CHAPTER 4

THE DRIVERS OF BILATERAL TRADE AND THE SPILLOVERS FROM TARIFFS

The presence of large and rising bilateral trade balances has raised concerns that asymmetric obstacles to trade may distort the international trade system. This chapter examines the drivers of bilateral trade balances, distinguishing between the roles of macroeconomic factors, the international division of labor, and bilateral tariffs. It also examines how, through their impact on the ways production is organized within and across countries, tariffs affect productivity, output, and employment. Three main findings emerge. First, the evolution of bilateral trade balances since the mid-1990s reflects mostly macroeconomic forces known to determine aggregate trade balances at the country level. Second, changes in bilateral tariffs played a smaller role than macroeconomic conditions in explaining the evolution of bilateral trade balances over the past two decades, reflecting tariffs' already-low levels in many countries and the fact that reciprocal tariff reductions had offsetting effects on bilateral trade balances. But other policy distortions—such as supply policies—may have played a role. Third, declining tariffs have lifted productivity by allowing greater international division of labor and further specialization by countries, including through participation in global value chains. The integrated nature of the current trade system suggests that a sharp increase in tariffs would create significant spillovers, leaving the global economy worse off. These findings support two main policy conclusions. First, the discussion of external imbalances (of which trade balances are the largest part for most countries) is rightly focused on the macroeconomic factors—for example, fiscal policy—which tend to determine trade and current account balances at the aggregate level. Targeting particular bilateral trade balances will likely only lead to trade diversion and offsetting changes in trade balances with other partners. Second, multilateral reductions in tariffs and other nontariff barriers will benefit trade and, over the longer term, improve macroeconomic outcomes.

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Introduction

In both advanced and emerging market economies, more than 80 percent of the public views trade in a positive light—yet, fewer than half of these people are convinced that trade benefits jobs, wages, or prices. This skepticism is particularly pronounced in advanced economies.[1] These mixed views reflect the fact that the benefits of trade can come at a cost. On one hand, trade allows countries to specialize according to comparative advantage, enhances competition, and enables knowledge and technology to flow across borders, boosting the productivity and income of all countries (see, for example, Chapter 4 of the April 2018 *World Economic Outlook* (WEO)). Lower trade barriers and efficiency gains from the globalization of production have also contributed to strong declines in the relative price of capital goods, thereby contributing to drive strong real investment and narrowing income gaps for emerging market and developing economies (Chapter 3 of the April 2019 WEO). And trade benefits consumers by widening the choice and lowering the price of goods and services, especially those that account for a large share of lower-income households' consumption. On the other hand, there are serious concerns that trade can be associated with dislocations and involve costly adjustment for some groups of workers and communities. However, the overwhelming consensus of the large and still-growing empirical literature is that, on balance, open and fair trade, with lower or no tariffs or other obstacles to trade, can bring lasting net benefits to all involved if the right policies are in place to ensure that the gains are widely shared and those bearing the brunt of adjustment receive the help they deserve.[2]

In this context, the presence of large and rising bilateral trade balances has come under scrutiny, raising the question of whether they may be a sign of asymmetric obstacles to trade and pose concerns for policymakers. If, however, bilateral trade balances reflect mostly the macroeconomic forces known to determine countries'

[1]Pew Research Center spring 2018 *Global Attitudes Survey*. In emerging market economies, slightly more than half of respondents agree with the statement "trade creates jobs."

[2]See IMF (2017a) and IMF/WB/WTO (2017, 2018).

aggregate trade balances—such as fiscal policy strengthening or a weakening of demand relative to what is produced domestically—the behavior of trade at the bilateral level would be of little relevance, and the focus should be on addressing possible macroeconomic policy distortions. At the same time, the analysis of bilateral trade patterns promises insights into the economic costs that obstacles to trade, such as tariffs, could have—beyond their impact on bilateral trade balances—through their longer-term effect on the international division of labor, productivity, output, and employment.

With this in mind, the chapter aims to answer the following questions:

- What drives bilateral trade balances—specifically, what is the role of macroeconomic factors compared with tariffs and other determinants that are more micro-structural in nature and impact comparative advantage and the international division of labor?[3]
- What is the link between aggregate trade balances (and their drivers) and bilateral balances?
- What are the consequences for countries involved when bilateral tariffs are raised? And what spillovers arise for others when accounting for the presence of global value chains?

The chapter starts by examining what drives changes in bilateral trade balances, using the gravity model for bilateral trade flows. Model estimates are used to explain changes observed in bilateral trade balances, disentangling the impact of trade costs (including tariffs), the international division of labor, and macroeconomic factors. While the gravity model remains the workhorse model of the trade literature, it is worthwhile keeping certain limitations to this exercise in mind. First, the variables included in the gravity model do not capture completely all the time-invariant factors that determine the level of the trade balance between two countries. Hence, the chapter focuses on explaining changes in bilateral balances over time. Second, macroeconomic factors include all factors that determine aggregate supply and demand of a country. This includes macroeconomic policies and fundamental drivers, such as demographics, but also longer-term effects of large and persistent tariff changes and supply-side policies (for example, widespread subsidies) that are more difficult to measure systematically across countries. To give a more complete account of the role of policies, the chapter then takes a closer look at macroeconomic factors and how they are shaped by macroeconomic policies and other measurable determinants.

The second part of the chapter examines the impact of tariff changes beyond bilateral trade balances, on measures of economic activity more closely related to welfare, such as output, employment, and productivity. It highlights the role of greater supply chain connections and estimates the impact of tariffs through several channels: protection for domestic producers, effects on producers up and down the supply chain, and trade diversion. Simulations of a hypothetical tariff war scenario between the United States and China conclude the chapter, with different modeling approaches used to examine potential effects on the two economies and the spillovers on bystanders.

The findings of the chapter are as follows.

- Overall trade balances matter more than bilateral trade balances. Changes in overall (that is, aggregate) trade balances tend to affect most bilateral trade balances while—absent changes in macroeconomic conditions—a change in a bilateral trade balance tends to be offset by changes in bilateral balances with other trading partners, with little or no impact on the overall trade balance.
- The evolution of bilateral trade balances over the past two decades was, to a significant extent, driven by macroeconomic factors—specifically, the relative movement of aggregate demand and supply in both trading partners and their underlying drivers. These drivers included fundamental factors, such as demographics and the level of economic and institutional development; macroeconomic policies, in particular fiscal policy and credit cycles; and—in some cases—exchange rate policies and domestic supply-side policies (for example, subsidies to production costs).
- In contrast, changes in bilateral tariffs played a smaller role in the evolution of bilateral trade balances, reflecting their already-low starting levels in many countries and the fact that most countries reduced tariffs at the same time, creating offsetting effects on net trade. At the same time, however, the level of tariffs is an important part of bilateral trade costs, which help shape the international division of labor and, thereby, the way changing macroeconomic factors impact bilateral trade and trade balances.
- For the same reason, tariffs have important effects on productivity, output, and employment over the longer term. The decline of tariffs to lower

[3]More specifically, trade can arise from the fact that trading partners have a different sectoral composition of supply and demand, which in part reflects the international division of labor according to comparative advantage.

levels enabled a greater international division of labor—including through global value chains—and enhanced competition and access to foreign inputs, resulting in strong productivity improvements. This suggests scope for significant positive spillovers from shifts to lower tariffs, but also negative spillovers from tariff wars. Increases in bilateral tariffs will hurt output, employment, and productivity, not only in the affected economies, but also in bystanders up and down value chains. While some countries may benefit from trade diversion, higher tariffs would leave the global economy worse off.

These findings suggest two main policy conclusions. First, discussion of external balances is rightly focused on macroeconomic determinants of trade and current account balances. Changes in macroeconomic policies (for example, fiscal policy) will affect all bilateral balances. An important implication is that, unless macroeconomic conditions are addressed, targeting a particular subset of bilateral trade balances will likely result only in trade diversion and offsetting changes in trade balances with other partners. Second, broad-based, multilateral reductions in tariffs and other nontariff barriers will benefit trade and, over the longer term, improve macroeconomic outcomes. Reductions in tariffs lead to efficiency and dynamic gains by allowing countries to further specialize according to their comparative advantage, to integrate into supply chains, and improve access to foreign inputs. In contrast, higher tariffs on bilateral trade can come at significant economic cost, not only for the countries involved, but also for others. These effects are greatly amplified by global supply chains, which transmit spillovers from bilateral tariffs, affecting countries up and down the value chain. While some countries may benefit from trade diversion, negative confidence effects and tighter global financial conditions triggered by trade tensions would affect all countries negatively (Chapter 1 of the October 2018 WEO).

While these findings suggest that reducing barriers to trade would benefit the global economy, there are valid concerns about the distributional effects of trade. It is important to put in place specific policies to ensure that the gains from trade are widely shared and that those left behind are adequately protected (IMF 2017a; IMF/WB/WTO 2017, 2018). Policies to help those harmed by structural adjustment or dislocations include enhancing social safety nets in affected economies—for example, with modern income support programs and unemployment assistance programs—policies to retrain and reintegrate the dislocated groups into the labor market, and changes in tax and benefit policies to redistribute the gains from trade more evenly.

Stylized Facts

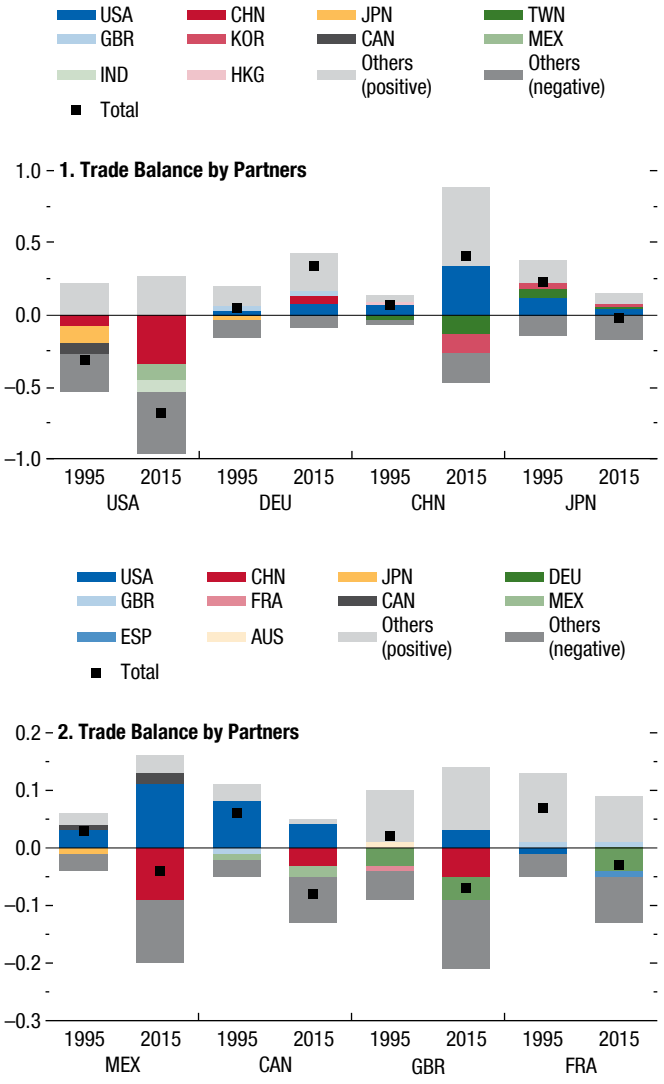
From the perspective of a single country, the overall trade balance is the sum of its bilateral trade balances, which in turn account for the difference between the values of exports and imports with each trading partner. This suggests aggregate and bilateral balances are highly related—and, indeed, for countries with large overall trade imbalances, bilateral trade balances appear to be more one-sided, either on the positive side (for example, Germany) or on the negative side (for example, the United States) (Figure 4.1). At the same time, a striking degree of variation of bilateral trade balances is apparent across trading partners: most countries have positive and negative bilateral trade balances, and even countries with small overall trade balances can have large (and offsetting) bilateral trade balances. Similar observations hold more broadly beyond the countries shown in the figure.

These stylized facts suggest that bilateral trade balances are shaped by two broad forces: (1) macroeconomic factors, more specifically countries' imbalances between aggregate domestic supply and domestic spending, as captured by their overall trade balances; and (2) tariffs and more micro-structural factors that determine varying bilateral trade intensities between two countries.

