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POLICY BRIEF

16-15 Increased Trade: A Key to Improving Productivity

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Global trade growth slowed abruptly after 2010, following decades of expansion. According to the World Trade Organization (WTO), 2015 marked the fourth consecutive year in which annual world merchandise trade growth stayed below 3 percent. The WTO forecasts growth in global trade volume to remain sluggish in 2016, at 2.8 percent.[1]

A variety of reasons have been cited for the decelerating growth of trade: sluggish world economy, shorter supply chains, absence of new liberalization on a global scale, and rise of microprotectionism.[2]

As global trade has slowed, the growth rate of productivity—defined as output per hour worked—is declining worldwide.[3] Labor productivity growth has slowed markedly since the global financial crisis in most advanced countries and many emerging-market economies (OECD 2016).

The decline in productivity has been a puzzle to many economists—and a concern to policymakers, because productivity growth is a key component of economic growth and rising living standards. Economists disagree about the cause of the decline. Some argue that productivity has improved more than what statistics indicate. Others cite the slowdown in capital investment by both the private and public sectors, as well as the absence of technological breakthroughs and lagging expenditure on research and development (R&D). Still others cite the influx of younger, less skilled employees replacing retired workers.

...had US two-way trade grown at its historical annual rate of 5.86 percent between 2011 and 2014, annual US productivity growth would have been substantially higher than what it was over those four years.

This *Policy Brief* examines an additional factor: the possibility that reduced volumes of trade have impeded growth in

1. "Trade Growth to Remain Subdued in 2016 as Uncertainties Weigh on Global Demand," World Trade Organization Press Release 768, April 7, 2016, www.wto.org/english/news_e/pres16_e/pr768_e.htm (accessed on July 14, 2016).

2. Gary Clyde Hufbauer and Euijin Jung, "Why Has Trade Stopped Growing? Not Much Liberalization and Lots of Micro-Protection," Trade and Investment Policy Watch blog, March 23, 2016, https://piie.com/blogs/trade-investment-policy-watch/why-has-trade-stopped-growing-not-much-liberalization-and-lots (accessed on July 11, 2016). In *Global Trade Plateaus: The 19th Global Trade Alert Report*, Evenett and Fritz (2016) argue that corrections made by international organizations (notably the World Bank and the International Monetary Fund) for changes in the prices of traded goods are flawed. A more credible data source, according to them, is the World Trade Monitor from the Netherlands Bureau of Economic Policy Analysis (CPB), which reports high-quality monthly data on merchandise trade volumes. The WTO (2011) refers to the CPB as "a timely indication of current trends in the volume of world trade"; Barhoumi and Ferrara (2015) call it "the benchmark indicator for world trade." Evenett and Fritz (2016) use CPB data to show that world export volumes have not grown at all since 2015, in advanced economies or emerging markets. The duration of the current trade plateau is unusually long for the period since the fall of the Berlin Wall.

3. For more detail, see "Making Sense of the Productivity Slowdown, Panel 2: Comparative National Perspectives on the Slowdown," Event Recap, Peterson Institute for International Economics, November 16, 2015, https://piie.com/events/making-sense-productivity-slowdown (accessed on July 11, 2016).

productivity because of diminished competition in national economies and the shrinking role of comparative advantage. Our calculations suggest that had US two-way trade grown at its historical annual rate of 5.86 percent between 2011 and 2014, annual US productivity growth would have been substantially higher than what it was over those four years.

The first section explains why trade is critical to productivity growth by describing the basic Ricardian model and more recent theories about the differences between high- and low-productivity firms in a national economy (firm heterogeneity). These theories lay the foundation for the second section, a review of the empirical literature, which shows evidence on trade-induced productivity gains. The third section presents data on the US economy that document the trade stagnation and productivity slowdown in recent years. It considers—and ultimately rejects—the mismeasurement hypothesis (the argument that conventional statistics miss the contributions of information technology). The fourth section speculates about how productivity might have grown had trade continued growing at its historical rate. It shows that, although factors other than trade—notably physical and human capital accumulation and path-breaking innovations—also drive productivity, the negative contribution of sluggish trade growth is significant. According to our calculations, if US trade had increased at its historical rate, that would have delivered a $74 billion increase in US GDP through supply-side efficiencies in 2014. The concluding section examines the findings in the context of the current antitrade atmosphere in the United States and calls for policies that support freer trade and thus foster productivity growth.

I HOW ARE TRADE AND PRODUCTIVITY LINKED?

Two major trade theories explain the connection between trade and productivity. The Ricardian model features the concept of comparative advantage. A less well-known theory, developed in the 21st century, features the interaction between heterogeneous firms and international trade.

Comparative Advantage and the Ricardian Model

David Ricardo launched the idea of comparative advantage in his 1817 book *On the Principles of Political Economy and Taxation,* which he famously illustrated with the example of England and Portugal producing cloth and wine. James Mill (1844) and his son John Stuart Mill (1848) extended the Ricardian model.

Comparative advantage illustrates why countries trade and how international trade can make every worker in each country better off.[4] To understand the concept, imagine a world with two countries, A and B. Both countries produce computers and cotton. Labor is the only factor of production, labor supply is fixed in both countries, and workers are fully employed. Country A produces one bale of cotton using the same amount of labor it uses to produce one computer. Country B produces one bale of cotton using the same amount of labor it uses to produce three computers (table 1). Country A therefore produces cotton at a lower opportunity cost than Country B. It has a comparative advantage in producing cotton. Country B has a comparative advantage in producing computers.

Table 1 Hours of labor required for a unit of production

Country	Computer	Bale of cotton
Country A	1 hour	1 hour
Country B	2 hours	6 hours

In this example, Country A enjoys an absolute advantage in producing both goods (it takes less time to produce a computer and less time to produce a bale of cotton). But what matters for international trade is not absolute advantage but comparative advantage. If Country A specializes in producing cotton and Country B specializes in producing computers and the two countries trade, total production of both products will increase with the same level of labor inputs. Both Country A and Country B can enjoy a higher level of consumption (or national income). As a result, labor productivity—output per unit of labor—increases. Trade leads to higher productivity because each country specializes in what it produces best.

To illustrate further, suppose each country has 24,000 worker-hours, 6,000 of which are spent producing computers and 18,000 of which are spent producing cotton. Table 2 shows output and consumption in each country under autarky (economic self-sufficiency) and total output of computers and cotton by the two countries combined.

Once trade opens, all workers in Country A will produce cotton, and all workers in Country B will produce computers—even though Country A is better at producing both. World production of both goods rises as a result of the increase in productivity associated with specialization.

