CHAPTER 3

THE PRICE OF CAPITAL GOODS: A DRIVER OF INVESTMENT UNDER THREAT?

Over the past three decades, the price of machinery and equipment has fallen dramatically relative to other prices in advanced and emerging market and developing economies alike. Could rising trade tensions, a slowing pace of trade integration, and sluggish productivity growth threaten this potential driver of investment going forward? This chapter sets out to answer this question by documenting key patterns in the price of capital goods, its drivers, and its impact on real investment rates. Worldwide, investment growth has slowed considerably since the global financial crisis of 2008–09. Yet, when compared with its levels in the early 1990s, real investment in machinery and equipment as a share of real GDP has increased significantly. The chapter finds that the decline in the relative price of tradable investment goods has provided sizable impetus to the rise in real investment rates in machinery and equipment over the past three decades. The broad-based decline in the relative price of machinery and equipment, in turn, has been driven by faster productivity growth in the capital-goods-producing sector and rising trade integration. Yet, emerging market and developing economies still face higher relative prices of tradable investment goods, consistent with their higher policy-induced trade costs and lower productivity in the tradable goods sector. Taken together, the chapter's findings provide an additional, often overlooked, argument in support of policies aimed at reducing trade barriers and reinvigorating international trade. The analysis also highlights the importance of continued technological progress to maintain the pace of decline in relative capital goods prices, which has provided an important tailwind to investment around the world.

Introduction

The investment needs of most emerging market and developing economies remain substantial. These economies still have only a small fraction of the capital available in advanced economies, even though their investment rates have increased significantly over the past three decades, with a near doubling of real investment rates in machinery and equipment (Figure 3.1, panels 1–2). Meeting the United Nations Sustainable Development Goals would require a sizable boost to investment in many low-income developing countries (Gaspar and others 2019). High investment rates have been a key reason for significantly higher growth in emerging market and developing economies than in advanced economies since the early 2000s, which has helped narrow income gaps. The assumption of continued strength in investment in emerging market and developing economies underpins the projection that they will grow faster than advanced economies in the medium term (Figure 3.1, panels 3–4).[1]

The capital deepening in emerging market and developing economies over the past three decades has coincided with sizable declines in the price of investment goods and, in particular, of tradable capital goods, such as machinery and equipment, relative to other prices in the economy (Figure 3.1, panels 5–6).[2] Economists have long hypothesized that the relative price of investment is one of the key drivers of investment rates and therefore economic development.[3] The decline in relative investment prices, in turn, is often attributed to faster

The authors of this chapter are Weicheng Lian, Natalija Novta, Evgenia Pugacheva, Yannick Timmer, and Petia Topalova (lead), with support from Jilun Xing and Candice Zhao, and contributions from Michal Andrle, Christian Bogmans, Lama Kiyasseh, Sergii Meleshchuk, and Rafael Portillo. The chapter benefited from comments and suggestions by Andrei Levchenko and Maurice Obstfeld.

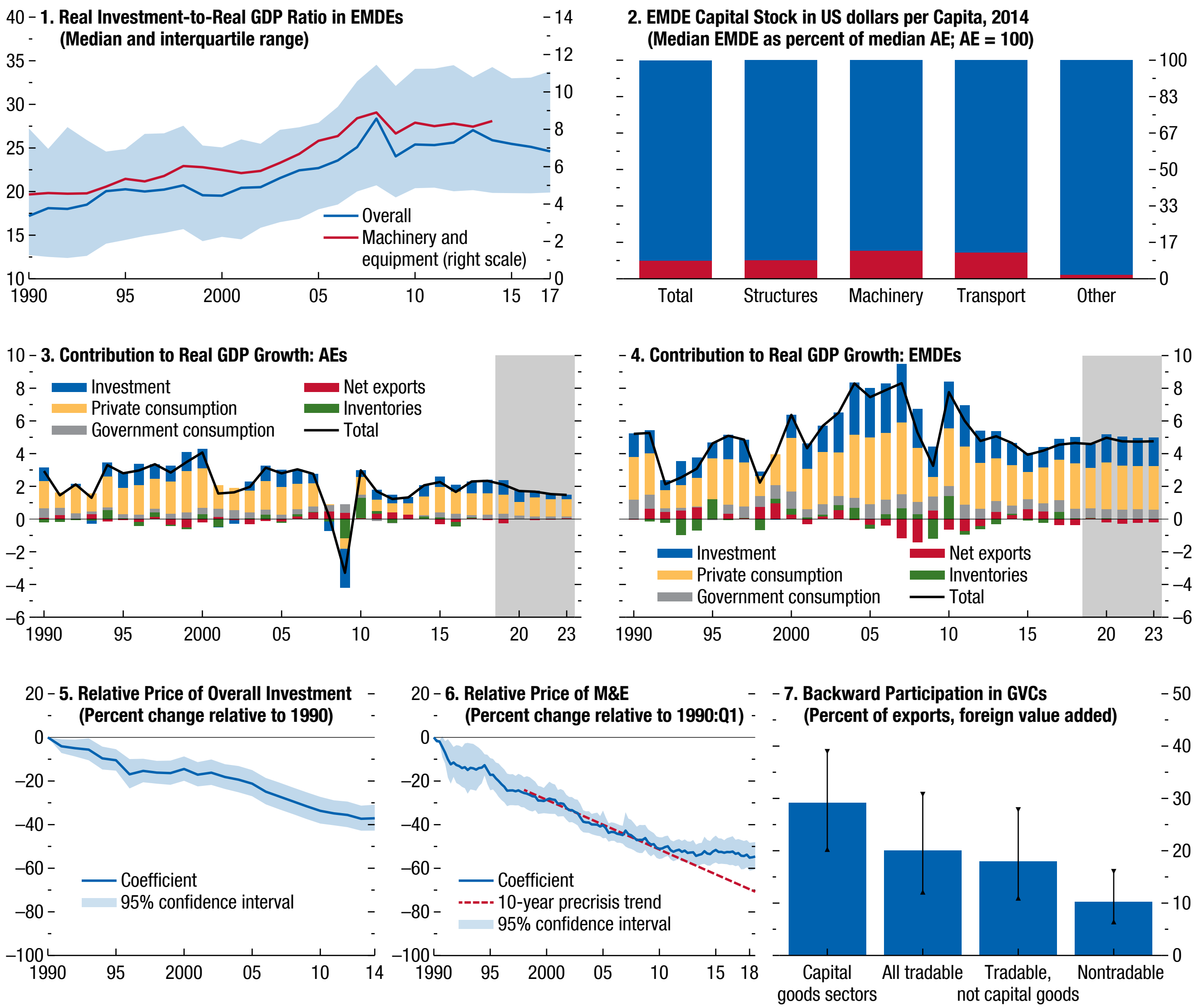
[1]Advanced economies experienced a similar increase in real investment rates in machinery and equipment until the 2008 global financial crisis. For an analysis of the investment slump in these economies in the aftermath of the global financial crisis, see Chapter 3 of the April 2015 *World Economic Outlook* (WEO).

[2]In this chapter, the relative price of investment refers to the ratio of the price of investment to the price of consumption. All stylized patterns and findings are qualitatively similar if the price of investment is instead compared with the overall GDP price level. The capital deepening also occurred in the context of improved macroeconomic policy and institutional frameworks, a synchronized pickup in economic activity until the global financial crisis, and falling global real interest rates.

[3]See, for example, DeLong and Summers (1991, 1992, 1993); Sarel (1995); Collins and Williamson (2001); Hsieh and Klenow (2007); Armenter and Lahiri (2012); and Mutreja, Ravikumar, and Sposi (2018). The relative price of investment goods tends to be inversely related to investment or per capita growth (Jones 1994; Sarel 1995; Restuccia and Urrutia 2001), and high relative investment prices likely serve as a headwind to the structural transformation many low-income developing countries need to converge to advanced economies' income levels. High tariffs on imported equipment, part of many developing economies' import-substitution growth strategies in the 1970s and 1980s, have often been cited as an important impediment to development (Taylor 1998a; Sen 2002; Estevadeordal and Taylor 2013; Johri and Rahman 2017).

Figure 3.1. Capital Stock, Investment, and the Relative Price of Capital Goods
(Percent, unless noted otherwise)

Real investment-to-real GDP ratios increased substantially in emerging market and developing economies over the past three decades, but capital stocks per capita remain very low. The rise in real investment-to-real GDP ratios coincided with large declines in the price of machinery and equipment relative to the price of consumption, with production of machinery and equipment being strongly embedded in global value chains.



Sources: Eora Multi-Region Input-Output (MRIO) database; Haver Analytics; Penn World Table (PWT) 9.0; World Economic Outlook (WEO) database; and IMF staff calculations.
Note: Panel 1 shows the median and interquartile range of the overall real investment-to-GDP ratio (from WEO) and real investment in machinery and equipment to real GDP ratio (from PWT 9.0). Panels 3 and 4 show contributions to real GDP growth for advanced economies and emerging market and developing economies, respectively, based on WEO historical data and projections. In panels 5 and 6, the solid line plots year (quarter) fixed effects from a regression of log relative prices on year (quarter) fixed effects and country fixed effects to account for entry and exit during the sample period and level differences in the overall investment price relative to the price of consumption. Year (quarter) fixed effects are normalized to show percent change from the relative investment prices in 1990 (1990:Q1). Shaded areas indicate 95 percent confidence intervals. The relative price of investment is obtained by dividing the investment deflator by the consumption deflator. For further details, see Online Annex 3.1. The figure in panel 6 is based on quarterly data from select advanced economies, including: Australia, Canada, Germany, Hong Kong SAR, Italy, Norway, Portugal, Spain, United Kingdom, United States. Panel 7 depicts the median and interquartile range of the sector's backward global value chain participation (defined as the foreign value added in exports) across all economies in the Eora MRIO database deemed to have sufficient data quality at the sectoral level during 1995–2015. AEs = advanced economies; EMDEs = emerging market and developing economies; GVCs = global value chains; M&E = machinery and equipment.

growth in the productivity of sectors that produce capital goods than in sectors producing consumption goods and services, linked in part to advances in information technology. Efficiency gains from globalization and the associated specialization of production around the world have also supported the downward trend in capital goods prices because the production of machinery and equipment is strongly embedded in global value chains (Figure 3.1, panel 7). As emerging market and developing economies have become increasingly integrated into the world economy and have reduced barriers to trade, they have been able to benefit from, and contribute to, this engine of economic expansion, thus further reducing the relative prices of tradable capital goods.

Could this potential driver of investment come under threat going forward? The slowdown in global trade, the potential maturation of global value chains, and the waning pace of trade liberalization since the mid-2000s, as discussed in Chapter 2 of the October 2016 WEO, may limit further declines in the price of investment. Even more immediate is the threat from higher trade barriers in some advanced economies, which could jeopardize the benefits from free trade—taken for granted for so long in these economies. Hikes in tariffs and nontariff barriers could disrupt cross-border supply chains and, by making production less efficient, slow or even reverse the downward trend in capital goods prices. Even if not directly involved in the current trade tensions, many emerging market and developing economies stand to lose if the disputes escalate. As net importers of capital goods, they may face higher prices of machinery and equipment and, more broadly, diminished opportunities to benefit from the cross-border spread of knowledge and technology brought on by globalization (see Chapter 3 of the April 2018 WEO).

Sluggish productivity growth in advanced economies—a concern even before the global financial crisis—poses another threat to further declines in capital goods prices. Productivity in the world's leading capital-goods-producing economies has slowed further, with the global financial crisis leaving lasting scars on research and development spending and technology adoption (see Adler and others 2017 and Chapter 2 of the October 2018 WEO). Aging and the rise of market power in some of the main capital-goods-producing economies (see Chapter 2 of the April 2019 WEO) also cast a shadow on the innovation and continued technological advances that may be needed to spur further decline in the price of investment goods. The pace of decline in the relative price of machinery and equipment has already slowed considerably in advanced economies in the past decade, potentially exerting an additional drag on these economies' lackluster investment since the global financial crisis (Figure 3.1, panel 6).

With this backdrop in mind, the chapter examines several interrelated questions.[4]

- How have prices of investment goods evolved over time and across countries? Do lower-income countries face higher capital goods prices, in absolute terms and/or relative to other prices in the economy?
- What drives the price of tradable capital goods over time, and which factors explain differences across countries? How much have technological advances and trade integration contributed to the relative decline in the prices of machinery and equipment? To what extent are capital goods prices shaped by policy choices, particularly barriers to trade?
- How responsive is investment in machinery and equipment to the price of these assets? How much have changes in capital goods prices contributed to capital deepening over the past three decades?