The relationship between overall and bilateral trade balances is also evident at a global level (Figure 4.2). Measured in absolute value to highlight their sizes, global bilateral and overall trade balances have evolved broadly in parallel over the past two decades, increasing strongly up to the 2008–09 global financial crisis and dipping during the crisis.[4] However, some differences can be seen, too—for example, bilateral balances increased more than aggregate trade balances and did not decline as much as aggregate trade balances after the crisis. A few countries with large overall balances, such as China, the United States, Germany, Korea, and Japan, are also big contributors to global bilat-

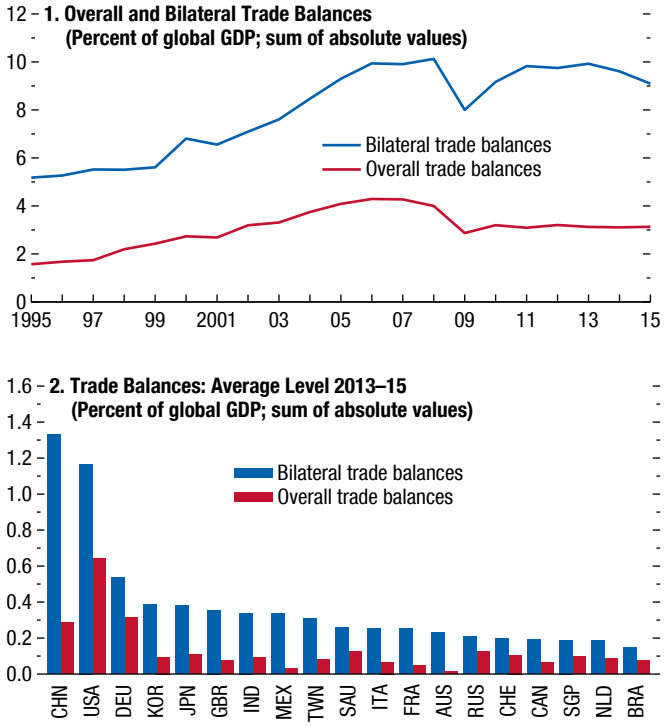
[4]Specifically, global bilateral balances are measured by taking the sum of the absolute values of all countries' bilateral balances. Similarly, for global overall balances, the sum of the absolute value of all countries' overall trade balances is calculated.

Figure 4.1. Bilateral Trade Balances, by Major Partners[1]
(Percent of global GDP)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Data labels use International Organization of Standardization (ISO) country codes.
[1]Top three partners shown per year.

Figure 4.2. Global Trade Imbalances



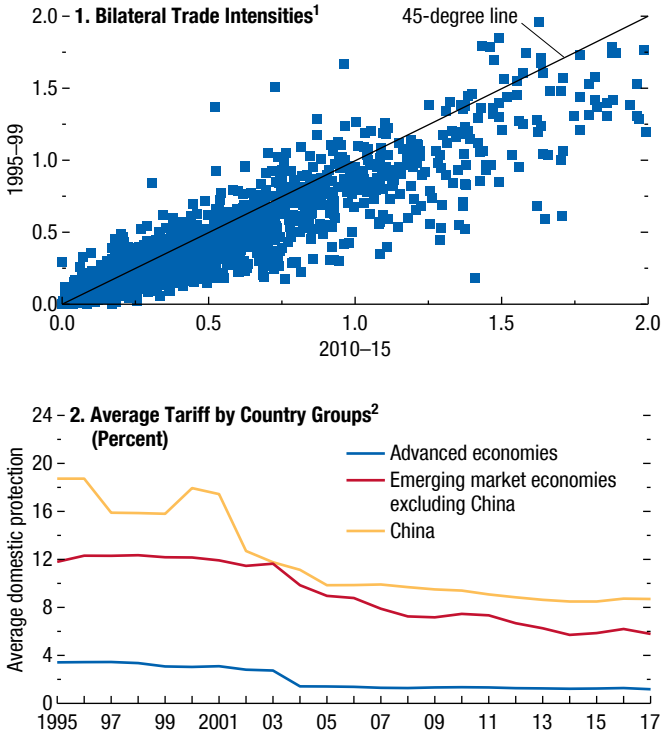
Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes.

eral balances. However, in all these cases, bilateral trade balances are significantly wider than the overall trade balances.

Global trade integration has been crucial to all these developments and was fostered by a persistent fall in trade costs. The average bilateral *trade intensity* across country pairs, discussed later in the chapter, captures the relative size of impediments to trade attributable, at a first approximation, to the presence of trading costs (Figure 4.3). Higher trade intensity for a given pair suggests that trade between those countries is easier. Looking at the evolution between 1995–99 and 2010–15, it is clear that, for most country pairs, trade has become relatively easier. This finding is not surprising, in light of the observation that barriers that hinder trade flows have fallen over time. Improvements in transportation technologies have reduced shipping costs over long distances. Policy changes have also been crucial, with the expansion of World Trade Organization membership leading to a generalized decline in import tariffs. Reductions were particularly marked where tariffs were initially high, as in China and in other emerging market economies. At the same time, large variability of bilateral trade intensity is seen across country pairs. This reflects bilateral trade costs, such as tariffs and more micro-structural factors, and suggests some variation in the way macroeconomic factors affect the various bilateral trade balances of a country.

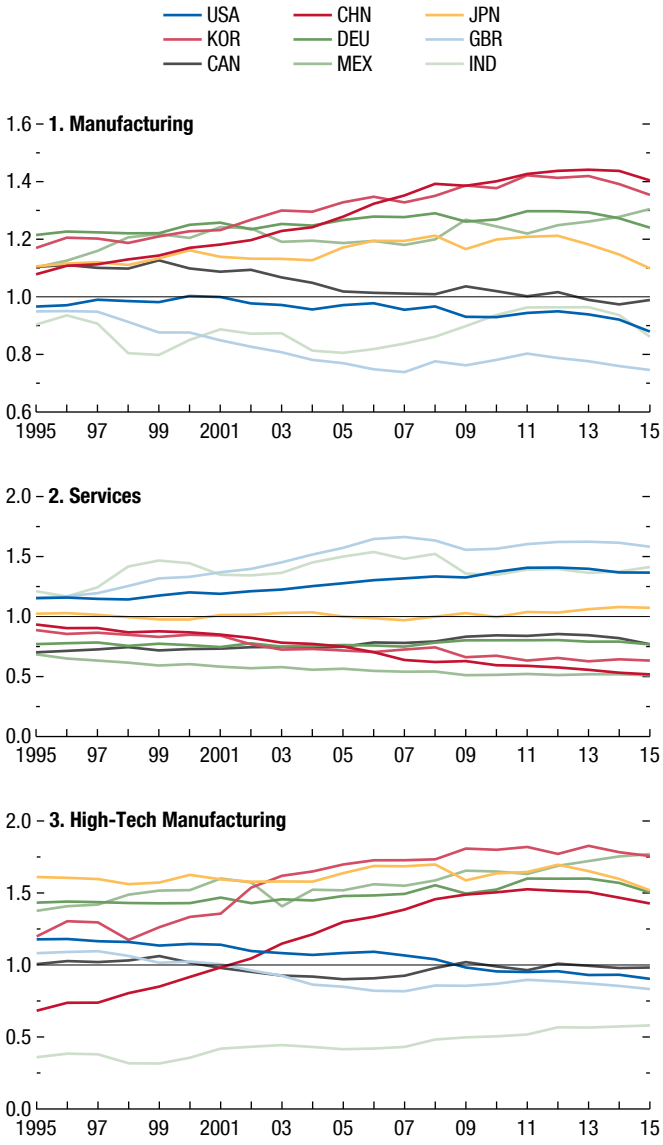
Another determinant of the bilateral intensity of trade between two countries is their international spe-

Figure 4.3. Trade Intensity and Barriers to Trade



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; World Bank, World Integrated Trade Solution database; and IMF staff calculations.
[1]Each dot represents a country pair. For a given pair of countries, the estimated trade intensity provides the impact on exports of the pair-specific bilateral and multilateral trading costs. To improve readability, pairs with intensity greater than two have been excluded.
[2]Averages are aggregated from the country-sector level using constant (2000) value-added shares as weights.

Figure 4.4. Revealed Comparative Advantage[1]



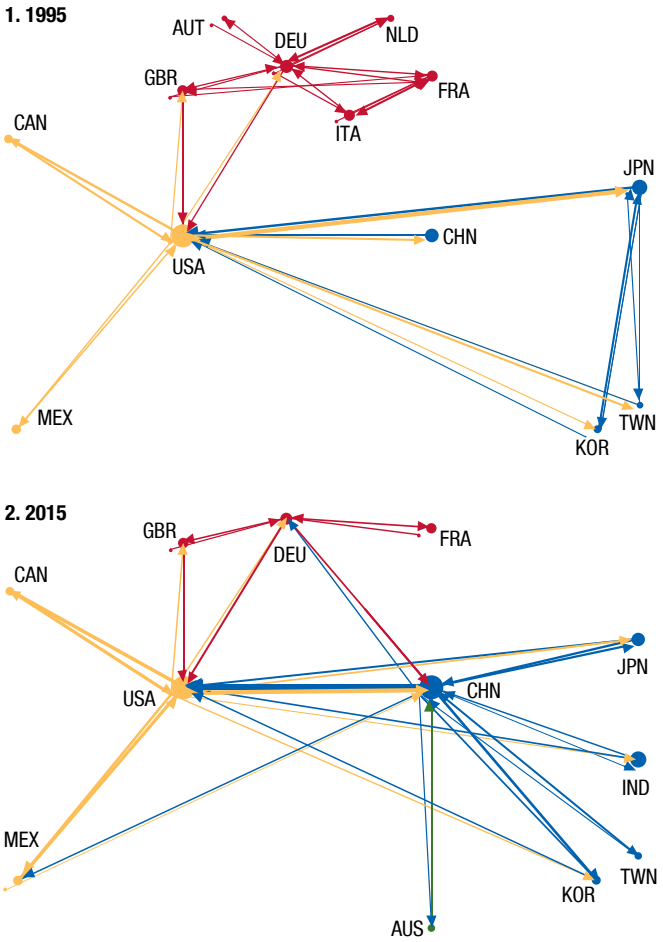
Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes.
[1]Values greater than 1 indicate a revealed comparative advantage in the sector.

cialization. As the cost of trading declined, countries tended to further specialize in what they were best at producing (their comparative advantage)—at least at a broad sectoral level—while importing other products from other countries—deepening the international division of labor and realizing further gains from trade. The country-specific demand and supply structures can generate complex multicountry trade patterns, whereby trade flows across countries occur because countries consume and produce specific goods with different intensities. Countries that had a revealed comparative advantage in manufacturing in 1995 reinforced their specialization in manufacturing—notably, China, Korea, Germany, Japan, and Mexico (Figure 4.4).[5]

[5]Revealed comparative advantage is measured by the share of a sector in a country's exports relative to the sector's share in world exports.

Conversely, relative de-specialization in manufacturing exports took place in countries that had an initial comparative disadvantage in this sector, such as the United States and the United Kingdom. A similar pattern can be observed in services, where the United Kingdom, India, and the United States built on their initial comparative advantage. The evolution of these comparative advantages was also reflected in these countries' manu-

Figure 4.5. Largest Trade Flows, 1995 versus 2015
(Billions of US dollars)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Countries with largest export in year (>= 1 percent of world GDP in 1995 and 2015, respectively), deflated by the US GDP deflator. The size of the bubbles represents the world share of a country's GDP. Data labels use International Organization for Standardization (ISO) country codes.

facturing and services trade balances, with the United States, for example, increasing its surplus in services.

However, the evolution of comparative advantage is not determined by declining trade costs alone. Korea and China are examples of countries developing high-tech manufacturing sectors with a strong global trade impact despite a lack of (or in the case of Korea, modest) initial comparative advantage in this area. Other examples can be found at a more disaggregated level.[6] These developments could reflect, among other things, relatively higher productivity growth in certain sectors due to innovation. At the same time, there is much debate about the role of supply-side policies in helping build such comparative advantage.[7]

The development of global supply chains has also deepened the specialization of countries across and within sectors, amplifying multicountry trade patterns. A focus on the largest bilateral trade flows in 1995 and 2015 suggests that global production is broadly organized around three poles, though with changing intensity (Figure 4.5): the North America pole (or "factory") organized around the United States with Canada and Mexico; the European factory centered around Germany; and the Asian factory.[8] There are also important links between the three production poles, in particular between the United States and Asia. While poles remained broadly intact from a regional perspective between 1995 and 2015, they changed within and intensified over time—with Asia experiencing the most notable changes. In 1995, Japan was at the center of factory Asia, whereas China now plays a central role, and some goods that Japanese firms used to ship directly to the United States are now first shipped to China for further processing. Greater participation in such global value chains should be expected to generate larger bilateral balances (measured by the sum of their absolute values) but not necessarily a larger overall trade balance.[9] Indeed, data suggest a strong positive relationship between a country's participation in global value chains and the size of its bilateral balances, while the relationship is much weaker when it comes to the size of the overall trade balance (Figure 4.6).

Another implication of these trends is that the difference between traditional gross trade measures and value-added measures (which capture the actual value added exchanged between two countries) has increased because the good sold incorporates value added from

[6]See Daruich, Easterly, and Reshef (2019) for a more detailed analysis of changes in specialization of countries at a more disaggregated level.

[7]Such policies could include, among other measures, sectoral subsidies, incentivization of innovation (for example, China's patent promotion policy; see Chapter 4 of the April 2018 WEO), and technology transfer policies and practices. Supply-side policies are discussed later in the chapter.

[8]See Baldwin and Lopez-Gonzalez (2013) for a more detailed analysis of global patterns of supply-chain trade.