4. At least since Nicholas Kaldor (1970), economists have recognized that the gains from international trade are seldom, if ever, redistributed in a manner that ensures that every worker is better off compared with the status quo ante. Gains usually exceed losses by a large multiple, but those who lose within a country are seldom compensated, even though each country in the aggregate is better off.

Table 2 Units produced and consumed using 24,000 labor hours in each country under autarky

	Computers		Cotton	
Country	Production	Consumption	Production	Consumption
A	6,000	6,000	18,000	18,000
B	3,000	3,000	3,000	3,000
Total (A + B)	9,000	9,000	21,000	21,000

Table 3 Units produced and consumed with specialization and trade using 24,000 labor hours in each country

	Computers		Cotton	
Country	Production	Consumption	Production	Consumption
A	0	8,000	24,000	20,000
B	12,000	4,000	0	4,000
Total (A + B)	12,000	12,000	24,000	24,000

Suppose the international terms of trade (determined by demand conditions) settles at two computers per bale of cotton. Country A could exchange 4,000 bales of the cotton it produced for 8,000 computers that Country B produced (table 3). As a result, Country A consumes 2,000 more computers and 2,000 more bales of cotton than it did under autarky, and Country B consumes 1,000 more of each product. International trade benefits both countries, even though Country A enjoys an absolute advantage in producing both goods.

Heterogeneous Firms and International Trade

The Ricardian model assumes that each economy has only one factor of production, labor. Later trade models incorporated more than one factor of production and allowed varying degrees of factor mobility across industries, notably the specific factors model and the Heckscher-Ohlin model.[5] These models extended the Ricardian model, focusing on cross-country differences. They treated firms within each industry in an economy as homogeneous (that is, products and productivity were identical across firms within an industry) and thus emphasized resource allocation across industries.[6]

The homogeneity assumption is unrealistic, because firms differ widely in size, productivity, and performance. To take firm-level differences into consideration, economists—led by Paul Krugman (1979, 1980)—built models under the framework of monopolistic competition with differentiated products and economies of scale (see also Melitz 2002, Melitz and Ottaviano 2005, and Bernard et al. 2003).

In these models, trade supports productivity growth by forcing the least productive firms to exit the industry and reallocating their resources to more productive firms in the same industry. Although the theoretical models are complex, the logic is simple: When the domestic market opens to foreign competitors, domestic firms face more intense competition than they do in a closed economy. Meanwhile, better market access abroad enables the most productive companies to expand their exports, drawing resources from less productive firms.[7] Highly productive firms bid up the prices of factors of production (labor, for example). Competition from abroad and higher factor prices at home force the least efficient firms to shut down and exit their industries. As a result, labor and capital previously engaged by exiting firms are released and bid up by more productive firms in the industry. By closing the least productive firms and reallocating resources to more productive ones, international trade raises the overall productivity level of each industry.[8]

5. In the basic specific factors model, there are two goods and three factors of production: labor, capital, and land. Labor is mobile and can move between sectors; capital and land are immobile and specific to certain industries. In the basic Heckscher-Ohlin model, there are two goods and two factors of production: labor and capital. Both factors are mobile across industries.

6. All trade theories that assume firm homogeneity—the Ricardian model, the specific factors model, and the Heckscher-Ohlin model—suggest that international trade benefits the economy as a whole. They also indicate that trade has strong effects on the distribution of income. In the specific factors model, trade benefits the factor that is specific to the export sector of the economy, hurting the factor that is specific to the import sector of the economy. The effect on the mobile factor is ambiguous. In the Heckscher-Ohlin model, trade increases the real return to the economy's relatively abundant factor but makes owners of the relatively scarce factor worse off. (For a more detailed discussion of income distributions, see chapters 4 and 5 of Krugman, Obstfeld, and Melitz 2011.) The distribution issue makes protectionism understandable: Although international trade brings a bigger pie, it may reduce the size of some slices. Political debates focus on how much each sector, and each decile of the income distribution, gets from international trade.

7. Abundant evidence shows that exporting firms are larger and more productive than firms that do not engage in international trade. See, for example, Biesebroeck (2003), Bernard et al. (2007), De Loecker (2007), and Wagner (2007). Exporters can usually apply a reservoir of firm-specific knowhow at low marginal cost to facilitate their incremental sales in foreign markets.

8. This line of literature usually focuses on productivity gains induced by trade in final goods. Another line of research focuses on trade in intermediate goods, arguing that productivity gains stem from more varieties, higher qualities, and learning effects through broader access to intermediate inputs. Theoretical models include Ethier (1979) and Markusen (1989). Empirically, Amiti and Konings (2007), Goldberg et al. (2008), and Kasahara and Rodrigue (2008) all find that intermediate imports or input tariff liberalization raises productivity.

II WHAT DOES THE EVIDENCE SHOW?

Rigorous empirical research connects trade and productivity. Two types of studies have been conducted: aggregate country-level studies and disaggregated industry- or firm-level studies.

Evidence from Aggregate Country-Level Studies

Aggregate country-level studies usually start by defining a country's "openness" to international trade, using particular metrics, and then try to test the link between openness and productivity growth. Coe and Helpman (1995) sampled 21 OECD countries plus Israel during 1971–90. They defined a concept called *foreign R&D capital stocks* by taking the weighted sum of each country's trading partners' cumulative R&D expenditures based on import shares for the target country. Their analysis found a positive relationship between foreign R&D capital stocks and total factor productivity (TFP): They uncovered a feature of globalization, in addition to domestic physical and human capital accumulation, that contributes to long-run economic growth. Foreign R&D capital stocks embodied in exported goods and services transmit positive technology spillovers to the importing country, which raise its productivity.

Using an expanded dataset and modern econometric techniques, Coe, Helpman, and Hoffmaister (2009) confirm the earlier conclusions. Alcala and Ciccone (2004) define "real openness" as imports plus exports relative to GDP, measured in purchasing power parity. Their regression results suggest that trade has a positive, statistically significant, and robust effect on productivity.

Although empirical studies along this line provided evidence of the positive effect of trade on productivity, they were often subject to the critique that openness indices vary widely in quality. Recognizing the difficulty of finding a satisfactory indicator of openness, Edwards (1998) turned in another direction. Based on a dataset of 93 countries, he tested the relationship between TFP growth and trade using nine distinct openness indices that covered different aspects of trade policy. He found significant coefficients in 13 of his 18 trials (70 percent), indicating that more open countries experience faster TFP growth.[9] Given the robustness of the findings, he concluded that a more open trade environment delivers productivity growth.

