Review in Advance first posted online on August 8, 2016. (Changes may still occur before final publication online and in print.)

The China Shock: Learning from Labor-Market Adjustment to Large Changes in Trade

David H. Autor,[1,2] David Dorn,[3,4] and Gordon H. Hanson[2,5]

[1]Department of Economics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02142; email: dautor@mit.edu

[2]The National Bureau of Economic Research, Cambridge, Massachusetts 02138

[3]Department of Economics, University of Zurich, CH-8001 Zurich, Switzerland; email: david.dorn@econ.uzh.ch

[4]Centre for Economic and Policy Research, London EC1V 0DX, United Kingdom

[5]School of Global Policy and Strategy, University of California, San Diego, La Jolla, California 92093; email: gohanson@ucsd.edu

Annu. Rev. Econ. 2016. 8:205–40

The *Annual Review of Economics* is online at economics.annualreviews.org

This article's doi:
10.1146/annurev-economics-080315-015041

JEL codes: E24, F14, F16, J23, J31, L60, O47, R12, R23

Keywords

globalization, labor-market adjustment, local labor markets, inequality

Abstract

China's emergence as a great economic power has induced an epochal shift in patterns of world trade. Simultaneously, it has challenged much of the received empirical wisdom about how labor markets adjust to trade shocks. Alongside the heralded consumer benefits of expanded trade are substantial adjustment costs and distributional consequences. These impacts are most visible in the local labor markets in which the industries exposed to foreign competition are concentrated. Adjustment in local labor markets is remarkably slow, with wages and labor-force participation rates remaining depressed and unemployment rates remaining elevated for at least a full decade after the China trade shock commences. Exposed workers experience greater job churning and reduced lifetime income. At the national level, employment has fallen in the US industries more exposed to import competition, as expected, but offsetting employment gains in other industries have yet to materialize. Better understanding when and where trade is costly, and how and why it may be beneficial, is a key item on the research agenda for trade and labor economists.

1. INTRODUCTION

Mainstream economists have long argued that international trade improves welfare. Although trade may redistribute income, theory assures us that under standard conditions the gains to winners are more than sufficient to offset any losses incurred by those suffering adverse effects from foreign competition. Belief in the Pareto-improving nature of trade made economists front-line advocates for the broad-based liberalization of commerce that was embedded in the General Agreement on Trade and Tariffs (GATT) and other institutions built to manage the global economy after World War II (Bhagwati 1989). Paul Krugman states this view vividly in his 1997 *Journal of Economic Literature* article: "If economists ruled the world, there would be no need for a World Trade Organization (WTO). The economist's case for free trade is essentially a unilateral case: a country serves its own interests by pursuing free trade regardless of what other countries may do" (Krugman 1997).

Of course, introductory trade theory also teaches us that international trade is not generally Pareto improving. In their undergraduate textbook, Krugman & Obstfeld (2008, p. 64) write, "Owners of a country's abundant factors gain from trade, but owners of a country's scarce factors lose. . . [C]ompared with the rest of the world the United States is abundantly endowed with highly skilled labor and (. . .) low-skilled labor is correspondingly scarce. This means that international trade tends to make low-skilled workers in the United States worse off—not just temporarily, but on a sustained basis." For the first three or four decades of the Bretton Woods era, however, there was little occasion to scrutinize the benefits of trade. Most goods flows were North–North—between nations with relatively similar average incomes—which helped subdue distributional impacts.

Views on how trade affects wages and employment turned less sanguine in the 1990s. As wage inequality rose, low-skill wages and employment fell, and manufacturing employment contracted in the United States, globalization was seen initially as a prime suspect. After vigorous inquiry, concern about the labor-market consequences of trade receded. Economists did not find trade to have had substantial adverse distributional effects in developed economies, either for low-skill workers specifically or for import-competing factors and sectors more generally.[1] The broad sentiment that emerged in the literature was that labor-market developments were primarily attributable to technological changes that complemented high-skill workers and reduced labor demand in manufacturing. The impact of international trade on these outcomes seemed to be modest, at best.

