3. China's Evolving Trade with Advanced Upstream Economies and Commodity Exporters

Introduction and Main Findings

China is in the midst of a fundamental transformation. Growth has been slowing since 2012 as the economy has been rebalancing to a more sustainable growth model. This process of rebalancing or growth transition in China involves not only lower growth but also a shift from heavy industry and construction to more advanced manufacturing and services in production, and from investment and export to consumption in final demand. This transition has profound implications for China's trade patterns, as import intensities vary across sectors and components of final demand. At the same time, trade patterns are also changing because of China's evolving comparative advantage, driven in part by demographics and the implied changes for the relative labor supply, as well as by increasing human capital.

This chapter reviews recent changes in China's broad merchandise trade patterns and examines their implications for trading partners.[1] These changes in trade patterns are part of the channels through which China's growth transition has affected growth and macroeconomic conditions in trading partners and other economies. Chapter 2 reviews and analyzes in detail such spillovers from China's transition. The analysis in this chapter is less concerned with the spillovers as it seeks to understand the changes in the trade patterns on their own, thereby contributing to the broader understanding of the changing spillover patterns highlighted in Chapter 2.

The changes in trade patterns are broad, and the chapter focuses on advanced upstream economies and commodity exporters. This analysis builds on recent work examining the implications of changes in these trade patterns for China's neighboring low-income countries. Specifically, the chapter first examines whether China's growing competitiveness in producing upstream parts and components has affected exports of five major trading partners—Japan, Korea, and Taiwan Province of China within the Asia economic region, and Germany and the United States—in China's home market and in third markets. The chapter then examines China's impact on commodity exporters and global commodity markets more generally. Rebalancing and structural change are also likely to profoundly affect trade patterns in services. Indeed, advanced economies facing growing competition from China in manufacturing have benefited from increased Chinese demand for tourism and other services—an issue that is beyond the scope of this chapter.

This chapter offers evidence that for some higher-technology goods, advanced upstream countries have lost market share to China since the beginning of rebalancing. The loss is most noticeable and strongest in China's domestic market, as reflected in the onshoring of production of previously imported parts and components. But China's exports of such goods to other countries have also started rising. The chapter also shows that China's growth transition has contributed to a slowing of demand for commodities, particularly those used primarily in investment, heavy industry, and construction. Export values of many commodity exporters have been affected as a result. But for some exporters, values have been affected more by declining global prices than by changes in export volumes. In this regard, other factors have also contributed to recent commodity price declines—research presented in the chapter suggests that China's rebalancing might account for between one-fifth and one-half of the declines in broad commodity

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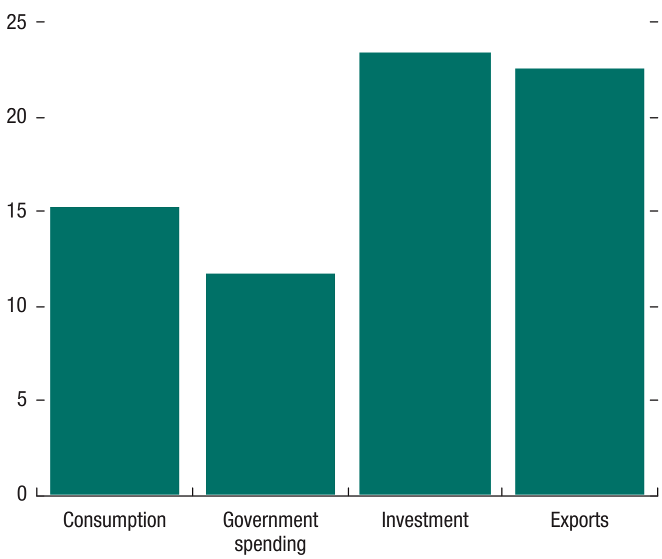
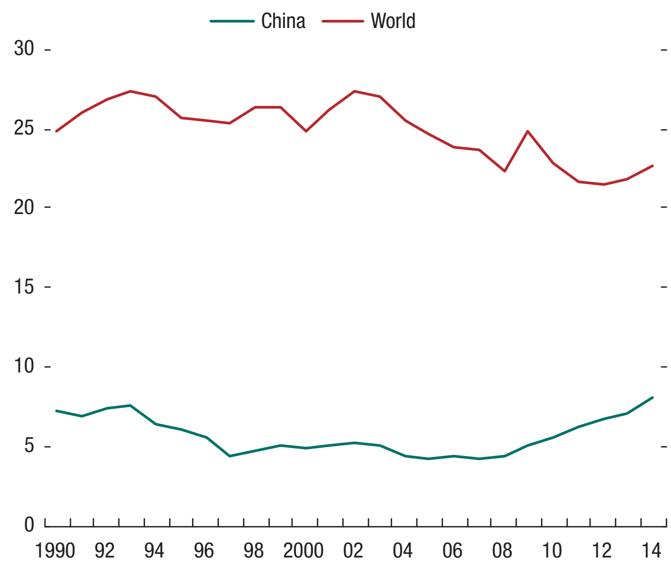
[1]The chapter takes China's rise as an export powerhouse as a given. For recent analysis of the factors at play see Chinn (2015), Gaulier and others (2015), and Veenendaal and others (2015).

Figure 3.1. Import Intensity of GDP Components, 2011
(Percent of total)



Source: Hong and others (forthcoming).

Figure 3.2. Consumption Imports
(Percent of respective total imports)



Sources: United Nations, Comtrade database; and IMF staff calculations.

price indices, with marked differences across commodities. The width of the range highlights that the contributions are quite sensitive to the specifics of the analysis.

Recent Changes in China's Trade Patterns[2]

This section summarizes the main changes in China's trade patterns. These changes have been driven by changes in economic growth and the composition of final demand and production, as well as by evolving comparative advantage.

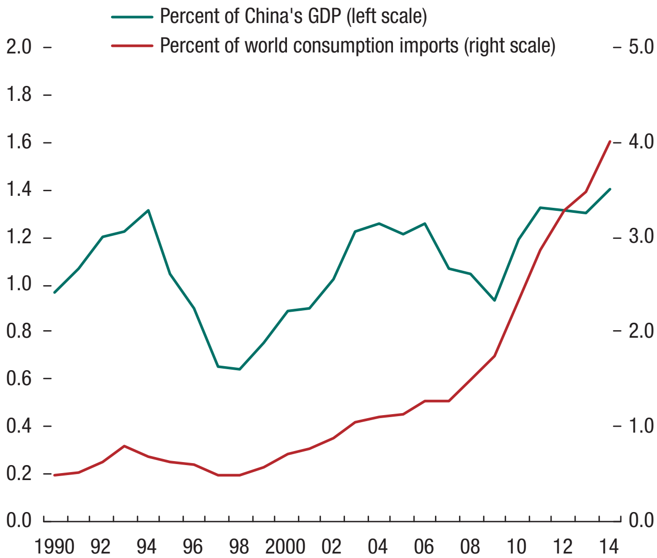
China's import volume growth has softened as the overall economy has slowed, and this trend is likely to continue. In addition, the rebalancing of the economy—from external to domestic demand, and from investment to consumption—has exerted a further drag on imports. Using the Trade in Value Added (TiVA) data set of the Organisation for Economic Co-operation and Development and the World Trade Organization, one can calculate that consumption is less import-intensive than either investment or exports (Figure 3.1). Of course, the composition of those imports will change: consumption-related imports are likely to grow—and indeed have already begun to do so, albeit from a low base (Figures 3.2 and 3.3)—while investment- and export-related imports will decline.[3] In terms of commodities, food demand has grown and petroleum demand has remained robust but, at the same time, with the slowdown in infrastructure and real estate investment, real demand for iron and copper has weakened (Figure 3.4).

Going beyond the growth slowdown and economic rebalancing, China's trade patterns are also being affected by its evolving comparative advantage, driven by growing human capital and diminishing labor supplies. As discussed further in Box 3.1, China is possibly beginning to lose competitiveness in the labor-intensive sectors that formed the core of its early success as an

[2]This section relies heavily on Mathai and others (forthcoming), which provides further details on the evolution of China's trading patterns.

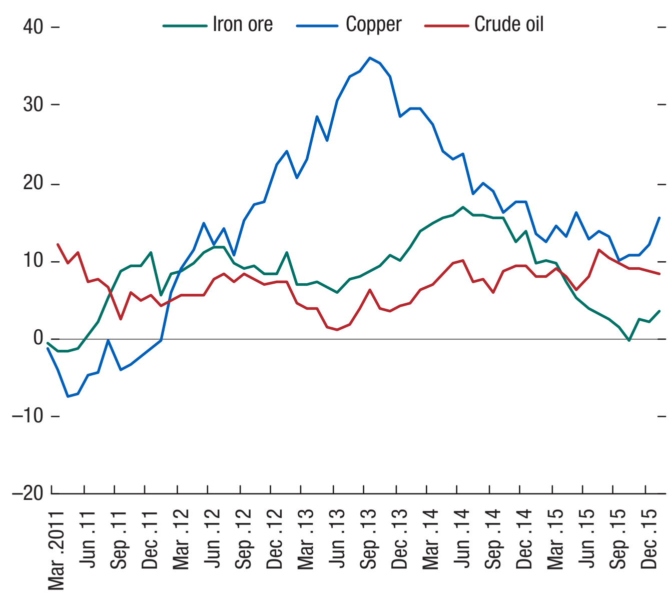
[3]The aggregate import intensity will also depend on relative prices in general equilibrium. Depending on the drivers of rebalancing, import intensity could increase over time, as discussed in the IMF's 2012 Spillover Report (IMF 2012a).

Figure 3.3. China: Consumption Imports



Sources: United Nations, Comtrade database; and IMF staff calculations.

Figure 3.4. Real Commodity Import Growth
(Year-over-year percent change of 12-month rolling sum)



Sources: CEIC Data Company. Ltd.; and United Nations, Population Division.

exporter. This trend may create opportunities for other countries with lower wages to enter this space.

