SPECIAL FOCUS

Pandemic, war, recession: Drivers of aluminum and copper prices

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Over the past three years, the pandemic, the war in Ukraine, and concerns about global recession buffeted global aluminum and copper markets and contributed to large swings in global prices. Record price rebounds from pandemic lows in April 2020 were followed by renewed steep declines starting in March 2022. The price rebound after the pandemic was mainly driven by the economic recovery but, in contrast to the rebound after the global financial crisis, supply-side factors also contributed about one-quarter to the rebound. Since March 2022, a steep global growth slowdown, an unwinding of supply constraints, a shutoff of energy-intensive smelters amid record high energy cost (especially for aluminum), and concerns about an imminent global recession (especially for copper) contributed to the plunge in prices. More price volatility can be expected as the energy transition unfolds and global commodity demand shifts from fossil fuels to metals. Appropriate policies can help metal exporters make the most of the resulting opportunities for growth while limiting the impact of price volatility.

Introduction

Aluminum and copper prices have undergone sizable swings in the past three years. The COVID-19 pandemic triggered a severe global recession and, in the three months from January 2020, global aluminum and copper prices suffered record declines. This episode was followed by the strongest economic rebound in eight decades and steep rebounds in prices (figures SF.1A, B). By March 2022, inflation-adjusted copper and aluminum prices had reached their highest and second-highest levels, respectively, in a decade. Since then, aluminum and copper prices have fallen again by 36 and 24 percent, respectively.

These swings were the outcome of a confluence of different shocks caused by the pandemic. Global economic activity contracted by more than 3 percent in 2020, but then rebounded by almost 6 percent in 2021 (figure SF.1C). In China, which accounts for about 60 percent of global aluminum and copper demand, growth slowed sharply from 6 percent in 2019 to 2 percent in 2020 before rebounding to 8 percent in 2021 (figure SF.1D). Since metals are heavily used in cyclical sectors, such as construction, the swings in global and Chinese growth led to a collapse and rebound in global demand for metals. As global economic activity shifted online and demand gravitated towards consumer durables, demand for copper and aluminum—heavily used in consumer electronics, household appliances, and cars—increased disproportionately (figure SF.1E). Meanwhile, COVID-19 restrictions, strikes and political tensions, trade restrictions, and rapidly rising energy prices disrupted mining, refining, or shipments of metals in Australia, Chile, China, Guinea, and Peru (figure SF.1F).

As global metal price swings buffet economies, metal exporters will need to understand the sources, features, and impacts of these swings to design appropriate policy responses. Different types of shocks may cause price swings of different magnitudes and duration. More permanent shocks may warrant economic adjustments while the impact of temporary shocks may be smoothed with countercyclical policies.