Several pieces of evidence favored these conclusions. First, the share of US employment in manufacturing had been in decline since the end of World War II, peaking at 39.0% of US nonfarm employment in January of 1944 and then falling decade after decade to a low of 8.6% in June 2015 (**Figure 1**). The disappearance of manufacturing jobs was nothing new. Second, the steep rise in wage inequality and fall in real wages of low-education workers in the United States and many other developed countries did not coincide closely with rising trade openness. As Feenstra (1998) and Leamer (2000) note, the ratio of merchandise trade to GDP in the developed world rose steeply during the 1970s but stabilized thereafter, which greatly weakened the case for trade, having caused rising wage inequality and falling low-skill wages during the 1980s and early 1990s.

Third, contrary to the predictions of textbook trade models, manufacturing industries in developed countries appeared to be substituting toward high-skill workers despite rising skill prices, suggesting that these industries were experiencing a skill-biased demand shift that emanated

[1]For formal surveys of the literature on trade and wages, see Feenstra & Hanson (2003) and Harrison et al. (2011). In developing economies, the labor-market impacts of globalization have been more diffuse (Goldberg & Pavcnik 2007).

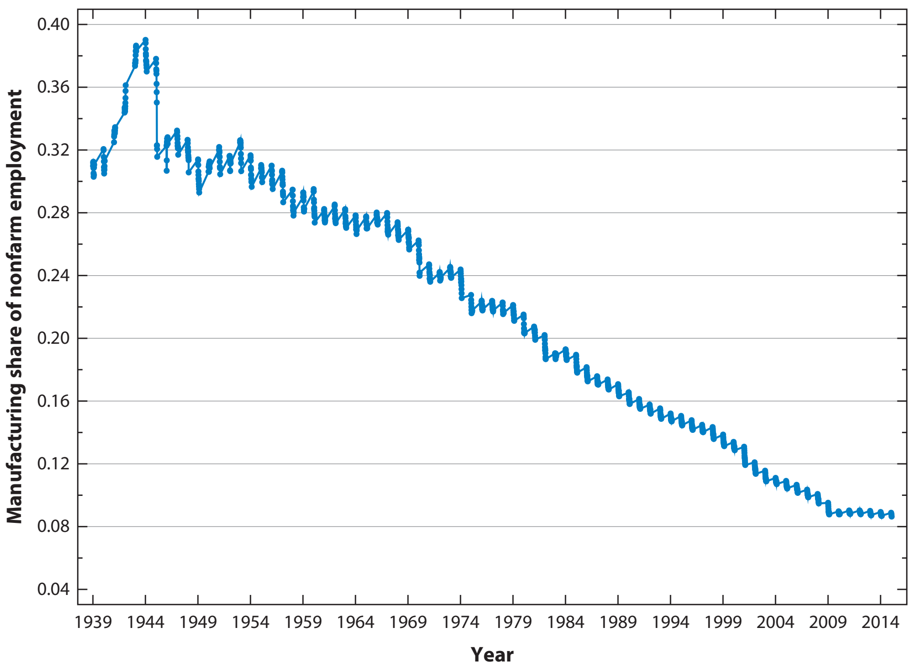

Figure 1

Manufacturing share of US nonfarm employment (1939–2015). Source: FRED Economic Data (**https://research.stlouisfed.org/fred2/graph/?g=1Gor**).

logically from the adoption of new technology (Berman et al. 1998). Although trade in the form of offshoring may produce such demand shifts, its modest scale in the 1980s and early 1990s meant that its estimated impacts were far smaller than those of investments in high-tech capital and equipment (Feenstra & Hanson 1999).[2] Finally, simple factor-content calibration exercises—which rescaled traded-good imports into embodied labor imports—found that rising trade integration could account for only a small part of the fall in relative wages of low-skill workers in the United States (Borjas et al. 1997, Krugman 2000).[3] When Richard Freeman asked in 1995 if US wages were "being set in Beijing," his answer was an emphatic no (Freeman 1995).