[9]For instance, consider a global value chain located in three countries and characterized by a flow of intermediate goods from the first country to the second, and from the second to the third. In this case, an intensification of the global value chain link would imply an increase in the trade deficit of the second country with respect to the first, and an increase in its surplus with respect to the third. See Ahn and others (forthcoming) for a discussion of the correlation between bilateral trade balances and participation in global value chains.

various countries along the value chain (Box 4.1).[10] This is particularly relevant and accounted for in the analysis of the impact of tariffs on value added and employment in the section titled "A Closer Look at Tariffs and Their Spillovers."

Determinants of Bilateral Trade Balances

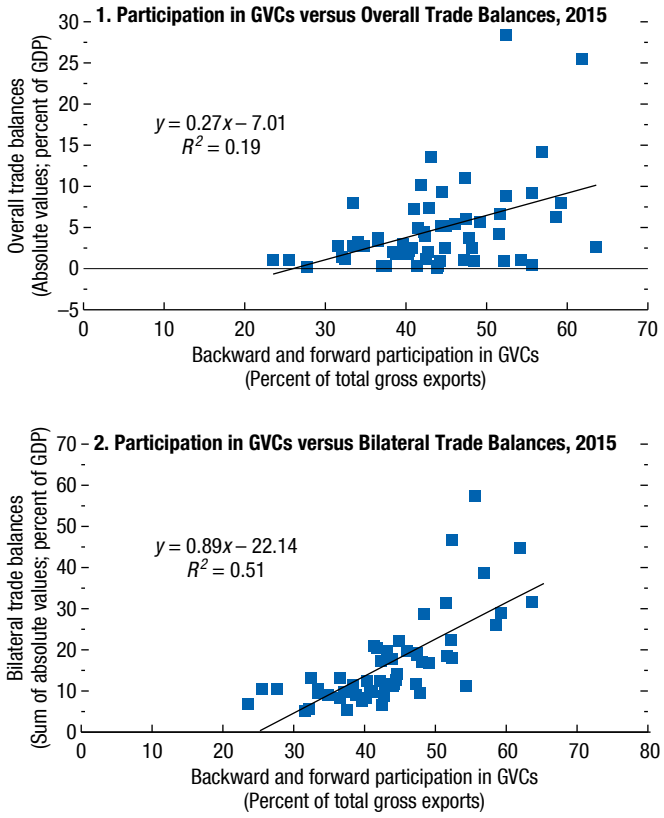
To understand and quantify the drivers of bilateral trade, this chapter uses the workhorse model of the trade literature, the so-called gravity model. A wide body of theoretical and empirical literature shows that this model does a good job of explaining bilateral exports as a function of trade costs, aggregate supply and demand of trade partners, and the sectoral composition of demand and supply. The estimated determinants of bilateral exports can then be mapped to estimated bilateral imports and to bilateral net trade patterns. This method allows bilateral trade balances to be broken down into the components that drive them—namely, specific trade policy actions and broad macroeconomic policies and conditions.[11]

The Gravity Model in a Nutshell

The gravity model explains *bilateral exports* as a function of three sets of determinants (see, among others, Anderson and van Wincoop 2003).

- *Macroeconomic factors:* Specifically, bilateral exports increase with the aggregate supply (gross output) of the exporting country and the aggregate demand (gross spending) of the importing country, scaled by world output. The analysis uses *gross* output and spending (instead of value added and final spending) to account for growth in global-value-chain-related intermediates' trade, which is included in export measures.
- *Trade costs:* These include natural trade costs and man-made—or policy-related—trade costs. Two countries are more likely to trade with each other if they are in close geographic proximity, have historical ties, or have lower overt trade costs (lower tariffs, trade agreements).[12] In addition to bilateral trade costs between the two countries, it is important to control for the average trade costs faced by the exporter across all trading partners and the average trade costs imposed by the importer to capture that the effect of bilateral tariffs is relative to trade costs with other partners. These factors capture the general equilibrium effects of trade costs.[13]

Figure 4.6. The Role of Global Value Chains[1]



Source: Organisation for Economic Co-operation and Development, Trade in Value Added database.
Note: GVCs = global value chains.
[1]Each dot represents a country.

[10]See Johnson and Noguera (2012a, 2012b, 2017); and Koopman, Wang, and Wei (2014).

[11]See, for instance, Feenstra (2004); Silva and Tenreyro (2006); Baldwin and Taglioni (2011); Bacchetta and others (2012); and Yotov and others (2016) for a discussion of the estimation of the gravity model for bilateral exports. There is very little empirical literature that attempts to identify determinants of bilateral trade balances (for example, Davis and Weinstein 2002).

[12]The model used here includes geographic distance between trading partners; bilateral tariffs; and dummy variables for a common border, a common language, common colonial history, and a common free trade agreement. The traditional gravity literature does not explicitly consider the role of exchange rate arrangements. For instance, common currency areas, such as the euro area, can help reduce real trade costs among participants by eliminating the need for currency hedging. In standard gravity regressions, such effects would be in part picked up, through collinearity, by the geographic proximity variables or the free trade agreement dummies.

[13]General equilibrium effects, include, for example, effects of trade costs of a third country on trade between the bilateral pair. The literature also speaks about multilateral trade costs as "multilateral

- *Sectoral composition of supply and demand:* The sectoral composition of supply and demand—which reflects the international division of labor—will affect how much two countries trade in various sectors and, hence, how much they trade in the aggregate. For instance, if a country specializes in producing manufacturing goods, and its trading partner spends more on manufacturing goods than it produces, it will generate a larger trade flow between the two countries. Estimating the gravity model at the sectoral level and aggregating to the country level allows identification of the role of differences in the sectoral structure of exporters' supply and importers' demand on bilateral trade flows.

It is important to recognize up front the limitations of this approach. First, while the gravity model clearly distinguishes between the principal drivers of bilateral trade, these can be more difficult to disentangle in practice. For example, as discussed, changes in tariffs do not only affect bilateral trade. Over the longer term, large and persistent changes in tariffs can also influence the international division of labor and, thereby, macroeconomic factors—an issue further investigated in the section titled "A Closer Look at Tariffs and Their Spillovers." The results presented are thus best interpreted as partial-equilibrium effects and not necessarily as a reflection of the complete dynamic interaction of trade, macroeconomic factors, and tariffs over time. Second, macroeconomic factors capture all factors and policies that impact aggregate supply and demand, including fundamental factors (such as demographics or institutional development), macroeconomic policies, and supply-side policies. However, the latter are difficult to identify separately given the lack of consistent measures across countries—this is particularly true for measures of macroeconomic policy distortions, such as widespread export or production subsidies that distort trade similarly across all trading partners.[14] The section titled "The Role of Macroeconomic Factors" explores in more detail these underlying drivers.

With these caveats in mind, the model of bilateral exports is estimated at the country and the sector levels, using the Organization for Economic Co-operation and Development's Trade in Value Added database. The database reports bilateral export data for 63 countries at the International Standard Industrial Classification of All Economic Activities 3 level for 34 sectors from 1995 to 2015. All variables are expressed in nominal US dollars. In line with the literature, the estimation is carried out over five-year periods to remove the short-term effect of nominal variables, such as nominal exchange rate movements.[15] Online Annex 4.1 provides more details about the estimation and results.[16]

The estimated effects are consistent with other studies (see, for example, Bacchetta and others 2012; and Yotov and others 2016). They confirm that domestic aggregate supply of the exporter and aggregate demand of the importer are key determinants of bilateral export flows. Trade costs are estimated to be important barriers to trade, with the estimated elasticity implying that a 1 percent increase in gross ad valorem tariffs reduces gross bilateral exports by about 3–6 percent.[17] These country-level results are highly robust to the sector-level specification, which allows for introduction of the role of specialization in determining trade. As expected, important differences exist between services and non-services sectors, which can be observed only in sector-level data. For instance, although distance is a significant hindrance to both types of trade, it is more important for trade in services. Overall, the model explains bilateral exports (and imports) very well across all specifications.

resistance" or, equivalently, as indices of market potential or access (see, for example, Head and Mayer 2014). In the empirical application, a common proxy for multilateral trade costs is the GDP-weighted trade costs against all trading partners.

[14]One example of concern over such distortionary policies is the Group of Twenty policymakers' agreement to avoid market-distorting subsidies and other support measures that contribute to excess capacity in steel production—see, for example, G20 (2018).

[15]The traditional gravity model is therefore better interpreted as capturing the determinants of bilateral exports over the medium term. For instance, a sudden depreciation of the exporter's currency would have neutral medium-term effects on the US dollar price of its exports. In fact, as time goes by, firms would compensate for the initial depreciation of the domestic currency by increasing their domestically denominated export prices. The gravity model also does not control for other relative price changes between the importer and exporter (such as those driven by commodity prices). However, adding measures of exporter and importer price indices does not have a notable effect on the other coefficients and adds little explanatory power to the model.

[16]All annexes are available at www.imf.org/en/Publications/WEO.

[17]This approach focuses on the partial equilibrium effect of these variables, and the range of effects reflects the different sector- and country-level estimates reported in Online Annex 4.1. The section titled "A Closer Look at Tariffs and Their Spillovers" discusses some of the general equilibrium implications.

Decomposing Bilateral Trade Balances through the Gravity Lens

The model of bilateral exports (or imports) also provides information about the determinants of bilateral trade balances—defined as the difference between bilateral exports and imports. The gravity model loses explanatory power when applied to the level of bilateral trade balances, reflecting the difficulty in accounting for structural factors—beyond tariffs and broad sectoral specialization—that are time invariant and that determine the balance of trade between two countries (see Online Annex 4.1).[18] This chapter therefore focuses on explaining changes in bilateral trade balances.

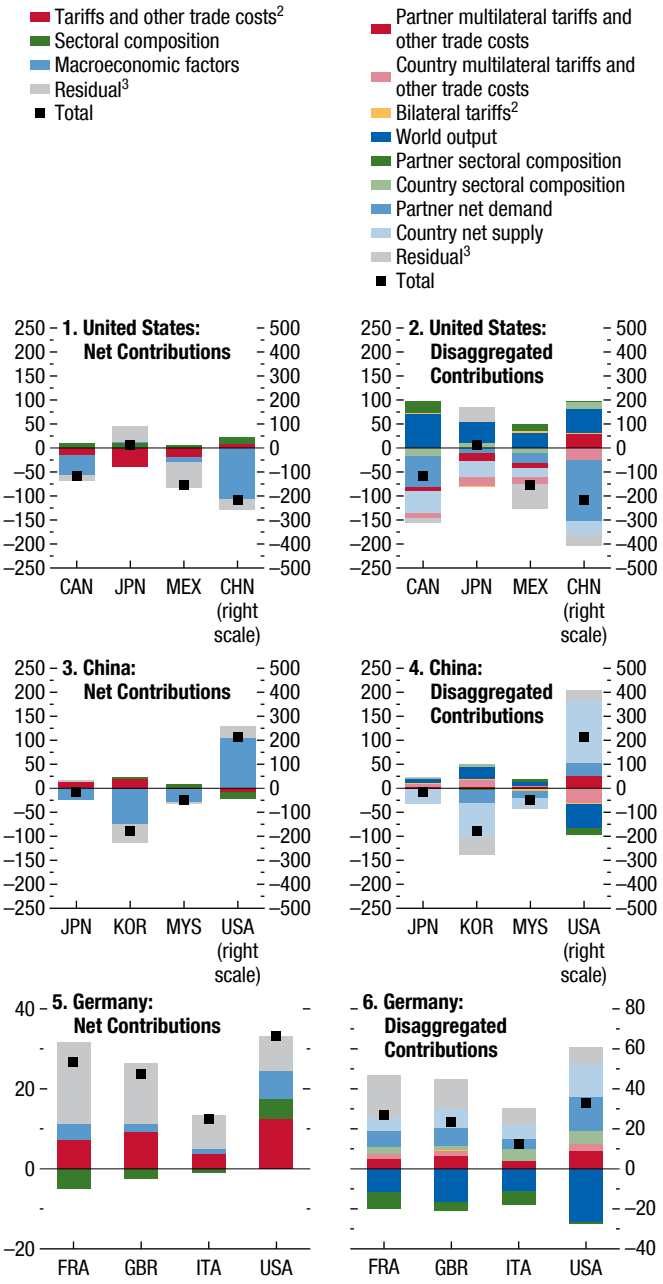
An intuitive way to understand and quantify how trade costs, macroeconomic factors, and changes in sectoral composition explain an observed change in a bilateral trade balance over the sample period 1995–2015 is to look at the estimated contribution of each explanatory variable in the model to that change (see Online Annex 4.1 for the derivation). The contributions to changes in the bilateral trade balances are presented for the major trading partners of three of the largest trading countries and manufacturing centers globally—the United States, China, and Germany (Figure 4.7).[19] The figure highlights the prominent role that macroeconomic factors play in explaining changes in bilateral trade balances. Trade costs contribute, too, although to a lesser degree. Another observation is that the precise impact of macroeconomic factors on bilateral trade balances depends on the initial state of this relationship—in particular, whether the bilateral balance was large and positive or negative. Since trade

[18]One possible candidate is the increasing international division of labor and integration of countries made possible by global value chains, which is only imperfectly captured by the standard gravity model. For example, Ahn and others (forthcoming) shows that, in a gravity equation estimated with country-time fixed effects, estimation residuals increase over time and can be accounted for by the increasing participation of countries into global value chains. This is in line with the section titled "A Closer Look at Tariffs and Their Spillovers" and Box 4.4, which stress the importance of considering the key current role of global value chains when thinking about the role of tariffs. In addition, as indicated by Figure 4.6, panel 1, macro factors and global value chain participation are not significantly correlated and thus provide potentially independent information regarding the evolution of trade patterns.