Evidence from Disaggregated Micro-Level Studies

All cross-country analyses are subject to the criticism of unobserved heterogeneity—the fact that country-specific characteristics not included in the model may be correlated with explanatory factors in the model, biasing the estimates. Although consistent industry- or firm-level data are usually more difficult to obtain, many researchers have focused on micro-level firm or industry activities within a country in order to circumvent this problem.[10]

Studies that address firm heterogeneity show evidence of trade-induced productivity gains. Bernard, Jensen, and Schott (2006) investigate US manufacturing industries and plants from 1977 to 2001. They find that greater exposure to trade via declining trade costs supports aggregate industry-level productivity.[11] Pavcnik (2002), Muendler (2004), Eslava et al. (2013), and Trefler (2004)—on Chilean trade liberalization, Brazilian trade reform, Colombian trade reform, and Canadian industries following the Canada-US Free Trade Agreement, respectively—also find positive impacts of trade liberalization on industry-level productivity as a result of the reallocation effect of international trade.

Some studies also find within-plant productivity improvements. Pavcnik (2002) finds that following trade liberalization, firms facing import-competing goods raised their productivity by 3 to 10 percent on average over firms that did not face international competition. Muendler (2004) and Bernard, Jensen, and Schott (2006) draw similar conclusions. These findings, which are consistent with results from Aghion et al. (2005), suggest that in addition to resource reallocation, which improves industry-level productivity, trade can induce innovation and invention by firms facing competition from foreign competitors, which also improves plant productivity.

III TRADE STAGNATION AND THE PRODUCTIVITY SLOWDOWN IN THE UNITED STATES

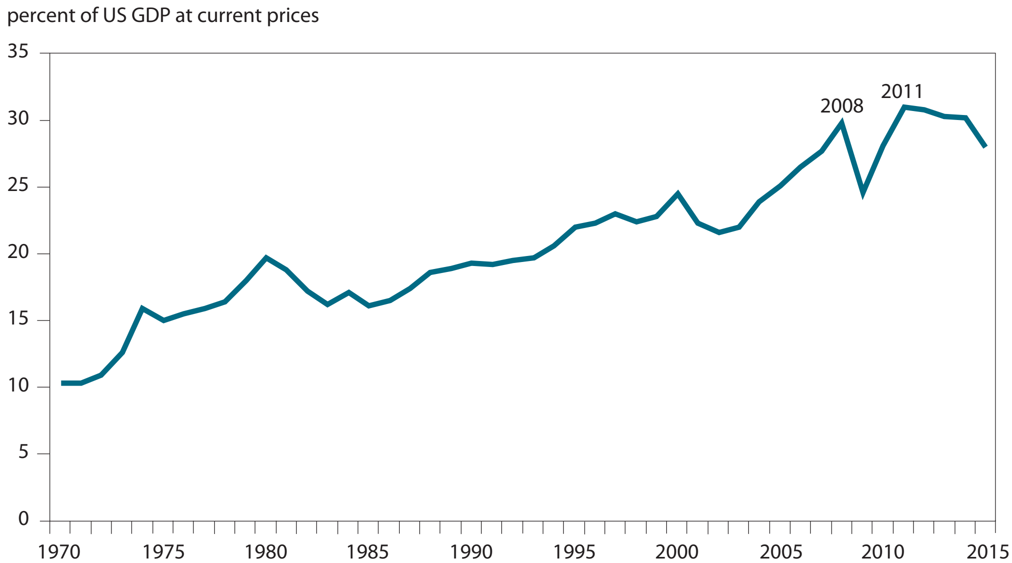
The trade-to-GDP ratio is one of the most prominent indicators used to assess trade dynamics. The US ratio of two-way trade in goods and services to GDP increased sharply, from 10 percent in 1970 to a peak of 30 percent in 2008 (figure 1). The financial crisis triggered a precipitous fall in US trade in 2009, followed by a sharp recovery in 2010. Since 2011, the US trade-to-GDP ratio has been roughly flat, although

9. Coefficients of the openness indicator in all but 1 of the 18 estimated equations have the expected sign. Of the 17 equations with the expected sign, the openness indicator is significant in 13.

10. Such studies also face the issue of unobserved heterogeneity, but the problem seems less pervasive.

11. Trade costs in this study include not only transportation costs but also average tariffs.

Figure 1 US two-way nominal trade in goods and services, 1970–2015



Source: US Bureau of Economic Analysis.

it declined in 2015. Annual growth in the US trade-to-GDP ratio enjoyed a historic average annual increase of 3.1 percent between 1970 and 2008; but between 2011 and 2015 the increase averaged just 0.1 percent.[12]

Figure 1 indicates stagnation in nominal US trade relative to GDP since 2011. However, nominal values are subject to volatile commodity prices: A sharp decline in commodity prices can depress the growth of trade relative to GDP. Commodity prices have been falling since 2011, especially in the energy sector (figure 2). The price index for petroleum, the biggest component of the energy sector, plummeted from 249.7 in July 2008 to 77.7 in December 2008, as the financial crisis engulfed the world economy (figure 3). The index recovered to 218.8 in April 2011, but it plunged after June 2014 to reach 68.6 by the end of 2015, as a result of sluggish world growth and rising US production of shale oil.

Oil trade makes a limited contribution, if any, to US labor productivity performance. It is therefore excluded from the analysis. Trade henceforth refers to trade in nonoil goods and services. To better assess the trade dynamics of the US economy, each trade component is deflated by its corresponding implicit GDP deflator (from the US Bureau of Economic Analysis) to get real trade values.[13]

The adjusted US ratio of two-way trade in nonoil goods and services to GDP tells a different story from figure 1.[14] This ratio increased 10 percentage points, from 14 percent in 1989 to a peak of 24 percent in 2008, with fluctuations (figure 4).[15] Since the Great Recession, real nonoil trade has been growing relative to GDP, but at a slower rate. Between 1990 and 2008, the US ratio of trade in nonoil goods and services to GDP grew by 3.0 percent a year. That rate fell to 2.3 percent after 2011, the lowest five-year annual growth in the nonoil trade-to-GDP ratio the US economy has experienced since 1989, apart from recovery periods following the dot-com recession and the Great Recession.

Many explanations of trade slowdown (relative to GDP) have been put forth, such as the investment slump

12. The years 2009 and 2010 are excluded from these comparisons because US trade experienced an abnormally sharp decline followed by an unusually sharp rebound, as a result of the financial crisis.