The trade and wages debate reached something of a coda around the year 2000. The following is a reasonable summary of the contemporaneous consensus:

1. Trade had not in recent decades been a major contributor to declining manufacturing employment or rising wage inequality in developed countries;

[2]A further development, seen initially as damning for trade-based explanations of changes in labor-market outcomes, was the simultaneous rise in wage inequality in developed and developing economies (Berman et al. 1998). We now know that in the presence of offshoring (Feenstra & Hanson 1997, Grossman & Rossi-Hansberg 2008) or heterogeneous firms and skill-technology complementarity (Burstein & Vogel 2012, Sampson 2014), greater economic integration between countries may cause wage inequality to rise worldwide.

[3]The usefulness of factor-content calculations for predicting labor-market outcomes was the subject of a spirited debate in the 1990s (Krugman 2000, Leamer 2000). This debate has since been largely resolved by the discovery that a tight (although structurally model-specific) relationship between the factor content of trade and relative factor prices holds for a wide class of trade theories (Burstein & Vogel 2011).

2. Workers employed in regions specializing in import-competing sectors could readily reallocate to other regions if displaced by trade; and
3. Due to the law of one price for skill, any labor-market impacts of trade would be felt by low-skill workers generally, not by trade-exposed workers specifically.

A corollary of these observations is that trade should affect prevailing wage levels nationally but not employment rates locally or regionally. Moreover, given the presumed fluidity of US labor markets, even in the short- or medium run, the aggregate gains from trade in the United States should be positive.[4]

Just as the economics profession was reaching consensus on the consequences of trade for wages and employment, an epochal shift in patterns of world trade was gaining momentum. China, for centuries an economic laggard, was finally emerging as a great power and toppling established patterns of trade accordingly. The advance of China, as we argue below, has also toppled much of the received empirical wisdom about the impact of trade on labor markets. The consensus that trade could be strongly redistributive in theory but was relatively benign in practice has not stood up well to these new developments. Nor has the belief that trade adjustment is relatively frictionless, with impacts that diffuse over large skill categories rather than being concentrated among groups of workers in trade-competing industries or locations. In quantifying these impacts and adjustment frictions, recent evidence further suggests that the short- and medium-run adjustment costs demanded by large trade shocks are sizable entries in the accounting of gains from trade.

China's rise has provided a rare opportunity for studying the impact of a large trade shock on labor markets in developed economies. An emerging literature on this topic offers a wealth of evidence and surprises that should catalyze and discipline research for many years to come. We believe that this evidence calls into question the consensus of the early 2000s and makes clear that, after the early Bretton Woods era aberration, the distributional consequences of trade are alive and well. Although these results do not at all suggest that international trade is in the aggregate harmful to nations—indeed, China's unprecedented rise from widespread poverty bears testimony to trade's transformative economic power—they make clear that trade not only has benefits but also significant costs. These include distributional costs, which theory has long recognized, and adjustment costs, which the literature has tended to downplay. Better understanding when and where trade is costly, and how and why it may be beneficial, is a key item on the research agenda for trade and labor economists. Developing effective tools for managing and mitigating the costs of trade adjustment should be high on the agenda for policymakers and applied economists.

This review discusses findings from the rapidly growing literature on China's rise that have enriched our understanding of the impact of trade shocks on developed countries. We begin by discussing why China's long-awaited reemergence is helpful for studying the impacts of trade on labor-market outcomes. We then offer a simple theoretical framework that guides inquiry on measuring and interpreting these impacts. Next, we present evidence on how trade shocks originating in China have affected industries and plants, local labor markets housing those plants, and individual workers employed (or formerly employed) in those industries and local markets. We suggest how these results should cause us to rethink the short- and medium-run gains from trade. Finally, we argue that having failed to anticipate how significant the dislocations from trade might be, it is incumbent on the literature to more convincingly estimate the gains from trade,

[4]Although these views may appear as a straw man, they are not. On point 1, see Baily & Bosworth (2014). On points 2 and 3, see Edwards & Lawrence (2013). And on the broader implications of these points, see President's Council of Economic Advisors (2015).

such that the case for free trade is not based on the sway of theory alone, but on a foundation of evidence that illuminates who gains, who loses, by how much, and under what conditions.

2. CHINA'S RISE

On June 23, 1989, the *Wall Street Journal* marked the publication of its centennial edition by predicting what the global economy would look like 25 years hence. It selected the countries that it thought would be growth leaders and those it saw as future growth laggards. On the former list were Bangladesh, Thailand, and Zimbabwe. On the latter list was China, which, as the newspaper prognosticated, would fail to shake off "the stultifying bureaucracy of hard-line communism" (Anders 2014).

