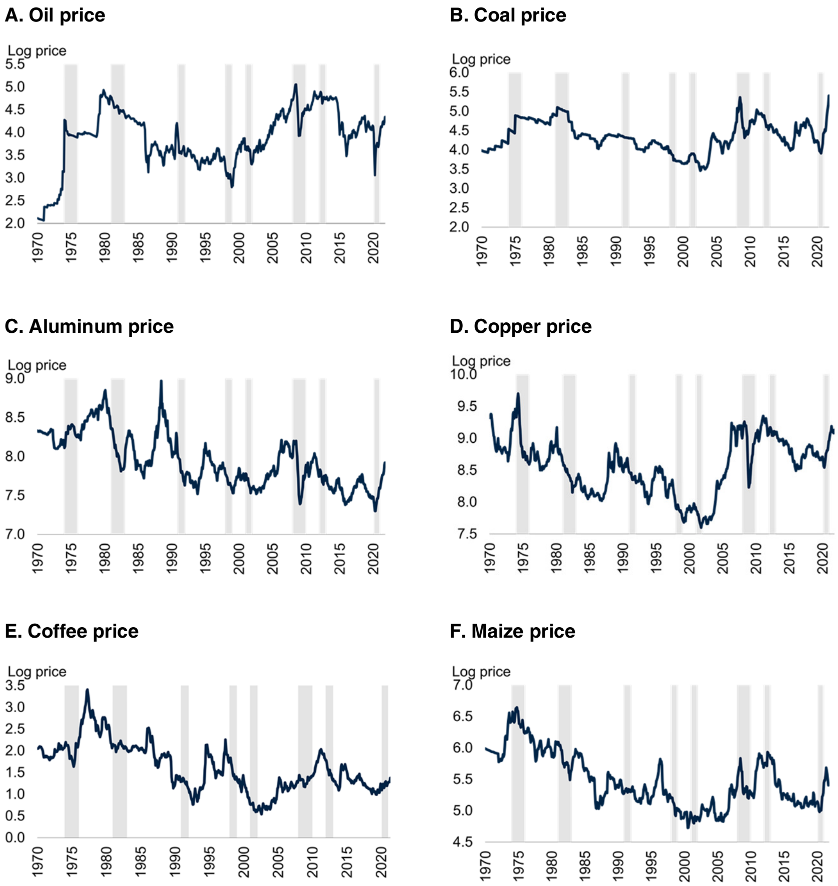
Global recessions. Four of the identified troughs (1975, 1998, 2001, 2020) in oil prices were associated with global recessions or slowdowns. The global recession and oil price slump of 1975 followed the shock to world oil prices from the OPEC price hike and the Arab oil embargo initiated in October 1973 (chapter 1). The sharp decline in oil prices in 1998 was associated mostly with weakening global demand stemming partly from the 1997-98 Asian financial crisis, although continued expansion of OPEC production until mid-1998 may have been another contributing factor (Fattouh 2007). The trough in oil prices in 2001 was triggered by weakening global growth following the bursting of the dot.com bubble, exacerbated by the disruptions and uncertainty set off by the September 11 terrorist attacks in the United States (Baffes et al. 2015; World Bank 2015a). The most recent trough, in April 2020, followed the steepest price collapse on record. Global oil demand dropped due to the deepest global recession since World War II as well as widespread COVID-19-related restrictions on transport and travel, which account for about two-thirds of global oil demand (Kabundi and Ohnsorge 2020; Wheeler et al. 2020).

OPEC decisions/agreements. The oil price slump in 1986 can mostly be attributed to changing supply conditions as OPEC reverted to a production target of 30 million barrels per day after cutting production significantly in the early 1980s (Baffes et al. 2015; World Bank 2015a). Real oil prices dropped by almost 60 percent from January to July 1986, followed by a two-decade-long period of low oil prices. Likewise, the slide in oil prices after 2014 was triggered by a change in OPEC's policy objective, from price targeting to preserving market share.

BOX 3.1 Evolution of commodity cycles *(continued)*

FIGURE B3.1.1 Commodity prices and global recessions

Price troughs are common among major commodities. Crude oil prices have experienced 11 troughs since 1970, aluminum 10, and coal and copper each experienced 8. These troughs have typically been associated with global recessions, although several commodity-specific factors have also played a role. Maize prices experienced 9 troughs and coffee 10. The latter is somewhat less correlated with global recessions, with price swings more closely tied to policy and supply factors.



Sources: Federal Reserve Economic Data (St Louis Fed); World Bank.
Note: Real price of commodities in logs. Shaded areas indicate global recessions as in Kose, Sugawara, and Terrones (2020) and the global recession of 2020. Data from January 1970 to October 2021.

BOX 3.1 Evolution of commodity cycles *(continued)*

Muted demand and rising oil supply from non-OPEC producers, including U.S. shale oil, Canadian oil sands, and biofuels also contributed to the decline in prices at this time.

Geopolitical events. Major spikes in oil prices have been associated with geopolitical events affecting supply. For instance, during the 1973 Yom-Kippur War, OPEC members cut production, and Arab suppliers imposed an oil embargo against Canada, Japan, the Netherlands, the United Kingdom, and the United States. Average real oil prices in 1974 were more than four times their 1973 level. Subsequent disruptions in oil supplies following the war between Iraq and the Islamic Republic of Iran, and the Iranian revolution caused oil prices to more than double in 1979.

Aluminum

Aluminum prices saw ten troughs since 1970. Price cycles for major industrial metals like aluminum, copper, lead, and zinc generally follow global economic cycles since their demand is closely related to global economic activity, particularly industrial production (chapter 2). These metals are used in a wide range of applications, with changes in usage and related demand occurring only slowly over time. The troughs in real aluminum prices have also been associated with the emergence of new producers and consumers.

Global recessions. Three of the identified troughs in aluminum prices (1982, 2009, 2020) were associated with global recessions. In addition, the global slowdown associated with the 1997-98 Asian financial crisis was accompanied by a sharp decline in aluminum prices. The most recent trough, in April 2020, was associated with the pandemic-related recession, with real aluminum prices falling to their lowest level in over half a century. Prices have since rebounded with the global economic recovery.

Emergence of new producers. In the early 1970s, aluminum production was highly concentrated in a few countries, notably the United States, the former Soviet Union, and Japan. Since then, major shifts have occurred in the geographic location of production with the arrival of new private producers and conglomerates of state-owned enterprises. The collapse in prices in the early 1990s was caused by the breakup of the Soviet Union: countries that had been members of the bloc began participating in the global aluminum market, which resulted in a large increase in supply, especially from the Russian Federation. At the same time, demand for aluminum in these economies declined, adding additional downward pressure. In the 2000s, China emerged as the world's largest aluminum producer, accounting for more than half of global production by 2020 compared to just 1 percent in 1970.

BOX 3.1 Evolution of commodity cycles *(continued)*

Emergence of new sources of demand. Since 2000, the intensity of aluminum use in global GDP has risen, reflecting strong demand from EMDEs, especially China. Between 2000 and 2010, China's consumption of aluminum as a share of global consumption increased threefold. Aluminum consumption has also been driven by its increasing use as a substitute for other metals such as copper in power transmission and steel in the manufacture of automobiles.

Copper

Copper prices experienced eight troughs since 1970. The troughs have been associated with global recessions or slowdowns, technological innovations, shifts in demand away from copper to other materials for some uses, and the emergence of new producers. Additionally, U.S.-China trade tensions contributed to a steep decline in prices in the second half of 2018.

Global recessions. The price troughs of 1999 and 2001 stemmed, respectively, from the global recession associated with the Asian financial crisis and the global slowdown of 2001. Similarly, copper prices fell sharply during (and in some cases after) the global recessions of 1982, 1992, and 2020.