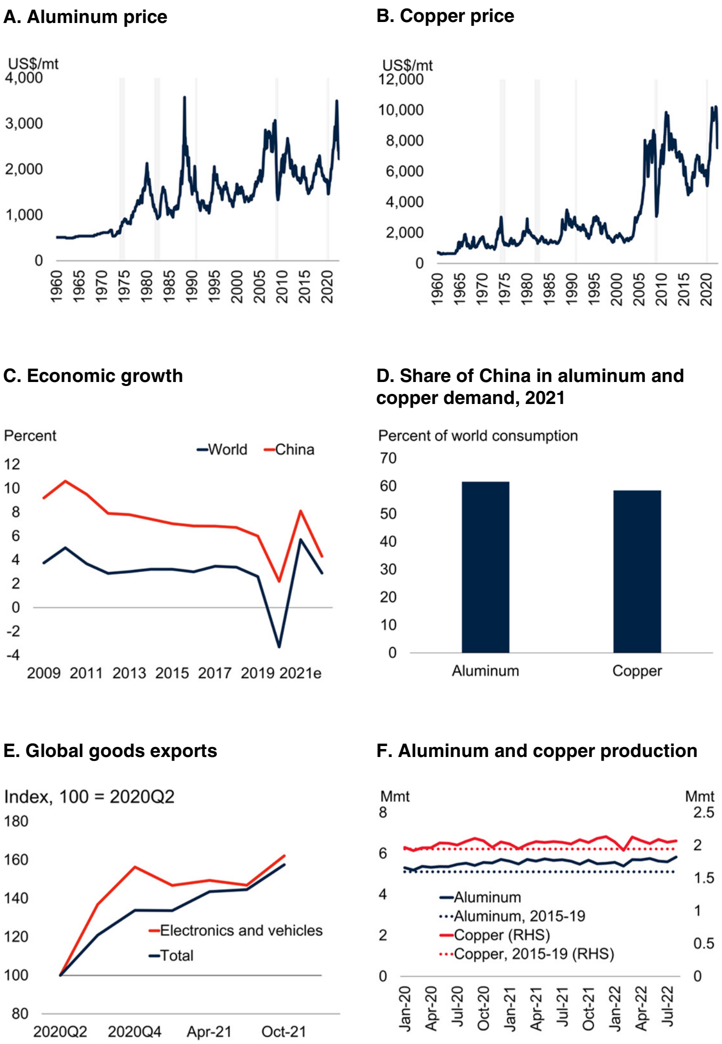
This Special Focus explores how different types of shocks affect global prices for copper and aluminum. Specifically, it addresses the following questions:

- How large and persistent is the impact of different types of shocks on copper and aluminum prices?
- Which shocks play the largest role in copper and aluminum price variations?

This Special Focus was prepared by Christiane Baumeister, Guillermo Verduzco-Bustos, and Franziska Ohnsorge. Research assistance was provided by Kaltrina Temaj. Helpful comments were provided by Alain Kabundi, Francisco Arroyo Marioli, Jeetendra Khadan, Ayhan Kose, and Peter Nagle.

FIGURE SF.1 Recent developments in global aluminum and copper markets

In early 2020, aluminum and copper prices underwent one of their steepest three-month declines in a decade, followed by one of their strongest increases in more than three decades. This in part reflected the steep global recession and subsequent economic rebound as well as a shift in demand towards goods and away from services from mid-2020.



Source: UNComtrade; World Bank *Pink Sheet Global Economic Prospects* (June 2022); World Bureau of Metal Statistics.

A.B. Grey shades show global recessions.

C. GDP-weighted average at 2010-19 average prices and exchange rates. "e" stands for estimated value.

E. Export values. Electronics and vehicles include Harmonized System categories 85 (electrical machinery and equipment and parts thereof; sound recorders and reproducers; television image and sound recorders and reproducers, and parts and accessories of such articles), 87 (vehicles; other than railway or tramway rolling stock, and parts and accessories thereof), and 90 (Optical, photographic, cinematographic, measuring, checking, medical or surgical instruments and apparatus; parts and accessories).

F. Refined aluminum and copper production. Monthly data until August 2022.

- How did the evolution of aluminum and copper prices during the pandemic-induced global recession in 2020 compare with that during the global financial crisis-induced global recession in 2009?

This Special Focus builds on a rapidly growing literature that, thus far, has focused on oil markets. Baumeister and Hamilton (2019) identified four shocks as the main drivers of oil prices—aggregate demand shocks ("economic activity shock"), commodity-specific demand shocks ("consumption demand shock"), commodity-specific supply shocks, and speculative demand shocks ("inventory demand shocks"). Their methodology is now widely used for oil prices but has not yet been applied to metal prices. A variant that identifies only a subset of these shocks has been applied to metal prices by Stuermer (2018) and Kabundi et al. (2022). Stuermer (2018) identifies only long run ("commodity demand") shocks and short run ("commodity supply") shocks without any further decomposition of short run shocks. Kabundi et al. (2022) neglect speculative demand shocks, which turn out to be an important driver of short run volatility in the analysis presented here.

This Special Focus offers the following main findings. First, inventory and consumption demand shocks cause much volatility in metal prices in the very short term, accounting for about one-third of global metal price volatility on impact. However, these shocks are small, reverse quickly, and have modest price impacts.