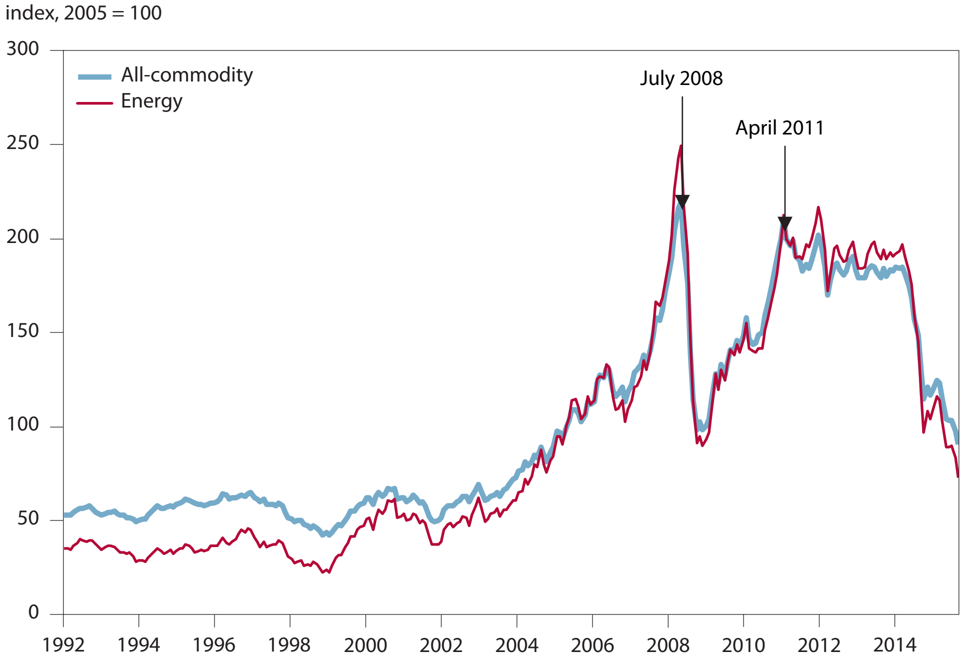
13. The base year of the implicit GDP deflators is 2009. The four components of trade are exports of nonoil goods, imports of nonoil goods, exports of services, and imports of services. The nominal value of each component in each year is deflated by its implicit GDP deflator for that year.

14. The adjusted trade-to-GDP ratio =

$$\frac{\text{real trade values according to authors' calculations}}{\text{real GDP in chained 2009 dollars from the Bureau of Economic Analysis}}$$

15. The adjusted trade-to-GDP ratio starts from 1989, the earliest year for which the US Bureau of Economic Analysis reports detailed merchandise trade data. Some readers may be surprised by the rising trade-to-GDP ratio in 2014 and 2015 shown in figure 4. Based on data from the Netherlands Bureau of Economic Policy Analysis, US merchandise imports (including oil) grew 5.1 percent in 2014 and 6.2 percent in 2015; and US merchandise exports (including oil) grew 3.2 percent in 2014 and declined 1.1 percent in 2015. According to the US Bureau of Economic Analysis database, real US GDP at 2009 constant prices grew 2.4 percent in 2014 and 2.6 percent in 2015. These data are consistent with the growing trade-to-GDP ratio shown in figure 4.

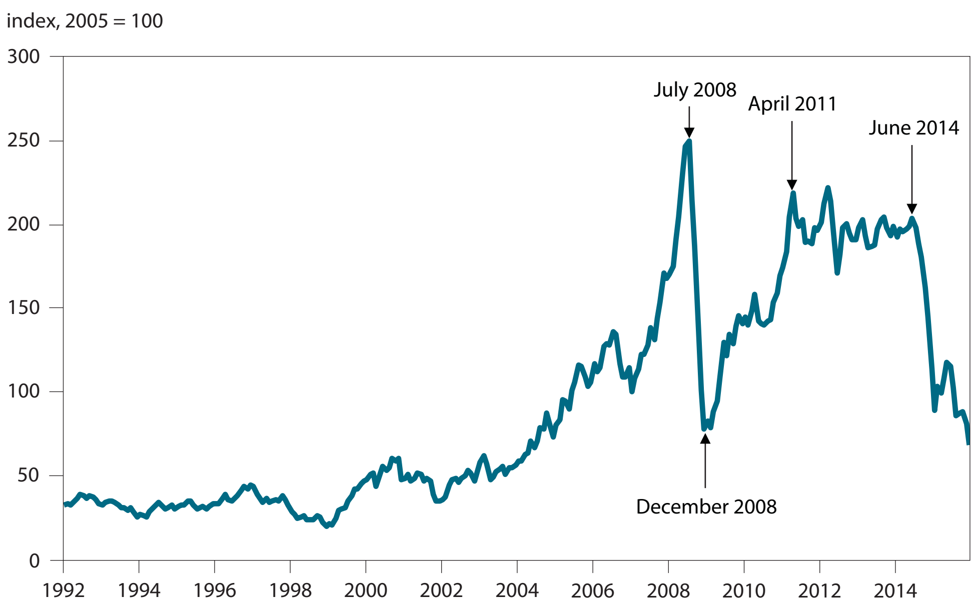
Figure 2 Energy and all-commodity price indices, 1992–2015



Note: Weights: Energy = 63.1; energy includes petroleum (weight = 53.6), natural gas, and coal. Weights are based on 2002–04 average world export earnings.

Source: International Monetary Fund.

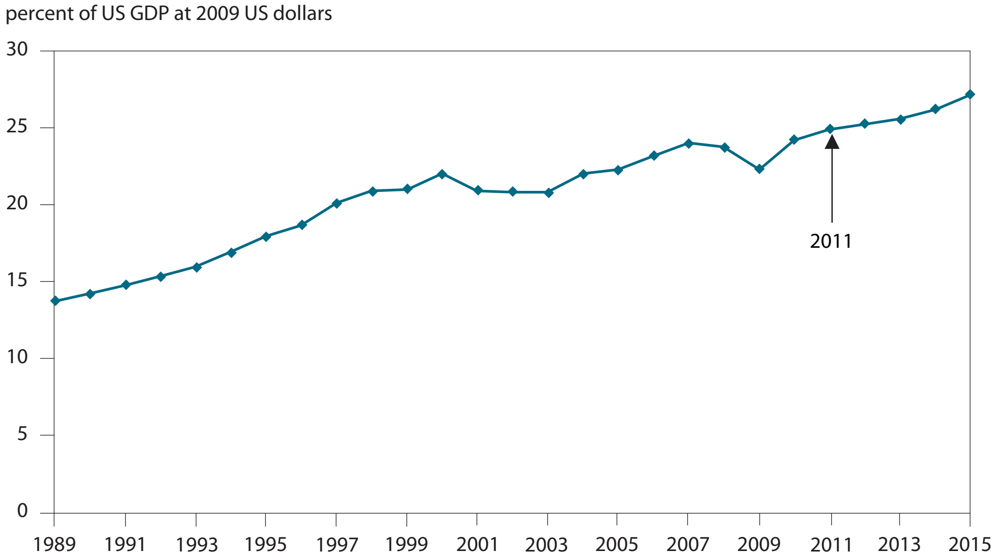
Figure 3 Spot crude petroleum price index, 1992–2015



Note: Average of UK Brent (light), Dubai Brent (medium), and West Texas Intermediate (heavy), equally weighted.