Technological innovations. During the 1980s and 1990s, technological innovations reduced costs of copper production. An important breakthrough was the development of the solvent extraction and electrowinning technology, which extracted copper through dissolution and subsequent electrolysis instead of mining. By 1995, this process accounted for 27 percent of U.S. primary copper output, up from 6 percent in 1980 (Radetzki 2009).

Shifting demand. Over the past half century, copper demand has been dampened by substitutions toward aluminum, plastics, and glass fiber. Aluminum has been the predominant substitute, gaining substantial market share and suppressing copper's relative price (Radetzki 2009).

Emergence of new producers. After a decade of largely stagnant mine production, the discovery of new supply sources and new technologies that reduced processing costs played an important role in driving down copper prices from 2011 to 2015. During this period mine supply grew strongly, particularly in the Democratic Republic of Congo, Kazakhstan, Peru, and Zambia.

Coffee

There have been ten troughs for coffee (Arabica) prices since 1970. The troughs were associated mostly with weather-related supply shocks and the emergence of new producers. In contrast to the industrial commodities, the troughs had little

BOX 3.1 Evolution of commodity cycles *(continued)*

correlation with global recessions. The pre-pandemic trough in 2019 was largely caused by overproduction in Brazil, the world's largest coffee producer.

Weather. Following historically low levels in the early 1970s, real coffee (Arabica) prices tripled during 1975-77 and reached a record high in April 1977, following a major frost in Brazil (Akiyama and Varangis 1990). As supplies recovered and producing countries failed to extend the International Coffee Agreement, real coffee prices declined, reaching a trough in late 1992. The agreement operated an export-quota system, which was first implemented in 1963, and continued intermittently until 1989. In 2016, the end of a drought supported the coffee harvest in Brazil and resulted in a trough in coffee prices. More recently, a drought hit Brazil in 2021, which once again pushed coffee prices sharply higher (World Bank 2021).

New producer. When adverse weather events in 1994 (frost in Brazil) and 1997 (El Niño in Peru) led to a spike in coffee prices, a new entrant was drawn to the coffee market—Vietnam. Vietnam's emergence as a major Robusta coffee producer not only pushed prices lower, but it also altered the landscape of the global coffee market for the long term: the country now accounts for nearly 20 percent of global coffee supplies, up from less than 0.1 percent in 1980.

Maize

Maize prices have had nine troughs since 1970. These were associated mostly with commodity-specific supply and policy shocks and less so with aggregate demand shocks, although at times prices were affected by multiple shocks.

Global recessions. Two troughs occurred around global recessions. In both instances, supply side factors also played a major role. After peaking in 1974, maize prices trended downward for several years, reaching a trough in late 1977. During the 2000s, maize prices followed a pattern similar to other commodity prices: sharp increases during the 2000s leading to a mid-2008 peak, followed by a sharp decline during the global financial crisis.

Technology and policy shocks. Maize prices saw a prolonged downward trend between 1974-1987, due to a combination of productivity improvements, falling energy prices, and policy measures (mainly domestic support and export subsidies by OECD countries). The diversion of maize to the production of biofuels was a key reason behind the price boom in the 2000s (Tyner 2008). The U.S. Energy Policy Act of 2005 mandated strict biofuel requirements in the fuel energy mix, which meant as much as one-third of U.S. maize supplies were diverted to the production of biofuels. However, the mandate made the price of maize more

BOX 3.1 Evolution of commodity cycles *(continued)*

closely linked with that of crude oil, and the sharp fall in crude oil prices from 2014 consequently spilled over to maize prices.

Weather shocks. A drought contributed to a price boom during the mid-1990s, with prices peaking in June 1996. This was exacerbated by reduced harvests during the transition of the former Soviet Union and policy changes in the European Union (McCalla 1999). As inventories were replenished, prices began falling again, with prices reaching a trough in August 2000 (exacerbated by the Asian financial crisis). In 2012, the United States experienced its worst drought since 1950, sharply reducing U.S. maize production and contributing to U.S. corn export prices rising to their highest level since the 1980s (Adonizio, Kook, and Royales 2012; World Bank 2013). However, as weather conditions eased, the United States saw a bumper crop in 2013, triggering a sharp fall in prices and a prolonged period of low and stable prices.

New producers. In contrast to other commodities, production of maize has been dominated by a single producer since the 1970s—the United States. The U.S. accounted for between 30-40 percent of global production over this period, and its output continues to grow steadily due to productivity improvements. However, other major producers have emerged. China's production tripled between 1970-90, increasing its share of global output from 12 to 20 percent. Between 2000-2020, Brazil and Argentina saw increases in their share of global production, from 7 to 9 percent and 3 to 5 percent, respectively.

far mostly been applied to business cycles (Corbae and Ouliaris 2006; Corbae, Ouliaris, and Phillips 2002). The analysis rests on monthly data for 27 commodity price series over the period 1970-2019. It includes 3 energy prices, 6 base metal and 3 precious metal prices, 11 agricultural commodity prices (separated into annual and perennial crops), and 4 fertilizer prices (annex 3A).[4]

The transitory component consists of three components—short-term fluctuations (that unwind in less than 2 years); traditional business cycles with a frequency of 2-8 years, which are typically associated with economic activity (Burns and Mitchell 1946); and

[4] The commodity prices analyzed in this chapter were selected by excluding commodities that are close substitutes (for example, selecting only one edible oil), that are no longer economically important (for example, hides and skins), or their prices are not determined at an exchange (for example, bananas). A few studies that have used both individual commodity price series and indexes used data obtained directly from the International Monetary Fund or World Bank commodity price databases without applying selection criteria (for example, Erten and Ocampo 2013; Jacks 2019; and Ojeda-Joya, Jaulin-Mendez, and Bustos-Pelaez 2019).

medium-term cycles with periodicity of 8-20 years, which are often associated with long-term investment trends (Slade 1982). The permanent component captures movements with periodicity of more than 20 years—consistent with supercycles (Cuddington and Jerrett 2008).

The permanent and transitory components account for roughly equal shares. On average across commodities, the permanent component accounted for 47 percent of price variability. Of the remainder (that is, the transitory component), medium-term cycles accounted for 32 percent of price variability and business cycles for 17 percent. Only a small portion (4 percent) of the price variability is due to the short-term component that is unwound in less than two years. The large role of the permanent component is in line with the findings of research on commodity price supercycles (Erten and Ocampo 2013; Fernández, Schmitt-Grohé, and Uribe 2020). Furthermore, the predominance of the medium-term cycle in the transitory component is in line with recent research that finds a greater role of medium-term cycles than shorter business cycles in output fluctuations or domestic financial cycles (Aldasoro et al. 2020; Cao and L'Huillier 2018).

These averages mask heterogeneity across commodities. The transitory components were more relevant to the variation in prices of industrial commodities, while the permanent component mattered most for agricultural commodity price movements (figure 3.2). For agricultural commodities, the permanent component accounted for two-thirds of price variability, for metals (including base and precious) it accounted for about 45 percent, while for energy it accounted for less than 30 percent. Precious metals exhibited the largest heterogeneity as a group, with gold prices seeing a larger share accounted for by the permanent component, silver having an equal share accounted for by permanent and transitory components, and platinum exhibiting one of the highest shares of medium-term cyclicality.

The composition of the transitory component differed across commodities. The medium-term component accounted for 55 and 27 percent of price variability in energy and metals, respectively, and only 14 percent for agriculture. In contrast, business cycles accounted for 24 percent of price variability for metals. This greater contribution of the business cycle to metal commodity price fluctuations is in line with the strong response of metal consumption to economic activity (chapter 2; Baffes, Kabundi, and Nagle 2022). Indeed, metal prices, especially copper, are often considered leading indicators of global economic activity (Bernanke 2016; Hamilton 2015). Some of the commodities that had the highest contribution of the transitory component to price variability are used mainly in the transport sector. For example, nearly two-thirds of crude oil is used for transportation, three-quarters of natural rubber goes to tire manufacturing, and half of platinum is used to produce catalytic converters (World Bank 2020b).

