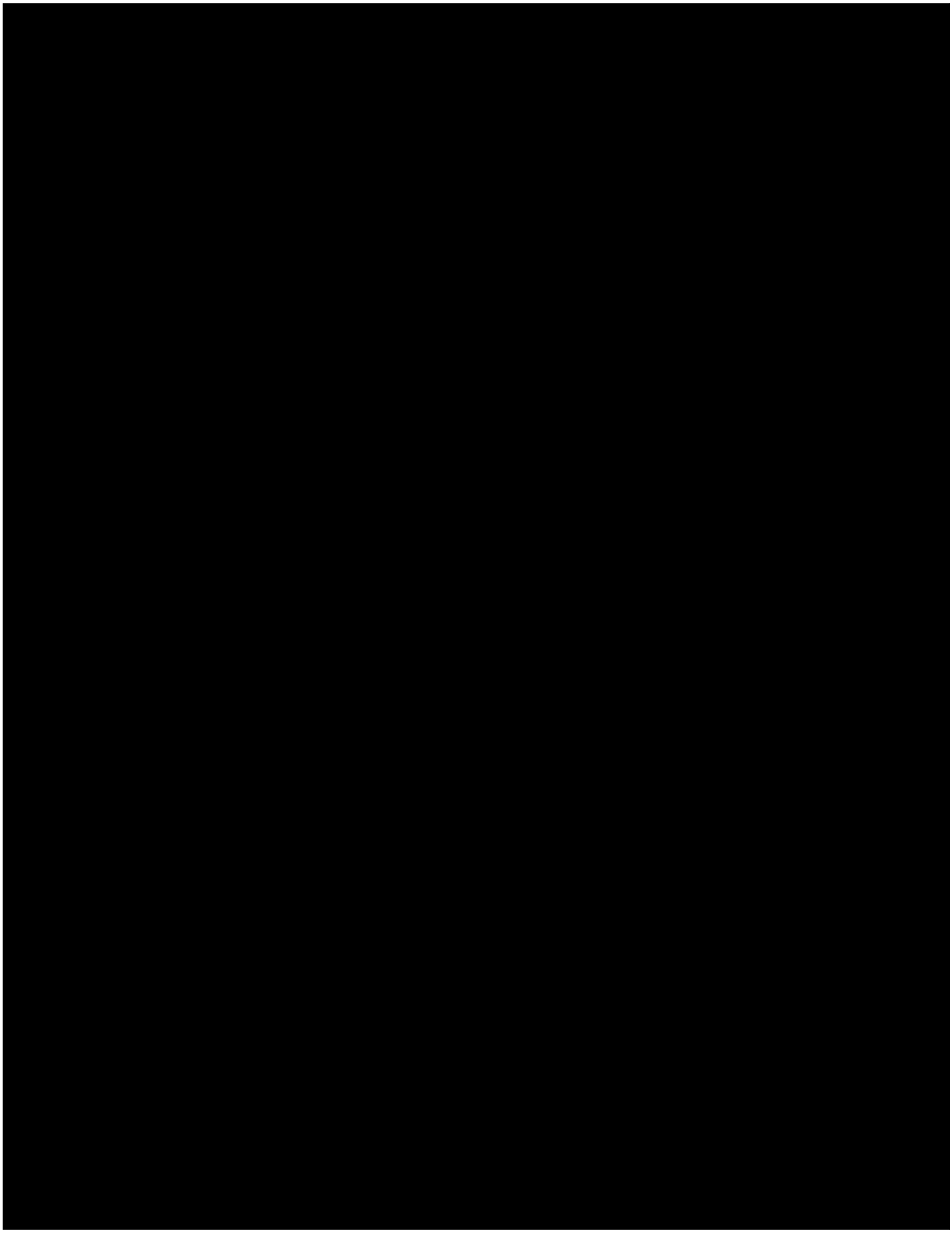

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IMF Working Paper

Research Department

Trading on Their Terms? Commodity Exporters in the Aftermath of the Commodity Boom[1]

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Abstract

Commodity prices have declined sharply over the past three years, and output growth has slowed considerably among countries that are net exporters of commodities. A critical question for policy makers in these economies is whether commodity windfalls influence potential output. Our analysis suggests that both actual and potential output move together with commodity terms of trade, but that actual output comoves twice as strongly as potential output. The weak commodity price outlook is estimated to subtract 1 to 2¼ percentage points from actual output growth annually on average during 2015-17. The forecast drag on potential output is about one-third of that for actual output.

JEL Classification: O13, P48, Q02, Q33
Keywords: Natural Resources , Potential Output, Resource Boom, Terms of Trade

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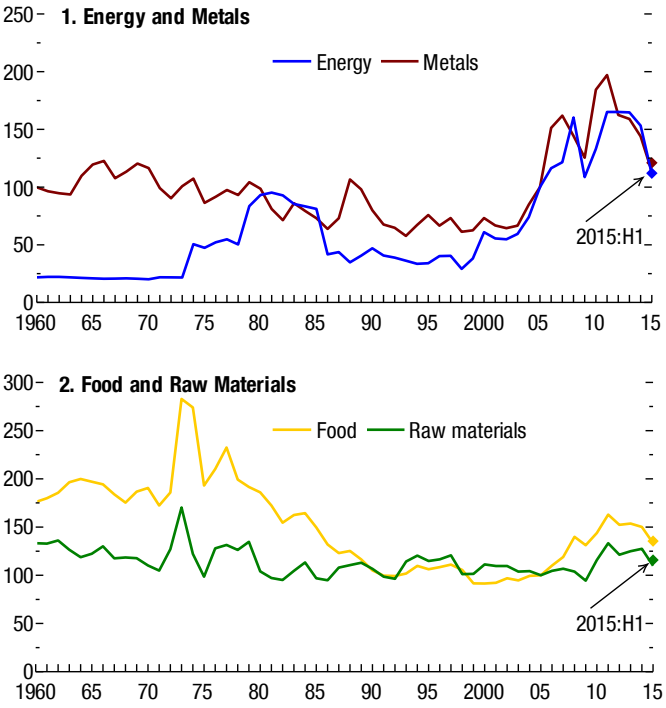
I. INTRODUCTION

After rising dramatically for almost a decade, the prices of many commodities, especially those of energy and metals, have dropped sharply since 2011 (Figure 1). Many analysts have attributed the upswing in commodity prices to sustained strong growth in emerging market economies, in particular those in east Asia, and the downswing to softening growth in these economies and a greater supply of commodities.[2] Commodity prices are notoriously difficult to predict, but analysts generally agree that they will likely remain low, given ample supplies and weak prospects for global economic growth. Commodity futures prices also suggest that, depending on the commodity, future spot prices will remain low or rebound only moderately over the next five years.

Figure 1. World Commodity Prices, 1960–2015
(In real terms; index, 2005 = 100)

After a dramatic rise in the 2000–10 period, the prices of many commodities have been dropping sharply. The cycle has been especially pronounced for energy and metals.



Sources: Gruss 2014; IMF, Primary Commodity Price System; U.S. Energy Information Administration; World Bank, Global Economic Monitor database; and IMF staff calculations.
Note: The real price index for a commodity group is the trade-weighted average of the global U.S. prices of the commodities in the group deflated by the advanced economy manufacturing price index and normalized to 100 in 2005. The commodities within each group are listed in Annex 2.1. The values for the first half of 2015 (2015:H1) are the average of the price indices for the first six months of the year.

The decline in commodity prices has been accompanied by stark slowdowns in economic growth among commodity-exporting emerging market and developing economies, most of which had experienced high growth during the commodity price boom (Figure 2). Besides the decline in growth, commodity exporters have seen downgrades in their medium-term growth prospects: almost 1 percentage point has been shaved off the average of their five-year-ahead growth forecasts since 2012, while the

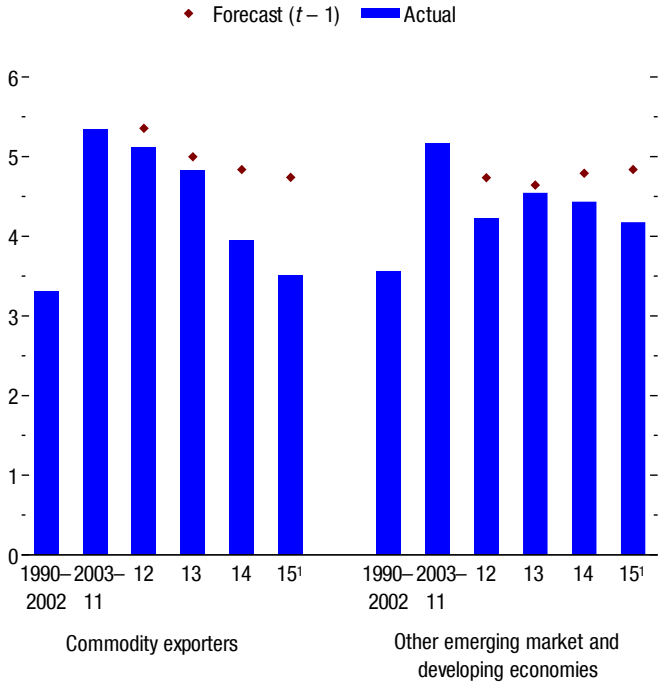
[2] The role of global and emerging market demand in driving the surge in commodity prices in the first decade of the 2000s is discussed in Erten and Ocampo 2012, Kilian 2009, and Chapter 3 of the October 2008 *World Economic Outlook*. On the impact of slowing emerging market growth on commodity prices, see "Special Feature: Commodity Market Review" in Chapter 1 of the October 2013 *World Economic Outlook*. Roache 2012 documents the increase in China's share in global commodity imports in the 2000s and Box 1.2 of the April 2014 *World Economic Outlook* examines the impact of China's rebalancing on commodity consumption.

medium-term growth forecasts of other emerging market and developing economies had, as of October 2015, remained broadly unchanged.

Weaker commodity prices raise key questions for the outlook in commodity-exporting economies. One that looms large is whether the faster rate of output growth during the commodity boom reflected a cyclical overheating as opposed to a higher rate of growth in potential output. The flipside of this question is whether it is only actual or also potential output growth that is slowing in the aftermath of the commodity boom.[3] Distinguishing between the cyclical and structural components of growth is particularly challenging during prolonged commodity booms, when a persistent pickup in incomes and demand makes it harder to estimate the underlying trend in output.[4]

Figure 2. Average Growth in Commodity-Exporting versus Other Emerging Market and Developing Economies, 1990–2015
(Percent)

The recent drop in commodity prices has been accompanied by pronounced declines in real GDP growth rates, much more so in commodity-exporting countries than in other emerging market and developing economies.



Source: IMF staff estimates.
Note: "Commodity exporters" are emerging market and developing economies for which gross exports of commodities constitute at least 35 percent of total exports and net exports of commodities constitute at least 5 percent of exports-plus-imports on average, based on the available data for 1960–2014. "Other emerging market and developing economies" are defined as the emerging market and developing economies that are not included in the commodity exporters group. Countries are selected for each group so as to have a balanced sample from 1990 to 2015. Outliers, defined as economies in which any annual growth rate during the period exceeds 30 percent (in absolute value terms), are excluded.
[1]Average growth projected for 2015 in the July 2015 *World Economic Outlook Update*.

The diagnosis of how actual and potential growth is influenced by commodity price fluctuations is crucial for the setting of macroeconomic policies in commodity exporters. Price declines that lead to a mostly cyclical slowdown in growth could

[3] Potential output is defined in this paper as the amount of output in an economy consistent with stable inflation. Actual output may deviate from potential output because of the slow adjustment of prices and wages to changes in supply and demand. In most of the empirical analysis, potential output is proxied by trend output—based on an aggregate production function approach and using the growth rates of the capital stock as well as smoothed employment and total factor productivity series. Chapter 3 of the April 2015 *World Economic Outlook* includes a primer on potential output (pp. 71–73).

[4] See the discussion in De Gregorio 2015.

call for expansionary macroeconomic policies (if policy space is available) to pick up the slack in aggregate demand. In contrast, lower growth in potential output would tend to imply a smaller amount of slack and, therefore, less scope for stimulating the economy using macroeconomic policies. In countries where the decline in commodity prices leads to a loss in fiscal revenues, weaker potential output growth would also require fiscal adjustments to ensure public debt sustainability.

This paper contributes to the literature on the macroeconomic effects of booms and downturns in the commodity terms of trade (the commodity price cycle) in net commodity exporters. The "commodity terms of trade" as referred to in this paper is the price of a country's commodity exports in terms of its commodity imports. It is calculated as a country-specific weighted average of international commodity prices, for which the weights used are the ratios of the net exports of the relevant commodities to the country's total commodity trade.

Using a variety of empirical approaches, the paper makes a novel contribution by analyzing changes in the cyclical versus structural components of output growth in small open net commodity-exporting economies during the commodity price cycle.[5] The empirical analysis focuses on emerging market and developing economies that are net exporters of commodities, with the exception of case studies that examine the sectoral reallocation resulting from commodity booms in Australia, Canada, and Chile.

Specifically, the paper seeks to answer the following questions about the effects of the commodity price cycle:

- *Macroeconomic effects:* How do swings in the commodity terms of trade affect key macroeconomic variables—including output, spending, employment, capital accumulation, and total factor productivity (TFP)? How different are the responses of actual and potential output?
- *Policy influences:* Do policy frameworks influence the variation in growth over the cycle?

[5] The literature has mostly focused on the comparative longer-term growth record of commodity exporters. Surveys can be found in van der Ploeg 2011 and Frankel 2012. Other major topics in the literature include the contribution of terms-of-trade shocks to macroeconomic volatility (for example, Mendoza 1995 and Schmitt-Grohé and Uribe 2015), the comovement between the commodity terms of trade and real exchange rate (for example, Chen and Rogoff 2003 and Cashin, Céspedes, and Sahay 2004), the impact of natural resource discoveries on activity in the nonresource sector (Corden and Neary 1982; van Wijnbergen 1984a, 1984b), and the relationship between terms-of-trade movements and the cyclical component of output (Céspedes and Velasco 2012). Chapter 1 of the October 2015 *Fiscal Monitor* discusses the optimal management of resource revenues, a topic that has also been the subject of a large literature (for example, IMF 2012).

- *Sectoral effects:* How do swings in the commodity terms of trade affect the main sectors of the economy—commodity producing, manufacturing, and nontradables?
- *Growth outlook:* What do the empirical findings imply for the growth prospects of commodity-exporting economies over the next few years?

The main findings of the paper are as follows:

Swings in the commodity terms of trade lead to fluctuations in both the cyclical and structural components of output growth, with the former tending to be about twice the size of the latter. In previous prolonged terms-of-trade booms, annual actual output growth tended to be 1.0 to 1.5 percentage points higher on average during upswings than in downswings, whereas potential output growth tended to be only 0.3 to 0.5 percentage point higher. These averages mask considerable diversity across episodes, including in regard to the underlying changes in the terms of trade.

The strong response of investment to swings in the commodity terms of trade is the main driver of changes in potential output growth over the cycle. In contrast, employment growth and TFP growth contribute little to the variations in potential output growth.