At the same time—and more relevant to this chapter's focus on the spillovers to advanced upstream economies—there is clear evidence that China is moving up the value chain. The domestic value-added content of China's exports has risen across all sectors and now exceeds that of both Korea and Taiwan Province of China (Figure 3.5). This has been driven both by a decline in the importance of what is known as the processing trade (Figure 3.6), which is characterized by a low degree of value addition, and by a decline in the import intensity of many of China's exports (Figure 3.7). There is evidence that China is increasingly becoming a global export leader in parts that it previously imported from advanced Asian economies—liquid-crystal display (LCD) screens are a particularly striking example (Figure 3.8), though similar patterns hold for many other components.[4]

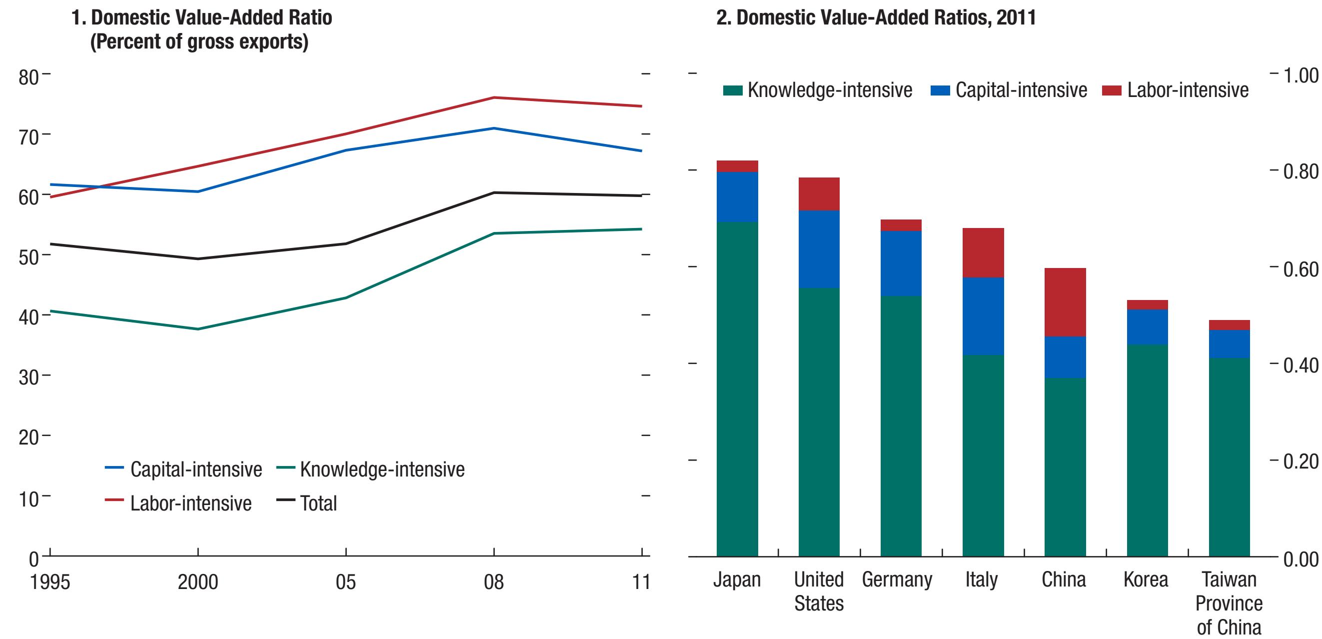
[4]Some of these exports may be to Hong Kong SAR, from where they possibly return to the Chinese mainland to satisfy domestic demand. But at the very least there is evidence that Chinese production of these components is increasing.

Advanced Upstream Economies

This section attempts to analyze whether China's move up the value chain, as documented above, has led to displacements in exports of advanced upstream countries. Although there is anecdotal evidence for some products, including, as mentioned, LCD screens, the extent to which China's growing competitiveness in producing advanced components and products has challenged other, established exporters more broadly is unclear. It could be that in a world of growing trade in some products, China's entry could be absorbed with incumbents maintaining their volumes.

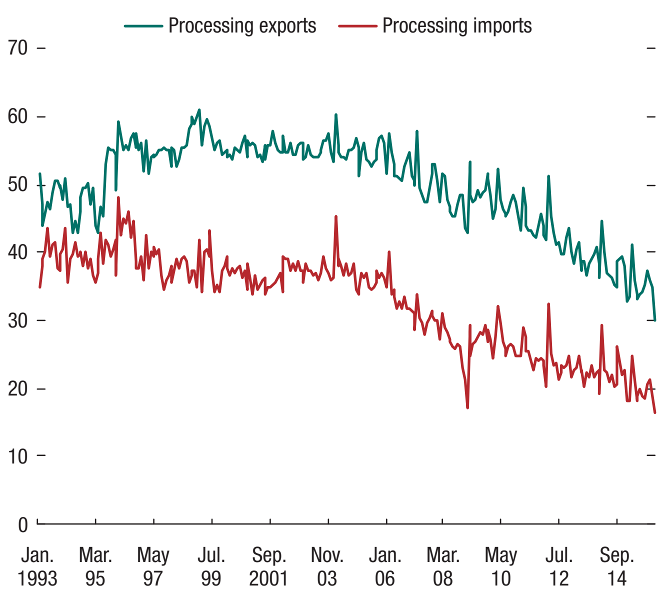
Bilateral trade balances provide some evidence that suggests incumbents have lost market share in China because of onshoring (that is, China substituting imports with its own production). Japan and Taiwan Province of China have seen a clear deterioration in their trade balances with China, mostly on account of a shift in the balance in medium- and high-technology goods (Figure 3.9). In contrast, the deterioration in the bilateral trade balance appears small in Korea. The three

Figure 3.5. Domestic Value Added in Exports



Sources: Organisation for Economic Co-operation and Development and World Trade Organization, Trade in Value Added database; and IMF staff calculations.

Figure 3.6. Processing Trade
(Percent of total exports)



Sources: CEIC Data Company Ltd.; and IMF staff calculations.

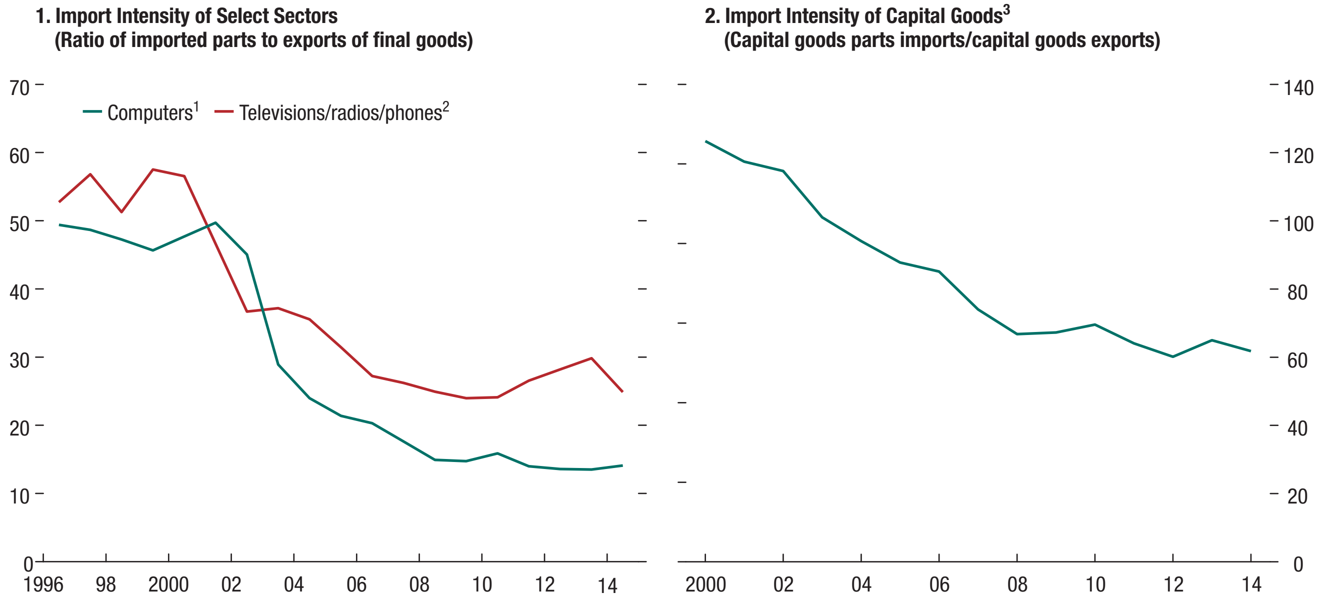
economies' bilateral trade balances with China in intermediate goods—which typically are more high-technology than final goods—have also been worsening (Figure 3.10).

Econometric analysis is needed to corroborate the evidence. Bilateral trade balances could also have deteriorated because of other factors beyond onshoring, including differences in price dynamics across goods. For robust conclusions, other controls need to be incorporated into the analysis. The same considerations also apply to trade effects in third markets, another area where greater competition from China in higher-value-added products could play out. Following the recent trade literature, this section uses a gravity approach to model China's trade flows and their effects on other countries.[5]

Several studies have already used this approach to analyze China's trade patterns, with often

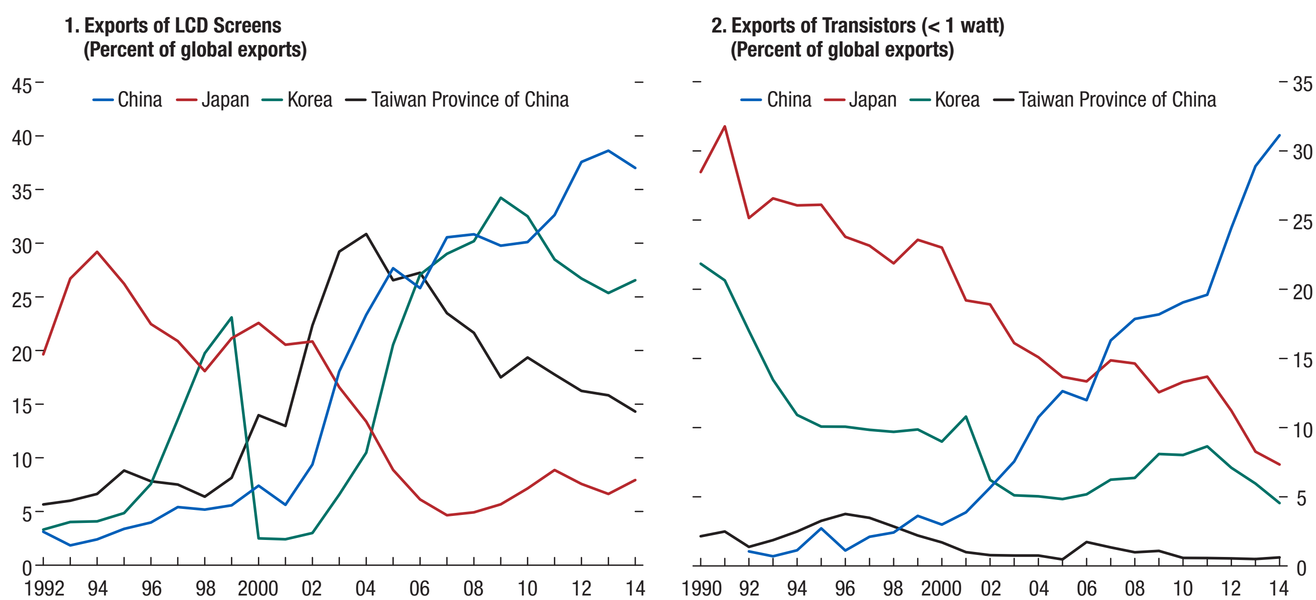
[5]See Baldwin and Taglioni (2006) for the panel framework followed here, building upon the seminal work of Anderson and van Wincoop (2003). Crozet, Emlinger, and Jean (2015) use a similar framework to study trade determinants more generally.