The chapter's main findings are as follows:

- The relative price of tradable investment goods, namely machinery and equipment, has declined across advanced, emerging market, and developing economies over the past three decades. The declines have been significant and have been driven by faster productivity growth in capital goods production and deepening trade integration.
- Yet, the most recently available data on the price of comparable baskets of machinery and equipment across countries suggest that, in 2011, emerging market and developing economies faced higher machinery and equipment prices, both in absolute terms and especially relative to the price of consumption. The higher relative prices of machinery and equipment reflect these economies' lower relative efficiency in producing investment goods and tradable goods more broadly, and significantly higher trade costs, such as those arising from higher tariffs.
- Finally, model simulations and empirical evidence suggest that the relative price of investment goods is an important driver of real investment rates. There has been a slowdown in investment worldwide since the global financial crisis. Yet, over the past 30 years,

[4]In this chapter, unless otherwise noted, the terms tradable capital goods, tradable investment goods, and machinery and equipment are used interchangeably to denote tangible tradable investment goods—namely, machinery, equipment, and transportation capital goods.

real investment in machinery and equipment as a share of real GDP has increased significantly in both advanced as well as emerging market and developing economies. A nontrivial share of this increase can be attributed to the decline in the relative prices of machinery and equipment.

Taken together, the findings of this chapter provide an additional, often overlooked, argument in support of policies aimed at reducing trade costs and reinvigorating international trade. Many emerging market and developing economies still maintain trade barriers that raise the relative price of capital goods for domestic investors. An effort to remove these barriers would provide further impetus for investment in tradable capital goods and support the capital deepening needed in many of these economies, helping to counterbalance headwinds from abroad. Advanced economies, whose real investment—recent weakness notwithstanding—has been similarly supported by declining prices of capital goods, should also guard against protectionist measures that raise trade costs. For both groups of economies, reviving the process of trade liberalization, which has slowed down significantly since the mid-2000s, is vital for maintaining the pace of decline in relative capital goods prices. The impetus this would provide to real investment would come on top of the well-known welfare and productivity gains from international trade (for a discussion, see IMF/WB/WTO 2017).

The analysis in this chapter also highlights the importance of continued technological advances and innovation in capital goods production in advanced and emerging market and developing economies alike. Such advances, by lowering the relative price of investment goods, could generate dividends beyond their effect on aggregate productivity growth. As discussed in Adler and others (2017) and Chapter 2 of the April 2016 *Fiscal Monitor*, policies that stimulate research and development, entrepreneurship, and technology transfer, alongside continued investment in education and public infrastructure, can help.

The Price of Capital Goods: Key Patterns

Over Time

Since the 1990s, capital goods prices relative to consumption prices have displayed two key patterns.[5]

First, the relative prices of the four main types of fixed capital assets—structures, machinery and equipment (excluding transportation), transportation equipment, and intellectual property products—have evolved quite differently (Figure 3.2, panels 1–4). According to data in the Penn World Table version 9.0 across 180 countries, the prices of machinery and equipment and transportation equipment have declined significantly since the early 1990s when compared with the consumption deflator.[6] On one hand, the relative price of machinery and equipment fell by about 60 percent in advanced and 40 percent in emerging market and developing economies. The price of residential and nonresidential structures, on the other hand, has more closely tracked consumption prices and, in advanced economies, has even increased since the mid-2000s in relative terms. The price of other investment, which consists mostly of intellectual property products, such as research and development and computer software and databases, has also come down, although more modestly than for tangible tradable investment goods. Finally, the dramatic decline in the relative prices of computing equipment (such as computer hardware, whose prices fell by 90 percent since 1990) and, to a lesser extent, communications equipment (whose prices fell by almost 60 percent), within the machinery and equipment asset type (Figure 3.2, panels 5–7), supports the hypothesis that advances in information technology have played an important role in driving down the relative price of investment.[7] Zooming in on the price of green capital goods, Box 3.1 documents large declines in the cost of installing and operating low-carbon electric generation capacity for some renewable energy sources over the past decade.

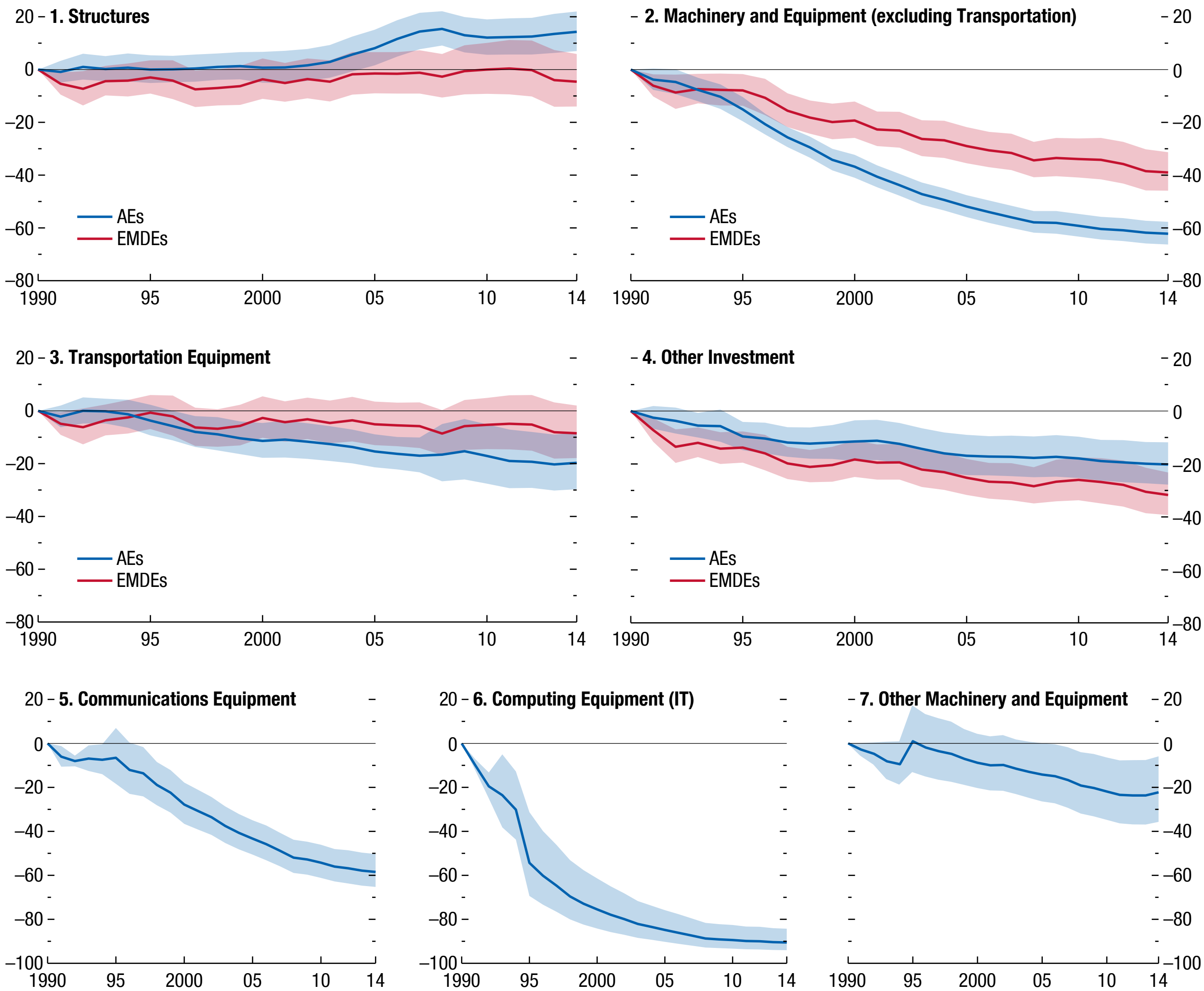
[5]See Online Annex 3.1 for country coverage, data sources, and variables definitions. All annexes are available at www.imf.org/en/Publications/WEO.

[6]The pace of decline in the relative price of tangible tradable capital goods accelerated significantly in the 1990s, especially for the emerging market and developing economy country group, as discussed in Online Annex 3.2. Recent data from 10 advanced economies suggest that the rate of decline in the relative price of machinery and equipment has slowed since the global financial crisis. Online Annex 3.2 provides additional stylized facts on the evolution of investment rates across types of fixed capital assets and country groups and the composition of investment across types of capital.

[7]Measuring changes in the prices of goods that undergo substantial quality improvements, such as computers, communications equipment, and so on, is a daunting task because of the difficulty of comparing products with very different attributes (Schreyer 2002). Statistical offices make substantial efforts to accurately reflect these changes in price indices, although methodologies likely differ significantly across countries. The chapter relies on the data provided by national authorities and compiled in Penn World Table 9.0.

Figure 3.2. Dynamics of Relative Prices across Types of Capital Goods and Broad Country Groups
(Percent change relative to 1990)

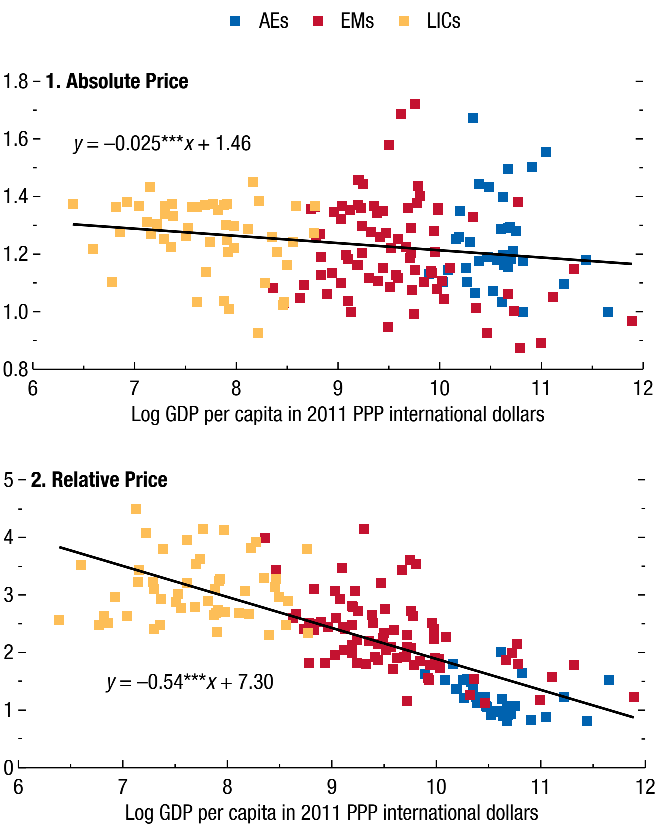
The decline in the relative price of investment was driven by a broad-based decline in the relative price of machinery and equipment. Within tangible tradable capital goods, computing and communications equipment experienced the largest price declines.



Sources: EU KLEMS; Penn World Table 9.0; World KLEMS; and IMF staff calculations.
Note: Panels 1–4 use data from the Penn World Table 9.0 capital detail file, while panels 5–7 use data from the EU and World KLEMS databases. The relative price of investment (for each type of capital good) is obtained by dividing the relevant investment deflator by the consumption deflator. The solid line plots year fixed effects from a regression of log relative prices on year fixed effects and country fixed effects to account for entry and exit during the sample period and level differences in relative prices. Year fixed effects are normalized to show percent change from the relative investment prices in 1990. Shaded areas indicate 95 percent confidence intervals. Other investment incudes intellectual property investment, such as research and development. AEs = advanced economies; EMDEs = emerging market and developing economies. IT = information technology.

Figure 3.3. Absolute and Relative Prices of Machinery and Equipment across Countries in 2011
(Ratio)

Relative to the price of consumption, the prices of machinery and equipment are significantly higher in emerging market and developing economies than in advanced economies. Lower-income countries also face marginally higher absolute prices of machinery and equipment.



Sources: International Comparison Program (ICP) 2011; *World Economic Outlook*; and IMF staff calculations.
Note: The absolute price of machinery and equipment is the price level of machinery and equipment relative to its US level, derived by the ICP using a similar basket of products across countries. The relative price is the price of machinery and equipment relative to the price of consumption. See Online Annex 3.1 for a detailed description of country coverage, data sources, and methodology. AEs = advanced economies; EMs = emerging market economies; LICs = low-income countries; PPP = purchasing power parity. ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Second, the decline in the relative price of *tangible tradable* investment goods (namely, machinery and capital equipment and transportation equipment) is widespread. Compared with the early 1990s, by 2014, the price of machinery and equipment has declined relative to the consumption deflator in all advanced economies, 87 percent of emerging market economies, and 68 percent of low-income developing countries. In contrast, trends in the relative price of structures are very different across broad country groups.