Source: International Monetary Fund.

Figure 4 US two-way real trade in nonoil goods and services, 1989–2015



Source: Authors' calculations using data from US Bureau of Economic Analysis.

and the shortening of supply chains.[16] Hufbauer and Jung (2016) identify two other reasons: the rise of "microprotection" (small-scale barriers to trade) and the absence of fresh liberalization.[17] The Great Recession sparked multiple microprotective measures, including the quiet return of old and new forms of local content requirements (LCRs). Evenett and Fritz (2016) show that products whose trade contracted the most in 2015 tended to be hit by LCRs more frequently (map 1).[18] According to the Global Trade Alert, an independent initiative that provides real-time information on state measures that are likely to affect trade, the United States implemented more than 600 discriminatory measures between November 2008 and May 2016, the most among G-20 members.

Some scholars argue that falling shipping costs in recent years should offset the negative impact of rising microprotection. However, taking all aspects of trade costs into consideration (tariffs, other barriers, shipping, communication difficulties, etc.), US trade costs appear to have increased continuously since the Great Recession. The ESCAP–World Bank Trade Cost Database reports bilateral comprehensive tariff and nontariff trade costs, based on the gravity modeling work of Anderson and van Wincoop (2003) and Novy (2012).[19] The intuition behind these models is that the magnitude of US trade flows with its trading partners, relative to US internal trade flows, reflects the burden of bilateral trade costs. Nontariff trade costs include not only transportation costs but also the costs associated with import and export procedures and differences in languages and currencies. Year-to-year changes in nontariff trade costs mainly reflect changes in trade facilitation and logistics performance. According to the database, US nontariff trade costs (expressed as an ad valorem equivalent) with major trading partners rose 5 percent since 2010, and the upward tendency continues.[20]

This trend is consistent with what industry insiders report since the Great Recession. Speaking at a Peterson Institute event in April 2016, Ralph Carter, the managing director of legal and international affairs at FedEx, said, "Very small border barriers are being put up just to slightly and subtly slow and add cost to trade. It may be an additional signature, an additional stamp, an additional document. Some

16. On the investment slump, see Caroline Freund, "The Global Trade Slowdown and Secular Stagnation," Trade and Investment Policy Watch blog, April 20, 2016, https://piie.com/blogs/trade-investment-policy-watch/global-trade-slowdown-and-secular-stagnation (accessed on August 3, 2016). On the shortening of supply chains, see Constantinescu, Mattoo, and Ruta (2015).

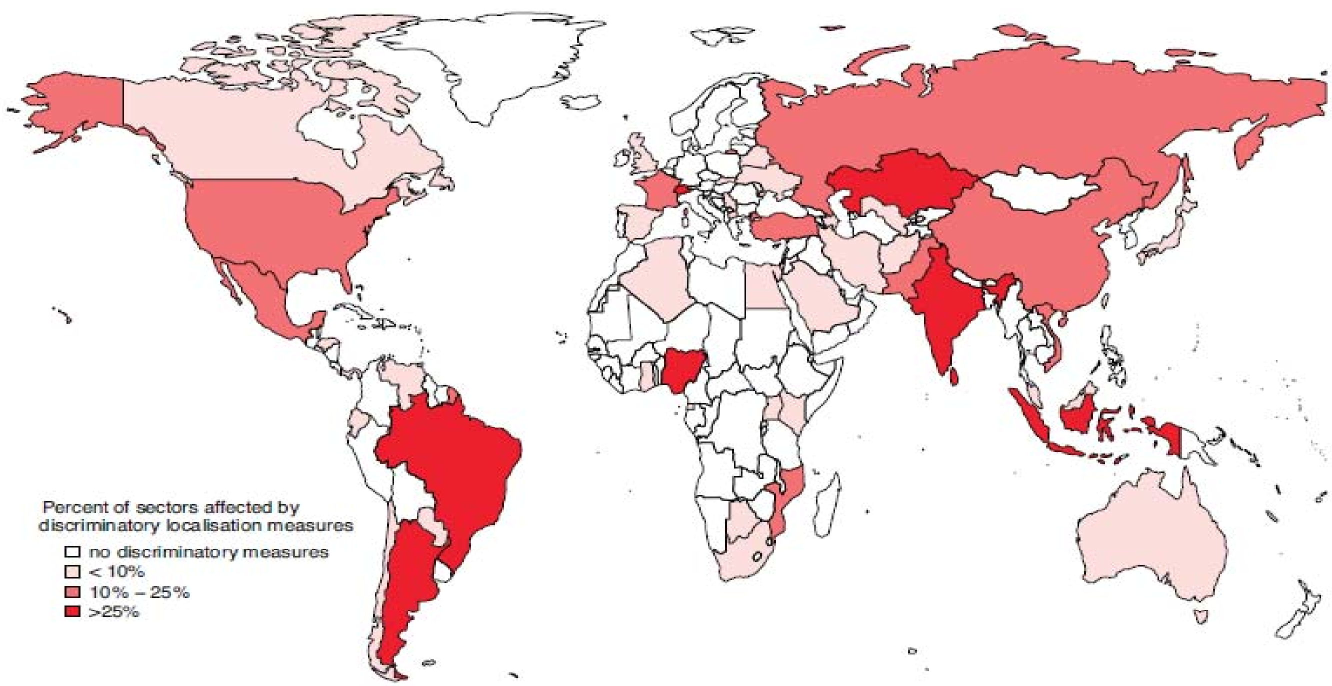
17. Gary Clyde Hufbauer and Euijin Jung, "Why Has Trade Stopped Growing? Not Much Liberalization and Lots of Micro-Protection," Trade and Investment Policy Watch blog, March 23, 2016, https://piie.com/blogs/trade-investment-policy-watch/why-has-trade-stopped-growing-not-much-liberalization-and-lots (accessed on July 11, 2016).

