CHAPTER 2

NAVIGATING THE TIDES OF COMMODITY PRICES

Commodity prices are subject to large and recurrent volatility. This chapter explores the external sector implications of energy price swings for the global economy and individual countries, differentiating among drivers behind the price swings as well as accounting for countries' energy importer or exporter status. Energy-importing countries bear the brunt of negative oil supply shocks. Nonetheless, they can resort to several policy tools to mitigate the adverse effects. Two newly emerging challenges arise from the clean energy transition and the possible shift in the correlation between the oil price and the US dollar.

Introduction

Commodity prices are one of the most volatile. Since 2000, real aggregate commodity prices have undergone three episodes of continuous rising by more than 30 percent.[1] Most recently, real commodity prices rose by about 150 percent between April 2020 and August 2022, led by a fivefold increase in the average price of energy commodities (oil, natural gas, coal).[2] This surge in energy prices was driven by the robust post-pandemic recovery and disruptions caused by Russia's invasion of Ukraine.

Commodity price swings carry broad implications for the global economy. Commodities, most notably energy commodities, account for a significant share of global trade, reflecting the fact that they are universally used and demanded while their production is geographically concentrated. Their price swings often exhibit a negative correlation with the US dollar (Figure 2.1). They are also key drivers of individual countries' terms of trade, which play a critical role for external adjustment as well as economic growth and business cycle fluctuations.[3]

Looking ahead, commodity-trading countries and the global economy will face two new challenges. The first is the clean energy transition, which requires a major transformation of the energy system with a shift away from fossil fuels to an increasing use of some critical metals, such as copper. The transition is expected to bring about permanent changes in the price of fossil fuels and critical metals and reshape trade flows, as the concentration in the production of most metals is even higher than that of fossil fuels. Second, the negative correlation between the oil price and the dollar has turned positive since 2020. If persistent, this shift in the correlation could carry substantial macroeconomic implications for the global economy and individual commodity-trading countries.

A better understanding of the causes and consequences of commodity price developments would improve the diagnosis of and responses to future volatile commodity price movements (see Chapter 1). With that aim, this chapter first documents the key characteristics of the price swings of 42 commodities. It then zooms in on energy price swings, the most volatile and prominent internationally traded group of commodities. Reflecting the prominence of oil among energy commodities, the chapter focuses on two key drivers of oil prices: global economic activity and oil supply shocks. The chapter examines their effects on the global economy and individual countries that are grouped into energy importers and exporters. For energy importers that face adjustment challenges due to limited international risk sharing, the chapter analyzes how their policies and country characteristics could mitigate

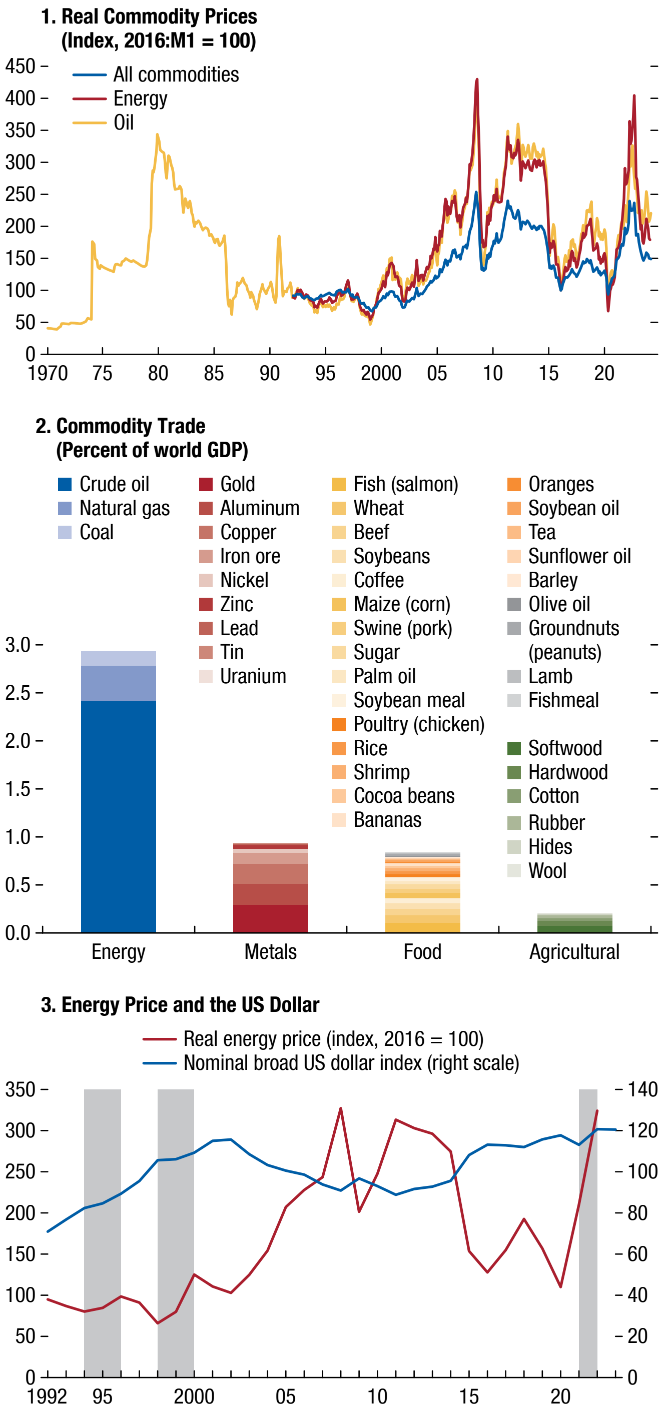
The authors of the chapter are Lukas Boer, Jiaqian Chen (lead), Keiko Honjo, Ting Lan, Roman Merga, and Cyril Rebillard, with contributions by Geoffroy Dolphin, Rafael Portillo, and Pedro Rodriguez, under the guidance of Jaewoo Lee. Santiago Gomez, Jair Rodriguez, Xiaohan Shao, and Brian Hyunjo Shin provided research support and Jane Haizel provided editorial assistance. Christiane Baumeister was the external consultant. The chapter has also benefited from comments by Gian-Maria Milesi-Ferretti, Andrea Pescatori, Martin Stuermer, internal seminar participants, and reviewers.

[1]Following the literature, real commodity prices are calculated by deflating the nominal price series from the IMF Primary Commodity Price System by the US consumer price index.

[2]See Box 2.1 for a discussion on the impact of the recent energy price shock on the EU manufacturing sector.

[3]For the impact of terms-of-trade shocks on growth, see Dehn (2000) and Collier and Goderis (2012). On business cycle fluctuations, see Mendoza (1995); Kose (2002); Aghion and others (2010); Fernández, Schmitt-Grohé, and Uribe (2017); and Schmitt-Grohé and Uribe (2018). On real exchange rate movements, see Chen and Rogoff (2003); Cashin, Céspedes, and Sahay (2004); and Ricci, Milesi-Ferretti, and Lee (2013). On international reserves, see Aizenman, Edwards, and Riera-Crichton (2012).

Figure 2.1. Commodity and the US Dollar



Source: IMF staff calculations.
Note: The real price index for a commodity group is the trade-weighted average of the global US dollar prices of the commodities in the group deflated by the US consumer price index. Energy commodity group includes oil, natural gas, and coal. Oil price refers to crude oil (petroleum), Brent, in US dollar. Commodity trade is the average of global gross commodity exports and imports. For panel 2, legend only displays selected commodities for clarity. The grey areas in panel 3 denote years when the US dollar and the real energy prices are positively correlated.

the adverse effects of energy price swings. Moreover, the chapter discusses the potential implications of a permanent shift to a positive correlation between the oil price and the US dollar on exchange rate policies and discusses potential effects of the clean energy transition on the exporters of fossil fuels and critical metals.

The chapter's main findings are as follows:

- *Commodity prices exhibit substantial swings, most prominently for the group of energy commodities.* For 42 commodities, the chapter identifies about 360 upswings and downswings since 1960. While price swings have comparable durations across commodities, the energy commodity group exhibits the most pronounced price swings, with prices almost tripling during a typical upswing and falling by as much during a downswing.
- *The effects of energy price swings on individual economies vary both with an economy's importer/exporter status in energy trade and with the source of energy price changes.* Higher energy prices are accompanied by current account improvements for energy exporters and deteriorations for energy importers, regardless of the source of energy price changes. However, when energy prices rise owing to stronger global economic activity or higher demand for oil consumption or inventories, output and consumption rise for both exporters and importers, despite the negative terms-of-trade effect for importers. When energy prices rise owing to a negative oil supply shock, exporters' output increases but importers' output and consumption fall, although some risk sharing occurs including via valuation gains in importers' net foreign assets.[4]
- *Energy importers' exposure to shocks to energy prices varies with their economic characteristics, as well as with global financial conditions.* The adverse effects of negative oil supply shocks on energy importers are mitigated by greater exchange rate flexibility, lower government debt, more anchored inflation expectations, stronger external positions, lower intensity of energy imports, and looser global financial conditions, which allow a smaller decline in consumption and a larger external borrowing (i.e., decline in the current account). Foreign investments

[4]It is left for future research to investigate the external implications of supply and demand shocks to nonenergy commodities. See, for example, Di Pace, Juvenal, and Petrella (forthcoming) and De Winne and Peersman (2021) for the effects of nonenergy commodity price shocks on economic activity.

in major oil-exporting economies represent another mitigating factor, which enables importing economies to partake of the economic improvement in exporting economies.

- *Following two decades of negative correlations, the relationship between the US dollar and the oil price has turned positive since 2020.* This change coincided with the shift of the United States from a net oil importer to a modest oil exporter in early 2020. It also coincides with periods of high global risk aversion, as well as a shift in foreign investor behavior: following an increase in the oil price, foreign investors tend to increase their holdings of US assets, in contrast to periods with a negative correlation. If permanent, this shift to a positive US dollar–oil price correlation could have several important implications. It would bring about, everything else being equal, larger terms-of-trade shocks due to oil prices for net oil importers with a floating exchange rate and greater financial stability risks for importers with short (net) exposure to the US dollar.
- *The clean energy transition is likely to pose challenges for both fossil fuel and critical metal exporters.* A permanently lower price for fossil fuel commodities brings about weaker GDP growth and initial improvement in the current account for exporters. A permanently higher price for critical metals would trigger an initial investment boom in exporting countries that worsens their current accounts and gradually improves output.

These findings add to the literature on macroeconomic analyses of oil prices in several dimensions. First, empirical evidence on the impact of oil supply and global economic activity shocks on an extensive list of macro and external sector variables is provided. In particular, the empirical literature on external sector effect provides mixed results. For instance, Kilian, Rebucci, and Spatafora (2009) find oil supply shocks to have opposite effects on current account balances of oil importers and exporters which are statistically significant only after four years, while Allegret, Mignon, and Sallenave (2015) find the effect to be of opposite sign for two net oil importers, China and the euro area, and Lebrand, Vasishtha, and Yilmazkuday (2024) find effects of the same sign for both importers and exporters. This chapter provides empirical evidence that is in line with the more consensual results derived from the theoretical literature, such as Bodenstein, Erceg, and Guerrieri (2011), who analyze the repercussions of a negative oil supply shock on the United States (then a large net oil importer) using a two-country structural model. The chapter also illustrates the main transmission channels via multiregion model simulations for a set of key empirical findings. This chapter's econometric approach uses a large panel of exporters and importers to strengthen the estimation of the average impact of different drivers of oil prices. Last, this chapter explores how the impact varies across importers' structural characteristics and policy regimes in a comprehensive manner relative to the extant literature.

