2. Weathering the Commodity Price Slump

The dependence on natural resource exports has made nearly half of sub-Saharan African countries vulnerable, one way or another, to the ongoing decline in commodity prices. But how much and how deeply countries will be affected remains an open debate. To shed light on this issue, this chapter considers three sets of questions:

- How important are extractive (energy and metal) commodities in the region? Which specific countries are affected? For these countries, how important are these commodities compared with commodity exporters elsewhere in the world?

- How have previous episodes of booms and busts in commodity prices affected macroeconomic outcomes in sub-Saharan Africa, and what does it tell us about the impact of the current commodity price slump?

- Which policies can help mitigate the macroeconomic effects of adverse terms-of-trade shocks?

The main findings are as follows:

- About half of sub-Saharan African countries are net commodity exporters and, unlike other regions, the importance of extractive commodities exports has risen since the 1990s, putting the region among the world's most commodity-dependent regions, broadly at par with the Middle East and North Africa region. As a consequence, though higher extractive commodity prices have in part supported the strong growth of the past decade or so, the region's exposure to commodity price volatility has also increased—a trend that is coming to haunt these countries now.

- The most exposed countries by far are the oil exporters. For them, the commodity terms-of-trade shock, which captures the income loss from price fluctuations in terms of GDP, has been particularly marked since mid-2014. On average, the commodity terms-of-trade index fell by 20 percent of GDP in a matter of a few years, after fairly steady gains of about 45 percent during 2000–14. Unsurprisingly, the macroeconomic impact is found to be large. The analysis suggests that a negative terms-of-trade shock of this size typically triggers a slowdown in annual growth of 3 to 3½ percentage points for several years after the shock. This is indeed the order of magnitude observed among sub-Saharan African oil exporters, whose average growth has gone from 5.9 percent in 2014 to a projected 2.4 percent in 2015–16.

- Comparatively, metal exporters in the region have tended to be less affected. This is because they are exposed to a wider range of commodity exports, and commodities play a less prominent role in their economies. Also, many of them are oil importers, so the impact of the commodity price slump has been partly offset for them by the decline in their energy import bill. That is not to say, though, that they will not be affected; there are thresholds for the price of their commodity exports, under which mines close, and jobs are lost, as has already been witnessed in some countries, with substantial detrimental impact on activity.

- The remaining 25 of the 45 sub-Saharan African countries that are not major exporters of oil or metals have tended to be less affected by commodity price swings. Indeed, many of them sustained solid growth during the commodity supercycle of the 2000s despite worsened commodity terms of trade, owing in part to relatively high oil import bills.

- Macroeconomic policies have a critical role to play in supporting the resilience of sub-Saharan African economies to commodity price busts,

particularly for the highly exposed oil exporters. Evidence from past downswings highlights the important role of exchange rate flexibility as a shock absorber for countries that are not part of a monetary union. Countercyclical fiscal policy can also be important to smooth the impact of the shock, but this only holds in so far as countries have space to implement that type of stimulus.

- In the last few years, commodity exporters in the region have indeed allowed fiscal deficits to widen in response to declining fiscal revenues from the extractive sector and as they continued implementing public investment projects to meet infrastructure gaps. However, with rising public debt, increasing borrowing costs, and sharply reduced revenues, fiscal space is rapidly diminishing in many of these countries, calling for adjustment as commodity prices are foreseen to remain low for long.

- For commodity exporters that are in a monetary union, the onus of adjustment is squarely on fiscal policy. Enhanced domestic revenue mobilization offers substantial potential to improve the fiscal balance, and expenditure rationalization should also take precedence. In particular, efforts will be required to better prioritize the numerous infrastructure investment projects that these countries were ready to embark on. Contingent on financing, choice should be given to the highest-return ones, in order to minimize the negative impact on medium-term growth prospects.

- Over the medium term, in addition to rebuilding policy space and buffers as commodity prices gradually recover, sub-Saharan African commodity-exporting countries should more actively increase the quality and efficiency of public investment, continue efforts to mobilize domestic revenues, and pursue economic diversification to enhance resilience to commodity price shocks, including by improving the business climate.

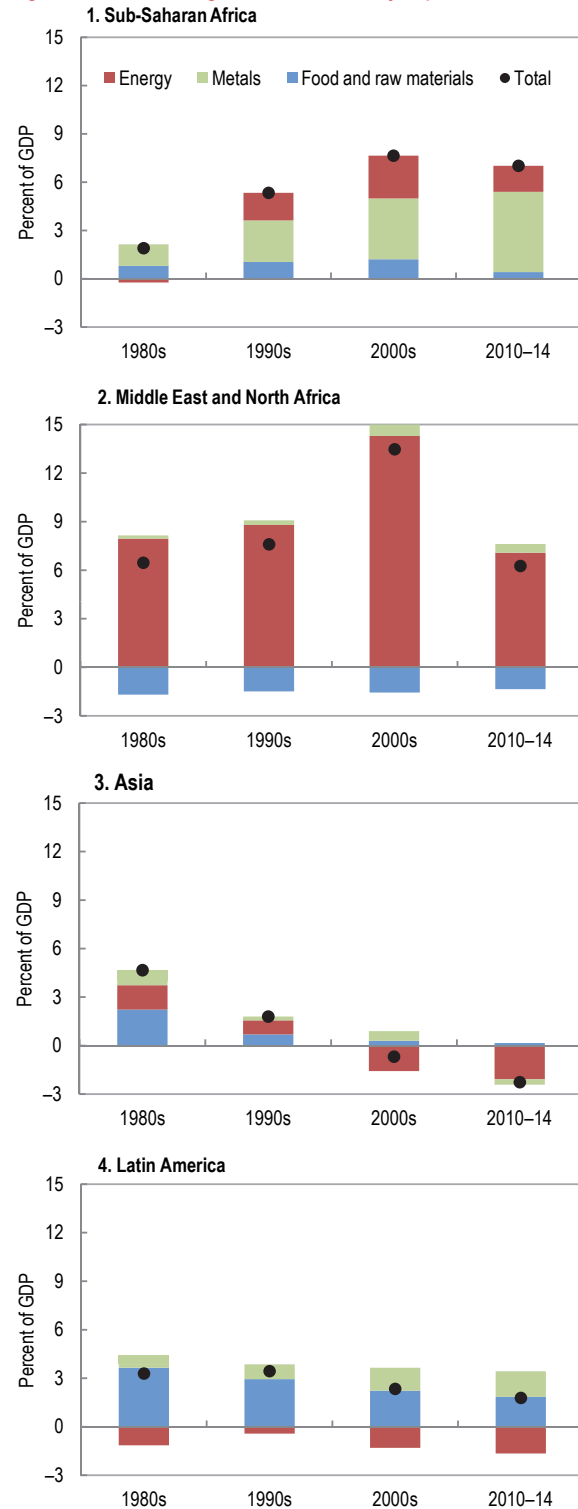# COMMODITY TERMS-OF-TRADE CYCLES IN SUB-SAHARAN AFRICA

The role of commodities has increased steadily in sub-Saharan Africa over the past 30 years. Unlike in other developing regions such as Latin America and Asia, net commodity exports (the difference between commodity exports and commodity imports) rose for the region as a whole from 2 percent of GDP in the 1980s to 6 percent during 2010–14, reflecting mostly the expansion of extractive commodities—oil and metals (Figure 2.1). Indeed, during 2010–14, commodity exports represented almost half of the region's total exports, up from less than one-fourth in the 1980s. These developments have placed the region among those with the highest dependence on commodity exports, broadly at par with the Middle East and North Africa.

Exports of natural resources are heavily concentrated in about half of the countries in the region, and by far the highest reliance is found among oil-exporting countries.

- We follow the literature and classify a country as an exporter of commodities if exports of commodities (oil, metals, food, and raw materials) comprise more than one-fourth of goods exports, and net commodity exports represent more than 5 percent of goods trade (exports plus imports).[1] On this basis, for the period 2010–14, 22 out of the 45 sub-Saharan African countries are classified as net commodity exporters (Figure 2.2).

- The steady increase in the role of commodities in sub-Saharan Africa has been underpinned by the increase in exports of extractive commodities. As a result, 20 countries are now classified as exporters of extractive commodities, compared with 14 in the 1990s.

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[1] The classification of commodity exporters follows earlier publications of the *Regional Economic Outlook: Sub-Saharan Africa* and the October 2015 *World Economic Outlook*. With the exception of Zimbabwe, which would no longer be classified as a commodity exporter in the 1990s, the classification is broadly robust to raising the threshold of commodity exports in total exports to 35 percent (see "Commodity Classification" in Annex 2.1).
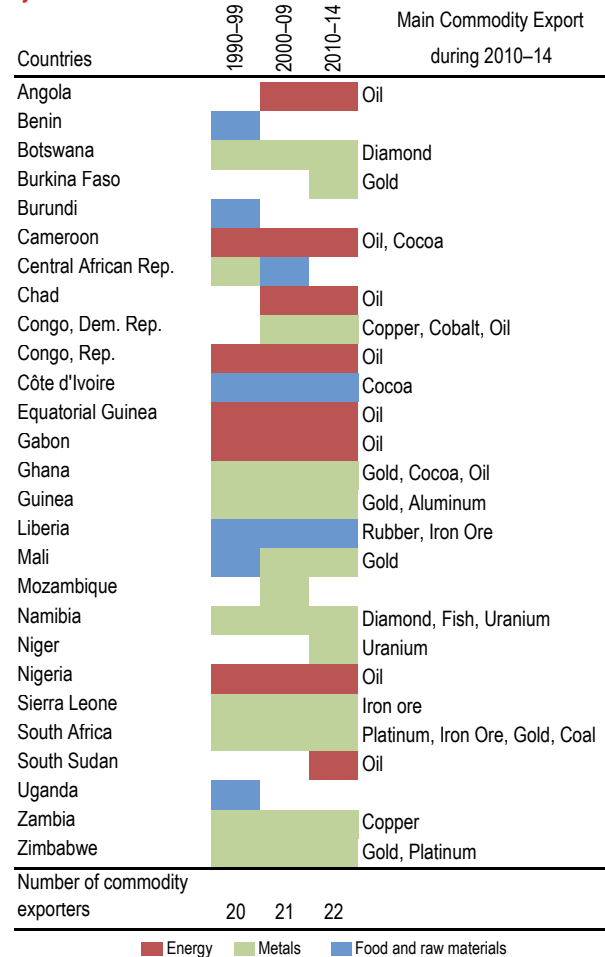
Figure 2.1. Selected Regions: Net Commodity Exports to GDP

1. Sub-Saharan Africa

■ Energy ■ Metals ■ Food and raw materials ● Total

2. Middle East and North Africa

3. Asia

4. Latin America

Sources: IMF, World Economic Outlook database; United Nations, COMTRADE database; and IMF staff calculations.
Note: Simple averages across countries in each region.

• The reliance on commodities also varies heavily among commodity exporters. The role of commodities is by far the largest among oil exporters, where net commodity exports ranges between 45 percent and 85 percent of GDP for countries such as Angola, the Republic of Congo, Equatorial Guinea, and Gabon, and is well above the average for energy exporters outside the region. Even in Nigeria, a much more diversified economy, net commodity exports account for 15 percent of GDP. Though still significant, the dependence on commodities

Figure 2.2. Sub-Saharan African Commodity-Exporting Countries by Decade

Countries	1990–99	2000–09	2010–14	Main Commodity Export during 2010–14
Angola				Oil
Benin				
Botswana				Diamond
Burkina Faso				Gold
Burundi				
Cameroon				Oil, Cocoa
Central African Rep.				
Chad				Oil
Congo, Dem. Rep.				Copper, Cobalt, Oil
Congo, Rep.				Oil
Côte d'Ivoire				Cocoa
Equatorial Guinea				Oil
Gabon				Oil
Ghana				Gold, Cocoa, Oil
Guinea				Gold, Aluminum
Liberia				Rubber, Iron Ore
Mali				Gold
Mozambique				
Namibia				Diamond, Fish, Uranium
Niger				Uranium
Nigeria				Oil
Sierra Leone				Iron ore
South Africa				Platinum, Iron Ore, Gold, Coal
South Sudan				Oil
Uganda				
Zambia				Copper
Zimbabwe				Gold, Platinum
Number of commodity exporters	20	21	22	

■ Energy ■ Metals ■ Food and raw materials

Sources: IMF, World Economic Outlook database; United Nations, COMTRADE database; and IMF staff calculations.
Note: Countries are classified as commodity exporters if commodity exports constitute at least 25 percent of total goods exports and net commodity exports are at least 5 percent of goods trade (goods exports plus goods imports) in each decade. See "Commodity Classification" in Annex 2.1.

is lower for metal exporters: for these countries, net commodity exports range between 5 percent and 30 percent of GDP, both because their commodity exports weigh less in GDP and because they are oil importers. In several countries such as Burkina Faso, Guinea, Niger, South Africa, and Zimbabwe, the dependence is similar to or lower than the average for metal exporters outside the region (Figure 2.3).