Across Countries

Despite the broad-based decline in the relative price of tradable capital goods over time, the prices of these goods vary substantially across countries, especially relative to the price of consumption. According to the latest data from the International Comparison Program (ICP), which collects prices of comparable baskets of goods and services across countries, the absolute price of machinery and equipment in 2011 was inversely related to countries' development levels, with lower-income countries facing slightly higher prices than advanced economies. The same basket of machinery and equipment costs about 8 percent more in the median low-income country than in the median advanced economy. The difference between advanced economies and lower-income countries is particularly striking for the price of machinery and equipment relative to the countries' consumption price level, with the price in the median low-income country being 2.7 times the price in the median advanced economy (Figure 3.3).[8] Online price data from a global retailer of electronic goods, such as computers, cellular phones, and tablets, across a sample of 27 advanced and emerging market economies, reveal a similar pattern, as discussed in Box 3.2.

The dramatic and widespread changes in the relative prices of capital goods over the past three decades, against a backdrop of large cross-country differences in these relative prices at a particular point in time, raise a number of questions. How significant is the relative price of capital goods for countries' real investment rates? What are the drivers of the relative prices of tradable investment goods? What is required for the downward trend in these prices to continue? And, if the relative price of capital goods is indeed important for real investment, what can lower-income countries

[8]Comparable cross-country data on the price of capital goods are extremely scarce. The key source is the ICP, which collects detailed price data through cross-country surveys every 5–10 years. Using data from the 1985 and 1996 ICP rounds, Eaton and Kortum (2001) and Hsieh and Klenow (2007) find a strong negative correlation between relative investment prices and the level of development, similar to findings in this chapter. At the same time, they find little correlation between absolute prices of capital goods and per capita GDP. As argued by Alfaro and Ahmed (2009), the absence of a correlation may be attributed to data quality issues, which were largely addressed by methodological improvements in the 2011 ICP round (Feenstra, Inklaar, and Timmer 2015; Deaton and Aten 2017). Mutreja and others (2014) demonstrate that the smaller dispersion in absolute prices does not necessarily imply the absence of large trade costs.

do to bring down the price of capital goods relative to the price of consumption in their economies?

The Relative Price of Capital Goods: A Simple Framework

Theoretically, the importance of the relative price of investment in investment decisions is not hard to establish. As economic agents decide how to allocate their limited resources between consuming today and investing in machinery and equipment that will increase their future output, the price at which they can trade consumption goods for capital goods will be among the key influences of that choice (see, for example, Sarel 1995 and Restuccia and Urrutia 2001 for a simple theoretical framework). All else equal, a decline in the price of capital goods relative to other prices in an economy would make it more attractive for agents to invest than to consume and hence lead to higher real investment rates (in other words, a higher ratio of real investment to real output).[9] Of course, investment decisions, which hinge on a comparison between the user cost of capital and its marginal product, are influenced by many other factors, such as expectations of economic prospects, the availability and cost of finance, the quantity of capital already in use relative to the desired capital stock, the rate of depreciation of capital goods, agents' impatience, and the like.

The relative price of capital goods, in turn, is shaped by several factors. Of prime importance is the efficiency with which an economy can produce machinery and equipment (or other tradable goods that it can exchange for investment goods) compared with the efficiency in other sectors.[10] In countries that import a significant fraction of investment goods (as in many emerging market and developing economies), the relative price of machinery and equipment also reflects prices that international suppliers charge for these goods and other factors that drive a wedge between international and domestic prices. These factors include transportation costs, the efficiency of the domestic distribution sector, import tariffs, customs regulations, and the time and cost associated with the logistics of importing goods. Tax policies, such as accelerated depreciation, investment tax credits, and subsidies, as well as the extent of corruption (see Chapter 2 of the April 2019 *Fiscal Monitor*), also influence the relative investment price.[11]

Guided by this simple framework, the chapter proceeds to examine empirically the key sources of differences in the relative prices of tradable capital goods across countries and the factors underpinning the dramatic declines in the relative price of machinery and equipment over time. In the subsequent section, the importance of changes in the relative prices of capital goods for real investment rates and output is quantified using model simulations and empirical analysis of country and sectoral data.

Drivers of Relative Investment Prices

Across Countries

Determining which factors explain the observed differences in the absolute and relative prices of tradable capital goods in the 2011 ICP data is a daunting task. Because price levels of capital goods that bear comparison across countries are available only at one point in time, it is difficult to disentangle the causal contribution of various potential drivers. The chapter examines each potential source of differences in capital goods prices across countries—namely, the prices charged by key exporters, trade costs, and relative efficiency in the production of tradable goods—and relates these to the relative price of capital goods from the 2011 ICP data.

To assess whether differences in prices charged by key capital goods exporters can explain the higher relative prices of capital goods observed in emerging market and developing economies (compared with advanced economies), the chapter examines highly disaggregated data on trade in capital goods. Given that a small number of countries account for the bulk of global exports of machinery and equipment (Figure 3.4, panels 1–2), and given that most emerging market and developing econo-

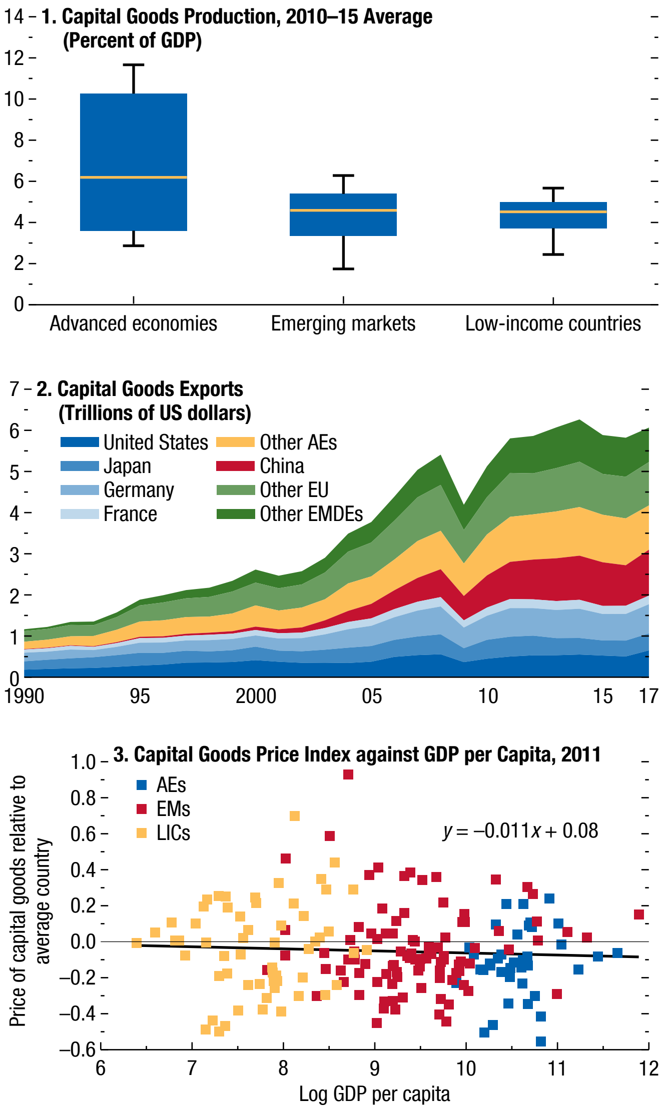
[9]In a closed economy, where investment goods are produced only domestically, the relationship between the relative price of capital goods and investment is less clear cut, as discussed in Foley and Sidrauski (1970).

[10]Hsieh and Klenow (2007) presents a simple two-sector model that delivers these patterns for relative prices, under the assumption that markups, factor intensities, and factor prices are equal across sectors. The relative productivity in the production of capital goods across countries is conceptually tightly linked to countries' relative efficiency in the production of all tradable goods, including tradable consumer goods (the well-known Balassa-Samuelson effect).

[11]See Estevadeordal and Taylor (2013) for the role of tariffs; Sarel (1995) for the role of taxes; and Justiniano, Primiceri, and Tambalotti (2011) for investment-specific technology shocks that would affect relative sectoral productivity. Cross-country differences in the relative prices of capital have been emphasized as an important factor explaining the lack of capital flows from rich to poor economies, as discussed in Caselli and Feyrer (2007).

Figure 3.4. Unit Values of Tradable Capital Goods across Countries

A relatively small number of advanced economies and China account for a large share of global production and exports of capital goods. Unit values of capital goods exports by five major exporters are not systematically correlated with the per capita income of the importing country.



Sources: Eora Multi-Region Input-Output database; Eurostat; Ministry of Finance of Japan; UN Comtrade database; US Census Bureau; and IMF staff calculations.
Note: Panel 1 shows the cross-country distribution of the average 2010–15 production of capital goods as percent of GDP, using Eora sectors 9 and 10 to identify capital goods. The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles; and the black markers denote the top and bottom deciles. Panel 2 uses Comtrade SITC Revision 2, sector 7, to plot overall capital goods exports of the identified countries. Panel 3 uses export data for major capital goods exporters. For more details on data sources and methodology, see Online Annex 3.3. AEs = advanced economies; EMs = emerging market economies; EMDEs = emerging market and developing economies; EU = European Union; LICs = low-income countries.

mies import a significant proportion of these goods, unit values of various types of machinery and equipment from five of the largest capital goods exporters—the United States, China, Germany, France, and Japan—are compared across importing countries.[12] This approach, which builds on Alfaro and Ahmed (2009), ensures the cross-country comparability of capital goods, given that quality differences within such narrowly defined products sourced from the same exporter are likely minimal.[13] It also permits isolating the differences in the price charged by exporters from other sources of cross-country price variation that are reflected in the ICP data, such as trade, transportation, delivery, and installation costs paid by buyers and discounts that may be available to them.

The analysis uncovers little systematic correlation between the price of capital goods and the per capita income of the importing country when trade data from the five large capital goods exporters are pooled (Figure 3.4, panel 3). Trade costs, on the other hand, exhibit a clear pattern: they tend to be much lower for advanced economies.[14] Despite significant progress in liberalizing the international exchange of goods and services and reducing trade costs, emerging markets, and especially low-income developing countries, still have significantly higher policy-related barriers to trade than advanced economies, in addition to their larger natural trade barriers (Figure 3.5). They tend to be located farther from capital goods exporters and are less connected to global shipping networks. They impose significantly higher tariffs on imports of capital goods, and the time and cost associated with the logistics of importing goods—such as documentary and border compliance and domestic transportation—are substantially higher. Countries with higher trade costs in any of these measures tend to have higher absolute prices of machinery and equipment in the 2011 ICP data (Figure 3.6, panel 1).

[12]While exports of capital goods continue to be concentrated in a few countries, emerging market and developing economies have gained significant market share, accounting for about one-third of global exports in 2016, up from 5 percent in 1990. China has played a particularly prominent role, with its share in global exports rising from 1–2 percent in the 1990s to 18 percent in 2017.

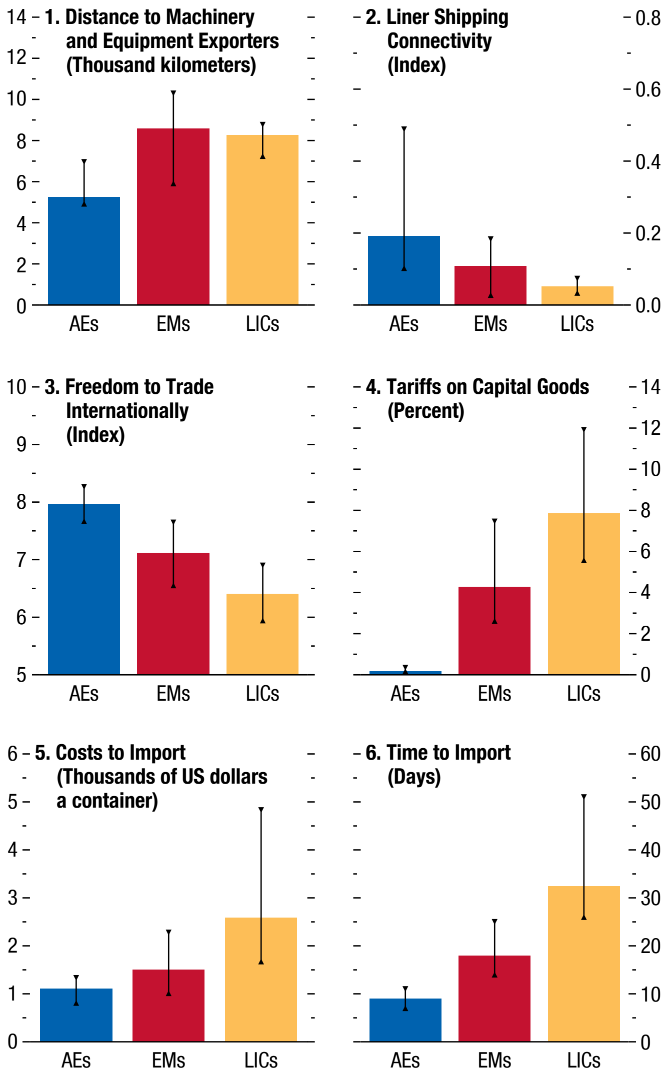
[13]In particular, the analysis relates the unit value of each product to the importing country's per capita GDP, controlling for exporter-product-year fixed effects, similar to Schott (2004), Alfaro and Ahmed (2009), and Manova and Zhang (2012). See Online Annex 3.3 for details on the specification and findings.