[19]Panel 1 presents the macroeconomic, sectoral, and trade cost contributions on a net basis. Panel 2 separates these net contributions into their components as follows: macroeconomic factors into country net supply, partner net demand, and world output; sectoral composition into country sectoral composition and partner sectoral composition; and tariffs and other trade costs into bilateral tariffs, country multilateral trade costs, and partner multilateral trade costs.

Figure 4.7. Contributions to Changes in Bilateral Trade Balances, 1995–2015[1]

(Billions of US dollars)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Panels 1, 3, and 5 present the macroeconomic, sectoral, and trade cost terms on a net basis. Panels 2, 4, and 6 separate these net terms into their components as follows: macroeconomic factor into country net supply, partner net demand, and world output; sectoral composition into country sectoral composition and partner sectoral composition; and tariffs and other trade costs into bilateral tariffs, country multilateral trade costs, and partner multilateral trade costs. Data labels use International Organization for Standardization (ISO) country codes.
[1]Average value 2010–15 minus average value 1995–99.
[2]This includes tariffs and free or preferential trade agreements.
[3]The residual is the sum of the model residuals plus the approximation error.

costs, along with other more micro-structural factors, determine countries' comparative advantage and the international division of labor over the longer term, this suggest another way that tariffs can leave a mark on the path of bilateral trade balances over time.[20]

Role of macroeconomic factors. Macroeconomic factors—both domestic and foreign—appear to be, by far, the largest contributors to changes in bilateral trade balances over the period of analysis. That both domestic and foreign macroeconomic conditions matter suggests that the relative evolution of the *aggregate* trade balances of the two trading partners has a role to play—a notion that is explored in the section titled "The Role of Macroeconomic Factors."

- *Domestic macroeconomic conditions* reflect the evolution of gross output and gross spending in a particular country. The magnitude of impact depends on the initial bilateral trade balance between the two countries, as determined by trade costs, the international division of labor, initial macroeconomic conditions, and other structural factors.[21] For instance, over 1995–2015, US domestic macroeconomic factors had a negative effect on its bilateral trade balances across trading partners because US gross output was growing more slowly than spending. Put simply, the United States was, in the aggregate, spending more than it was producing, so it had to import more goods from its trading partners.[22] In contrast, Germany's domestic macroeconomic factors had a positive effect on its bilateral trade balances, reflecting faster growth of output than spending. Finally, output was also growing faster than spending in China over this period—in part reflecting domestic supply-side policies, such as subsidies to the cost of production of manufactured (traded) goods (see, for example, IMF 2011, 2017b; and the 2017 *External Sector Report*). Where China initially had a bilateral surplus (for example, with the United States), reflecting its strong comparative advantage in manufacturing goods, its faster growth of output than spending amplified the bilateral surplus. In contrast, for trading partners with which it maintained an initial trade deficit, such as Korea and Malaysia, the growth of spending, applied to much larger initial imports, had a larger impact than the growth of supply, amplifying the bilateral deficit.
- *Foreign macroeconomic factors* are the contributions of the evolution of spending and output in partner countries. As with the contribution of domestic macroeconomic factors, the initial structure of trade matters in the determination of the change in the bilateral trade balances. For instance, in the case of Germany, foreign macroeconomic factors contributed to its bilateral surpluses, reflecting the faster growth of spending relative to output in partner countries and the initial surplus position that Germany held with its partners.

Role of sectoral specialization: Changes in the sectoral composition of aggregate demand and supply play a nontrivial role for many bilateral imbalances.[23] Overall, a positive effect on the bilateral trade balance indicates that the output share of sectors where a country had large initial exports rose (more than the spending share)—supporting the idea that countries build on existing production structures and comparative advantage—or that the spending share of sectors where the country had high initial demand fell (more than the output share). In the case of the United States, sectoral changes in its supply and demand seem to have contributed positively to its bilateral balances with China, Germany, and Japan. The same holds true for Germany's bilateral trade balances with Italy and the United States.

Role of trade costs: Although declines in bilateral tariffs contributed to growth in the level of gross trade (exports and imports), they had a more muted impact on trade balances (that is, "net" trade—the difference between exports and imports). This, in part, reflects the fact that tariffs were already low in the mid-1990s in many countries and that tariff reductions were reciprocal, with offsetting effects on bilateral trade balances. For example, changes in bilateral tariffs contributed slightly positively to changes in US bilateral trade balances with Canada, China, and Mexico because these countries' tariffs on US goods were falling faster than tariffs imposed by the United States on their goods (albeit from a higher level). All else equal, this mechanically promoted a greater rise in US exports to these countries than in their exports to the United States. For example, if Chinese tariffs on US goods had remained at their 1995 level, the estimation suggests that the US–China trade deficit would have been, on average, $30 billion (about 12 percent) larger

[20]Note, however, in the case of the US–China trade balance, that trade was relatively small in 1995 (see Figure 4.1).

[21]On a technical level, this is because of the multiplicative form in which the different determinants of bilateral trade interact with each other.

[22]The section titled "The Role of Macroeconomic Factors" takes a closer look at the drivers of these macroeconomic factors.

[23]For a discussion of the relationship between sectoral specialization, asymmetric trade costs across sectors, and external balances, see Barattieri (2014); Joy and others (2018); and Boz, Li, and Zhang (2019).

over 2010–15. Of course, this would not have translated into an equal deterioration in the US overall trade balance, given that trade diversion effects would have led to larger US exports to other countries.

In many cases, changes in the average trade costs faced by countries across all their trading partners played a larger role during the sample period than changes in particular bilateral tariffs. As noted above, world output shares of emerging market economies, especially China, rose over time. For most countries, this resulted in additional trade with these emerging market economies, while reducing trade with some others. However, at the same time, trade patterns also adjusted to the fact that those rapidly growing countries happened to display higher tariffs than the typical advanced economy, which drove up average trade costs. All else equal, this increase in average trading costs made trade between lower-cost country pairs more attractive, contributing positively to trade intensity between many countries and amplifying bilateral trade balances—for example, widening US bilateral deficits and increasing Germany's bilateral surpluses.

Compared with macroeconomic factors, changes in bilateral tariffs played a smaller role in the evolution of bilateral balances, but their role should not be underestimated. As discussed further in the section titled "A Closer Look at Tariffs and Their Spillovers," over the longer term, large and persistent changes in tariffs can have a significant impact on the international division of labor, productivity, and macroeconomic factors. Indeed, an increase in bilateral tariffs to prohibitive levels would cripple trade, whether at the bilateral or global level, with severe consequences for the economies involved.

The Role of Macroeconomic Factors

The previous section shows that changes in a country's bilateral trade balances are, to a significant extent, driven by changes in the imbalance between gross production and the spending of each trading partner. This imbalance (in its unweighted form) is simply the country's *aggregate* trade balance. Starting from this observation, this section provides a more detailed view of the role of macroeconomic factors by decomposing the aggregate trade balance into a set of specific macroeconomic drivers, including the effect of macroeconomic policies.

It is possible to manipulate the usual gravity equation to show more clearly that, under mild assumptions, any bilateral trade balance depends on the *relative* size of the two countries' aggregate trade balance-to-GDP ratios, the two countries' sizes relative to the world economy, and bilateral trade intensities. Box 4.2 discusses this relationship and illustrates how changes in the aggregate trade balances of the United States and China can account for most of the evolution in their bilateral trade balance. In particular, once aggregate and bilateral trade balances are scaled in a theory-consistent way (that is, by taking into account the changing sizes of the trading partners), it becomes clear that the shrinking of the aggregate trade balances of the United States and China after the global financial crisis was matched by a corresponding contraction in their bilateral trade balance.

The precise way a given change in a country's aggregate trade balance is reflected in its bilateral balances depends on a set of partner-specific *trade intensities*. A simple example illustrates this point: consider a ½ percentage point exogenous decrease in Germany's overall trade balance—holding everything else constant, Germany's bilateral trade balances with, among others, China, the Netherlands, and the United States would decline by about 0.1 percent of Germany's GDP, while bilateral trade balances with the United Kingdom and France would decline by 0.05 percent of Germany's GDP (Figure 4.8).[24] A greater effect on bilateral balances reflects either a higher trade intensity with Germany (for example, in the case of the Netherlands) or a higher share in world output (for example, in the case of the United States).

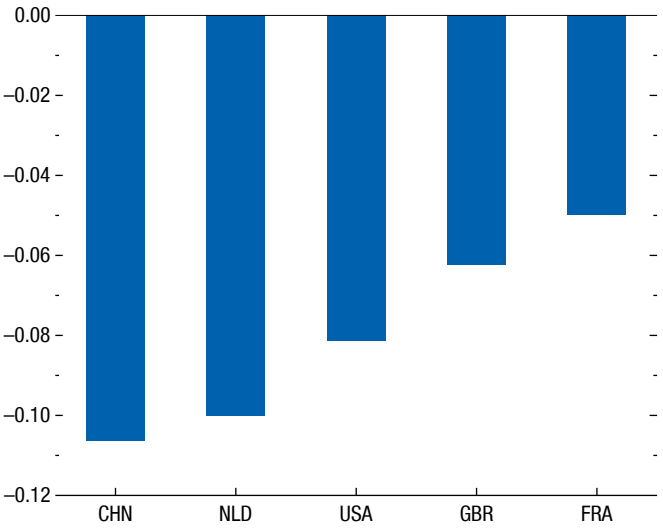
From a policy perspective, it is important to understand the factors behind the movement of aggregate trade balances over time. This question can be answered through the IMF's External Balance Assessment (EBA) framework, which relates the current account of a country to macroeconomic policies and other drivers. Given that the current account of a country consists of the aggregate trade balance and net foreign incomes and transfers, the EBA model can also be applied to the trade balance directly (see Online Annex 4.2).[25] The main EBA determinants fall into four broad groups:[26]

[24]This example considers only partial effects and does not include important general equilibrium responses.

[25]In the exercise presented here, countries' aggregate trade balance-to-GDP ratios are regressed on the standard EBA drivers. As noted, given that the trade balance is just a subcomponent of the current account, the EBA drivers remain valid explanatory variables, but their quantitative role can change. The current account and the trade balance EBA regressions turn out to be quite consistent with each other (see Online Annex 4.2).

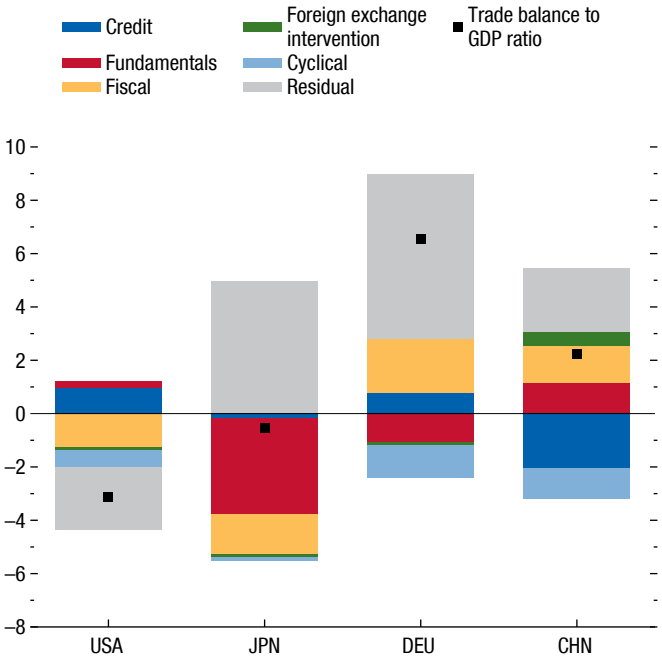
[26]The IMF's EBA methodology, which has been in place since 2013, estimates the level of the current account and exchange rate consistent with fundamentals and desired macroeconomic policies. The scope of the trade balance exercise presented here, instead, does not discuss desired policies. For this reason, and for ease of

Figure 4.8. Effect of a Deterioration of Germany's Aggregate Trade Balance on Selected Bilateral Balances
(Percent of Germany's GDP)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes. The figure shows the effect on selected bilateral balances of a 0.5 percentage point deterioration in Germany's aggregate trade balance to GDP.

Figure 4.9. Contributions of Macroeconomic Drivers to Aggregate Trade Balances, Average 2010–17[1]
(Percent of GDP)



Source: IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes.
[1]Contributions were obtained by regressing the countries' trade balance-to-GDP ratio on the standard IMF External Balance Assessment variables.

- *Macroeconomic policies*: Those included are fiscal policy (cyclically adjusted fiscal balance) and exchange rate policy (foreign exchange interventions). Macroeconomic policy distortions (for example, widespread export or production subsidies that distort trade similarly across all trading partners) could also affect macroeconomic imbalances, however, these policies are difficult to measure systematically across countries and are not explicitly captured here.
- *Credit*: This dimension is captured by detrended private credit to GDP.
- *Cyclical*: This represents temporary factors of a cyclical nature, such as the output gap and the commodity terms of trade, capturing fluctuations in commodity prices.
- *Fundamentals*: This includes such factors as demographics, the level of economic and institutional development, social safety nets, reliance on commodity exports, the country's net foreign asset position, and the country's role as a provider of safe and reserve assets.