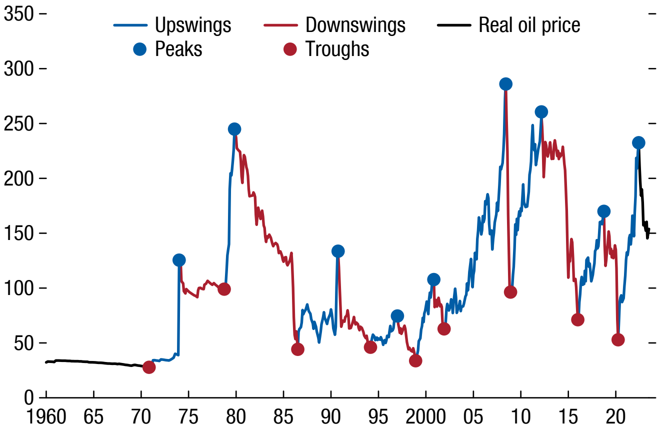
The rest of the chapter is structured as follows. The first section presents stylized facts on key features of commodity price swings. The second section estimates the impact of oil supply and global activity shocks—two prominent drivers of energy price swings—on energy importers and exporters. The empirical analysis is complemented by model-based simulations, allowing for a fuller discussion of the transmission mechanisms. The third section discusses the correlation between the oil price and the US dollar, while also discussing the implications of the clean energy transition for fossil fuel and critical metal exporters, underscoring potential challenges and benefits for the latter. The final section concludes.

Features of Commodity Price Swings

This section documents real commodity price swings and their key features, including the duration and magnitude for all commodities from the IMF Primary Commodity Price System and four commodity groups (energy, metals, food, agricultural).[5] The analysis adopts the standard business cycle (Burns and Mitchell 1946; Bry and Boschan 1971; Harding and Pagan 2002) and commodity price swings (Cashin and McDermott 2002) dating procedures to define the upswing and downswing phases with three modifications. First, the time series is not filtered to avoid the potential loss of some large, but short-lived, price fluctuations and to be independent of the filtering methods. Second, the analysis imposes no minimum duration, thereby capturing the sharp oil price

[5]Commodity group prices are calculated as the weighted average of individual commodity prices based on the average of global import share of 2014–16.

Figure 2.2. Real Oil Price Swings
(Index, 2016 = 100)



Sources: Bureau of Economic Analysis; IMF, Primary Commodity Price System database; and IMF staff calculations.
Note: Real oil prices are calculated by deflating the nominal price series by the US consumer price index.

downswing during the global financial crisis, which lasted only six months. Third, as a consequence from the absence of a minimum duration, a larger window (±24 months compared to around ±5 months in the business cycle literature and ±2 months in Cashin and McDermott 2002) is used to identify peaks and troughs.

Amid a strong co-movement among commodity prices, the energy commodity group displays the most pronounced swings. The chapter identifies 362 upswing and 363 downswing phases for 42 commodities over the period from 1960 to 2023 and documents strong co-movements between commodity prices (Box 2.2). While price swings have comparable durations across commodities, energy commodities stand out regarding the magnitude of price swings, which tend to be more pronounced than for other commodities. Energy prices typically triple during an upswing episode and fall almost as much in a downswing (Figure 2.2). In contrast, other commodity prices "only" double and nearly halve during upswings and downswings.[6]

[6]The magnitude of a commodity price increase (decrease) during a typical upswing (downswing) increases with the window size that is used to identify the upswing (downswing), as, typically, the larger the window size, the longer the average duration. However, the findings—that commodity price swings tend to display similar duration, and energy prices exhibit larger swings than other commodity prices—are robust to different window sizes.

Zooming In on Energy Price Swings

Empirical Analysis: Sources of Energy Price Swings and Impact

Energy prices are determined by the global interplay of supply and demand conditions. The effects of energy price changes on macroeconomic variables depend on their underlying drivers, as shown in the seminal paper by Kilian (2009) for oil prices. Following this literature (see, also, Kilian and Murphy 2014; Baumeister and Hamilton 2019; and Känzig 2021), the chapter focuses on the impact of underlying drivers of oil prices. The focus on oil prices is motivated by the observed strong co-movement between the prices of energy commodities (Box 2.2). Underlying drivers of oil prices are uncovered from the structural vector autoregression (VAR) for the global crude oil market in Baumeister and Hamilton (2019).[7] The VAR is estimated with monthly data on global crude oil production, real oil prices, inventories, and global industrial production from January 1995 to May 2023.[8] To identify the structural shocks, the VAR leverages insights from the economic theory on how its variables respond to a given structural shock (sign restrictions) and existing empirical estimates on oil demand and supply elasticity—how production and consumption respond to exogenous price changes (prior information; see Baumeister and Hamilton 2019 for further detail). It uncovers four structural drivers of oil prices: a global economic activity shock that alters the demand for all commodities, including oil; an oil consumption demand shock that could, for instance, capture changes in the preference for oil relative to other energy inputs; an oil inventory demand shock that reflects changes in demand due to precautionary concerns about future oil supply and demand condi-

[7]Most empirical analyses reported in this chapter are robust to the use of alternative global economic activity and oil supply shocks identified in the oil market VAR literature, including Baumeister and Hamilton (2023), Känzig (2021), and an updated identification along the lines of Kilian and Murphy (2014) as described by Zhou (2020) (see Online Annex 2.6). This chapter relies on Baumeister and Hamilton (2019) as the baseline, since it is the most recent comprehensive global oil market model estimated in the literature and relies on the global industrial production index instead of a freight rate index–derived measure for global economic activity, considering that the COVID-19 shock created a break in the historical relationship between global activities and freight rates.

[8]The data are adjusted to account for extreme observations during the COVID-19 pandemic (see Lenza and Primiceri 2022 and Online Annex 2.3 for more information).

tions; and an oil supply shock that is determined by an exogenous change in the production of oil.

The rest of the chapter focuses on two of the identified structural shocks. First, it focuses on global activity shocks, as those are highly correlated with the global factor that accounts for a significant share of the variation of a broader set of commodity prices (Box 2.2; Delle Chiaie, Ferrara, and Giannone 2022). Second, it focuses on oil supply shocks as they pose adjustment challenges for energy importers, which constitute the majority of world economies.[9]

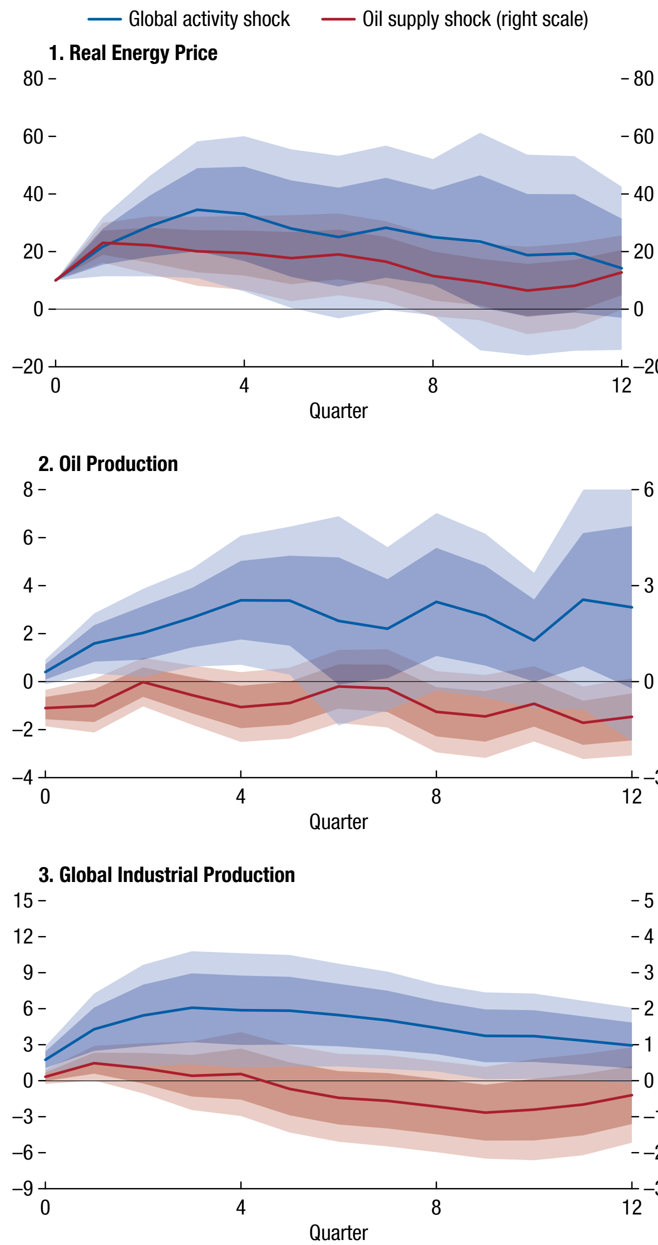
A local projections (LP) approach is used to estimate normalized impulse responses to different drivers of energy price variation (Jordà 2005; Jordà, Schularick, and Taylor 2015; Stock and Watson 2018). This chapter's approach, detailed in the online annexes, uncovers impulse responses to the structural shocks that are scaled to increase the energy price by 10 percent on impact. In contrast to the conventional VAR practice, this approach directly regresses the macroeconomic variables at future horizons on the current (and lagged) shocks, instead of extrapolating them from estimated VAR coefficients, and normalizes the unit effect of the structural shock rather than its unit standard deviation.[10]

Responses of Real Energy Prices, Oil Production, and Global Industrial Production

The first set of regressions estimates the propagation of oil supply and global economic activity shocks to real energy prices, global oil production, and global industrial production over the 1996:Q1 to 2023:Q2 sample period.[11] The regression controls for four lags of the log changes in the global variable of interest, as well as for contemporaneous and one-quarter lag of the other shocks in the global oil market VAR. The results are presented in Figure 2.3.

The shocks have transitory, though persistent, effects on energy prices and other global variables. Following a positive global activity shock that increases the real energy price by 10 percent on impact, global industrial production increases by about ¾ percent on impact, peaking after one year before converging to zero after another year. The strong global activity leads to a period of elevated energy prices, with the effect peaking three quarters after the shock and remaining (statistically) significant for about eight quarters. In response, oil production picks up gradually and remains positive and statistically significant for about six quarters. In contrast,

Figure 2.3. Effects of Oil Supply and Global Activity Shocks
(Percent)



Source: IMF staff calculations.
Note: Impulse responses show the effects of oil supply (in red) and global activity (in blue) shocks that increase real energy price by 10 percent on impact with 68 and 90 percent confidence intervals.

[9]The effects of oil consumption demand and inventory demand shocks on global variables and on energy exporters and importers are similar to those of global activity shocks and are reported in Online Annex 2.5.

[10]See Online Annexes 2.1, 2.2, and 2.3 for technical details, including on the use of instrumental variables local projections (LP-IV) for the unit effect normalization (Stock and Watson 2018). See Li, Plagborg-Møller, and Wolf (2024) for a discussion of advantages and disadvantages of LP vis-à-vis VAR.

[11]Quarterly oil shock series are computed as averages of the monthly shocks following Kilian, Rebucci, and Spatafora (2009).

a negative oil supply shock brings about a decline in global industrial production by 1 percent after eight quarters, following some uptick in the initial quarter.[12] Oil production falls somewhat more persistently, with the effects remaining statistically significant for three years, probably reflecting the long-lasting effect of supply disruptions. Nonetheless, the response of energy prices resembles the tapering (or hump-shaped) response as in the case of global activity shock, with the peak effect reached slightly earlier.

Given the transitory or tapering effects of underlying shocks on energy prices and production, exporters' current accounts can be expected to improve following an energy price increase, as saving would increase to smooth consumption, and vice versa for energy importers. This expectation is borne out in the subsequent empirical results.[13]

Impact on Exporters versus Importers

This subsection examines the impact of the two shocks on individual economies, grouped into energy exporters and importers.[14] Adding a country fixed effect to the previous specification, the effects on real, external, and financial variables are estimated across a large sample of net energy exporters and importers covered by the IMF's External Balance Assessment. The substantial cross-sectional dimension helps tighten the estimation of average effects for exporters and importers.