Figure 3.7. Import Intensity



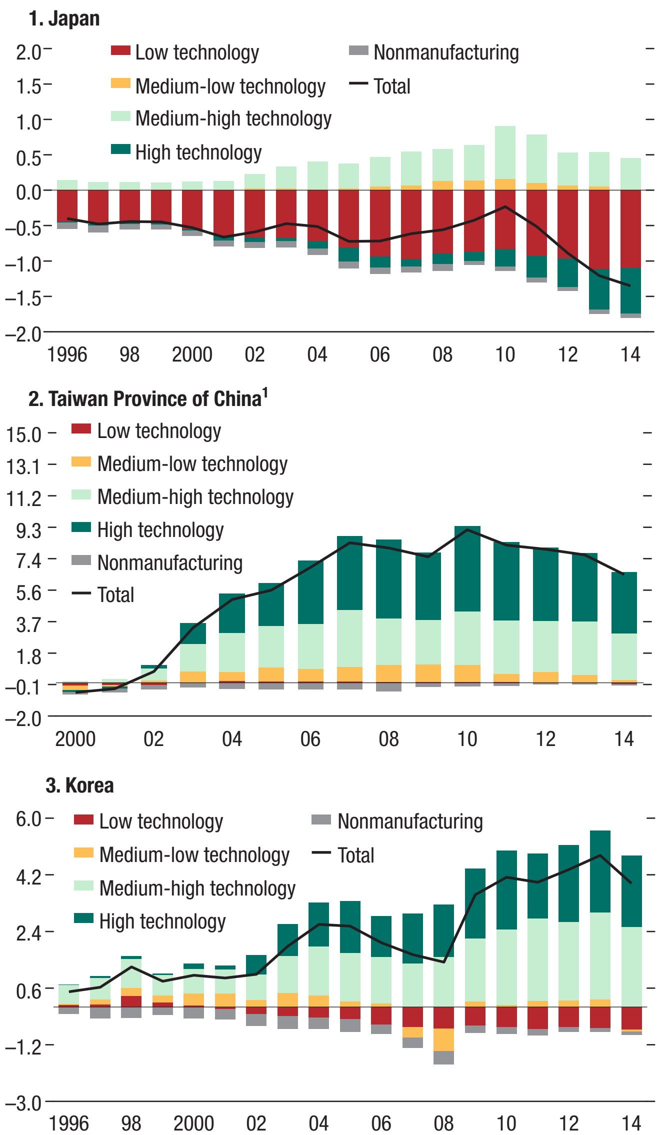
Sources: United Nations, Comtrade database; and IMF staff calculations.
[1]Calculated as imports of computer parts and accessories (SITC code 759) divided by exports of computer equipment (SITC codes 751 and 752).
[2]Calculated as imports of parts and accessories of televisions, radios, and phones (SITC code 7649) divided by exports of televisions, radios, and phones (rest of SITC codes in 2-digit SITC product category number 76).
[3]Calculated as imports of parts and accessories of capital goods (Broad Economic Classification code 41) divided by exports of capital goods (Broad Economic Classification code 42).

Figure 3.8. Exports of LCD Screens and Transistors



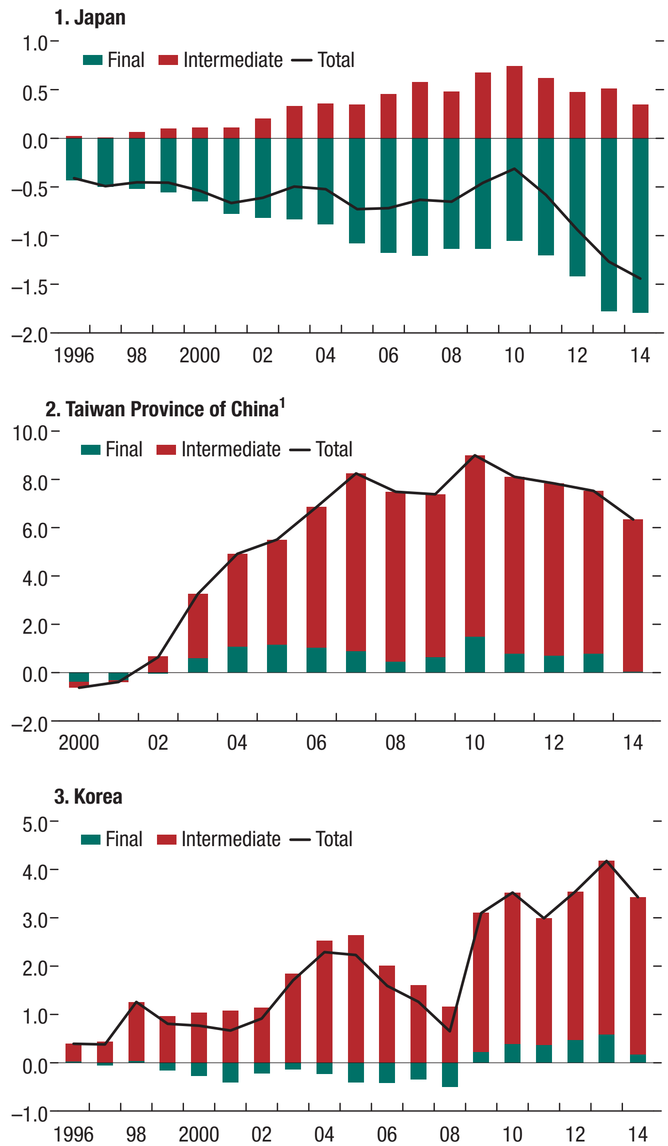
Source: United Nations, Comtrade database; and IMF staff calculations.

Figure 3.9. Trade Balance with China by Technology Sophistication
(Percent of GDP)



Sources: United Nations, Comtrade database; and IMF staff calculations.
[1]Taiwan Province of China starts in 2000 due to lack of data.

Figure 3.10. Trade Balance with China by End-Use Category
(Percent of GDP)



Sources: United Nations, Comtrade database; and IMF staff calculations.
[1]Taiwan Province of China starts in 2000 due to lack of data.

contradictory results regarding the extent to which China has been either a competitor or collaborator with other trading nations.[6] In a recent paper, Kong and Kneller (2016) confirm that estimates are very sensitive to the estimation period and methodology. They use a novel strategy to address some of the econometric issues in previous studies.

We estimate gravity equations to examine the extent to which China's growing competitiveness in higher-value-added production has affected export growth of upstream economies. The analysis uses two equations to consider effects operating both through onshoring and through

[6]Eichengreen, Rhee, and Tong (2004), for example, find that advanced Asia benefited from China's rise, while developing Asia was adversely affected. In contrast, Greenaway, Mahabir, and Milner (2008) using a similar approach, find exactly the opposite results.

exports to other markets on account of competition from Chinese exports ('third market effects"). We estimate these effects using two panel data sets for growth in export values.[7] The first one is a panel based on foreign value added from the five upstream countries to China and domestic value added in China from the TiVA data set for the period 2000–11. The second one is based on gross exports data for 180 countries and territories for the period 2000–14. Given the relatively short time period, we distinguish between a precrisis period of five and seven years, respectively, and a postcrisis period of four years, depending on the underlying export data. Given the extensive time and country-pair fixed effects used, identification rests on cross-sectoral variation of changes in trade flows.

The analysis suggests that some export categories of advanced upstream economies are indeed adversely affected by China's move up the value chain. Sectors in which China has grown increasingly competitive are those in which economies such as Germany, Japan, Korea, Taiwan Province of China, and the United States have seen a fall in their exports both to China and to third markets. The competitive effect is only apparent in the postcrisis part of the sample; in fact, earlier on, as global supply chains were developing, there appears to have been some complementarity between China's exports and those of its advanced partner countries. (See Annex 3.1 for the econometric specifications and detailed regression results.)

Moreover, China's imports from advanced economies are increasingly affected by the rise of China's competitiveness in high-technology, knowledge-intensive, and more complex goods. In third markets, that shift is less pronounced. There, exports from advanced economies were initially competed away in low-technology and labor-intensive goods, while in the postcrisis part of the sample we find evidence that China is now competing in medium-tech, capital-intensive goods and, to a lesser extent, in higher-technology, knowledge-intensive goods.

It is worth keeping in mind that this analysis of trade patterns does not consider issues of ownership, which are important to accurately assess the impact on relative national incomes. Indeed, China's rise as an exporter of manufactured goods has to a substantial degree been driven by foreign-owned firms. As a result, although China's labor force benefited from the wage income associated with the relocation to China of production from upstream producers elsewhere, the returns on the related investments have accrued to foreign investors. Still, the increase in foreign direct investment in China has led to a transfer of technology to the broader economy, which, over time, has also enabled an increasing number of domestically owned firms to become exporters of manufacturing goods.

Commodity Exporters

This section explores how evolving Chinese trade patterns are affecting commodity exporters and commodity markets more generally. The section documents the changes in commodity use, production, and imports in China since the rebalancing started; examines what this has meant for key commodity producers; and explores how much of the recent decline in global commodity prices can plausibly be attributed to China, as opposed to other factors such as slowing demand in other economies or supply response to the pickup in global commodity demand in the early 2000s.

China's growth transition affects global commodity markets through a number of channels. First and foremost, lower output growth will generally translate into lower growth in commodity demand volumes and thus commodity imports. And, insofar as the shock to China's growth spills over to other countries' growth,

[7]We use trade values rather than volumes in the analysis because of data availability issues. This choice should not affect results meaningfully, given the set-up of our empirical analysis. While departures to the law of one price in different directions between China and partner countries could, in principle, mean that results could be influenced by price changes for reasons other than changes in comparative advantage, this seems unlikely, given that we control for common and country-specific factors, as well as trade costs and total exports at the level of individual goods.

those countries' own commodity demands are likely to fall as well. Rebalancing in China also plays an independent role, as commodity intensity—that is, the amount of commodities used per unit of output or good consumed—differs considerably by final demand component or across sectors. In analyzing all of these changes, it is important to keep in mind that China is a large producer of some commodities, including coal, crude oil, and iron ore. Because the growth transition has contributed to lower commodity prices, both currently and in terms of expectations, it might have negatively affected supply both domestically and globally.

The Growth Transition in China and Domestic Commodity Markets

Commodity demand growth in China has generally slowed in recent years, albeit, as will be shown subsequently, with important differences across commodities. The slowing is particularly noticeable for commodities used as inputs in heavy manufacturing and construction, such as iron ore and other industrial metals. In contrast, growth in demand for food commodities has remained robust, while the slowing seems minor for some energy commodities such as crude oil.

A key question regarding the global commodity market impact of the growth transition is whether the slowing in commodity demand was broad as had been anticipated in 2010–11. The distinction between expected and unexpected shifts matters because the former will, to some extent, already have been reflected in prices and investment plans at the time.

To gauge the impact of unexpected growth shifts, we compare actual consumption and production trajectories for major commodities to counterfactuals. The panels in Figure 3.11 show two counterfactual trajectories for five commodities.[8] The first is based on pre-transition average growth rates (during 2001–11), which are representative of myopic expectations based on trend extrapolation. The second projects commodity consumption ("demand") based on pre-transition forecasts for real GDP growth and real commodity prices for 2011–15, using parameters from regression estimates with data up to 2011.[9] Figure 3.12 shows the deviations between the latest actual (annual data) and the counterfactuals for a broader set of commodities.

The comparison of actual consumption with counterfactuals shows that for many commodities, the growth transition has resulted in slowing demand growth. In some cases, the slowing has been greater than what would have been expected given lower GDP growth (as indicated by the bars in Figure 3.12). This is particularly striking in the case of iron ore and coal, but also nickel, all of which are particularly exposed to the heavy industry and construction sectors. For metals with broader use across sectors, such as steel and aluminum, the slowdown relative to counterfactuals has been smaller or absent. This is consistent with the notion that these more versatile metals have been less affected by sectoral change and changes in the composition of demand. In terms of food commodities, consumption has grown faster than would have been expected from the counterfactuals for a number of them.[10] As discussed in Box 3.2, this faster growth reflects the increasing demand for protein-rich foods and vegetable oils, given rising per capita income levels in China.

On the output side, domestic commodity production has fallen short of trend counterfactuals for a number of commodities, highlighting how lower prices and other factors appear to have reduced incentives for production (Figure 3.13).[11] The shortfalls are particularly prominent in the production of metals, coal, and crude oil, where some domestic producers have become less competitive at lower world market prices. In contrast, China's production of a few

[8]The dating convention for the latter is that the growth transition began in 2012 when economic growth in China started slowing.