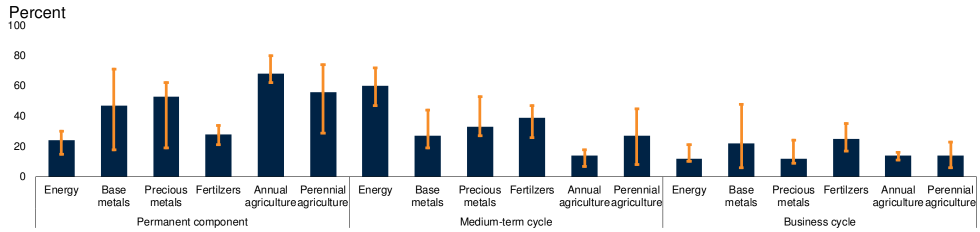
How have the transitory and permanent components evolved?

Almost all commodities have undergone three medium-term cycles since 1970 (figure 3.3). The first medium-term cycle, which involved all commodities, began in the early

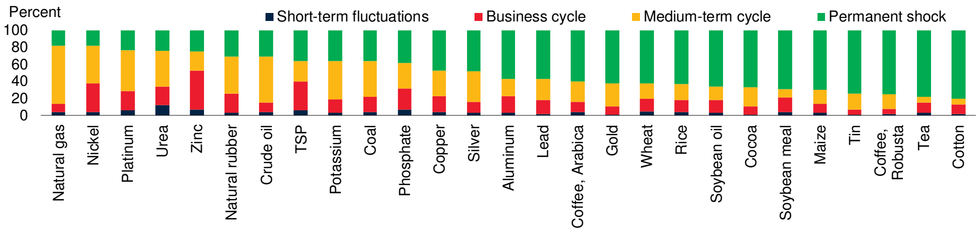
FIGURE 3.2 Commodity price decomposition

Across commodities, transitory and permanent shocks are found to be equally important in explaining commodity price cycles. At a group level, however, there is a marked difference. Agricultural prices are dominated by permanent shocks while industrial commodities are influenced mostly by transitory shocks.

A. Contribution of shocks, 1970-2019



B. Price decomposition, individual commodities, 1970-2020



Sources: Baffes and Kabundi (2021); World Bank.
A. Blue bars and orange whiskers denote weighted averages and ranges of each group.

1970s, peaked in 1978, and lasted until the mid-1980s. The second, which peaked in 1994, was most pronounced in base metals and agriculture (with similar duration and amplitude to the first cycle) but did not include energy commodities. The third cycle, which again involved all commodities, began in the early 2000s, peaked in 2010, and for some commodities is still underway.

Crude oil's "missing cycle" reflected offsetting oil-specific shocks. Of the 27 commodities, crude oil and natural gas (whose price is highly correlated with oil) are the only commodities that had two, instead of three, medium-term cycles. During the period spanning the second medium-term cycle, the oil market saw three shocks:

- *Unconventional and offshore oil.* New production from unconventional sources of oil came into the market (North Sea, Gulf of Mexico, and Alaska). This was a result of innovation and investment in response to the high prices during the 1970s and early 1980s, partly caused by OPEC supply restrictions (chapter 1; World Bank 2020b).[5]

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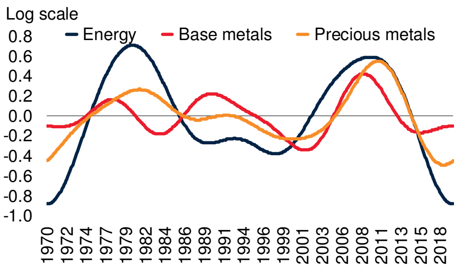
[5] The three unconventional sources of oil—U.S. shale oil, Canadian oil sands, and biofuels—are also associated with the third medium-term cycle (Baffes et al. 2015). In the first and third medium-term cycles, these unconventional sources of oil account for about 10 percent of global oil supplies (measured at the end of the cycle).

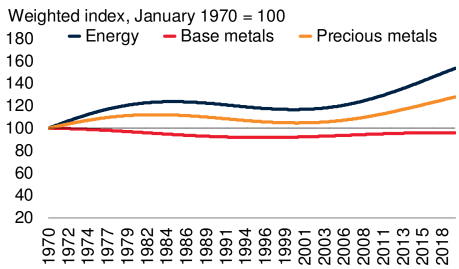
FIGURE 3.3 Contributions of global shocks to commodity prices

Almost all commodities have undergone three medium-term cycles since 1970, with the exception of energy. Energy did not have a second cycle as a result of offsetting shocks specific to the crude oil market. The evolution of the permanent component differed markedly across commodity groups. For energy commodities, the permanent component of prices has trended upward, for agricultural and fertilizer prices downward, and for most base metals it has been largely trendless.

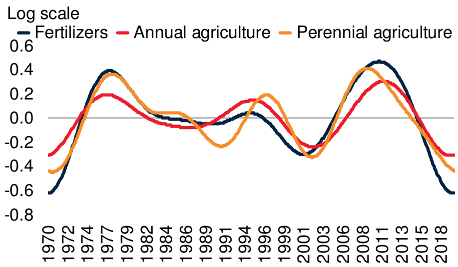
A. Medium-term component—energy and metals



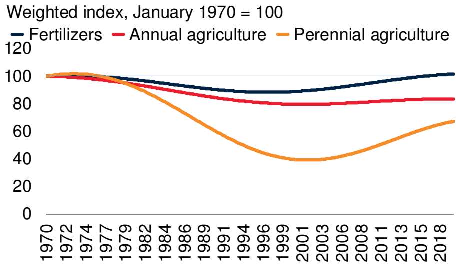
B. Permanent component—energy and metals



C. Medium-term component—agriculture and fertilizer



D. Permanent component—agriculture and fertilizer



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

Note: Charts show the medium-term and permanent component of the commodity price indexes, decomposed using a frequency domain approach (see Baffes and Kabundi 2021 for more details). The medium-term component refers to price dynamics with a frequency of 8-20 years, while the permanent component covers price movements of greater than 20 years.

C.D. Annual agricultural commodities are produced on an annual basis, which means land usage (and other factors of production) can change each crop year, depending on demand and supply conditions. Annual crops include cotton, maize, rice, soybeans, and wheat. Perennial agricultural commodities include cocoa, coffee Arabica, coffee Robusta, natural rubber, and tea.

- *New spare capacity from the former Soviet Union.* Considerable spare capacity became available in the global oil market following the collapse of the Soviet Union. Prior to its collapse, the Soviet economy featured both inefficient production and energy-intensive consumption (World Bank 2009).

- *Substitution and demand contraction.* In response to the high oil prices during the late 1970s and early 1980s, energy for electricity generation began to shift from oil to other energy sources (especially coal and nuclear energy). Policy-mandated efficiency standards in many OECD countries lowered global demand for energy (Baffes, Kabundi, and Nagle 2022).

BOX 3.2 Commodity price comovement and the impact of COVID-19

Commodity prices frequently move in tandem, especially during periods of major economic upheaval. Considering all commodity prices, there is evidence of a global common factor that has become increasingly important over time. The COVID-19-driven global recession of 2020 is the latest example of a common global shock to commodity markets. When compared with previous recessions, the rebound in prices in 2020-21 was faster and steeper for almost all major commodity groups. This reflected the extraordinarily strong economic rebound from the pandemic-induced global recession, along with difficulties in quickly restoring commodity supply.