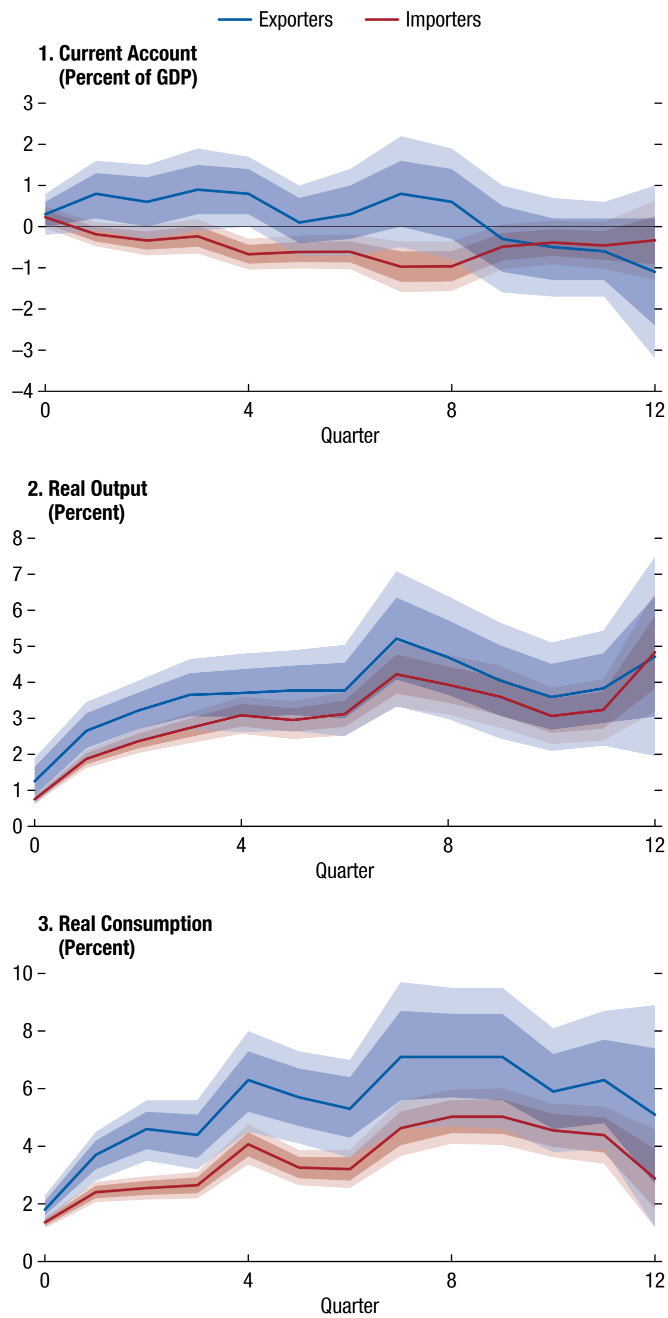
When energy prices increase by 10 percent (on impact) owing to a positive global activity shock, the average of exporters' current account balances as a share of GDP improves by 1 percentage point after four quarters (Figure 2.4). Importers' current account balances gradually decline to reach a comparable size (–1 percentage point) in two years. Reflecting consumption smoothing, exporters' saving increases temporarily with higher export revenues, thereby offsetting the effects of gradually increasing investment on

[12]This initial uptick appears to be the combined outcome of energy exporters benefiting from favorable terms-of-trade effects and importers initially running down their inventories to mitigate the adverse effects of higher energy prices.

[13]In addition to these familiar effects of transitory shocks, classical intertemporal models imply that an exporter's current account balance could deteriorate initially if shocks were to have permanent positive effects on energy prices. For analogous examples discussed for permanent productivity shocks, see Obstfeld and Rogoff (1995) or Aguiar and Gopinath (2007). Arzeki, Ramey, and Sheng (2017) is a case of large oil discoveries.

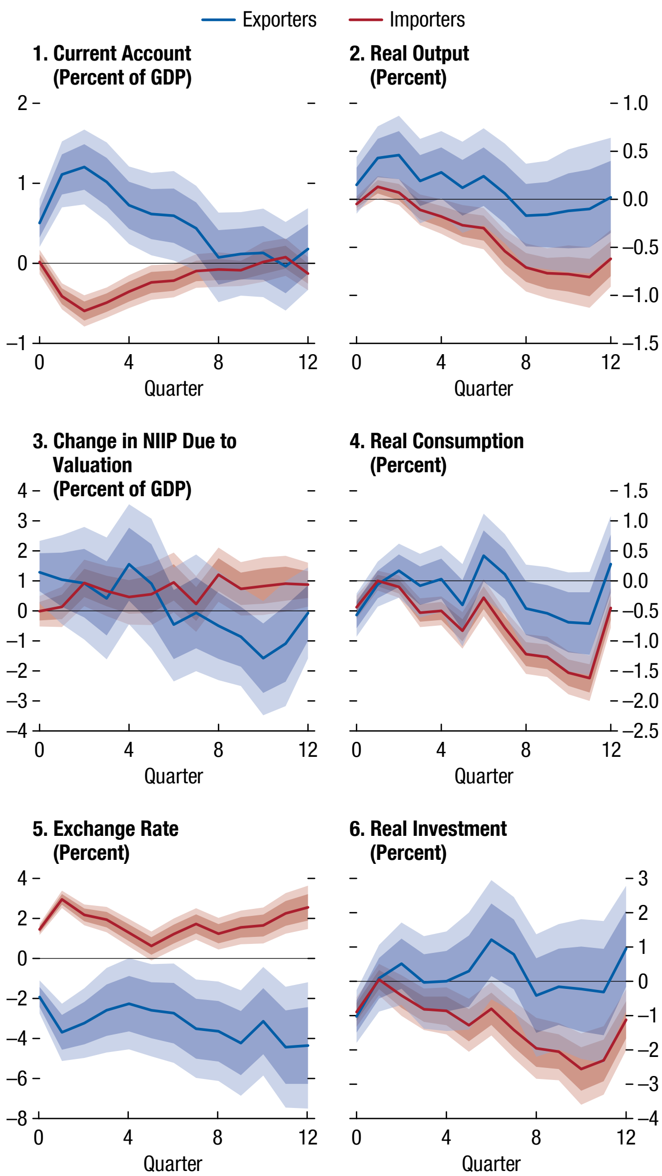
[14]A country is classified as a net energy exporter (importer) if its median net energy export share over the sample period is above (below) zero. In total, our sample encompasses 11 net energy exporters and 33 net energy importers (see Online Annex Table 2.4.1 for the full list of sample countries). As a robustness check of the country group, the baseline local projection estimations are rerun using a sample of large (top 25th percentile) and small (bottom 25th percentile) net energy importers. The estimation results suggest the analysis is robust to a more selective criterion for importers. Specifically, the impact of an oil supply shock on importers is broadly proportional to the importer's net energy trade balance, with no evidence of nonlinearity (see Online Annex 2.4).

Figure 2.4. Effects of Global Activity Shocks on Energy Exporters and Importers



Source: IMF staff calculations.
Note: Impulse responses show the effects of a global activity shock that increases real energy price by 10 percent on impact with 68 and 90 percent confidence intervals.

Figure 2.5. Effects of Oil Supply Shocks on Energy Exporters and Importers



Source: IMF staff calculations.
Note: Impulse responses show the effects of an oil supply shock that increases real energy price by 10 percent on impact with 68 and 90 percent confidence intervals. The exporter's nominal exchange rate is measured as the local currency against the US dollar, while the importer's nominal exchange rate is measured as the local currency against the Norwegian krone. Valuation changes are calculated as the difference between change in net international investment position (NIIP) and current account.

current account balances. Meanwhile, importers' saving changes little while consumption and investment increase gradually. Despite the contrasting responses in external balances, other macro variables that include real output, consumption, investment, inflation, and fiscal balances increase for exporters and importers alike. However, higher energy prices lead to a more modest increase in consumption, investment, and output for energy importers. Consequently, importers' interest rates rise to a lesser extent, resulting in depreciation of their exchange rates relative to energy exporters.

In contrast, when energy prices increase by 10 percent due to a negative oil-supply shock, importers bear the brunt of the shock, given the inelastic demand for energy and limited international risk sharing. Current account balance decreases (increases) for energy importers (exporters), reflecting the negative (positive) terms-of-trade effects. The average importer's current account balance as a share of GDP falls by about 0.5 percentage point two quarters after the shock, accompanied by a decline in saving that reflects consumption smoothing. Exchange rate depreciations help improve the nonenergy trade balance and bring about positive valuation effects on the net international investment position. Capital inflows to the private sector, in the form of portfolio debt, aid the adjustment, while capital inflows to the public sector decline despite a higher fiscal deficit. Despite several insulating channels against higher energy prices, importers' real consumption, investment, and output fall by about 1.5, 2.5, and, 0.8 percent, respectively, after two years. In contrast, exporters' consumption remains broadly unchanged for the first two years, indicating a limit to international risk sharing (Figure 2.5).

Energy Importers under Oil Supply Shocks

Given the significant adverse effects of oil supply shocks on importers, this subsection explores policy and economic factors that influence the ease of adjustment by energy importers. Following Ramey and Zubairy (2018) and Jordà (2023), a state-dependent local projection approach is used, allowing for differential responses evaluated at different policy and country characteristics. A wide range of policy and country characteristics can be explored, thanks to the large variation in the panel data.[15] Considering that negative oil supply shocks could be associated with tighter global financial conditions, this subsection also explores how these effects differ under various financial conditions.

Tighter global financial conditions weaken importers' capacities to borrow, necessitating greater adjustments

[15]State-dependent responses are estimated either by splitting the sample into corresponding subgroups or by interacting energy price changes with the continuous variable of interest and evaluating the impulse responses using the variable's value at its 75th and 25th percentiles. Online Annex 2.2 reports details of the regression specification as well as additional results.

to the higher energy prices, including sharper reductions in consumption and investment. The current account deteriorates by less, reflecting the weaker domestic demand (Figure 2.6).[16] Financial tightening associated with US monetary shocks leads to a more gradual downward adjustment in consumption and investment than financial tightening associated with higher global risk aversion, reflecting a more gradual transmission of monetary policy shocks (Online Annex 2.7).

Cross-border investment in energy-exporting countries allows importing economies to share the economic gains. Importers with higher foreign direct investment in energy-exporting countries are found to experience more positive valuation effects on their net foreign assets. This positive wealth effect allows importers to reduce consumption and investment by less, together with a larger decline in the current account (Figure 2.6).

Lower government debt allows greater borrowing for energy importers, facilitating a smoother adjustment to the higher energy prices, including a more moderate decline in consumption and investment. Importers with lower government debt experience a smaller increase in borrowing costs and higher capital inflows to both the private and the public sectors, keeping the credit to the nonfinancial sector broadly unchanged. The lower decline in consumption and investment is accompanied by a larger decline in the current account (Online Annex Figure 2.8.1).

More flexible exchange rate regimes allow the exchange rate to play a greater shock-absorbing role.[17] Importers with more flexible exchange rate regimes exhibit a sharper currency depreciation, higher exports, and shallower declines in consumption and output. The central bank raises interest rates by less, helping reduce a decline in the credit to the nonfinancial sector (Online Annex Figure 2.8.1).

Better-anchored inflation expectations enable central banks to adopt a more accommodative policy stance, providing more support to the real economy. Higher energy prices increase importers' inflation both directly and indirectly via second-round effects. When inflation expectations are better anchored, second-round effects are better contained and the central bank can adopt a more accommodative policy stance. This supports investment and consumption better and allows the exchange rate to depreciate more to absorb the shock (Figure 2.6).

Importers with stronger external positions experience larger capital inflows, shallower declines in consumption and investment, and larger deteriorations in their current account balances. Stronger external positions, measured by the IMF staff current account gap greater or equal to −1 percent of GDP, can reduce financing risks associated with running more negative current account balances, thereby allowing importers to mitigate the impact of rising energy prices (Online Annex Figure 2.8.1).

Among other examined country characteristics, a lower dependence on energy imports mitigates the negative effects for importers.[18] Importers with a lower dependence on energy imports experience smaller terms-of-trade effects and less deterioration in energy trade balance. Their consumption, investment, and real output decline less (Figure 2.6).

Model Simulations: Shocks and Price Swings

This subsection uses the IMF's Flexible System of Global Models (FSGM) to examine the impact of two structural shocks—an increase in global demand and a decrease in global oil supply—on the global economy and on a net oil exporter and importer. It also explores how two characteristics—lower government debt and less flexible exchange rate regimes—can change the effect of oil supply shocks on oil importers. The model-based simulations illustrate the main transmission channels and complement the analysis in the previous subsection, which empirically looks at the impact of these shocks.