Applying the EBA analysis to the United States, Japan, Germany, and China (as examples) highlights the role of macroeconomic policies and of financial variables in the evolution of external trade imbalances during 2010–17 (Figure 4.9). In recent years, financial conditions (captured by credit) have contributed to the reduction in external imbalances. This is the case in the United States, where the contribution of credit conditions to the trade balance is now positive after the correction of the credit boom before the global financial crisis, and in China, where the credit expansion after the crisis led to an increase in domestic demand and to a reduction in the external surplus. Fiscal policies also matter. For example, a tight fiscal policy in Germany contributed to a large trade surplus while, in Japan, a relatively loose fiscal stance contributed to balancing the external trade position. In the United States, the relatively expansionary fiscal stance after the global financial crisis offset other improvements in the trade balance and, going forward, the recent fiscal stimulus is projected to further widen the trade deficit.[27] Among

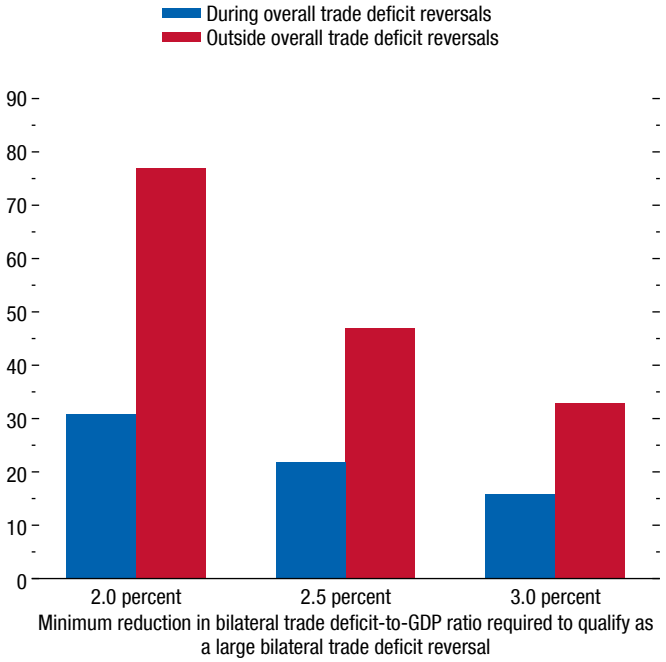
presentation, the EBA explanatory variables have been grouped in a somewhat different way than in the original EBA framework.

[27]The fiscal contribution for China here is calculated under the official, legal-based, definition of the government sector. However,

the other drivers, foreign exchange interventions have had only a limited impact on aggregate trade balances and, for China, have largely disappeared in recent years, while cyclical factors have provided, on average, a significant negative component in all countries, except Japan. Among the group of fundamental drivers, the level of development—a proxy for growth prospects and investment opportunities—is estimated to have made a positive contribution to the aggregate trade balance of advanced economies, and a negative contribution for China, consistent with the idea that goods and services should flow "downhill" from advanced to emerging market economies. Moreover, demographic variables make a negative contribution to the trade balance of countries in the late stage of the aging process.[28] Finally, the unexplained residual is quantitively significant, but in line with the original EBA regression. The residual is likely to reflect, among other things, the role of macroeconomic distortions not directly accounted for by the EBA drivers. These include supply-side policies, such as production subsidies and regulatory policies that affect aggregate supply. Such policies have been pointed to in the case of China (see, for example, IMF 2011, 2017b; and the 2017 *External Sector Report*).[29]

As a further cross-check of the role of aggregate macroeconomic factors in driving external imbalances, Box 4.3 discusses the relationship between bilateral and overall trade balances during episodes of large trade deficit adjustments. It finds that empirically large changes in overall trade balances tend to go along with similar changes in a country's bilateral trade relationships, while the opposite does not hold. That is, large adjustments in specific bilateral deficits do not necessarily lead to large adjustments in the overall trade balances (Figure 4.10), suggesting that, absent changes in macroeconomic conditions, large changes in one of the bilateral trade balances of a country tend to result in compensating adjustments in other bilateral balances.

Figure 4.10. Bilateral Trade Deficit Reversal Episodes
(Number of episodes)



Source: IMF, Direction of Trade Statistics database.
Note: See Box 4.3 for definition of large overall and bilateral trade deficit reversals. There are 92 overall trade deficit reversals.

A Closer Look at Tariffs and Their Spillovers

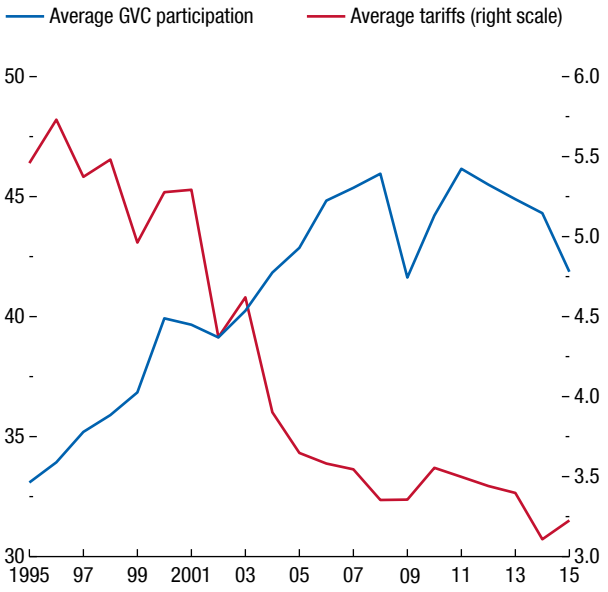
The analysis so far finds that the direct impact of tariffs on trade balances is small relative to macroeconomic factors. However, as discussed, in the longer term, large, sustained changes in tariffs can shape the international division of labor, as firms adjust domestic and international investment and production structures, including by organizing themselves into global value chains. Indeed, the reduction in tariffs and transportation and communications costs since the mid-1990s has gone hand in hand with a significant increase in complex global value chain participation, which—loosely speaking—is the share of exports that crosses at least two borders (Figure 4.11). Changes in tariffs can thus have important ramifications for

under the IMF staff's economic-based ("augmented") definition of the general government sector, it would likely be negative.

[28]Goods and services are expected to flow "downhill" from advanced economies to raise investment by emerging market economies, which explains the sign of the contribution to the trade balance of the level of development driver. This result is in line with what is obtained in the original, current account-based EBA regression. Instead, while the original EBA finds that demographic variables make a *positive* contribution to the current account of countries in the late stage of the aging process, the contribution in the trade balance regression is *negative*. This is intuitive, given that aging is expected to boost the net income account of a country, stemming from the return on the net foreign assets previously accumulated abroad. At the same time, given that part of this income is later repatriated and consumed by an aging population, the trade balance deteriorates.

[29]More generally, the list of EBA drivers does not include tariffs. This choice is not particularly problematic as long as tariffs are relatively low. It is also important to recognize that macroeconomic policies directly captured in the EBA drivers may be devised as a response to other distortions that operate at the aggregate level.

Figure 4.11. Tariffs and Global Value Chain Participation[1]
(Value added-weighted average over countries and sectors; percent)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; World Bank, World Integrated Trade Solution database; and IMF staff calculations.
Note: GVC participation is the backward and forward participation in GVCs as a percent of total exports. Tariffs are for agriculture, mining, and manufacturing sectors. GVC = global value chain.
[1]2012–15 extrapolated based on Trade in Value Added database (2018).

productivity, output, and employment.[30] For instance, Amiti and others (2017) finds that China's tariff reductions—associated with its accession to the World Trade Organization—lowered the cost of inputs, boosted Chinese firms' productivity, and, in conjunction with reduced US tariff uncertainty, expanded export participation to the United States.

Increased global integration of production through global value chains creates scope for specialization and productivity improvement—but, at the same time, it increases the risk of international spillovers, including from increases in tariffs and trade wars.[31] As firms use intermediate inputs from other sectors and countries, tariffs imposed in those sectors and countries can affect their cost of production. The effect of tariffs up the value chain (that is, tariffs on direct or indirect suppliers of inputs) is most direct if intermediate inputs are imported. However, effects can also arise indirectly through other sectors and countries. What holds for tariffs upstream also applies to tariffs down the value chain (that is, tariffs imposed by direct or indirect users of the country's output). The firm selling intermediate goods to a sector or country that imposes a new tariff can be affected through reduced demand from customers. Finally, it is possible that tariffs have effects even on countries not directly related to the two parties involved. Relative prices impact trade at all levels, and so do relative tariffs. A change in the tariffs imposed on competitors can therefore affect a firm's international competitiveness and demand for its output; this is similar to the idea of trade diversion, when imposing tariffs on a trading partner's goods leads to a switch of demand to another trading partner's goods on which there are no tariffs.

Measuring Spillovers from Tariffs

What is the impact of tariffs on production, employment, and productivity, accounting for how firms operating in a global value chain context are affected, both domestically and internationally? To capture the various effects of tariffs, four measures are constructed:[32]

- The *upstream tariff* is the average cumulative tariff applied to the intermediate inputs as a share of the sector's output. It captures the average effect tariffs have on the cost of production. It is calculated using the global input-output matrix, in which individual elements are scaled by the relevant sectoral output.
- The *domestic protection tariff* captures the average tariff (import-weighted) imposed on imports that compete with the output of the domestic sector. Its level will most directly affect domestic demand for the sector's output.
- The *downstream tariff* is the average cumulative tariff the sector's output faces when exported either directly or indirectly through other (intermediate-output-using) sectors and countries. Just as for the upstream tariff, it is calculated using a global input-output matrix, scaled by the sector's output. Its level affects the international demand for the sector's output.

[30]The question of the empirical effects of tariffs on economic outcome variables relates to a vast literature (for example, Amiti and Konings 2007; Topalova and Khandelwal 2011; Ahn and others 2016; and Furceri and others 2018); see Online Annex 4.3 for a discussion. Criscuolo and Timmis (2017) provides a discussion of the relationship between global value chains and productivity.

[31]It takes time for firms to change their production structure to minimize the consequences of tariff increases. These short-term costs can be magnified by policy uncertainty, which delays firms' investment decisions.

[32]The construction of upstream and downstream tariffs relies on Vandenbussche, Connell, and Simons (2017) for a theoretical justification and follows Rouzet and Miroudot (2013) in terms of practical implementation. See Online Annex 4.3 for further details.

Table 4.1. Sign and Significance of Tariff Effects on Economic Variables

	(1) Real Value Added	(2) Number Employees	(3) Labor Productivity	(4) Total Factor Productivity
Upstream Tariff	–	–	–	–
Domestic Protection	+	–	–	+
Downstream Tariff	–	–	–	–
Diversion Tariff	+	+	+	–

Source: IMF staff calculations.
Note: Dependent variables are expressed in natural logarithm. Errors are clustered at the country-sector level. Pattern coding: white is not significant at the 10 percent level; light color is significant at the 10 percent level; medium color is signifcant at the 5 percent level; full color is significant at the 1 percent level; green for positive coefficients; red for negative ones.

- The *diversion tariff* captures the weighted average tariff that partner countries impose on all other suppliers except the country-sector in question. The relative weights are a function of the importance of the exporter and importer countries.

The empirical analysis—from a large panel data set of 35 countries and 13 manufacturing sectors, controlling for country-specific macroeconomic changes and country-industry characteristics—suggests that tariffs have significant and economically sizable effects both along the value chain and horizontally on real value added, employment, and productivity (Table 4.1; Online Annex 4.3).

Two main conclusions emerge. First, tariffs up and down the value chain matter for output and productivity generally much more than domestic protection of the given sector. Upstream and downstream tariffs have statistically significant negative effects on value added, consistent with the idea that either they increase input costs (upstream tariff) or reduce international demand for the sector's output (downstream tariff). Both labor productivity and total factor productivity are also significantly reduced by higher upstream or downstream tariffs because they either make foreign inputs more expensive or reduce the ability to benefit from returns to scale by participating in international markets. In contrast, tariffs aimed at increasing protection for domestic producers do not appear to have significant effects, except for a small negative effect on employment. This may reflect a rough offset of negative effects of reduced competition by a larger market share of domestic suppliers. Second, there is evidence of trade diversion. The diversion tariff is positive and statistically significant for value added and employment, consistent with the idea that firms, and therefore sectors, can benefit from a tariff imposed on competitors. The effect, however, does not extend to labor productivity and total factor productivity, for which the diversion tariff is insignificant.

Illustrative Simulations of Tariff Changes

Simulations can illustrate the economic significance of the estimated effects and how a given tariff change affects different countries through different channels. In line with the empirical model discussed above, the simulations illustrate partial equilibrium effects and do not include channels other than the direct trade effects (for example, policy uncertainty, confidence effect, and financial conditions).[33] A different approach using general equilibrium models is discussed later in this chapter.