The *Wall Street Journal*'s predictions reveal just how uncertain China's future appeared in the late 1980s. After a decade of "reform and opening" under Deng Xiaoping, hardliners had reestablished control over economic policy. Their resurgence, fueled on the economic side by rising inflation and on the political side by the events at Tiananmen Square, caused reform to stall and cast doubt on China's market transition (Naughton 2007). Seen in this context, skepticism about China's future, although far off the mark from today's vantage point, would then have been entirely warranted.

China's one-quarter century of dizzying export growth began once the reformist camp reaffirmed its authority over economic policy in the early 1990s. Deng, in one of the final political gambits of his career, launched his famous "southern tour" in 1992 to focus national attention on the successes of earlier policy experiments in a handful of locations on China's east coast (Vogel 2011). These efforts had included the creation of special economic zones (SEZs), which allowed foreign companies to set up factories that imported inputs and exported final outputs, relatively free from the interference of government minders (Yu & Tian 2012, Alder et al. 2013). As reformers retook the helm, China embraced global markets more fully, pushing the number of SEZs from 20 in 1991 to 150 in 2010. According to the World Bank, inflows of foreign direct investment, which had averaged only 0.7% of GDP during the 1980s, surged to 4.2% of GDP during the 1990s and 2000s. Production for foreign markets began a spectacular ascent, with China's share of world manufacturing exports growing from 2.3% in 1991 to 18.8% in 2013 (**Figure 2**; see also Storesletten & Zilibotti 2014 on the factors that have shaped China's development process).

To provide context for China's reintegration into the world economy, we highlight key aspects of its recent performance that inform the analysis of attendant labor-market outcomes in developed countries. One is the idiosyncratic nature of China's transition from central planning to market orientation. The momentum of this transition—which has propelled China's trade—owes much more to dismal conditions in China at the time of Mao's death than to China's subsequent responses to contemporaneous shocks in high-income economies. Also important is the nature of China's postreform manufacturing surge. When and how China became "the global factory" are important for defining the scope and intensity of the China trade shock. Finally, there is the structure of global trade balances. China's penchant for running large current account surpluses has shaped the temporal distribution of trade gains and losses arising from its growth.

2.1. Making Use of Trade Shocks

The interest of trade economists in China is driven both by its large quantitative importance as an exporter of manufactured goods and by the paucity of natural experiments in international trade. Among the most challenging issues for empirical analysis is that changes in trade policy in one country are often dictated by changes in the behavior of its trading partners. Consider the

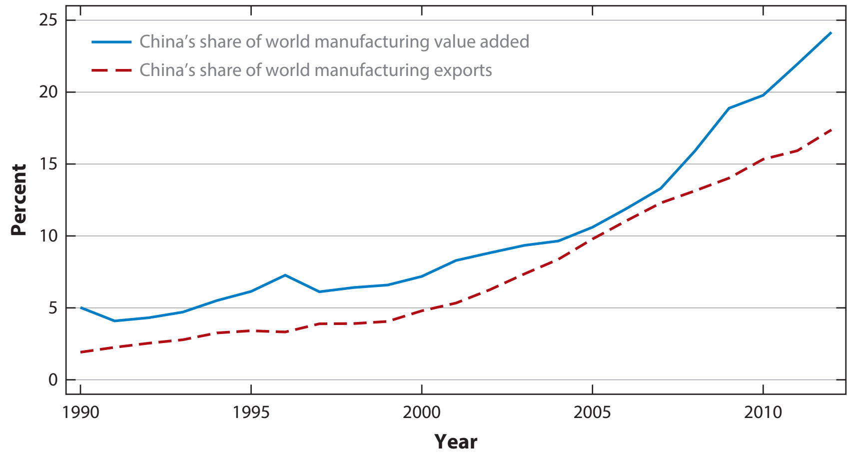

Figure 2

China's share of world manufacturing activity (1990–2012). Source: World Development Indicators (**http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators**).