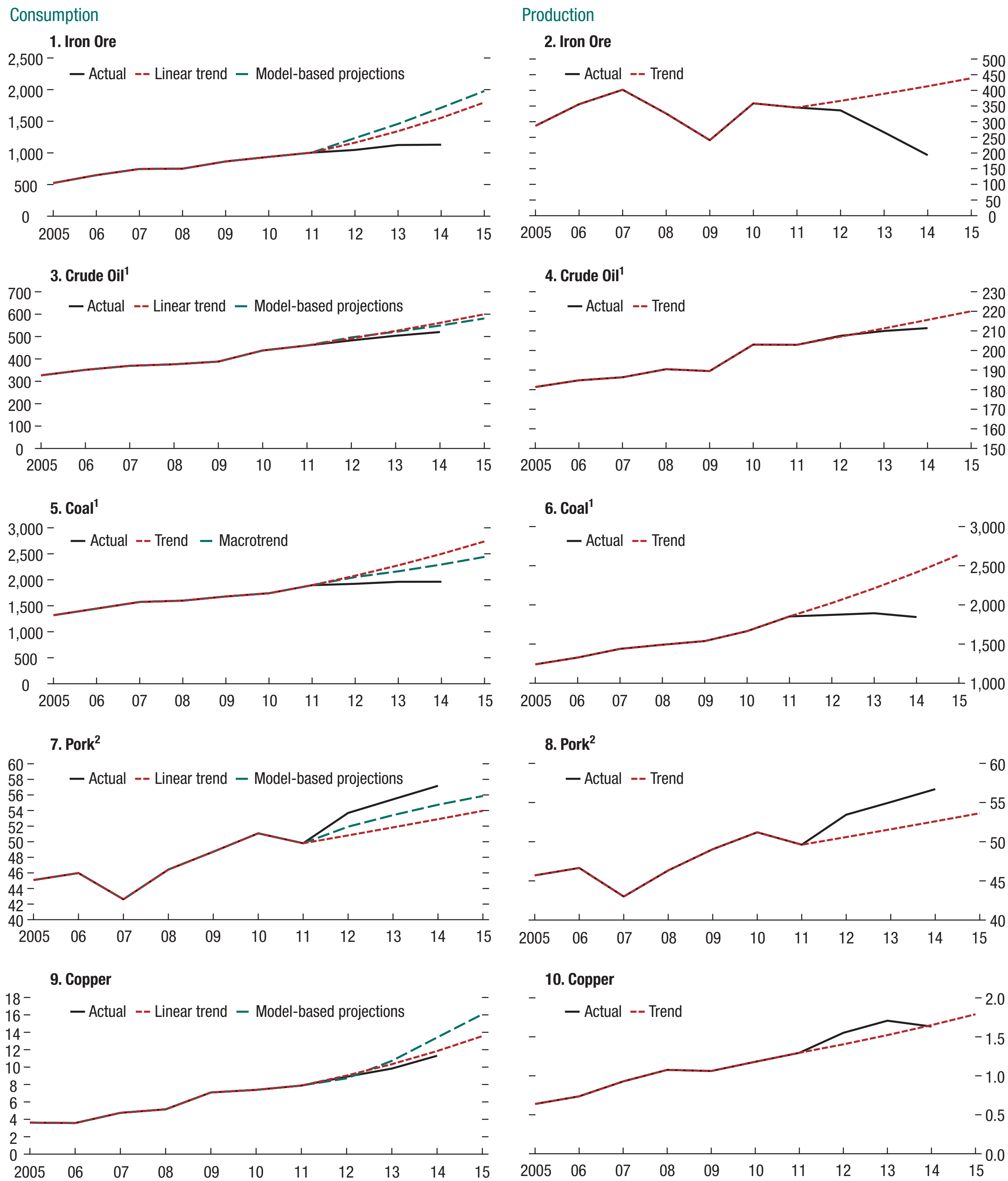
[9]The forecasts used in the construction of the counterfactuals are those presented in the April 2011 *World Economic Outlook*.

[10]The analysis focuses on a number of commodities for which globally consistent consumption and production data are available.

[11]On the production side, the counterfactual analysis is limited to trend extrapolation, as relevant producer prices are not available.

Figure 3.11. China: Commodity Consumption and Production

(Millions of metric tons unless otherwise noted)

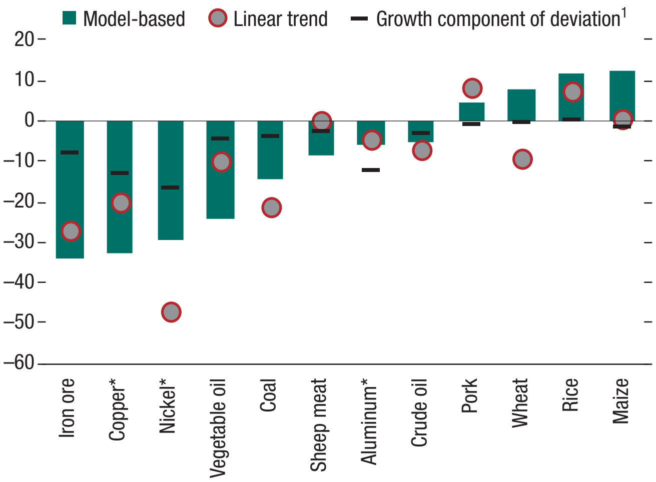


Sources: BP Global; United Nations Food and Agriculture Organization; International Energy Agency; and IMF staff calculations.

[1]Units for crude oil and coal are million tons oil equivalent (mtoe).

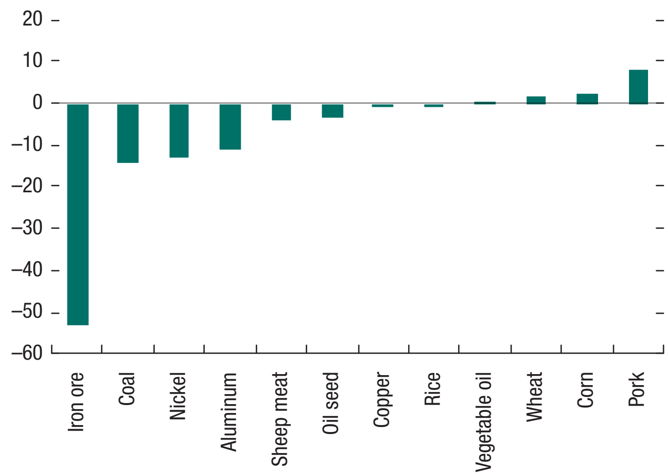
[2]Units for pork are thousands of metric tons.

Figure 3.12. China: Deviations of Actual Consumption from Counterfactual
(Percent)



Source: IMF staff calculations.
Note: For 2014 consumption levels (* for 2015). See text for details of the calculations.
[1]Percent difference in actual GDP (latest observation) and GDP forecast in April 2011, times the estimated income elasticity.

Figure 3.13. Commodity Production in China: Deviation of Actual from Counterfactual
(Percent, latest observation for actual)



Sources: BP Global, *Statistical Review of World Energy*; United Nations, Food and Agriculture Organization; Organisation for Economic Co-operation and Development and Food and Agriculture Organization, *Agricultural Outlook 2015–2024*; World Steel Association, *Steel Statistical Yearbook 2015*; World Bureau of Metal Statistics; and IMF staff calculations.
Note: Counterfactual calculated using average annual growth during 2000–11.

agricultural products, notably pork and corn, has been above trend in the growth transition so far.

China's import volumes of many commodities have continued to grow at a relatively robust pace despite the slowing in domestic commodity consumption growth (Figure 3.4). The backdrop to recent developments in China's commodity trade is that after having been largely self-sufficient, China has become a net importer for many commodities in the 2000s. This broad trend has continued, as shown in Figure 3.14, which presents growth in net import volumes for the commodities analyzed previously and the contribution of consumption and production to these changes.[12] That said, compared to developments before the growth transition, net import volume growth has slowed in some instances, including, for example, iron ore. Hence, commodity producers that based their expectations of future sales on extrapolation of net import trends before the transition may have faced shortfalls in their sales volumes.

Some major commodity exporters have been hard hit by the growth transition, despite continued relatively robust growth in China's import volumes. As shown in Figure 3.15, a number of exporters have seen marked declines in their export volume growth compared with the growth registered in the immediate pretransition period. However, other exporters have seen continued rapid volume growth, sometimes even for commodities for which exports of other exporters have declined. In addition, the rapid growth before the transition reflected new capacity or newly established trade linkages from a very low initial base (for example, coal in Mongolia).

Although the implications of China's growth transition on commodity export volumes have differed considerably across exporters, all of them have felt the adverse effects from the decline in commodity prices (the terms-of-trade effect). This is a key spillover channel. Commodity demand and supply tend to be price-inelastic,

[12]Net imports are defined as the difference between domestic production and consumption. While this difference also includes changes in commodity inventory holdings, those changes are unlikely to account for systematic changes in net imports of most commodities over a span of several years. Precious metals are a notable exception in this regard, but they are not considered in this chapter.

especially in the short to medium term, and small shocks to volumes can trigger large price changes. Nevertheless, commodity export values to China as a percent of GDP for a number of major exporters have remained stable or risen (Figure 3.15). This reflects the offset of the price effects from not only increased export volumes, but also currency depreciation in many exporters, highlighting that the ultimate spillover impact also depends on policy responses and regimes.

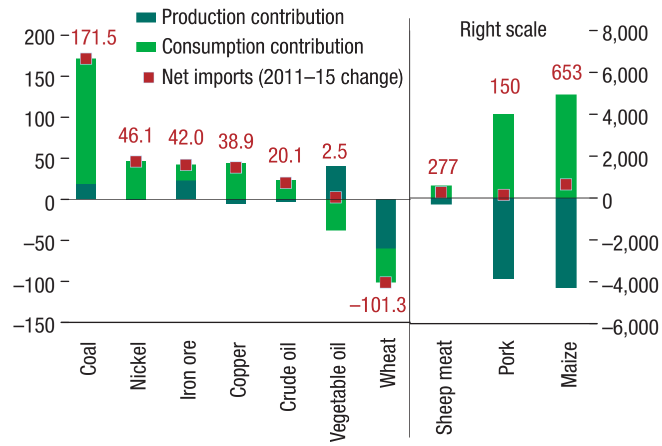
The Impact of China's Growth Transition on Global Commodity Markets

Demand and supply developments in China have dominated global market conditions for base metals (Table 3.1). Given China's large market share, the cumulative changes in global consumption and production of the major commodities analyzed in this chapter have been dominated by the contributions to change by China.[13] For many other commodities, for which China's shares are smaller, domestic market developments have been a less dominant influence.

An important question is how much of the recent decline in global commodity prices can plausibly be explained by the growth transition in China since 2012. It should be noted at the outset that the answer to this question will inevitably be tentative. Global commodity prices, similar to many other prices, are the ultimate endogenous variables in the global economy, as they are influenced by many factors. Moreover, they tend to be forward-looking, given the possibility of storage. Controlling for expectations is difficult in empirical work. It is thus very challenging to precisely identify the contribution of one factor to commodity price developments at any given point in time.

A simple way to approach the question is to use rules of thumb. Simulations of the IMF's G20MOD macro model (a module of the IMF's Flexible System of Global Models) suggest that

Figure 3.14. China: Contribution to Changes in Net Commodity Imports, 2011–15
(Percent change)



Sources: BP Global, *Statistical Review of World Energy*; United Nations, Food and Agriculture Organization, Organisation for Economic Co-operation and Development and Food and Agriculture Organization, *Agricultural Outlook 2015–2024;* World Steel Association, *Steel Statistical Yearbook 2015;* World Bureau of Metal Statistics; and IMF staff calculations.
Note: Only commodities in which China was a net importer in 2011 are included. Net imports are defined as production minus consumption. Data are for 2014 (2015 for nickel and copper). Positive contribution of production indicates a decline in production.