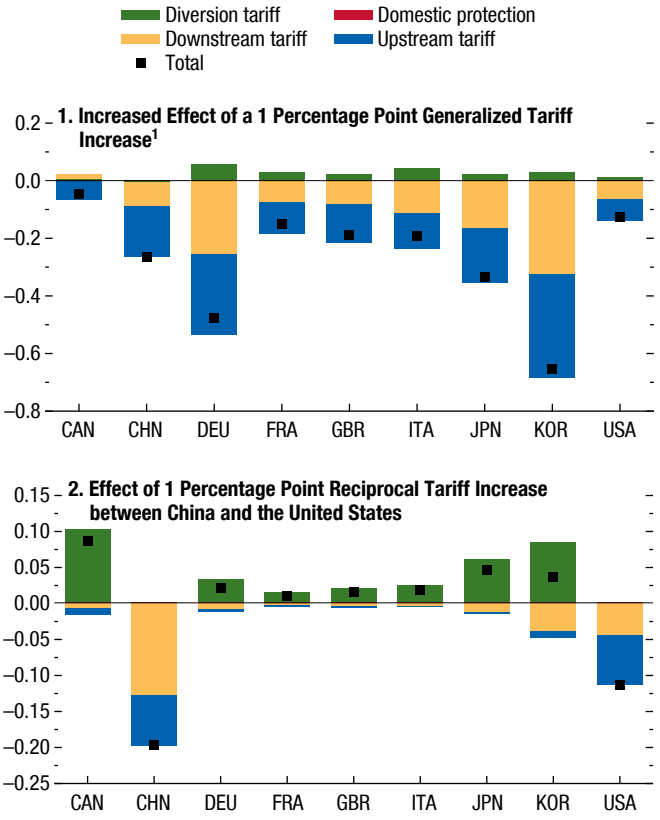
Impact of Greater Integration on Tariff Spillovers

Closer integration into global value chains has increased the sensitivity of the upstream and downstream tariffs to nominal tariff changes, amplifying their effect. A 1 percentage point tariff increase by all countries would have a larger negative effect today than in 1995 (Figure 4.12).[34] The effect of a nominal tariff hike on real value added has become more negative for all countries, but to varying degrees. For countries such as Germany and Korea and, to a slightly lesser extent, China and Japan, whose manufacturing sectors are both rather big and particularly integrated

[33]The inclusion of the different fixed effects in the estimated model helps make a precise identification of the tariff effect by controlling for country-specific macroeconomic changes or constant characteristics of a given country-industry. The related caveat is that, by absorbing those, the estimated coefficients show partial equilibrium effects. For example, general equilibrium effects of widespread tariff increases on the exchange rate would not be captured by the model. Historically, changes in relative tariffs were predominantly due to tariff declines. In principle, a tariff increase could have a different effect from a tariff decline, even over the medium to long term, but this potential asymmetry is not explored here.

[34]Given data requirements and infrequent data releases, 2011 was the most recent year for which the simulation could be carried out. This is, however, a good approximation of today's links as most of the increase in global value chain integration took place before 2011 (see Figure 4.11). The simulations use the coefficients estimated over the entire sample. Changes in the effects thus reflect changes in weights, notably closer integration of production, as captured by the global input-output matrix.

Figure 4.12. Illustration of the Effect of Tariff Changes on Real Value Added
(Percent of GDP)



Source: IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes.
[1]The figure shows the change in the simulated tariff spillovers between 1995 and 2011, the last year for which such an exercise is possible given data constraints. 2011 is a good approximation of current global value chain links because most of the growth in global value chain integration took place before 2011.

into global value chains, the effects in terms of overall GDP are larger. For Canada and the United States, whose manufacturing sectors are smaller and have evolved less in terms of global integration, the effects tend to be smaller.

Spillovers from Bilateral Tariffs

When tariff changes are more discriminatory and less generalized across countries, the relative importance of the different tariff measures changes, and trade diversion becomes a relevant force for third countries. This becomes apparent when the 1 percentage point tariff increase is limited to trade between China and the United States (see Figure 4.12). China and the United States are the countries most affected and are both hurt by the move.[35] For China, the effects of the downstream and—to a slightly lesser extent—upstream tariffs dominate. For the United States, upstream tariffs are more important because intermediate imports from China play a relatively bigger role. This underlines how tariffs can be harmful to the countries imposing them when they target those with which they are closely integrated through supply chains. For third countries, trade diversion offsets negative spillovers from value chain links with China and the United States. Japan and Korea, which supply inputs to China, are affected by downstream tariffs, but also benefit from trade diversion. For Canada, the relative importance of trade diversion is most pronounced, and the overall effect is most likely to be positive.

The analysis so far has focused on small, first-round sectoral effects of tariffs, abstracting from, among other things, the additional domestic and international effects that stem from resulting aggregate changes in productivity, employment, or output. For a better understanding of the global general equilibrium effects, a hypothetical, large US–China trade dispute is simulated using three different modeling approaches that each emphasize different transmission channels (Box 4.4). China and the United States are found to suffer the largest losses from their reciprocal tariff increases, due to the collapse in bilateral trade—with only partial substitution from other sources—and lower returns to capital, reflecting tariff distortions. Trade diversion leads to substitution of China's exports to the United States: Mexico and Canada benefit most, reflecting their close proximity to, and strong trade relations with, the United States; east Asia also benefits to some extent. At the same time, these countries increase imports of intermediates from China and from other countries. While the level of bilateral trade between China and the United States is much reduced, there is no economically significant change in either country's aggregate trade balance. Overall, macroeconomic spillover effects in third countries are modest in size, but sectoral spillovers are larger as global value chains are repositioned. In particular, over the long term, sizable shifts in manufacturing capacity away from China (and the United States) toward Mexico, Canada, and east Asia would occur (Figure 4.13). These sectoral shifts would imply sizable job losses in specific sectors, especially in China and the United States.

The trade diversion effects—found both in the sectoral empirical analysis and in the general equilibrium simulations—suggest that attempts to target one

[35]The smaller cost on the United States in percent of GDP reflects the relatively smaller weight of the US manufacturing sector in US GDP; the change in manufacturing value added itself is actually somewhat larger for the United States than for China.

bilateral trade balance through tariffs or other distortions will likely be met with offsetting changes in the trade balances with other partners. Under given macroeconomic conditions, changes in bilateral trade balances are unlikely to translate into sustained changes in the overall trade balance. Finally, while some third countries may benefit from trade diversion, a trade war between China and the United States would also trigger increased uncertainty, negative confidence effects, and a tightening of global financial conditions, with negative effects on most countries (Chapter 1 of the October 2018 WEO). Therefore, most countries are likely to be worse off, even those that benefit from trade diversion.

Conclusion

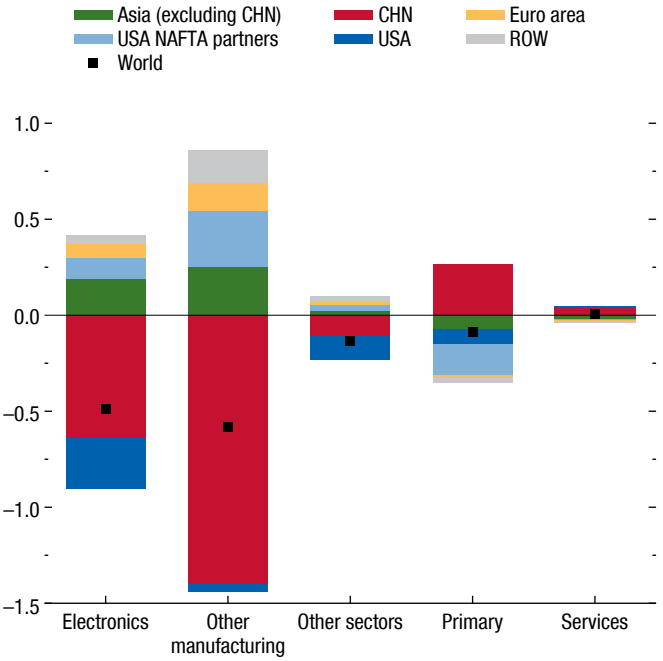
The findings in this chapter strongly suggest that aggregate imbalances tend to be reflected at the bilateral level, while bilateral imbalances are of little consequence for the aggregate—indeed, unless macroeconomic conditions change, attempts to influence a particular bilateral trade balance are likely to lead to compensating adjustments elsewhere, leaving the overall trade balance unchanged.

Over the past two decades, macroeconomic factors played a key role in explaining changes in bilateral balances. The path of bilateral imbalances was, to a significant extent, determined by the relative movement of the two partners' domestic imbalance between supply and demand—as mirrored in their respective overall trade balance. Macroeconomic factors reflected a variety of drivers, including fundamental factors, macroeconomic policies—such as fiscal policies and credit cycles—and, in some cases, exchange rate policies and supply-side policies.

At the same time, bilateral balances are also a reflection of the international division of labor and economic benefits accruing through trade. Declines in tariffs and other trade costs have allowed global value chains to grow and countries to further specialize according to their comparative advantage while production arrangements spread across borders and became more efficient.

Looking beyond the effects on bilateral trade balances, higher tariffs would have significant negative impacts on value added, employment, and productivity for the countries involved and for third countries through value chain links. Greater international division of labor, in particular through global value chains, has increased the scope for negative spillovers of tariffs on other countries and spillback effects on countries imposing the tariffs. While some countries may benefit from trade diversion, all will be affected by adverse confidence effects and tighter financial conditions as trade tensions escalate.

Figure 4.13. Sectoral Effects from a 25 Percent Increase in Tariffs Affecting All US–China Trade: World Real Value Added
(Contributions to total percent change from baseline)



Source: IMF calculations using the model in Caliendo and others (2017).
Note: NAFTA = North American Free Trade Agreement; ROW = rest of the world. Data labels use International Organization for Standardization (ISO) country codes.

Two main policy conclusions emerge from the analysis. First, given the important role of macroeconomic imbalances in bilateral trade and trade balances, the discussion of external balances is rightly focused on aggregate trade balances and current accounts—as well as the macroeconomic policies and distortions driving them. Aggregate external imbalances are not bad in and of themselves, given that they allow countries to borrow to finance investment and future growth, or to smooth consumption at times when income is temporarily lost. But policymakers should avoid distortive macroeconomic policies that create excessive—and possibly unsustainable—imbalances.

Second, there is a strong case for lowering tariffs. The evidence provided here implies that lower tariffs will not only boost trade, they will also allow adjustment in the international division of labor to more fully reflect comparative advantage—which in turn leads to output, employment, and productivity gains for countries themselves and for others up and down the value chain. But as highlighted elsewhere, it is important to have policies in place to ensure that the benefits from trade are widely shared and the burden of adjustment does not fall on only a few (IMF 2017a; IMF/WB/WTO 2017, 2018).

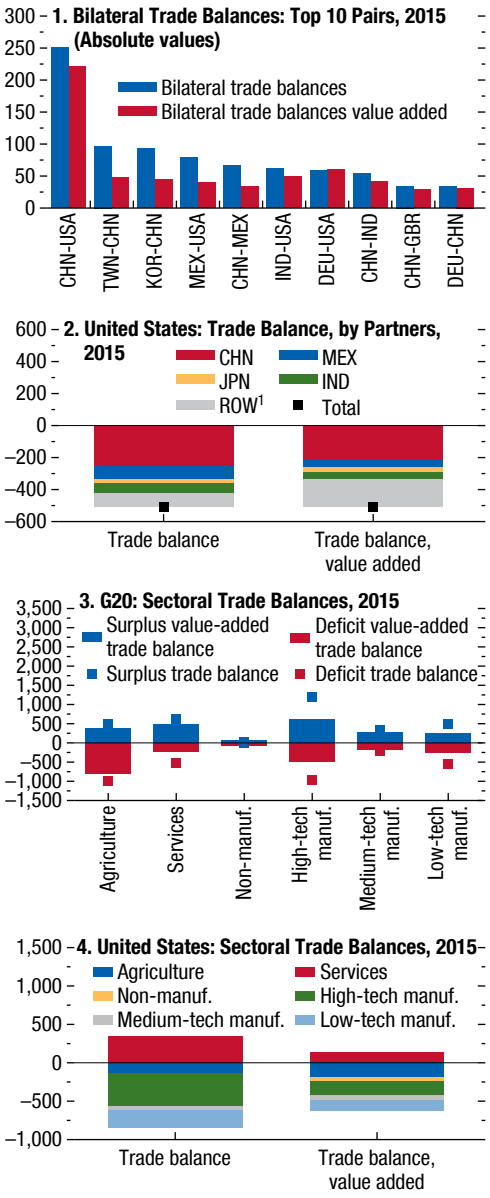
Box 4.1. Gross versus Value-Added Trade

Popular debate about bilateral trade balances usually focuses on the standard measure of *gross balances*—that is, exports to a country minus imports from the same country. However, over the past few years, the literature has emphasized that a more complete picture of bilateral trade relations needs to include the evolution of *value-added balances* (Johnson and Noguera 2012a, 2012b, 2017; Koopman, Wang, and Wei 2014). The importance of differentiating between gross and value-added bilateral balances has become more relevant as global value chains continue to develop.