[14]Data limitations prevent examination of the potential contribution of tax policies, such as accelerated depreciation or investment tax credits.

Figure 3.5. Trade Costs in 2011

(Median and interquartile range)

Trade costs are higher in emerging market and developing economies.

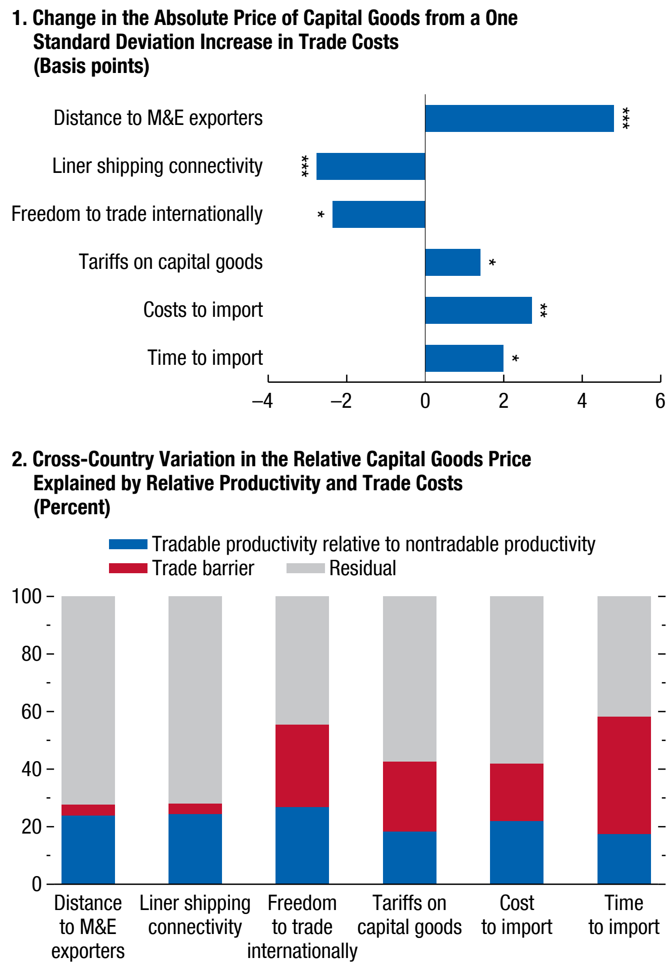


Sources: CEPII, GeoDist database; Eora Multi-Region Input-Output database; Feenstra and Romalis (2014); Fraser Institute; United Nations Conference on Trade and Development (UNCTAD); World Bank, Doing Business Indicators; and IMF staff calculations.

Note: Distance to exporters of machinery and equipment is calculated as the weighted average of a country's distance to all other countries, where the weights are equal to the partner countries' exports of capital goods as a share of global capital goods exports. The UNCTAD liner shipping connectivity index captures how well countries are connected to global shipping networks based on five components of the maritime transport sector: number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's port. The Fraser Institute's Freedom to Trade Internationally index is based on four different types of trade restrictions: tariffs, quotas, hidden administrative restraints, and controls on exchange rate and the movement of capital. The cost and time indicators measure the cost (excluding tariffs) and time associated with three sets of procedures—documentary compliance, border compliance, and domestic transport—within the overall process of importing a shipment of goods. AEs = advanced economies; EMs = emerging market economies; LICs = low-income countries.

Figure 3.6. Trade Costs, Relative Productivity, and the Price of Capital Goods in 2011

The absolute price of machinery and equipment in 2011 was higher in countries with larger trade costs. Trade costs and labor productivity in the tradable versus the nontradable sector can together explain a significant share of the cross-country variation in the relative price of machinery and equipment.



Source: IMF staff calculations.

Note: Panel 1 depicts the percent change in the 2011 International Comparison Program (ICP) absolute price of machinery and equipment associated with a one standard deviation increase in alternative measures of trade costs, based on estimates in Online Annex Table 3.4.1. In panel 2, the cross-country variation in the 2011 ICP price of machinery and equipment relative to consumption is decomposed into the share explained by differences in the labor productivity in the tradable goods sectors relative to the nontradable goods sectors, and alternative measures of trade costs, based on estimates in Online Annex Table 3.4.2. See notes to Figure 3.5 for definitions and sources of trade costs. M&E = machinery and equipment.

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Putting all the pieces together as outlined in the conceptual framework, the chapter next examines the contribution of efficiency in the production of tradable goods relative to efficiency in the nontradable sector, as well as alternative measures of trade costs' contribution to the cross-country variation in the relative prices of capital goods.[15] As shown in panel 2 of Figure 3.6, relative productivity differences in the production of tradable goods and trade costs can together explain up to 60 percent of the cross-country variation in the relative price of machinery and equipment, depending on which measure of trade cost is used.[16] Interestingly, policy-related trade barriers, such as tariffs and cost and time of importing, are a more powerful predictor of relative prices than are natural barriers to trade, such as distance and connectivity. While causal interpretation is difficult in the cross-country setting and, in light of the likely relationship between relative productivity and trade barriers, these findings are consistent with the idea that the relative prices of capital goods are higher in emerging market and developing economies due both to higher trade barriers and lower productivity in the production of capital goods and tradable goods more broadly.[17]

[15]The chapter estimates a simple ordinary least squares regression of the log of the relative price of machinery and equipment (using ICP 2011 data) on the log of the relative labor productivity in the tradable-goods-producing sectors and alternative measures of trade costs, which are included one at a time. In a second step, the regression estimates are used to decompose the variation in the log of relative prices into the variance that can be explained by the relative productivity measure versus trade costs. Given the cross-sectional nature of the data, this analysis is purely illustrative. As elaborated in the next section, relative productivity and trade costs are not independent of one another, complicating the interpretation of their estimated contribution to the variation in relative prices. The relative productivity in the tradable goods sector may be affected by trade barriers, as production of tradable goods likely relies on imported inputs. Furthermore, policy-related trade barriers may be erected with the goal of protecting low-productivity tradable goods sectors. See Online Annex 3.4 for further details on the specification and findings.

[16]Given the high correlation among different components of trade costs, including all of the measures considered in the same regression does not significantly increase the share of variation in relative prices that can be explained by trade costs.

[17]Sposi (2015) similarly argues that trade barriers play an important role in explaining the relative price of tradable goods and services across countries, noting that removing trade barriers would eliminate more than one-half of the observed gap in relative prices between rich and poor countries.

Over Time

While cross-country variation in relative capital goods prices has been the focus so far, this section aims to shed light on the drivers of the big declines in the relative prices of tradable capital goods seen in most countries over the past 30 years. The analysis attempts to disentangle the roles of technological progress—which may have boosted productivity of the capital goods sectors—and deepening trade integration. To do so, it follows a two-step approach. First, sectoral producer price data across 40 advanced and emerging market economies during 1995–2011 from the World Input-Output Database are analyzed to estimate the elasticity of producer prices to changes in sectoral labor productivity and exposure to international trade (as measured by import penetration—the ratio of imports to domestic value added). The analysis controls for all factors that affect prices equally across sectors within a country in a particular year (such as exchange rate fluctuations and policies, commodity price changes, aggregate demand and productivity shocks, and the like) and all time-invariant differences in prices across countries and sectors.[18] Given the endogenous nature of trade exposure, the analysis isolates changes in import penetration that were triggered by policy choice, by using import tariffs as an instrument.[19] Second, the estimated elasticities are combined with the change in relative labor productivity and trade exposure of the capital goods sector to estimate how much each factor can account for the decline in the relative prices of machinery and equipment during 2000–11. Recognizing that exposure to foreign competition affects relative domestic prices indirectly through its impact on sectoral productivity, the decomposition attempts to separate out the contributions made by trade-related changes in labor productivity and changes in productivity due to other factors (such as sectoral technological advances) in the decline in the sectoral price of machinery and equipment.[20]

[18]See Online Annex 3.5 for further details. The analysis relies on producer prices due to their availability for a wide range of sectors and countries. All sectoral variables are measured relative to their economy-wide equivalent.

[19]While widely used in the literature, the choice of tariffs as an instrument for trade integration does not fully address endogeneity concerns as policymakers may set tariff rates in response to various political economy considerations.

[20]For evidence on the productivity-enhancing effects of trade reforms, see, among others, Amiti and Konings (2007); Topalova and Khandelwal (2011); and Ahn and others (2019).

Table 3.1. Sectoral Producer Prices

	Relative Producer Prices			Relative Productivity
	OLS	OLS	IV	IV
Dependent Variables:	(1)	(2)	(3)	(4)
Relative Import Penetration$_{t-1}$	–0.135***	–0.107***	–0.574***	1.363***
	(0.033)	(0.037)	(0.163)	(0.363)
Difference for Capital Goods Sectors		–0.191**	0.033	1.407**
		(0.081)	(0.322)	(0.671)
Relative Productivity$_{t-1}$	–0.316***	–0.314***	–0.328***	
	(0.035)	(0.035)	(0.032)	
Number of Observations	16,077	16,077	16,077	16,077
R^2	0.62	0.62	0.56	0.91
Relative Import Penetration for Capital Goods Sectors		–0.298***	–0.541*	2.770***
		(0.071)	(0.287)	(0.564)

Source: IMF staff calculations.
Note: All regressions include country-year and country-sector fixed effects. Standard errors clustered at the country and sector level are in parentheses. Difference for capital goods sectors refers to the interaction term between import penetration and a dummy indicating whether a sector produces capital goods. IV = instrumental variable; OLS = ordinary least squares. See Online Annex 3.5 for details.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

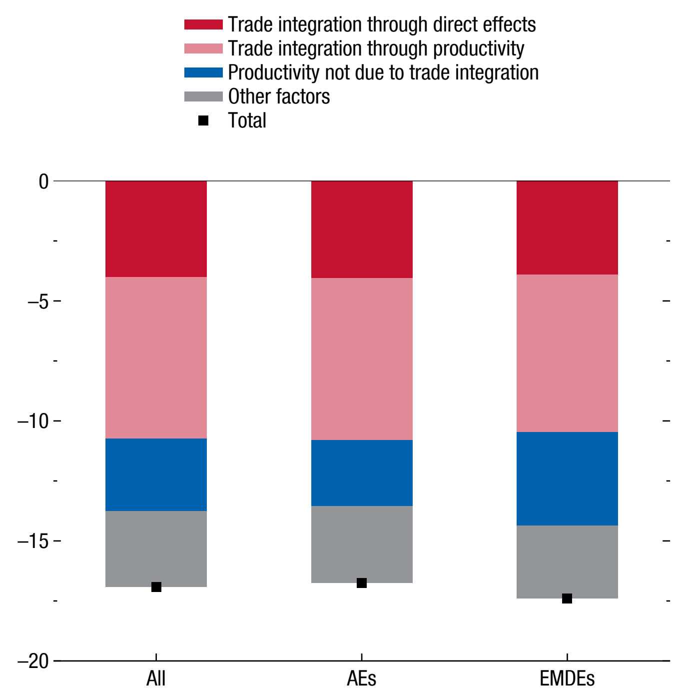
The econometric analysis (details of which can be found in Online Annex 3.5 and Table 3.1) confirms that both greater exposure to trade and faster productivity growth lead to lower domestic producer prices. A 1 percent increase in the import ratio, which can be achieved by a 0.7 percentage point cut in tariffs, reduces the sectoral producer price by about 0.5 percent. Changes in labor productivity also have a significant impact on producer prices, with a 1 percent increase in sectoral labor productivity reducing producer prices by about 0.3 percent. Confirming findings of other studies, the analysis also uncovers a strong positive effect of policy-induced changes in import penetration on labor productivity at the sector level (Table 3.1, column 4). Labor productivity of the capital-goods-producing sector is particularly sensitive to deepening trade integration—a finding consistent with the larger reliance on global value chains for the production of these goods (Figure 3.1, panel 7).[21]

Figure 3.7 decomposes the decline in the relative price of the machinery and equipment producing sectors relative to the price of consumption between 2000 and 2011 into four parts: (1) the direct effect of deepening trade integration; (2) the effect of trade integration through higher labor productivity; (3) the effect of higher labor productivity, which is not due to

[21]These results suggest that, if low-income countries were to bring capital goods tariffs to the level of those in advanced economies (in other words, they reduce tariffs by roughly 8 percentage points), the price of investment goods would decline by about 16 percent (with roughly 40 percent of the decline coming from the direct trade integration effect and the rest coming from higher productivity in the capital goods sector due to greater import competition).