Introduction

Commodity prices have historically seen periods of comovement and have become increasingly synchronized over time (World Bank 2022). They share common drivers, such as global economic activity, and so tend to be positively correlated with global business cycles. Furthermore, several sets of commodities are close substitutes in demand, and so demand surges or supply disruptions in one commodity market affect the prices of similar commodities. For annual agriculture commodities, prices may be synchronized because of the substitutability of inputs to production, including land, labor, and machinery. Energy is a key input in the production of some metals (such as aluminum) and an important cost component for most grains and oilseed crops. Thus, increases in energy prices will tend to put upward pressure on the costs of production (and hence the prices) of these commodities (Baffes 2007).

The COVID-19 pandemic and subsequent economic recession is the latest common global shock to affect commodity markets. Against this background, this box first empirically assesses how closely commodity prices comove and the role played by global factors in driving this comovement. It then conducts an event study to compare how commodity prices behaved during the COVID-19 pandemic with previous global recessions and recoveries. Specifically, it answers the following questions:

- How has commodity price comovement evolved over the past five decades?
- How does the recent recovery in commodity prices compare with such episodes after previous global recessions and downturns?

Global commodity price comovement

Data and methodology. Global commodity prices are defined as the common factor among 39 monthly commodity prices, estimated from a dynamic factor

BOX 3.2 Commodity price comovement and the impact of COVID-19 *(continued)*

model as in Kose, Otrok, and Whiteman (2003).[a] The commodity price data are obtained from the World Bank Commodities Price Data (the *Pink Sheet*), which covers more than 70 commodity prices and indexes. The prices, which are reported in nominal U.S. dollar terms, were deflated with the U.S. Consumer Price Index (CPI) (taken from the St. Louis Federal Reserve Bank). Series that are either averages or close substitutes of other series are excluded to avoid introducing price comovement by construction. This leaves 39 commodity prices. The resulting common factor is a standardized (demeaned with unit standard deviation) representation of global commodity price growth.

Main components of global commodity prices. The global factor has played an important role in driving fluctuations in industrial commodity prices (figure B3.2.1). During 1970-2021, it accounted for 18 percent of the variation in energy prices, on average, and 22-37 percent of the variation in the prices of base metals, rubber (used in tires and tubes), and platinum (used in catalytic converters). It accounted for only 2-14 percent of the variation in agricultural commodity prices (excluding natural rubber), precious metal, and fertilizer prices. The larger contribution of the global factor in explaining the variation in industrial commodity prices reflects the strong response of metal and energy consumption to industrial activity. This is in contrast to agriculture where supply shocks (primarily driven by weather conditions and policies) dwarf demand shocks.

Main components of commodity prices over time. In recent decades, the contribution of the global factor to industrial commodity prices has increased considerably: it doubled for energy prices and nearly doubled for base metal and platinum prices during 1996-2021 compared to the entire data period studied, which spans 1970-2021. This increased comovement in global commodity prices from the mid-1990s was part of a broader trend toward greater comovement in macroeconomic variables such as inflation and output (Eickmeier and Kühnlenz 2018; Ha, Kose, and Ohnsorge 2019). Trade liberalization and expanding use of financial instruments for commodity market trading have also contributed to the increased synchronization of commodity prices.

Recent commodity price movements compared with historical experience

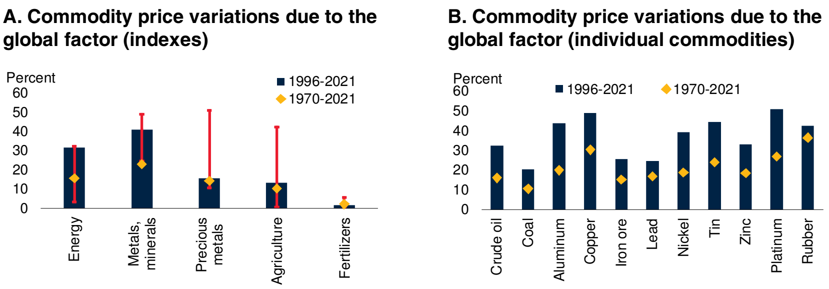
Event study. An event study is used to compare the behavior of commodity prices during the 2020 global recession with price movements around global recessions and slowdowns over the past 50 years.[b] For brevity, the results are presented for

a. A number of other studies use a similar framework to examine determinants of commonalities in commodity prices (for example, Byrne, Fazio, and Fiess 2013; Lombardi, Osbat, and Schnatz 2010; Poncela, Senra, and Sierra 2014; and Vansteenkiste 2009). However, they focus on a subset of commodities.

BOX 3.2 Commodity price comovement and the impact of COVID-19 *(continued)*

FIGURE B3.2.1 Global commodity prices

Movements in global commodity prices have often been associated with global business cycles as well as developments specific to commodity markets. Industrial commodity prices, such as energy and metals and minerals, have been largely driven by global commodity price movements. Industrial commodity prices have become more synchronized since the mid-1990s.



Sources: Baumeister and Hamilton (2019); Ha, Kose, and Ohnsorge (2021); World Bank.
A.B. Share of variation in month-on-month growth of 39 commodity prices (3 energy commodities, 7 metal and mineral commodities, 3 precious metals, 5 fertilizers, and 21 agricultural commodities) accounted for by the global factor and derived from a one-factor dynamic factor model as in Kose, Otrok, and Whiteman (2003). Bars show consumption-weighted averages. Whiskers indicate range from minimum to maximum during 1996-2021 (A).

three major World Bank commodity indexes—energy, metals, and agriculture. During the 2020 global recession, the troughs in commodity prices generally coincided with those in global economic activity. This is in sharp contrast with previous, more prolonged recessions, where commodity prices continued to decline for several months after the trough in economic activity.

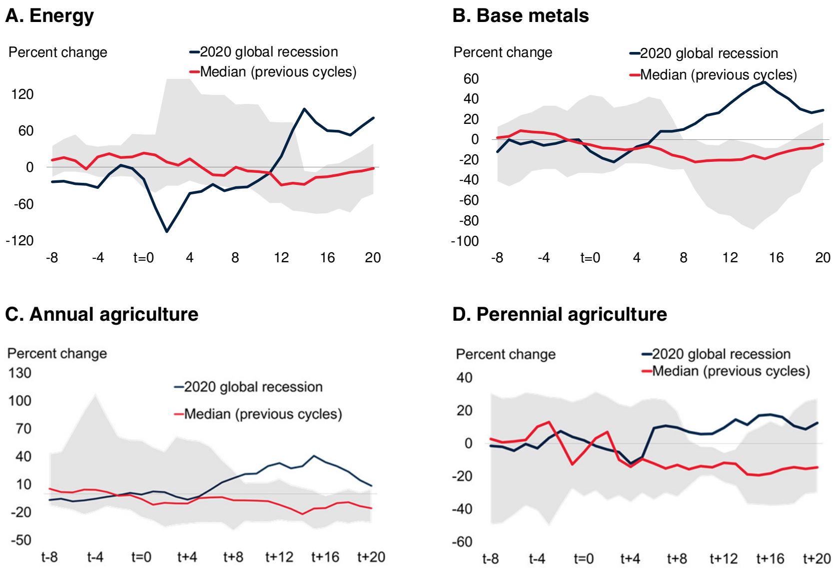
Energy and metal prices. The collapse in the energy price index in early 2020 was the steepest of any during global recessions in the past five decades, and the subsequent recovery was likewise the steepest (figure B3.2.2). The fall in energy prices in 2020 was driven by oil, which experienced its largest one-month decline in prices on record in April 2020. Oil demand plummeted by around 8 percent in 2020 due to the twin effects of travel disruptions and the global recession. Energy prices rebounded by about 50 percent within three months of their early 2020 trough, however, and surpassed their pre-crisis peak in about a year. In comparison, the median recovery after previous recessions was less than five percent in 13 months. In addition to rebounding oil prices, natural gas and coal

b. Prior to 2020, there were four global recessions (1975, 1982, 1991, and 2009) and three global slowdowns (1998, 2001, and 2012). See Kose, Sugawara, and Terrones (2020).