18. Hufbauer et al. (2013) estimate that LCRs imposed since 2008 reduced global exports by $93 billion in 2010. The figure would probably be much larger today.

19. The database is available at http://artnet.unescap.org/databases.html#first.

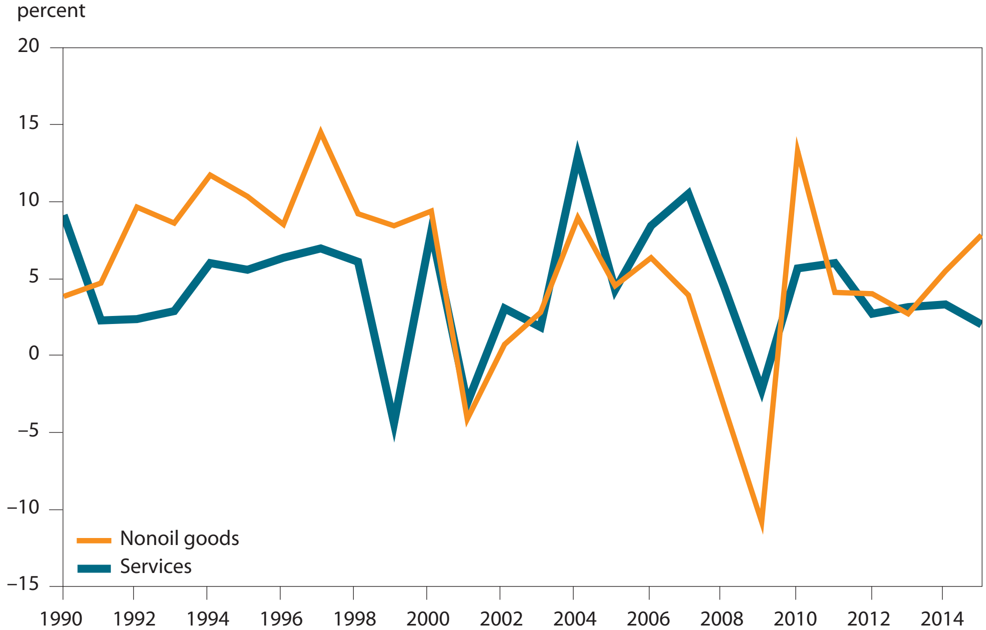
20. The first year covered by the ESCAP–World Bank Trade Cost Database is 2013. Major US trading partners included are Canada, China, France, Germany, Japan, Korea, Mexico, and the United Kingdom.

Map 1 Since the global economic crisis began, localization measures have been implemented in every continent



Source: Global Trade Alert, cited in Evenett and Fritz (2016). Reprinted with permission.

Figure 5 Annual growth of real US two-way trade in nonoil goods and services, 1990–2015



Source: Authors' calculations using data from US Bureau of Economic Analysis.

small little thing that, when you add them all up, makes the process more expensive and time consuming for companies like us, who are having to go through and get those goods cleared across the borders."[21]

More important than the rise of microprotection is the absence of fresh liberalization on a global scale after the commitments made in the Uruguay Round were fully phased in, around 2005.[22] Global tariffs on manufactures (averaging about 7 percent), still higher tariffs on agriculture (frequently exceeding 20 percent), and nontariff barriers on services (often exceeding 40 percent on a tariff-equivalent basis) all indicate ample room for further liberalization. But sputtering Doha Round negotiations over the past decade reflect strong and widespread political resistance to a fresh installment of freer trade. The current US presidential campaign furnishes abundant evidence of this regrettable phenomenon.

Global services trade should be leading the way, given the technological opportunities opened by the internet and the dominant role of services in national economies. But the world has seen little liberalization of services trade over the past two decades. Barriers remain high, in both the United States and abroad. US two-way services trade has not grown faster than US two-way nonoil merchandise trade since 1990, and services trade grew more slowly than merchandise trade after 2011 (figure 5). This record reflects the conspicuous absence of fresh liberalization for more than 20 years.

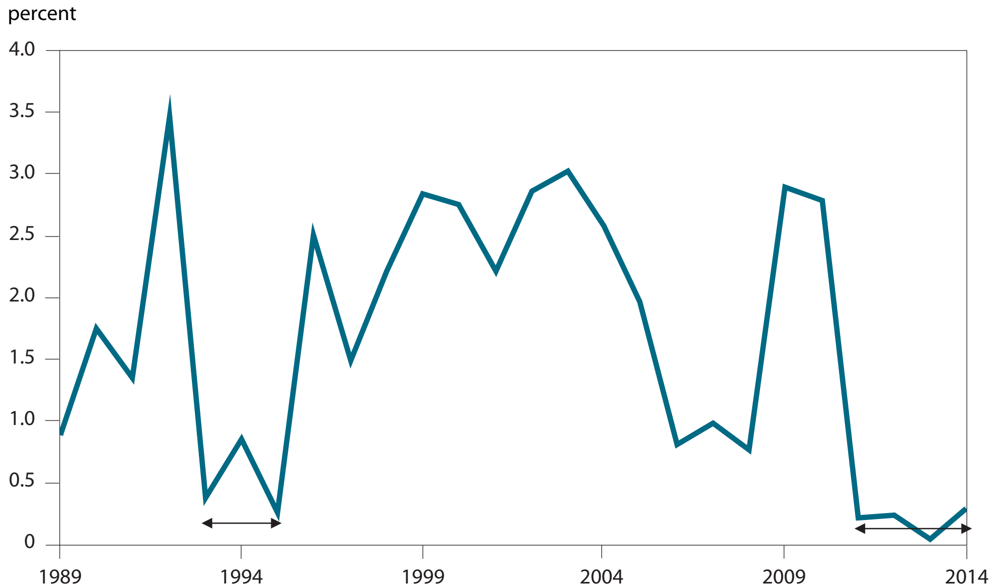
The growth of US output per labor hour slowed after the Great Recession. Annual productivity growth averaged 1.8 percent in 1989–2008; since 2011, it has been stuck at just over $62 of GDP per working hour, implying a growth rate of only 0.19 percent a year (figure 6).[23] Table 4 documents the slower rise of both the US trade-to-GDP ratio and US productivity growth since the Great Recession. The coincidence of the two stagnations is too great to ignore.

21. Explanations for Slowdown of Global Trade, event at the Peterson Institute for International Economics, Washington, April 20, 2016, https://piie.com/events/explanations-slowdown-global-trade.