Second, a negative economic activity shock that reduces copper or aluminum prices by 1 percent on impact would continue to put downward pressure on prices such that three quarters later prices would be more than 5 percent below the baseline before the effect begins to dissipate.

Over a one-year horizon, economic activity shocks—which capture the global business cycle—are the single most important driver of copper and aluminum prices, accounting for 74 and 91 percent of the variance in these prices, respectively.

Third, during global recessions and their recoveries, economic activity shocks have been the main drivers of price changes. However, in the recovery from the pandemic-induced global recession of 2020, supply shocks also contributed, on average, one-quarter to the rebound in aluminum and copper prices. This contrasts with the price swings during the financial crisis-induced global recession of 2009 when supply shocks played a negligible role in price swings.

Methodology and data

Shocks are estimated in a Bayesian vector autoregression of aluminum or copper prices, production, and inventories as well as global economic activity. Sign restrictions and estimates of elasticities from the literature are used to identify four types of shocks.

- *Economic activity shocks*—such as global recessions—imply a reduction in global economic activity, metal prices, and production but an increase in metal inventories.
- *Consumption demand shocks*—such as a shift in demand caused by substitution from one commodity to another, or an unanticipated drop in construction activity in China, the world's largest consumer of aluminum and copper—imply a reduction in metal prices and production but an increase in metal inventories and global economic activity.
- *Commodity supply shocks*—such as the opening of new mines—imply an increase in metal production, inventories and economic activity, but a reduction in metal prices.
- *Inventory demand (speculative) shocks*—such as metal sales in anticipation of slowing construction activity in China—imply a reduction in metal prices, production, and inventories but an increase in global economic activity.

The methodology corrects for the unusual nature of the pandemic as in Ng (2021) and allows for the possibility of measurement error in inventories data as in Baumeister and Hamilton (2019). Details of the methodology are presented in Baumeister et al. (forthcoming).

The Special Focus relies on monthly data from January 1995 to July 2022. This is a period when China's role in global metal markets surged such that, by 2019, China alone accounted for about one-half of global metal demand. Aluminum and copper prices are from the World Bank's *Pink Sheet*. Aluminum and copper production is from the World Bureau of Metal Statistics. Aluminum and copper inventories are registered mineral inventories as reported by the London Metal Exchange and the World Bureau of Metal Statistics. Global economic activity is proxied by the GDP-weighted average of the OECD's index of industrial production in OECD countries and industrial production in six major non-OECD economies (Brazil, China, India, Indonesia, the Russian Federation, and South Africa).