BOX 3.2 Commodity price comovement and the impact of COVID-19 *(continued)*

FIGURE B3.2.2 Commodity prices around global recessions and downturns

The recovery in commodity prices since the COVID-19 recession is in stark contrast to those following previous recessions. The rebound in prices has been exceptionally fast for most major commodity groups.



Sources: World Bank.
Note: The horizontal axis represents time periods in months, where t=0 denotes the peak of global industrial production before global recessions and downturns since 1970. 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 (as in Kose, Sugawara, and Terrones 2020). Gray shaded areas represent the range of observed values in previous cycles. Data from January 1970 to October 2021.

prices rose to record highs in 2021 amid a recovery in demand and supply disruptions (World Bank 2021).

Likewise, for metal and mineral prices, the pandemic-driven decline in 2020 was steeper than that during most of the previous global recessions. The subsequent price recovery was also faster than in previous episodes. This was mostly a reflection of the relatively short-lived nature of the pandemic-related recession, a rebound in demand from China due to strong industrial activity, and supply disruptions in Latin America.

BOX 3.2 Commodity price comovement and the impact of COVID-19 *(continued)*

Agricultural commodity prices. Prices for annual agricultural commodities declined only slightly during the pandemic but increased sharply in late 2020 and early 2021. This surge in prices was mostly driven by strong demand from China, in part because of the recovery in demand for animal feed after the Africa swine flu outbreak in 2019, and higher energy costs (and, hence, fertilizer costs). For the perennial agricultural price index—which comprises coffee, rubber, and tea—the price decline in 2020 was broadly in line with historical episodes, while the subsequent recovery was faster. Fertilizer prices were relatively unaffected by the recession, but rapidly increased in subsequent months as rising energy prices (especially natural gas and coal) drove up the cost to manufacture fertilizers.

The evolution of the permanent component differed markedly across commodity groups. For energy commodities, the permanent component of prices has trended upward, for agricultural and fertilizer prices downward, and for most base metals it has been largely trendless. The upward trend in energy prices may reflect resource depletion and a rising cost of production as well as limited options for substitution, while the largely trendless nature of long-term metal price movements may reflect the opposing forces of technological innovation and resource depletion alongside many options for substitution.[6] The downward trend in the permanent component of agricultural prices is consistent with low income elasticities of food commodities and consistent productivity growth in agricultural production (chapter 2; Baffes and Etienne 2016). Commodities with a history of widespread policy interventions (cotton) or subjected to international commodity agreements (cocoa, coffee, crude oil, cotton, natural rubber, and tin) followed a highly non-linear path (see table 3A.1).

Annual agricultural price trends are highly synchronized and differ from those of other commodity groups. The contribution of the permanent component to annual agricultural price variability (68 percent) is the highest among all six commodity groups, and this component has evolved in a similar manner across annual agricultural prices (figure 3.3).[7] This similarity reflects the diffusion of shocks across commodities due to input substitutability, consumption substitutability, and agricultural policies, which are similar across most crops.

- *Input substitution.* Annual agricultural commodities tend to be farmed using the same land, labor, machinery, and other inputs. As a result, reallocation between different annual crops from one year to another prevents large price fluctuations in

[6] See discussions in Hamilton (2009) and Marañon and Kumral (2019) on oil and metals, respectively.

[7] Permanent shocks to agriculture have lasting effects on economic activity in low-income countries through their impact on labor productivity (Dieppe, Francis, and Kindberg-Hanlon 2020).

individual crops. The impact of the restrictions on soybean imports by China from the United States in 2018 was short-lived due to land reallocation and trade diversion. Separately, despite a policy-induced increase in demand for maize, sugarcane, and edible oils for use in biofuels over the past two decades, price increases in these three crops were in line with those of other annual crops (for example, rice and wheat) as land was reallocated (World Bank 2019). For example, global demand for maize, a key feedstock for ethanol production in the United States, doubled over the past two decades. This compares with 26-28 percent increases in global demand for rice and wheat, broadly in line with global population growth.

- *Consumption substitution.* Since annual crops have overlapping uses, substitution in consumption can dampen price fluctuations in any one of them. In the example of import restrictions on soybeans discussed earlier, maize replaced soybean meal for animal use in China while palm oil replaced soybean oil for human consumption (World Bank 2019).[8]

- *Policy synchronization.* Policy interventions for agricultural markets tend to apply to the entire sector and stay in place for several years, even decades, with few or no changes (chapter 1). For example, agricultural policies in the United States and the EU—the world's largest producers in several agricultural commodity markets—are renewed every few years and apply to the same crops. Indeed, the 1985 Farm Bill reform in the United States and the 1992 Common Agricultural Policy reform in the EU applied to all commodities of the respective programs (Baffes and de Gorter 2005).

What have been the main drivers of common cycles in commodity prices?[9]

The preceding section focused on statistical properties of commodity prices and their cycles. This section assesses the drivers of commodity prices, particularly the role of global shocks. It uses a factor-augmented vector autoregression (FAVAR) model to empirically estimate the importance of different drivers of commodity prices, particularly the relative role of global demand and supply shocks, and commodity-specific shocks.

Several studies have examined the drivers of common cycles in commodity prices. A popular view in the literature that attempts to provide a macroeconomic explanation for this phenomenon is that there is a common component of commodity price fluctuations that may be captured by measures of the ebbs and flows in global economic activity (Alquist, Bhattarai, and Coibion 2020; Byrne, Sakemoto, and Xu 2020; Chiaie, Ferrara, and Giannone 2017; and Marañon and Kumral 2019). However, fluctuations in global

[8] The imposition of tariffs by China on U.S. soybean imports resulted in trade diversion. China began importing less from the United States and more from Brazil while the EU began importing more from the United States and less from Brazil.

[9] This section draws heavily on World Bank (2022).

economic activity alone do not explain the evolution of commodity prices. Other factors, particularly supply conditions within and across commodity markets, are likely to be key determinants of commodity price cycles (Borensztein and Reinhart 1994; Cashin, McDermott, and Scott 2002).

For example, the 2006-08 spike and the 2014-16 collapse in commodity prices were caused by factors other than global demand. Fluctuations in factor input costs, such as the prices of oil and other energy products, can affect a wide range of commodity markets simultaneously. Energy is both a key input in the production of metals and an important cost component for most grain and oilseed crops, through both direct channels (fuel prices) and indirect channels (chemical and fertilizer prices). Thus, when energy prices increase, the costs of these commodities go up concurrently (Baffes 2007). Similarly, for annual crops, prices could be synchronized because of input substitutability. Often weather patterns (for example, the El Niño or La Niña phenomena) increase or reduce production across a number of commodities (World Bank 2015b). Yet another strand of the literature has argued that the comovement in commodity prices is partly a response to the financialization of commodity markets, especially following the price boom of the late 2000s (Le Pen and Sévi 2018; Ohashia and Okimoto 2016).

Identifying and measuring shocks

Data and methodology. A FAVAR model is estimated with three variables—global consumer price inflation, global industrial production growth, and global commodity price growth. Each is expressed in month-on-month log changes over 1970-2021, in seasonally adjusted terms, and included with twelve lags. By construction, the methodology is designed to analyze the links between short-term fluctuations in the global economy and global commodity markets, not long-term trends. Global commodity prices are defined as the common factor among 39 commodity prices. Global industrial production is defined as the global economic activity index of Baumeister and Hamilton (2019). Global consumer price inflation is defined as the median headline CPI inflation for up to 143 economies (taken from Ha, Kose, and Ohnsorge 2021).[10]

Identification of shocks. While the specific nature of shocks changes over time, they can be grouped into three categories: global demand shocks, global supply shocks, and commodity price shocks. The shocks are identified using a set of sign restrictions on interactions between the three variables in the FAVAR on impact. The restrictions to identify the structural shocks are consistent with theoretical predictions (Fry and Pagan 2011) and follow other empirical studies in the literature (Charnavoki and Dolado 2014; Peersman 2005; Peersman and Straub 2006).