22. Evenett and Fritz (2016) also note that discriminatory measures outnumbered liberalizations 3 to 1 in 2015.

23. The trauma years 2009 and 2010 are excluded. The other recent period of very low productivity growth (under 1 percent a year) was 1993–95. Productivity stagnation since 2011 has lasted longer than the earlier period, and the growth rate is even lower (see figure 6). The average annual productivity growth rate was 0.2 percent in 2011–14, compared with 0.5 percent in 1993–95. In conversations with the authors, Bradford Jensen points out that imports to the United States tend to displace relatively low-productivity domestic sectors first. As the process goes on, imports tend to displace firms/industries with higher labor productivity. Therefore, over time, as the United States becomes increasingly specialized as a producer, labor productivity gains from trade may diminish.

Figure 6 Annual growth rate of US productivity, 1989–2014



Source: Organization for Economic Cooperation and Development.

Table 4 Average annual growth of US trade and productivity, 1989–2008 and 2011–15 (percent)

Period	Trade-to-GDP ratio	Productivity
1989–2008	3.0	1.8
2011–15	2.3	0.2

Note: Trade-to-GDP ratios are based on data for 1990–2008 and 2011–15. Productivity growth rates are based on data for 1989–2008 and 2011–14.

Sources: US Bureau of Economic Analysis and Organization for Economic Cooperation and Development.

Some experts point to poor measurement as the source of what they see as an illusory productivity slowdown. According to Hal Varian, chief economist at Google, "There's a lack of appreciation for what's happening in Silicon Valley because we don't have a good way to measure it."[24] In this view, current methods of valuing GDP do not capture productivity gains from free goods and services delivered by digital technologies. The exclusion, it is argued, leads to an underestimate of US productivity growth.

Syverson (2016) and Byrne, Fernald, and Reinsdorf (2016) evaluate the mismeasurement argument. They reject the claim that the productivity slowdown largely reflects measurement error. Syverson notes that the degree of productivity slowdown across dozens of countries is uncorrelated with the relative size of the information and communication technology (ICT) sector, usually considered the major source of productivity mismeasurement.

He also addresses the "free product" argument. Proponents of this explanation argue that workers are paid to produce goods and services that are sold free of charge or at deep discounts, leading to an underestimation of total output and thus underestimation of productivity. Following this argument, measured gross domestic income (GDI) should be higher than measured gross domestic product (GDP)—as was true during the recent productivity deceleration period. However, this pattern started well before the productivity slowdown period, including the earlier productivity acceleration period.

Syverson also evaluates the quantitative plausibility of the mismeasurement hypothesis. According to his calculation, if measured productivity had not slowed, measured US GDP in the third quarter of 2015 would have been at least $2.7 trillion higher than observed. Previous research indicated that uncounted consumer surplus from new technologies could explain at most one-third of the missing $2.7 trillion. Considering this calculation and related evidence, Syverson concludes that mismeasurement is not the major source of productivity slowdown.

24. See "Silicon Valley Doesn't Believe US Productivity Is Down," *Wall Street Journal*, July 16, 2015, www.wsj.com/articles/silicon-valley-doesnt-believe-u-s-productivity-is-down-1437100700 (accessed on July 11, 2016).

IV HOW HIGH WOULD PRODUCTIVITY HAVE BEEN IN 2014 HAD TRADE NOT SLOWED?

Many empirical studies attempt to retrospectively analyze or forecast GDP gains that arise from increased trade resulting from liberalization (such as free trade agreements). Hufbauer, Schott, and Wong (2010) relate growth in GDP to growth in two-way trade by using two coefficients: the ratio between dollar GDP gains and dollar two-way trade gains (dollar ratios) and the ratio between the percentage GDP gains and the percentage increase in two-way trade (percentage ratios).[25] For simplicity, this *Policy Brief* uses the dollar ratio, augmenting the earlier survey with three recent analyses of the link between trade growth and GDP growth:

- Petri and Plummer (2016) conclude that, measured in 2015 dollars, the Trans-Pacific Partnership (TPP) would increase real US exports by $357 billion over the baseline level (and the same for US imports) and real US GDP by $131 billion in 2030. The implied dollar ratio from these estimates is 0.18.
- The US International Trade Commission (USITC 2016) projects increases from the TPP in real US exports by $27.2 billion over the baseline, real US imports by $48.9 billion, and real GDP by $42.7 billion in 2032. The implied dollar ratio is 0.56.
- The Centre for Economic Policy Research (CEPR 2013) assesses the prospective impact of the Transatlantic Trade and Investment Partnership (TTIP) on the United States and the European Union. It projects a €239.5 billion increase in US exports over the baseline, a €200.5 billion increase in US imports, and a €94.9 billion gain in US GDP in 2027. The implied dollar ratio for the United States (after converting euros to dollars) is 0.22. For the European Union, CEPR projects exports to increase by €220.0 billion over the baseline, imports by €225.9 billion, and GDP by €119.2 billion. The implied dollar ratio for the European Union is 0.27.[26]

Table 5 summarizes the findings reported in these and other studies. Some researchers, including William Cline and Edwin Truman, have voiced skepticism over the high dollar ratios implied by some of them.[27] Therefore, this *Policy Brief* calculates an average dollar ratio excluding all ratios that exceed 0.50. The average dollar ratio of the 12 remaining studies is 0.24. This value implies that a $1 billion increase in two-way trade increases potential GDP, through supply-side efficiencies, by $240 million. This *Policy Brief* applies this dollar ratio to perform speculative calculations for 2014, the most recent year for which OECD data on working hours per employee are available. Between 1990 and 2008, real US two-way trade in nonoil goods and services increased at an average rate of 5.86 percent a year.[28] If two-way trade had increased at this pace after 2011, the real value of US two-way nonoil trade in 2014 would have been $308 billion greater than the observed value ($4.50 trillion versus $4.19 trillion). Based on the average dollar ratio of 0.24, the hypothetical increase in US two-way trade would have delivered a $74 billion increase in US GDP through supply-side efficiencies in 2014.

The shortfall in trade growth reflects not only liberalization failures and protectionist backsliding at home and abroad but also a sluggish world economy since the Great Recession (caused partly by liberalization failures and protectionist backsliding). Between 1990 and 2008, the world economy grew by 3.0 percent a year; since 2011 it has grown at only 2.7 percent a year.[29] The growth shortfall of 0.3 percent a year took a toll on US exports. Assuming an income elasticity of foreign demand of US exports of 2, the cumulative impact of the growth shortfall may have reduced US exports by $11.8 billion in 2014.[30] Whatever the combination of forces that led to slow US trade growth, US two-way trade could have been much more robust with better economic policies.