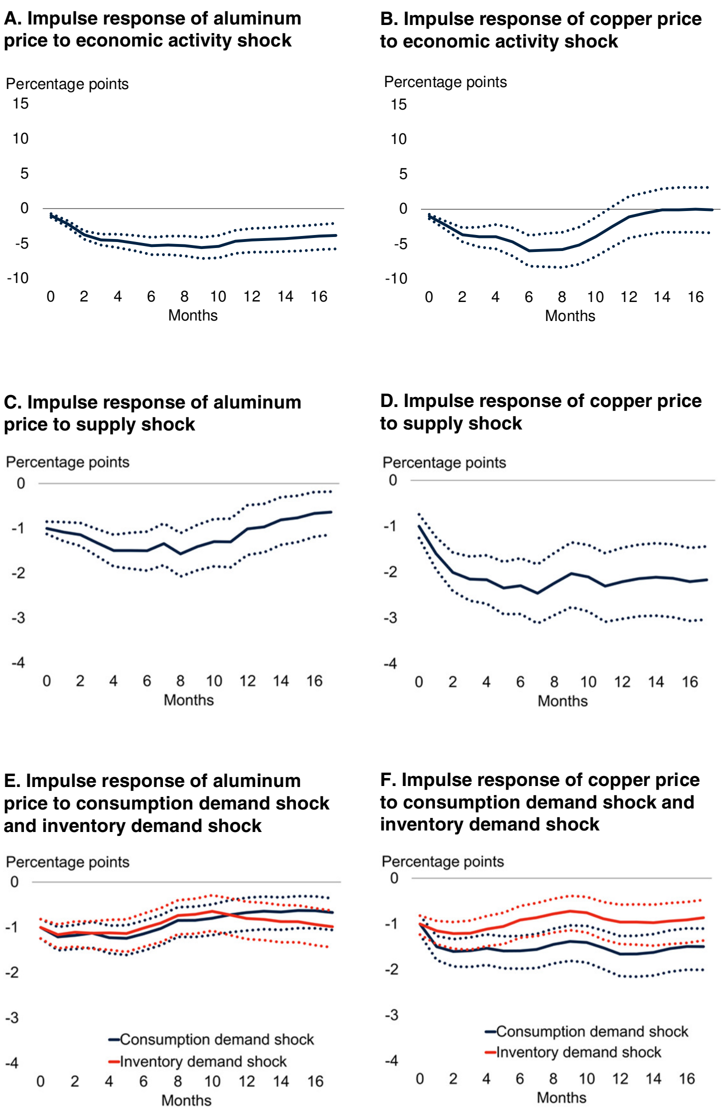
Drivers of aluminum and copper prices

Aluminum and, especially, copper prices are highly sensitive to the global business cycle (World Bank 2018). Consequently, economic activity shocks that reduced aluminum and copper prices on impact by 1 percent had a considerably larger and longer-lasting impact on prices than any of the other three types of shocks. Three quarters after such a shock, aluminum and copper prices were still more than 5 percent below the baseline (figure SF.2A,B).[1] The impact of the economic activity shock on copper prices was somewhat larger initially than on aluminum prices but dissipates sooner. For copper prices, the effect dissipated and became statistically insignificant after about a year. For aluminum prices, the effects lessened over time but continued to be statistically significant even 18 months later. The more pronounced swings in copper prices may reflect the fact that copper is used considerably more intensively than aluminum in highly cyclical infrastructure construction activity, especially in China, which now accounts for more than half of global copper and aluminum consumption

[1] A 1 percent decline in aluminum and copper prices on impact due to an economic activity shock is associated with a decline in global industrial production by 1.0 and 1.3 percent, respectively, on impact.

FIGURE SF.2 Dynamics of aluminum and copper prices

Economic activity shocks that reduced aluminum and copper prices on impact by 1 percent had a considerably larger and longer lasting effect on prices than the other types of shocks: consumption demand, supply, and inventory demand. Consistent with these impulse responses, longer-term fluctuations in aluminum and copper prices were predominantly driven by economic activity shocks whereas the other shocks mostly caused short-term volatility in prices.



Source: World Bank.

Note: Solid lines represent median responses, dotted lines represent upper and lower bounds of 68 percent confidence intervals.

A.B. Impulse response of aluminum (A) and copper (B) prices to economic activity shock that lowers the price on impact by 1 percent. A 1 percent decline in aluminum and copper prices on impact due to an economic activity shock is associated with a decrease in global industrial production by 1.0 and 1.3 percent, respectively, on impact.

C.-F. Impulse response of aluminum (C, E) and copper (D, F) prices to supply shock (C, D) and consumption demand and inventory demand shocks (E, F) that lower the price on impact by 1 percent. A 1 percent decline in aluminum and copper prices on impact due to a supply shock is associated with a 1.1 percent increase in aluminum or copper production. A 1 percent decline in aluminum and copper prices on impact due to an inventory demand shock is associated with a 0.7 percent decline in aluminum inventories and 0.6 percent decline in copper inventories.

(Kabundi et al. 2022; Kabundi, Vasishtha, and Zahid 2022).