Implications of commodity terms-of-trade fluctuations

Given the strong and rising reliance on commodities of about half of the countries in the region, it is legitimate to ask about the impact of past cycles in commodity prices and of the recent slump. Indeed, after experiencing a sustained rise during the 2000s—one that drove many of the region's countries to start exploiting extractive resources—the prices of energy, metals, and, to a lesser extent, food started declining in 2011, with the decline accelerating from mid-2014 onward (Figure 2.4). Crude oil prices slumped by about 70 percent between June 2014 and February 2016, and the metal commodity price index decreased by 35 percent since early 2011.

To understand the implications of fluctuations in commodity prices for individual countries, and how they compare with other emerging market and developing countries, the analysis relies on

Figure 2.4. World Commodity Prices, 1971–2015
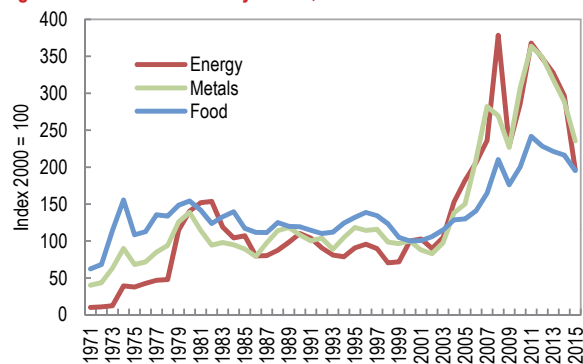
Sources: IMF, Commodity Price System; and IMF staff calculations.

country-specific measures of commodity terms of trade that take into consideration the composition of the particular country's commodity export and import baskets as a percent of GDP (Box 2.1). In this formulation, a commodity price increase implies an increase in the terms-of-trade index if the country is a net exporter of this commodity, and a decrease if the country is a net importer. Moreover, as net exports are measured in terms of GDP, variations in the index directly show the income gain or loss from a shock.

Reflecting their generally much higher reliance on commodities discussed earlier, sub-Saharan African energy exporters experienced exceptional terms-of-trade gains during the 2000s boom, and the downward correction since 2014 has been equally exceptionally large, as illustrated in the following:

Figure 2.3. Sub-Saharan African Energy and Metal Exporters: Net Commodity Exports to GDP, 2010–14 Average
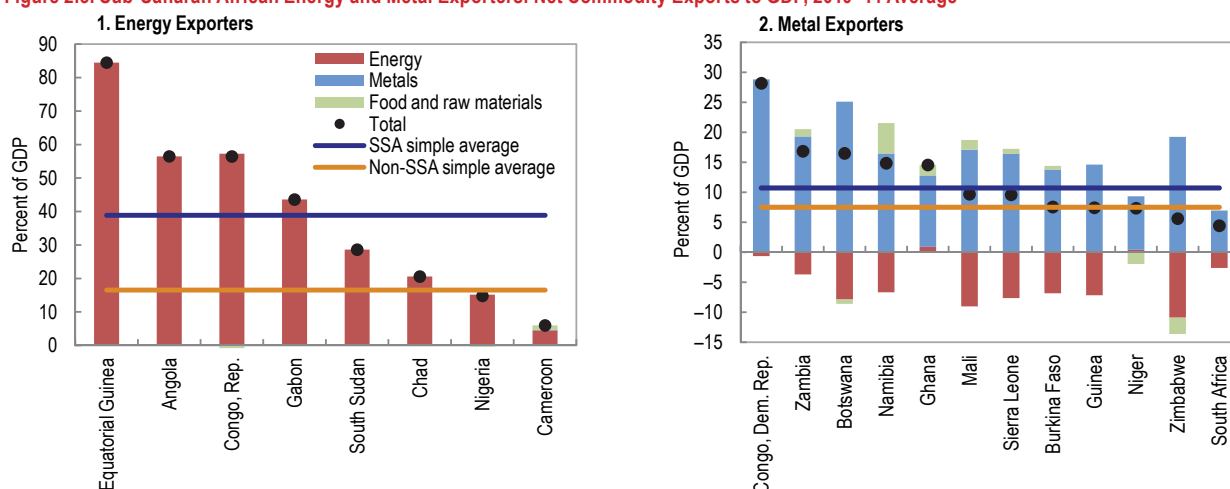
Sources: IMF, World Economic Outlook database; United Nations, COMTRADE database; and IMF staff calculations.
Note: SSA = sub-Saharan Africa.

Figure 2.5. Sub-Saharan Africa and Comparator Countries: Commodity Terms of Trade
(Index, 100 = 1990–2000 average, median)
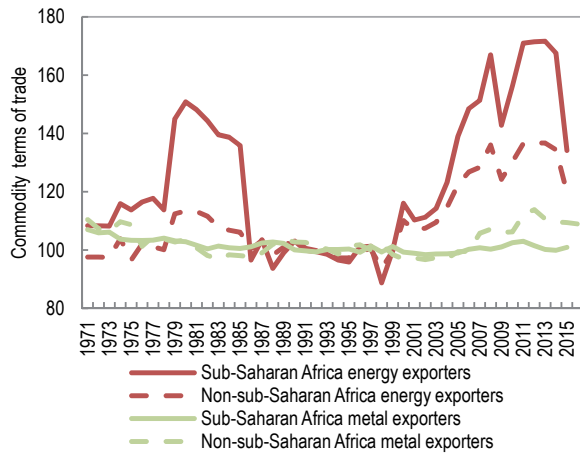
Source: IMF staff calculations.
Note: See "Commodity Classification" in Annex 2.1.

- These movements have exceeded in magnitude those witnessed by energy exporters outside the region—further underscoring the extreme sensitivity to oil prices of sub-Saharan African oil exporters (Figure 2.5).

- The terms-of-trade decline has been generalized across oil exporters, but has generally been sharper for the economies that are more highly concentrated around oil production, such as Angola, the Republic of Congo, Equatorial

Guinea, and Gabon (Figure 2.6). There, the cumulative decline in commodity terms of trade since 2011, and hence the decline in income, has ranged between 25 and 45 percentage points of GDP.

- For oil exporters, the substantial improvement of the commodity terms of trade in the 2000s was associated with improved growth performance, as strong income flows from rising oil prices and increased oil production allowed the funding of investment and domestic consumption (Figure 2.7 and Box 2.2). This result does not bode well for the outlook in those countries now that these terms of trade have reversed trend in a significant manner.

Terms-of-trade movements for the region's metal exporters have been much more muted, even compared with metal exporters outside the region.

- Two factors underpin this result. First, these countries often depend on a wider range of metals with heterogeneous price developments (for example, copper, iron ore, diamonds, gold, among others), and the dependence on each of these metal exports tends to be lower with respect to the size of the economy. Second, while metal prices were going up in the 2000s, so were oil prices, raising their

Figure 2.6. Sub-Saharan African Extractive Commodity Exporters: Commodity Terms of Trade, 2000–15
(Cumulative change from 2000; percentage points of GDP)
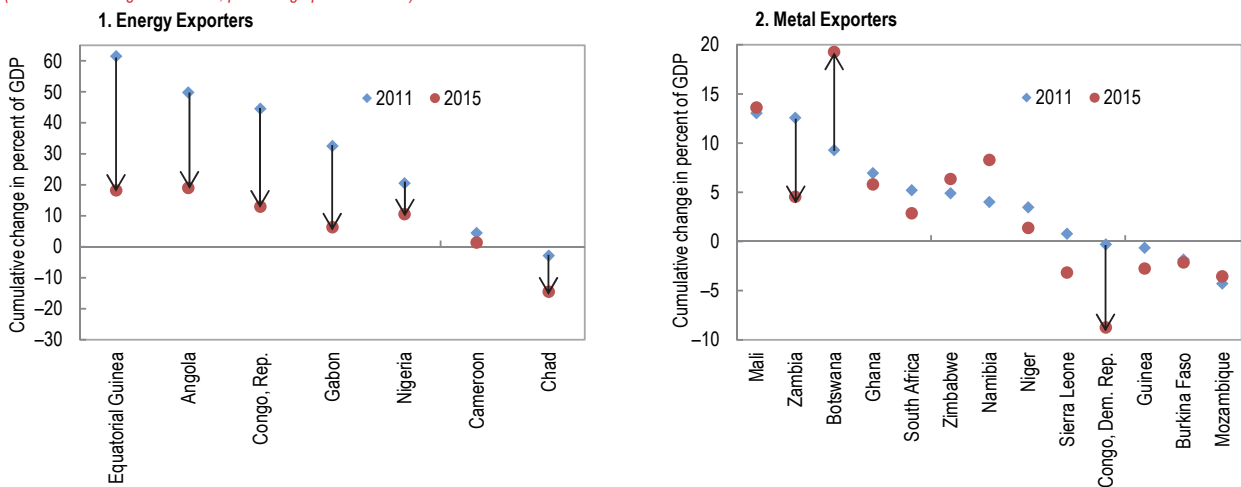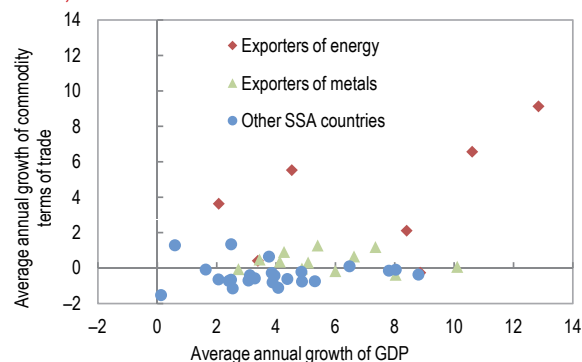

Source: IMF staff calculations.
Note: Cumulative change in commodity terms of trade from 2000 through (1) 2011 when commodity prices peaked (blue diamond), and (2) 2015 after commodity prices had fallen (red dot). Thus, differences between the blue and red markers indicate the change in the commodity terms of trade between 2011 and 2015.

energy import bills and muting the net impact on their commodity terms of trade. Now that commodity prices are trending down, the reduced oil import bill is acting as a cushion.

• Nevertheless, metal exporters too have experienced a broad pattern of losses since 2011, although with marked heterogeneity. Among the most affected, the Democratic Republic of Congo, Sierra Leone, and Zambia have seen their commodity terms of trade drop by about 5 to 10 percentage points of GDP since 2011, as the decline in iron ore and copper prices, respectively, more than offset the beneficial impact of the drop in oil prices on their import bill. Movements in metal and oil prices have also been net negatives on the commodity terms of trade of countries such as Guinea, Niger, and South Africa, although to a lesser extent. Two noteworthy outliers are Botswana and Namibia, whose commodity terms of trade increased during 2011–15, benefiting from the increase in diamond prices in play during 2009–14.