Figure 3.7. Contributions to Changes in Relative Producer Prices of Capital Goods: 2000–11
(Percent)

The decline in the price of capital goods relative to the price of consumption has been supported by faster labor productivity growth and deepening trade integration.



Source: IMF staff calculations.
Note: The figure combines the estimated elasticities of producer prices to trade integration and relative labor productivity from Table 3.1 and changes in these factors for the capital goods sector between 2000 and 2011 to compute their contribution to the observed change in the producer price of capital goods relative to the price of consumption. See Online Annex 3.5 for a detailed description of country coverage, data sources, and methodology. AEs = advanced economies; EMDEs = emerging market and developing economies.

deepening trade integration; and (4) a residual. Deepening trade integration accounts for the bulk of the decline in relative prices of machinery and equipment, both through its direct effect on producer prices and, indirectly, through higher labor productivity of domestic capital goods producers. Productivity gains in the capital-goods-producing sectors, which cannot be directly linked to trade integration, are also a significant factor.

The empirical exercise also suggests that a nontrivial portion of the decline in the price of investment goods, especially in emerging market and developing economies, can be attributed to other factors. These could include the downward trend in world interest rates, financial liberalization, and the emergence of China as a key supplier of tradable investment goods over this period (see Figure 3.4, panel 2 and Online Annex 3.3).[22]

Macroeconomic Implications of Shocks to the Price of Capital Goods

The last section of this chapter aims to quantify the relevance of relative investment prices for macroeconomic outcomes. How much does the relative price of capital goods matter for a country's real investment rate? What share of the dramatic increase in machinery and equipment investment over the past 30 years can be attributed to the decline in the relative price of these goods? To answer these questions, the analysis relies both on model-based explorations and on empirical evidence.[23]

As discussed in Box 3.3, analysis of the macroeconomic effects of the relative price of investment within a structural model is insightful as it captures the aggregate effect of exogenous changes in relative investment prices in a general equilibrium environment, which accounts for all feedback mechanisms in the economy. Moreover, given that relative prices within an economy are endogenously determined, model simulations make it possible to isolate changes in these prices that are driven by specific exogenous shocks. As a result, their effects on investment rates and other macroeconomic outcomes can be credibly traced. Using the IMF's Global Integrated Monetary and Fiscal model, the analysis reveals that both shocks to the relative productivity of the investment-goods-producing sector and tariff cuts that permanently lower the price of capital goods imports lead to sizable and long-lasting increases in the real investment rate in a representative emerging market economy. Shocks that result in a 1 percent decline in the price of investment relative to consumption lead to a roughly 0.8 percent increase in the ratio of real investment to real GDP in the medium term.[24] Guided by these findings, the empirical analysis sets out to examine whether the model predictions are reflected in the historical relationship between the relative prices of machinery and equipment and real investment rates, at both the country and sectoral levels.

Cross-Country Empirical Evidence

The cross-country analysis relies on over 60 years of data across 180 advanced and emerging market and developing economies from the latest release of the Penn World Table database. Using a reduced-form framework, the analysis relates real investment in machinery and equipment as a share of a country's real output and the price of machinery and equipment relative to the price of consumption. The analysis controls for all global shocks (for example, global financial conditions, commodity price changes, uncertainty, and world economic prospects), all time-invariant country characteristics, and a host of other country-specific and time-varying factors shown by economic theory and previous studies to shape investment rates. These include proxies for the availability and cost of finance within each country, the strength of economic prospects, exposure to global markets and commodity price fluctuations, and the quality of institutions and infrastructure. The estimation is based on five-year averages to smooth out cyclical fluctuations and approximate more closely the medium-term relationship between the relative price and investment rate uncovered in the structural model simulations.

Estimation results, detailed in Online Annex 3.6, confirm that real investment rates are shaped by

[22]Capital-goods-producing sectors tend to be more capital intensive than other sectors in developing economies. Hence, easier access to financing may benefit capital goods production more than other sectors, contributing to a decline in the relative price of investment.

[23]As discussed in the conceptual framework, investment decisions are shaped by numerous factors. A comprehensive analysis of the relative importance of all potential factors is beyond the scope of this chapter. The goal of the analysis is to zoom in on the relative price as a potential driver of real investment rates and attempt to provide suggestive evidence of its quantitative importance.

[24]For an average emerging market and developing economy with a ratio of real investment to real output of about 22 percent, this finding would imply that a 1 percent decline in the relative price of investment would lead to an increase in the investment rate to 22.2 percent.

Table 3.2 Real Investment Rate and the Relative Price of Machinery and Equipment

Dependent Variable: Log Real Investment-to-GDP Ratio	Cross-Country Regressions All (1)	Post-1990 (2)	EMDEs (3)	Sectoral Regressions (4)	(5)
Log Relative Price	–0.377***	–0.292*	–0.491***	–0.326***	–0.528***
	(0.116)	(0.171)	(0.161)	(0.078)	(0.068)
Number of Observations	658	553	457	971	971
Number of Countries	127	127	93	18	18
R^2	0.41	0.36	0.38	0.94	0.93
First Stage F-Statistic	118.80	81.81	64.04	644.60	728.80

Source: IMF staff calculations.
Note: The dependent variable is log real machinery and equipment investment-to-GDP ratio. Regressions are estimated with data averaged over nonoverlapping five-year windows using instrumental variable regressions, where the main independent variable—log price of machinery and equipment relative to consumption—is instrumented with its lagged value. All cross-country panel regressions in columns (1)–(3) control for country and period fixed effects, and a set of other determinants of investment-to-GDP ratios. Sectoral regression in column (4) is estimated with country-period and country-sector fixed effects, and in column (5) with period and country-sector fixed effects, where period refers to the nonoverlapping five-year windows. Standard errors clustered at the country level are in parentheses. See Online Annexes 3.6 and 3.7 for details. EMDEs = emerging market and developing economies.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

a variety of factors. Although estimates are often imprecise, a stronger regulatory environment, higher trade and financial integration, lower-cost finance, and greater financial development—as well as better infrastructure—are all associated with a higher ratio of real investment in machinery and equipment to real output. Importantly, the analysis reveals a strong and statistically significant negative relationship between real investment in machinery and equipment and its relative price (Table 3.2). The findings are robust to alternative specifications, focusing on the post-1990 period, examining the sample of emerging market and developing economies only, and using alternative instrumental variable strategies to correct for the negative bias that may arise from potentially correlated measurement errors in the real investment rate and its price. A 1 percent decline in the relative prices of tradable capital goods is associated with a 0.3–0.5 percent increase in the real investment rate over a five-year period. It is important to note that these empirical estimates likely represent an upper bound of the true effect of changes in relative price on real investment rates. As discussed above, relative investment prices are endogenous and reflect many factors, including changes in policies that could have a direct impact on investment rates.

Sectoral Empirical Evidence

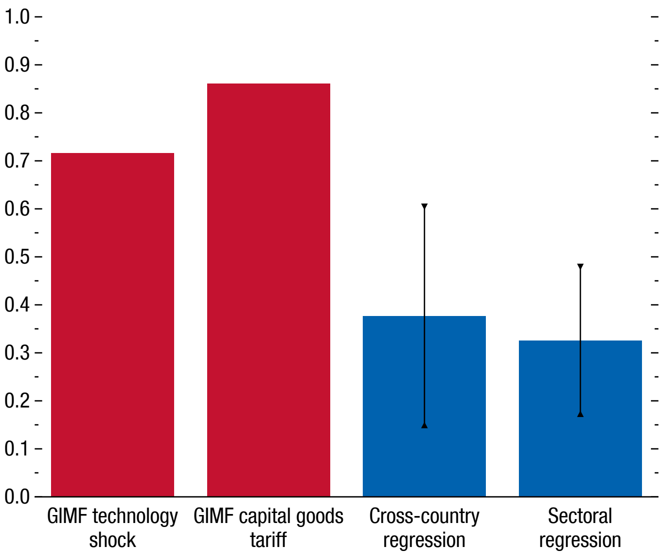
A sectoral perspective can complement the cross-country analysis in an important way. The relative price of capital goods is but one of the considerations that shape investment decisions. While the cross-country analysis attempts to control for many factors, the estimated relationship between real investment rates and prices could be biased due to the omission of factors that may correlate with relative prices but are not properly captured in the estimation. Sectoral analysis makes it possible to isolate the relationship between real investment rates and the price of investment across different sectors while properly accounting for the role of all factors that affect overall investment within a country in a particular year. These include financial conditions, economy-wide growth prospects, quality of regulations that affect investment returns, exchange rate fluctuations and policies, international capital flows, availability of complementary public infrastructure, and the like.

The analysis relies on EU and World KLEMS data covering 18 (mostly advanced) economies over 1971–2015 to construct measures of real investment in machinery and equipment and the relative prices of these capital goods specific to 15 broad economic sectors.[25] As in the cross-country analysis, the baseline estimation relates machinery and equipment investment as a share of sectoral real value added to relative prices, using five-year averages. The estimated elasticity, according to which a 1 percent decline in the relative price of machinery and equipment is associated with a 0.2–0.5 percent increase in the real investment rate in these capital goods, is comparable to those uncovered in the cross-country analysis. Further, as in the model simulations presented in Box 3.3, declining investment

[25]See Online Annex 3.7 for details.

Figure 3.8. Elasticity of Real Investment-to-GDP Ratio to Relative Price of Capital Goods: Model Simulations versus Empirical Evidence
(Percent)

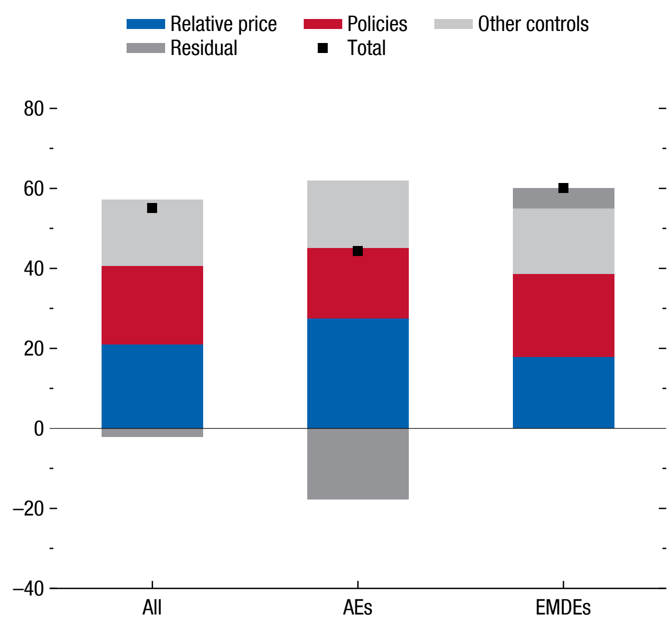
Model simulations and empirical evidence deliver broadly consistent estimates of the elasticity of the real investment-to-real GDP ratio to the relative price of capital goods.



Source: IMF staff calculations.
Note: The bars depict the simulated/estimated elasticity of the real investment-to-GDP ratio to the price of capital goods relative to the price of consumption. See Box 3.3 for details on the model, and Online Annexes 3.6–7 for details on the empirical analyses. GIMF = Global Integrated Monetary and Fiscal model.

Figure 3.9. Contributions of Relative Prices to Increases in Real Investment in Machinery and Equipment, 1990–94 to 2010–14
(Percent)

Between 1990–94 and 2010–14, real investment-to-real GDP ratios in machinery and equipment grew by approximately 60 percent. A significant portion of this increase can be explained by the precipitous fall in the relative price of machinery and equipment.