Certain country characteristics and policy frameworks can influence how strongly output growth responds to the swings in the commodity terms of trade. Growth responds more strongly in countries specialized in energy commodities and metals, and in countries with a low level of financial development. Less flexible exchange rates and more procyclical fiscal spending patterns (that is, stronger increases in fiscal spending when the commodity terms of trade are improving) also tend to exacerbate the cycle.

Case studies of Australia, Canada, and Chile suggest that investment booms in commodity exporters are mostly booms in the commodity sector itself. Evidence of large-scale movements of labor and capital toward nontradables activities is mixed.

All else equal, the weak commodity price outlook (as of August 2015) is projected to subtract about 1 percentage point annually from the average rate of economic growth in commodity-exporting economies over 2015–17 as compared with 2012–14. In energy exporters the drag is estimated to be larger, about 2¼ percentage points on average.[6]

The findings of the paper suggest that, on average, some two-thirds of the decline in output growth in commodity exporters during a commodity price downswing should be

[6] In this paper, all references to growth prospects are based on commodity futures prices as of end August 2015, with other assumptions and projections as shown in the October 2015 *World Economic Outlook*. Many commodity prices have declined further in the last quarter of 2015 and early 2016. Hence the estimates in this paper are likely to be a lower bound, with actual impacts potentially larger than those presented here.

cyclical. Whether the decline in growth has opened up significant economic slack (that is, whether it has increased the quantity of labor and capital that could be employed productively but is instead idle) and the degree to which it has done so are likely to vary considerably across commodity exporters. The variation depends on the cyclical position of the economy at the start of the commodity boom, the extent to which macroeconomic policies have smoothed or amplified the commodity price cycle, the extent to which structural reforms have bolstered potential growth, and other shocks to economic activity. Nevertheless, a key takeaway for commodity exporters is that attaining growth rates as high as those experienced during the commodity boom will be challenging under the current outlook for commodity prices unless critical supply-side bottlenecks that constrain growth are alleviated rapidly.

The rest of this paper is structured as follows. The second section briefly reviews the literature on the macroeconomic implications of a terms-of-trade windfall in a commodity-exporting economy. Two sets of empirical tests are presented in the third section: event studies and regression-based estimates. The event studies cover a large sample of prolonged upswings and subsequent downswings in the commodity terms of trade to document the key regularities in the data; by design, they do not control for contextual factors. To isolate the effects of the terms-of-trade movements, the section also presents regression-based estimates of the responses of key macroeconomic variables to terms-of-trade shocks. In the fourth section, case studies examine the sectoral implications of terms-of-trade booms. The final section summarizes the findings and discusses their policy implications.

II. Commodity Terms-of-Trade Windfalls: Concepts and Channels

This section starts off by reviewing the concept of potential output and how commodity price cycles might be expected to affect small open economies that are net exporters of commodities (hereafter, commodity-exporting economies). It then turns to the transmission channels through which a terms-of-trade boom can affect a typical commodity-exporting economy.

Potential Output

The following discussion of the macroeconomic implications of a terms-of-trade windfall distinguishes between temporary effects on potential output (those over a commodity cycle) and permanent effects (beyond a commodity cycle). Over a commodity cycle, potential output is defined as the level of output consistent with stable inflation—captured by the path of output under flexible prices. The short-term divergence of actual output from potential output—resulting from the slow adjustment in prices—is referred to as the output gap. These two components of output fluctuations can also be called the "structural" and "cyclical" components. Beyond the commodity cycle, potential output in a

commodity-exporting economy is driven by changes in global income, the implied change in the relative price of commodities, and any durable effects of the commodity price boom on domestic productive capacity (as discussed next). All else equal, a permanent increase in the commodity terms of trade would lead to an increase in potential output.[7]

In a growth-accounting framework (which measures the contribution to growth from various factors), potential output can be decomposed into capital, labor, and the remainder unexplained by those two—TFP. Terms-of-trade booms can affect the path of potential output through each of these three components. More durable changes in potential growth are possible to the extent that productivity growth is affected.

Capital. A commodity terms-of-trade boom that is expected to persist for some time will increase investment in the commodity sector and in supportive industries. A broader pickup in investment could be facilitated by a lower country risk premium and an easing of borrowing constraints that coincide with a better commodity terms of trade. Higher investment rates in the commodity and noncommodity sectors, in turn, will raise the economy's level of productive capital and hence raise the level (but not the permanent growth rate) of its potential output.

Labor supply. Large and persistent terms-of-trade booms may also affect potential employment. Structural unemployment may decline following a period of low unemployment through positive hysteresis effects. Lower unemployment rates may also encourage entry into the labor force as well as job search, raising the trend participation rate. As with investment, the labor supply channels have an effect on the level of potential output, but not on its permanent growth rate.

Total factor productivity. Terms-of-trade booms can raise TFP by inducing faster adoption of technology and higher spending on research and development. The sectoral reallocation of labor and capital during a terms-of-trade boom could also influence economy-wide TFP, but the sign of the effect is uncertain (because factors of production may be reallocated from high- to low-productivity sectors and vice versa).

[7] See also the discussion in Gruss 2014.

Although the increases in productive capital and the labor force during a commodity price boom translate into increased potential output, this increase may not be sustainable. For example, investment may no longer be viable at lower commodity prices (once the boom has abated); thus the growth rate of aggregate investment may fall along with the terms of trade.

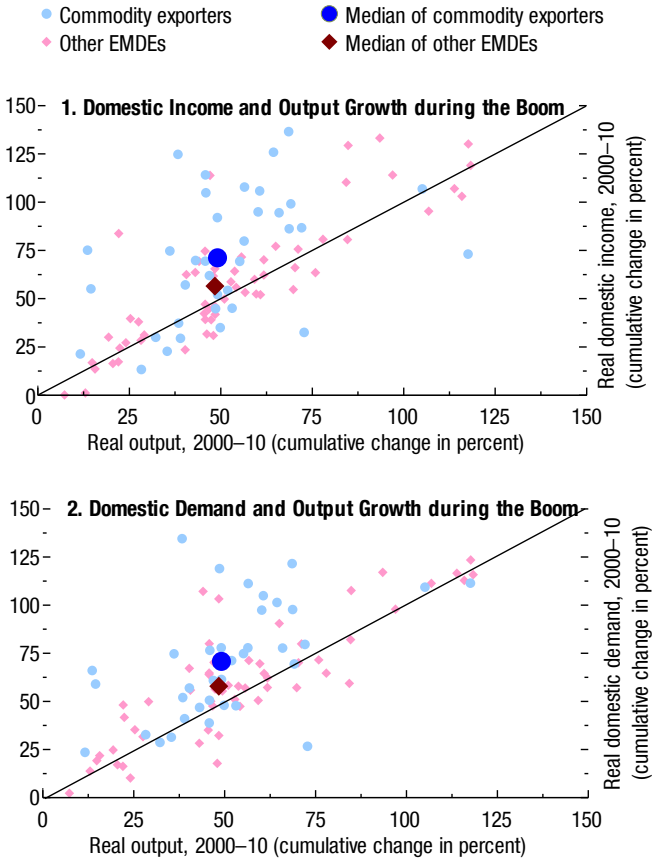
Transmission Channels for Commodity Cycles

Upswings in the commodity terms of trade affect the macroeconomy through two main channels, income and investment.

Income. The commodity price boom generates an income windfall, as existing levels of production yield greater revenues. Higher income boosts domestic demand and thereby stimulates domestic production. Because the income windfall is generated by a more favorable terms of trade, the response of real domestic output is more subdued than that of income and domestic demand.[8] This was indeed the case during the most recent commodity boom (2000–10) (Figure 3). Consistent with Dutch disease, the domestic supply response to higher domestic income occurs disproportionately in the nontradables sector because demand for tradables can be met in part

Figure 3. Real Income, Output, and Domestic Demand, 2000–10

The 2000–10 commodity price boom sharply improved the terms of trade for commodity exporters and induced an income windfall. Real domestic income and demand in the median commodity-exporting economy increased considerably more than real output.



Source: IMF staff calculations.
Note: Real income is calculated by deflating nominal GDP using the domestic consumer price index. Countries with a decline in real GDP, income, or domestic demand over 2000–10 or those with greater than 150 percent growth over the same period are excluded. EMDEs = emerging market and developing economies.

[8] Corden (1981) and Corden and Neary (1982) refer to this channel as the *spending effect*. However, Kohli (2004) and Adler and Magud (2015) show that real GDP (which captures aggregate spending), tends to underestimate the increase in real domestic income when the terms of trade improve. In addition, Adler and Magud (2015) provide estimates of the income windfall during commodity terms-of-trade booms during 1970–2012.

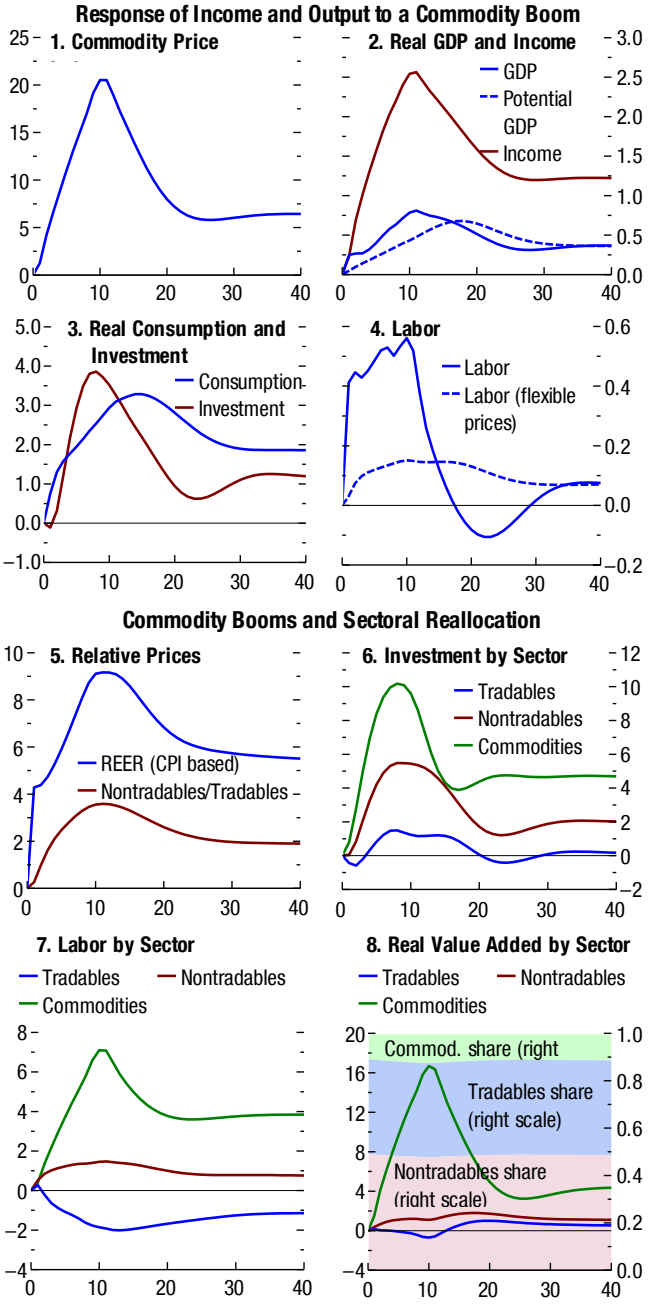
by a rise in imports.[9] In the process, the prices of the relatively scarce nontradable goods and services increase relative to the prices of tradables, and the real exchange rate appreciates (Figure 4).

Investment. In addition, commodity price booms heighten incentives to invest in the commodity sector and supporting industries—such as construction, transportation, and logistics.[10] The resulting increase in economic activity ultimately generates spillovers to the rest of the economy and raises incomes further. Moreover, in the medium term, the increase in the supply of commodities can reverse the commodity price boom, contributing to the commodity cycle itself.[11]

Figure 4. Model Simulations: Macroeconomic Effects of a Commodity Boom

(Percent deviation, unless noted otherwise; years on x-axis)

The IMF's Global Economy Model predicts that a commodity price boom should induce higher investment, consumption, output, and labor effort in commodity-exporting economies. The gains in output and labor effort have cyclical and structural components. The model also predicts that these economies' factors of production will shift toward the nontradables and commodity sectors and that the currency will appreciate in real terms.



Source: IMF staff estimates.

Note: Potential output is given by the path of output under flexible prices. All variables except shares in real value added are shown in percentage deviations from their paths in the absence of a commodity boom. Commod. = commodities; CPI = consumer price index; REER = real effective exchange rate.

(continued…)

[9] An extensive theoretical and empirical literature studies the *Dutch disease* effect, starting with early papers including McKinnon (1976) on Kuwait, and Gregory (1976) and Snape (1977) on Australia, Ellman (1981) on the Netherlands, Enders and Herberg (1983) on Norway. Corden and Neary (1982) present a theoretical small open economy model with factor mobility to generalize the Salter (1959) and Snape (1977) frameworks for commodity exporters. See also Box 2.1 in Chapter 2 of the October 2015 *World Economic Outlook.*

[10] This channel has been referred to as the *resource movement* effect (Corden and Neary, 1982).

[11] The strength of the supply response in the commodity sector depends on the sector's maturity. That is, output in the sector will respond more to a boom the more potential there is for new resource discoveries and the less costly it is to ramp up production volumes. Anecdotal evidence from some countries in the 2000s boom illustrates the case of a relatively more mature sector: boosting or even just

The income and investment channels are interrelated. The income gain in the domestic economy will be higher and more broadly based if investment and activity in the commodity sector respond more strongly to the increase in the terms of trade. Likewise, a greater income windfall will make higher investment more likely.

Additional Factors Affecting the Commodity Cycle

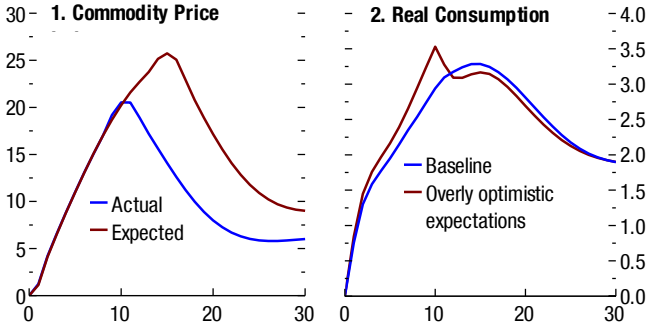
There are numerous other factors that could influence the commodity cycle and its effect on the commodity-exporting economy. Four such factors are expectations about the price of the commodity, the reaction of fiscal policy to higher revenues, the easing of financial frictions due to the commodity boom, and sectoral reallocation of capital and labor.