• For metal exporters, the 2000–11 period was associated with both high growth performance and modest changes in commodity terms of trade because the increase in the price of their commodity exports went hand in hand with the increases of the price of imported oil—leading to an apparent absence of correlation between growth and terms of trade for them, as shown in Figure 2.7. However, potentially large macroeconomic impacts from relatively smaller declines in commodity terms of trade (or export prices) for metal exporters cannot be discounted. It would be particularly the case where discrete events such as the closure of mines are leading to substantial job layoffs, as already experienced in the Democratic Republic of Congo, Sierra Leone, South Africa, and Zambia.

Among the 25 remaining sub-Saharan African countries (including exporters of food and raw materials), 20 of them experienced cumulative declines in their commodity terms of trade between 2000 and 2014, mainly because of increased oil import bills. However, despite the adverse

Figure 2.7. Sub-Saharan Africa: Commodity Terms of Trade and GDP Growth, 2000–11

Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: SSA = sub-Saharan Africa.

commodity terms-of-trade developments facing these countries, many sustained solid growth over that period, averaging 4 percent.

COMMODITY PRICE SWINGS AND MACROECONOMIC PERFORMANCE

Sharp swings in commodity prices present a formidable challenge for macroeconomic management. Output, fiscal revenues and external accounts all received strong support during the years of rising commodity prices. This section assesses the macroeconomic effects of the current commodity price shock on sub-Saharan African countries, building on the evidence of past commodity price swings, and discusses the implications for the region's commodity exporters' growth outlook.

Evidence from event studies

A first approach consists in examining the macroeconomic effects of previous episodes of commodity price swings during 1962–2014, both in sub-Saharan Africa and in other emerging market and developing countries, using event studies. More specifically, the analysis compares the behavior of key macroeconomic variables before and after the peaks observed in commodity terms of trade, but without controlling for factors that may also affect output growth and other macroeconomic variables such as global financial conditions, the size and duration of the shock, or domestic factors, including the occurrence of armed conflicts or

Table 2.1. Sub-Saharan Africa Commodity Exporters: Largest Commodity Terms-of-Trade Declines

1. Largest 10 Declines from Peak to Trough of 37 Episodes				2. Largest 10 Declines in First 3 Years of 37 Episodes			
Country	Episode	Duration (Number of Years)	Cumulative Change (Percent of GDP)	Country	Episode	Duration (Number of Years)	Cumulative Change (Percent of GDP)
Gabon	1981–86	6	–44.6	Zambia	1970–72	3	–34.8
Zambia	1970–72	3	–34.8	Côte d'Ivoire	1978–81	4	–16.4
Nigeria	1981–86	6	–29.2	Guinea	1989–93	5	–14.3
Côte d'Ivoire	1978–81	4	–22.0	Liberia	2012–14	3	–12.1
Congo, Rep.	1981–86	6	–20.0	Nigeria	1991–94	4	–9.9
Guinea	1989–93	5	–15.8	Botswana	2006–08	3	–9.6
Liberia	1995–01	7	–14.1	Congo, Rep.	1991–95	5	–9.0
Nigeria	1991–94	4	–13.0	Guinea	1971–74	4	–8.3
Congo, Rep.	1991–95	5	–12.2	Gabon	1981–86	6	–7.8
Liberia	2012–14	3	–12.1	Guinea	2007–09	3	–7.6

Source: IMF staff calculations.

changes in political regimes. As such, the event studies are simply intended to shed light on stylized facts and detect commonalities across episodes and regions.

To maximize the similarity of the events studied with the current bout of commodity price declines, the episodes studied involve at least two years of commodity terms-of-trade upswing followed by at least three consecutive years of decline—so as to capture persistent downward shocks.[2] Also, the cumulative decline in the terms of trade is required to be at least 1 percent of GDP in the first three years of the shock.[3] These criteria identify 201 episodes for 105 countries, of which 75 episodes occurred in sub-Saharan Africa (see Annex 2.1, Figure 2.1.2).

Most sub-Saharan African countries have gone through two or more cycles in the past five decades. Table 2.1 shows the 10 episodes with the largest declines in commodity terms of trade from peak

to trough and in the first three years among the 37 episodes identified for sub-Saharan African commodity exporters. Most episodes occurred in the 1980s and 1990s, and on average lasted five years, had large income effects, and affected countries as varied as Côte d'Ivoire, Guinea, Nigeria, and Zambia.[4]
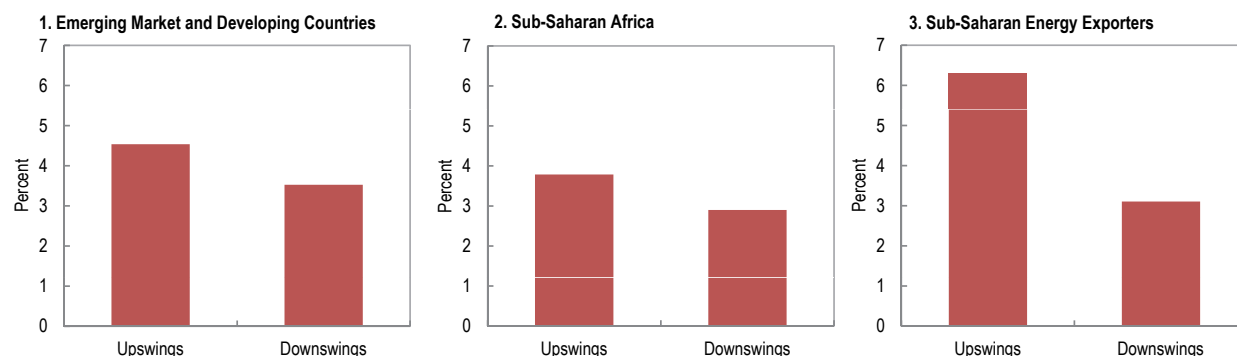
Although growth was only moderately affected on average during these episodes of commodity terms-of-trade declines, energy exporters have tended to suffer a much larger growth slowdown (Figure 2.8), as follows:

- The slowdown averaged about 1 percentage point when all 75 episodes in sub-Saharan Africa were considered. This is broadly the same average deceleration observed for the entire sample of emerging market and developing countries.[5]

- The growth deceleration was, however, much more marked when only episodes among sub-Saharan African oil exporters were examined. On average, growth has tended to slow from about 6 percent prior to the shock

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[2] Episodes are constrained to those with a peak before 2012 so that the first three years of a downswing in the commodity terms of trade can be examined.

[3] This is similar to Adler and Sosa (2011). The 1 percent of GDP decline threshold allows the identification of above-average declines in the overall sample of emerging market and developing countries, while retaining a reasonable number of episodes. The findings reported are robust to (1) a more stringent criterion for the cumulative decline of at least 2 percentage points of GDP in the first three years; and (2) at least one year of terms-of-trade upswing that is then followed by at least three consecutive years of decline and a cumulative loss of either 1 percent or 2 percent of GDP over this period (see the discussion of methodology for dating commodity price cycles in Annex 2.1).

[4] Because the criteria used to identify downswing episodes required at least three years of decline in the commodity terms of trade, short-lived events such as the decline in commodity prices associated with the 2008–09 global financial crisis are excluded from the analysis. Similarly, the recent fall in the commodity terms of trade of the region's oil exporters is not captured because it only took place in 2015.

[5] The focus here is on the impact of the shock in the first three years, but where shocks persisted longer, the overall impact might have been even larger.

Figure 2.8. Selected Country Groupings: Real GDP Growth during Commodity Price Upswings and Downswings
(Three-year averages)

1. Emerging Market and Developing Countries

2. Sub-Saharan Africa

3. Sub-Saharan Energy Exporters

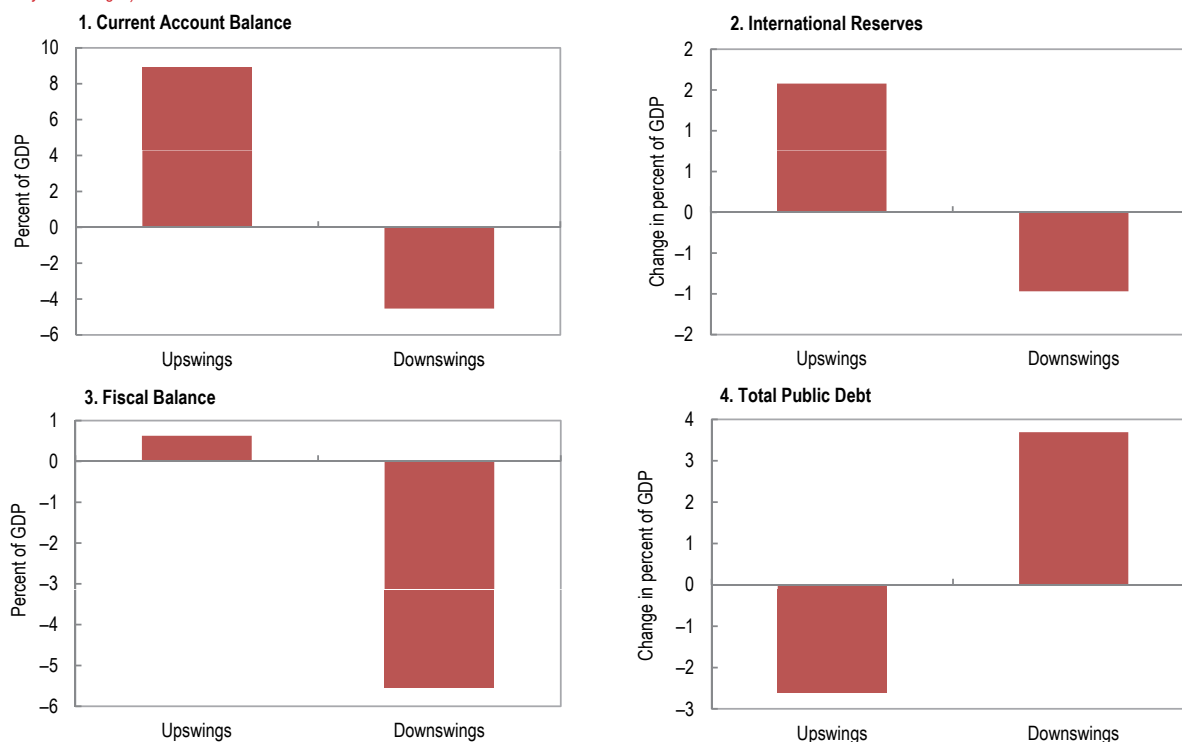Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: Samples consist of cycles with peaks before 2012.The bars show simple average values of the variables in the three years leading to the peak (upswings) and the three years after the peak (downswings).

to about 3 percent in the three years following a fall in oil prices. In fact, the recent episode quite narrowly mirrors this pattern, with growth among oil-exporting countries decelerating from 5.9 percent in 2014 (the peak year for oil prices) to 2.6 percent in 2015 and projected to further weaken to 2.2 percent in 2016. This once more highlights the specific vulnerability

of sub-Saharan African oil-exporting countries to commodity price reversals.

- The more pronounced impact of shocks in sub-Saharan African oil exporters shows in all macroeconomic variables (Figure 2.9). Current account balances tend to swing from large surpluses to large deficits and these swings are

Figure 2.9. Sub-Saharan African Energy Exporters: Key Macroeconomic Variables during Commodity Price Upswings and Downswings
(Three-year averages)

1. Current Account Balance

2. International Reserves

3. Fiscal Balance

4. Total Public Debt

Sources: IMF, World Economic Outlook database; and IMF staff calculations.