In contrast, consumption demand shocks, inventory demand shocks, or commodity supply shocks that also reduced copper or aluminum prices by 1 percent on impact had much smaller impacts (figure SF.2C-F).[2] At their peak impacts, they reduced aluminum and copper prices by 1.2 percent (for inventory demand shocks), 1.2 and 1.6 percent (consumption demand shocks), and by 1.6 and 2.5 percent (supply shocks), respectively. The effects of these shocks were persistent: estimated impulse responses are statistically significant even 18 months after the initial shocks. The impacts of consumption demand and inventory demand shocks peaked two to four months earlier than the impacts of economic activity shocks. The impact of global aluminum supply shocks remained statistically significant for two years after the shock but more than halved in magnitude, whereas those for copper supply shocks remained broadly steady. The decline in the impact of supply shocks on aluminum prices may in part reflect the larger share of China—and its proactive policies to stabilize markets—for aluminum than copper (Kabundi et al. 2022).

Consistent with these impulse responses, longer-term fluctuations in aluminum and copper prices were predominantly driven by economic activity shocks whereas inventory, consumption demand and supply shocks mostly caused short-term volatility in prices. A forecast error variance decomposition suggests that supply shocks accounted for about one-quarter of aluminum and copper price fluctuations on impact, and inventory and consumption demand together for another one-third (figure SF.3A, B). In contrast, over a one-year horizon, economic activity shocks, which capture the global business cycle, were the single most important driver of copper and

[2] A 1 percent decline in aluminum and copper prices on impact due to a supply shock is associated with a 1.1 increase in aluminum or copper production on impact. A 1 percent decline in aluminum and copper prices on impact due to an inventory demand shock is associated with a 0.7 percent decline in aluminum inventories and 0.6 percent decline in copper inventories.

aluminum prices, accounting for 74 and 91 percent of the variance in these prices, respectively.

Drivers of aluminum and copper prices during global recessions

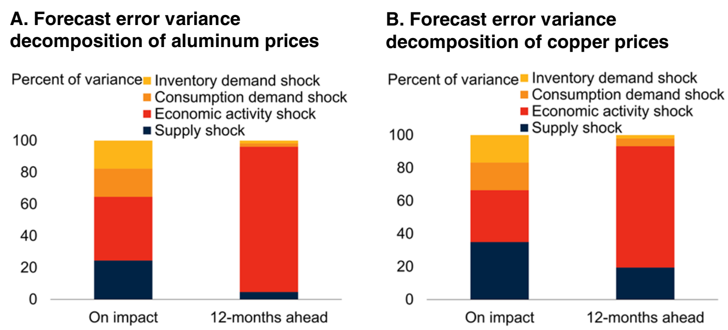
Over the past three years, a series of shocks have buffeted global metal markets. A steep pandemic-induced global recession was followed by a sharp rebound in global economic activity, which then slowed sharply again amid policy tightening; COVID-19 restrictions closed mines and intermittently disrupted activity in China, the world's largest metals consumer; global demand initially shifted from services to goods followed by a reversal; and pandemic policies, the war in Ukraine, and the recent policy tightening to rein in inflation caused much speculation about commodity market prospects.

In the three months between January and April 2020, aluminum and copper prices declined by 18 percent and 16 percent, respectively, their steepest drops over a corresponding period in more than a decade. Subsequently, between April 2020 and March 2022, aluminum and copper prices more than doubled—their steepest increases over a corresponding period in more than three decades for aluminum and more than one decade for copper. Since then, within five months, one-quarter of the aluminum price gains and almost one-half of the copper price gains has been unwound again as mounting concerns about a global recession put downward pressure on commodity prices more broadly.

A historical decomposition of price movements into the four shocks identified by the methodology used here suggests that these aluminum and copper price fluctuations were largely the result of economic activity shocks (figure SF.4A,B). Between January and April 2020, economic activity shocks depressed aluminum and copper prices by 27 and 23 percent, respectively; this was only partially offset (9.7 and 4.4 percentage points, respectively) by consumption demand shocks that raised prices. These consumption shocks may reflect above-average economic growth in China during the

FIGURE SF.3 Decomposition of aluminum and copper price volatility

Consistent with these impulse responses, longer term fluctuations in aluminum and copper prices were predominantly driven by economic activity shocks whereas inventory demand, consumption demand, and supply shocks mostly caused short-term volatility in prices.