Commodity price expectations. Expectations are central to the commodity cycle. Consumption and investment in the commodity-exporting economy increase only if the boom is expected to be long lasting. Overly optimistic expectations regarding the persistence of the boom can therefore aggravate the boom-bust cycle by generating a greater boom in domestic demand during the upswing, which in turn requires a greater correction in spending during the downswing (Figure 5). Overoptimism is more likely in the case of persistent upswings in commodity prices, like those experienced in the early 2000s. It can be global, rather than country specific; for example, the prices embedded in commodity futures may not materialize.[12]

Fiscal policy. Much of the commodity price windfall accrues to the government in commodity-producing economies—especially in energy exporters. Thus, the terms-of-trade boom may loosen the government budget constraint and allow the government to finance a higher level of spending. Moreover, the government's use of the income windfall can substantially affect

Figure 5. Consumption Dynamics with Overly Optimistic Commodity Price Expectations
(Percent deviation; years on x-axis)

The IMF's Global Economy Model predicts that overestimating the ultimate size and persistence of a commodity price boom will yield a more pronounced initial increase in consumption that is followed by a dip in growth rates to levels below those in the baseline scenario.



Source: IMF staff estimates.
Note: All variables are shown in percentage deviations from their paths in the absence of a commodity boom.

maintaining production required extractive companies to dig deeper, use more sophisticated technology, and incur higher costs than in the past; thus, the boom in commodity sector investment was associated with only a relatively modest rise in commodity output.

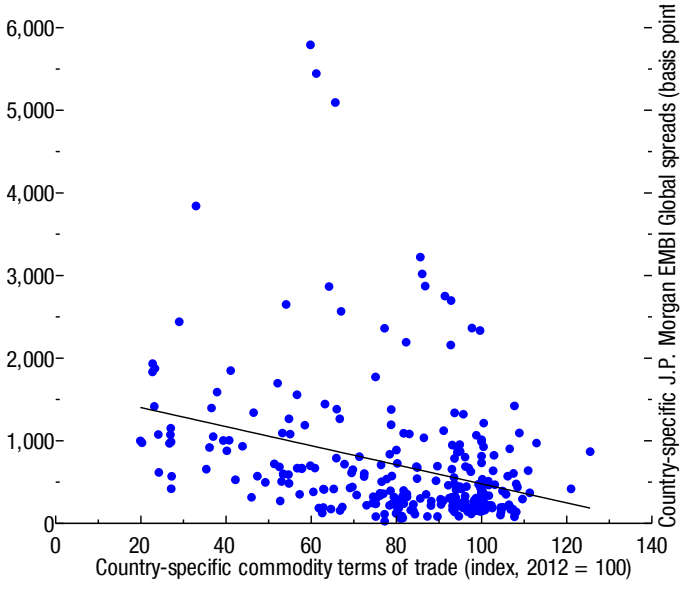
[12] See for instance Boz , Daude, and Durdu 2011.

the economy's response to the commodity price cycle.[13] For example, if the government pursues a procyclical fiscal policy during the boom, using the additional revenues to reduce taxes on households or increase consumption spending, it can aggravate the boom-bust cycle in economic activity. In contrast, if the government invests in productivity-enhancing capital (whether infrastructure or human capital), productive capacity and income can benefit over the longer term.[14]

Financial frictions. The commodity boom increases returns, thereby improving companies' net worth and reducing their leverage. Reduced leverage, in turn, decreases both the premium firms pay to obtain financing and their cost of capital. The result is to reduce the economy's financial frictions, broadly defined. Increased global risk appetite during the boom can further magnify this channel. The effect can be illustrated with one summary measure of the cost of external financing—sovereign bond yield spreads—for a sample of commodity-exporting economies from 1997 to 2014 (Figure 6). The negative relationship between the country-specific terms of trade and spreads implies that the cost of financing decreases for exporters during commodity booms and increases during downswings.

Figure 6. Sovereign Bond Yield Spreads and the Commodity Terms of Trade

During 1997–2014, commodity-exporting economies had lower spreads on sovereign bond yields when their commodity terms of trade was higher, which meant lower financing costs during the boom phase of the commodity cycle.



Sources: Thomson Reuters Datastream; and IMF staff calculations.
Note: Data are for commodity-exporting emerging market and developing economies for which J.P. Morgan Emerging Markets Bond Index Global (EMBI Global) spreads are available. See Annex 2.1 for the definition of the commodity terms-of-trade index.

The reduction in the cost of financing and the easing of financial frictions further boosts income and potential output during the upswing; its effects reverse during the downswing. The effect of the commodity price cycle on financial frictions is therefore another channel that aggravates the boom-bust dynamics in a commodity-exporting economy. Such effects are unlikely to affect the economy beyond the horizon of the commodity cycle unless they lead to a sustained

[13] See the discussion in Chapter 1 of the October 2015 *Fiscal Monitor*.
[14] See Box 2.2 in Chapter 2 of the October 2015 *World Economic Outlook* for the implications of such a scenario using a model calibrated to a low-income developing country.

improvement in financial sector development.

Sectoral reallocation. The responses to a terms-of-trade boom feature a shift of labor and capital away from the noncommodity tradables sector toward the commodities and nontradables sectors as part of the equilibrium adjustment to the windfall. The sectoral reallocation of factors raises additional issues. If manufacturing is associated with positive externalities for the broader economy (such as learning-by-doing externalities), the shrinking of the relative size of the manufacturing sector can raise concerns.[15] In addition, the reallocation could change the weights of the different sectors in the overall economy and thus affect measured aggregate TFP growth. The case studies in section four of the paper investigate this issue by examining whether sectoral shifts in activity during commodity booms have altered aggregate TFP growth.

III. Commodity Terms-Of-Trade Windfalls: Empirical Evidence

How does actual and potential output respond to commodity windfall gains and losses? This section analyzes the question empirically, using data for a sample of 52 commodity-exporting emerging market and developing economies. A country is classified as a commodity exporter (using data available for 1962–2014) if (1) commodities constitute at least 35 percent of its total exports and (2) net exports of commodities are at least 5 percent of its gross trade (exports plus imports) on average. A list of the countries and their average shares of commodity exports over 1960-2014 is provided in Table 1.

In the first step of the empirical analysis, event studies are carried out to shed light on how actual and potential output growth have behaved during and after prolonged upswings in the commodity terms of trade. The event study findings provide an overview of the main regularities in the data. However, event studies do not control for contextual factors (such as the broader effects of global demand booms that often accompany prolonged upswings in international commodity prices). Therefore, in the second step, the analysis uses a regression approach to isolate the impact of changes in the terms of trade by controlling for relevant contextual factors, such as output growth in trading partners.

The Commodity Terms of Trade

To capture the country-specific impact of global commodity price movements, the analysis focuses on the commodity terms of trade calculated by weighting the global prices of individual commodities according to country-specific net export volumes (following Gruss

[15] See Box 2.1 in Chapter 2 of the October 2015 *World Economic Outlook*.

2014).[16] This approach has two advantages over using the price indices of individual export commodities or standard terms-of-trade measures. First, few of the non-oil commodity exporters are so specialized that focusing on the price of a single commodity would be representative of the changes in their terms of trade. Second, the approach recognizes that fluctuations in commodity prices affect countries differently depending on the composition of both their exports and their imports. For instance, despite the upswing in food and raw materials prices in the 2000s, many agricultural commodity exporters did not experience terms-of-trade windfalls given the even stronger surge in their oil import bills.

Table 1. Commodity-Exporting Emerging Market and Developing Economies

	Commodity Exports (Percent of total exports)					Net Commodity Exports (Percent of total exports-plus-imports)
	Total Commodities	Extractive		Nonextractive		
		Energy	Metals	Food	Raw Materials	
Emerging Markets						
Algeria	89.2	87.9	0.7	0.5	0.2	37.6
Angola	81.1	47.8	5.5	26.2	3.2	34.6
Argentina	49.8	5.7	1.5	30.0	12.7	20.1
Azerbaijan	76.7	73.2	0.7	0.8	1.9	35.9
Bahrain	60.4	35.5	24.1	0.7	0.1	12.4
Brazil	45.3	3.3	9.5	23.5	8.9	8.3
Brunei Darussalam	90.0	89.9	0.0	0.1	0.0	55.5
Chile	61.2	0.8	48.0	7.0	5.5	20.9
Colombia	58.5	21.7	0.3	34.7	1.9	20.8
Costa Rica	36.2	0.4	0.4	34.9	0.5	8.4
Ecuador	79.0	40.1	0.2	38.8	0.7	32.6
Gabon	78.4	66.3	1.2	0.5	10.8	44.4
Guatemala	45.4	2.4	0.3	36.6	6.1	8.1
Guyana	66.3	0.0	21.5	41.9	2.9	14.4
Indonesia	64.4	40.8	5.0	8.5	10.1	24.9
Iran	81.5	78.9	0.6	0.4	1.6	41.4
Kazakhstan	70.5	53.3	11.7	4.3	1.3	35.5
Kuwait	72.2	71.7	0.1	0.4	0.1	42.4
Libya	96.8	96.7	0.0	0.1	0.0	58.2
Malaysia	45.0	12.7	6.3	8.2	17.8	15.3
Oman	79.8	77.8	1.4	1.0	0.0	42.3
Paraguay	65.4	0.2	0.4	36.6	28.5	12.4
Peru	60.6	7.4	32.8	18.0	2.3	17.5
Qatar	82.5	82.4	0.0	0.1	0.0	49.2
Russia	60.5	50.3	6.6	1.0	2.5	34.0
Saudi Arabia	85.8	85.5	0.1	0.1	0.1	47.3
Syria	54.3	45.8	0.1	2.7	6.2	8.2
Trinidad and Tobago	64.2	60.9	1.2	2.0	0.2	19.8
Turkmenistan	58.9	45.5	0.4	0.2	12.8	19.7
United Arab Emirates	49.6	36.8	13.4	2.4	0.1	12.6
Uruguay	37.0	0.6	0.2	22.5	13.7	5.5
Venezuela	87.1	82.1	4.1	0.8	0.1	46.6

[16] Other papers that study the macroeconomic impact of country-specific commodity terms of trade include Deaton and Miller 1996, Dehn 2000, Cashin, Céspedes, and Sahay 2004, and Céspedes and Velasco 2012.

Table 1. Commodity-Exporting Emerging Market and Developing Economies (concluded)

	Commodity Exports (Percent of total exports)					Net Commodity Exports (Percent of total exports-plus-imports)
	Total Commodities	Extractive		Nonextractive		
		Energy	Metals	Food	Raw Materials	
Low-Income Developing Countries						
Bolivia	65.9	25.3	27.7	6.0	6.8	28.4
Cameroon	71.3	16.1	6.6	34.7	13.9	22.6
Chad	91.6	4.5	0.0	15.6	71.5	8.6
Republic of Congo	61.3	52.6	0.2	1.8	6.7	30.6
Côte d'Ivoire	70.9	11.9	0.2	44.7	14.0	26.7
Ghana	66.0	5.4	7.0	50.2	3.3	12.3
Guinea	67.3	0.5	61.4	3.9	1.5	9.3
Honduras	66.6	1.3	2.8	60.0	2.5	14.1
Mauritania	75.9	9.2	47.2	23.8	0.0	12.2
Mongolia	59.2	4.6	35.6	1.9	17.2	12.4
Mozambique	46.1	4.7	26.7	10.9	3.9	5.1
Myanmar	52.8	36.1	0.7	6.1	9.8	24.4
Nicaragua	55.9	0.6	0.5	42.7	12.2	7.2
Niger	65.8	2.1	38.0	23.2	2.5	10.2
Nigeria	88.4	79.5	0.7	6.2	2.0	46.8
Papua New Guinea	58.0	6.7	24.5	20.7	6.1	15.7
Sudan	69.4	56.5	0.3	11.8	9.8	11.3
Tajikistan	63.4	0.0	51.6	0.2	11.6	21.5
Yemen	82.5	79.6	0.2	2.4	0.4	20.8
Zambia	77.0	0.4	72.4	2.7	1.6	30.4
Memorandum						
Number of Economies	52	52	52	52	52	52
Maximum	96.8	96.7	72.4	60.0	71.5	58.2
Mean	67.1	34.6	11.6	14.5	6.7	24.2
Median	65.9	30.4	1.3	6.2	2.7	20.8
Standard Deviation	14.5	32.6	18.2	16.5	11.0	14.5

Sources: UN Comtrade; and IMF staff calculations.
Note: Countries listed are those for which gross commodity exports as a share of total exports were greater than 35 percent and net commodity exports as a share of total trade (exports plus imports) were greater than 5 percent, on average, between 1962 and 2014. Commodity intensities are determined using a breakdown of the first criterion into the four main commodity categories: energy, food, metals, and raw materials.

For each country, the commodity terms-of-trade indices are constructed as a trade-weighted average of the prices of imported and exported commodities. The annual change in country i's terms-of-trade index ($CTOT$) in year t is given by:

$$\Delta \log CTOT_{i,t} = \sum_{j=1}^{J} \Delta \log P_{j,t} \tau_{i,j,t},$$

in which $P_{j,t}$ is the relative price of commodity j at time t (in U.S. dollars and divided by the IMF's unit value index for manufactured exports) and Δ denotes the first difference. Country i's weights for each commodity price, $\tau_{i,j,t}$, are given by

$$\tau_{i,j,t} = \frac{x_{i,j,t-1} - m_{i,j,t-1}}{\sum_{j=1}^{J} x_{i,j,t-1} + \sum_{j=1}^{J} m_{i,j,t-1}},$$

in which $x_{i,j,t-1}$ ($m_{i,j,t-1}$) denote the average export (import) value of commodity j by country i between $t-1$ and $t-5$ (in U.S. dollars). This average value of net exports is

divided by total commodity trade (exports plus imports of all commodities, averaged over $t-1$ and $t-5$).