Total US employment was 146.3 million in 2014, and total working hours were 261.8 billion hours.[31] Following the standard approach of computable general equilibrium models, the boost in potential GDP would not affect the number of working hours. The additional potential GDP of $74 billion in 2014 would imply a potential increase of $0.28 per working hour (table 6). The observed real GDP

25. See Appendix A: Methodology for Reciprocity Measure and GDP Gains in Hufbauer, Schott, and Wong (2010).

26. Estimates from this study are based on the assumptions that the TTIP would reduce negotiable nontariff barrier–related costs by 25 percent, procurement-related nontariff barrier–related costs by 50 percent, and tariffs by 100 percent.

27. One argument is that estimated GDP growth might in part reflect higher employment or longer hours worked. However, standard computable general equilibrium models assume a fixed labor supply. One exception is the US International Trade Commission (USITC 2016) model for the TPP. It is excluded from the average because of its high implied dollar ratio.

28. Real US two-way trade in nonoil goods and services increased 4 percent a year during 2011–14.

29. World economic performance is measured by the annual GDP growth rate, taken from the World Bank.

30. US real exports of nonoil goods and services in 2014 were $1.975 trillion. The cumulative impact of the growth shortfall on US exports is calculated as 0.3 percent * 2 * $1,975 = $11.8 billion.

31. Average annual hours actually worked per employee were 1,789 in 2014, according to the OECD. Therefore, total working hours in 2014 were 146.3 million * 1,789/1,000 = 261.8 billion hours.

Table 5 Ratios of GDP growth and two-way trade growth from regression and computable general equilibrium (CGE) models

Study	Covered trade (base year)	Model type	Dollar ratio
Petri and Plummer (2016)	TPP (2030)	CGE	0.18
US International Trade Commission (2016)	TPP (2032)	CGE	0.56*
Centre for Economic Policy Research (2013)	TTIP (2027)-US	CGE	0.22
Centre for Economic Policy Research (2013)	TTIP (2027)-EU	CGE	0.27
OECD (2003)	Developed countries (2000)	Regression	0.48
Cline (2004)	Various developing countries	Regression	1.09*
Freund and Bolaky (2008)	Global economic performance (2000)	Regression	0.70*
Anderson, Martin, and van der Mensbrugghe (2006)	Global liberalization (2008)	CGE	0.13
Brown, Kiyota, and Stern (2005)	Free Trade Area of the Americas (FTAA) (1997)	CGE	0.91*
Brown, Deardorff, and Stern (2001)	Uruguay Round (1995)	CGE	0.48
Decreux and Fontagne (2009)	Goods, services, and trade facilitation (2020)	CGE	0.37
Decreux and Fontagne (2008)	Goods and services (2025)	CGE	0.96*
Francois, van Meijl, and van Tongeren (2005)	Doha Round (2001)	CGE	0.11
Gilbert (2009)	Uruguay Round (2004)	CGE	0.06
Gilbert (2009)	Transportation costs (2004)	CGE	0.39
Scollay and Gilbert (2001)	APEC liberalization (1995)	CGE	0.12
Lodefalk and Kinnman (2006)	Doha Round (2001)	CGE	0.12
Simple average after eliminating studies with ratios exceeding 0.5 (shown by *)			0.24

TPP = Trans-Pacific Partnership; TTIP = Transatlantic Trade and Investment Partnership; APEC = Asia-Pacific Economic Cooperation forum

Note: The dollar ratio is the ratio of the dollar increase in GDP over the dollar increase in two-way trade.

Sources: In addition to the studies in the table, UN Comtrade Database, 2009, via World Integrated Trade Solution; IMF, *World Economic Outlook*, April 2009, www.imf.org.

Table 6 Observed and hypothetical US trade and productivity, assuming historical growth rate of trade, 2011–14

Trade/productivity	2011	2012	2013	2014
Observed real trade (trillions of dollars)	3.75	3.89	4.00	4.19
Hypothetical real trade (trillions of dollars)	3.79	4.02	4.25	4.50
Hypothetical trade gains (billions of dollars)	45.56	130.20	255.43	307.61
Hypothetical GDP gains (billions of dollars)	10.94	31.25	61.30	73.83
Total employment (millions)	139.89	142.47	143.94	146.31
Average hours worked per employee	1,786	1,789	1,788	1,789
Observed productivity (dollars per hour)	62.05	62.20	62.23	62.41
Hypothetical productivity (dollars per hour)	62.10	62.33	62.46	62.69
Hypothetical productivity gains (dollars per hour)	0.04	0.12	0.24	0.28

Sources: Nominal trade data are from US Bureau of Economic Analysis, deflated by corresponding GDP deflators; total employment data are from the US Bureau of Labor Statistics; productivity and average annual hours actually worked per worker are from Organization for Economic Cooperation and Development.

Table 7 Observed and hypothetical US productivity, 2010–14

	Observed		Hypothetical	
Year	Dollars per hour	Percent increase over previous year	Dollars per hour	Percent increase over previous year
2010	61.93	—	—	—
2011	62.05	0.21	62.10	0.28
2012	62.20	0.24	62.33	0.36
2013	62.23	0.04	62.46	0.22
2014	62.41	0.29	62.69	0.36
Average	—	0.19	—	0.31

Source: Organization for Economic Cooperation and Development.

per working hour was $61.93 in 2010 and $62.41 in 2014, implying annual productivity growth of just 0.19 percent. If real GDP per working hour in 2014 had been $62.69 ($0.28 higher), productivity would have increased 0.31 percent a year between 2011 and 2014, substantially higher than the observed growth rate (table 7).

This figure is still well below the historical average of 1.8 percent during 1989–2008. Other factors also contributed to poor productivity performance, notably deficiencies in investment, education, and infrastructure, coupled with the retirement of skilled workers as the population ages. Collectively, these factors dominate the productivity story. But weak trade growth contributed to sluggish productivity growth. The role of trade in the productivity slowdown was not insignificant.

V CONCLUSION

As Paul Krugman famously said, "Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker" (Krugman 1997). Productivity is the engine of long-run growth and prosperity. Theory, empirical studies, and speculative calculations in this *Policy Brief* all convey a simple message: Greater exposure to trade increases productivity.

Policies that support greater trade liberalization would help escape the productivity slowdown. Ratifying the TPP and energizing negotiations on the TTIP and the Trade in Services Agreement (TiSA) would make important contributions. The opposition to the TPP expressed by Hillary Clinton and Donald Trump is misguided.[32] The next US president should view renewed trade liberalization as essential to enhancing productivity and spurring economic growth in the decade ahead.

32. Libertarian US presidential candidate Gary Johnson is an avid supporter of free trade in general and TPP in particular.

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