North American Free Trade Agreement, enacted in 1994. After investing heavily in Mexico in the 1980s and early 1990s, multinational companies lobbied hard for the US Congress to approve the pact (Mills 1993). The treaty's passage, which contributed to a further expansion in foreign direct investment, was arguably induced at least in part by the earlier foreign direct investment. In the North American Free Trade Agreement (NAFTA) case, as in similar episodes of economic opening, identifying trade's impact on labor markets is complicated by the joint determination of trade barriers and trade and investment flows (see McLaren & Hakobyan 2016 on the local labor-market effects of NAFTA in the United States).

Three features of China's experience help to overcome these challenges in identifying the causal effects of trade shocks. The first is the unexpected nature of China's export growth, which caught many observers—including those at the *Wall Street Journal*—by surprise. Even after the launching of reform in the 1980s, few anticipated how important China would become for the world economy. Between 1984 and 1990, China's share of world manufacturing exports ticked up only modestly, from 1.2% to 1.9%. Its trade expansion did not begin in earnest until the 1990s, 15 years after Mao's death. China's post-Tiananmen crackdown made it difficult to foresee the confluence of events that would allow it to unleash its potential. After all, the Chinese economy had underperformed relative to Western Europe during every epoch since the 1500s (Zhu 2012).

Second is the degree of China's isolation under Mao, which created abundant opportunities for later catch up (Zhu 2012, Brandt et al. 2014). The distortions of the Maoist era kept China far inside its production frontier. Between 1952 and 1978—from three years after the Communist Party's rise to power until Deng's rehabilitation following Mao's death—China's GDP per capita sank from 59th in the world to 134th out of 167 Penn World Table countries.[5] By 1991, China's income ranking had nudged up modestly from 134th to 126th in the world. Convergence did not begin in earnest until the rapid globalization of the ensuing two decades. By 2001, China's income ranking had risen to 101st and by 2011 it had reached 77th. Once China's economy took off, it

[5]These ranks are of GDP at constant national prices (in 2005 US dollars) from the Penn World Tables 8.0 database.

ignited a phase of transitional growth that was governed largely by the country's accumulated productivity gap with the developed world (Song et al. 2011).[6]

A final key feature of China's rise—which we explore in more detail below—is its distinctive comparative advantage. Manufacturing is at the heart of the country's economic turnaround. Between 1991 and 2012, China's share of world manufacturing value added increased by a factor of six, from 4.1% to 24.0% (**Figure 2**). Whereas many large emerging economies specialize in primary commodities—Brazil in iron ore, Indonesia in rubber, and Russia in oil and gas—China's advantage is overwhelmingly in industrial goods. Over the period 1990 to 2013, the manufacturing sector averaged 88% of China's merchandise exports, compared to 50% for Brazil, 46% for Indonesia, and 20% for Russia.[7] This trade concentration means that China's growth has represented a large positive net global supply shock for manufacturing and a large positive net global demand shock for raw materials. The impacts of China's rise are consequently likely to vary across regional and national economies according to their initial patterns of industry specialization.

2.2. The Global Factory

China's manufacturing performance reflects a comparative advantage in the sector that remained latent during the Maoist era. Today, China's net exports in manufacturing are strongly positive and its net exports of raw materials are strongly negative (**Figure 3*a***). Its true strength in the sector emerged only in the 1990s. **Figure 3*b*** plots revealed comparative advantage (RCA: a country's share of global exports in an industry divided by its share of aggregate global exports) for China in two broad sectors, manufacturing and primary commodities, where the latter group comprises foods, fuels, ores and metals.[8] It was not until 1992 that China moved from disadvantage to advantage in manufacturing, as indicated by positive log RCA values, and from advantage to disadvantage in primary commodities, as indicated by negative log RCA values. The strength of China in manufacturing surely reflects its abundant supply of labor relative to the rest of the world (Amiti & Freund 2010). The massive increase in China's industrial labor force—resulting from the decollectivization of agriculture, the closing of inefficient state-owned enterprises, and the migration of 250 million workers from farms to cities—has made China the default location for all types of labor-intensive production (Li et al. 2012). However, factor abundance cannot be the whole story behind the country's specialization. Its advantage is far from uniform across labor-intensive industries (Autor et al. 2014). **Figure 4** plots the change in net import penetration from China between 1991 and 2007 against the share of production workers in total employment in 1991 for 397 four-digit US manufacturing industries.[9] We group industries into 10 sectoral aggregates, which share a common marker in the figure. That few points in **Figure 4** show a

[6]This period of transitional growth will of course come to an end ultimately and indeed may have ended already (see Eichengreen et al. 2013 for a discussion).