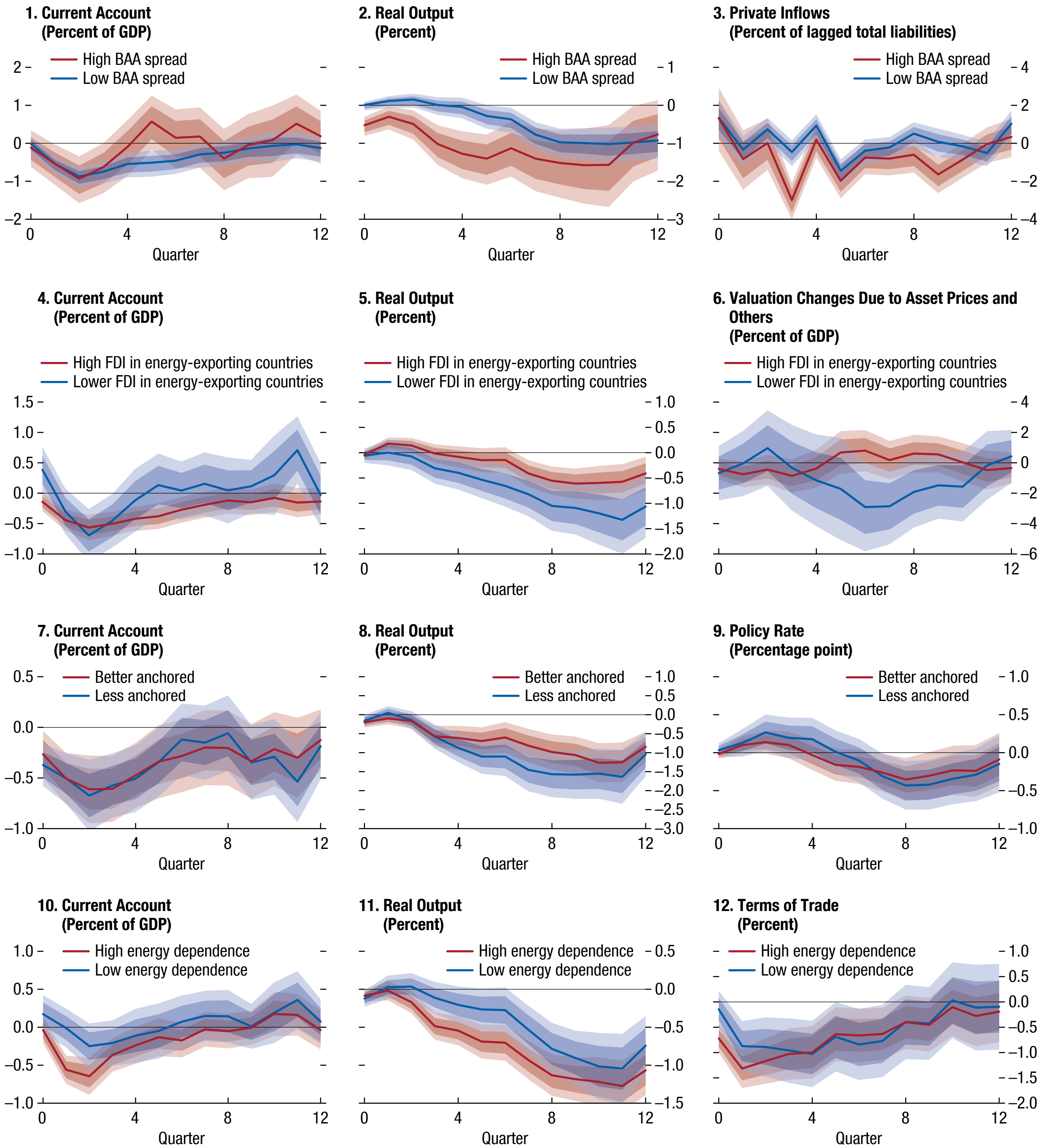
FSGM is an annual multiregion model of the global economy that combines micro-founded and reduced-form formulations of economic sectors and relationships. The analysis presented in this chapter uses the G20MOD module of the FSGM, which includes every Group of Twenty (G20) economy and five additional regions to cover the remaining countries in the world.

[16]Following Juvenal and Petrella (2024), this analysis uses BAA spread as an indicator of global financial conditions. It measures the difference between the yield of 10-year US treasuries and Baa-rated corporate bonds.

[17]Using a measure of exchange rate flexibility developed by Ilzetzki, Reinhart, and Rogoff (2019), an importer is categorized as having a flexible exchange rate if its currency floats freely. The analysis reclassifies euro area countries as having a flexible exchange rate regime. Importers who are using the US dollar as a currency anchor are excluded from the analysis.

[18]This chapter explores a range of other characteristics for which no conclusive results are obtained. These characteristics include income per capita, institutional quality, default risks, external debt, and bond yields.

Figure 2.6. Effects of Oil Supply Shocks and Selected Country Characteristics



Source: IMF staff calculations.
Note: Impulse responses show the effects of an oil supply shock that increases real energy price by 10 percent on impact with 68 and 90 percent confidence intervals. High/low BAA spread represents the impact of an oil supply shock evaluated with BAA spread at its 75th/25th percentile. High FDI in energy-exporting countries refers to importers with FDI in Saudi Arabia as a share of GDP above the median of all importers. Valuation changes due to asset prices and other statistical changes reflect the change in valuation excluding changes due to exchange rate movements (see Allen, Gautam, and Juvenal 2023). Better/less anchored inflation expectations refer to energy importers with their measure in Bems and others (2021) at the 75th/25th percentile. High/low dependence denotes importers with their median energy import share at the 75th/25th percentile of the sample median. FDI = foreign direct investment.

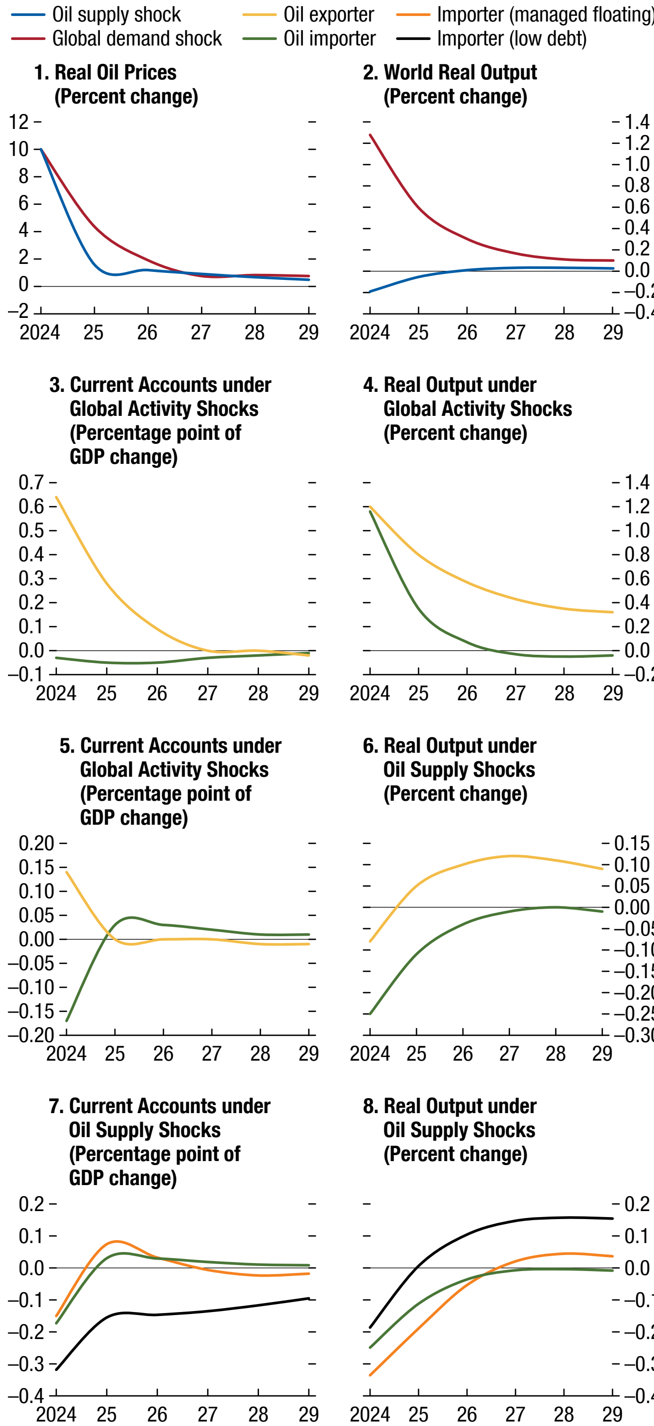
The following model features are particularly relevant for the chapter's analysis (see Andrle and others 2015 for a detailed discussion of the FSGM).

- *Commodity sector.* The model incorporates three types of commodities—oil, food, and metals, whose prices are determined by global supply and demand conditions. Commodity prices affect real economic activity primarily through three channels: (1) higher commodity prices lead to higher inflation which deflates real household income and wealth, (2) higher commodity prices increase cost of production and decrease hiring by firms, and (3) higher commodity prices can trigger second-round effects, leading central banks to tighten monetary policy. Commodities are priced in US dollars.
- *Monetary authorities and interest rates.* For most countries, monetary policy is represented by an interest rate reaction function (an inflation-forecast-based rule), operating under a flexible exchange rate regime. The reaction function can be also adjusted to replicate less flexible exchange rate regimes. Interest rates, including those relevant for consumption and investment, are related to the monetary policy rate but subject to various risk premiums.
- *External sector.* Domestic and foreign trading partners' demand and exchange rate determine exports and imports. Investment decisions of firms, saving decisions of households, and fiscal policy determine the current account. Exchange rates are determined by the interest rate parity condition in the short run and by external sustainability in the long run.

The model simulations consider a temporary shock to private domestic demand that is applied equally to all countries and an exogenous temporary reduction in oil supply that is applied equally to all oil-producing countries, leading to a temporary increase in oil prices. Both shocks are calibrated such that real global oil prices increase by 10 percent on impact. Figure 2.7 presents the simulation results on key variables for an oil exporter and importer, both with a flexible exchange rate regime.

The global activity shock is associated with an increase in output for both exporters and importers, while raising oil prices. Higher oil prices improve the current account of oil exporters and initially deteriorate the current account of oil importers, while output and consumption of both exporters and importers increase on the force of global activity (demand) shock. Higher aggregate demand raises inflation, prompting monetary

Figure 2.7. Impulse Responses to an Oil Supply and a Global Activity Shock in the Flexible System of Global Models



Source: IMF staff calculations.
Note: The panels depict the impact of oil supply and global activity shocks on real oil prices, world real output, and on a representative oil exporter and importer. Moreover, the impact of oil supply shocks on importers with lower government debt and more fixed exchange rate regime (managed floating) are illustrated in panels 7 and 8.

authorities to raise policy rates. For oil importers, however, higher oil prices lead to a more moderate improvement in consumption, investment, and output. Their exchange rates depreciate vis-à-vis oil exporters, because their interest rates rise less. The depreciation improves the non-oil trade balance of importers, albeit falling short of offsetting the decline in the oil trade balance.

A negative shock to oil supply raises oil prices while lowering global output, thereby creating a divergence between oil importers and exporters. Faced with a higher headline inflation and a weaker terms of trade, oil importers experience a decline in household real income and consumption, lower investment by firms, and a negative output gap. The central bank eases in response to economic downturn, also reflecting a limited pass-through of oil prices to core inflation. Despite the currency depreciation and weak growth that help with net exports, the current account balance deteriorates due to a higher energy import bill. In contrast, higher oil prices bring about increased consumption, investment, output, and current account in oil-exporting countries.

An importer with lower government debt tends to experience tapered adverse effects following negative oil supply shocks. Faced with lower borrowing costs (reflecting lower risk premiums due to lower government debt), firms reduce investment and employment to a lesser extent, resulting in higher real wages and household consumption than those with higher government debt. Consequently, the stronger domestic demand, compared with importers that have higher government debt, leads to higher inflation and monetary tightening, which in turn appreciates the currency. The stronger currency and domestic demand dampen exports and strengthen imports, worsening net exports and expanding external borrowing.