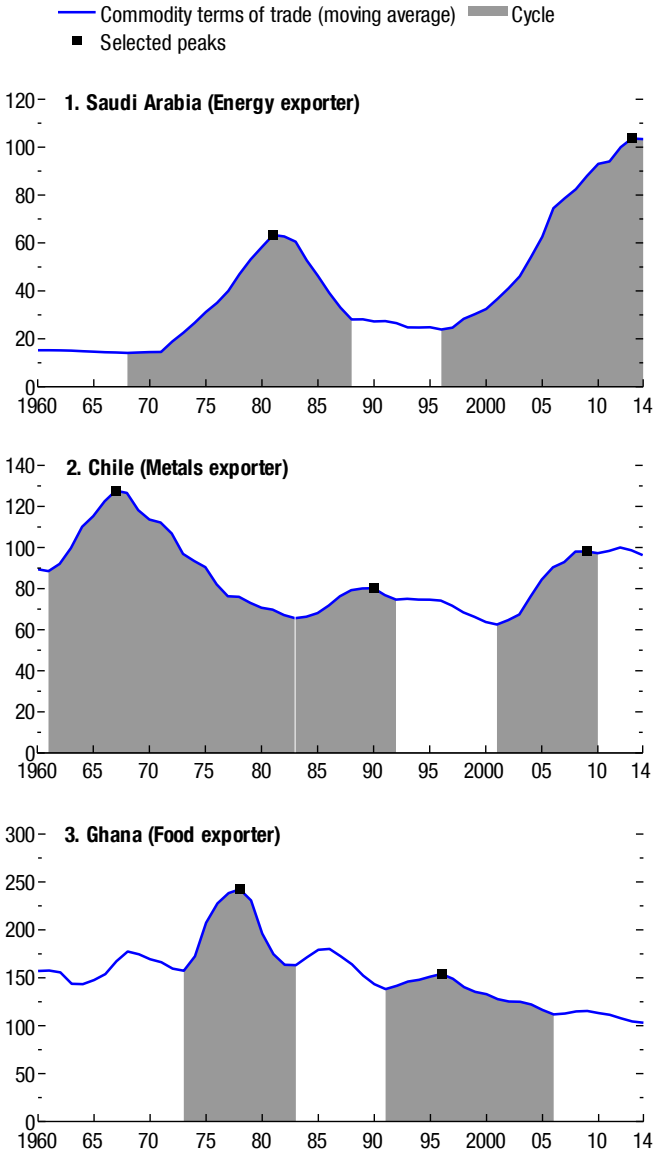
The commodity price series start in 1960. Prices of 41 commodities are used, sorted into four broad categories:

1. *Energy:* coal, crude oil, and natural gas;
2. *Metals:* aluminum, copper, iron ore, lead, nickel, tin, and zinc;
3. *Food:* bananas, barley, beef, cocoa, coconut oil, coffee, corn, fish, fish meal, groundnuts, lamb, oranges, palm oil, poultry, rice, shrimp, soybean meal, soybean oil, soybeans, sugar, sunflower oil, tea, and wheat;
4. *Raw materials:* cotton, hardwood logs and sawn wood, hides, rubber, softwood logs and sawn wood, soybean meal, and wool.

The price of crude oil is the simple average of three spot prices: Dated Brent, West Texas Intermediate, and Dubai Fateh. The World Bank's Global Economic Monitor database has been used to extend the price series of barley, iron ore, and natural gas from the IMF's Primary Commodity Prices System back to 1960. The price of coal is the Australian coal price, extended back to

Figure 7. Identification of Cycles in the Commodity Terms of Trade: Three Country Examples
(Index, 2012 = 100)

The event studies focus on the behavior of variables during commodity terms-of-trade cycles with prolonged upswings that peaked before 2000. On average, those upswings were eight years long for exporters of extractive commodities and five years long otherwise, and the commodity terms of trade improved by 63 percent.

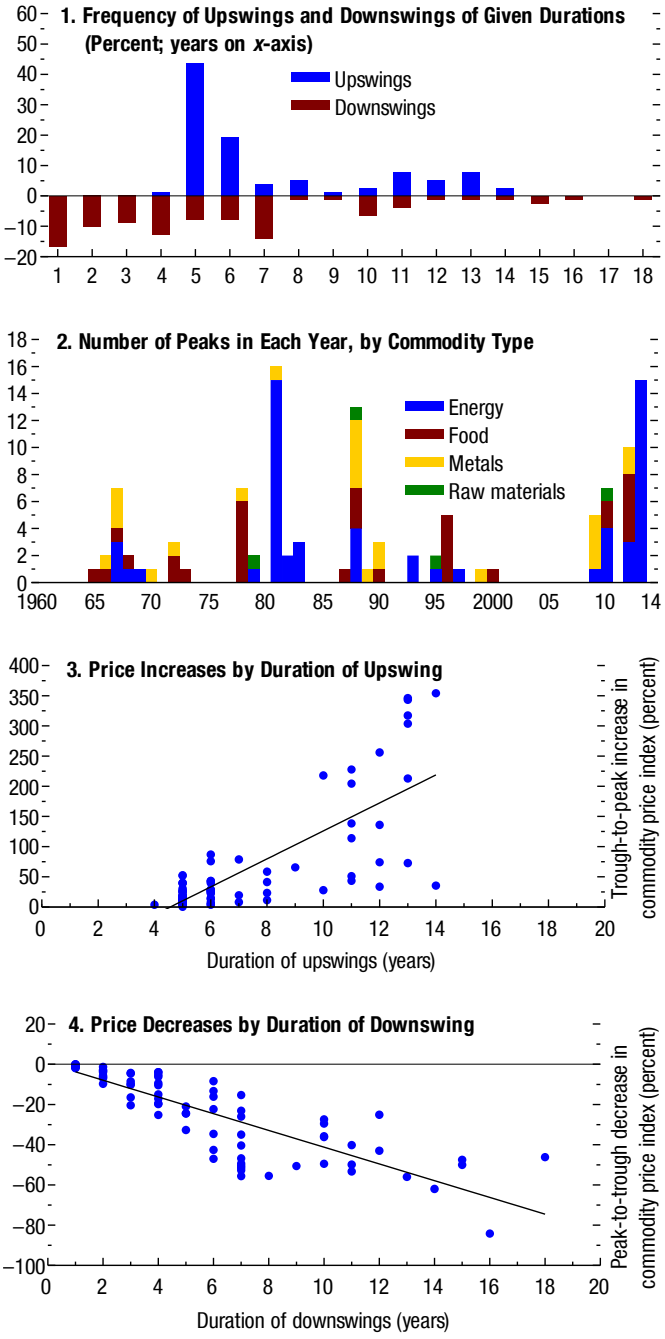


Sources: Gruss 2014; IMF, Primary Commodity Price System; U.S. Energy Information Administration; World Bank, Global Economic Monitor database; and IMF staff calculations.
Note: The definition of the commodity terms of trade is given in Annex 2.1. The algorithm for selecting the cycles is described in Annex 2.2. The portion of a cycle before (after) the peak is referred to as an upswing (downswing).

1960 using the World Bank's Global Economic Monitor database and U.S. coal price data from the U.S. Energy Information Administration.

Since the recent declines in commodity prices have occurred after an unusually prolonged boom phase, the event studies focus on past episodes of *persistent* upswings in the commodity terms of trade. A modified version of the Bry-Boschan Quarterly algorithm (standard in the business cycle literature; Harding and Pagan 2002) is used to identify commodity price cycles, which were similar to the most recent cycle (Figure 7 presents three examples). In particular, the algorithm as used here differs from the standard version in two ways: (1) it is applied to a smoothed (five-year centered moving-average) version of the price index because the underlying series are choppy, making it difficult for standard algorithms to identify meaningful cycles, and (2) it allows for asymmetry between upswings and downswings, as the focus here is on cycles in which the upswing was at least five years long, even if the subsequent downswing was sudden. By contrast, most existing studies have focused on price changes of at least a given magnitude, rather than a given duration, and on samples of disjointed price increases or decreases, rather than full cycles that include an upswing and a downswing phase.

Figure 8. Characteristics, Amplitudes, and Durations of Cycles



Sources: Gruss 2014; IMF, Primary Commodity Price System; U.S. Energy Information Administration; World Bank, Global Economic Monitor database; and IMF staff calculations.
Note: The cycles shown are for the country-specific commodity terms-of-trade indices. See Annexes 2.1 and 2.2 for the data definitions and cycle-dating methodology.

The algorithm identifies 115 cycles since 1960 (78 with peaks before 2000 and 37 with peaks after 2000). There are approximately two cycles a country. Upswings are slightly longer than downswings, with a mean (median) of seven (six) years for upswings and six (five) years for downswings (Figure 8, panel 1). The duration of phases and the amplitude of price movements are correlated (Figure 8, panels 3 and 4). Most peaks were in the 1980s and the most recent years, particularly for extractive commodities (Figure 8, panel 2).[17]

Event Studies of Commodity Cycles with Pre-2000 Peaks

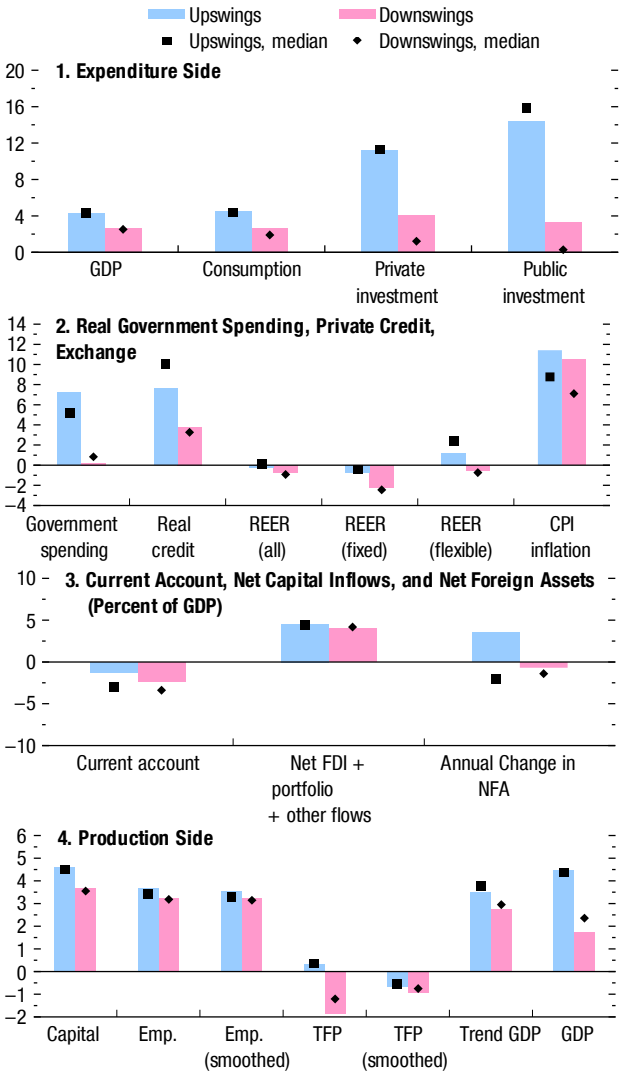
Event studies are carried out for the cycles with peaks before 2000, where the full downswing has been observed already (the end of the downswing phase cannot yet be identified for the post-2000 upswings). Average growth rates over upswings (downswings) are computed by first averaging for a given country over all upswing (downswing) years, then taking simple averages of these across countries.[18]

The event studies confirm that output and domestic spending tend to grow faster during upswings in

Figure 9. Event Studies: Average Annual Growth Rates of Key Macroeconomic Variables during Commodity Terms-of-Trade Upswings and Downswings

(Percent, unless noted otherwise)

Output and domestic spending tend to grow faster during upswings in the commodity terms of trade than in downswings. The growth of trend output tends to vary as well, as capital accumulation comoves with the terms of trade. Credit to the private sector and government spending expand faster during upswings, and net capital inflows tend to be higher.



Sources: External Wealth of Nations Mark II data set (Lane and Milesi-Ferretti 2007 and updates thereafter); IMF, Balance of Payments Statistics database; IMF, Fiscal Monitor database; IMF, International Financial Statistics database; Penn World Table 8.1; and IMF staff calculations.

Note: Samples consist of cycles with peaks before 2000. They are balanced across upswings and downswings, but differ across panels depending on data availability. See Annex 2.2 for the cycle identification methodology. The exchange rate classification is based on Reinhart and Rogoff 2004. See Annex 2.3 for details. CPI = consumer price index; Emp. = employment; FDI = foreign direct investment; NFA = net foreign assets; REER = real effective exchange rate; TFP = total factor productivity.

[17] 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).

[18] Samples are fully balanced, that is, they include the same country cycles for upswings and downswings.

commodity terms of trade than in downswings. The variation in investment growth—both private and public—is particularly pronounced (Figure 9, panel 1). During upswings, real GDP has grown about 1.5 percentage points more per year than in downswings, real consumption about 2.0 to 2.5 percentage points more, and investment about 8.0 to 8.5 percentage points more. Differences are statistically significant at the 5 percent level for all of these variables. Investment and consumption contribute about equally to the difference in the growth of real GDP, as the stronger response of investment makes up for its smaller share in overall spending.

Factors supporting domestic demand, such as credit to the private sector and overall government spending, tend to expand more strongly in upswings than in downswings, and differences for government spending are significant at the 5 percent level (Figure 9, panel 2).[19]

Somewhat surprisingly, the real effective exchange rate in the identified episodes did not appreciate during the average pre-2000 upswing (differences between upswings and downswings are not significant at conventional levels). This pattern, however, holds only for the cycles with peaks before 2000. During the pre-2000 upswings, factors other than the commodity terms of trade appear to have dominated the movements in the real exchange rate. By contrast, the most recent upswing is more in line with priors, showing about 2.0 to 2.5 percent average real appreciation per year. However, even before 2000, breaking the sample into episodes involving countries with fixed versus flexible exchange rate regimes reveals that flexible regimes have been associated with currency appreciations during upswings (and depreciations during downswings), as would be expected, whereas depreciations have occurred in fixed regimes during both upswings and downswings.

The behavior of external accounts provides some additional evidence that financing constraints loosen during upswings. Even though outflows in the form of official reserves and foreign direct investment rise when commodity prices are high, net commodity exporters have received, on average, slightly higher net capital inflows during upswings than during downswings (Figure 9, panel 3). Given the higher net inflows, no general tendency toward improved net foreign asset positions has been observed for upswings, even though, as expected, current account balances have been stronger in those episodes. Specifically, the average ratio of net foreign assets to GDP has tended to rise during upswings, a result driven by a few oil exporters, while the median ratio has tended to decline more in upswings than in downswings.

[19] Husain, Tazhibayeva, and Ter-Martirosyan (2008) examine a sample of 10 oil exporters and find that oil price changes affect the economic cycle only through their impact on fiscal policy. Their results are particularly stark for Gulf Cooperation Council countries, in which all oil income accrues to the state.

A growth-accounting perspective highlights the key supply-side factors behind the cycle in output growth. Aggregate production factors (capital and labor) and TFP have tended to move in tandem with the changes in the commodity terms of trade (Figure 9, panel 4). The comovement is particularly strong for the rate of change in the capital stock (significant at the 10 percent level), which is consistent with the substantially faster growth in investment spending during upswings. TFP growth is also significantly different between upswings and downswings (at the one percent level), though as it is measured as a Solow residual, this could be capturing cyclicality in utilization rates or hours worked. The variation in employment growth is much smaller, not statistically significant, and is driven by Latin America, where employment has grown 1.5 percentage points more during upswings than in downswings.

The growth rate of trend output—calculated using estimates of the actual capital stock and smoothed employment and TFP series—is considerably smoother than that of actual output. Trend output growth weakens during downswings relative to upswings, but it does so with less vigor than actual output growth. Annual actual output growth tended to be 1.0 to 1.5 percentage points higher on average during upswings than in downswings, whereas potential output growth tended to be only 0.3 to 0.5 percentage point higher.[20] The fact that inflation tends to be higher during upswings than in downswings (Figure 9, panel 2) corroborates the notion of a smaller amount of slack in the economy during upswings.