[7]Over time, China has become even more specialized in manufacturing. Between 1990 and 2007, the share of manufacturing in China's merchandise exports rose from 72% to 93%, a level at which it has since stabilized.

[8]The denominator in China's RCA index is the country's share of world merchandise exports. Following World Bank definitions, manufacturing includes Standard International Trade Classification (SITC) sectors 5 (chemicals), 6 (basic manufactures except for division 68), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods). Food, fuels, ores and metals include SITC sectors 0 (food and live animals), 1 (beverages and tobacco), 2 (crude materials), 3 (mineral fuels), and 4 (animal and vegetable oils and fats), and division 68 (nonferrous metals).

[9]The change in import penetration is the 1991 to 2007 change in US imports from China divided by 1991 US domestic absorption (shipments plus imports minus exports); it is Winsorized at −20 and 100 in the figure. The employment share of production workers uses 1991 values from the NBER-CES Manufacturing Industry Database.

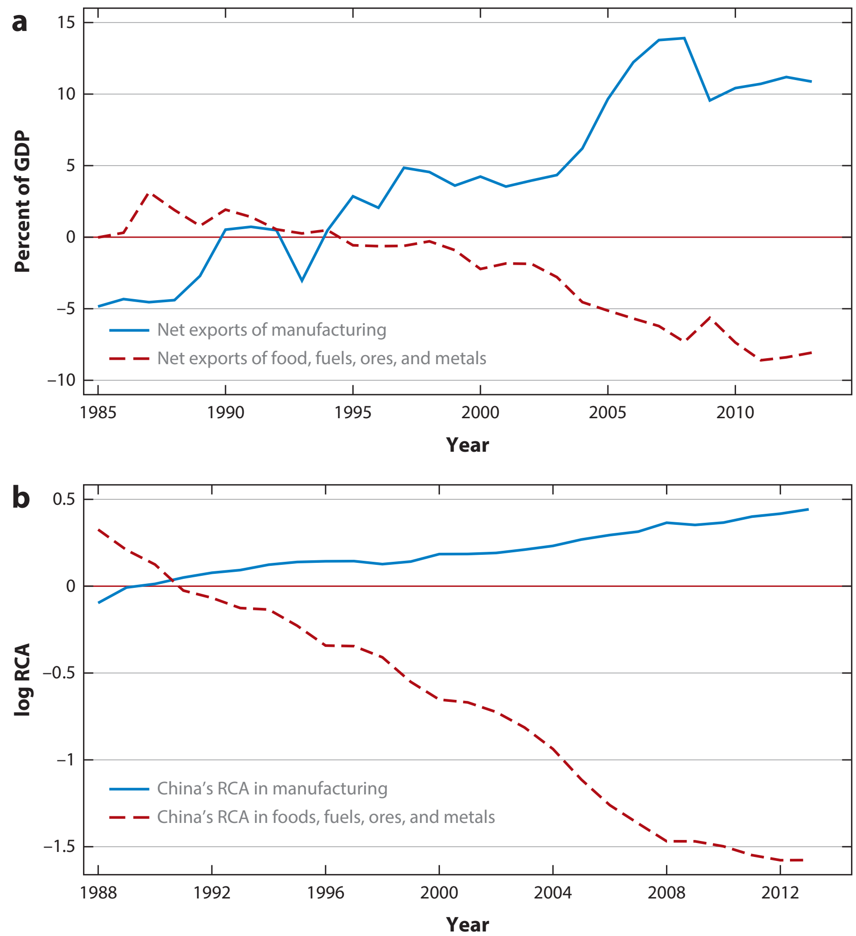

Figure 3

The evolution of China's imports and exports. (*a*) Exports minus imports as a share of gross domestic product (GDP) for China. (*b*) Revealed comparative advantage (RCA) for China. Source: World Development Indicators (**http://databank.worldbank.org/data/reports.aspx?source = world-development-indicators**).

negative change in net import penetration over the period reveals how US imports from China grew by more than exports—often substantially by more—in nearly every industry.