Importers with less flexible exchange rate regimes (managed floating) are associated with larger adverse effects. In response to the exchange rate depreciation following oil supply shocks, the central banks raise policy rates to stabilize the exchange rate. Higher interest rates dampen consumption and output and reduce the depreciation of importer currency, with the latter reducing the medium-term improvement in the current account.

The econometric and model analyses illustrate the policies that importers can use to mitigate some adverse spillovers from energy price swings (see also Box 2.1). More anchored inflation expectations and a more flexible exchange rate regime enable central banks to implement a more accommodative monetary policy and allow the exchange rate to act more forcefully as a shock absorber that provides support to the domestic economy. Lower government debt and stronger external positions help maintain investors' confidence, thereby enhancing importers' ability to borrow and mitigate the adverse effect on consumption and investment, with less need to curtail domestic demand. Finally, policies aimed at reducing energy imports, such as improvements to energy efficiency, would help limit importers' exposure to energy price swings.

Looming Challenges

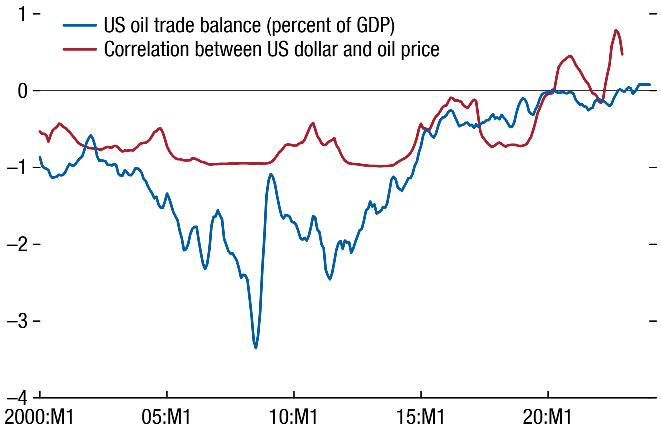
Energy price swings have traditionally been posing a greater adjustment challenge for energy importers than for exporters. While importers had to grapple with limiting the adverse consequences of negative supply shocks, exporters have benefited from the boost to prices that added to their buffers. In the coming years, however, two emerging changes could alter the landscape of the global energy and critical metal markets, potentially posing new adjustment challenges to exporters of these commodities as well as to importers. One is the reversal of the traditional negative correlation between the oil price and the US dollar, which would most likely amplify the volatility of terms of trade resulting from energy price swings, as energy commodities are priced primarily in US dollars. The other is the clean energy transition that can have lasting effects on the exporters of fossil fuels and several critical metals. This section discusses several leads on external sector developments and potential policy implications of these two emerging changes, while they harbor large uncertainty and would be intertwined with individual country characteristics, calling for further analysis.

Oil Price and the US Dollar

Following two decades of stable and negative correlation, the correlation between the oil price and the US dollar has turned positive since 2020 (Figure 2.8). The observed change can be related to three developments without excluding complementary or alternative explanations (Box 2.3).[19] First, the shift of the United

[19]Another possible explanation could be related to the strong US economy in the recent period, which has led to higher interest rates and a stronger US dollar, while the strong US economy could have contributed to raising oil prices via positive spillovers to the global economy.

Figure 2.8. US Oil Trade Balance and Rolling Correlations between Oil Price and the US Dollar



Sources: Federal Reserve Board; IMF, Primary Commodity Price System database; Trade Data Monitor; and IMF staff calculations.
Note: The red line illustrates the rolling correlation between oil price and the US dollar with a 36-month window spanning from January 2000 to May 2023. The blue line represents the US oil trade balance.

States to a net exporter of oil since early 2020 offers one potential explanation. Second, the BAA spread also helps to account for the positive correlation since 2020, suggesting a relevant role of global risk aversion. Another contributing factor (potentially related to the second) can be found in the change in foreign investors' purchases of US assets. Since 2020, foreign investors tended to increase their holdings of US assets—predominantly US treasuries—following an oil price increase. This increase in the demand for US assets can exert upward pressure on the US dollar, all else being equal. If this change in investment behavior were due to the heightened risk aversion following the COVID-19 pandemic, its effect on the positive correlation could dissipate, while there could be other more persistent causes of the change in investment behavior. In contrast, the transition of the United States to a net energy exporter would likely have a more persistent effect.

If the shift to a positive correlation between the US dollar and the oil price were to be permanent, it could strengthen the stabilizing role of the exchange rate for an oil exporter that pegs its currency to the dollar. As the currency appreciates with the oil price increases, it helps cool the economy and stave off inflation pressure. There arises less need for fiscal tightening. The reverse channel operates when the oil price decreases. While the strength of this channel depends on country characteristics, including the degree of economic diversification, the change in the correlation will likely add the stabilizing role to the traditional benefit of pegging in terms of providing a robust nominal anchor (Frankel 2019).

On the downside, the shift in the US dollar–oil price correlation from negative to positive numbers could call for a reassessment on the currency composition of government's external assets and liabilities, in terms of the trade-off among multiple objectives. For countries with sovereign wealth funds long on the US dollar, owing to the higher share of dollar-denominated assets, the valuation change of their external wealth moves in the same direction as the oil price, which will likely increase the cost (in US dollar terms) of fiscal stimulus when the oil price falls (compared to the situation with a negative correlation between the US dollar and the oil price).[20]

For net oil importers with a floating exchange rate, the positive US dollar–oil price correlation would amplify the terms-of-trade shock due to oil prices. They face the dual challenge of rising oil prices (in US dollar terms) and a weaker local currency vis-à-vis the dollar. A tighter monetary policy than under a negative US dollar–oil price correlation could be needed to head off higher inflation in spite of larger real income falls. The negative consequences on output are likely to be larger in countries with larger second-round effects that would require tighter monetary policy (see Chapter 2 of the October 2022 *World Economic Outlook*).

Downward pressure on activity will be partly offset by the export stimulus coming from the depreciated currency (vis-à-vis the dollar), especially if exports are priced in the producer currency. This offset via exports will be curtailed if exports are predominantly priced in the US dollar. On the other hand, the import-reducing effect of the depreciated currency would be larger if imports are priced in the US dollar rather than in local currency or non-US-producer currency (Gopinath and Itskhoki 2022).

For oil importers with short (net) exposure to the US dollar, the positive US dollar–oil price correlation means that a depreciation of the local currency (vis-à-vis the dollar) will tend to have a negative valuation effect, leading to a higher cost of servicing foreign currency–denominated liabilities (Krugman 1999). These negative balance sheet effects can also threaten

[20]For some of the Gulf Cooperation Council countries (Kuwait, Qatar, Saudi Arabia, United Arab Emirates) and other oil exporters (Iraq, Libya) during oil price drops in 1978, 2008, and 2014, fiscal policies turned procyclical due to lack of fiscal space (see Mazarei 2024).

financial stability (Bruno and Shin 2015). According to Allen, Gautam, and Juvenal (2023) and the 2023 *External Sector Report*, the share of emerging markets falling in this category, on the basis of aggregate balance sheets, has been shrinking over the past two decades. However, vulnerabilities remain in some countries, in particular with currency mismatches in portfolio debt. For net oil importers with their currency pegged to the US dollar, the positive correlation will hamper the exchange rate's ability to cushion the effects from oil price swings.

Clean Energy Transition

The clean energy transition requires a major transformation of the energy system from fossil fuels to renewable energy. Global fossil fuel production and consumption would need to decrease substantially to limit global temperature increases below 2 degrees Celsius by 2050. At the same time, the clean energy transition would substantially boost the demand for critical metals such as copper, nickel, cobalt, and lithium, which are key materials for renewable energy facilities and electric cars (see, for example, Chapter 3 of the October 2023 *World Economic Outlook*).

The transition would entail a mix of policies that constitute shocks to commodity markets. Given the large uncertainty around policies and technological changes, a stylized analysis in Box 2.4 models the energy transition as a permanent change in the relative price of fossil fuels and critical metals, which results from a mix of policies that reduce the demand for fossil fuels and increase demand for critical metals. The clean energy transition is likely to bring about initially stronger current account balances and gradually weakening economic performance for fossil fuel (for example, oil) exporters and the opposite effects for critical metal (for example, copper) exporters.

In light of major shifts in energy-related global commodity trade arising from the clean energy transition, exporters need to formulate adequate policy responses to address the economic consequences. For fossil fuel exporters, the transition will involve a reallocation of resources across sectors, as the extractive industries, as well as those that rely heavily on carbon-intensive inputs, would be the most affected (Chen and others 2020). Policymakers will need to facilitate this reallocation of resources, including via active labor market policies focused on job search assistance and retraining to help workers in the fossil fuel industry transition to new sectors. More generally, structural reforms to create a policy environment in which the private sector can respond more dynamically to opportunities would facilitate the growth of private businesses in other less-carbon-intensive and emerging green sectors (see Budina and others 2023; Mesa Puyo and others 2024 for further discussion). Critical mineral exporters, on the other hand, should mitigate the risks of the resource curse by improving their fiscal capacity to prudently manage the windfalls from higher commodity exports and reducing structural barriers to promote economic diversification (IMF 2012; Chapter 4 of the April 2012 *World Economic Outlook*).

Conclusion

This chapter documents the key characteristics of commodity price swings and takes an in-depth look into the consequences of shocks to energy prices, given their high volatility and the critical role of energy commodities in the global economy. While commodities generally experience comparable durations of price swings, energy commodities exhibit more pronounced swings, with prices nearly tripling during a typical upswing and falling by as much during a subsequent downswing. Many countries rely on imports for their critical need for energy, given its high geographic concentration of production. As a result, shocks to energy prices have appreciable effects on the global economy and the adjustment in external balances.

The effect of energy price swings varies both with the source of shocks to energy prices and with the characteristics of individual economies. When hit by a negative oil supply shock, energy prices increase, and energy importers face the unenviable challenge of cushioning the adverse effects on the economy and trade balances. Possible mitigating policy responses include greater exchange rate flexibility, lower government debt, and having a stronger external buffer, among others. Policies that promote greater financial integration, including strengthening the global financial safety net, could foster greater international risk sharing and reduce the adverse effects on energy importers. When hit by other shocks that increase energy prices, such as stronger global activity, importers fare worse than exporters but do not face as large adverse consequences, with output and consumption still rising, though less than those of exporters.

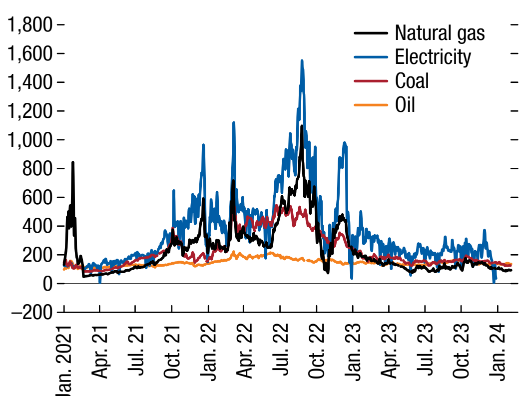
Going forward, close attention is warranted for the evolving correlation between the US dollar and the oil price and for the implications of the clean energy transition for affected commodity exporters. Were the correlation between the US dollar and the oil price to permanently change to a positive one (in a break from the negative correlation over the last two decades), dollar-pegging oil exporters could see a marginal increase in the cost of conducting countercyclical fiscal policies during a decline in oil prices. Oil importers would experience larger terms-of-trade shocks due to oil prices and be subject to larger financial stability risks in countries with net short exposure to the US dollar. Were the clean energy transition to proceed at the desired speed, fossil fuel exporters would need to facilitate the reallocation of resources toward low-carbon sectors, while critical mineral exporters should enhance their fiscal capacity to manage windfalls from higher commodity exports, complemented by structural policies to promote economic diversification.

Box 2.1. Impact of the Recent Energy Price Shock on the EU Manufacturing Sector

The European Union, as a significant net energy importer, faced a monumental challenge when Russia's invasion of Ukraine triggered an unprecedented increase in energy prices amid supply disruptions. At their peak in August 2022, the wholesale prices of natural gas, coal, and electricity skyrocketed by 1,100 percent, 600 percent, and 1,600 percent, respectively, compared to their 2019–21 average (Figure 2.1.1). This box delves into the repercussions of this energy price upheaval on the energy costs—measured by the share of energy expenditures in gross value added—of the manufacturing sector—one of the sectors most profoundly affected by such shocks—across a multitude of European economies. This box makes a compelling case study to explore the ramifications of supply-driven energy price swings on a major net energy importer.