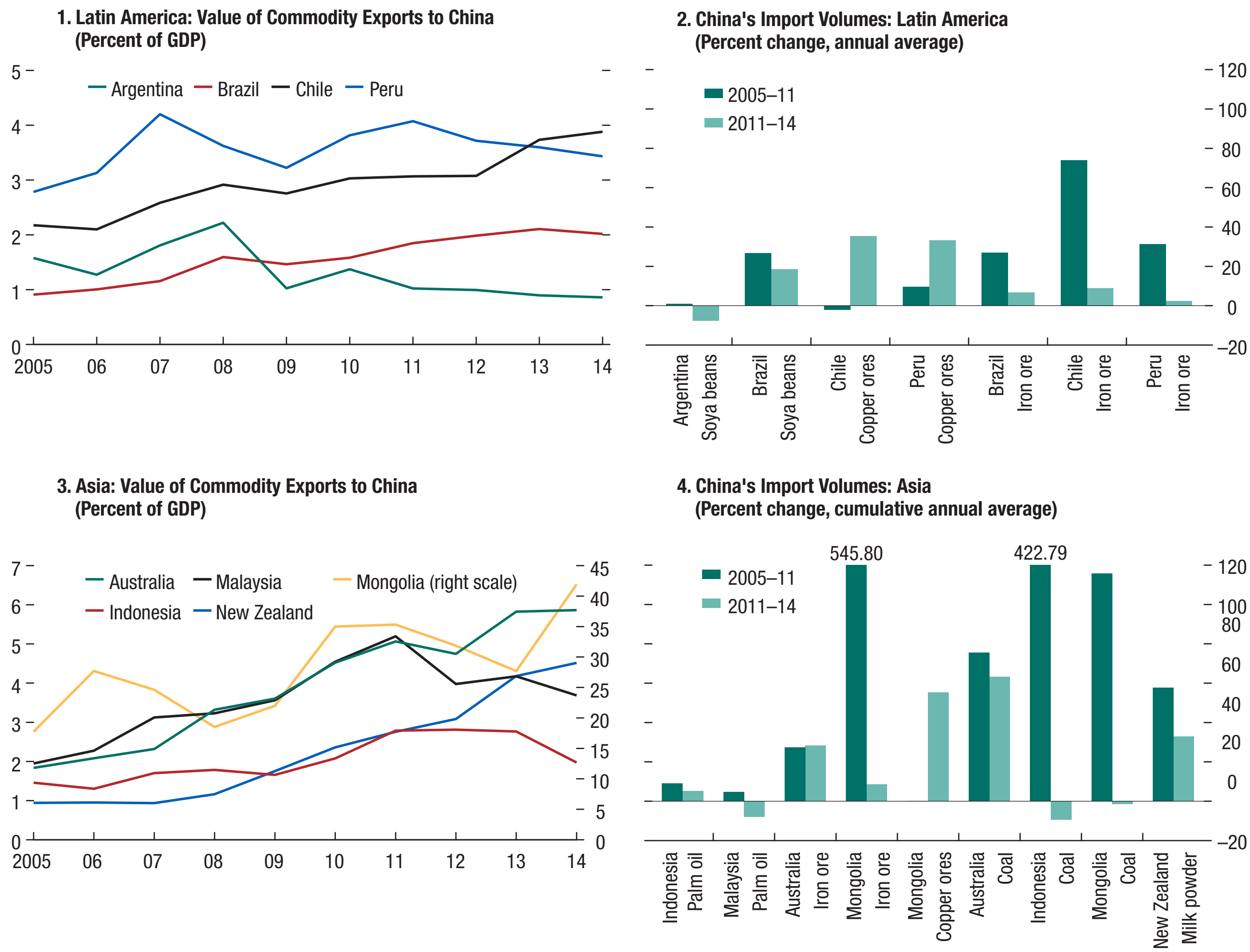
a demand shock lowering global real GDP by 1 percentage point over four years is associated with declines in real oil and metals prices of 7½ and 10 percent, respectively. Using long-term Consensus Forecasts as a metric for expectations, China's GDP in 2015 was some 4 percent lower than expected in the April 2011 forecast, and applying a spillover multiplier of 0.3 (see Chapter 2) implies that global GDP was about 1½ percent lower than expected as a result. Applying the G20MOD elasticities, one would thus have expected real oil and metals prices to have fallen by 14 or 18 percent, respectively. But in fact, these prices were about 45 and 25 percent, respectively, lower in 2015 than they were forecast to be in April 2011.[14]

These illustrative calculations suggest that China's growth transition explains only a part—albeit a

[13]The Commodities Special Feature in Chapter 1 of the October 2015 *World Economic Outlook* provides an in-depth discussion of China's role in global metals markets.

[14]This comparison is based on the commodity price assumptions and inflation forecasts in the April 2015 *World Economic Outlook*. Actual real oil and metals prices were about 51 and 45 percent lower in 2015 than they were in 2011 (based on annual average values). The greater difference in the price surprises relative to forecasts is that a sizeable decline for metals prices was expected in 2011.

Figure 3.15. Commodity Exports to China from Latin America and Asia and China's Import Volumes from Latin America and Asia



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

sizable one, especially for metals—of recent broad commodity price declines. It is important to keep the limitations of such calculations in mind. Magnitudes will depend on the underlying approach and assumptions. For example, an alternative approach based on factor-augmented vector autoregressions suggests that the unexpected slowdown in activity in China explains between one-third and one-half of the broad commodity price decline, depending on whether fuel prices are included (see Box 3.3). For individual commodities, the contributions may be larger of smaller, as factors other than general economic activity also play a role. The earlier discussion of differences across commodities in recent developments in China speaks to this point. Nevertheless, the fundamental point that China's rebalancing in recent years only accounts for some of the recent declines in commodity prices seems to be a robust conclusion.

Conclusion

This chapter has shown that changing patterns of trade in China are having important effects on advanced upstream economies. The trade data suggest that China is increasingly competing with upstream suppliers, both within China and in third markets, and an econometric analysis corroborates such evidence. Hence, China's move up the value chain is affecting economies such as Japan, Korea,

Table 3.1. World Consumption of Selected Major Commodities, 2011–15
(Cumulative change in percent)

	Demand		Production	
	World Growth	China's Contribution	World Growth	China's Contribution
Base Metal[1]				
Aluminum	32.92	31.85	27.64	30.31
Copper	13.62	14.97	16.01	2.25
Nickel	18.55	17.18	3.48	0.14
Iron ore[2]	–1.47	1.12	2.95	–7.81
Food[3,4]				
Wheat	0.80	–0.80	3.45	1.13
Coarse grains[5]	9.65	2.31	12.23	1.98
Rice	6.02	2.03	1.70	0.56
Pig meat	7.85	6.81	7.41	6.50
Sheep meat	5.62	3.26	5.57	1.71
Oil seeds	5.81	3.26	9.27	–0.13
Vegetable oil	7.86	1.34	6.65	1.72
Fuel				
Coal	2.77	1.76	1.66	–0.21
Crude oil	3.08	1.48	5.30	0.21

Sources: Organisation for Economic Co-operation and Development (OECD) and Food and Agriculture Organization, *Agricultural Outlook 2015–2024*; BP Global, *Statistical Review of World Energy,* June 2015; UN Comtrade database; and OECD and International Energy Agency, *World Energy Statistics.*
[1]2015 numbers mechanically extended from September 2015.
[2]Iron ore production 2011–14.
[3]Agriculture timespan: 2011–14.
[4]Coarse grains are primarily corn.

and Taiwan Province of China, in addition to Germany and the United States. These effects are present especially since the global financial crisis, and increasingly in higher-technology types of products.

The chapter has also shown that China's growth transition has had important implications for commodity markets and exporters. The transition has contributed to a slowing in consumption growth for many commodities. For investment-related commodities, the slowdown has been larger than could be attributed to China's slowing GDP growth alone, suggesting the important effect of the rebalancing of the economy. By contrast, the consumption of food commodities has surprised on the upside, reflecting the relatively higher demand for protein and vegetable oil as per capita income is rising. The analysis also suggests that much of the impact on commodity exporters has come through lower commodity prices, rather than export volumes. Although the growth transition in China has contributed materially to the price declines, other factors have contributed as well.

Much will depend on how the rebalancing will play out, including whether overall growth will decline further and the speed at which the structure of production and the composition of final demand will change. Policymaking will be important to this process, including the mix of macroeconomic policies and structural reforms. Policies that reduce the need for precautionary savings, for example, could boost consumption and increase domestic prices. This, in turn, could lead to some real exchange rate appreciation and an increase in import intensity. In this context, while China will likely continue moving up the value chain in its exports, this could also accelerate the decline in exports of labor-intensive goods. Similarly, reforms in the state-owned enterprise sectors could reduce unprofitable domestic productive capacity in some commodities, with feedback effects into global commodity markets.

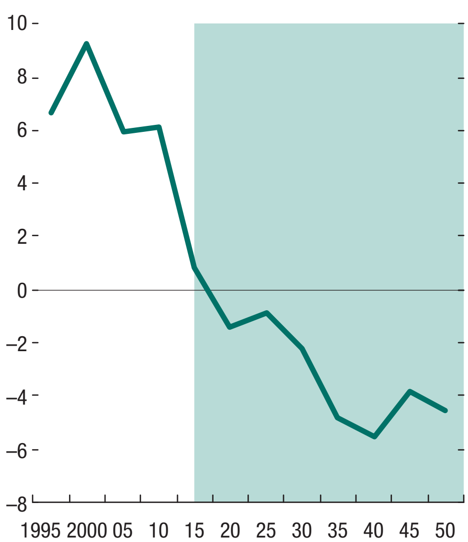
Box 3.1. The Evolution of China's Labor-Intensive Export

The labor supply has long been a key factor behind China's export success, but the era of cheap labor may now be ending as the country's demographics change. Working-age population growth has been shrinking for several years and has now turned negative (Figure 3.1.1). At the same time, private sector wages across the country have risen by close to 15 percent a year. Although productivity has also risen, it has not kept up, and with wages even in inland provinces of China now far higher than those in some neighboring countries, many observers have suggested that China is losing competitiveness in labor-intensive production (Figure 3.1.2).

A high-level decomposition of China's export basket according to factor intensity suggests that the country has long been diversifying away from labor-intensive production—that is to say, the share of labor-intensive goods in China's exports has been declining since the early 1990s, with a slight reversal in the past few years (Figure 3.1.3). At the same time, given China's rapid export growth over this period, the country's global export market share in labor-intensive goods remains higher than it is in any other type of production. Moreover, that market share has continued to rise, albeit at a slightly reduced rate over the past few years. This is hardly a picture of a country that has lost competitiveness in labor-intensive production.

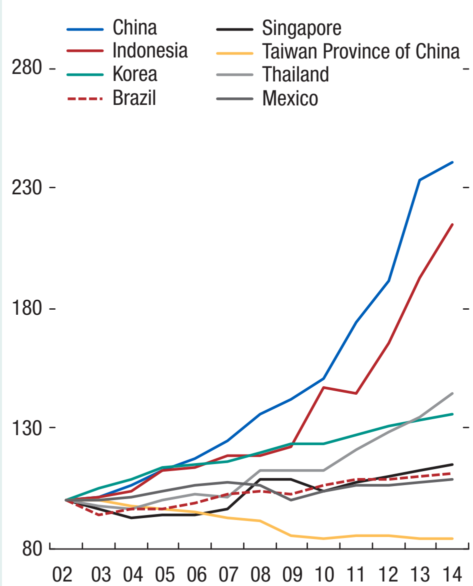
An examination of export market share trends for some of the goods known to be particularly important in China—light manufactures such as apparel, footwear, plastic toys, and furniture, as well as various consumer electronics—provides a more nuanced picture. Computer production appears to have plateaued, as has footwear, while China appears to have lost market share in furniture. In other categories, however, market share continues to rise—telephones are a striking example (Figure 3.1.4). The data as reported by China's trading partners (that is, those countries' imports from China, as opposed to what China reports as

Figure 3.1.1. Working-Age Population Growth
(Percentage change)



Sources: CEIC Data Company Ltd.; and United Nations, Population Division.