Figure 2.10. Sub-Saharan Africa: Exchange Rate Flexibility and Public Debt during Episodes of Low and High Resilience of Output Growth
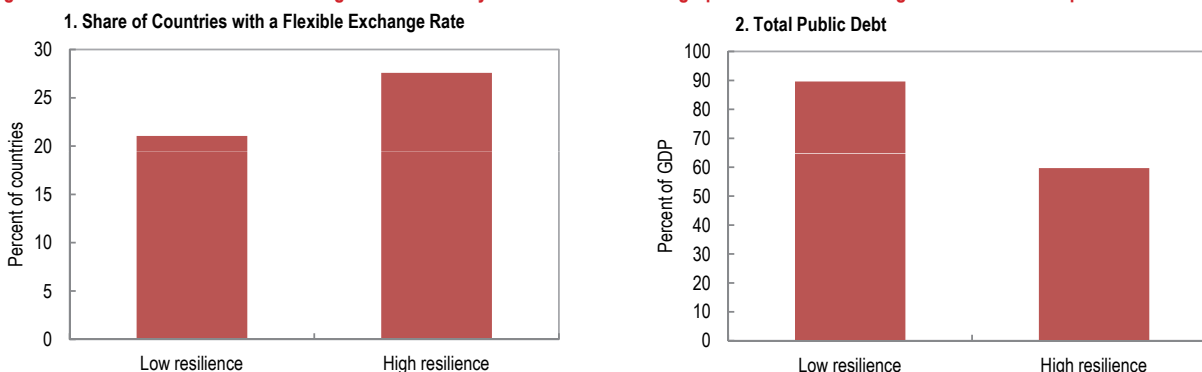
1. Share of Countries with a Flexible Exchange Rate

2. Total Public Debt

Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: The bars show average values of the policy variables in the three years prior to the shock. The exchange rate regime variable is a dummy variable with a value of 1 for a country with a de facto flexible exchange rate regime in the year before the shock. The exchange rate regime classification is based on Ilzetzki, Reinhart, and Rogoff (2010). An episode is classified as a high-resilience episode when the output growth variation between upswings and downswings is below the sample median.

typically accompanied by declines in international reserves. Also, small fiscal surpluses prior to the shock tend to turn into deficits of more than 5 percent of GDP.

Exchange rate flexibility and low public debt help weather persistent shocks

The event studies also allow a first glimpse at how specific policies influence the resilience of countries affected by commodity price shocks. To that effect, the past episodes of busts in commodity terms of trade that occurred in sub-Saharan Africa are split into two groups of countries according to their performance after a shock—the "high-resilience" group, where output was affected less negatively than for the median country, and the "low-resilience" group where output was more negatively affected.

- High-resilience countries tended to have more systematically flexible exchange rate regimes[6] at the onset of the adverse commodity price shock, allowing the exchange rate to play the role of a shock absorber on real activity (Figure 2.10, panel 1). Countries with flexible exchange rate regimes in place prior to the shock on average had higher inflation than countries with fixed regimes, but they were on average able to contain inflation during the

downswings triggered by the pass-through of exchange rate depreciation to domestic prices (Figure 2.11).

- High-resilience countries also had on average a lower debt-to-GDP level prior to the shock (Figure 2.10, panel 2). This would have provided, everything else equal, more fiscal space to increase borrowing and to smooth the impact of the shock once it happened, while still preserving debt sustainability.

Weak energy prices outlook a tremendous headwind for sub-Saharan African oil exporters

As noted earlier, the event studies do not control for other factors that could also affect economic performance at the time of the commodity price slump. To account for those, the event study analysis is complemented with an econometric study using the local projections method of Jordà (2005). This method allows better isolation of the specific response of macroeconomic variables to commodity price shocks. Annex 2.1 provides a detailed explanation of the model used.

Once these factors are controlled for, the negative effect of commodity price declines on sub-Saharan African net commodity exporters comes out more strongly than in the event studies. Unlike with other countries in the region where the impact of such

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[6] Countries are classified as having de facto flexible exchange rate regimes based on Ilzetzki, Reinhart, and Rogoff (2010).

Figure 2.11. Sub-Saharan Africa: Inflation during Commodity Price Upswings and Downswings by Type of Exchange Rate Regime
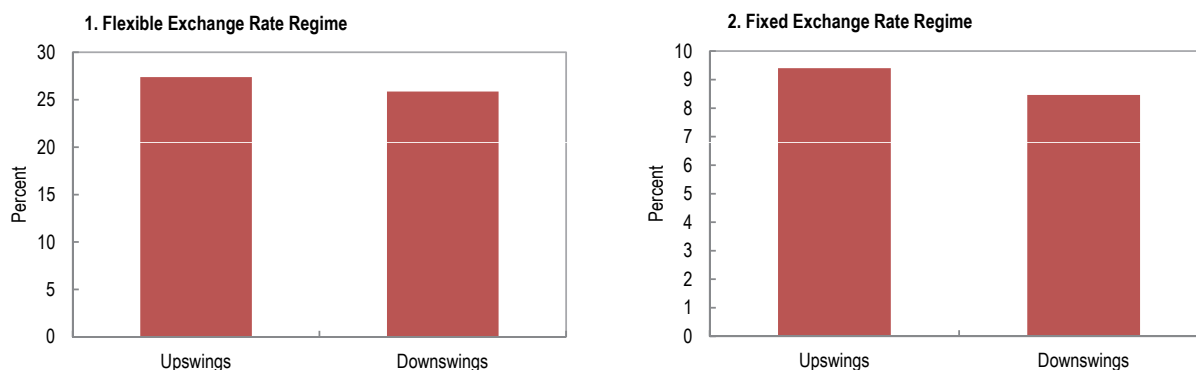
Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: The bars show average inflation in the three years leading to the peak (upswings) and the three years after the peak (downswings) for countries classified as having flexible and fixed exchange rate regimes based on Ilzetzki, Reinhart, and Rogoff (2010).

shocks are not found to be significant,[7] the effect on real GDP of a 1 percent decline in extractive commodity exporters' terms of trade is significant as early as the year of the shock, and cumulates to a reduction in the level of GDP of about 0.7 percentage point after four years (Figure 2.12, panels 1 and 2). The impact is also found to be larger than for other developing and emerging market countries that export the same commodities. For sub-Saharan African oil exporters, which on average have experienced a decline in their commodity terms of trade since mid-2014 of about 20 percent, this corresponds to a cumulated reduction in GDP of roughly 13 percent over the course of four years, or, put differently, lower growth by about 3½ percentage points for four straight years—a substantial effect. The recent slowdown in growth among sub-Saharan African oil exporters from about 6 percent in 2014 to a projection of below 2½ percent in 2015–16 is indeed of that order of magnitude.

The effects on the trade balance are also immediate and large (Figure 2.12, panel 3). A 1 percent deterioration in the commodity terms of trade results in a worsening of the trade balance of about 0.6 percentage point of GDP in the year of the shock. The effect of the shock, however, tends to dissipate after two years, possibly reflecting rapid external

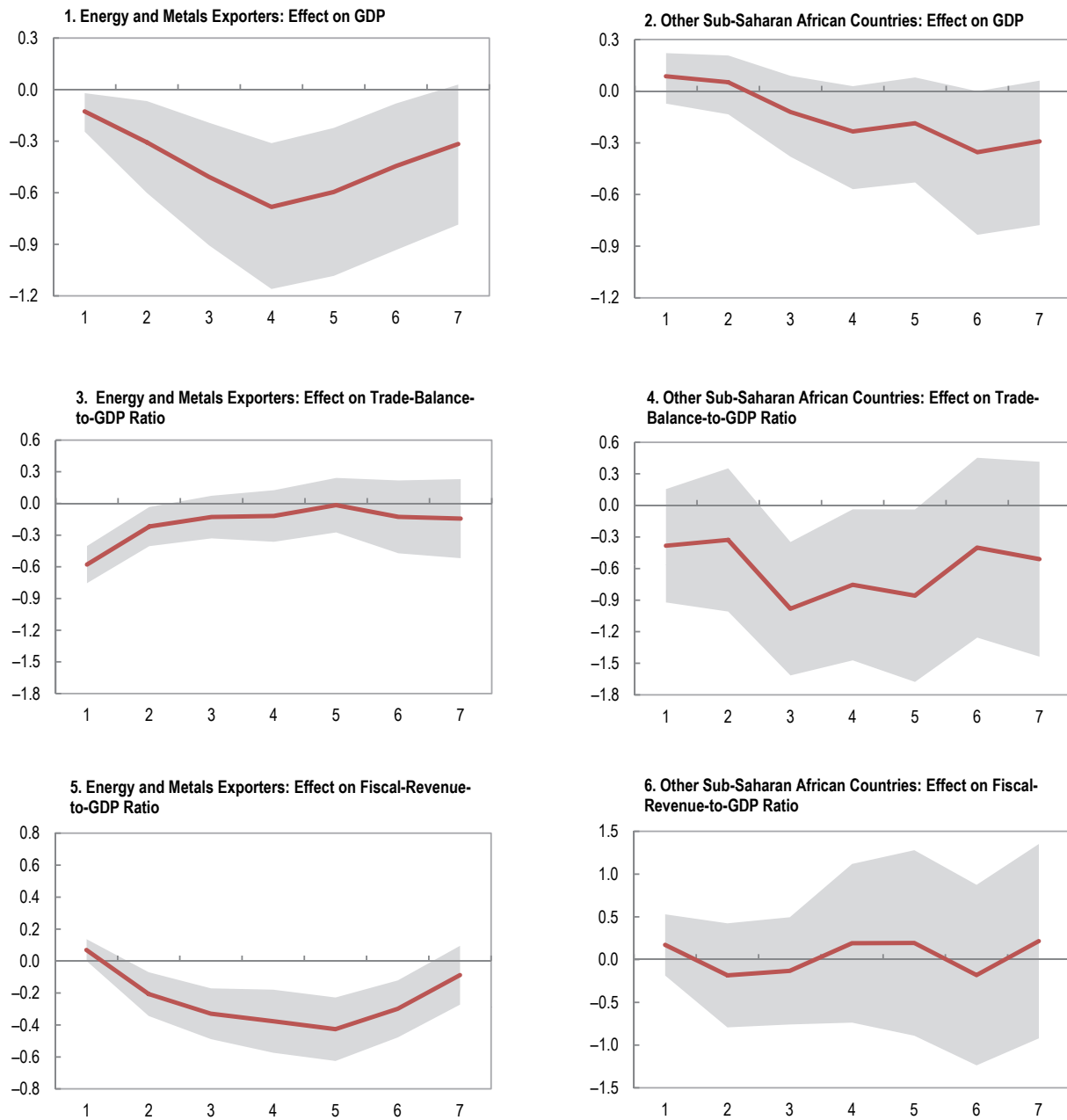adjustment through exchange rate depreciation and import compression.[8]

Conversely, the impact on fiscal revenues is found to be much more persistent (Figure 2.12, panel 5). A 1 percent decline in the commodity terms of trade is estimated to lead to a decline in fiscal revenues by about 0.2 percentage point of GDP in the year following the shock, and as much as 0.4 percentage point of GDP five years later. This effect is not found in other sub-Saharan African countries, highlighting the heavy reliance on extractive sectors for fiscal revenues among energy and metal commodity exports.[9]

These results highlight that persistent commodity terms-of-trade shocks can have large and long-lasting growth effects. At the same time, terms-of-trade shocks have implications for macroeconomic stability: both fiscal revenues and trade balances of extractive commodity exporters are considerably affected. Taken together, these findings suggest that the immediate focus of macroeconomic policies may need to be on eliminating macroeconomic imbalances rather than on minimizing output losses.

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[7] This is consistent with the finding in Aslam and others (2016) for a larger sample of emerging market and developing countries that are not exporters of extractive commodities.

[8] A similar phenomenon is also documented for a group of Latin American countries in Chapter 3, April 2015 *Regional Economic Outlook: Western Hemisphere* (IMF 2015a), and Caceres and Gruss (forthcoming).

[9] The estimations are conducted for sub-Saharan African oil and metal exporters together so as to have a large enough number of countries. It is likely, however, that the impact on oil exporters is much larger than for metal exporters, given their much higher reliance on extractive activities for fiscal revenues.

Figure 2.12. Sub-Saharan Africa: Effects of Commodity Terms-of-Trade Shocks
(Percentage points)

1. Energy and Metals Exporters: Effect on GDP

2. Other Sub-Saharan African Countries: Effect on GDP

3. Energy and Metals Exporters: Effect on Trade-Balance-to-GDP Ratio

4. Other Sub-Saharan African Countries: Effect on Trade-Balance-to-GDP Ratio

5. Energy and Metals Exporters: Effect on Fiscal-Revenue-to-GDP Ratio

6. Other Sub-Saharan African Countries: Effect on Fiscal-Revenue-to-GDP Ratio

Source: IMF staff calculations.