Source: IMF staff calculations.
Note: The figure presents the contribution to the observed increase in real machinery and transport equipment investment-to-GDP ratios between 1990–94 and 2010–14 from the relative price of machinery and transport equipment, various policies, and other controls. See Online Annex 3.6 for a detailed description of the estimated model. Black square indicates the total change in real machinery equipment investment-to-real GDP ratios. AEs = advanced economies; EMDEs = emerging market and developing economies.

prices are linked to higher output in the sector and marginally higher labor productivity. Analysis of firm-level data from Colombia further confirms that lower capital goods prices resulting from a sizable tariff cut following trade reform in 2011 prompted firms to boost investment (see Box 3.4).

Figure 3.8 compares the findings across the structural model, cross-country, and sectoral analyses, revealing a consistent pattern. Across all three approaches, the evidence that the relative price of capital goods matters for investment decisions is strong. It is challenging to obtain an unbiased estimate of the elasticity of real investment with regard to prices, given the endogenous nature of relative price changes and problems with measurement. With those difficulties in mind, Figure 3.9—as a purely illustrative exercise—uses the estimated elasticity from the cross-country analysis (Table 3.2) and the post-1990 change in the relative price of capital goods in each country to decompose the change in the real investment rate. These changes comprise the parts attributable to (1) the decline in real investment prices; (2) the change in relevant policies; (3) other factors, such as global trends in investment, convergence, and growth expectations; and (4) the residual. Improvements in policies and policy frameworks have contributed significantly to the rise of real investment in machinery and equipment in both advanced as well as emerging market and developing economies. The dramatic decline in the relative prices of tradable capital goods that occurred alongside can also explain a sizable share of the increase in investment in tradable capital goods in advanced and emerging market and developing economies. The anecdotal evidence presented in Box 3.1 on the rapid rise in investment in low-carbon technologies with steeper declines in production costs—and firm-level evidence from Colombia on the investment effects of arguably exogenous changes in the price of capital goods, discussed in Box 3.4—also point to relatively high price-elasticity of investment.

Summary and Policy Implications

The strengthening of investment in emerging market and developing economies over the past three decades was supported by their improved macroeconomic policy and institutional frameworks, the synchronized pickup in economic activity until the global financial crisis of 2008–09, and falling global real interest rates. But it also coincided with dramatic declines in the relative price of tradable capital goods, likely reflecting efficiency gains from international trade and advances in information and communications technology that led to more efficient production of capital goods. Could rising trade tensions, slower trade integration, and sluggish productivity growth threaten this potential driver of investment going forward?

This chapter sets out to answer this question by (1) examining whether declines in the relative prices of machinery and equipment have historically provided a quantitatively important boost to investment rates, and (2) shedding light on the drivers of the precipitous fall in the price of tradable investment goods relative to other prices in the economy.

Using both structural model simulations and empirical evidence, the chapter finds that the relative price of investment goods is an important driver of real investment rates in both advanced as well as emerging market and developing economies. The global financial crisis left lasting scars on investment worldwide. However, from a long-term perspective, real investment rates in machinery and equipment have increased significantly in both groups of economies. While exact quantification is challenging, empirical evidence suggests that a nontrivial share of the rise in the real investment rates in machinery and equipment in both groups of economies can be attributed to the dramatic fall in the relative price of these goods over the past three decades. The chapter's sectoral analysis of relative producer prices reveals that the significant decline in the price of machinery and equipment, in turn, was driven by faster productivity growth in the capital-goods-producing sector and deepening trade integration, which has bolstered price competition in domestic markets and improved the efficiency of production processes in the investment goods sector.

Taken together, the chapter's analyses suggest that the slowing pace of trade liberalization since the mid-2000s, and especially the possibility of its reversal in some advanced economies, could interfere with the tailwind to machinery and equipment investment generated by the falling price of capital goods. This finding provides an additional, often overlooked, argument in support of policies aimed at reducing trade costs and reinvigorating international trade.

Many emerging market and developing economies still maintain tariff and other trade barriers that significantly raise the relative price of investment paid by domestic investors.[26] Effective import tariffs on capital goods in 2011 were about 4 percent in emerging market and 8 percent in low-income developing countries, compared with close to zero in advanced economies (Figure 3.5, panel 4). Fully implementing commitments under the World Trade Organization's Trade Facilitation Agreement could reduce non-tariff barriers by an equivalent of a 15-percentage point tariff cut in less-developed economies (WTO 2015).

In advanced economies, which have similarly benefited from declining capital goods prices over the past three decades, avoiding protectionist measures and resolving disagreements without raising trade costs, will be crucial to prevent further weakening of the lackluster investment growth since the global financial crisis of a decade ago.[27] For all economies, reviving trade liberalization, reducing trade costs from both tariff and other barriers, and addressing areas most relevant for continued integration in the contemporary global economy—such as regulatory cooperation, e-commerce, and leveraging complementarities between investment and trade—would help maintain the pace of decline in relative capital goods prices and further spur investment. These benefits would complement the better-known welfare and productivity gains

[26]While the vast majority of emerging market and developing economies still have large investment needs, other countries (such as China) face the complex task of rebalancing growth models toward consumption and services, after decades of investment-led stimulus and policy interventions aimed at strengthening capital goods production and exports. Policy challenges are also different in some low-income developing countries where import tariffs represent a significant source of government revenue, and tariff reform would need to be accompanied by measures to compensate for revenue losses.

[27]Cavallo and Landry (2018) find that the rise in capital imports in the United States has added 5 percent to its output per hour since the 1970s, and that the imposition of tariffs on capital goods could lead to sizable productivity losses over the next decade.

from international trade (for a discussion, see Chapter 2 of the October 2016 WEO).

The analyses in this chapter also highlight the importance of continued technological advances and innovation in the capital-goods-producing sector in both advanced as well as emerging market and developing economies. By lowering the relative price of investment goods, these generate dividends beyond the effect of such advances on aggregate productivity growth. As discussed in Adler and others (2017) and Chapter 2 of the April 2016 *Fiscal Monitor,* policies that encourage research and development, entrepreneurship, and technology transfer more broadly, could also help the capital-goods-producing sector, as would continued investment in education and public infrastructure.

The economic benefits of declining capital goods prices notwithstanding, policymakers need to be mindful of their distributional consequences and potential for job disruptions. As discussed in Chapter 3 of the April 2017 WEO, the decline in the relative price of investment has eroded the share of economic output that goes to labor in economies where many jobs can be easily automated and performed by machines. Policies should be designed to help workers better cope with disruptions caused by technological progress and global integration, including through long-term investment in education, programs for skill upgrading throughout workers' careers, and policies facilitating the reallocation of displaced workers to new jobs (see IMF/WB/WTO 2017).

Box 3.1. The Price of Manufactured Low-Carbon Energy Technologies

Increasing use of renewable energy sources could help curb carbon emissions substantially—a necessary step to slow the pace of climate change, which threatens the economic future of countries across the globe (Chapter 3 of the October 2017 *World Economic Outlook*). Once considered uneconomical, in recent years, the cost of installing low-carbon electric generation capacity has declined dramatically for some renewable energy sources.[1] Between 2009 and 2017, prices of solar photovoltaics and onshore wind turbines fell most rapidly, dropping by 76 percent and 34 percent, respectively—making these energy sources competitive alternatives to fossil fuels and more traditional low-carbon sources (Figure 3.1.1).

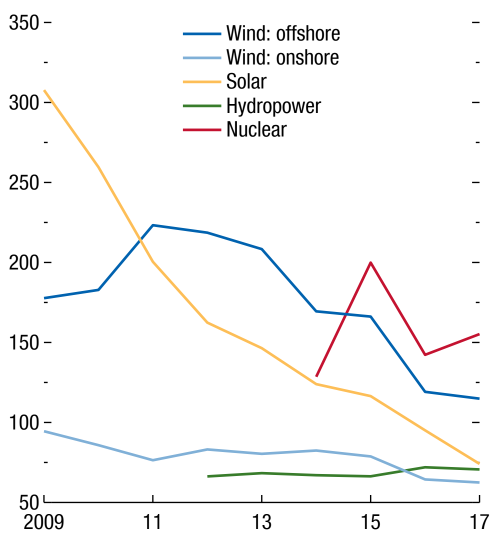
Cost reductions, coupled with favorable policies, have indeed led to a substantial increase in global renewable energy capacity, which grew by about 6.5 percent a year between 2000 and 2017 and captured more than two-thirds of global investment in new generation capacity in recent years. It is only in the past decade, however, with solar and wind emerging as cost-effective power sources, that total investment in renewable energy capacity accelerated, suggesting a strong link between investment and its relative price. While hydropower dominated renewable energy investment up to 2008, investment in wind technologies took the lead in 2009. With their relative price falling precipitously, solar photovoltaics became the most popular investment choice in 2016 (Figure 3.1.2). In 2017, more was invested in solar photovoltaics than in all other low-carbon sources combined.

However, not all low-carbon energy technologies declined in cost. Nuclear energy and hydropower costs rose by 21 percent and 9 percent, respectively, over this period. What explains these divergent price

The authors of this box are Christian Bogmans and Lama Kiyasseh.

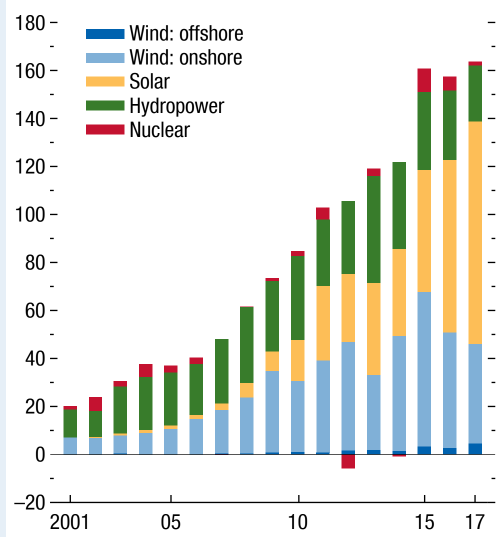
[1]This cost is typically measured by the so-called levelized cost of electricity, which measures the lifetime costs of building and operating a power plant divided by its lifetime energy production, based on recently financed projects in countries where deployment took place.

Figure 3.1.1. Levelized Cost of Electricity of Low-Carbon Energy Sources
(US dollars a megawatt hour)



Sources: Bloomberg New Energy Finance; Federal Reserve Economic Data; and IMF staff calculations.
Note: Levelized cost of electricity data has been deflated using GDP deflator and does not include subsidies and taxes.

Figure 3.1.2. Annual Additions to Global Electricity Capacity
(Thousand megawatts)



Sources: International Atomic Energy Agency; International Renewable Energy Agency; and IMF staff calculations.
Note: Solar includes solar photovoltaics and concentrated solar power. Hydropower refers to renewable hydropower and excludes pumped storage.

Box 3.1 *(continued)*

paths for energy technologies? The different trajectories of prices of machinery and equipment and those of residential and nonresidential structures (see Figure 3.2) certainly played a role. Nuclear energy and hydropower share similarities with large-scale civil engineering projects, such as the construction of bridges and railroads. Potential cost reduction for these kinds of projects is limited by the lumpiness of investment, relatively little component standardization (Sovacool, Nugent, and Gilbert 2014), construction delays (Berthélemy and Rangel 2015), and increasingly stringent—though necessary—local environmental and safety concerns.

In contrast, research and development in solar and wind technologies, their standardization, and economies of scale (through larger manufacturing plants) have resulted in increasingly efficient solar photovoltaics modules and larger wind turbines, with millions of quasi-identical experiences leading to continuous cost reductions achieved through learning by doing (Kavlak, McNerney, and Trancik 2018). Significant cost reductions in those sectors bode well for prices of electric batteries, whose production could become significantly more efficient with standardization and economies of scale and whose increased use could lastingly reduce carbon emissions, particularly those from the transportation sector.

Box 3.2. Evidence from Big Data: Capital Goods Prices across Countries

The International Comparison Project (ICP) has traditionally been the only data source for prices of comparable baskets of capital goods across countries. However, despite significant improvements, concerns about comparability across countries and methods of price collection remain. These potentially confound cross-country price comparisons (see, for example, Alfaro and Ahmed 2009; Deaton and Heston 2010; Inklaar and Rao 2017). A promising alternative is the use of big data, which allows the comparison of online prices of identical (capital) goods sold across the world. The newly available Billion Prices Project database (Cavallo, Neiman, and Rigobon 2014), used in this box, allows precisely that kind of comparison.

The analysis takes online price information for 674 distinct Apple products across 27 economies, with a monthly frequency from 2009 to 2012.[1] Normalized by US prices, the prices charged for each product sold within the same month across the 27 economies in the sample are compared.