Figure 3.1.2. Unit Labor Cost
(Index; 2002 = 100)

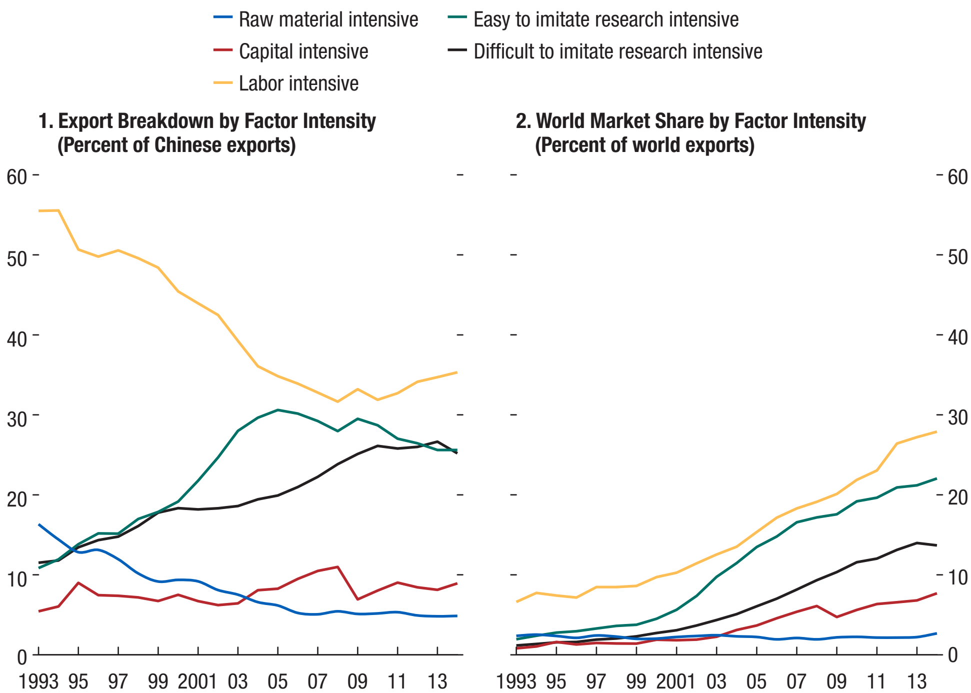


Sources: Haver Analytics; and IMF staff calculations.

This box is based on a forthcoming Asia and Pacific Departmental Paper (Mathai and others).

Box 3.1 *(continued)*

Figure 3.1.3. China: Export Breakdown and World Market Share by Factory Intensity



Sources: United Nations, Comtrade database; and IMF staff calculations.

its own exports) paint a clearer picture of market shares that are stabilizing or even declining in particular sectors (Figure 3.1.5). A fair conclusion from this evidence may be that China has possibly begun losing competitiveness in labor-intensive production, and that it may now be at an inflection point beyond which losses may start to accelerate.

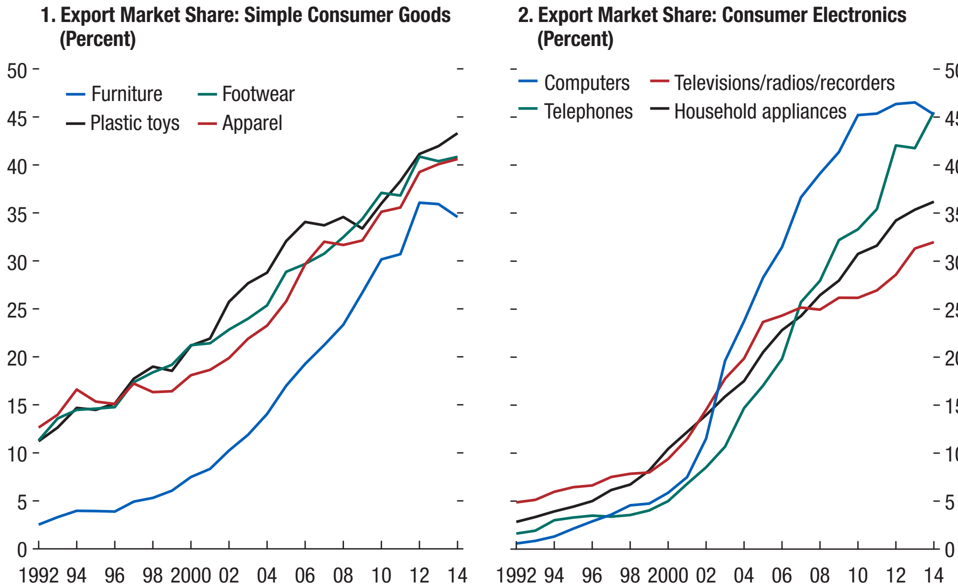
China has, however, been surprisingly resilient in maintaining its market share for such a long period, and at such high levels. Previous exporters often rose to 10 percent or 15 percent of global exports in a particular category, such as garments, and had a relatively short reign as market leader before exiting quite rapidly (Figure 3.1.6).

Why has China been different? One natural possibility is simply that China has shipped labor-intensive jobs to the interior provinces, where wages are lower. But though there has indeed been an increase in the share of industrial goods manufactured in those provinces (Figure 3.1.7), most of those goods appear to be intended for the domestic market—exports continue to be produced on the coast (Figure 3.1.8). The coast's long-lived competitiveness even as wages have risen sharply may be due to "new trade" factors such as network effects from an agglomeration of suppliers, the extreme efficiencies of port logistics, and the growing role of automation, which has reduced the importance of labor costs.

China's evolving comparative advantage in labor-intensive production can have important implications for low-income, labor-rich countries such as those in the Mekong region. As wages rise both on the coast and in the interior of China, it may become increasingly attractive to relocate labor-intensive production to such countries. At the same time, possible competitor countries will not be able to rely on their low wages alone, but will also need to improve structural factors, such as infrastructure, governance, and trade openness, to capitalize on future opportunities.

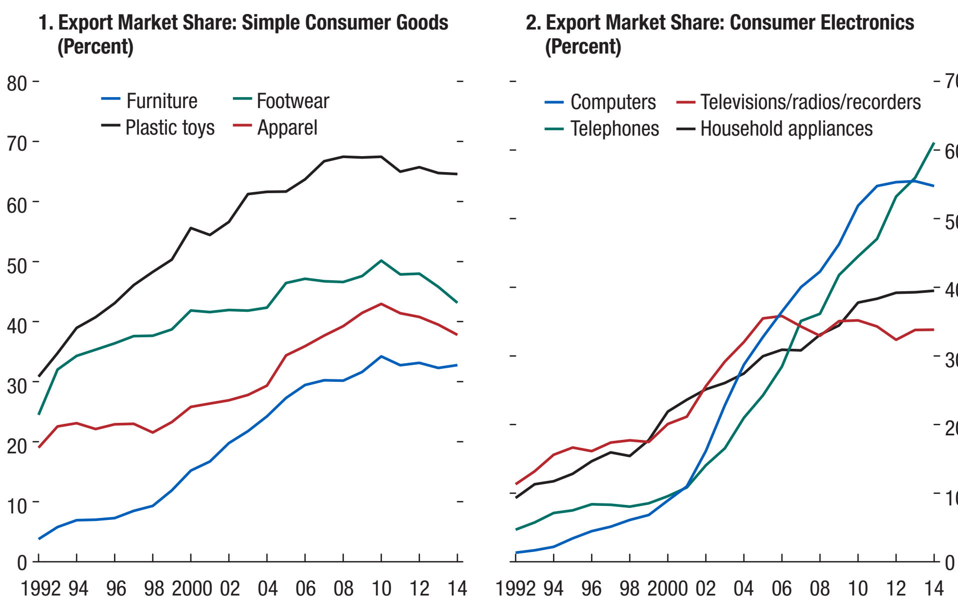
Box 3.1 *(continued)*

Figure 3.1.4. China's Export Market Shares for Simple Consumer Goods and Consumer Electronics, as Reported by China



Sources: United Nations, Comtrade database; and IMF staff calculations.

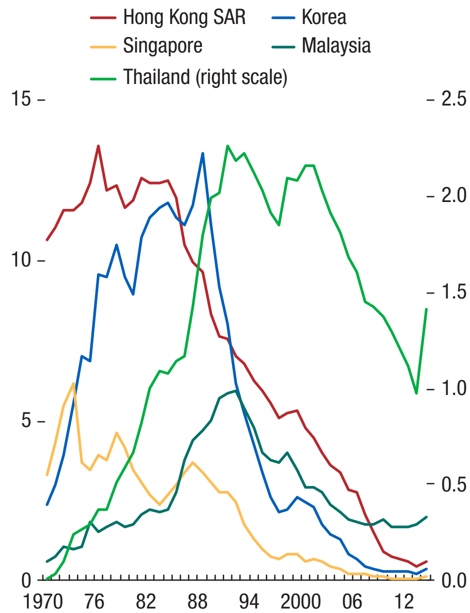
Figure 3.1.5. China's Export Market Shares for Simple Consumer Goods and Consumer Electronics, as Reported by Importers



Sources: United Nations, Comtrade database; and IMF staff calculations.
Note: Partner-reported data show more of an exit, although still a relatively modest one, from labor-intensive sectors.

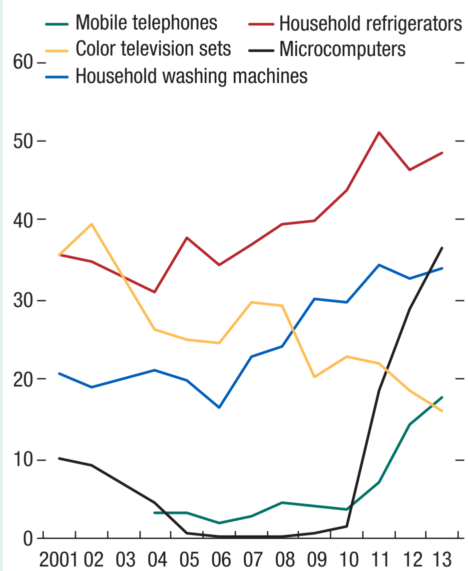
Box 3.1 *(continued)*

Figure 3.1.6. Exports of Apparel
(Percent of world gross exports)



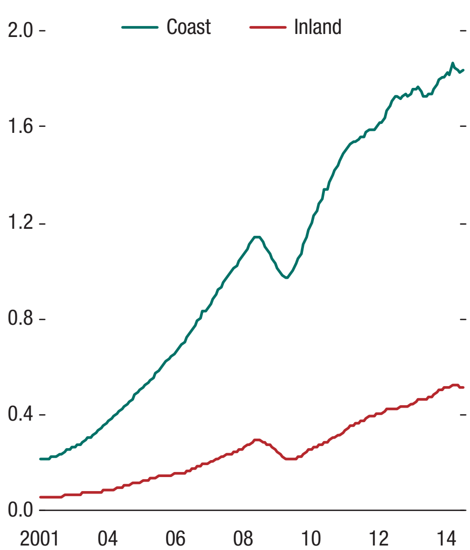
Sources: United Nations, Comtrade database; and IMF staff calculations.

Figure 3.1.7. Industrial Production of Inland Provinces
(Percent of national total)



Sources: *China Statistical Yearbook*; and IMF staff calculations.

Figure 3.1.8. Foreign Exports by Location of Producer
(Trillions of U.S. dollars)



Sources: CEIC Data Co. Ltd.; and IMF staff calculations.