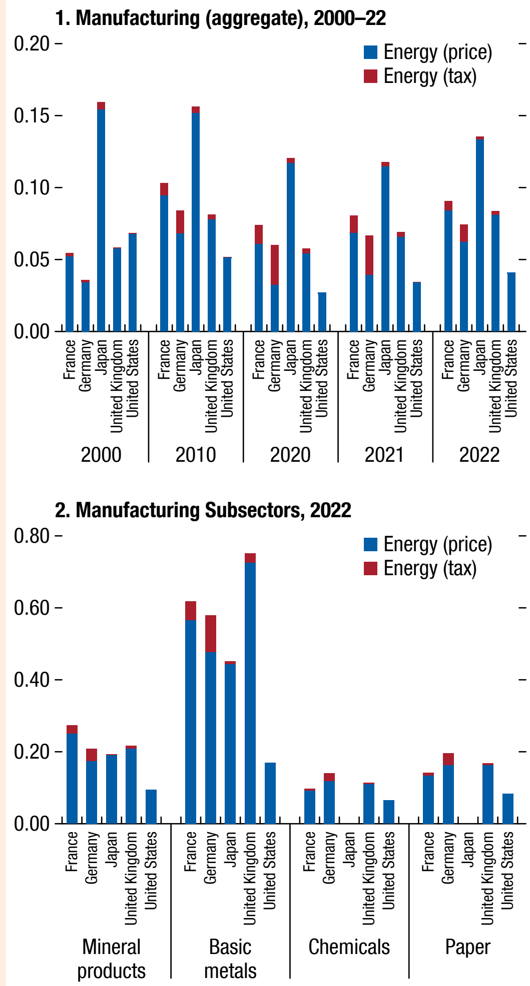
The impact goes through several steps and depends on various factors, including energy mix and intensity, which vary across countries and sectors, thereby having differential effects on manufacturing output (André and others 2023). The first step is the pass-through from wholesale to retail energy prices. In the case of natural gas, the correlation between contemporary wholesale and (pretax) retail prices is 0.81 in our sample of European countries. The second step is how the differences in taxes and levies impact the after-tax retail energy prices (Sato and others 2019). For instance, for electricity in 2021, taxes and charges represented 4 percent of retail prices in the United Kingdom and 48 percent in Germany. The final step is to combine information on the retail energy price with that on energy consumption mix and energy intensity to calculate the energy cost of manufacturing sectors (Figure 2.1.2, panel 1).

Figure 2.1.1. Wholesale Energy Prices in Europe
(Index; average January 2019–September 2021 = 100)



Sources: Argus Media; Ember; Haver Analytics; and IMF staff calculations.
Note: Natural gas refers to the Dutch TTF natural gas forward index; electricity refers to the average wholesale price of electricity in Central Western Europe; oil refers to Brent Crude Oil; coal refers to coal ARA 6000 kcal NAR cif London close (midpoint) contract.

Figure 2.1.2. Energy Cost in European Manufacturing
(US dollars per unit of gross value added)



Sources: International Energy Agency (2023a, 2023b, 2023c); and IMF staff calculations.
Note: The calculation of the energy cost accounts for the composition of the energy mix and the energy intensity of a sector. Energy prices used in the calculation are end-use (after-tax) prices for industry. Data for the "chemicals" and "paper" sectors in Japan are unavailable.

This box was prepared by Geoffroy Dolphin.

Box 2.1 *(continued)*

Energy cost in European countries increased by 3 percentage points on average in 2022 from 7 percent of the gross value added in 2021. Natural gas and electricity prices were the main drivers, mainly reflecting their high share in the manufacturing energy mix. For instance, they together account for 70 and 80 percent of energy consumed by manufacturing sectors in France and Germany, respectively.

There is a large heterogeneity across manufacturing subsectors and countries (Figure 2.1.2, panel 2). Subsectors such as basic metals production, characterized by high energy intensity, incur significantly higher energy costs, amounting to 60 to 70 percent of the gross value added. Likewise, the increase in energy costs also varies across countries. For example, the German manufacturing sector experienced the largest increase (pretax), while the smallest was observed in France. Government interventions played a role in mitigating the impact of the energy price shock. Despite the much larger energy price increase in Europe, the average increase in manufacturing sector energy costs is broadly comparable with that of other non-EU countries. Reductions in taxes alleviated the burden on manufacturing firms, attenuating the overall impact.

Historically, taxes account for a sizable share of the increase in the energy cost incurred by European manufacturing firms. In 2021, the cost incurred as a result of taxes and fees ranged between 4 percent (United Kingdom) and 40 percent (Germany) of the total energy cost. These values reduced to 3 to 10 percent in 2022–23 as governments reduced taxes and introduced other mechanisms to help manufacturing sectors cope with the increased energy prices. The fiscal measures provided important short-term relief, but—if sustained—would reduce firms' incentives to improve their energy efficiency.

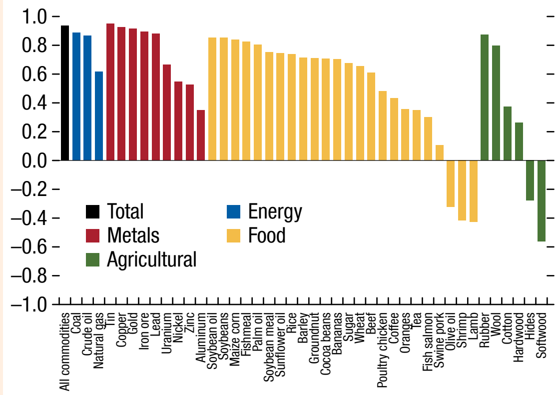
Box 2.2. Co-Movements between Commodity Prices

This box provides new empirical evidence on the co-movement between commodity prices. To investigate commodity price co-movements, the box employs a principal components analysis (PCA) of 39 monthly real commodity prices over the period from 1980 to 2023.[1] The first two components explain a significant share of the variance of commodity prices: 40 percent for the first component alone and 60 percent for the first two components. This result holds across commodity subgroups (food versus other commodities) and over subperiods. In particular, unlike Delle Chiaie, Ferrara, and Giannone (2022), who focus on pre- versus post-2000, we do not find a trend increase in co-movement over time, noting the co-movement between commodity prices is sensitive to the selection of the sample period (Figure 2.2.1).

Further, we characterize the first component of the principal components analysis through simple correlations. As shown in Figure 2.2.2, we find that the first component is highly correlated with energy prices (0.79 on average), with metals prices (0.74 on average), and with food prices (0.50). In contrast, other components are much less correlated with commodity prices. Moreover, the first factor displays the highest correlation with the global activity shocks followed by oil consumption demand, oil inventory demand, and oil supply shock. There are several reasons why commodity prices co-move:

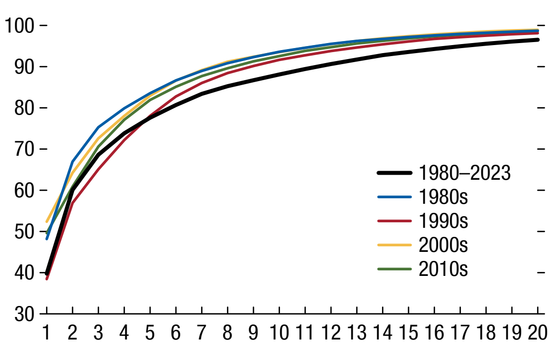
- Energy is a crucial input for production and transportation of all commodities. Agriculture and mining are now mostly mechanized. At the global level, oil, natural gas, and coal represent around 80 percent of total energy consumption. In addition, natural gas is a key input for the production of fertilizer and most chemical products. Therefore, changes in the price of energy commodities (oil, natural gas, coal) prices tend to pass through to other commodity prices.
- Substitution effects between similar commodities (such as oil and natural gas or wheat and corn) tend to equalize prices between these commodities. Competition between uses can have the same effect: land can be used to grow crops for either food or bio-fuel demand, creating a transmission channel between oil and crop prices (see, for example, Baumeister and Kilian 2014).
- Commodity prices share common drivers, namely global activities. For instance, China's demand in particular has played a growing role, given its rapid development and urbanization, which has resulted in higher demand for many commodities such as oil, copper, and iron ore (see, for example, Gauvin and Rebillard 2018).
- Finally, commodities have been increasingly used as financialized assets (Tang and Xiong 2012). Index investment into commodities has triggered an increase in correlation across commodity prices (for those commodities included in the index).

Figure 2.2.2. Correlation of First Principal Component with Commodity Prices



Source: IMF staff calculations.

Figure 2.2.1. Cumulative Explanatory Power of Components
(Percent)



Source: IMF staff calculations.
Note: The vertical axis displays percentage of the model explained by the principal component analysis. The horizontal axis displays the number of components used in the model.

This box was prepared by Cyril Rebillard.
[1]Excluding natural gas, not available before 1992; coal, not available before 1990; and fish meals, not available after 2018.

Box 2.3. The Evolving Correlation between the US Dollar and the Oil Price

This box evaluates the evolving correlation between the US dollar and the oil price and explores potential factors that contributed to the observed positive correlation since early 2020 and, occasionally, before 2000. Three factors are offered as potential explanations that warrant further investigation, without precluding alternative or complementary explanations.

The (monthly) correlation between the US dollar and the oil price has varied over the last five decades. From the 1970s to the 1990s, the correlation alternated between positive and negative signs. Since the 2000s, the correlation remained negative for two decades, wherein a rise (fall) in oil prices coincided with a depreciation (appreciation) of the US dollar. Recently, however, this long-standing negative correlation has shifted, turning positive since the early 2020s (Figure 2.3.1).

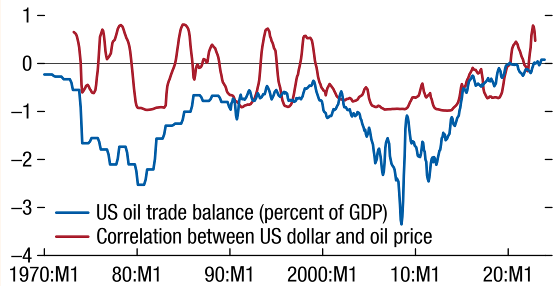
The changing correlations between the US dollar and the oil price can be examined through the prism of the distinct response of the US dollar to oil price shocks, mimicking a regime change. Using monthly data spanning from January 1975 to May 2023, this box estimates the US dollar response to the four structural shocks identified from Baumeister and Hamilton (2019)—oil supply shocks, oil consumption demand shocks, oil inventory demand shocks, and global economic activity shocks—on a rolling sample with a 36-month window.[1]

During periods of positive correlation between the US dollar and the oil price, the US dollar appreciates in response to negative oil supply shocks that lead to an oil price increase, while the US dollar shows no significant response to the other three shocks. In contrast, during periods of negative correlation, the US dollar depreciates in response to any of the four structural shocks that increases the oil price. Figure 2.3.2 illustrates this contrast for the US dollar response to oil supply and global activity shocks over two subperiods with negative (2000–19) and positive (2020:M1 to 2023:M5, post-2020) US dollar–oil correlations.[2]

These patterns of correlations are associated with three factors as potential explanations, with no claim of being conclusive or exclusive: for the post-2020 correlation, the shift of the United States from a net oil importer to a net exporter; and for the longer sample period, bouts of high global risk aversion and changes in foreign investors' purchase of US assets.

First, the shift of the correlation observed in early 2020 coincided with the United States transitioning from a net oil importer to a net oil exporter, which is consistent with the historically estimated response of oil exporter and importer currencies to negative supply shocks. This interpretation is also supported by the rolling window regressions that control for the US net oil import share, which find the dollar responding less to negative oil supply shocks, with the strongest effect estimated in the post-2020 samples (Online Annex Figure 2.9.1).