Note: The *t* = 1 is the year of the shock; grey shadows denote 90 percent confidence bands. The red lines represent the response of the variable to an exogenous 1 percent decrease in the commodity terms of trade. See "Local Projections Method" in Annex 2.1. The energy and metals exporters sample comprises Angola, Cameroon, Democratic Republic of Congo, Ghana, Mali, Niger, Nigeria, Uganda, and Zambia. Other sub-Saharan African countries comprise Guinea-Bissau, Kenya, Madagascar, Mauritius, Rwanda, Tanzania, and Togo.

POLICIES TO ENHANCE RESILIENCE TO SHOCKS

Policy responses to shocks matter for output resilience

The event studies illustrate the moderating effects on output from exchange rate flexibility and low debt related to commodity price slumps, but a more comprehensive approach is still needed to examine how best countries can prepare for such shocks and react when they are hit by them—as has now happened to many commodity exporters in the region, especially oil-exporting countries.[10] Such an analysis is conducted in this section, based on a regression relating the relative growth performance in the aftermath of a terms-of-trade shock—the difference in real GDP growth in the three years before and after the shock—to countries' policy space and policy responses.

Policy space and policy conditions consist of fiscal and external buffers existing at the time of the shock (used to implement countercyclical policies to mitigate the impact of the shocks), exchange rate policies (as flexibility can also act as a shock absorber), and the extent of fiscal and monetary policies implemented after the shock. In exploring the role of these factors, the econometric estimations also control for: (1) the magnitude of the commodity shock, especially when shocks are driven by lower export prices (to allow for asymmetric effects from changes in export prices and import prices), and (2) the prevailing global economic environment (that is, the strength of trading partners' growth, and global interest rates). The regression analysis builds on the episodes identified above for the sample of emerging market and developing countries, and on existing empirical research

(Adler and Sosa 2011; Céspedes and Velasco 2012; see Annex 2.1 for more details).

The main results are reported in Table 2.2. The explained variable is the gap between growth prior to the shock and subsequent to the shock, thus a positive coefficient on an explanatory variable indicates that the variable mitigates the adverse impact of the commodity shock on economic growth. The main results are as follows.

The size of the terms-of-trade shocks matters, and its impact is stronger when export prices slump. On average, a 1 percent decline in the commodity terms of trade is associated with about a ¼ percentage point decline in growth in each of the three years following the shock.[11] This estimate captures the direct effects of commodity shocks on the commodity-related sectors, as well as indirect effects on other sectors, for example, from lower oil prices. Though commodity terms-of-trade shocks occur for both commodity exporters and importers (for example, the shock to food and fuel prices in 2007–09), the shocks driven by declines in export prices for commodity exporters have a larger adverse impact on growth, reflecting an asymmetric impact on domestic production and private sector activity—as investment suffers, mines or oil fields can be shut down when prices are too low, and jobs are lost.

A reserve buffer helps mitigate the impact of shocks. Having a reserve level of 1 percentage point of GDP above the average level of reserves before the shock is found to help reduce the impact of the shock on growth by ⅓ percentage point. Drawing from these reserves can temporarily smooth the severity of the pressures from the shock on the external position and the exchange rate. Other indicators of policy space, such as low external debt and low initial inflation were not found to systematically mitigate the impact of shocks.[12]

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[10] The focus of the analysis is on the impact of commodity shocks on actual output and understanding the role of macroeconomic policies to smooth the adjustment to the shocks and bring actual output closer to potential. It is also possible that commodity price shocks affect potential output through lower investment and capital accumulation (as shown in Aslam and others 2016), in which case the slack in aggregate demand would be smaller, and there may be less scope for macroeconomic policies to stimulate the economy. The latter would put more emphasis on structural reforms to diversify the economy and raise potential output.

[11] A cumulative decline of ¾ percent in the three years following the shock is within the 90 percent confidence interval of the response to a similar shock estimated in the previous section (Figure 2.13, panel 1).

[12] The finding of a weak relationship between low inflation and resilience of growth is broadly in line with existing research; for example, Abiad and others (2015) report that, although single-digit inflation helps extend growth expansions, it is not a significant factor for growth recovery after a shock.

Table 2.2. Impact of Commodity Shocks on Real GDP Growth: Regression Results

Dependent variable: Difference in real GDP growth (average) between the three years after the terms-of-trade shock and the three years prior to the shock.	(1)	(2)
Shock size and types		
Size of terms-of-trade shock: three years (cumulative)	−0.270***	−0.228***
	(0.073)	(0.070)
Shocks caused by decline in export prices (dummy)	−2.994**	−4.096***
	(1.269)	(1.191)
Initial Conditions		
International reserves above median at time t_0 (% of GDP)	0.335***	0.367***
	(0.121)	(0.138)
High external debt before shock (40% of GDP or more)	1.150	0.381
	(1.289)	(1.442)
Flexible exchange rate regime (de facto) at time t_0	3.215**	
	(1.253)	
Policy Reactions		
Growth of real government consumption during shock (average)	0.356***	0.279**
	(0.133)	(0.135)
Growth of real government consumption x high external debt at time t_0	−0.283*	−0.245
	(0.164)	(0.183)
Broad money growth during shock	0.057*	0.006
	(0.033)	(0.030)
Depreciation of nominal exchange rate		0.138***
		(0.042)
Exchange rate collapse: 45% or more depreciation	−0.097***	−0.161***
	(0.035)	(0.040)
Observations (terms-of-trade shock events)	119	119
Countries	76	76
R-squared	0.50	0.51

Source: IMF staff calculations.

Note: The methodology for identifying events is described in Annex 2.1. All regressions control for country fixed effects, as well as changes in growth in trading partners of a country (as a proxy for the global economic conditions).
Robust standard errors in parentheses; significance levels: ***$p<0.01$, **$p<0.05$, *$p<0.10$.

The exchange rate is found to be a powerful shock absorber, provided its use is not postponed too much after the shock, when macroeconomic imbalances have built up.

- A higher degree of exchange rate flexibility beforehand helps mitigate growth losses after a shock. Countries with a de facto flexible exchange rate regime tend to experience growth losses that are significantly smaller compared with countries with less flexible regimes, everything else equal (Model 1 in Table 2.2).

- Nominal exchange rate depreciation in the first two years after a shock also has a strong mitigating effect on the growth loss—a 10 percent depreciation is associated with a lower growth loss of more than 1¼ percentage points during the shock period (Model 2 in Table 2.2), consistent with the findings of Edwards

and Levy-Yeyati (2005), Céspedes and Velasco (2012), and Adler and Sosa (2011).[13]

- However, very large exchange rate depreciations in the aftermath of the commodity busts (labeled as a "collapse") adversely affect growth. In three-quarters of the episodes concerned, these large depreciations, in excess of 45 percent within two years of the commodity shock, came as fixed or pegged regimes could not be sustained (based on llzetzki, Reinhart, and Rogoff's 2010 classification). In these circumstances, the adverse impact on growth from the exchange rate collapse is estimated to reach 4 percentage points, as the collapse pushes inflation up and causes severe import contractions. This suggests that if the exchange

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[13] It is possible that exchange rate depreciation may not always help mitigate growth losses if price elasticities of exports and imports are relatively low, for example, because of the lack of diversification of economies or if there are large dollar exposures.

rate tool is not used early enough to alleviate the macroeconomic implications of the terms-of-trade shock, it cannot play the shock-absorber role once severe imbalances have built up in the economy.

- This is not to say that fixed exchange rate regimes cannot be beneficial for sub-Saharan African countries, but that other macroeconomic policies need to be consistent with the sustainability of the peg over commodity price cycles. Hence, for commodity-exporter countries that are members of a monetary union—such as most countries in the Central African Economic and Monetary Community (CEMAC)—to maximize the benefits of a stable, credible policy environment that comes with the monetary anchor, special attention needs to be paid to other macroeconomic policies, in particular fiscal policy, in the adjustment to commodity terms-of-trade shocks.

Supporting fiscal and monetary policies can help but only if sufficient policy space has been built up. Increases in real public current spending in the years immediately after a shock are strongly associated with lower output losses—but only when the external-debt-to-GDP ratio is below 40 percent.[14] In situations of high debt, a fiscal stimulus has, on average, little effect on mitigating growth losses during the shock years, as more resources likely need to be diverted to repay larger debt and private investment may be deterred from expectations of higher future taxes (see also Pattillo, Poirson, and Ricci 2002, which identifies a similar threshold). An easing of monetary policy—proxied by the growth of broad money—is also found to mitigate output losses, but because postshock periods are often associated with capital outflows and depreciation pressures, central banks may have limited room to engage in easing monetary policy in response to shocks, and therefore this empirical result should be interpreted carefully.

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[14] The external-debt-to-GDP ratio is used to proxy fiscal space because of the paucity of long time series data for public debt. The findings are robust to alternative thresholds (above 40 percent) for external debt beyond which fiscal policy's effectiveness as a countercyclical tool is eroded.

## Implications for sub-Saharan Africa's commodity exporters

What are the policy implications for the sub-Saharan African net commodity exporters that have been affected to varying degrees by the bust in the commodity supercycle? Especially in light of the persistence of the shock, what should be the best course of action? As always, policy advice needs to be country- and context-specific, but informed by the analysis above, a set of general principles that apply includes:

- For countries that are not part of currency unions, increased exchange rate flexibility with supportive monetary and fiscal policies should be the first line of defense to minimize output losses, though the effect of exchange rate depreciations on bank and public sector balance sheets, and on inflation, would also need to be closely monitored (as elaborated in Chapter 1). In addition, recourse to flexibility should not be delayed particularly if shocks are likely to be persistent, as a buildup of balance of payments pressures has to be counteracted either through sales of scarce external reserves or exchange rate restrictions that take a toll on activity. Reserves are finite and a cushion should be preserved to deal with other shocks. Restrictions on current account transactions are suboptimal because they affect economic activity, give rise to different distortions, and could lead to a disorderly adjustment of the external sector. In that respect, the emergence of large parallel exchange rate premiums, such as in Angola and Nigeria, points to large imbalances in the foreign exchange markets and hence to the urgent need for the adoption of more sustainable macroeconomic policies.

- External reserves have provided buffers to face the shock, but the extent of that support is getting increasingly limited. International reserves were already lower than for commodity exporters in other emerging market and developing economies, partly as a result of countries' efforts to expand infrastructure investment to address longer-term development needs. Sub-Saharan African oil exporters, however, entered the period of lower oil prices with relatively

higher reserves than others in the region and higher than at the onset of previous shocks. This allowed cushioning of the hit from the oil price slump, but care should be taken to limit the drawdown, particularly in view of the expected persistence of the oil price shock (Figure 2.13).
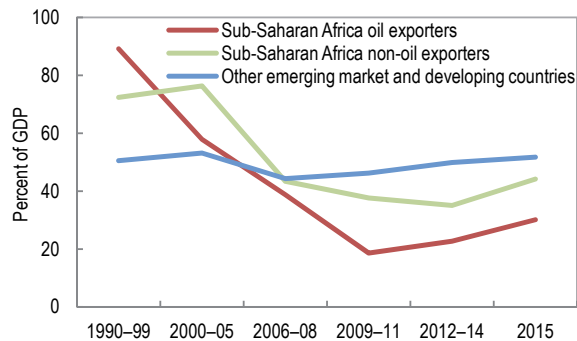
- Although in principle fiscal policy can provide support, fiscal adjustment is increasingly called for among the region's commodity exporters,

Figure 2.13. Sub-Saharan Africa and Other Countries: Total International Reserves
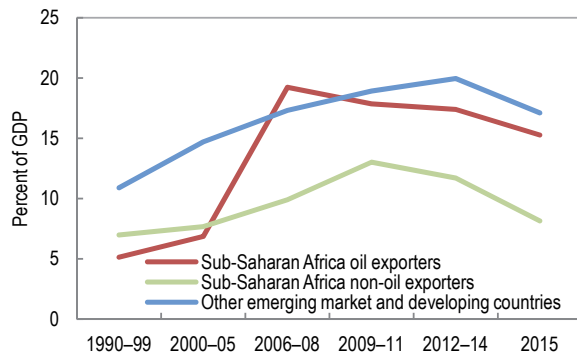
Source: IMF, International Financial Statistics.