Box 3.2. Food Consumption Patterns in China

This box explores patterns in China's consumption of food commodities in response to rising per capita incomes. To do so, the box examines cross-country evidence on the relationship between levels of food consumption and income, or "Engel curves."[1] We estimate Engel curves both for aggregate food consumption and for selected higher-value items (particulary proteins) to explore whether rising incomes in China have been accompanied by rising shares of higher-value foods in total food consumption.

The evidence corroborates that protein consumption in China has indeed outperformed relative to income, but it also suggests that aggregate food consumption has evolved as expected, given per capita income. Panels 1 and 2 of Figure 3.2.1 plot actual aggregate food consumption and aggregate protein consumption, respectively, for China and other selected economies (measured in calorie equivalents) against the path predicted by income and as derived from the panel regressions. The panels show that, while the level and income elasticity of aggregate food consumption in China aligns closely with the predicted path, consumption of protein is higher, and has grown faster than would be expected.[2] This suggests that the share of protein in household food expenditure may have risen in China. Indeed, in terms of share in calories consumed per capita, protein's share has risen from less than one-fifth in 1997 to nearly one-fourth in 2014.

Extending the analysis to specific commodities, China's actual consumption differs from the predicted level markedly. For instance, beef consumption per capita is well below the predicted level, whereas pork consumption is well above, and has risen at a faster rate than predicted by the Engel curve. Even though beef consumption has underperformed, and there has been a strong supply response in pork, demand growth has been strong enough such that China has become a net importer of these commodities in recent years, consuming nearly 3 percent of world beef exports and nearly 6 percent of world pork exports in 2014. Consumption per capita is also on a rising trend for other types of meat, poultry, and fish, and income elasticities for beef, pork, and fish were higher during 2012–15 than during 2001–11—from 0.1 to 0.6 for beef; from 0.22 to 0.67 for pork; and from 0.30 to 0.65 for fish. As the commodity-wise Engel curves indicate, per capita consumption of beef and pork may yet rise further with rising per capita incomes, which could have a sizable impact on commodity demand in the future, even as overall food consumption moves along the expected path. At unchanged relative prices for foods, sustained growth in per capita food consumption at average rates recorded in 2012–15 over the next 15 years would require world production to increase by about 5 percent relative to 2014 output for beef and poultry, more than 17 percent for sheep meat, more than 40 percent for pork, and nearly 30 percent for fish.[3]

On the other hand, China's consumption of whole milk powder (for which it imports one-third of total consumption) is in line with predicted levels. Further increases in income may not translate into additional per capita consumption, and volume growth may be driven by population growth alone.

This box was prepared by Adil Mohommad.

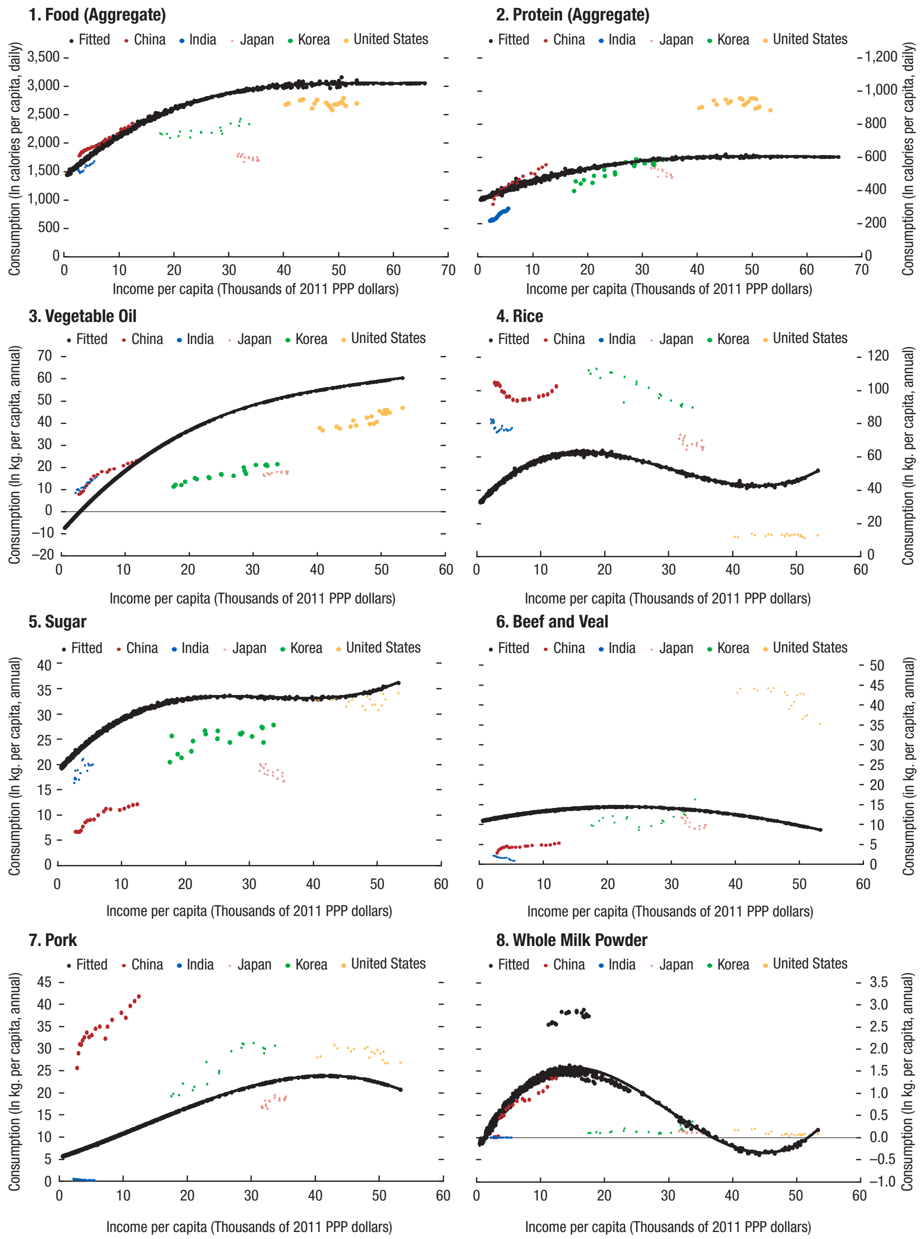
[1]See the note in Figure 3.2.1 for estimation details.

[2]Figures 3.2.1 and 3.2.2 account for calories lost due to food waste based on estimates for the United States (about 30 percent, based on U.S. Department of Agriculture estimates). The actual calorie consumption may vary across countries by the differences in the extent of food waste.

[3]As discussed in the main text, the year 2012 is treated as the starting period of China's growth transition.

Box 3.2 *(continued)*

Figure 3.2.1. Engel Curve Estimates and Consumption per Capita of Selected Food Items
(Kilograms/capita; income in 2011 constant purchasing power parity dollars per capita)



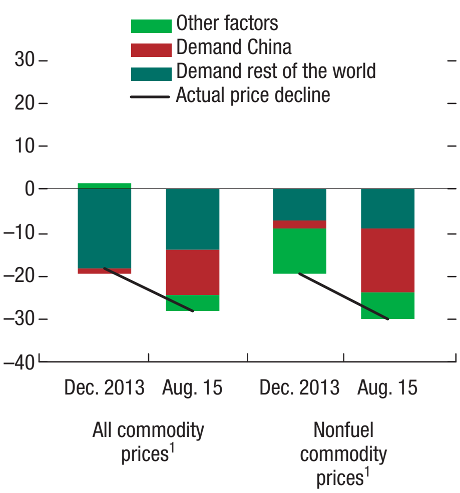
Source: IMF staff estimates.
Notes: (1) The estimated equations build on the methodology in Box 1.2 in the IMF's April 2014 *World Economic Outlook.* Engel curves for each commodity/aggregate are derived from a regression of consumption per capita (in annual calories per capita for aggregate food and aggregate protein, and in annual kilograms per capita for selected items) on a third-order polynomial, relative local food price inflation of the relevant commodity or aggregate, and country fixed effects. (2) The data set used for this analysis consists of the UN Food and Agriculture Organization's food consumption and local producer prices of 20 agricultural commodities, World Bank purchasing power parity (PPP) GDP in 2011 constant dollars, and local consumer price index inflation and population data from the IMF's World Economic Outlook database. The panel covers 1996–2014 and includes 42 countries: Bangladesh, Ethiopia, Haiti, Ghana, Mozambique, Tanzania, Vietnam, and Zambia (low-income); Argentina, Brazil, China, Colombia, Chile, Egypt, India, Indonesia, Malaysia, Mexico, Nigeria, Pakistan, Peru, the Philippines, Russia, South Africa, Thailand, Turkey, and Ukraine (emerging); Australia, Canada, Israel, Japan, Korea, New Zealand, Norway, Saudi Arabia, Switzerland, and the United States (high income); and others including Algeria, Iran, Kazakhstan, Paraguay, and Uruguay.

Box 3.3. The Contribution of China's Growth Transition to Commodity Price Declines

This box identifies the contribution of shocks associated with China's growth transition to recent declines in global commodity prices. As noted in the main text, this task is challenging, given that many forces influence these prices. For example, much will depend on the extent to which one attributes the growth slowdown in China to country-specific factors, as opposed to external factors such as slowing growth in the rest of the world for other reasons. The results will also depend on whether the analysis controls for expectations.

We apply a factor-augmented vector autoregressive (FAVAR) model to monthly data for 42 benchmark commodity prices in the IMF's Primary Commodity Price System with data going back at least to 1980, along with other data (Bernanke, Boivin, and Eliasz 2005) . The model builds on the fact that commodity price fluctuations have a strong common factor, which is typically interpreted as reflecting global economic conditions (Stock and Watson 2011). The latter rests on the fact that commodities are used jointly as inputs in the production of goods and services and, as such, are dependent on macroeconomic variables such as income or output (Alquist and Coibion 2014). To analyze the impact of shocks on economic activity in China as well as the rest of the world, the model uses industrial production indices for these entities.[1]

Figure 3.3.1. Contribution to Commodity Price Declines
(Percent)



Sources: Haver Analytics; IMF, Primary Commodity Price System; and IMF staff calculations.
Note: The figure shows the cumulative contributions of shocks to the cumulative change in actual commodity prices, based on a historical decomposition.
[1]Actual price declines show the change in the common factors, based on the indicated set of commodity prices.

Figure 3.3.1 shows the results of a decomposition of changes in a broad index of commodity prices, as measured by the common factor in these prices, from May 2011, when most commodity prices peaked. The results are for two specifications of the FAVAR model. The first uses a common factor based on all 42 commodity price series, while the second is based on 40 nonfuel prices.[2]

The figures show that up to December 2013, most of the broad decline in commodity prices could be attributed to the unexpected slowing of growth in the rest of the world. Subsequently, the unexpected growth slowdown in China was also a contributing factor. The contribution from China was larger for nonfuel commodity prices, to which it contributed about half of the general decline through August 2015. For all commodity prices including fuels, slowing growth in China accounted for about one-third of the decline in prices between mid-2011 and mid-2015.

As a caveat: the contributions are based on broad indices of commodity prices. They should thus be seen as average contributions. For individual commodities, the contributions can be larger or smaller, depending on the importance of China in the markets for these commodities. For metals, for example, the FAVAR model

This box was prepared by Thomas Helbling.
[1]The main identifying assumptions are that common shocks to commodity prices do not affect economic activity in the same months, and that spillovers to activity from shocks to activity in either China or the rest of the world are smaller than the direct domestic impact. The assumptions allow for the possibility that shocks to activity can influence commodity prices concurrently through the expectation channel.
[2]Alquist and Coibion (2014) note that fuels tend to be a common input into the production of other commodities, which could result in the common factor being influenced by oil shocks.