- A positive global demand shock is assumed to increase global industrial production, inflation, and commodity prices.

[10] The results remain qualitatively similar when CPI inflation for OECD countries or the common factor of headline CPI inflation for 143 countries is used as a measure of global inflation.

- A positive global supply shock is assumed to raise global industrial production and reduce global inflation; in commodity markets, it lifts global consumption of commodities and, hence, raises commodity prices.

- A positive commodity-specific shock is defined as raising commodity prices and global inflation but depressing global industrial production. Such shocks could reflect a wide range of commodity market developments that are unrelated to global demand or supply, including geopolitical risks, financialization of commodity markets, and expectations of future demand or supply pressures.

Note that these global demand and supply shocks differ materially from the commodity demand and supply shocks modeled in Kilian and Murphy (2014) and others (Baumeister and Hamilton 2019; Jacks and Stuermer 2020). Here, an increase in both economic activity and commodity prices can reflect either a global demand or a global supply shock—depending on movements in global inflation. Either of these two global shocks drives up commodity demand, consistent with the definition of a commodity demand shock in Kilian and Murphy (2014). But, in the latter, an increase in both economic activity and commodity prices reflects a commodity demand shock, in contrast to a commodity supply shock which is associated with an increase in commodity prices but a decline in economic activity.

Global demand, supply, and commodity shocks. The model identifies a series of global demand, global supply, and commodity price shocks from 1970 onward. These shocks have often been associated with turning points in the global business cycle and sharp movements in oil prices (figure 3.4). The role of these drivers for individual major commodities is investigated in greater detail in box 3.2.

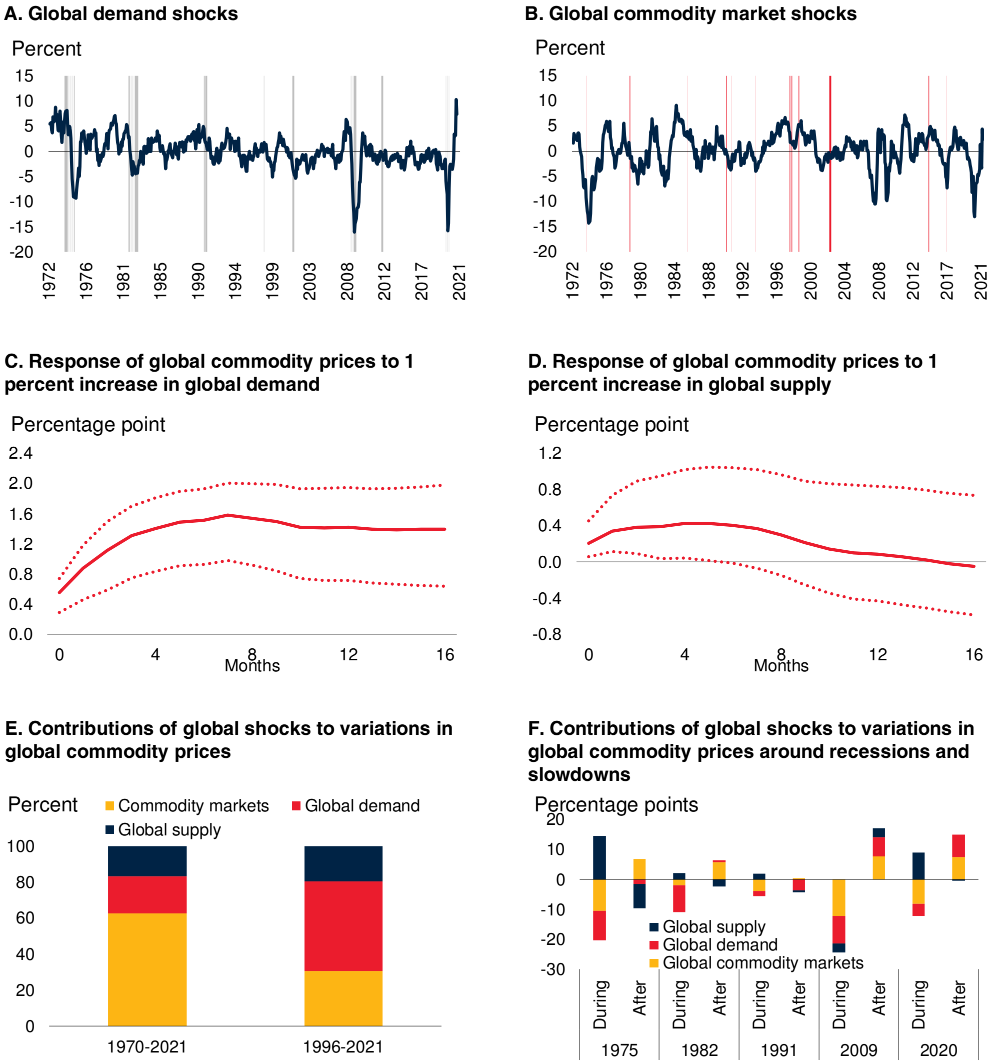
- *Global demand shocks.* Negative global demand shocks were associated with global recessions (1975, 1982, 1991, 2009, and 2020) and slowdowns (1998, 2001, and 2012). Large positive global demand shocks often occurred in the year before the global economy began to slide into a global recession or slowdown.

- *Global supply shocks.* The widespread rise in inflation amid slow growth during the 1970s and early 1980s has been partly attributed to negative global supply shocks—such as the 1973-74 and 1978-79 oil price shocks and productivity growth slowdowns that reflected expanding government sectors, macroeconomic volatility, and regulatory uncertainty (Bjork 1999; CBO 1981; Charnavoki and Dolado 2014). The global economic recovery starting in the late 1990s, however, has been attributed to positive global supply shocks associated with rising productivity growth linked to advances in information technology, rapidly rising investment, as well as widespread trade liberalization and global value chain integration in EMDEs, especially China.[11]

[11] The important role played by supply shocks in the late 1990s is consistent with other studies. See Charnavoki and Dolado (2014); Dieppe (2020); Kabundi and Zahid (forthcoming); Kotwal, Ramaswami, and Wadhwa (2011); Topalova and Khandelwal (2011); World Bank (2020c); and Zhu (2012).

FIGURE 3.4 Contributions of global shocks to commodity prices

Global demand shocks have had smaller and less persistent effects than global supply shocks on global commodity prices. Since the mid-1990s, global demand and supply shocks have accounted for the majority of global commodity price volatility. In the global recession of 2020, both global demand and commodity market shocks depressed commodity prices while supply shocks supported commodity prices.



Sources: Baumeister and Hamilton (2019); Ha, Kose, and Ohnsorge (2021); World Bank.

Note: Global demand, supply, and commodity shocks identified using sign restrictions in a FAVAR of month-on-month seasonally adjusted changes in global inflation, global commodity prices, and global industrial production. All in year-on-year growth rates.

A. Gray shades indicate quarters with global recessions (1975, 1982, 1991, 2009, 2020) and global slowdowns (1998, 2001, 2012), as defined in Kose, Sugawara, and Terrones (2020).

B. Red lines indicate events specific to commodity markets, including the first oil price crisis in October 1973; the Iranian Revolution in January 1979; the beginning of the Gulf War in August 1990; the memorandum of understanding between Australia, Canada, the European Union, Norway, the Russian Federation, and the United States to cut aluminum production; OPEC meetings to ease production quotas (December 1985 and November 2014); and selected OPEC meetings to reestablish production quotas (December 2016, 1998-1999).

C. D. Solid line indicates cumulative median response of global commodity price growth to a 1 standard deviation (about 1 percent) increase in global demand (C), or global supply (D). Dotted lines indicate 16-84th confidence intervals.