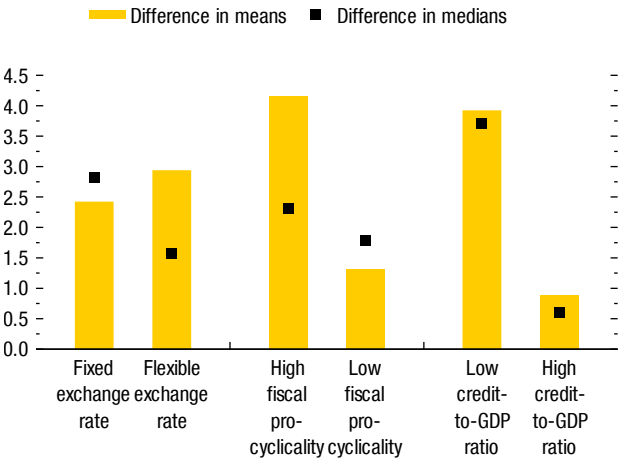
[20] Employment and TFP are smoothed using a standard Hodrick-Prescott filter on annual data; the capital and labor shares are from Penn World Table 8.1.

The exchange rate regime, cyclicality of fiscal policy, and depth of financial markets have a bearing on the difference in growth between upswings and downswings (Figure 10). Countries with fixed exchange rates experience slightly stronger variation in growth relative to countries with flexible exchange rates. This is consistent with the notion that a more flexible exchange rate tends to act as a shock absorber and cushion the domestic effects of terms-of-trade shocks, though differences are not significant at conventional levels.[21] The difference in the growth rate of output between upswings and downswings is larger in countries with more procyclical fiscal spending, and this is significant at the one percent level.[22] Countries with a lower level of credit to the private sector (relative to GDP) also exhibit stronger variation in growth, and again this is statistically significant at the one percent level.[23] The growth slowdown in these countries is

Figure 10. Variation in Average Output Growth between Upswings and Downswings: The Role of Policy Frameworks and Financial Depth

(Percentage points)

Commodity-exporting countries with more flexible exchange rates, less procyclical fiscal policy, and a higher level of credit to the private sector exhibit less growth variation over commodity price cycles.



Sources: IMF, Fiscal Monitor database; IMF, International Financial Statistics database; Penn World Table 8.1; and IMF staff calculations.
Note: The bars (blocks) show the difference between the average (median) growth rates during upswings and subsequent downswings. The exchange rate regime classification is based on Reinhart and Rogoff 2004. See Annex 2.3 for details. An episode is classified as having high fiscal policy procyclicality if the correlation between real government spending growth and the change in the smoothed net commodity terms of trade during the cycle is higher than the overall sample median (and having low fiscal policy procyclicality otherwise). A country is classified as having a high credit-to-GDP ratio if credit to the private sector (as a share of GDP) during the upswing is higher than the sample median (and having a low credit-to-GDP ratio otherwise).

[21] Exchange rate regimes are categorized as fixed or flexible according to the classification set out by Reinhart and Rogoff (2004). Regimes of countries in their coarse categories 1 and 2 are classified as fixed, and those in their coarse categories 3 and 4 are categorized as flexible. Countries in categories 1 and 2 have no separate legal tender or variously use currency boards, pegs, horizontal bands, crawling pegs, and narrow crawling bands. Countries in categories 3 and 4 variously have wider crawling bands, moving bands, and managed floating or freely floating arrangements. As very few countries maintain the same regime over an entire cycle, the exchange rate regime in the peak year is used to classify the cycle. The sample includes 34 cycles with fixed exchange rates but only 8 cycles with flexible exchange rates. Regimes classified as free-falling are dropped.

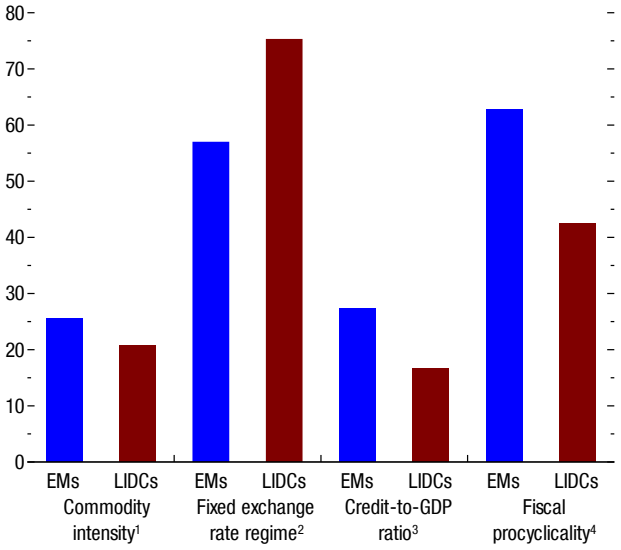
[22] As some correlation between fiscal spending and commodity prices may be optimal, cycles are classified here as having more procyclical fiscal policy if the correlation between the growth of real spending and the change in the commodity terms of trade is greater than the sample median.

[23] Cycles are classified as having a high (low) ratio of credit to GDP depending on whether average domestic credit to the private sector as a share of GDP during the upswing is above (below) the sample median.

sharper during downswings, probably because they experience a greater tightening of borrowing constraints when commodity prices decline than do countries with greater financial depth.[24]

Commodity exporters differ across many other dimensions—in terms of the weight of commodities in their aggregate production, the nature of the commodities they export (for example, exhaustible versus renewable resource bases), and their levels of economic and institutional development. Among the commodity-exporting countries, emerging market economies can be differentiated from low-income developing countries along four key dimensions: commodity intensity, exchange rate regime, credit ratio, and fiscal procyclicality (Figure 11). Emerging markets tend to have a greater degree of commodity intensity (GDP share of gross commodity exports). A greater share of low-income developing countries operate fixed exchange rates. Emerging markets tend to have greater financial depth, as captured by higher credit-to GDP ratios. And emerging markets tend to have a more procyclical fiscal stance (Figure 11).

Figure 11. Commodity Intensity, Policy Frameworks, and Financial Depth: Commodity-Exporting Emerging Markets versus Low-Income Developing Countries
(Percent)



Sources: IMF, Fiscal Monitor database; IMF, International Financial Statistics database; World Bank, *World Development Indicators*; and IMF staff calculations.
Note: Figures are the averages of data for all available years across all commodity exporters within each group. EM = emerging market; LIDC = low-income developing country.
[1]Average of commodity exports as a share of GDP.
[2]Share of commodity-exporting emerging markets and low-income developing countries with a fixed exchange rate regime as defined in Annex 2.3.
[3]Average of bank credit to the private sector as a share of GDP.
[4]Determined by whether the correlation between real spending growth and the change in the smoothed commodity terms of trade is greater or less than the sample median.

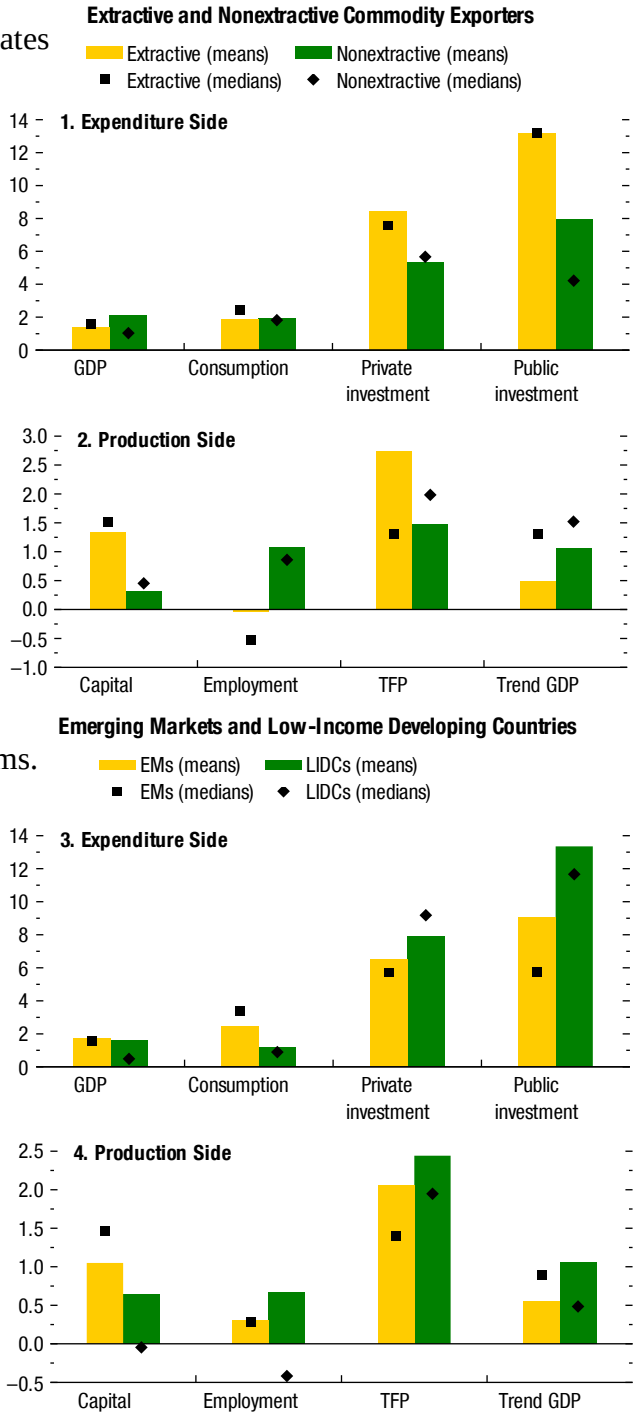
As could be expected, the growth patterns described previously are more marked for economies that are less diversified, that is, those in which commodity exports account for a larger share of GDP. They are also clearer for exporters of extractive commodities, whose economies tend to be less diversified and face more persistent commodity terms-of-trade

[24] This result is not driven by the variation in the level of economic development, which tends to be correlated with financial depth.

cycles. Low-income countries have less procyclical fiscal spending and a slightly lower degree of commodity intensity in production but also less flexible exchange rates and lower levels of financial development. They exhibit greater variability in their growth rates for investment, employment, and TFP compared with emerging market economies, but the differences between the two groups are not statistically significant (Figure 12).

Figure 12. Average Differences in Real Growth Rates between Upswings and Downswings

(Percentage points)



Sources: IMF, Fiscal Monitor database; Penn World Table 8.1; and IMF staff calculations.

Note: The bars show the average differences between growth rates during upswings and downswings. EM = emerging market; LIDC = low-income developing country; TFP = total factor productivity.

The Boom of the 2000s

The event studies of commodity price cycles with pre-2000 peaks provide evidence that is highly relevant for the current downswing in commodity exporters. Nevertheless, the most recent commodity price boom was different in a number of dimensions from the earlier booms. In particular, this boom entailed a larger upswing in the terms of trade, especially for commodity exporters specializing in energy and metals.[25] There were also a greater number of oil exporters in the recent upswing, for reasons of data availability or more recent oil discovery and development.

[25] For the sample of net exporters that experienced at least two upswings in our data sample—one in the 2000s and at least one in the 1960–99 period—the cumulative net terms-of-trade increase averaged slightly more than 70 percent in the 2000s, compared with 50 percent in past episodes. When all net exporters—not only those that recorded a pre-2000s upswing—are included, the average cumulative increase in the commodity terms of trade in the 2000s was even sharper, about 140 percent.

Despite the larger boom in commodity prices in the 2000s, the average growth rates of key macroeconomic variables during the most recent upswing were very similar to those in the pre-2000 upswings (Figure 13). If anything, investment and, accordingly, capital accumulation and trend growth were somewhat lower in the most recent upswing than in previous upswings. Increases in real credit and government spending were also slightly lower, helping to explain the more muted reaction of macroeconomic variables to the commodity price boom.

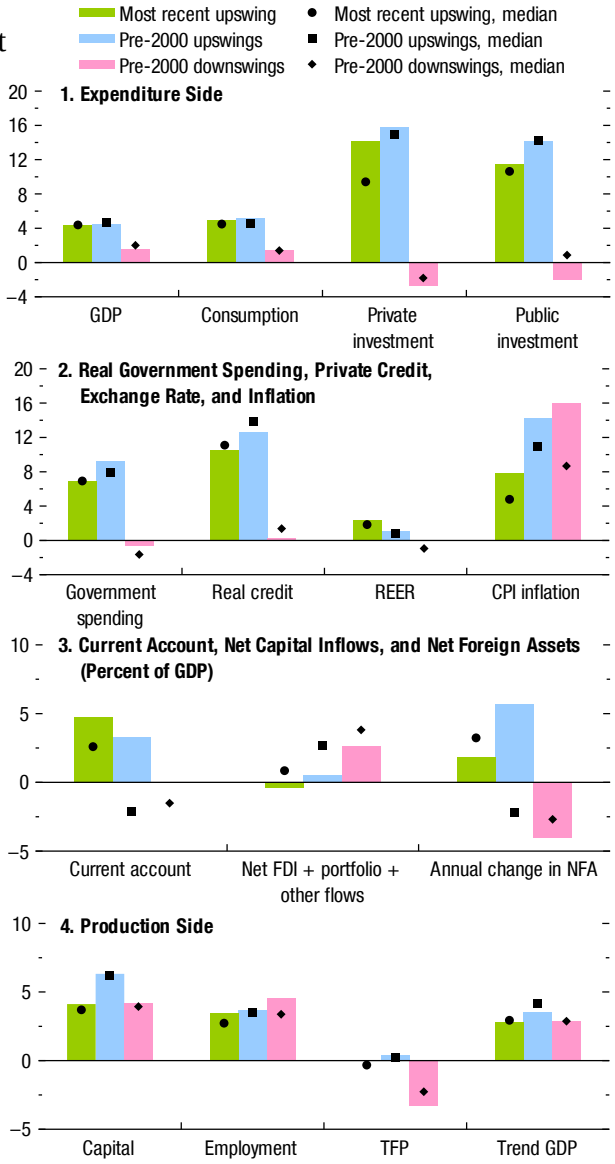
Improvements in their macroeconomic policy frameworks and financial depth since the earlier episodes have put commodity exporters in a better position to deal with a downswing. Fiscal policy was considerably less procyclical during the most recent upswing: the correlation of government spending growth with changes in the commodity terms of trade fell to half of what it was in the pre-2000 episodes (Figure 14, panel 1).[26] Financial depth and the extent of exchange rate flexibility, which in past downswings were associated with a smaller drop in output growth, have also increased in most commodity exporters. While there has been considerable movement across exchange rate regimes, the share of commodity exporters with hard pegs has declined relative to the 1960s and 1970s (Figure 14, panel 2).

Figure 13. Most Recent Upswing: Average Real Growth Rates during Upswings and Downswings

(Percent, unless noted otherwise)

annual

The most recent upswing in the commodity terms of trade was longer and larger than the upswings with pre-2000 peaks, notably for energy exporters, but it coincided with average annual growth rates in key macroeconomic variables that were similar to those in the earlier booms.