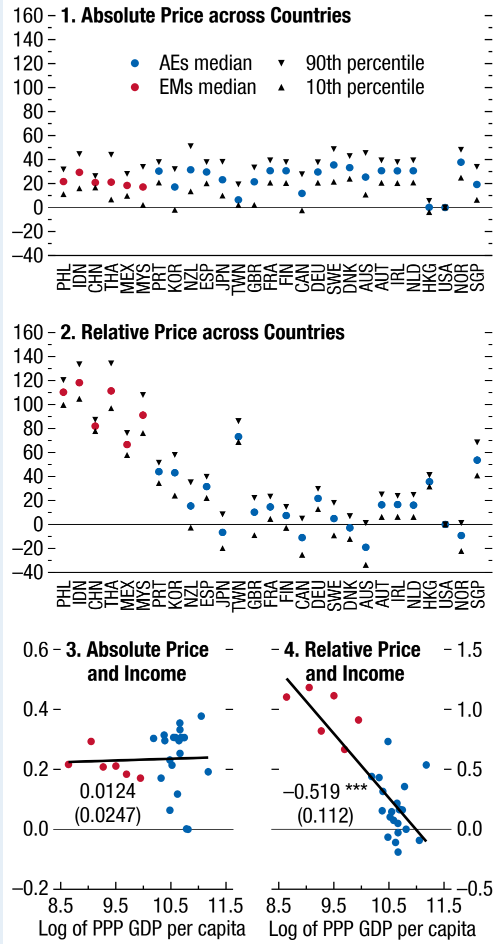
Online retail prices of identical goods across countries differ because they include markups, local taxes and subsidies, transportation costs, and tariffs and other nontariff barriers. Across the 27, mostly advanced, economies for which data are available, significant differences are observed in absolute prices of Apple products, although no clear correlation with the countries' per capita income is seen (Figure 3.2.1, panels 1 and 3). Relative to the overall GDP price level, however, the Billion Prices Project data confirm the regularity established with ICP data and reported in previous studies: the relative prices of capital goods tend to be significantly lower in richer countries (Figure 3.2.1, panels 2 and 4).

The author of this box is Jilun Xing.

[1]Product categories are, for example, MacBooks, iPhones, iPods, and cables and accessories. Product identifiers specify model, memory, storage, display size, and so on. The online price information from the Billion Price Project database is identical to the offline price of Apple products, except for shipping cost, local taxes, and store promotions (Cavallo, Neiman, and Rigobon 2014). Although Apple products could be considered consumer goods, they are increasingly used as capital goods—for example, roughly half of all iPads are bought by corporate and government users (Goel 2016).

Figure 3.2.1. Price of Apple Products and Income

(Percent)



Sources: Billion Prices Project; International Comparison Program; and IMF staff calculations.

Note: Countries on the *x*-axis in panels 1 and 2 are sorted by real GDP per capita in purchasing-power-parity international dollars. Dots denote medians of log prices for each country. Solid lines in panels 3 and 4 denote product-level regression results at monthly frequency, with product-time fixed effects, and standard errors clustered at the country level. Products sold on the website of Apple Inc. but not produced by Apple Inc. are excluded from the sample. Country labels in panels 1 and 2 use International Organization for Standardization (ISO) country codes. AEs = advanced economies; EMs = emerging markets; PPP = purchasing power parity. $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

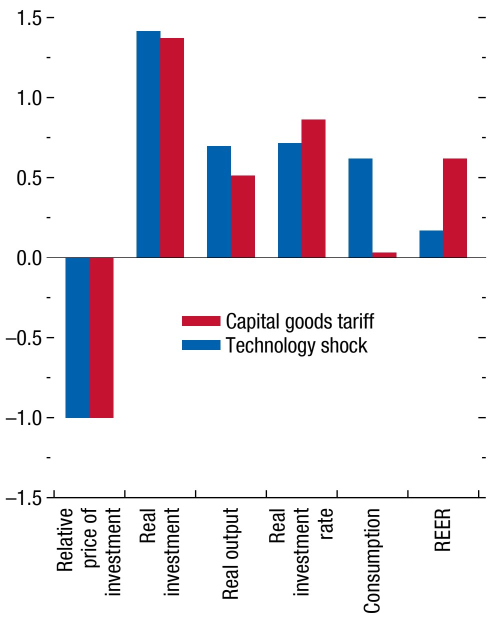
Box 3.3. On the Underlying Source of Changes in Capital Goods Prices: A Model-Based Analysis

The price of investment goods relative to other goods plays a significant role in capital accumulation. The price of investment goods in any country reflects multiple factors, such as the relative (1) price of investment goods in other, capital-goods-exporting, countries; (2) productivity of domestic investment-goods-producing sectors; (3) markups across sectors; and (4) incidence of tariffs and other trade costs. Although changes in any of these factors can affect the price of investment goods, and therefore trigger changes in capital accumulation, the macroeconomic effects may vary, depending on the underlying source of variation.

A structural model helps to formalize and quantify these possible differences. In this box, we use the IMF's Global Integrated Monetary and Fiscal model to study the medium-term macroeconomic effects—in a small emerging market economy—of two scenarios where the relative domestic price of investment goods (relative to the consumer price index) decreases. In the first scenario, the emerging market economy becomes permanently more efficient at producing new capital, in the spirit of Greenwood, Hercowitz, and Krussell (1997); in the second scenario, tariffs charged on imports of capital goods are permanently lowered.

The investment-specific technological change in the first scenario can be interpreted in several ways: greater international diffusion of technological know-how (possibly via global value chains) that disproportionately affects the production of capital (or durables more generally); lower domestic costs incurred by firms in capital goods sectors (for example, thanks to improvements in the regulatory environment); improved organizational efficiency; and so on.[1] In response, and assuming markups do not increase, firms in these sectors would lower their prices relative to the rest of the economy. The second scenario illustrates the effects of a decline in tariffs—or trade costs more broadly—on all imported capital. In this case, the decline in the overall investment price index reflects lower domestic prices of imported capital goods. Both simulations are normalized to obtain a 1 percent decline in the relative price of capital in the long term. Given the model's assumed share of capital goods imports in overall investment spending (about 33 percent), this requires a 4 percentage point permanent decline in investment goods tariffs in the second scenario, with a recurrent fiscal cost of about 0.25 percent of annual GDP.[2]

Figure 3.3.1. Model Simulations
(Deviation from the original steady state, percent)



Source: IMF staff calculations.
Note: REER = real effective exchange rate.

The medium-term impact (10 years after the shock) is presented in Figure 3.3.1. In both scenarios, the same decline in capital goods prices increases the returns to capital by similar amounts, thus triggering a similar increase in investment. The effect on output is different, however (0.7 percent of GDP and 0.5 percent of GDP, respectively). This difference is the result of a permanent increase in the efficiency of newly produced capital goods that expands the production possibility frontier of the local economy. As the economy becomes more productive, household income and consumption increase permanently.[3]

The authors of this box are Michal Andrle and Rafael Portillo.

[1]It can be argued that there is greater scope for efficiency gains in capital goods sectors in emerging markets given the greater complexity of production.

[2]The required decrease in tariffs also reflects the real exchange rate depreciation observed in this scenario.

[3]A 1 percent decrease in investment goods prices caused by a decrease in markups in the investment goods sector produces very similar effects to an increase in investment-specific productivity.

Box 3.3 *(continued)*

In the case of the decline in the tariff, there is no such initial expansion in the production possibility frontier (in the capital-goods-producing sector). The incentives to capital accumulation that come from lower capital goods prices can instead be thought of as reflecting a subsidy. Although it becomes cheaper to invest in capital projects, the tariff revenue forgone leads to a government revenue shortfall, which is resolved by lowering public transfers to households. Lower public transfers generate a headwind to private consumption. From a balance of payments perspective, higher relative demand for imports puts pressure on the real effective exchange rate to depreciate, which means an additional headwind to consumption because the domestic consumer basket becomes more expensive. As a result, there is little increase in consumption.

It is worth stressing that the supply-side effects in both scenarios are largely a result of lower investment costs. To illustrate this point, we also simulate a decrease in general tariffs equivalent in fiscal revenue terms to the investment-specific tariff decrease. In this case, there is no visible effect on the domestic relative price of investment. As a result, the increase in investment is much smaller (0.23 percent versus 1.34 percent in the investment-specific tariff scenario), as is the effect on output (0.18 percent versus 0.5 percent).

As these results emphasize, lowering barriers that hamper trade in capital goods and promoting research and development that improve efficiency in the capital goods sectors are good for output, investment, and consumption in the long term, even if they entail some fiscal costs.

Box 3.4. Capital Goods Tariffs and Investment: Firm-Level Evidence from Colombia

This box uses data from Colombia to shed light on the effect of a reduction in the price of capital goods—induced by cuts in capital goods tariffs—on firm-level investment. Given that capital goods prices within an economy are endogenously determined, it is difficult to pin down their causal effect on investment. Firm-level analysis helps overcome this issue by making use of differential, and arguably exogenous, changes in the prices of capital and other goods triggered by a substantial tariff reform in Colombia in 2011. The Colombian tariff reform aimed to simplify the tariff structure and boost economic growth (Torres and Romero 2013). Consequently, between 2010 and 2011, the average tariff rate on imported goods declined by close to 4 percentage points, from 12.5 percent in 2010 to 8.7 percent in 2011 (Figure 3.4.1).

Using an event study analysis, this box examines two different channels through which trade liberalization could affect firms' investment decisions: (1) increased competition, and (2) enhanced access to cheaper and potentially higher-quality inputs, including capital goods. While several studies have examined the productivity effect of tariff cuts through these channels (see, for example, Amiti and Konings 2007), evidence about their effect on investment is scant. The empirical approach relates the change in the firm-level investment rate before and after the tariff reform, which led to reductions in capital goods input tariffs, other input tariffs, and output tariffs. In particular, the following equation is estimated:

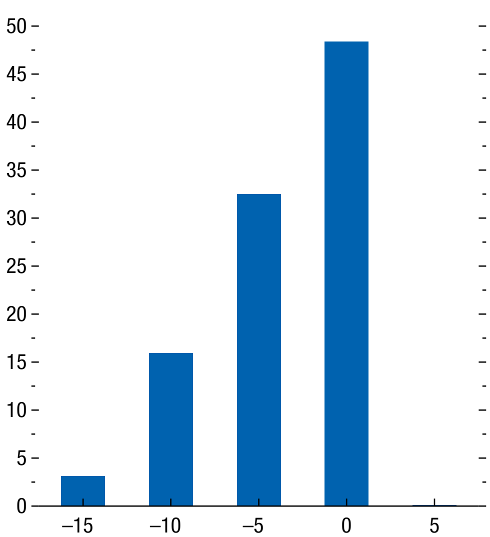
$$\begin{aligned}\Delta Investment_i = {} & \alpha + \beta_1 \Delta Capital\ Input\ Tariff_{s(i)} \\ & + \beta_2 \Delta Other\ Input\ Tariff_{s(i)} \\ & + \beta_3 \Delta Output\ Tariff_{s(i)} + \epsilon_i,\end{aligned}$$

in which $Investment_i$ is defined as investment over total fixed assets for a given firm i.[1] $Output\ Tariff_{s(i)}$

The authors of this box are Sergii Meleshchuk and Yannick Timmer.

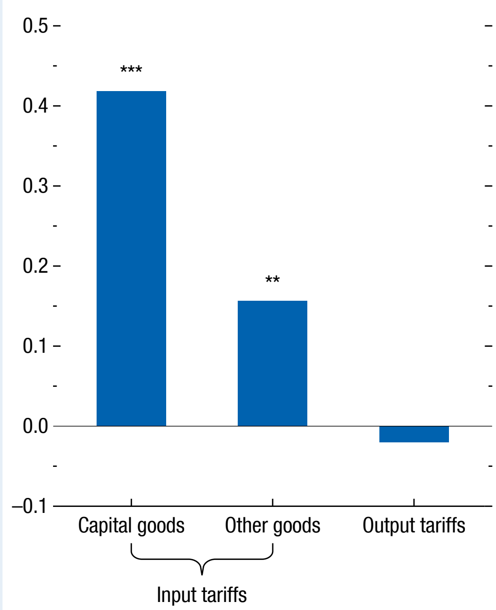
[1]The data for investment are taken from Encuesta Anual Manufacturera, an annual survey of manufacturing firms in Colombia. The data on tariffs come from Felbermayr, Teti, and

Figure 3.4.1. Distribution of Tariff Changes between 2010 and 2011
(Percent)



Sources: Meleshchuk and Timmer (2019); and IMF staff calculations.
Note: The histogram shows the change in tariffs on the *x*-axis and the percent of imported goods affected by this tariff change on the *y*-axis.