Source: World Bank.
Note: Forecast error variance decomposition of aluminum (A) and copper (B) prices on impact and at the 12-month horizon, based on a structural vector autoregression as in Baumeister and Hamilton (2019).

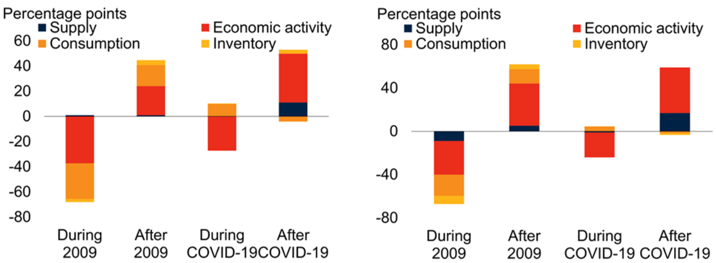
pandemic. During this period, demand in China, which accounts for about 60 percent of aluminum and copper demand, continued to expand, although at a much reduced pace, whereas it contracted steeply elsewhere amid pandemic lockdowns (IWCC 2022; Statista 2022). In the subsequent twelve months between May 2020 and May 2021, the rebound in economic activity lifted aluminum and copper prices by 39 and 42 percent, respectively. Supply disruptions, such as mine closures, added another 11 and 17 percentage points to the increase in aluminum and copper prices, respectively.

The role of supply shocks during the pandemic differed from their role during the global financial crisis. Both the pandemic and the global financial crisis were accompanied by steep global recessions, in 2020 and 2009, respectively, that drove down prices. In contrast to the global recession of 2009, when supply shocks played a negligible role, supply shocks contributed about one-quarter to the price rebounds following the pandemic. Aluminum and copper supply disruptions are part of a broader phenomenon of severe supply bottlenecks, shipping disruptions, and global value chain dislocations over the past two years. This largely demand-driven rebound in aluminum and

FIGURE SF.4 Drivers of aluminum and copper prices during global recessions

Aluminum and copper price fluctuations during and after the pandemic-induced global recession of 2020 were largely the result of economic activity shocks. Supply disruptions contributed about one-quarter to price rebounds after the pandemic-induced recession, unlike the global financial crisis-induced global recession of 2009 when supply shocks played a negligible role.

A. Contributions to aluminum price changes **B. Contributions to copper price changes**



Source: World Bank.

Note: Contributions to cumulative aluminum (A) and copper (B) price changes during the specified period. “During 2009” stands for the period September 2008-March 2009; “After 2009” stands for the period April 2009-April 2010; “During COVID-19” stands for the period January-April 2020; “After COVID-19” stands for the period May 2020-May 2021.

copper prices continued through March 2022, when prices soared to near-record (aluminum) and record (copper) highs (figure SF.5A).

Since then, however, prices for both commodities have plunged. This has reflected an exceptionally steep global growth slowdown as well as the unwinding of supply disruptions. In addition, aluminum smelting, which is extremely energy intensive, has fallen sharply amid soaring energy prices. As a result, negative consumption demand shocks contributed even more to the aluminum price decline than economic activity shocks (figure 5B). Similarly, the real estate sector slowdown in China that began to intensify in April constituted a negative consumption shock for copper prices. In addition, for copper, which is often considered a bellwether for global economic developments, growing concerns about the possibility of a global recession in 2023—an example of an inventory shock—have weighed on prices.

Policy implications

The results of the analysis conducted in this Special Focus suggest that inventory and consumption demand shocks cause considerable volatility in metal prices in the very short term, accounting for about one-third of global metal price volatility on impact. However, these shocks are small, reverse quickly, and have modest price impacts.

The estimated impulse responses of aluminum and copper prices to economic activity suggest considerable downside risks to global aluminum and copper prices. There is a material risk of a global recession as a result of highly synchronous policy tightening around the world to rein in record high inflation (Guénette, Kose, and Sugawara 2022). Since industrial production tends to be more volatile than output, this could be accompanied by an even steeper slowdown in industrial production which would also be reflected in lower aluminum and copper prices.