The point can be explained using, as an example, trade among China, Korea, and the United States in electrical goods, such as smart phones or televisions (WB and others 2017). If only final goods were traded internationally, then any good that the United States exports to Korea would stay in Korea. In this case, gross exports of the United States to Korea would give a correct representation of how much value produced in the first country actually reaches the other. However, this is not how production of electrical goods is carried out in today's global value chains, where trade occurs largely in intermediate goods. The United States exports some inputs (such as design) to Korea, which adds new inputs (semiconductors and processors) to the production stage and exports the resulting new intermediates to China, which in turn completes production by assembling the inputs and ships the final goods back to the United States. In the example of these goods, the United States accumulates a *gross* bilateral surplus with Korea and a deficit with China. These values, however, do not reflect the true origin and destination of the value of production generated—and consumed—in each country. Imports of the United States from China, in fact, reflect only partially the value generated in China, given that they incorporate not only the extra value generated in Korea, but also the value initially generated in the United States. Therefore, the trade deficit of the United States with regard to China is smaller if calculated in *value-added* terms.

Panel 1 of Figure 4.1.1 shows the 10 largest bilateral imbalances in 2015, in both gross and value-added terms. It is clear that, while large gross bilateral imbalances are, in general, also accompanied by large value-added imbalances, the imbalances in value-added

Figure 4.1.1. Gross versus Value-Added Trade Balance
(Billions of US dollars)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: G20 = Group of Twenty; manuf. = manufacturing; ROW = rest of the world. Data labels use International Organization for Standardization (ISO) country codes.
[1]Includes statistical discrepancy.

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Box 4.1 *(continued)*

terms are smaller. For example, Korea's surplus with China is smaller in value-added terms because Korea's figure for gross exports incorporates value added from other countries. Panel 2 looks specifically at the largest bilateral imbalances for the United States and shows that the trade deficits with Mexico and China shrink when measured in value-added terms. Clearly, when measured against the totality of the rest of the world, a country's overall trade balance is the same, regardless of whether it is measured in gross or in value-added terms.

Similar considerations hold when looking at the sectoral composition of trade imbalances. Panel 3 presents, for each of six sectors, the sum of surplus and of deficits across Group of Twenty countries. Sectoral trade surpluses and deficits are typically smaller on a value added than on a gross basis, reflecting the round-trip of production through different sectors. Panel 4 looks at imbalances for the United States. When measured in value added, the US surplus in services is reduced, and its manufacturing deficit shrinks. This happens, for example, when US services (such as intellectual property) are used as inputs in the manufacturing sector of other countries, and these manufactured goods are then imported back to the United States.

Box 4.2. Bilateral and Aggregate Trade Balances

This box derives an explicit relationship between bilateral and aggregate trade balances and illustrates, as an example, the role of macroeconomic factors for the US–China bilateral trade balance.

Under the relatively mild assumption that trade costs are symmetric—that is, the cost of shipping goods from country i to country j is the same as the cost of shipping from j to i—the standard gravity relationship that underpins the analysis in the previous section can be rearranged to obtain

$$\frac{TB_{ij}}{Y_i Y_j^W} = m_{ij} \cdot \left(\frac{TB_i}{Y_i} - \frac{TB_j}{Y_j} \right),$$

in which TB denotes trade balance and Y output, with one of the two outputs (Y_j^W in the equation) expressed as a share of world output (see Online Annex 4.2 for the derivation). The equation makes clear that the bilateral trade balance between two countries (appropriately scaled) depends on the relative evolution of the aggregate trade balance-to-GDP ratio of each of the two countries.

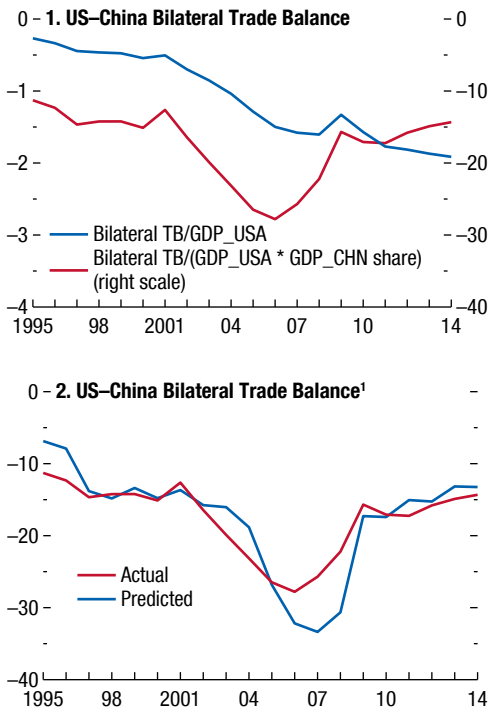
The appropriate scaling of the bilateral trade balance between countries i and j jointly accounts for the output level of both. This captures the intuition that, as the two countries grow, all else equal, their bilateral trade balance would tend to increase in absolute value. Figure 4.2.1, panel 1, shows that, when scaled by US GDP, the bilateral trade imbalance between the United States and China did not shrink after the 2008–09 global financial crisis. However, when the double scaling is applied—and therefore the growing share of China in the world economy is factored in—a notable reduction emerges. This is consistent with the decline in global imbalances seen after the global financial crisis.

Finally, the equation also makes clear that changes in a country's aggregate trade imbalance (driven by fundamentals, such as fiscal policy and credit cycles) are amplified or dampened at the bilateral level by the corresponding bilateral trade intensity m_{ij}, which summarizes how a specific trade relationship is affected by the pair-specific bilateral and multilateral trading costs (and other more micro-structural determinants) identified by the gravity framework.

Applying this relationship to the US–China bilateral trade balance confirms that macroeconomic imbalances played a key role in its evolution. Figure 4.2.1 (panel 2) plots again the scaled bilateral trade balance ("actual"), but now against a "predicted" value constructed as the product of a constant estimate for m_{ij} times the difference in the aggregate trade-balance-to-GDP ratios of the two countries. The fact that the two lines track quite closely shows that variations in aggregate trade balances explain the evolution of the (scaled) US–China bilateral balance very well. The imperfection of the relationship indicates that variations in trade intensity—for example, because of the changing constellation of world trade costs, also play a role.

The author of this box is Roberto Piazza.

Figure 4.2.1. US–China Bilateral and Aggregate Trade Balances
(Percent)



Sources: Organisation for Economic Co-operation and Development, Trade in Value Added database; and IMF staff calculations.
Note: TB = Trade Balance. Data labels use International Organization for Standardization (ISO) country codes.
[1]As a percentage of US GDP times the world share of China's GDP.

Box 4.3. Understanding Trade Deficit Adjustments: Does Bilateral Trade Play a Special Role?

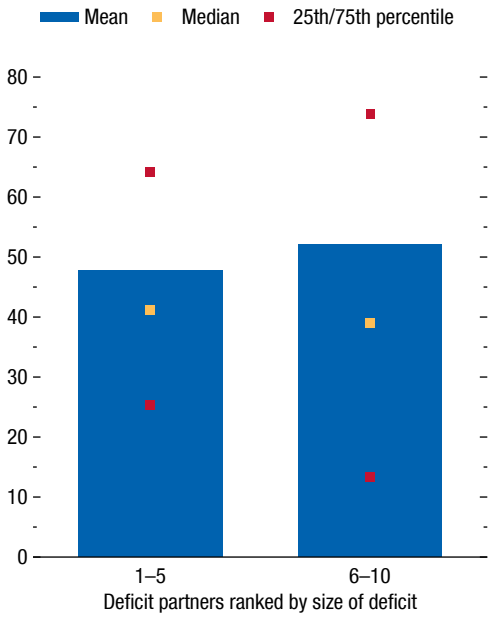
Will a policy of targeting bilateral trade deficits reduce a country's overall current account deficit? This box tackles this question by documenting the role of bilateral trade balances in past episodes of large trade deficit adjustments. The results suggest that (1) overall trade deficit adjustments are not necessarily driven by disproportionate or large trade adjustments of trading partners with the biggest deficits; and (2) large adjustments of these high-deficit trading partners are no guarantee that large adjustments in overall trade balances will take place.

Large Trade Deficit Reversal Episodes

Following the literature on current account deficit reversals (see Milesi-Ferretti and Razin 1998), episodes of large trade deficit adjustments are identified using three criteria: (1) the average reduction in the overall trade deficit is at least 3 percentage points of GDP over three years relative to the three-year average before the event, (2) the maximum trade deficit in the three years after the reversal is lower than the minimum deficit in the three years preceding the reversal, and (3) there is no other episode in the following six years. Episodes of large bilateral trade deficit adjustments relative to the trading partners with the five biggest deficits are then computed using the same concept.[1]

Using IMF Direction of Trade Statistics data from 1980–2017 for countries with nominal GDP above the world median in 2017 (excluding fuel exporters), 92 large deficit-adjustment episodes were identified. Of these, only 17 percent (16 out of 92) were associated with large bilateral trade adjustment by at least one of the five biggest deficit partners. Results are generally robust to the adjustment threshold for bilateral trade adjustments (for example, a lower threshold of 2½ percentage points would increase the number of episodes with large bilateral trade adjustments from 16 to 22). The findings suggest that the overall trade adjustments are not generally driven by large adjustments in a country's top trading partners (Figure 4.10 in Chapter 4, blue bar). Interestingly, in many cases, large adjustments in at least one of the five biggest deficit partners took place without a large reversal in the overall trade deficit (Figure 4.10 in Chapter 4, orange bar), suggesting that large adjustments of key bilateral deficit partners do not guarantee large adjustments in the overall trade balance.

Figure 4.3.1. Improvement in Bilateral Trade Deficits during Overall Trade Deficit Reversal Episodes
(Percent)



Source: IMF, Direction of Trade Statistics database.
Note: Improvement in bilateral trade balance deficit to GDP relative to initial level is calculated using the following formula: change in bilateral trade balance to GDP (between three-year average of trade balance to GDP prior to reversal and three-year average after the reversal) relative to the absolute value of initial bilateral trade balance to GDP level (three-year average of trade balance to GDP prior to reversal year). Positive value represents improvement in trade balance deficit against deficit trading partners.

How Broad Based Are Trade Deficit Adjustments?

As expected, absolute adjustments are concentrated at the top. The five biggest deficit partners are, on average, responsible for 54 percent of deficit correction, the next five are responsible for 12 percent of the correction, and the following five explain 8 percent of the correction. These results are not surprising, given that trade is fairly concentrated across trading partners, especially in advanced economies, where about half of trade is conducted with fewer than six partners.

Relative adjustments, however, are more evenly distributed. Adjustments are generally broad based or proportional across trading partners, such that the

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[1]To be conservative, the episodes of large bilateral trade deficit adjustments are initially computed using the first two requirements and then matched with the overall episodes. For bilateral episodes matched with overall episodes, any further bilateral episode within plus or minus six years is removed from the sample. Bilateral episodes happening outside overall reversal episodes are based on the remaining sample.

Box 4.3 *(continued)*

improvement in bilateral trade balances—adjusted for their initial trade balance—is similar across the top five and the sixth to tenth deficit partners (Figure 4.3.1). Specifically, the mean adjustment for the top five deficit partners is about 48 percent of their initial level, slightly lower than 52 percent of adjustment by the deficit partners ranked six to ten. Regression analysis confirms that all trading partners (top or bottom) contribute to trade deficit adjustments and that disproportionate reductions in the trade balances with top trading partners are by no means a necessary condition for the overall trade balance reduction.

In sum, the findings in this box suggest that targeting bilateral trade balances would likely not help to reduce a country's overall current account deficit. This is consistent with the conventional economic wisdom that changes in current account balances—the difference between national saving and investment—is best achieved through adjustments to macroeconomic policies, not trade policies.

Box 4.4. The Global Macro and Micro Effects of a US–China Trade Dispute: Insights from Three Models

Recent trade measures between the United States and China have revived interest in the macroeconomic effects of tariffs. Because most of the tariffs (implemented or envisaged) target trade between two large economies, an important question is the extent to which other countries not directly involved in the dispute (third countries) could be affected. The possible spillovers are both macro—affecting GDP and overall trade—and micro—including value-chain and sectoral disruptions.

This box provides a range of estimates for China, the United States, and third countries, in a hypothetical and illustrative scenario in which tariffs on all US–China goods trade increase by 25 percentage points. It covers a range of models used by macroeconomists, trade policy experts, and academic trade theorists: a dynamic stochastic general equilibrium model of the global economy (the IMF's Global Integrated Monetary and Fiscal model, or GIMF); a multisector perfect-competition computable general equilibrium model often used for trade policy analysis (the Global Trade Analysis Project, or GTAP); and a multisector heterogenous-firm model with entry and exit à la Melitz (Caliendo and others 2017, henceforth CFRT). Each model emphasizes different transmission channels.[1] GIMF focuses on the aggregate effects over time, with a distinction between the short term, during which nominal and real rigidities tend to amplify the expenditure-switching effects of tariffs, and the medium to long term, during which the effect stems mainly from the (distortionary) permanent impact of tariffs on the levels of key factors of production, capital, and labor. Given their rich sectoral and regional disaggregation, the two trade models (GTAP and CFRT) emphasize, instead, the disruption that tariffs cause by reallocating factors of production—inefficiently and unevenly—across sectors within countries over the medium to the long term. In CFRT, the extent of reallocation is amplified by the presence of increasing returns to scale associated with firm-level fixed costs of entering domestic and export markets.