Figure 2.3.1. US Oil Trade Balance and Rolling Correlations between Oil Price and the US Dollar



Sources: Federal Reserve Board; IMF, Primary Commodity Price System database; IMF, World Economic Outlook database; Trade Data Monitor; and IMF staff calculations.
Note: The red line illustrates the rolling correlation between oil price and the US dollar with a 36-month window spanning from January 1973 to May 2023. The blue line represents the US oil trade balance. Monthly US oil trade balance data are available from 1990. Prior to 1990, annual US oil trade balance data are used.

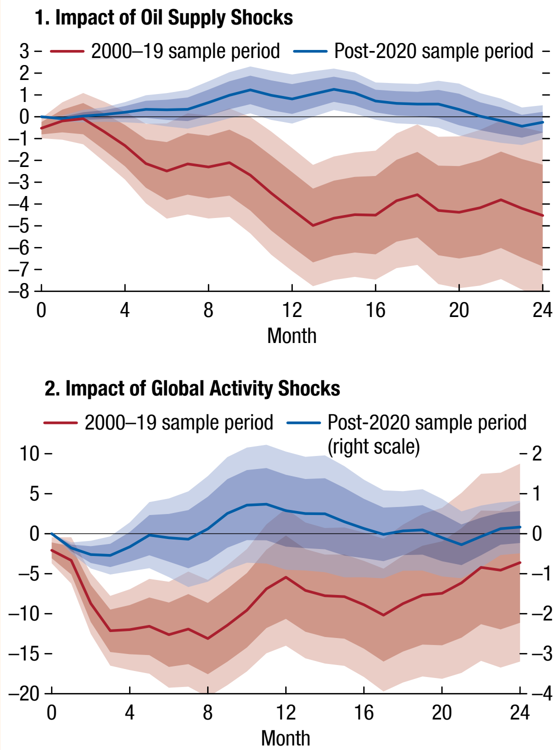
This box was prepared by Ting Lan.

[1]A rolling window time series instrumental variables local projections is estimated using a rolling sample with a 36-month window (see Online Annex 2.2 for technical details). The results are robust to alternative window sizes.

[2]The US dollar's response to oil consumption and inventory demand shocks mirrors its response to global economic activity shocks.

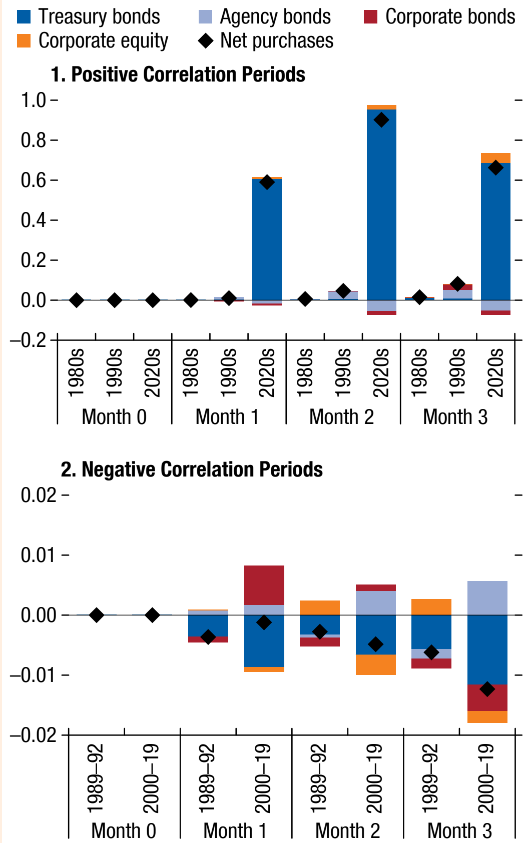
Box 2.3 *(continued)*

Figure 2.3.2. Impact of Oil Price Shocks on the US Dollar over Different Sample Periods
(Percent)



Source: IMF staff calculations.
Note: Impulse responses show the effects of an oil supply shock or a global activity shock that increases oil price by 10 percent on impact with 68 and 90 percent confidence intervals in a time series local projections exercise, using different sample periods.

Figure 2.3.3. Responses of Foreign Investors' Net Purchase of US Assets Following Negative Oil Supply Shocks
(Percent of US GDP)



Sources: Federal Reserve; and IMF staff calculations.
Note: The panels illustrate the foreign investors' net purchase of the US assets for the first three months following a negative oil supply shock that increases real oil price by 1 percent on impact, during positive and negative correlation periods, respectively.

Second, the increase in global risk aversion can also be a potential contributing factor to the positive correlation. Comparison of rolling regressions indicates that during periods with a positive US dollar–oil correlation (such as 1976, 1987, 1997, and post-2020), the US dollar appreciates less in response to a negative oil supply shock, after controlling for the global risk aversion—measured by the residual obtained from regressing BAA spreads on US monetary policy shocks[3] (Online Annex Figure 2.9.2).

[3]The result is robust to alternative measures of global risk aversion, including short-term volatility indexes and the high-yield corporate bond spread.

Another potential explanation can be found in the change in foreign investors' purchase of US assets, which turned from net sales to net purchases during the periods of positive correlation between the US dollar and the oil price (Figure 2.3.3). During the positive correlation periods, foreign net purchase of US assets was estimated to be positive in response to a negative oil supply shock while having had little responses to the other three shocks. This increased demand for US assets can exert upward pressure on the US dollar, all else

Box 2.3 *(continued)*

being equal.[4] During negative correlation periods, including most of the 2000s, foreign net purchase of US assets was negative in response to all four types of shocks that increase the oil price.

These three factors are neither mutually exclusive nor exhaustive. The change in foreign investor behavior could be associated with the heightened global risk aversion, as foreign investors seek the relative safety of US assets. Nor do they preclude other contributing factors. For example, investor behavior changes can be associated with other macroeconomic developments, such as a larger interest rate differential due to relatively tight US monetary policy. More generally, the well-known challenge of accounting for exchange rate movements applies to this question about the US dollar–oil price correlation, calling for further investigation of other channels and statistical evidence.

[4]Several papers have shown that changes in the relative demand for US assets can affect asset prices, including exchange rate and government bond yields under segmented market assumptions (for example, Greenwood and Vayanos 2014 and Koijen and Yogo 2020). It should also be noted that the United States shifting to a net energy exporter could be one reason for this change in investment behavior.

Box 2.4. Macroeconomic Impact of Energy Transition: The Case of Commodity Exporters

This box draws on IMF's Flexible System of Global Models (FSGM) to explore the potential macroeconomic and external sector effects of a global transition to clean energy technologies on commodity exporters, differentiating between exporters of fossil fuels (an input of the old emission intensive technology) and exporters of critical metals (an input of the new and clean technology).

The energy transition is considered heuristically as policies (for example, carbon taxation or subsidies for electric cars) that reduce the demand for fossil fuels relative to the demand for critical metals. The resulting energy transition is simulated in a stylized manner as a permanent 20 percent decline in the real price of oil and a permanent 20 percent increase in the real price of copper—a critical metal for green transition. The findings of the box are broadly consistent with other, more structural analyses (Carton and others 2023; Chapter 3 of the October 2022 *World Economic Outlook*), which used alternative global structural models to directly analyze the effects of a set of mitigation policies, including carbon taxation and green subsidies to the renewable sector. However, this box goes beyond these studies to highlight the potential implications for a major copper exporter.

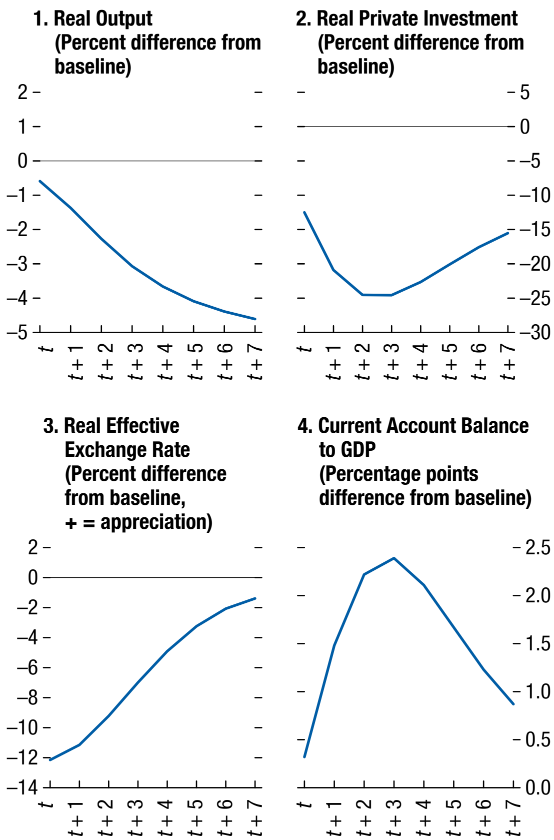
Macroeconomic impact on exporters of fossil fuels. The impact on oil exporters is analyzed using G20MOD, a version of FSGM that includes a bloc of representative major oil exporters. Figure 2.4.1 shows results in percent deviations from the current World Economic Outlook baseline. Permanently lower oil prices reduce the return on capital, leading firms to cut investment sharply and for an extended period of time until a lower desired level of capital is reached. These firms also cut their demand for labor, reducing household income and consumption. Central banks cut the interest rate to support the economy, while the real exchange rate depreciates to facilitate the adjustment. As such, real exports of noncommodities improve and real imports fall. The large drop in investment implies an improvement in the current account balance, while output declines incrementally.

Macroeconomic impact on exporters of metals. The impact on exporters of metals is analyzed using a version of FSGM for Latin America. Simulations are shown for Chile, which is the largest world exporter of copper, one of the metals that stands to gain the most from the clean energy transition. As in the previous simulation, results are shown in percent deviation from the current World Economic Outlook baseline (Figure 2.4.2). In response to permanently higher copper prices, the exporter's current account turns sharply negative, driven by a large investment boom in the copper-producing industry. In addition to higher investment, firms hire more workers, resulting in higher consumption and rising real output in combination with the investment boom. Central bank hikes interest rates and real exchange appreciates, contributing to weaker real exports and trade balance.

This box was prepared by Jiaqian Chen, Rafael Portillo, and Pedro Rodriguez.

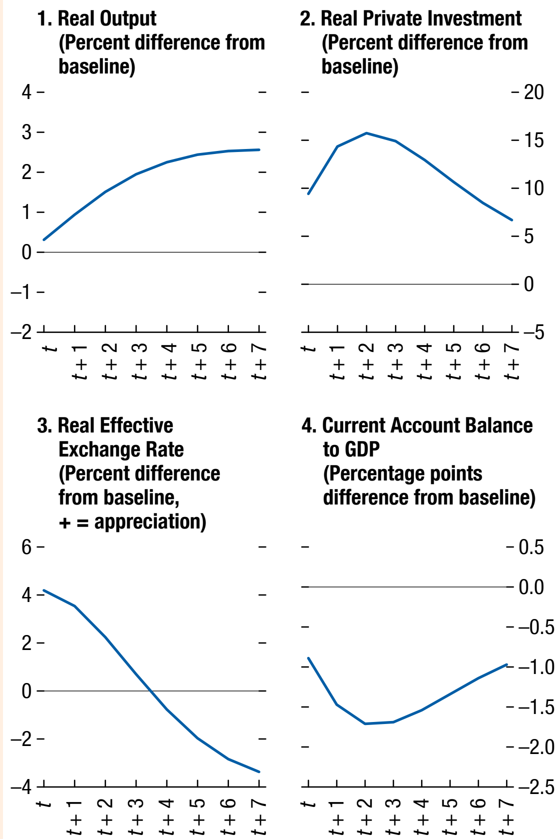
Box 2.4 *(continued)*

Figure 2.4.1. Impulse Response to a Permanent Decline in Global Real Oil Prices in the Flexible System of Global Models



Source: IMF staff calculations.
Note: The panels depict the impact of a permanent decline in real oil prices on a group of representative oil exporters.

Figure 2.4.2. Impulse Response to a Permanent Increase in Global Real Copper Prices in the Flexible System of Global Models



Source: IMF staff calculations.
Note: The panels depict the impact of a permanent increase in real copper prices in Chile.

References

Aghion, Philippe, George-Marios Angeletos, Abhijit Banerjee, and Kalina Manova. 2010. "Volatility and Growth: Credit Constraints and the Composition of Investment." *Journal of Monetary Economics* 57 (3): 246–65.