The results point to metal price swings as an important transmission channel for the global business cycle to countries that rely heavily on copper or aluminum sectors for exports, fiscal revenues, and economic activity. More swings in aluminum and copper prices can be expected as the energy transition away from fossil fuels towards renewable fuels and battery-powered transport gathers momentum. Renewable electricity generation is considerably more metal intensive than traditional energy generation. Solar or wind-powered electricity generation, for example, uses two to three times the amount of copper per kWh than gas-powered electricity generation; the production of a battery-powered car uses more than three times the amount of copper per car than an internal combustion engine car (IEA 2022). The war in Ukraine is likely to accelerate the energy transition as countries seek to reduce reliance on fossil fuels such as oil, coal, and natural gas, where Russia accounts for 11-25 percent of global exports (Guénette, Kenworthy, and Wheeler 2022).

For now, metal exporters are on average less commodity reliant than energy exporters. For example, in the average copper-exporting emerging market and developing economy (EMDE), revenues from resource sectors accounted for 10 percent of government revenues in

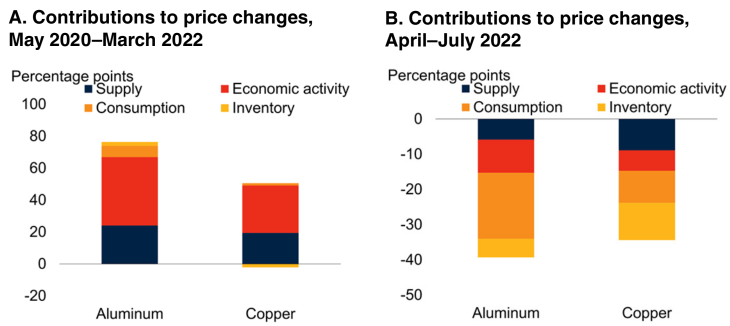
2019. This was about one-third of the share of resources sectors in government revenues in the average oil- or gas-exporting EMDE. However, the growing exposure of metal exporters to volatile global commodity prices points to two policy priorities (Kabundi et al. 2022).

First, well-designed fiscal and monetary policy frameworks can dampen the economic impact of metal price swings. This includes fiscal rules to save revenue windfalls, sovereign wealth funds, and countercyclical monetary and macro-prudential policy frameworks (see World Bank 2022 for details). Almost two dozen EMDE commodity exporters have established fiscal rules or sovereign wealth funds, including Chile, the world's largest copper producer. These tend to be particularly successful at stabilizing business cycles when they operate in the context of strong institutions and resilient fiscal, monetary, exchange rate, and financial frameworks.

Second, in addition to measures to dampen the impact of global metal price swings, proactive efforts at diversification may reduce metal exporters' exposure to global shocks. This could be achieved through export diversification or a more comprehensive "national asset portfolio diversification" approach (Gill et al. 2014). The latter would aim to strengthen non-resource sectors through investment in strong institutions and governance, broad access to high-quality infrastructure, and robust measures to increase human capital. Policies would also need to address broader concerns, such as the environmental pollution that can accompany metals mining.

FIGURE SF.5 Drivers of aluminum and copper prices since their pandemic trough

Following the pandemic trough in April 2020, strong demand pressures and continued supply disruptions pushed up aluminum and copper prices to record highs in March 2022. Since then, an exceptionally steep global growth slowdown and an unwinding of supply disruptions helped to reverse some of the price increases. For aluminum, consumption demand shocks also depressed price, in part because highly energy-intensive aluminum smelters were shut off around the world as energy prices soared. For copper, often considered a bellwether of global economic activity, concerns about an incipient global recession have depressed prices, as captured by inventory shocks.



Source: World Bank.
Note: Contributions to cumulative aluminum and copper price changes during May 2020-March 2022 when prices reached record or near-record highs (A), and during April-July 2022 when prices plunged (B).

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