Figure 2.14. Sub-Saharan Africa and Other Countries: External Debt

Source: IMF, World Economic Outlook database.

Figure 2.15. Sub-Saharan Africa and Other Countries: Inflation
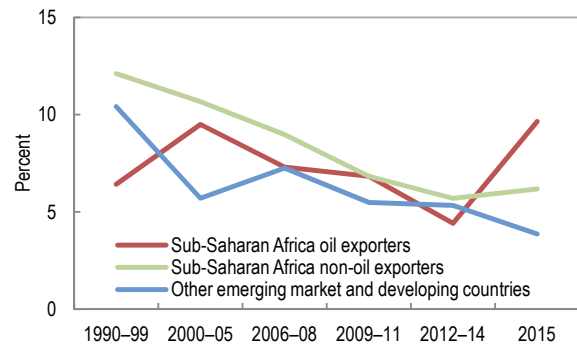
Source: IMF, International Financial Statistics.

particularly given the expected persistence of the commodity price shocks. Oil exporters in particular have allowed their deficit to widen as fiscal revenues dwindled, to a projected 5.5 percent of GDP deficit in 2016, from about 3 percent in 2014. But with public debt rising and borrowing costs also increasing, fiscal space is rapidly disappearing, as extensively elaborated in Chapter 1. This is especially true for countries that entered this period of declining commodity prices with already weak fiscal positions, such as Ghana and Zambia. More broadly, given the projected persistence of low commodity prices, the near-term focus will be on fiscal adjustment to preserve macro-economic stability in an increasing number of these countries. This will become increasingly important as countries' external debt levels rise above the threshold beyond which fiscal stimulus is found to no longer support output resilience (Figure 2.14).

- In the case of countries in a monetary union, such as the CEMAC, where five out of the six members are oil exporters, fiscal policy is the main policy tool to bring about the needed adjustment. There too, as buffers have been drawn on, the effort should squarely be on fiscal adjustment:

  - Better domestic revenue mobilization, especially where revenue from non-oil activities is particularly low, offers substantial potential to close the financing gap that has opened with the decline in oil fiscal revenue (for example, see Chapter 1, October 2015 *Regional Economic Outlook: Sub-Saharan Africa*).

  - Substantial savings need to be achieved from streamlining government spending, in particular by reforming across-the-board subsidies and improving the selection and execution of public investment projects.

- Inflation had fallen to single-digit levels in most commodity exporters in sub-Saharan Africa—averaging about 6 percent during 2010–14 (Figure 2.15). However, inflation trended up in 2015 as exchange rate depreciations—associated

with the commodity price declines and increased global risk aversion—passed through to inflation, although weather-related increases in food prices may have also played a role. Monetary and fiscal policy should seek to avoid spillover to more generalized inflation, including to achieve the real depreciation needed to help minimize output losses from the ongoing terms-of-trade shocks.

Beyond short-term policy actions, the focus of the policy agenda should also be turned back squarely to economic diversification. Even if somewhat slowed by financing constraints, the ongoing efforts to upgrade the region's infrastructure and education skills should be pursued to support the emergence of new sources of growth and hence create natural buffers against the dependence on natural resources. Stronger efforts to enhance the business climate, improve the efficiency of public spending, and mobilize domestic revenues will also help unleash the private sector's potential outside the extractive sector.

CONCLUSIONS

Many sub-Saharan African countries' dependence on extractive commodity exports has increased in recent decades, with about half of the region's countries now considered net commodity exporters. So long as commodity prices continued rising from the turn of the century onward, this proved a boon in terms of higher foreign exchange earnings, fiscal revenues, and foreign direct investment inflows—helping support the very strong growth momentum at the time. However, the generalized decline in commodities prices, first with metal prices starting in 2011, and oil prices since mid-2014, has triggered sizable deteriorations in the terms of trade for many of these commodity exporters. Oil exporters have been by far the most affected.

The analysis presented here shows that persistent slumps in extractive commodity prices do have a significant macroeconomic impact, but more so for oil exporters than other extractive commodity exporters. The current period should not be an exception to that pattern, with sub-Saharan African oil exporters' outlook particularly clouded. Although to a lesser extent, metal exporters' growth will likely be affected as well, especially where lower prices are also triggering a decline in extractive production, as mines are closed and jobs lost.

But policies have a strong role to play to help those countries weather the commodity price slump taking into account the expected persistence of the shock. For countries that are not part of a monetary union, exchange rate flexibility coupled with supportive policies should be the first line of defense. In the face of a large permanent commodity terms-of-trade shock implying durably reduced fiscal revenue from the extractive sector, countries have no choice but to undertake fiscal adjustment to close macroeconomic imbalances. Fiscal and external buffers can and are being used where available to smooth the pace of the adjustment, but as these diminish, fiscal deficits can become unsustainably large and balance of payments pressures can force disorderly adjustments. Fiscal adjustment efforts should mobilize revenues outside extractive sectors, as well as focus on streamlining recurrent spending to preserve growth-friendly capital investments.

In addition to gradually rebuilding policy buffers and persevering with efforts to strengthen policies as commodity prices recover, efforts should focus on structural reforms to support the diversification of the economies away from commodities. This puts the onus on better mobilizing domestic revenues, increasing the quality of public investment, and improving the business climate to promote the development of the private sector and diversify the export base beyond commodities.
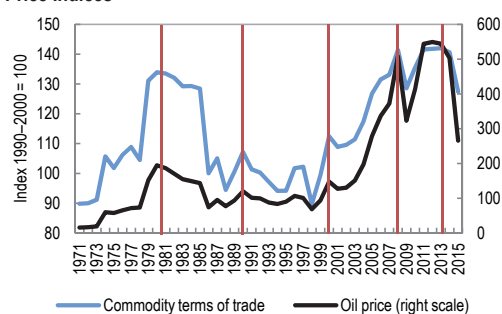
Box 2.1. Commodity Terms of Trade

The commodity terms-of-trade index weighs the changes in international prices of individual commodities according to country-specific net commodity exports as a share of GDP. The calculation of the country-specific index follows the approach used in Gruss (2014), the October 2015 *World Economic Outlook*, and Spatafora and Tytell (2009); see Annex 2.1. The construction of the index addresses some shortcomings of other commonly used terms-of-trade indices. For instance, standard aggregate terms-of-trade indicators have been found to poorly capture the behavior of commodity prices (Deaton and Laroque 1992; Cashin, Céspedes, and Sahay 2004). At the same time, analyzing the movements in one or two commodity prices would not provide a holistic examination of the impact of shocks affecting a country that is a net exporter of more than one commodity. Among advantages of the index used in this chapter are the following:

- The variation of the index shows the size of the income shock from price effects in terms of GDP.

- The effects of variations of commodity prices depend on the size of net exports of commodities of each country. This is important when countries are net importers of one commodity, for instance oil, but also net exporters of other commodities such as metals, food, or raw materials. This is the case for 11 of the 12 non-oil extractive-resource exporters in the region that are also oil importers.

- The weights used to calculate the terms-of-trade indicator are updated annually based on trade patterns in the preceeding three-year period using COMTRADE and IMF data. This is important to capture the evolving role of commodities in a country's exports. For instance, energy exports accounted for 2 percent of Angola's exports in the 1990s, but they now exceed 95 percent of total exports. Therefore, changes in energy prices have a much larger impact today than in the past.

- The index includes a wider range of metals (including precious stones) such as gold, platinum, and diamonds than in previous studies. This is important to capture the specificities of commodity terms-of-trade developments in several commodity exporters in sub-Saharan Africa such as Botswana, Burkina Faso, Mali, Namibia, or South Africa.

Box. 2.2. Commodity Price Slumps Hold Back Economic Activity: The Cases of Nigeria and the Republic of Congo

Nigeria and the Republic of Congo, the largest and the fourth largest oil exporters in sub-Saharan Africa, respectively, have experienced highly volatile terms of trade. This box explores the impact of the oil price cycles on these two economies over the period 1980–2015. Macroeconomic management in both countries faces challenges stemming from the high dependence on volatile oil revenue. In both countries, revenues from oil and gas accounted for more than 70 percent of total government revenues during 2011–13. Figures 2.2.1 and 2.2.2 show how the evolution of commodity terms of trade for the two countries closely follows global oil price developments and highlight two previous episodes of prolonged downswings.[1]

Figure 2.2.1. Nigeria: Commodity Terms-of-Trade and Oil Price Indices

Sources: IMF, World Economic Outlook database; and IMF staff calculations.


Figure 2.2.2. The Republic of Congo: Commodity Terms-of-Trade and Oil Price Indices
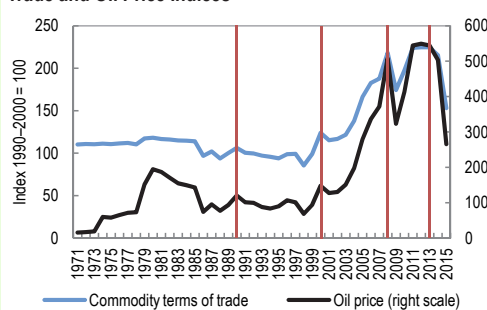
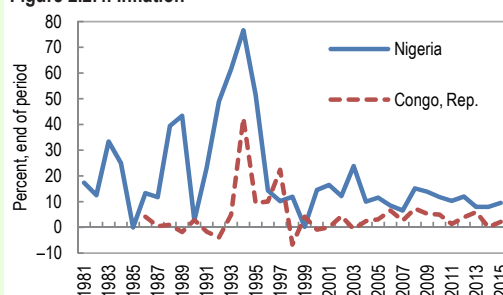Sources: IMF, World Economic Outlook database; and IMF staff calculations.

The oil price swings before the 2000s had serious macroeconomic effects for Nigeria. GDP growth decelerated markedly during terms-of-trade downswings (Figure 2.2.3), with the economy contracting by as much as 10 percent during the oil price slump in the early- to mid-1980s. Inflation was high and volatile owing to substantial currency depreciation (Figure 2.2.4). The naira depreciated by an average of 28 percent a year during the prolonged oil price downswing of 1980–87. However, growth and inflation became considerably less volatile from the early 2000s onward, partly the result of improved policy frameworks and a more supportive external environment.

Figure 2.2.3. Real GDP Growth
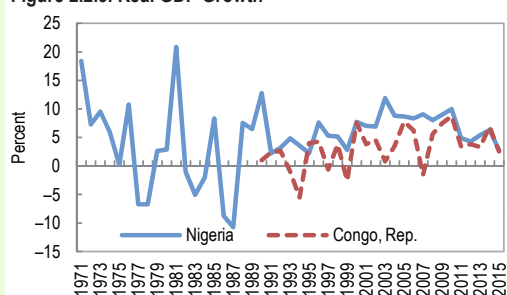
Source: IMF, World Economic Outlook database.


Figure 2.2.4. Inflation

Source: IMF, World Economic Outlook database.

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[1] For the Republic of Congo, our analysis covers the period starting in 1990 and onward, mainly because of issues pertaining to data availability and quality prior to 1990.

Box 2.2. *(continued)*

In contrast, the Republic of Congo has continued to experience more volatile GDP growth. Oil price downswings (for example, in 1990 and 2008) had a more significant adverse impact on growth in the Republic of Congo than in Nigeria. Also, civil conflict contributed to growth volatility in Congo in the 1990s, which remained high even after stability was restored in the early 2000s. As regards price stability, however, the Republic of Congo generally experienced lower and more stable inflation than Nigeria, in part because of its exchange rate regime (the Republic of Congo is part of the Central African Economic and Monetary Community—CEMAC), even in the immediate aftermath of the 1994 CFA franc devaluation (Figure 2.2.4).