The dominant pattern in **Figure 4** is that industries within a sector tend to occupy a relatively narrow range on the horizontal axis—indicating similar within-sector labor intensity—but a wide range on the vertical axis—indicating highly varying within-sector changes in import penetration.[10] Apparel, leather, and textiles stand out in **Figure 4** as the most labor-intensive activity, with an average initial share of production workers in industry employment of 0.85. Still, the industries within this sector diverge sharply in their changes in import penetration. In some (e.g.,

[10]Employment of production workers is a standard, but not problem-free, measure of industry intensity in low-skill labor. See Katz & Autor (1999) on the relation between production worker intensity and skill intensity.

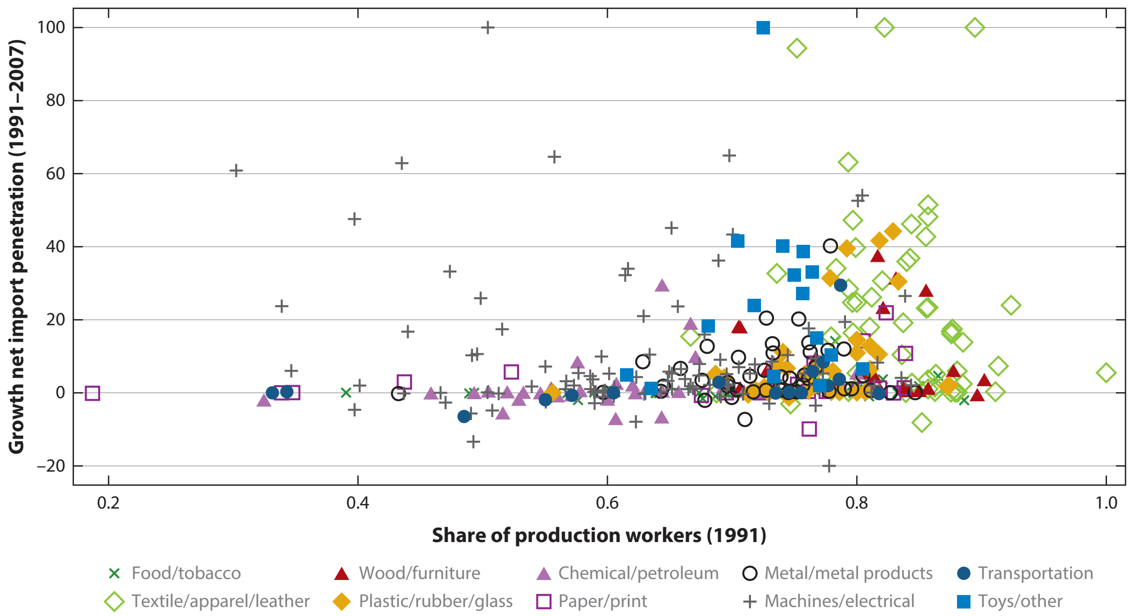

Figure 4

Change in China–US net import penetration in detailed manufacturing industries (1991–2007).

women's nonathletic footwear, waterproof outerwear), the increase in penetration approaches or even exceeds 100%, which indicates that the 1991 to 2007 growth in imports from China is nearly equal to or greater than initial domestic spending on goods produced by the industry. Other industries in the sector (e.g., coated fabrics, automotive and apparel trimmings) show near-zero increase in import penetration. Similar patterns of dispersion hold for sectors with comparably high labor intensity, such as furniture and wood products (average initial production worker share of 0.82) and toys and miscellaneous products (average initial production worker share of 0.72).[11]

The cross-industry variation in Chinese export growth evident in **Figure 4** is far from unusual. The distribution of comparative advantage across industries for a country tends to be fat-tailed, such that for most countries relatively few products dominate exports (Hanson et al. 2015). Because of this skewness, US industries—and the regions in which they locate—vary widely in their exposure to import competition from China. As we discuss in Section 4, this variation is useful for identifying the labor-market consequences of trade shocks.