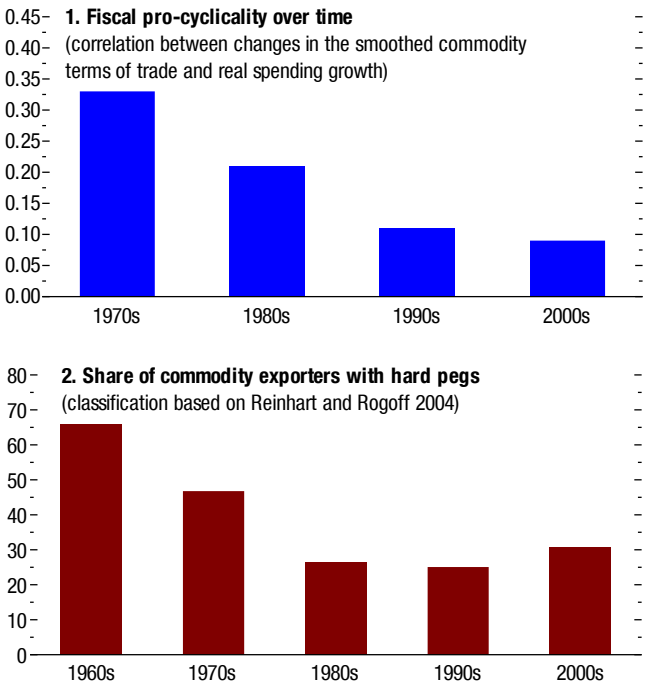
Sources: External Wealth of Nations Mark II data set (Lane and Milesi-Ferretti 2007 and updates thereafter); IMF, Balance of Payments Statistics database; IMF, Fiscal Monitor database; IMF, International Financial Statistics database; Penn World Table 8.1; and IMF staff calculations.

Note: Restricted samples of 17 (panel 1), 21 (panels 2 and 3), or 20 (panel 4) countries, each with one pre-2000 and one post-2000 cycle peak. See Annex 2.2 for the cycle identification methodology. CPI = consumer price index; FDI = foreign direct investment; NFA = net foreign assets; REER = real effective exchange rate; TFP = total factor productivity.

[26] Reduced procyclicality is consistent with the finding of greater fiscal savings out of commodity-based revenues in the 2000s, as reported in Chapter 1 of the October 2015 *Fiscal Monitor*.

Commodity exporters are entering the current downswing with stronger external positions as well. The median annual current account balance and the average annual change in the net foreign asset position were 5 percentage points of GDP stronger in the 2000s upswings than earlier.

Figure 14. Policies during the 2000s Boom



In summary, the larger increase in commodity prices in the 2000s could potentially presage sharper terms-of-trade downswings for some commodity exporters (beyond the decline already experienced) and therefore lead to sharper reductions in actual and potential growth. At the same time, stronger external positions, more robust policy frameworks, and more developed financial markets are likely to help mitigate some of the growth impacts.

Regression Analysis

This subsection examines the responses of key macroeconomic variables to changes in the commodity terms of trade.

The estimations of baseline impulse responses presented in the paper follow the local projection method proposed by Jordà (2005) and developed further by Teulings and Zubanov (2014). This method provides a flexible alternative to traditional vector autoregression techniques and is robust to misspecification of the data-generating process. Local projections use separate horizon-specific regressions of the variable of interest (for example, output, investment, capital) on the shock variable (in our analysis, the commodity terms of trade) and a series of control variables. The sequence of coefficient estimates for the various horizons provides a nonparametric estimate of the impulse-response function.

The local projection method estimates the following equation:

$$\Delta^h y_{i,t} = \alpha_i^h + \gamma_t^h + \beta^h \Delta s_{i,t} + \sum_{j=1}^{p} \beta_1^h \Delta s_{i,t-j} + \sum_{j=1}^{h-1} \beta_2^h \Delta s_{i,t+h-j} + \sum_{j=1}^{p} \theta_1^h \Delta y_{i,t-j} + \sum_{j=0}^{p} \theta_2^h x_{i,t-j} + \sum_{j=1}^{h-1} \theta_3^h x_{i,t+h-j} + \varepsilon_{i,t}^h$$

where the *i* subscripts index countries; the *t* subscripts index years; the *h* superscripts index the horizon of the projection after time *t*; *p* is the number of lags for each variable; $y_{i,t}$ is the natural logarithm of the variable of interest (for example, output); and $s_{i,t}$ is the natural logarithm of the commodity terms of trade, the shock variable of interest:

$$\Delta^h y_{i,t} \equiv y_{i,t+h} - y_{i,t-1}$$
$$\Delta s_{i,t} \equiv s_{i,t} - s_{i,t-1}$$
$$y_{i,t} \equiv \ln(GDP_{i,t}); s_{i,t} \equiv \ln(CToT_{i,t})$$

The equation also includes controls for additional factors, $x_{i,t}$, such as the trade-weighted output growth of trading partners, political regime transition, and conflict in the domestic economy. Regressions include country fixed effects, α_i^h, as well as time fixed effects, γ_t^h to control for common economic developments facing all countries in a given year. β_1^h is the contribution to the cumulative increase in (i.e., the level of) $y_{i,t}$ at horizon *h* from a 1 percentage point increase in $\Delta s_{i,t}$ in year *t*:

$$\frac{\partial \Delta^h y_{i,t}}{\partial \Delta s_{i,t}} = \beta^h$$

A balanced panel for the period 1960–2007 is used for the baseline regression. The period of the global financial crisis and its aftermath is thus omitted. However, because of differences in data availability, the number of economies included differs by variable. For example, for real GDP, the sample spans 32 commodity-exporting emerging market and developing economies (Table 2).

Table 2. Sample of Commodity Exporters Used in the Local Projection Method Estimations, 1960–2007

Emerging Markets		Low-Income Developing Countries	
Argentina	Iran	Bolivia	Mongolia
Brazil	Libya	Cameroon	Mozambique
Chile	Malaysia	Chad	Niger
Colombia	Paraguay	Republic of Congo	Nigeria
Costa Rica	Peru	Côte d'Ivoire	Zambia
Ecuador	Syria	Ghana	
Gabon	Trinidad and Tobago	Guinea	
Guatemala	Uruguay	Honduras	
Indonesia	Venezuela	Mauritania	

Sources: IMF, Fiscal Monitor database; Penn World Table 8.1; and IMF staff calculations.

However, the results are robust to the minimum sample of economies available for total factor productivity (Table 3).

Table 3. Country Coverage for Key Macroeconomic Variables in the Local Projection Method Estimations

Variable	Commodity Exporters		
	Emerging Markets	Low-Income Developing Countries	Total
Real GDP	18	14	32
Real Consumption	16	14	30
Real Total Fixed Investment	17	16	33
Real Capital Stock	16	14	30
Employment	14	9	23
Real Total Factor Productivity	14	5	19

Sources: IMF, Fiscal Monitor database; Penn World Table 8.1; and IMF staff calculations.
Note: The sample length for all variables is 1960–2007.

The estimations point to a positive, statistically significant, and fairly long-lasting effect of terms of trade on output (Figure 15). A 10 percentage point increase in a country's commodity terms of trade is found to lead to a slightly more than 1 percentage point increase in GDP after three years. The effect gradually subsides, but remains statistically significant, over a horizon of up to five years. The estimates suggest that the effects of negative shocks are somewhat larger and more persistent than those of positive shocks. Nonetheless, the analysis cannot statistically reject the possibility that output responds symmetrically to positive and negative changes in the commodity terms of trade.

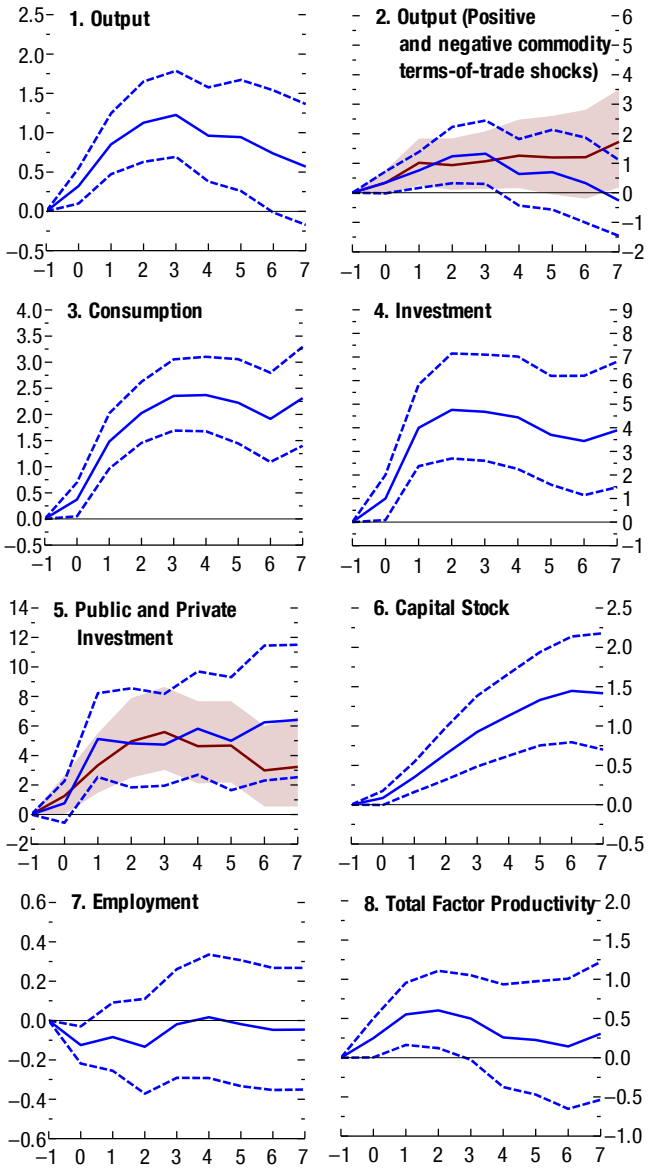
Turning to the spending side, both consumption and investment respond positively and with statistical significance to commodity terms-of-trade shocks over a seven-year period. The average response of total fixed investment is almost double that of consumption. The positive response of public investment is more immediate and long lasting than that of private investment.

On the production side, shocks to the commodity terms of trade raise capital accumulation over the medium term in line with the estimated persistent response of investment. The capital stock increases (or decreases) steadily for seven years after the shock by a cumulative 1 percentage point. In contrast, the impacts on labor supply and TFP are muted. The response of employment is not statistically significant. The impact on TFP is only weakly significant in the first two years after the shock, which could reflect a cyclical deterioration in the Solow residual relative to its underlying trend, as seen in the event studies. Overall, these results are consistent with the event study findings, which suggest that commodity terms-of-trade shocks affect potential output mainly by raising capital accumulation.[27]

Figure 15. Macroeconomic Variables in the Aftermath of Commodity Terms-of-Trade Shocks

(Percentage points; years on x-axis)

Terms-of-trade shocks have positive, fairly long-lasting, and symmetric effects on output. Consumption and investment respond positively to an increase in the terms of trade. On the production side, capital accumulation rises, whereas the responses of labor supply and total factor productivity are muted.



Source: IMF staff estimates.

Note: $t = 0$ is year of the shock; dashed lines and shaded areas denote 90 percent confidence bands. In panels 1 and 3–8, solid lines represent the response of the variable to an exogenous 10 percentage point increase in the commodity terms of trade. In panel 2, the blue (red) solid line denotes the response to an exogenous positive (negative) 10 percentage point change in the commodity terms of trade. In panel 5, the blue (red) solid line denotes the response of public (private) investment. See Annex 2.4 for the estimation methodology.

[27] The estimation does not distinguish between supply-driven and demand-driven changes in the commodity terms of trade. Chapter 3 of the April 2012 *World Economic Outlook* finds the output responses to demand-driven commodity price shocks to be somewhat larger than the responses to supply-driven shocks, but with no statistically significant difference.

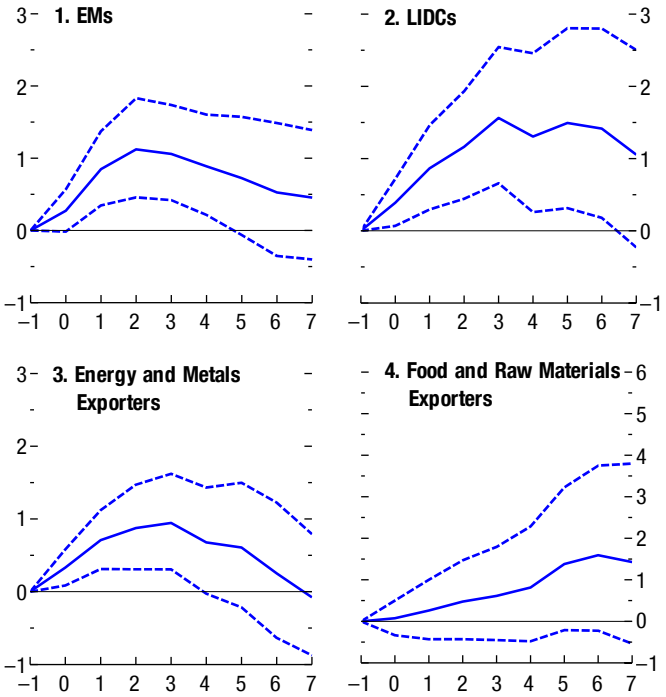
The response of output to terms-of-trade shocks is stronger among low-income developing countries than in emerging market economies (Figure 16). Terms-of-trade shocks are estimated to have a more rapid effect on growth in countries specializing in extractive commodities. In contrast, they take longer to build but appear more persistent for countries specializing in nonextractive commodities. Given the smaller sample and more varied responses, the estimates for the latter group are not statistically significant.

Given that the baseline regression analysis focuses on the macroeconomic impact of terms-of-trade shocks between 1960-2007 and thus excludes economies for which data are not available until the 1970s, the analysis is repeated using data starting a decade later. From 1970, nine additional commodity exporters, including the oil exporters of the Gulf region (Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates) join the dataset. The magnitudes of the impulse responses are broadly robust to the addition of these economies, though the results are no longer significant. This is likely due to the greater variation embodied in a number of the oil exporters joining the sample in that decade. By contrast, starting the estimation from 1980 (thereby omitting the 1970s oil shocks) boosts the GDP response in the outer years and sharpens the statistical significance of the results.

Figure 16. Output in the Aftermath of Commodity Terms-of-Trade Shocks: Role of Income Level and Type of Commodity

(Percentage points; years on x-axis)

Terms-of-trade shocks have stronger effects on output in low-income developing countries than in emerging market economies. The shocks are estimated to have a more rapid effect on output in countries specializing in the export of extractive commodities.



Source: IMF staff estimates.
Note: $t = 0$ is year of the shock; dashed lines denote 90 percent confidence bands; solid lines represent the response of the variable to an exogenous 10 percentage point increase in the commodity terms of trade. EM = emerging market; LIDC = low-income developing country.

In addition, investment and consumption are estimated to respond more strongly and with greater persistence to shocks that occur during a persistent commodity terms-of-trade cycle than to other shocks. This is consistent with the idea that successive commodity terms-of-trade gains can generate perceptions of a more persistent income windfall and therefore boost the incentive to invest (and consume), which in turn supports aggregate activity.