Aguiar, Mark, and Gita Gopinath. 2007. "Emerging Market Business Cycles: The Cycle Is the Trend." *Journal of Political Economy* 115 (1): 69–102.

Aizenman, Joshua, Sebastian Edwards, and Daniel Riera-Crichton. 2012. "Adjustment Patterns to Commodity Terms-of-Trade Shocks: The Role of Exchange Rate and International Reserves Policies." *Journal of International Money and Finance* 31 (8): 1990–2016.

Allegret, Jean-Pierre, Valérie Mignon, and Audrey Sallenave. 2015. "Oil Price Shocks and Global Imbalances: Lessons from a Model with Trade and Financial Interdependencies." *Economic Modelling* 49 (C): 232–47.

Allen, Cian, Deepali Gautam, and Luciana Juvenal, 2023. "Currencies of External Balance Sheets." IMF Working Paper 2023/237, International Monetary Fund, Washington, DC.

André, Christophe, Hélia Costa, Lilas Demmou, and Guido Franco. 2023. "Rising Energy Prices and Productivity: Short-Run Pain, Long-Term Gain?" OECD Economics Department Working Paper 1755, Organisation for Economic Co-operation and Development, Paris.

Andrle, Michal, Patrick Blagrave, Pedro Espaillat, Keiko Honjo, Benjamin L. Hunt, Mika Kortelainen, René Lalonde, and others. 2015. "The Flexible System of Global Models–FSGM." IMF Working Paper 15/64, International Monetary Fund, Washington, DC.

Arezki, Rabah, Valerie A. Ramey, and Liugang Sheng. 2017. "News Shocks in Open Economies: Evidence from Giant Oil Discoveries." *Quarterly Journal of Economics* 132 (1): 103–55.

Baumeister, Christiane, and James D. Hamilton. 2019. "Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks." *American Economic Review* 109 (5): 1873–910.

Baumeister, Christiane, and James D. Hamilton. 2023. "A Full-Information Approach to Granular Instrumental Variables." Working Paper, University of California, San Diego.

Baumeister, Christiane, and Lutz Kilian. 2014. "Do Oil Price Increases Cause Higher Food Prices?" *Economic Policy* 29 (80): 691–747.

Bems, Rudolfs, Francesca Caselli, Francesco Grigoli, and Bertrand Gruss. 2021. "Expectations' Anchoring and Inflation Persistence." *Journal of International Economics* 132: 103516.

Bodenstein, Martin, Christopher J. Erceg, and Luca Guerrieri. 2011. "Oil Shocks and External Adjustment." *Journal of International Economics* 83 (2): 168–84.

Bruno, Valentina, and Hyun Song Shin, 2015. "Cross-Border Banking and Global Liquidity." *The Review of Economic Studies* 82 (2): 535–64.

Bry, Gerhard, and Charlotte Boschan. 1971. "Cyclical Analysis of Time Series: Selected Procedures and Computer Programs." National Bureau of Economic Research, Cambridge, MA.

Budina, Nina, Christian H. Ebeke, Florence Jaumotte, Andrea Medici, Augustus J. Panton, Marina Mendes Tavares, and Bella Yao. 2023. "Structural Reforms to Accelerate Growth, Ease Policy Trade-Offs, and Support the Green Transition in Emerging Market and Developing Economies." IMF Staff Discussion Note 2023/007, International Monetary Fund, Washington, DC.

Burns, Arthur F., and Wesley C. Mitchell. 1946. "Measuring Business Cycles." National Bureau of Economic Research, Cambridge, MA.

Carton, Benjamin, Christopher Evans, Dirk V. Muir, and Simon Voigts. 2023. "Getting to Know GMMET: The Global Macroeconomic Model for the Energy Transition." IMF Working Papers 2023/269, International Monetary Fund, Washington, DC.

Cashin, Paul, Luis F. Céspedes, and Ratna Sahay. 2004. "Commodity Currencies and the Real Exchange Rate." *Journal of Development Economics* 75 (1): 239–68.

Cashin, Paul, and C. John McDermott. 2002. "The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability." *IMF Staff Papers* 49 (2): 175–99.

Chen, Jiaqian, Maksym Chepeliev, Daniel Garcia-Macia, Dora M. Iakova, James Roaf, Anna Shabunina, Dominique van der Mensbrugghe, and Philippe Wingender. 2020. "EU Climate Mitigation Policy." IMF Departmental Paper 2020/013, International Monetary Fund, Washington, DC.

Chen, Yu-chin, and Kenneth Rogoff. 2003. "Commodity Currencies." *Journal of International Economics, Special Issue, Empirical Exchange Rate Models* 60 (1): 133–60.

Collier, Paul, and Benedikt Goderis. 2012. "Commodity Prices and Growth: An Empirical Investigation." *European Economic Review* 56 (6): 1241–60.

De Winne, Jasmein, and Gert Peersman. 2021. "The Adverse Consequences of Global Harvest and Weather Disruptions on Economic Activity." *Nature Climate Change* 11 (8): 665–72.

Dehn, Jan. 2000. "Commodity Price Uncertainty and Shocks: Implications for Economic Growth." CSAE Working Paper 2000-10, Centre for the Study of African Economies, University of Oxford, Oxford UK.

Delle Chiaie, Simona, Laurent Ferrara, and Domenico Giannone. 2022. "Common Factors of Commodity Prices." *Journal of Applied Econometrics* 37 (3): 461–76.

Di Pace, Federico, Luciana Juvenal, and Ivan Petrella. Forthcoming. "Terms-of-Trade Shocks Are Not All Alike." *American Economic Journal: Macroeconomics*.

Fernández, Andrés, Stephanie Schmitt-Grohé, and Martín Uribe. 2017. "World Shocks, World Prices, and Business Cycles: An Empirical Investigation." *Journal of International Economics* 108: S2–14.

Frankel, Jeffrey. 2019. "The Currency-plus-Commodity Basket: A Proposal for Exchange Rates in Oil-Exporting Countries to Accommodate Trade Shocks Automatically." In *Institutions and Macroeconomic Policies in Resource-Rich Arab Economies*, edited by Hoda Selim, Jeffrey B. Nugent, and Kamiar Mohaddes, 149–82. Oxford, UK: Oxford University Press.

Gauvin, Ludovic, and Cyril C. Rebillard. 2018. "Towards Recoupling? Assessing the Global Impact of a Chinese Hard Landing through Trade and Commodity Price Channels." *World Economy* 41 (12): 3379–415.

Gopinath, Gita, and Oleg Itskhoki. 2022. "Dominant Currency Paradigm: A Review." In *Handbook of International Economics*, vol. 6, edited by Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, 45–90. Amsterdam, The Netherlands: North-Holland.

Greenwood, Robin, and Dimitri Vayanos. 2014. "Bond Supply and Excess Bond Returns." *Review of Financial Studies* 27 (3): 663–713.

Harding, Don, and Adrian Pagan. 2002. "Dissecting the Cycle: A Methodological Investigation." *Journal of Monetary Economics* 49 (2): 365–81.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. "Exchange Arrangements Entering the 21st Century: Which Anchor Will Hold?" *Quarterly Journal of Economics* 134 (2): 599–646.

International Energy Agency (IEA). 2023a. "Energy and Emissions per Value Added Database." Paris, France.

International Energy Agency (IEA). 2023b. "World Energy Balances." Paris, France.

International Energy Agency (IEA). 2023c. "Energy Prices and Taxes for OECD Countries." Paris, France.

International Monetary Fund (IMF). 2012. "Fiscal Regimes for Extractive Industries-Design and Implementation." IMF Policy Paper, Washington, DC.

Jordà, Òscar. 2005. "Estimation and Inference of Impulse Responses by Local Projections." *American Economic Review* 95 (1): 161–82.

Jordà, Òscar. 2023. "Local Projections for Applied Economics." Working Paper 2023-16, Federal Reserve Bank of San Francisco.

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2015. "Betting the House." *Journal of International Economics* 96 (S1): S2–S18.

Juvenal, Luciana, and Ivan Petrella. 2024. "Unveiling the Dance of Commodity Prices and the Global Financial Cycle." *Journal of International Economics* 150: 103913.

Känzig, Diego R. 2021. "The Macroeconomic Effects of Oil Supply News: Evidence from OPEC Announcements." *American Economic Review* 111 (4): 1092–125.

Kilian, Lutz. 2009. "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market." *American Economic Review* 99 (3): 1053–69.

Kilian, Lutz, and Daniel P. Murphy. 2014. "The Role of Inventories and Speculative Trading in the Global Market for Crude Oil." *Journal of Applied Econometrics* 29 (3): 454–78.

Kilian, Lutz, Alessandro Rebucci, and Nikola Spatafora. 2009. "Oil Shocks and External Balances." *Journal of International Economics* 77 (2): 181–94.

Koijen, S. J. Ralph, and Motohiro Yogo. 2020. "Exchange Rates and Asset Prices in a Global Demand System." NBER Working Papers 27342, National Bureau of Economic Research, Cambridge, MA.

Kose, Ayhan. 2002. "Explaining Business Cycles in Small Open Economies: 'How Much Do World Prices Matter?'" *Journal of International Economics* 56 (2): 299–327.

Krugman, R. Paul. 1999. "Balance Sheets, the Transfer Problem, and Financial Crises." *International Tax and Public Finance* 6: 459–72.

Lebrand, Mathilde, Garima Vasishtha, and Hakan Yilmazkuday. 2024. "Energy Price Shocks and Current Account Balances: Evidence from Emerging Market and Developing Economies." *Energy Economics* 129: 107209.

Lenza, Michele, and Giorgio E. Primiceri. 2022. "How to Estimate a Vector Autoregression after March 2020." *Journal of Applied Econometrics* 37 (4): 688–99.

Li, Dake, Mikkel Plagborg-Møller, and Christian K. Wolf. 2024. "Local Projections vs. VARs: Lessons from Thousands of DGPs." *Journal of Econometrics* 105722.

Mazarei, Adnan. 2024. "Why Do Oil Producers in the Middle East and North Africa Still Fix Their Currencies?" In *Floating Exchange Rates at Fifty*, edited by Douglas A. Irwin and Maurice Obstfeld, 237–50. Washington, DC: Peterson Institute for International Economics.

Mendoza, Enrique G. 1995. "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations." *International Economic Review* 36 (1): 101–37.

Obstfeld, Maurice, and Kenneth Rogoff. 1995. "The Intertemporal Approach to the Current Account." In *Handbook of International Economics*, vol. 3, edited by Gene M. Grossman and Kenneth Rogoff. Amsterdam, The Netherlands: North-Holland.

Ramey, Valerie A., and Sarah Zubairy. 2018. "Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data." *Journal of Political Economy* 126 (2): 850–901.

Ricci, Luca Antonio, Gian Maria Milesi-Ferretti, and Jaewoo Lee. 2013. "Real Exchange Rates and Fundamentals: A Cross-Country Perspective." *Journal of Money, Credit and Banking* 45 (5): 845–65.

Sato, Misato, Gregor Singer, Damien Dussaux, and Stefania Lovo. 2019. "International and Sectoral Variation in Industrial Energy Prices 1995–2015." *Energy Economics* 78: 235–58.

Schmitt-Grohé, Stephanie, and Martín Uribe. 2018. "How Important Are Terms-of-Trade Shocks?" *International Economic Review* 59 (1): 85–111.

Stock, James H., and Mark W. Watson, 2018. "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments." *Economic Journal* 128 (610): 917–48.

Tang, Ke, and Wei Xiong. 2012. "Index Investment and the Financialization of Commodities." *Financial Analysts Journal* 68 (6): 54–74.

Mesa Puyo, Diego, Augustus J. Panton, Tarun Sridhar, Martin Stuermer, Christoph Ungerer, and Alice Tianbo Zhang. 2024. "Key Challenges Faced by Fossil Fuel Exporters during the Energy Transition." IMF Staff Climate Note 2024/001, International Monetary Fund, Washington, DC.

Zhou, Xiaoqing. 2020. "Refining the Workhorse Oil Market Model." *Journal of Applied Econometrics* 35 (1): 130–40.