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

- *Commodity-specific shocks.* Positive commodity-specific shocks were associated with the oil price shocks in 1973 and 1979, the Gulf War in 1990, an agreement among major producers to cut aluminum production in 1994, and a general strike in República Bolivariana de Venezuela in 2002-03 that disrupted oil production. OPEC agreements to ease production cuts in December 1985 and November 2014 were associated with negative commodity price shocks. In addition, new producers entered global markets in the 1980s (coal and palm oil), the 1990s (aluminum, coffee, and grains), and in the 2010s (copper, soybeans, and shale oil), and this contributed to declining or negative commodity price shocks.

Responses of global commodity prices to global shocks. Since 1970, on average, a 1 percent increase in global demand raised global commodity price growth by up to 0.4 percent over the subsequent six months, but the impact dissipates thereafter. In contrast, global supply and commodity market shocks had longer-lasting impacts. A 1 percent increase in global supply raised global commodity price by 1.6 percentage points over the following 7 months and the effect remained statistically significant for a year and a half. Similarly, a 1 percent global commodity market shock that raises commodity prices was followed by more than 1.1 percent higher commodity prices within 12 months of the shock and the effect persisted for at least a year and a half. The persistence of the response of prices to shocks can partly be attributed to a low elasticity of supply because of long lead times between resource discovery and production (World Bank 2016).

Relative contributions of shocks to global commodity prices. In the full data period since 1970, shocks specific to commodity markets have been the main source of variability in global commodity prices, accounting for more than 60 percent of the variance.[12] These shocks have included major disruptions to oil markets, the collapse of the Soviet Union in the case of agricultural and metals markets, and the emergence of new producers of metals and agricultural commodities in the 1970s, 1980s, and 1990s. Since 1996, however, global macroeconomic shocks have been the main source of commodity price volatility: global demand shocks account for 50 percent and global supply shocks for 20 percent of the variance of global commodity prices.[13]

Interactions between global shocks and commodity prices

The three types of shocks discussed above—global demand shocks, global supply shocks, and commodity price shocks—can occur simultaneously and may influence one another, especially during times of global recession. Commodity prices are generally depressed in recessions due to weak global economic demand. Other forces, however, can come into play that either amplify or ease pressure on prices. For example, during the recessions of 1995, 1991, and 2020, weak demand for commodities was amplified by commodity-

[12] The predominant role of commodity-specific shocks in the variability of commodity prices is in line with Charnavoki and Dolado (2014), Ha et al. (2019), and Jacks and Stuermer (2020).

[13] These numbers refer to the variance decompositions for one-year-ahead forecast errors of global commodity price growth. Over a medium- to long-term (5-10 years) forecasting horizon, the variance contribution of global commodity shocks (57 percent) is greater than that of global demand shocks (28 percent) since global commodity shocks are more persistent than demand shocks.

specific supply pressures. In contrast, in 1975 weak demand for commodities was offset by supply disruptions resulting from large-scale trade embargoes, and in 2020 weak demand was worsened by supply chain disruptions (Mahajan and Tomar 2020). During recoveries, commodity price increases are typically driven by an unwinding of global supply shocks or commodity-specific shocks and, since 2000, by rebounds in global demand. Positive global supply shocks can also depress global commodity prices during non-recession periods, such as in the 1970s and 1980s. The downward pressure on prices during these periods temporarily reversed between 2000 and 2008 when rapid global value chain integration and productivity growth lifted commodity prices.

Conclusion

This chapter examined the characteristics and drivers of commodity price cycles. The results show that, on average across commodities, the transitory and permanent components account for roughly equal shares of commodity price variability. At a group level, however, agricultural prices are dominated by the permanent component, while the transitory component is more important for industrial commodities. Within the transitory component, the medium-term cycle component (frequency of 8-20 years) accounts for twice the variation of the traditional business cycle component (frequency of 2-8 years), particularly for industrial commodities, in turn highlighting the importance of the investment cycle for commodities.

The chapter also identified three medium-term cycles. While both the first and third medium-term cycles involved all commodities, the latter exhibited higher amplitude and was more synchronized than the first, thus rendering it the largest post-World War II commodity price cycle. The second cycle, which was most relevant to metal commodities, did not involve energy at all. In addition, the permanent component trended upward for most industrial commodities and downward for agriculture.

Considering the drivers of commodity price variability, global macroeconomic shocks have become the main source of fluctuations in commodity prices, accounting for more than two-thirds of the variance of global commodity price growth since the mid-1990s. Global demand shocks, such as recessions, have accounted for the majority of this. In contrast, commodity-specific shocks, such as those arising from adjustment to long-term trends in supply and demand, have accounted for just under a third of the variability in global commodity prices since the mid-1990s.

A number of policy implications stem from the analysis. Heterogeneity of shocks across commodities implies that policies should be tailored to the terms-of-trade faced by each country, rather than applying one-size-fits-all policies. Countries that depend on exports of highly cyclical commodities that experience frequent transitory shocks will need to be more proactive in using fiscal and monetary policy to smooth these shocks and support economic activity. In contrast, in countries that rely heavily on commodities that are subject to permanent shocks, structural policies may be needed to facilitate adjustments to new economic environments.

ANNEX 3A Decomposing commodity prices into cycles and long-term trends

Model and data description

The real price of the commodity at time t, p_t, is expressed as the following sum:

$$p_t \equiv PC_t + TC_t^{[8,20]} + TC_t^{[2,8]} + S_t$$

PC_t, which represents the permanent component, can be a linear trend, perhaps subjected to structural breaks. Alternatively, one could include non-linearities. TC_t denotes the medium-term cycle with a periodicity of 8-20 years as proposed by Blanchard (1997) and popularized by Comin and Gertler (2006). TC_t represents the business cycle with a periodicity of 2-8 years, following NBER's traditional definition (Burns and Mitchell 1946). Lastly, S_t captures fluctuations with periodicity of less than 2 years, which may reflect short-term movement in economic activity or other macroeconomic variables (such as exchange rates and interest rates), seasonality or weather patterns (in the case of agriculture), and ad hoc policy shocks. These fluctuations are typically studied within the context of VAR models (Baumeister and Hamilton 2019; Kilian and Murphy 2014) and GARCH models by utilizing high-frequency data, focusing mostly on volatility (Engle 1982). The decomposition is based on the frequency domain methodology developed by Corbae, Ouliaris, and Phillips (2002) and Corbae and Ouliaris (2006).

The price data were taken from the World Bank's *Pink Sheet* database. The sample covers 50 years: January 1970 through December 2019 (600 observations). The prices, which are reported in nominal U.S. dollar terms, were deflated with the U.S. CPI (taken from the St. Louis Federal Reserve Bank). Although the World Bank covers more than 70 commodity price series, this paper uses only 27 series. The selection was based on the following criteria:

- **Substitutability.** If two commodities are close substitutes only one was included. For example, because the edible oils are close substitutes, only soybean oil is used in the analysis.

- **Importance.** Commodities whose share in consumption declined throughout the sample (either because of changes in preferences or substitution from synthetic products) were not included in the sample. Notable exclusions include wool, hides and skins, sisal, and tobacco.

- **Price determination process.** Prices are determined by market-based mechanisms, such as on commodity exchanges or at auctions (in the case of tea). Notable exclusions are iron ore (its price used to be the outcome of a negotiation process among key players of the steel industry until 2005), bananas (its price reflects quotations from a few large trading companies), and sugar (policy interventions reduce the significance of the world price indicator), groundnuts (thinly traded commodity), and tropical timber products (not traded on exchanges).

Following the decomposition analysis, prices were grouped into six broad categories, each of which contained at least three series: energy (coal, crude oil, and natural gas); base metals (aluminum, copper, lead, nickel, tin, and zinc); precious metals (gold, platinum, and silver); fertilizers (phosphate rock, potassium chlorate, TSP, and urea); annual agriculture (cotton, maize, rice, soybean meal, soybean oil, and wheat); and perennial agriculture (cocoa, coffee Arabica, coffee Robusta, natural rubber, and tea).