What do the estimated responses of output growth to the commodity terms of trade imply for the growth outlook for commodity exporters? To answer this question, projections for the country-specific commodity terms-of-trade indices through 2020 were constructed using the forecasts for international commodity prices, as of August 2015.[28]

To extract the annual growth effect of change in the terms of trade from the shock in year *t*. To obtain a year-over-year growth rate between horizons (in log differences):

$$y_{i,t+h} - y_{i,t+h-1} \equiv \left(y_{i,t+h} - y_{i,t-1}\right) - \left(y_{i,t+h-1} - y_{i,t-1}\right)$$

Therefore, the contribution to year-over-year growth of a given change in the commodity terms of trade, $\Delta s_{i,t}$, can be calculated by subtracting the contribution to the level from horizon $h-1$ from the contribution to the level at horizon *h*:

$$\left(y_{i,t+h} - y_{i,t-1}\right)\Big|_{\Delta s_{i,t}} = \beta^h \Delta s_{i,t}$$
$$\left(y_{i,t+h-1} - y_{i,t-1}\right)\Big|_{\Delta s_{i,t}} = \beta^{h-1} \Delta s_{i,t}$$
$$\left(y_{i,t+h} - y_{i,t+h-1}\right)\Big|_{\Delta s_{i,t}} = \beta^h \Delta s_{i,t} - \beta^{h-1} \Delta s_{i,t}$$

where $\left(y_{i,t+h} - y_{i,t+h-1}\right)\Big|_{\Delta s_{i,t}}$ is the portion of the growth rate attributable to changes in the shock variable, $\Delta s_{i,t}$.

The next step is to convert this annual contribution from log differences to growth rates using the following formulae. For a general variable, $M_{i,t}$, where $m_{i,t} = \ln M_{i,t}$, let $\Delta m_{i,t} = \beta$:

$$\Delta m_{i,t} \equiv m_{i,t} - m_{i,t-1} = \ln M_{i,t} - \ln M_{i,t-1} = \ln \frac{M_{i,t}}{M_{i,t-1}} = \beta$$

$$\text{Growth rate of } M_{i,t}\text{: } \frac{M_{i,t} - M_{i,t-1}}{M_{i,t-1}} = \frac{M_{i,t}}{M_{i,t-1}} - 1 = e^{\beta} - 1$$

Therefore the portion of growth at horizon *h* to which the year *t* shock is contributing can be defined as:

$$\gamma^h_{\Delta s_{i,t}} \equiv e^{\beta^h \Delta s_{i,t} - \beta^{h-1} \Delta s_{i,t}} - 1$$

[28] Output projections for all the countries in the sample were then generated, feeding the relevant historical data and the forecasts for the terms of trade into the impulse response functions for output under the main specification.

The cumulative growth contribution from a change in the commodity terms of trade in 2015, i.e., from shocks that originated up to five years before 2015 (for example, at horizon 5 in 2010, horizon 4 in 2011, horizon 3 in 2012, etc.), is calculated as follows:

$$\left(1+\gamma^{5}_{\Delta s_{i,2010}}\right)\left(1+\gamma^{4}_{\Delta s_{i,2011}}\right)\left(1+\gamma^{3}_{\Delta s_{i,2012}}\right)\left(1+\gamma^{2}_{\Delta s_{i,2013}}\right)\left(1+\gamma^{1}_{\Delta s_{i,2014}}\right)\left(1+\gamma^{0}_{\Delta s_{i,2015}}\right)-1$$

On average, the weaker outlook for commodity prices implies that the annual growth of output for net commodity exporters will decline further, by almost 1 percentage point in 2015–17 compared with 2012–14. The results differ sizably among the different types of commodity exporters. Most notably, reflecting a relatively larger and more recent decline for energy prices, the reduction in growth for energy exporters is projected to be about 2¼ percentage points over the same period.[29] The effect of commodity prices on capital accumulation implies a reduction in the growth of potential output as well. Based on the estimated response of capital accumulation to the commodity terms of trade, the projected decline in the growth of potential output in 2015–17 compared with 2012–14 is about 1/3 percentage point on average and 2/3 percentage point for energy exporters.

IV. Sectoral Reallocation during Commodity Booms: Case Studies

Theoretical studies predict that the composition of economic activity will change following a boom in the commodity terms of trade, with a reallocation of output and factors from the manufacturing sector toward the commodity and nontradables sectors (Corden 1981; Corden and Neary, 1982).[30] The sectoral reallocation could shift the share of sectors in overall output; to the extent that TFP levels and growth rates differ across sectors, the change in sectoral shares could affect the economy's overall TFP growth rate. The sectoral reallocation patterns are thus relevant to country growth prospects in the aftermath of the boom, but data constraints make them challenging to examine for a large set of countries.

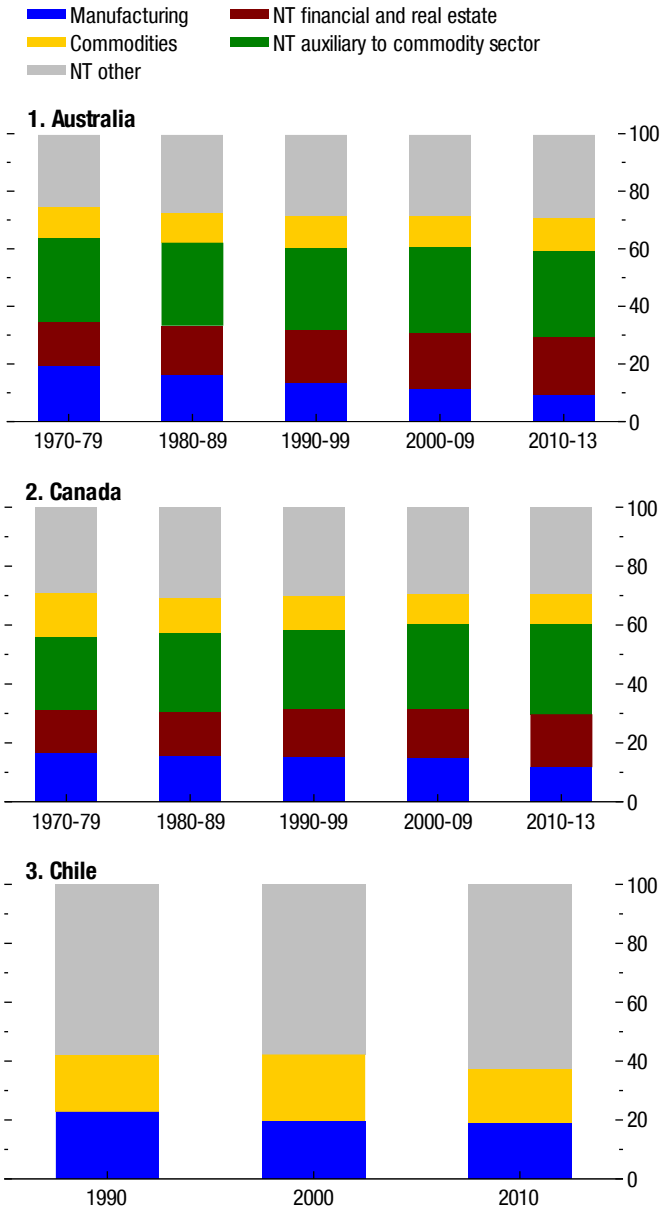
[29] These projections assume that all other factors are unchanged and therefore are not equivalent to regular *World Economic Outlook* forecasts, which take other factors into account.

[30] More recent case studies of sectoral change among commodity exporters include Francis 2008; Steenkamp 2014; Bjørnland and Thorsrud, forthcoming; and Fornero, Kirchner, and Yany 2014.

This section uses data from the Latin America KLEMS and World KLEMS data sets to examine patterns of sectoral reallocation and their implications for aggregate TFP growth in three commodity exporters—Australia, Canada, and Chile—during the commodity boom of the 2000s.[31] The analysis seeks to answer the following questions:

- How did the growth rates of sectoral capital and labor stocks change during the boom period (2000–10) relative to the preboom period (1990–99)? Which sectors contributed the most to the pickup in the growth rates of aggregate investment and employment?
- Were the shifts in the relative shares of nontradables and manufacturing in economy-wide output and factor stocks different from those in commodity importers over the same period?
- Did the reallocation of output across sectors during the boom have an effect on the growth rate of TFP?

Figure 17. Sectoral Composition of Output
(real; percent of total)



Source: IMF staff calculations.
Note: NT = nontradables. NT auxiliary to commodity sector includes the following subsectors: utilities, construction, trade, hotels, transport and communications. For Chile, a breakdown of NT subsectors is not available therefore all are shown under "NT other".

[31] The analysis focuses on the most recent boom because comparable data on sectoral output, capital, and labor stocks are available for only a very small subset of commodity-exporting advanced and emerging market and developing economies for limited periods. KLEMS databases document growth and productivity patterns around the world, based on a growth-accounting framework at a detailed industry level.

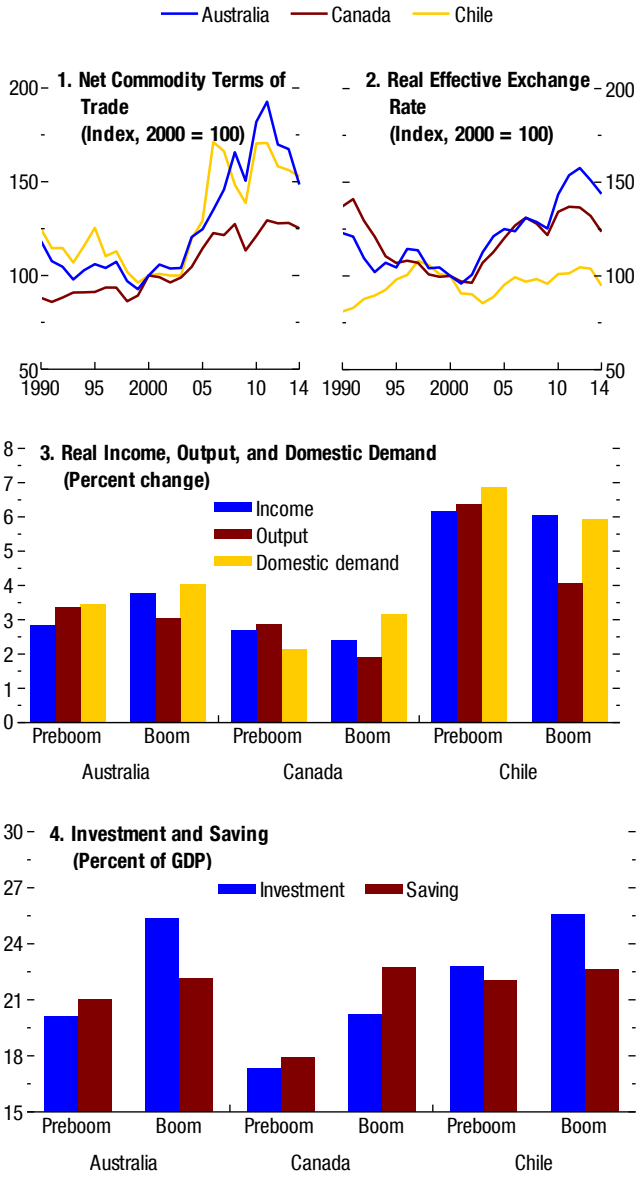
Background

The surge in global commodity prices in the first decade of the 2000s led to commodity terms-of-trade gains for Australia, Canada, and Chile given their relatively large extractive industries: coal and iron ore in Australia, oil and natural gas in Canada, and copper in Chile. Among these three countries, the relative share of the commodity sector is largest in Chile, closely followed by Australia, and is the smallest in Canada (Figure 17). Australia and Chile enjoyed larger terms-of-trade gains over the decade than Canada (Figure 18, panel 1). Chile experienced the smallest real appreciation of its currency over the boom period, likely reflecting higher foreign ownership in the commodity sector, while Canada's real appreciation was the largest relative to its terms-of-trade gain (Figure 18, panel 2).

In line with the theoretical predictions, the rate of income growth exceeded the rate of output growth in all three countries during the boom. Domestic demand grew in line with incomes, if not more than incomes (Figure 18, panel 3). Investment as a share of GDP rose strongly in all three cases, surpassing the change in savings as a share of GDP (Figure 18, panel 4).

Figure 18. Commodity Booms and Macroeconomic Indicators in Australia, Canada, and Chile

Australia, Canada, and Chile experienced commodity terms-of-trade booms in the first decade of the 2000s. In that period, the three countries differed in the extent of their real currency appreciation, but in all three, real incomes grew faster than real output, and investment picked up strongly.



Source: IMF staff calculations.
Note: Preboom is 1990–2000; boom is 2000–10. In panel 3, bars show annualized average growth rates during the specified periods. In panel 4, bars are annual averages over the specified periods.

Did Capital and Labor Reallocate toward the Commodities and Nontradables Sectors?

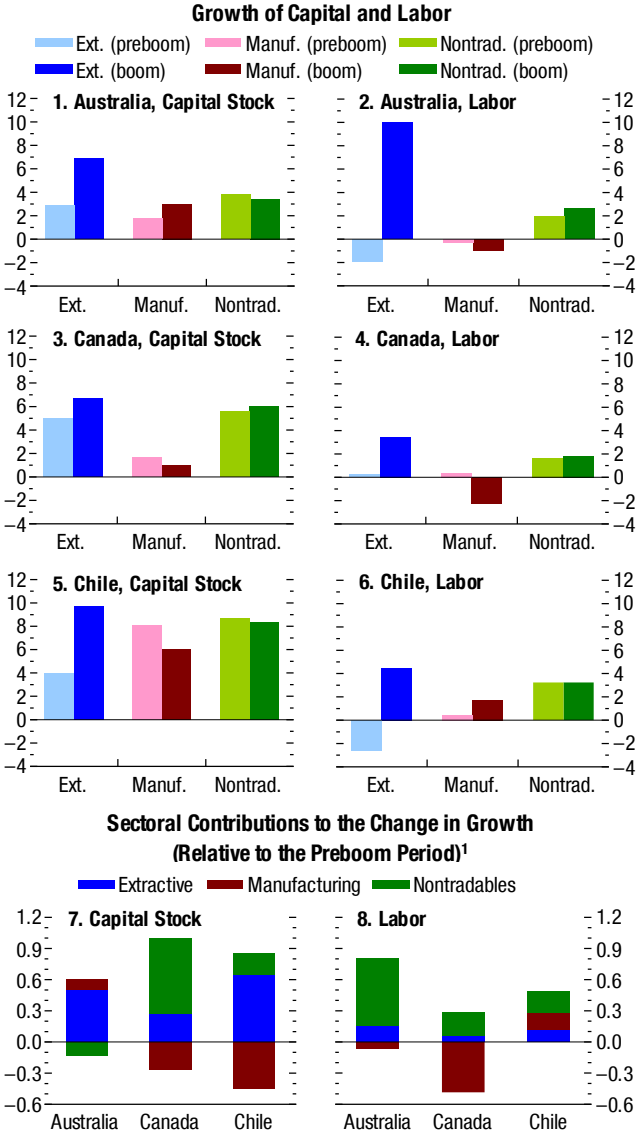
In all three countries, there was a clear pickup in the growth rates of both capital and labor in the extractive sector during the boom period (Figure 19, panels 1-6).[32] Higher investment in the sector accounted for the bulk of the increase in economy-wide investment in Australia and Chile (Figure 19, panel 7). But the broader changes in investment and employment growth across the commodities, manufacturing, and nontradables sectors did not always conform to theoretical predictions. Contrary to those predictions:

- In Australia the pace of capital accumulation in manufacturing picked up during the boom period, reflecting in part strong demand from export markets (mainly east Asia), while it declined in the nontradables sector.[33] A number of suggest that an important part of the capital stock increase in manufacturing was partly related to the mining boom itself. For example, Barnes and others (2013)

Figure 19. Growth of Capital and Labor by Sector: Boom versus Preboom Periods

(Average annual percent change)

In Australia, Canada, and Chile, the 2000–10 commodity boom period coincided with a clear increase in both capital and labor in the extractive sector; in Australia and Chile, that sector accounted for the bulk of economy-wide capital accumulation in the period. Labor and capital in the three countries did not shift notably into the nontradables sector.