Between 2004 and 2008, the Nigerian authorities sought to improve the management of oil and gas revenues. In 2004, they established an oil-price-based rule for the budget along with the Excess Crude Account (ECA)—a stabilization fund—designed to delink spending from oil revenues. Meanwhile, the central bank showed some flexibility in its management of the exchange rate and accumulated substantial international reserves (Figure 2.2.5). Together, these steps helped to smooth the impact of oil revenue shocks in 2008. In addition, debt buyback operations, partly funded by the ECA, and debt relief resulted in significantly reducing Nigeria's external debt (Figure 2.2.6). During 2003–08, macroeconomic stability was restored, and the procyclicality of spending in response to changes in oil prices was reduced (Figure 2.2.7). Significant fiscal surpluses were generated, contributing to the accumulation of sizable assets in the ECA. The countercyclical fiscal policy was complemented by a strong anti-inflationary monetary policy which brought inflation down to single digits.

Figure 2.2.5. International Reserves
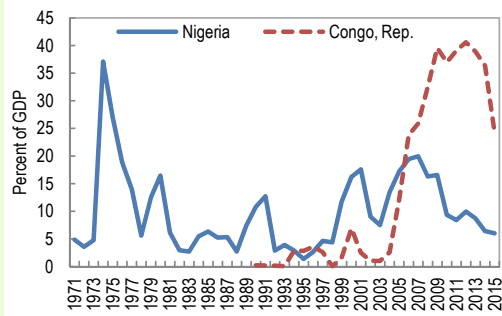
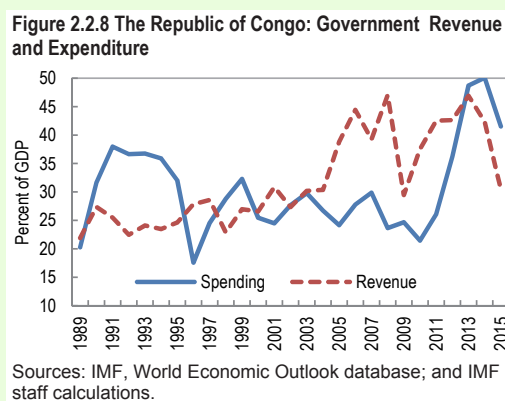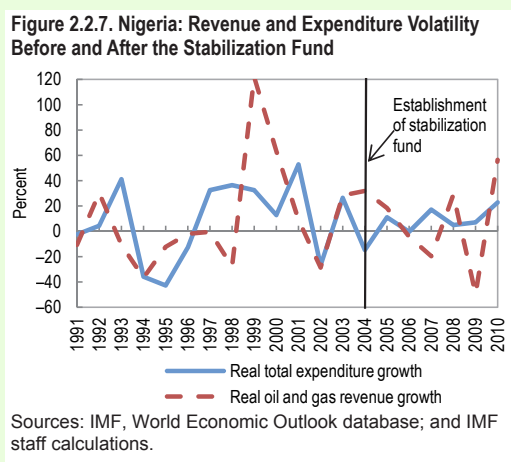Source: IMF, International Financial Statistics.

Figure 2.2.6. Total Public Debt
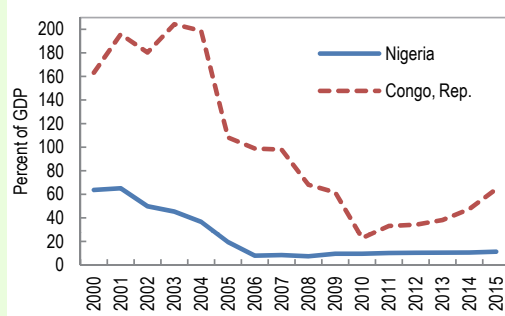
Source: IMF, World Economic Outlook database.

However, procyclical fiscal policy resumed after the global financial crisis: a substantial increase in government spending accompanied the high oil prices during 2010–14. Combined with a sharp drawdown from the ECA savings—which reached a low of $3.1 billion in 2014, down from $11 billion in 2012—this has left Nigeria with minimal fiscal buffers to smooth the recent decline in oil prices. Against this background, the central bank of Nigeria has imposed restrictions on access to foreign exchange during the current oil price downswing in an attempt to preserve international reserves and contain pressures on the currency. This has introduced significant distortions in the economy, led to the emergence of a significant spread between the official interbank exchange rate and other markets for foreign exchange, and adversely affected economic activity.

The Republic of Congo, meanwhile, has yet to establish a robust fiscal framework for dealing with oil price shocks. Public spending has displayed considerable procyclicality throughout 1990–2014. Expenditure doubled in absolute terms in recent years, to reach 50 percent of GDP in 2014 (Figure 2.2.8). Past efforts to adopt a fiscal rule, most recently in 2013, have been ineffective. The current oil price slump could provide the impetus to establish effective fiscal rules for smoothing the expenditure path during oil booms and busts.

Box 2.2 *(continued)*

Figure 2.2.7. Nigeria: Revenue and Expenditure Volatility Before and After the Stabilization Fund

Sources: IMF, World Economic Outlook database; and IMF staff calculations.

Figure 2.2.8 The Republic of Congo: Government Revenue and Expenditure

Sources: IMF, World Economic Outlook database; and IMF staff calculations.

As in the case of Nigeria, the steep fall in oil prices since mid-2014 has resulted in pronounced declines in fiscal and external buffers in the Republic of Congo and caused economic growth to slow. When peace was restored in the early 2000s, the accumulation of reserves and fiscal buffers was a clear policy focus of the government of the Republic of Congo. This was supported by a series of IMF-supported programs, culminating in debt relief in 2010 under the Heavily Indebted Poor Countries Initiative. As a result, by mid-2014, the Republic of Congo had the largest reserves among CEMAC countries along with additional government deposits abroad and fiscal savings at the central bank. In the face of the current oil price slump, both reserves and government deposits declined sharply in 2015 as the scaling up of public investment was maintained in the face of declining oil revenues. International reserves fell to about 5.5 months of imports in 2015, the lowest level since 2007. At the same time, the Republic of Congo's debt has increased significantly to 64 percent of GDP in 2015—almost three times the level immediately following debt relief in 2010—and is limiting the fiscal space available to pursue countercyclical policies.

Annex 2.1. Commodity Terms of Trade: Variable Construction and Methods

This annex provides further details on the classification of commodity exporters, the construction of the commodity terms-of-trade index, the methodology to date commodity price shock episodes, and the other econometric methods and data used in the chapter.

Commodity Classification

A country is classified as a commodity exporter in a given decade if it meets the following two conditions (decades: 1962–79, 1980–89, 1990–99, 2000–09, and 2010-14):

1.   Commodities constitute at least 25 percent the country's total goods exports, on average, in a given decade; and

2.   Net commodity exports accounted for at least 5 percent of its gross trade (exports plus imports) in goods on average.

Commodity Terms-of-Trade Index

For each country, the change in the commodity terms-of-trade index (CTOT) corresponds to the weighted sum of annual variations in global prices of commodities, weighted by the country's net exports of each commoditiy as a share of GDP, following the approach used in Gruss (2014). The change in the commodity terms-of-trade for a given country i in year t is obtained as:

$$\Delta \text{Log(CTOT)}_{i,t} = \sum_{j=1}^{J} \Delta P_{j,t} \cdot \omega_{i,j,t}, \quad \text{with } \omega_{i,j,t} = \frac{1}{3} \sum_{s=1}^{3} \frac{x_{i,j,t-s} - m_{i,j,t-s}}{\text{GDP}_{i,t-s}}$$

- where $P_{j,t}$ is the logarithm of the price of commodity j in period t (in U.S. dollars and divided by the IMF's price deflator for exports of manufactures in advanced economies);

- Δ denotes first differences;

- $x_{i,j,t}$ ($m_{i,j,t}$) denotes the exports (imports) value of commodity j by country i (in U.S. dollars, from UN COMTRADE and IMF data) at time t;

- $GDP_{i,t}$ denotes country i's nominal GDP in U.S. dollars at time t; and

- the weights $\omega_{i,j,t}$ are predetermined vis-à-vis the price change in each period, but are allowed to vary over time reflecting changes in the basket of commodities actually traded. This implies that at any point in time, changes in CTOT reflect changes in prices only and not in the volumes traded. When a weight is not available for a country in a given year, we use the previous available weight.

We use prices for commodities starting in 1960, and commodities are sorted into four broad categories:

- *Energy*—Coal, crude oil, and natural gas.

- *Metals*—Aluminum, cobalt, copper, diamond, gold, iron ore, lead, nickel, platinum, tin, titanium, uranium, and zinc.

- *Food*—Bananas, barley, beef, cocoa, coconut oil, coffee, corn, fish, fish meal, groundnuts, lamb, olive oil, oranges, palm oil, poultry, rapeseed oil, rice, shrimp, soybean meal, soybean, soybeans oil, sugar, sunflower oil, swine, tea, and wheat.

- *Raw materials*—Cotton, hard logs, sawn hardwood, hides, rubber, soft logs, sawn softwood, and wool.

Methodology for Dating Commodity Price Cycles and Identifying Episodes

Cycles in country-specific CTOT indices are identified using the Bry-Boschan algorithm, a standard in the business cycle literature (Harding and Pagan 2002). Cycles are defined as episodes in which the CTOT increased for at least two consecutive years, with a subsequent decline of at least three consecutive years, and with a cumulated decline of at least 1

percent (Annex Figure 2.1.1). Upswings are defined trough to peak (excluding the trough year, but including the peak year); downswings are defined peak to trough (excluding the peak year, but including the trough year). The analysis of the event studies further restricts the episodes to downswings that are driven by declines in the prices of commodity exports. Thus, episodes in which import price developments drive the declines in commodity terms of trade and which may have a different economic impact are excluded.

Based on this methodology, 201 episodes for 105 countries are identified, of which 75 episodes are in sub-Saharan Africa. Figure 2.1.2 shows the episodes identified for sub-Saharan African commodity exporters and selected others.