Decomposition results are reported in table 3A.1. The numbers in the square brackets of the first column represent weights and add to 100 for each commodity group, subject to rounding. The shares of each component add to 100, subject to rounding. For example, coal's shares are: 0.36 + 0.42 + 0.18 + 0.04 = 1. The penultimate column reports the parameter estimate from the regression of PC_t on a time trend while the last column reports the Root Mean Square Error (RMSE)—a proxy for nonlinearity.

TABLE 3A.1 Real commodity price decomposition

	Share of variance explained by				Number of cycles		Trend	
	PC_t	$TC_t^{[8\text{-}20]}$	$TC_t^{[2\text{-}8]}$	S_t	$TC_t^{[8\text{-}20]}$	$TC_t^{[2\text{-}8]}$	β	RMSE
Energy								
Coal [**4.6**]	0.36	0.42	0.18	0.04	3	11	0.43	5.31
Crude oil [**84.6**]	0.31	0.54	0.11	0.04	2	12	1.02	7.65
Natural gas [**10.8**]	0.19	0.68	0.10	0.03	2	11	0.57	2.50
Average	**0.29**	**0.55**	**0.13**	**0.04**	**2**	**11**	**0.95**	**6.99**
Base metals								
Aluminum [**32.9**]	0.57	0.20	0.20	0.03	4	10	-0.14	0.64
Copper [**47.4**]	0.47	0.30	0.19	0.04	3	9	-0.80	3.31
Lead [**2.2**]	0.57	0.25	0.16	0.02	3	8	-0.54	4.75
Nickel [**9.9**]	0.18	0.44	0.34	0.04	3	11	-0.78	1.63
Tin [**2.6**]	0.74	0.19	0.06	0.01	3	12	0.05	4.38
Zinc [**5.0**]	0.25	0.22	0.46	0.07	3	8	-0.09	2.08
Average	**0.46**	**0.27**	**0.24**	**0.04**	**3**	**10**	**-0.52**	**2.46**
Precious metals								
Gold [**77.8**]	0.62	0.27	0.10	0.01	3	8	1.28	5.38
Platinum [**18.9**]	0.22	0.48	0.23	0.06	3	11	-0.22	1.85
Silver [**3.3**]	0.47	0.36	0.13	0.03	3	11	0.27	13.47
Average	**0.44**	**0.37**	**0.15**	**0.03**	**3**	**10**	**0.96**	**4.98**
Fertilizers								
Phosphate [**16.9**]	0.37	0.30	0.25	0.07	3	9	-0.40	6.48
Potassium [**20.1**]	0.36	0.45	0.16	0.03	3	10	-0.46	3.43
TSP [**21.7**]	0.36	0.24	0.34	0.06	4	9	-0.52	3.91
Urea [**41.3**]	0.24	0.42	0.22	0.12	3	12	-0.02	4.44
Average	**0.33**	**0.35**	**0.24**	**0.07**	**3**	**10**	**-0.28**	**4.47**
Annual agriculture								
Cotton [**8.5**]	0.80	0.07	0.11	0.02	3	13	-0.07	9.00
Maize [**20.5**]	0.70	0.16	0.11	0.03	3	10	-0.50	3.55
Rice [**15.2**]	0.63	0.19	0.14	0.04	3	9	-0.43	3.29
Soybean meal [**29.0**]	0.69	0.10	0.17	0.04	3	10	-0.48	3.48
Soybean oil [**14.3**]	0.66	0.16	0.15	0.03	3	11	-0.72	3.15
Wheat [**12.5**]	0.62	0.18	0.15	0.05	3	9	-0.42	2.60
Average	**0.68**	**0.14**	**0.14**	**0.04**	**3**	**10**	**-0.47**	**3.78**
Perennial agriculture								
Cocoa [**25.6**]	0.67	0.22	0.10	0.01	3	11	0.03	15.41
Coffee Arabica [**15.7**]	0.61	0.24	0.12	0.04	3	14	0.22	10.38
Coffee Robusta [**15.7**]	0.75	0.17	0.06	0.02	3	13	0.42	15.86
Natural Rubber [**30.6**]	0.31	0.43	0.23	0.03	3	10	-0.36	17.39
Tea [**12.4**]	0.78	0.07	0.12	0.03	3	13	-0.17	9.47
Average	**0.62**	**0.23**	**0.13**	**0.03**	**3**	**12**	**-0.03**	**14.56**
All average	**0.47**	**0.32**	**0.17**	**0.04**	**3**	**11**	**0.10**	**6.21**

Source: World Bank.

Note: Description of terms appear in the text. Numbers in square brackets indicate weight of the commodity used in constructing weighted indexes.

ANNEX 3B Methodology: Factor-augmented vector autoregression

After estimating a common global factor that affects all commodity prices using a dynamic factor model (World Bank 2022), the drivers underlying the dynamics of the common factor, f_t, are identified using a factor-augmented vector autoregressive (FAVAR) model. The model comprises, in addition to the common factor, a monthly index of world industrial production, q_t, developed by Baumeister and Hamilton (2019), and a measure of global inflation, π_t, proxied by a median inflation rate constructed from the seasonally adjusted consumer price indexes of 143 countries developed by Ha et al. (2019). The data covers the period from January 1970 to September 2021.

The following general form of a structural FAVAR model is employed:

$$B_0 y_t = \sum_{i=1}^{p} B_i y_{t-i} + w_t \qquad \text{(A3.2.1)}$$

where y_t is the $K \times 1$ vector that contains the endogenous model variables, w_t is the $K \times 1$ vector of mutually uncorrelated structural shocks, B_0 is the structural impact multiplier matrix that describes the contemporaneous relationships among the model variables, B_i is the matrix of coefficients, and $p = 3$ is the lag length. The reduced form errors can be written as $u_t = B_0^{-1} w_t$, where

$$u_t = y_t - \sum_{i=1}^{p} A_i y_{t-i} \qquad \text{(A3.2.2)}$$

$A_i = B_0^{-1} B_i$ and $E(u_t u_t') = \Sigma_u$ is $K \times K$ reduced form variance-covariance matrix. Thus, given the structural impact multiplier matrix, B_0, the reduced-form innovations can be represented as weighted averages of the mutually uncorrelated structural shocks, w_t. However, since the model is under identified, further identifying restrictions are required to estimate B_0.

The analysis identifies three shocks: a global demand shock, a global supply shock, and a commodity-specific shock as underlying drivers of the common global factor of commodity prices. The identification scheme is based on sign restrictions applied to the matrix B_0. Specifically, the following sign restrictions are used

$$u_t = \begin{bmatrix} + & + & - \\ + & - & + \\ + & + & + \end{bmatrix} \begin{pmatrix} u_t^{Global\ Demand} \\ u_t^{Global\ Supply} \\ u_t^{Commodity-specific} \end{pmatrix} = B_0^{-1} w_t$$

where signs are imposed on the elements of the inverse of the structural impact multiplier matrix, B_0^{-1}, and all shocks are normalized to increase the commodity price factor.

The impact sign restrictions on B_0 are in line with theoretical predictions and other empirical studies.[14] For example, positive global demand shocks are characterized by positive comovement in the global industrial production index, global inflation, and the common commodity price factor. A positive global supply shock, on the other hand, increases global output, decreases global inflation, and increases commodity prices. A positive commodity-specific shock decreases output, increases global inflation, and increases commodity prices. Commodity-specific shocks are designed to account for innovations to commodity prices that are orthogonal to global demand and global supply shocks, such as unexpected shifts in speculative or precautionary demand for commodities (see Charnavoki and Dolado 2014; and Kilian and Murphy 2014).

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