Sources: Hofman and others 2015; Latin America KLEMS; World KLEMS; and IMF staff calculations.

Note: Preboom is 1990–2000; boom is 2000–10. The contributions of the agriculture sector are small and not shown. Ext. = extractive; Manuf. = manufacturing; Nontrad. = nontradables.

[1]The change in the growth of capital and labor relative to the preboom period is decomposed into sectoral contributions. A sector's contribution to the change in growth is calculated as the annual growth of capital or labor multiplied by the weight of that sector in the total capital and labor stock and averaged across the 10-year period.

[32] To analyze sectoral shifts arising from the commodity boom, the economy is disaggregated into three sectors: extractive industries (fuels and mining), manufacturing, and nontradables. Agriculture is omitted for simplicity—it accounts for 2 to 4 percent of aggregate value added in the three countries studied.

[33] In the 2000s, manufacturing exports to east Asia accounted for more than one-third of total manufacturing exports in Australia, about 15 percent in Chile, and about 5 percent in Canada.

and Tulip (2014) show that fabricated metal output grew strongly to meet increased demand from the construction and mining sectors, with metal products responsible for the most of the capital growth in Australian manufacturing.

- In Chile, manufacturing employment growth strengthened during the boom, while capital accumulation slowed in nontradables and declined in manufacturing.

- Canada is the only case among the three countries in which the sectoral factor accumulation patterns consistently favored the extractive and nontradables sectors as predicted by theory: both the pace of capital accumulation and employment levels fell in the Canadian manufacturing sector during the boom, while those in the extractive and nontradables sectors increased (Figure 19, panels 7-8).[34]

Were the Shifts between Manufacturing and Nontradables Different from Those in Commodity Importers?

The reallocation of activity from manufacturing toward nontradables in the 2000s was not unique to the commodity-exporting economies; many advanced economies have experienced a similar shift during the past three decades (see Figure 20). Thus, to draw definitive conclusions on whether the boom of the 2000s accelerated the reallocation of activity toward nontradables in commodity exporters, it is useful to examine whether the shift was stronger than in commodity importers. The data indeed suggest that the three commodity exporters considered here saw a faster reallocation of output shares toward nontradables during the boom relative to importers (Figure 20, panel 1). But only in Canada did this represent a change relative to the preboom years; in Australia and Chile, the faster reallocation toward nontradables represented a continuation of a preexisting trend. Data on factors of production paint an even more mixed picture: only in the case of capital and labor in Canada is there a steepening in the trend relative to importers during the boom period (Figure 20, panels 2 and 3). In sum, benchmarking against the experience of commodity importers suggests little evidence of a faster shift from manufacturing toward nontradables activities during the boom among the three countries studied, except in Canada. The evolution of house prices offers a slightly different view: in all three countries, especially in Canada, real house prices rose faster than the average real house price in commodity importers, providing some evidence of relative strength in nontradables activities during the boom period (Figure 20, panel 4).[35]

[34] See also see the discussion in Sharpe 2010.

[35] For Australia, Tulip (2014) provides evidence that the mining boom put upward pressure on the demand for housing and housing rental rates with the supply response being more sluggish. Corden (1984) points to the

(continued…)

The different patterns of sectoral reallocation across the three countries can be attributed in part to the destination of their export manufacturing products. Among the countries, Australia—which saw a pickup in manufacturing investment during the boom period—sent a relatively larger share of its manufacturing exports to east Asia, particularly China, on the eve of the boom. In contrast, the majority of Canada's manufacturing exports went to the United States, where manufacturing output growth slowed in the 2000s. To the extent that booms in commodity prices coincide with strong global activity, Dutch disease effects in commodity exporters could be offset, especially if the manufacturing sector has trade linkages with faster-growing countries and regions.[36]

Did the Reallocation of Activity Hamper Aggregate TFP Growth?

The evidence on sectoral growth rates of output, capital, and labor points to unambiguous shifts toward the commodity sector as well as shifts—though not as consistent—toward nontradables activities. To examine whether these changes had an impact on economy-wide TFP growth, the latter is decomposed into within-sector and between-sector effects, applying the decomposition in Dabla-Norris and others 2015.

The decomposition is based on the following specification:

$$tfp_t - tfp_{t-1} = \sum_i \omega_{i,t-1}\left(tfp_{i,t} - tfp_{i,t-1}\right) + \sum_i tfp_{i,t}\left(\omega_{i,t} - \omega_{i,t-1}\right),$$

in which i refers to the sectors of the economy (here, extractive commodities, manufacturing, and nontradables); tfp_t and $tfp_{i,t}$ refer to economy-wide and sectoral TFP, respectively; and $\omega_{i,t}$ is the share of real value added of sector i. The first term on the right side is the within-sector effect given by the weighted sum of TFP growth in each sector. The second term is the between-sector effect, which captures the effect of the sectoral reallocation of real value added on aggregate TFP growth.

impact of immigration during commodity booms which places upward pressure on the demand for nontradables.

[36] See Box 2.1 in Chapter 2 of the October 2015 *World Economic Outlook*. Corden (1984) also shows that immigration into economies experiencing large commodity booms can offset Dutch disease effects.

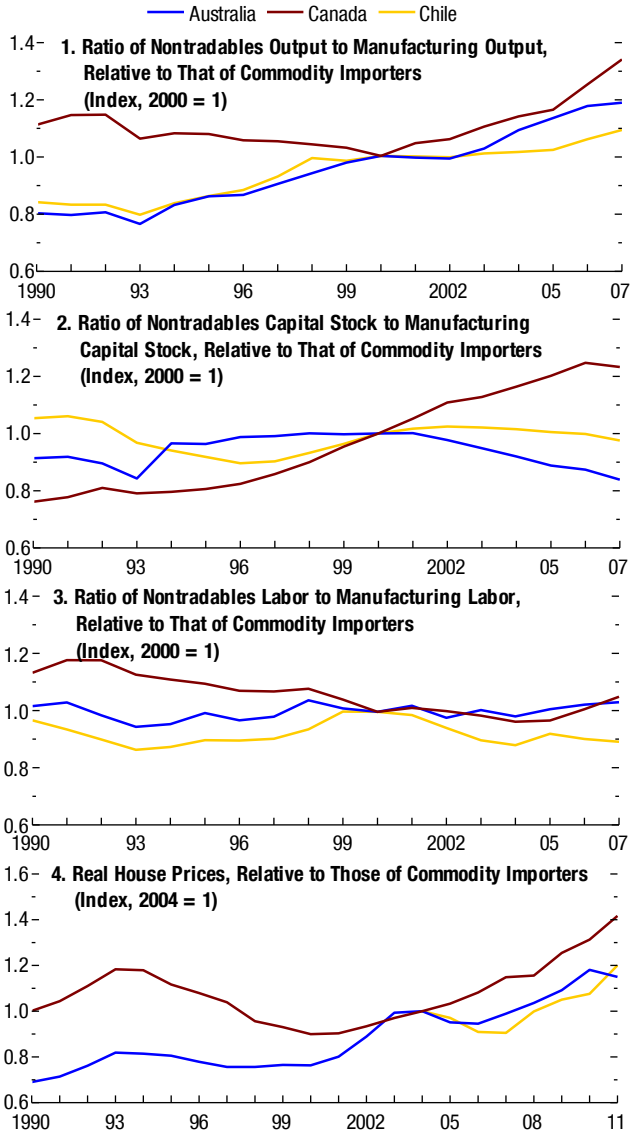
Data from Latin America KLEMS and World KLEMS indicate that aggregate TFP growth declined in all three case study countries during the commodity boom relative to the previous decade and even turned negative in Australia and Chile. The decomposition indicates that this decline was entirely due to the within-sector effect (Figure 19, panels 1, 3, and 5). The between-sector effect in fact attenuated the decline in TFP, particularly in Canada.[37] This finding of a negative contribution from the within-sector effect holds more broadly for Latin American economies (Aravena and others 2014; Hofman and others 2015).

Declining TFP growth in extractive industries and manufacturing appears to be a common factor behind the weak within-sector TFP performance in all three cases (Figure 19, panels 2, 4, and 6). A marked decline in TFP growth in nontradables was also a key factor in Australia and Chile, including due to lower TFP growth in construction towards the latter part of the boom period. The weak TFP growth in the extractive sectors during the boom is likely to have been associated with the time-to-build associated with large-scale mining investments and the tapping of less efficient mines in all three cases

[37] See the discussion in Sharpe (2010) for details on regional contributors to the positive contributors to sectoral reallocation.

Figure 20. Evolution of Activity in Nontradables Relative to Manufacturing, Commodity Exporters Relative to Commodity Importers

In Australia and Chile, the 2000–10 commodity boom did not accelerate the shift of output, capital, and labor shares from manufacturing into nontradables. House prices, however, grew more strongly in Australia, Canada, and Chile than in their commodity-importing peers.



Sources: Haver Analytics; Hofman and others 2015; Latin America KLEMS; national authorities; World KLEMS; and IMF staff calculations.
Note: Panels 1–3 show the evolution in commodity exporters of the ratios of output, capital, and labor in nontradables to those in manufacturing, scaled by the average ratio across a sample of commodity importers in the same year. An increase in the trend of a ratio beginning in 2000 relative to the pre-2000 trend indicates that the reallocation from manufacturing to nontradables in commodity exporters intensified relative to that in importers during the commodity boom. Panel 4 shows the evolution of real house prices in commodity exporters scaled by the average real house prices across commodity importers. The sample of commodity importers comprises Denmark, Finland, Germany, Japan, Sweden, the United Kingdom, and the United States.

(Figure 20).[38] The remoteness of extractive production sites may have contributed to higher marginal costs in the supporting nontradables service industries.

In summary, the case studies point to substantial heterogeneity across countries in terms of sectoral reallocation patterns during commodity booms. While all three countries under study experienced a flow of factors of production into the commodity sector, they experienced varying degrees of reallocation between the manufacturing and nontradables sectors. The fact that the countries were exposed to different manufacturing export destinations (that were experiencing different rates of expansion) seems to have been a factor behind the varying intensity of sectoral reallocation; countries with stronger trading linkages to faster-growing countries had more limited Dutch disease symptoms. Decompositions of economy-wide TFP growth do not suggest that sectoral reallocation hindered TFP growth during the commodity boom of the 2000s but instead point to a marked decline in productivity growth within sectors. Understanding the mechanisms behind the drop in TFP growth in these economies is an important area for future research.[39]

V. CONCLUSIONS

The evidence presented in this paper suggests that fluctuations in international commodity prices, through their impact on domestic spending, can lead to sizable output fluctuations in commodity exporters. In exporters of energy and metals, the comovement between output and the commodity terms of trade tends to be particularly strong. It is also stronger in countries with lower levels of financial development, more procyclical fiscal policies, and less flexible exchange rates.

The strong investment response to changes in the commodity terms of trade means that the latter affect not only actual output, but also potential output. As a result, the growth of potential output can be expected to decline during downswings in commodity prices. The change in the cyclical component of output is, however, about twice the size of the change in potential output, the structural component.

Against the backdrop of the recent declines in the commodity prices, the findings of the paper suggest that the growth slowdown in commodity exporters mirrors experiences during earlier downswings. The slowdown could even be larger than those experienced in past episodes, since the terms-of-trade upswings that many exporters experienced in the first

[38] See the discussion in Francis 2008 and Sharpe 2010. This TFP weakness in extractive commodities comes in stark contrast to the strong positive TFP growth of agricultural commodities in all three country cases, particularly during the second half of the boom period.

[39] Recent studies of this issue include Parham 2012 and Barnes and others 2013 for Australia and Sharpe 2010 and Baldwin and others 2014 for Canada.

decade of the 2000s were much larger than earlier ones. As a result, they may have led to much larger increases in actual and potential output growth than in the past upswings analyzed in the paper. If the terms-of-trade downswings are now also larger, the declines in growth would likely be correspondingly larger as well.

The paper's regression-based analysis indeed suggests that the recent commodity price declines, together with the weak commodity price outlook, could subtract about 1 percentage point on average from the growth rate of commodity exporters in 2015–17 relative to 2012–14. For energy exporters, the reduction in growth could be even larger—about 2¼ percentage points on average. The projected drag on the growth of potential output is about 1/3 percentage point on average for commodity exporters and 2/3 percentage point on average for energy exporters.

At the same time, many commodity exporters have moved toward policy frameworks and structural characteristics that are more conducive to smoothing the macroeconomic effects of terms-of-trade fluctuations—less procyclical fiscal policies, more flexible exchange rates, and deeper financial systems. These changes could mitigate some of the growth impact of commodity price downswings.

The analysis in the paper suggests that policymakers must avoid overestimating output gaps and the scope for expansionary macroeconomic policies to support demand. As commodity-exporting economies are likely to overheat toward the end of a prolonged surge in commodity prices, the growth slowdown in the immediate aftermath of the boom most likely reflects a cooling of output toward potential, which may itself be growing at a reduced pace, given a slowdown in investment. If indicators of slack show few signs of output having fallen below potential, expansionary monetary and fiscal policies are more likely to raise inflation than to sustainably raise investment and employment.

In countries where output has fallen below potential, supportive domestic demand policies could help avoid a costly underutilization of resources. But two considerations suggest that the drop in the commodity terms of trade may itself limit the scope to ease macroeconomic policies. First, in economies with some exchange rate flexibility, currency depreciation may have led to an easing of monetary conditions without a change in the stance of monetary policy; thus, any easing in the stance could risk further depreciation and unwelcome increases in inflation. In other economies, declining resource-based fiscal revenues may call for fiscal adjustment to secure debt sustainability.

Although the comovement of potential output with the commodity terms of trade tends to be less pronounced than that of actual output, the analysis in this paper suggests that declining growth of potential output exacerbates the post boom slowdowns. The decline in

the structural component of growth suggests that the policy agenda to restore stronger growth in commodity exporters should include targeted structural reforms to alleviate the binding supply-side bottlenecks and boost productivity growth.

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