Figure 3.4.2. Effect on Investment from Cuts in Tariffs on Capital Goods Inputs, Other Inputs, and Output
(Percent)



Sources: Meleshchuk and Timmer (2019); and IMF staff calculations.
Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Box 3.4 *(continued)*

is the simple average of most-favored-nation tariffs across Harmonized System six-digit products within the 33 sectors, $s(i)$, and is meant to capture the effect of higher competition on investment rates. *Capital Input Tariff*$_{s(i)}$ and *Other Input Tariff*$_{s(i)}$ are constructed following Amiti and Konings (2007) as weighted averages of output tariffs in all capital goods and other sectors, with weights reflecting the share of inputs from each of the sectors used in the production of the sector ***s*** output, based on the 2007 input-output table. The input tariff variables capture the effect of access to cheaper inputs. Unlike earlier studies, the analysis allows for a differential investment response to cuts in the tariffs on capital goods versus other inputs.

Figure 3.4.2 shows the estimated coefficients on the three types of tariffs. A 1 percentage point reduction in capital goods input tariffs is associated with a 0.4 percentage point increase in investment, a point estimate that is statistically significant at the 1 percent level.[2] A reduction in noncapital input tariffs leads to a smaller (0.15 percentage point) yet still statistically significant increase in investment. This finding echoes the results of model simulations discussed in Box 3.3, which similarly uncover a much smaller investment response to a general tariff cut, compared with a cut in capital goods tariffs. The effect of a reduction in output tariffs is not associated with significant changes in firms' investment decisions, at least in the short term.[3]

These findings present further evidence—from a recent trade reform in a large emerging market economy—that firms' investment choices are sensitive to the price of capital goods.

Yalcin (2018). Use of fixed input-output matrices at the sector level alleviates endogeneity concerns that arise when firm-level input-output matrices are employed.

[2]The coefficients on changes in input tariffs can be interpreted as the effects of changes in prices on investment rates under the assumption that tariffs are fully passed into the prices importers pay. If there is only partial pass-through, the estimated coefficients are attenuated toward zero relative to the true effect of prices.

[3]The results are robust to including standard controls, such as firm size or sales growth. The results are presented using a one-year window, but are also robust to using a wider time window around the tariff cuts.

References

Adler, Gustavo, Romain Duval, Davide Furceri, Sinem Kilic Celik, Ksenia Koloskova, and Marcos Polawski-Ribeiro. 2017. "Gone with the Headwinds: Global Productivity." IMF Staff Discussion Note 17/04, International Monetary Fund, Washington, DC.

Ahn, JaeBin, Era Dabla-Norris, Romain Duval, Bingjie Hu, and Lamin Njie. 2019. "Reassessing the Productivity Gains from Trade Liberalization." *Review of International Economics*, 27(1): 130–54.

Alfaro, Laura, and Faisal Z. Ahmed. 2009. "The Price of Capital: Evidence from Trade Data." Harvard Business School Working Paper 07–073, Harvard Business School, Boston.

Amiti, Mary, and Jozef Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review* 97 (5): 1611–638.

Armenter, Roc, and Amartya Lahiri. 2012. "Accounting for Development through Investment Prices." *Journal of Monetary Economics* 59: 550–64.

Berthélemy, Michel, and Lina Escobar Rangel. 2015. "Nuclear Reactors' Construction Costs: The Role of Lead-Time, Standardization and Technological Progress." *Energy Policy* 82: 118–30.

Calderón, César, Enrique Moral-Benito, and Luis Servén. 2015. "Is Infrastructure Capital Productive? A Dynamic Heterogeneous Approach." *Journal of Applied Econometrics* 30 (2): 177–98.

Caceres, Carlos, Yan Carriere-Swallow, Ishak Demir, and Bertrand Gruss. 2016. "US Monetary Policy Normalization and Global Interest Rates." IMF Working Paper 16/195, International Monetary Fund, Washington, DC.

Caselli, Francesco, and James Feyrer. 2007. "The Marginal Product of Capital." *The Quarterly Journal of Economics* 122 (2): 535–68.

Cavallo, Alberto, Brent Neiman, and Roberto Rigobon. 2014. "Currency Unions, Product Introductions, and the Real Exchange Rate." *The Quarterly Journal of Economics* 129 (2): 529–95.

Cavallo, Michele, and Anthony Landry. 2018. "Capital-Goods Imports and US Growth." Bank of Canada Staff Working Paper, Bank of Canada, Ottawa.

Chinn, Menzie D., and Hiro Ito. 2006. "What Matters for Financial Development? Capital Controls, Institutions, and Interactions." *Journal of Development Economics* 81 (1): 163–92.

Collins, William J., and Jeffrey G. Williamson. 2001. "Capital Goods Prices and Investment 1879–1950." *Journal of Economic History* 61 (1): 59–94.

DeLong, J. Bradford, and Lawrence H. Summers. 1991. "Equipment Investment and Economic Growth." *Quarterly Journal of Economics* 106: 445–502.

———. 1992. "Equipment Spending and Economic Growth: How Strong is the Nexus?" *Brookings Papers on Economic Activity* (2): 157–99.

———. 1993. "How Strongly Do Developing Economies Benefit from Equipment Investment?" *Journal of Monetary Economics* 32: 395–415.

Deaton, Angus, and Bettina Aten. 2017. "Trying to Understand the PPPs in ICP 2011: Why Are the Results So Different?" *American Economic Journal: Macroeconomics* 9 (1): 243–64.

Deaton, Angus, and Alan Heston. 2010 "Understanding PPPs and PPP-Based National Accounts." *American Economic Journal: Macroeconomics* 2 (4): 1–35.

Eaton, Jonathan, and Samuel Kortum. 2001. "Trade in Capital Goods." *European Economic Review* 45: 1195–235.

Estevadeordal, Antoni, and Alan M. Taylor. 2013. "Is the Washington Consensus Dead? Growth, Openness, and the Great Liberalization, 1970s–2000s." *Review of Economics and Statistics* 95 (5): 1669–690.

Feenstra, Robert, Robert Inklaar, and Marcel Timmer. 2015. "The Next Generation of the Penn World Tables." *American Economic Review* 105 (10): 3150–182.

Feenstra, Robert, and John Romalis. 2014. "International Prices and Endogenous Quality." *Quarterly Journal of Economics* 129 (2): 477–527.

Felbermayr, Gabriel, Feodora Teti, and Erdal Yalcin. 2018. "On the Profitability of Trade Deflection and the Need for Rules of Origin." CESifo Working Paper Series 6929, CESifo Group, Munich.

Foley, Duncan K., and Miguel Sidrauski. 1970. "Portfolio Choice, Investment, and Growth." *American Economic Review* 60 (1): 44–63.

Gaspar, Victor, David Amaglobelo, Mercedes Garcia-Escribano, Delphine Prady, and Mauricio Soto. 2019. "Fiscal Policy and Development: Human, Social and Physical Investment for the SDGs." IMF Staff Discussion Note 19/03, International Monetary Fund, Washington, DC.

Goel, Vindu. 2016. "Once Taunted by Steve Jobs, Companies Are Now Big Customers of Apple." *The New York Times*, August 7.

Greenwood, Jeremy, Zvi Hercowitz, and Per Krussell. 1997. "Long-Run Implication of Investment-Specific Technological Change." *American Economic Review* 87 (3): 342–62.

Gruss, Bertrand, and Suhaib Kebhajz. 2019. "Commodity Terms of Trade: A New Database." IMF Working Paper 19/21, International Monetary Fund, Washington, DC.

Hsieh, Chang-Tai, and Peter J. Klenow. 2007. "Relative Prices and Relative Prosperity." *American Economic Review* 97: 562–85.

Inklaar, Robert, and D.S. Prasada Rao. 2017 "Cross-Country Income Levels over Time: Did the Developing World Suddenly Become Much Richer?" *American Economic Journal: Macroeconomics* 9 (1): 265–90.

International Monetary Fund, World Bank, and World Trade Organization (IMF/WB/WTO). 2017. "Making Trade and Engine of Growth for All: The Case for Trade and for Policies to Facilitate Adjustment." Policy Papers for Discussion at the Meeting of G20 Sherpas, Frankfurt, March 23–24.

Johri, Alok, and Md Mahbubur Rahman. 2017. "The Rise and Fall of India's Relative Investment Price: A Tale of Policy Error and Reform." Unpublished, McMaster University.

Jones, Chad. 1994. "Economic Growth and the Relative Price of Capital." *Journal of Monetary Economics* 34: 359–82.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti. 2011. "Investment Shocks and the Relative Price of Investment." *Review of Economic Dynamics* 14 (1): 102–21.

Karabarbounis, Loukas, and Brent Neiman. 2013. "The Global Decline of the Labor Share." *Quarterly Journal of Economics* 129 (1): 61–103.

Kavlak, Goksin, James McNerney, and Jessika E. Trancik. 2018. "Evaluating the Causes of Cost Reduction in Photovoltaic Modules." *Energy Policy* 123: 700–10.

Lim, Jamus Jerome. 2013. "Institutional and Structural Determinants of Investment Worldwide." World Bank Policy Research Working Paper 6591, World Bank, Washington, DC.

Manova, Kalina, and Zhiwei Zhang. 2012. "Export Prices across Firms and Destinations." *Quarterly Journal of Economics* 127: 379–436.

Magud, Nicolás, and Sebastián Sosa. 2017. "Corporate Investment in Emerging Markets: The Role of Commodity Prices." *Economía* 18 (1): 157–95.

Meleshchuk, Sergii, and Yannick Timmer. 2019. "Trade Liberalization and Firm Investment: Evidence from Colombia." Unpublished.

Mutreja, Piyusha, B. Ravikumar, Raymond Riezman, and Michael Sposi. 2014. "Price Equalization, Trade Flows, and Barriers to Trade." *European Economic Review* 70: 383–98.

Mutreja, Piyusha, B. Ravikumar, and Michael Sposi. 2018. "Capital Goods Trade, Relative Prices, and Economic Development." *Review of Economic Dynamics* 27: 101–22.

REN21. 2018. *Renewables 2018 Global Status Report*. Paris: REN21 Secretariat.

Restuccia, Diego, and Carlos Urrutia. 2001. "Relative Prices and Investment Rates." *Journal of Monetary Economics* 47 (1): 93–121.

Salahuddin, Mohammad, and Rabiul Islam. 2008. "Factors Affecting Investment in Developing Countries: A Panel Data Study." *The Journal of Developing Areas* 42 (1): 21–37.

Sarel, Michael. 1995. "Relative Prices, Economic Growth and Tax Policy." IMF Working Paper 95/113, International Monetary Fund, Washington, DC.

Schott, Peter. 2004. "Across-Product versus Within-Product Specialization in International Trade." *Quarterly Journal of Economics* 119 (2): 647–78.

Schreyer, Paul. 2002. "Computer Price Indices and International Growth and Productivity Comparisons." *Review of Income and Wealth* 48 (1): 15–31.

Sen, Kunal. 2002. "Trade Policy, Equipment Investment and Growth in India." *Oxford Development Studies* 30 (3): 317–31.

Shorrocks, A.F. 1982. "Inequality Decomposition by Factor Components." *Econometrica* 50 (1): 193–211.

Sposi, Michael. 2015. "Trade Barriers and the Relative Price of Tradables." *Journal of International Economics* 96 (2): 398–411.

Sovacool, Benjamin. K., Daniel Nugent, and Alex Gilbert. 2014. "Construction Cost Overruns and Electricity Infrastructure: An Unavoidable Risk?" *The Electricity Journal* 27 (4): 112–20.

Taylor, Alan M. 1998a. "On the Costs of Inward-Looking Development: Price Distortions, Growth, and Divergence in Latin America." *Journal of Economic History* 58: 1–28.

———. 1998b. "Argentina and the World Capital Market: Saving, Investment, and International Capital Mobility in the Twentieth Century." *Journal of Development Economics* 57: 147–84.

Topalova, Petia, and Amit Khandelwal. 2011. "Trade Liberalization and Firm Productivity: The Case of India." *The Review of Economics and Statistics* 93 (3): 995–1009.

Torres, Mauricio, and Germán Romero. 2013. "Efectos de la Reforma Estructural Arancelaria en la Protección Efectiva Arancelaria de la Economía Colombiana." *Cuadernos de Economía* 32 (59): 265–303.

World Trade Organization (WTO). 2015. *World Trade Report 2015: Speeding Up Trade: Benefits and Challenges of Implementing the WTO Trade Facilitation Agreement*. Geneva.