Annex Figure 2.1.1. Upswing and Downswing in Terms-of-Trade Cycles
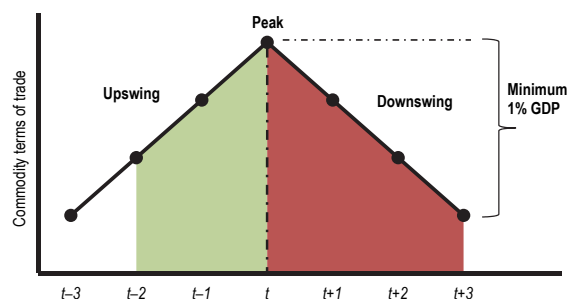
Annex Figure 2.1.2. Sub-Saharan African Commodity Exporters and Other Countries: Episodes of Commodity Terms-of-Trade Busts
(Time span of each episode)
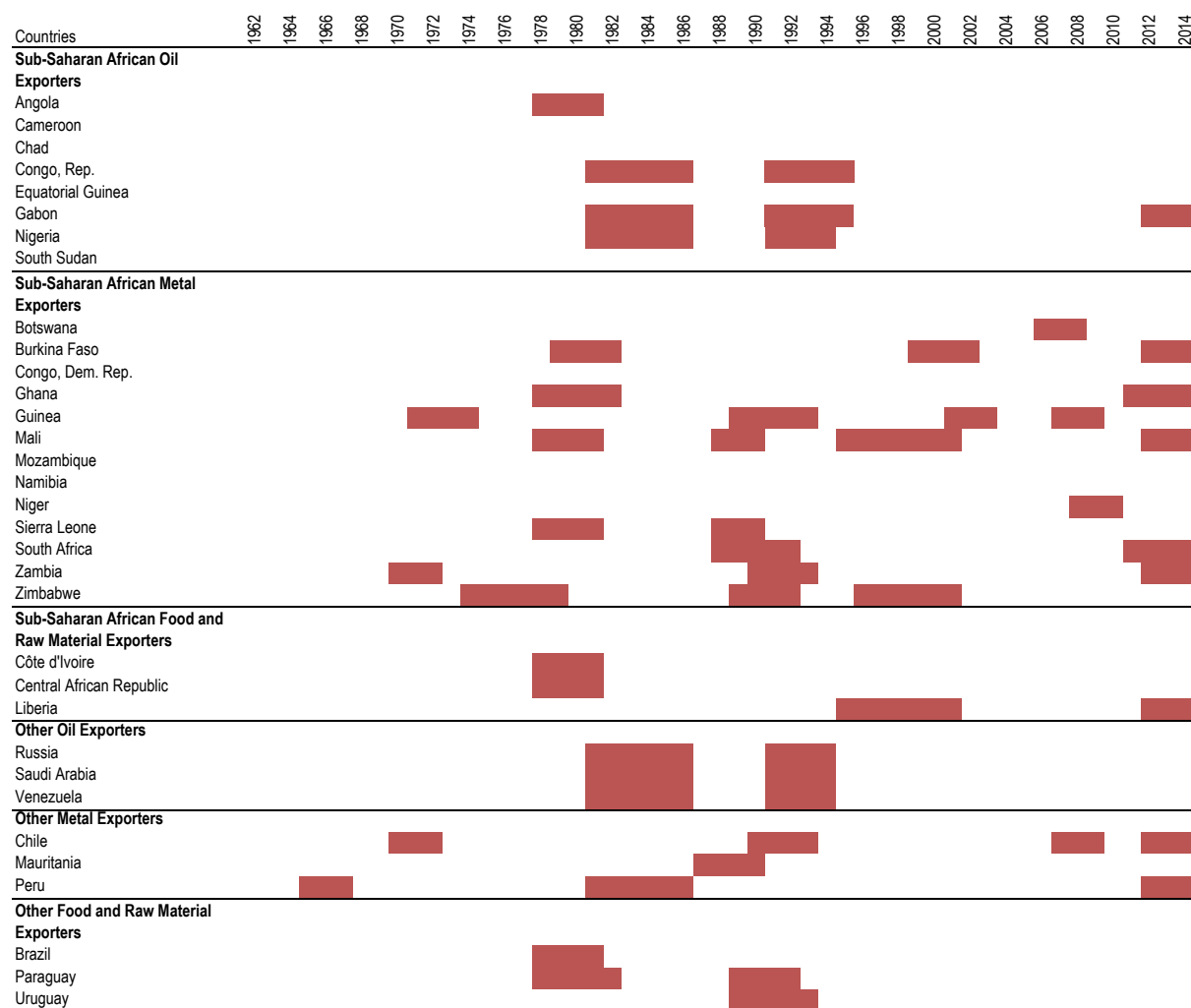
Source: IMF staff calculations.

Note: A country is classified as a commodity exporter if commodity exports constitute at least 25 percent of total goods exports, on average during the respective decade, and net commodity exports accounted for at least 5 percent of goods trade (goods exports plus goods imports), on average during the respective decade. Episodes of negative commodity terms-of-trade shocks are identified on the basis of at least three years of consecutive decline in the commodity terms-of-trade index and a cumulative drop in the index of at least 1 percentage point of GDP within three years of the peak.

Local Projections Method

The effects of commodity terms-of-trade shocks on macroeconomic aggregates are evaluated using the local projections method of Jordà (2005), which was later refined by Teulings and Zubanov (2014). This method allows the estimation of the dynamic effects of a shock in commodity terms of trade using impulse-response functions that are obtained from ordinary least squares regressions. Unlike impulse-responses obtained from vector autoregression (VAR), the impulse-responses obtained with local projections do not require assumptions about the structure through which shocks are transmitted in the system, which is a common issue in VAR models.

For the estimation of the effects of a contemporary shock of CTOT on the variable of interest (output, trade balance, and fiscal revenues), the models used control for other determinants of economic performance such as trading partners' GDP growth, an indicator of global financial conditions, and country-specific indicators of war or armed conflicts and changes in political regimes.

The equation used to estimate the effect of CTOT shocks is shown below. In this expression, the first two terms represent country and time effects. The third term contains the shock variable, represented by $\Delta s_{i,t}$, which is the change in the natural log of the country-specific CTOT at time t. The cumulative effect on the variable of interest is represented by the estimate β^h, where h denotes the time horizon. The other terms are control variables. The fourth and fifth terms control for shocks in CTOT and other determinants that occur before time t but still may have an effect on the outcome of the dependent variable. The sixth term controls for effects on the dependent variable coming from its own lagged variations. The last two terms, introduced by Teulings and Zubanov (2014), control for the effects of shocks in CTOT and other determinants occurring between t and $t+h$ that can influence the outcome of the dependent variable at time $t+h$. For each horizon h for which the effect of CTOT is estimated, it is necessary to estimate a different equation. The cumulative responses are obtained from the h different β. The equations are estimated using balanced panels for the period 1962–2015 and robust standard errors (White 1982).

$$
\begin{aligned}
y_{i,t+h} - y_{i,t-1} = {} & \alpha_i^h + \gamma_t^h + \beta^h \Delta s_{i,t} + \sum_{j=1}^{p} \beta_{1,j}^h \Delta s_{i,t-j} + \sum_{j=0}^{p} \theta_{1,j}^h x_{i,t-j} + \sum_{j=1}^{p} \theta_{2,j}^h \Delta y_{i,t-j} \\
& + \sum_{j=0}^{h-1} \beta_{2,j}^h \Delta s_{i,t+h-j} + \sum_{j=0}^{h-1} \theta_{3,j}^h x_{i,t+h-j} + \varepsilon_{i,t}^h
\end{aligned}
$$

Methodology for Evaluating the Effect of Policies on Countries' Resilience in the Aftermath of a Negative Commodity Price Shock

A multivariate ordinary least squares regression analysis is undertaken that relates the relative real GDP growth performance in the aftermath of a terms-of-trade shock to variables capturing countries' policy space and policy responses. The regression analysis builds on the previously identified episodes for the sample of emerging market and developing countries and existing empirical research (Adler and Sosa 2011; Céspedes and Velasco 2012).

Although terms-of-trade shocks can be of varying lengths, the focus of the analyses is on the first three years after a shock hits an economy. To assess the role of policy space and policy reactions in mitigating the impact of a shock on real economic growth, we need to construct appropriate measures of the impact. A growth difference measure is used to capture the gap between the real economic growth rate in the first three years of a shock versus the average growth rate observed during the three years before the shock (as a proxy of what growth could have been in the absence of the shock). In the aftermath of shocks, countries' growth paths will vary depending on a number of factors—some countries show more resilience than others to shocks, as displayed in Annex Figure 2.1.3. The variables used in the regression analysis are detailed in Annex Table 2.1.

Annex Figure 2.1.3. Stylized Growth Response to a Commodity Terms-of-Trade Decline
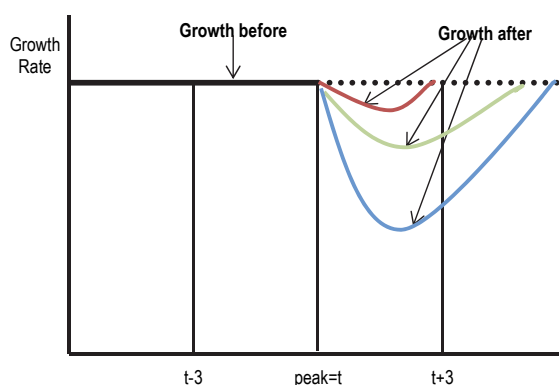
Source: IMF staff calculations.

Annex Table 2.1.1. Descriptions of Variables

Variable	Description	Source
Real GDP growth and growth differential	Annual real GDP growth, growth differential measured as average growth of real GDP in first three years of a shock minus average growth of real GDP in previous three years.	Penn World Tables and IMF, World Economic Outlook database.
Private consumption	Real terms, national currency, percent growth.	IMF, World Economic Outlook database.
Current account balance	Percent of GDP.	IMF, World Economic Outlook database.
International reserves	Gross, in percent of GDP.	IMF, International Financial Statistics and IMF, World Economic Outlook database.
Fiscal balance	General government, national currency, in percent of GDP.	IMF, World Economic Outlook database.
Total public debt	General government gross debt, national currency, in percent of GDP.	IMF, World Economic Outlook database.
Consumer price index	Annual percent growth.	IMF, International Financial Statistics.
Size CTOT shock	Cumulative percent change in the CTOT over the first three years after a shock.	IMF staff calculations.
Shocks caused by decline in export prices	Dummy variable equal to 1 if a CTOT shock is related to a decline in export prices.	IMF staff calculations.
International reserves above median at time t_0	Above-average reserve buffers calculated as actual reserves (in percent of GDP) minus regime-specific (fixed or flexible exchange rate) median levels of reserves for all emerging market and developing countries, in the year immediately before a shock.	IMF staff calculations based on data from IMF, International Financial Statistics.
High external debt before shock	Dummy variable with value 1 if external-debt-to-GDP ratio is 40 percent or more.	IMF, World Economic Outlook database.
Flexible exchange rate regime at time t_0	Dummy variable with value 1 when the de facto exchange rate regime is flexible in the year immediately before the CTOT shock.	Ilzetzki, Reinhart, and Rogoff (2010) database.
Depreciation of nominal exchange rate (percent)	Cumulative depreciation in the nominal exchange rate (U.S. dollars per national currency) over the first two years of a shock—used as a proxy for exchange rate flexibility.	IMF staff calculations based on data from IMF, International Financial Statistics.
Exchange rate collapse: 45% or more depreciation	Cumulative depreciation (in percent) during currency collapses, where such events are defined as declines of 45 percent or more in the value of the domestic currency during the first two years of a shock.	IMF staff calculations based on data from IMF, International Financial Statistics.
Growth of real government consumption	Average annual percent change in real government consumption over first three years of the shock.	Penn World Tables and IMF, World Economic Outlook database.
Growth of real government consumption interacted with high external debt	Interaction term between average percent change in real government consumption and a dummy variable for external-debt-to-GDP ratio at 40 percent of GDP or more the year before the shock.	Penn World Tables and IMF, World Economic Outlook database.
M2 growth during shock	Average annual percent change in broad money (M2) over the first three years after the shock.	IMF, International Financial Statistics.
War or armed conflict	Dummy variable equal to 1 if the number of deaths in battle-related conflicts is at least 1,000.	World Bank, World Development Indicators.
Change in political regime	Dummy variable equal to 1 and the following four years in case of a change in political regime.	Center for Systemic Peace, Polity IV dataset.
Financial conditions	Slope of the yield curve of U.S. bonds. Difference between rates of 10-year and 3-year bonds.	Federal Reserve.
External demand	Indicator of external demand. Chained index based on weighted sum of GDP growth rates of trading partners, weighted by share of exports to each partner.	IMF, World Economic Outlook database.

Note: CTOT = commodity terms-of-trade index.

Country Coverage

Depending on the data availability, the event studies and regression analyses in the chapter included the following countries:

Sub-Saharan African countries: Angola, Benin, Botswana, Burkina Faso, Central African Republic, Comoros, Republic of Congo, Côte d'Ivoire, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritius, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

Non-sub-Saharan African countries: Albania, Algeria, Argentina, Armenia, Azerbaijan, Bahrain, Bangladesh, Belize, Bhutan, Bolivia, Bosnia and Herzegovina, Brazil, Brunei Darussalam, Chile, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Fiji, FYR Macedonia, Georgia, Grenada, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Iran, Iraq, Kazakhstan, Kiribati, Kuwait, Kyrgyz Republic, Libya, Malaysia, Maldives, Mauritania, Mexico, Moldova, Mongolia, Myanmar, Nicaragua, Oman, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Russia, Samoa, Saudi Arabia, Solomon Islands, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Syria, Tajikistan, Thailand, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Uruguay, Vanuatu, Venezuela, and Vietnam.