Two preliminary remarks are in order. First, the emphasis of this box is on trade-related channels. The negative spillovers from trade policy uncertainty were previously analyzed with GIMF in the October 2018 *World Economic Outlook* and are not included here. Second—and as is typical in trade policy simulations—the results depend crucially on the ease with which producers can substitute inputs from different countries (trade elasticities). In line with estimates found in the literature, results are based on a calibration in which substitution between any two foreign suppliers is easier than substitution between a foreign supplier and a domestic firm.[2] This tends to amplify the (positive) effects on third countries, given that production tends to be diverted toward them rather than re-shored to the countries imposing the tariffs.

Effects on the United States and China

Figures 4.4.1 and 4.4.2 show that the United States and China suffer the largest losses. This result is broadly robust across models. The starting point is a collapse in

The authors of this box are Carlos Caceres, Diego Cerdeiro, Rui Mano, Rafael Portillo, and Marika Santoro.

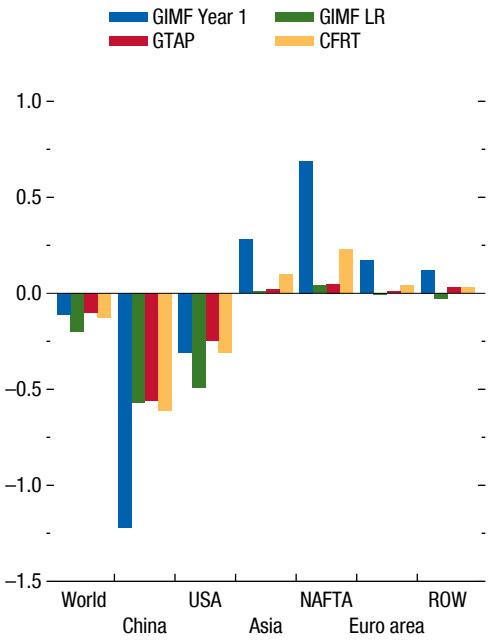
[1]All models feature trade in intermediate goods, though to a varying degree, depending on the extent of the sectoral and regional disaggregation in the model.

[2]This is the case in both trade models and in the short term in GIMF. The elasticities between domestic and foreign production in CFRT are calibrated using the estimates in Feenstra and others (2018); they broadly match the elasticities in GTAP.

Box 4.4 *(continued)*

Figure 4.4.1. Macro Effects from a 25 Percent Increase in Tariffs Affecting All US–China Trade: Real GDP

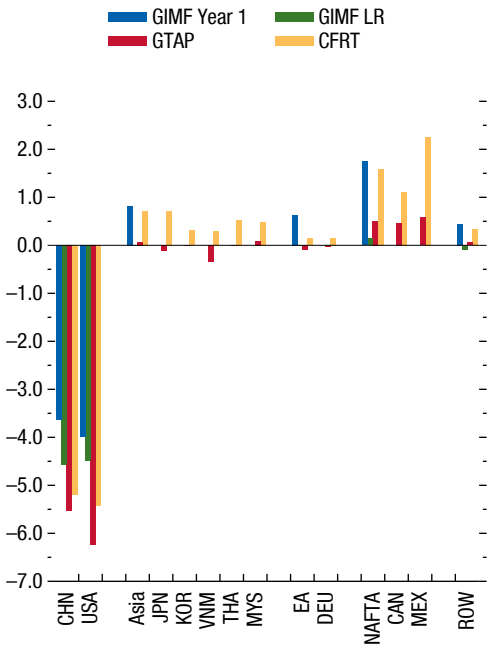
(Percentage point change from baseline)



Source: IMF calculation using the model in Caliendo and others (2017).
Note: CFRT = Caliendo and others (2017) model; EA = euro area; GIMF = Global Integrated Monetary and Fiscal model; GTAP = Global Trade Analysis Project; LR = long run; NAFTA = North American Free Trade Agreement; ROW = rest of the world.

Figure 4.4.2. Macro Effects from a 25 Percent Increase in Tariffs Affecting All US–China Trade: Real Exports

(Percentage point change from baseline)



Source: IMF calculation using the model in Caliendo and others (2017).
Note: CFRT = Caliendo and others (2017) model; EA = euro area; GIMF = Global Integrated Monetary and Fiscal model; GTAP = Global Trade Analysis Project; LR = long run; NAFTA = North American Free Trade Agreement; ROW = rest of the world. Data labels use International Organization for Standardization (ISO) country codes.

US–China trade, which falls by 25–30 percent in the short term (GIMF) and somewhere between 30 percent and 70 percent over the long term, depending on the model and the direction of trade (Table 4.4.1). The decrease in external demand leads to a decline in total exports and in GDP in both countries. Annual real GDP losses range from –0.3 percent to –0.6 percent for the United States and from –0.5 percent to –1.5 percent for China. The effect on China is typically larger across all models, as exports to the United States represent a larger share of the Chinese economy (than vice versa). In GIMF, the effects on China are more pronounced in the short term, given that wages and prices do not adjust sufficiently to help offset the decrease in external demand; the negative effects on the United States become larger over the long term, as higher tariffs and a more appreciated exchange rate (not shown) lower the returns to capital. In CFRT, instead, the effects on China are amplified by the loss of economies of scale. The asymmetry in the effects of the tariff dispute is also reflected in each country's terms of trade: these improve in the United States and worsen in China. Finally, although the US–China bilateral trade deficit is reduced, there is no economically significant change in each country's multilateral trade balance.[3]

Macro Spillovers

Figure 4.4.2 and Table 4.4.1 show the effects on total exports and bilateral exports to China and the United States by regions of the world and selected

[3]The latter result (shown in Table 4.4.1) is based on GIMF simulations only, as the two trade models are solved under the explicit assumption that each country's multilateral trade balance does not change.

Box 4.4 *(continued)*

Table 4.4.1. Macro Effects from a 25 Percent Increase in Tariffs Affecting All US–China Trade: Bilateral Trade Flows with Third Countries

	GIMF		GTAP	CFRT
Macro Variables	Year 1	Long Run		
Trade Balance (percent of GDP)				
China	–0.2	–0.3	. . .	. . .
United States	–0.2	–0.3	. . .	. . .
Exports to the United States				
China	–20.9	–25.1	–71.3	–56.0
Asia	3.7	1.8	10.6	7.7
Japan	. . .	. . .	9.2	5.8
Korea	. . .	. . .	10.3	7.7
Vietnam	. . .	. . .	13.9	9.7
Thailand	. . .	. . .	10.8	9.3
Malaysia	. . .	. . .	10.9	7.7
Euro Area	3.8	1.7	8.4	5.7
Germany	. . .	. . .	8.6	4.9
NAFTA	2.6	0.7	3.2	3.2
Canada	. . .	. . .	7.5	2.5
Mexico	. . .	. . .	2.8	4.3
Rest of the World	3.1	1.7	6.1	5.8
Exports to China				
United States	–27.5	–36.4	–77.6	–63.7
Asia	0.5	–1.5	–4.9	–1.1
Japan	. . .	. . .	–5.3	–0.8
Korea	. . .	. . .	–5.3	–1.3
Vietnam	. . .	. . .	–3.4	–3.4
Thailand	. . .	. . .	–4.4	–2.1
Malaysia	. . .	. . .	–4.9	–0.6
Euro Area	1.3	–1.6	–4.3	–1.4
Germany	. . .	. . .	–4.4	–1.4
NAFTA	–0.4	–2.6	–4.4	–2.9
Canada	. . .	. . .	–0.1	–2.8
Mexico	. . .	. . .	–6.3	–3.5
Rest of the World	–0.1	–1.6	–1.0	–2.8

Source: IMF staff calculations.
Note: CFRT = Caliendo and others (2017); GIMF = Global Integrated Monetary and Fiscal model; GTAP = Global Trade Analysis Project.

countries.[4] A very robust result across models is that, while third countries experience an increase in exports to the United States, they also experience a decrease in exports to China. Much of the trade diversion at the global level is therefore about third countries increasing their exports to the United States at the expense of China (as well as importing more intermediate goods from China; more on this follows). The effect on third countries' overall exports is, in general, positive, with Mexico and Canada benefitting the most, thanks to their proximity to, and strong trade relations with, the United States. Across models, the increase in third-country exports is most notable in GIMF in the short term and in CFRT, with GTAP showing weaker, and in some cases negative, responses.

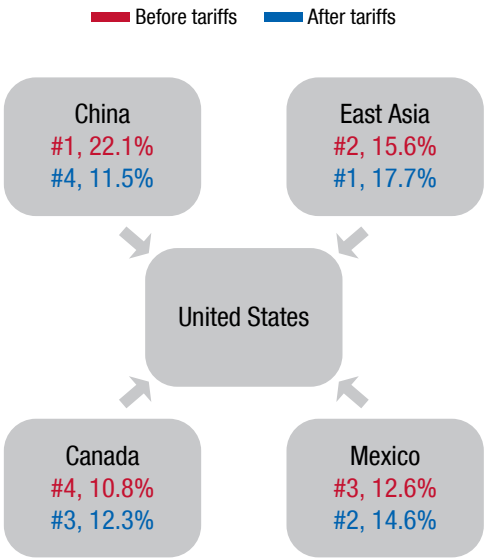
There is more variation across models in terms of the effects on output in third countries, though these are typically modest in size. GIMF shows positive effects in the short term, including relatively large ones in other North America (excluding the United States), which reflect the strength of trade diversion in the presence of nominal rigidities.[5] The effects are small but negative over the long term, however, in every region except other North America (excluding the United States), as some of the capital-reducing distor-

[4]This version of GIMF includes four other regions (Asia excluding China, North America excluding the United States, the euro area, and remaining countries) besides the United States and China.

[5]As already mentioned, this study does not focus on possible trade-policy-related uncertainty, which can create short-term negative spillovers for third countries that can more than offset the positive effects from the trade diversion.

Box 4.4 *(continued)*

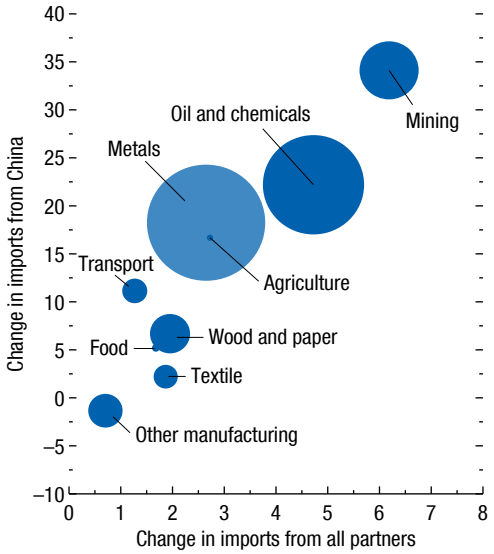
Figure 4.4.3. US Imports of Electronics and Machinery before and after Tariffs



Sources: Caliendo and others (2017) model; and IMF staff calculations.
Note: #x means rank, xx% means share in total US imports of electronics.

Figure 4.4.4. Mexico's Imports of Intermediate Inputs for the Electronics and Manufacturing Sectors

(Percent of GDP)



Source: IMF staff calculations.
Note: Excluding machinery and electronics. Dot size is proportional to input intensity in Mexico's machinery and electronics sector.

tions from higher tariffs mentioned earlier spill over to third countries. GTAP shows positive but small effects, while CFRT shows a number of countries (such as Mexico, Canada, Malaysia, Thailand, and Korea) experiencing a relatively large expansion in output and benefiting from economies of scale.

Sectoral Reallocations across Countries

Results from the two trade models illustrate that, while, in the aggregate, the spillovers tend to be moderate, this is not true at the sectoral level. The manufacturing sector shows a large worldwide contraction, with major fallout in the electronics and other manufacturing sectors in China (see Figure 4.13 in the main text). In contrast, manufacturing sectors expand in Mexico, Canada, and in Asian countries. Services expand in China and contract in the other countries mentioned previously, while the US agricultural sector experiences a sizable contraction. The magnitude of the reallocation varies across models; it is larger in CFRT due to economies of scale.

These sectoral reallocations imply sizable job losses in specific sectors, which compound the macroeconomic adjustment for those experiencing an overall contraction (mainly the United States and China). For example, in CFRT, large sectors in both countries shed a significant number of jobs—about 1 percent of the workforce in the US agricultural and transportation equipment sectors, and 5 percent in China's other manufacturing sector.

Repositioning of Global Value Chains

Finally, the sectoral reallocations also have implications for global value chains and the structure of international trade. The electronics and machinery sector provides a good illustration, given its importance in global trade (about 20 percent of world imports). In CFRT—the model in which the reallocation effects are most pronounced—China would eventually stop being the number one exporter of electronics and machinery to the United States, with other countries in Asia, Canada, and Mexico replacing China (Figure 4.4.3). In, for example, Mexico, the sizable entry of new firms into the electronics sector would then lead to large increases in imports of intermediates from everywhere else and especially from China (Figure 4.4.4).

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