Box 3.3 *(continued)*

suggests larger contributions from China's growth slowdown. Another caveat is that the analysis does not explicitly consider changes in the composition of aggregate demand. For this reason, results tend to be sensitive to the time period. One should also keep in mind that supply developments are often thought to be more commodity-specific. As such, the fluctuations in broad commodity price indices might lead to an underestimation of the contribution of supply factors to commodity price declines. This can also be seen in the fact that the cumulative declines in the broad indices are smaller than the declines in the prices of a few major commodities where supply shocks have been relatively more important (for example, crude oil or iron ore).

Annex 3.1. Econometric Analysis of Advanced Upstream Economies

An initial specification for estimating onshoring, using value-added trade data, is as follows (equation 1):

$$d\ln FVA_{i,CHN,s,t} = \alpha + \beta d\ln VA_{CHN,s,t} + \gamma d\ln VA_{CHN,s,t} \times \text{int}_{i,s,t} + \theta X_{i,j,s,t} + \delta_{i,t} + \tau_t + \varepsilon_{i,s,t} \quad (1)$$

where:

- $d\ln$ is the log difference in two different periods, 2000–05 and 2005–11
- $FVA_{i,j,s,t}$ is the foreign value added from country i to country j in period t and sector s
- $VA_{j,t,s}$ is the ratio of total value added to production in country j in period t and sector s
- $X_{i,j,s,t}$ includes other controls: $dTariffs_{i,j,s,t}$ and $d\ln Exp_{All,World,s,t}$ are changes in bilateral tariffs at the sector level and changes in total world exports in sector s
- $\text{int}_{i,s,t}$ is a dummy that captures characteristics of i,j,s or t depending on the specification.

In other words, we estimate whether sectors in which China is growing more competitive (as proxied by increasing Chinese production) are also those in which advanced economy exports to China are declining. Using value-added data, which are available for 62 countries, allows for a matching of production and trade that is difficult with gross data. A major disadvantage, however, is that the value-added data are available only with a substantial lag, with the last observations pertaining to 2011. Also, the value-added data are available only at the two-digit International Standard Industrial Classification (ISIC) level, and at such a high level of aggregation we will be biased toward finding complementarities between Chinese and foreign production. Other factors, such as differences in price dynamics across goods, can also drive in part the behavior of large and heterogeneous sectors.

The results suggest that China is becoming a competitor for upstream countries (Annex Table 3.1.1). While there are complementarities in the precrisis period 2000–05, this gives way to competition in the latest period. Moreover, competition is strongest in high-technology, knowledge-intensive, and more complex goods.

We complement the analysis with an alternative specification using gross trade data for 180 countries. This allows us to examine more recent data (from 2000 through 2014) at the five-digit level. Here we proxy China's competitiveness in a sector by its exports in that sector, and again ask whether rising competitiveness has reduced upstream countries' exports to China (equation 2):

$$d\ln Exp_{i,CHN,s,t} = \alpha + \beta d\ln Exp_{CHN,World,s,t} + \gamma d\ln Exp_{CHN,World,s,t} \times \text{int}_{i,s,t} + \theta X_{i,j,s,t} + \delta_{i,t} + \tau_t + \varepsilon_{i,s,t} \quad (2)$$

where:

- $d\ln$ denotes the log difference in two different periods, 2000–07 and 2010–14
- Controls and interactions are the same as in equation (1)
- $Exp_{i,s,t}$ are gross exports from country i to country j in period t and five-digit level product s.

Using the specification in equation (2) to test for onshoring is likely an inappropriately demanding test.[1] The gross trade data, at the five-digit level, are much more granular than the former data. There may be many goods for which China has developed the competence to produce, but either chooses to continue importing those parts domestically or is not sufficiently competitive in their manufacturing to be able to compete overseas, given trade costs, while being competitive at home. It would be better to use a measure of production in China as a proxy for competitiveness, but matching production and gross trade data at that level of detail is difficult.

Still, the gross trade results are broadly consistent with those obtained from the value-added data (Annex Table 3.1.2). Here too, China's imports

[1]The main results referenced in the text focusing on interaction terms are robust to changes to the period of analysis and the time window over which variables are measured.

Annex Table 3.1.1. Onshoring Regressions Using Value-Added Data

Dependent Variable: China's foreign value added from country *i*	(1)	(2)	(3)	(4)
China's value added	0.142***	–0.008	0.005	0.063***
	(3.506)	(–0.511)	(0.306)	(3.006)
China's value added (latest period)	–0.158***	0.052***	0.034**	0.002
	(–2.645)	(2.850)	(2.418)	(0.114)
Interaction for medium-low-technology goods		–0.072		
		(–1.411)		
Interaction for medium-high-technology goods		0.117***		
		(4.896)		
Interaction for high-technology goods		0.209***		
		(4.505)		
Interaction for medium-low-technology goods (latest period)		0.146*		
		(1.875)		
Interaction for medium-high-technology goods (latest period)		–0.138***		
		(–4.283)		
Interaction for high-technology goods (latest period)		–0.856***		
		(–5.152)		
Interaction for capital-intensive goods			–0.002	
			(–0.057)	
Interaction for knowledge-intensive goods			0.215***	
			(4.273)	
Interaction for capital-intensive goods (latest period)			–0.035	
			(–0.762)	
Interaction for knowledge-intensive goods (latest period)			–0.348***	
			(–3.762)	
Interaction for good complexity				0.273***
				(4.583)
Interaction for good complexity (latest period)				–0.614***
				(–4.227)
Number of observations	160	160	160	160
R-squared	0.390	0.786	0.571	0.613

Source: IMF staff estimates.
Note: *t*-statistics in parentheses, standard errors clustered at good/country-pair/time level. Controls included but omitted from table: bilateral tariffs and world export growth at the product level, and relevant dummies when including interaction terms. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

from advanced upstream countries are falling most where China's competitiveness is rising fastest, and the effect is again only present in the later part of the sample period. Another common result is that competition is present particularly in relatively high-technology, knowledge-intensive products, but it does not appear to vary systematically with the complexity of goods (which was the case in the estimates based on value-added data). Interestingly, the complementarity between China and upstream countries in the beginning of the sample is not present in the gross trade data, unlike the value-added data, which may be explained by the higher level of aggregation in value-added data.

Finally, a third equation, using gross trade data, is estimated to analyze China's growing competition with advanced economies in third markets (equation 3):

$$\begin{aligned} d\ln Exp_{i,j,s,t} = {} & \alpha + \beta d\ln Exp_{CHN,j,s,t} + \gamma d\ln Exp_{CHN,j,s,t} \\ & \times \text{int}_{i,j,s,t} + \theta X_{i,j,s,t} \\ & + \delta_{i,t} + \delta_{j,t} + \tau_t + \varepsilon_{i,j,s,t} \end{aligned} \tag{3}$$

where:

- $d\ln$ is the log difference in two different periods, 2000–07 and 2010–14
- Controls and interactions are the same as equation extended to trade partner country *j*

Annex Table 3.1.2. Onshoring Regressions Using Gross Trade Data

Dependent Variable: Gross exports to China from country *i*	(1)	(2)	(3)	(4)
China's gross exports to the world	0.018	–0.091*	–0.098*	–0.014
	(0.586)	(–1.658)	(–1.770)	(–0.416)
China's gross exports to the world (latest period)	–0.140***	–0.057	–0.054	–0.134**
	(–2.721)	(–0.718)	(–0.673)	(–2.331)
Interaction for medium-low-technology goods		0.088		
		(1.594)		
Interaction for medium-high-technology goods		0.119**		
		(2.148)		
Interaction for high-technology goods		0.359***		
		(3.501)		
Interaction for medium-low-technology goods (latest period)		–0.035		
		(–0.350)		
Interaction for medium-high-technology goods (latest period)		–0.173*		
		(–1.788)		
Interaction for high-technology goods (latest period)		–0.346**		
		(–2.114)		
Interaction for capital-intensive goods			0.090	
			(1.618)	
Interaction for knowledge-intensive goods			0.159***	
			(2.940)	
Interaction for capital-intensive goods (latest period)			–0.037	
			(–0.367)	
Interaction for knowledge-intensive goods (latest period)			–0.154*	
			(–1.666)	
Interaction for good complexity				0.031
				(1.237)
Interaction for good complexity (latest period)				–0.034
				(–0.648)
Number of observations	5,183	5,183	5,183	5,090
R-squared	0.349	0.354	0.352	0.352

Source: IMF staff estimates.
Note: *t*-statistics in parentheses, standard errors clustered at good/country-pair/time level. Controls included but omitted from table: bilateral tariffs and world export growth at the product level, and relevant dummies when including interaction terms. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

- $Exp_{i,j,s,t}$ are gross exports from country *i* to country *j* in period *t* and five-digit level product *s*.

Here we are seeking to analyze whether China is threatening upstream economies not only by reducing its own imports from those countries, but also by competing with them in other markets. We thus estimate whether sectors in which China's exports to any given country *j* have risen are also sectors in which advanced upstream economies *i* have seen their exports falling. If so, we would conclude that there is competition.

We find evidence that China is increasingly competing with advanced economies in third markets (Annex Table 3.1.3). Results are remarkably consistent with the findings for onshoring. The competitive effect is present more for the Germany and the United States than for the Asian advanced upstream exporters (column 1) and is only statistically significant in the postcrisis period 2010–14. In third markets, however, China's competition is increasingly felt in medium-technology and capital-intensive goods rather than in higher-technology or knowledge-intensive goods, as was the case for onshoring. This finding is consistent with the intuition that, with China moving up the value chain and producing increasingly complex goods, there are levels of technology and complexity at which China is unable to compete in export markets even though it is able to substitute for imports.

Annex Table 3.1.3. Third Market Regressions Using Gross Trade Data

Dependent Variable: Gross exports *i* to *j*	(1)	(2)	(3)	(4)	(5)
China's gross exports to *j*	–0.006*	0.034***	–0.014	–0.013	0.024***
	(–1.751)	(8.664)	(–1.579)	(–1.505)	(5.227)
China's gross exports to *j* (Asian advanced economies)	0.059***				
	(9.689)				
China's gross exports to *j* (latest period)		–0.045***	0.008	0.008	–0.024***
		(–7.197)	(0.578)	(0.509)	(–3.134)
Interaction for medium-low-technology goods			0.046***		
			(4.502)		
Interaction for medium-high-technology goods			0.058***		
			(6.463)		
Interaction for high-technology goods			0.042***		
			(3.863)		
Interaction for medium-low-technology goods (latest period)			–0.064***		
			(–3.486)		
Interaction for medium-high-technology goods (latest period)			–0.062***		
			(–4.054)		
Interaction for high-technology goods (latest period)			–0.045**		
			(–2.472)		
Interaction for capital-intensive goods				0.046***	
				(4.418)	
Interaction for knowledge-intensive goods				0.053***	
				(5.775)	
Interaction for capital-intensive goods (latest period)				–0.064***	
				(–3.434)	
Interaction for knowledge-intensive goods (latest period)				–0.056***	
				(–3.594)	
Interaction for good complexity					0.016***
					(4.405)
Interaction for good complexity (latest period)					–0.033***
					(–5.247)
Number of observations	139,705	139,705	139,705	139,705	139,261
R-squared	0.089	0.088	0.091	0.091	0.090

Source: IMF staff estimates.
Note: t-statistics in parentheses, standard errors clustered at good/country-pair/time level. Controls included but omitted from table: bilateral tariffs and world export growth at the product level, and relevant dummies when including interaction terms.
*** p<0.01, ** p<0.05, * p<0.1.