China's export surge in manufacturing accelerated after 2001, the year in which the country entered the WTO (**Figure 2**). On first consideration, one wonders why WTO accession mattered much for China's trade. Europe and the United States had granted China most-favored nation (MFN) status as far back as the 1980s. WTO membership would seem to have done little more than formalize trade relations that were already two decades old. Still, something happened to deepen China's manufacturing prowess: Between 1998 and 2007, productivity in the sector grew at the astounding rate of 8% per year (Brandt et al. 2012). Although the literature has yet to

[11]An industry-level regression of the change in net import penetration between 1991 and 2007 on 10 subsector dummies has an r-squared value of just 0.17, indicating that the majority of the variation in penetration occurs across detailed industries within subsectors.

provide a full accounting of China's recent export growth, it has uncovered several mechanisms through which reform strengthened its manufacturing industries.

One such mechanism is privatization. In the late 1990s and early 2000s, China idled many state-owned manufacturing enterprises, moving toward compliance with WTO provisions that sanction state subsidies for domestic industries. Capital and labor were then reallocated from smaller, less productive state-owned companies to privately owned manufacturing plants, raising productivity and output in the sector (Hsieh & Song 2015). Joining the WTO also forced China to phase out requirements that had obligated many private establishments to export through state intermediaries. Such restrictions constitute barriers to export, which the WTO forbids expressly. Bai et al. (2015) estimate that had private firms not been granted direct trading rights, China's manufacturing exports in the 2000s would have been one-third smaller. Along with greater ease in exporting, WTO membership gave Chinese manufacturers greater access to imported intermediate inputs (Brandt & Morrow 2014), which were an added boon to productivity (Manova & Zhang 2012). A further consequence of China's WTO entry regards the insecurity of its earlier MFN access to the US market. Prior to 2001, China's MFN status in the United States was subject to annual reauthorization by Congress. Pierce & Schott (2016) and Handley & Limao (2014) argue that the lurking prospect of a return to non-MFN tariffs, which averaged 37.0% in 1999 as compared to average MFN tariffs of only 3.4% in that year, dissuaded Chinese firms from investing in exporting to the United States. WTO accession removed this uncertainty and encouraged China–US trade.

2.3. The Global Macroeconomic Context

The impact of China's recent growth on the global economy is not just about the country's long-run comparative advantage. The near-term labor-market consequences of its trade expansion included China's trade surplus widening substantially. **Figure 5** shows the current account balance as a share of GDP for China and the United States from 1985 to 2012. China's average current account surplus rose from 1.7% of GDP in the 1990s to 4.8% in the 2000s. In mirror-like fashion, the average US current account deficit rose from 1.6% of GDP in the 1990s to 4.4% in the 2000s. In a world economy with many countries, there is no reason why the trade balance for any one country would be related systematically to that for any other country. However, because the US dollar functions as a global reserve currency, China's massive net capital outflows have been associated with net foreign purchases of dollar-denominated assets.

In trade theory, it is standard to assume that trade is balanced and to analyze the impact of trade shocks on the long-run global equilibrium. Why should trade imbalances matter for the labor-market consequences of China's growth? With balanced trade, growth in China's exports is matched by growth in its imports. Although the United States sees greater import competition in some industries, it also sees expanded exports elsewhere in manufacturing and in other traded sectors. China's rise may cause US workers to reallocate from one traded industry to another but it would not necessarily cause them to exit the traded sector altogether.

Trade imbalances complicate matters by introducing a temporal dimension into sectoral employment adjustment (see Crino & Epifani 2014 on how changes in trade balances affect labor-market outcomes in a North–South trade model). Suppose that policy distortions in China—such as the excess absorption of credit by state-owned enterprises (Song et al. 2011)—induce the country to run a trade surplus and the US to run a trade deficit. Growth in China's manufacturing sector due to enhanced productivity arising from its market transition would cause employment in US traded industries to contract, pushing workers either into nontraded jobs or out of work entirely. In effect, China would be loaning the US the funds that it needs to enjoy positive net

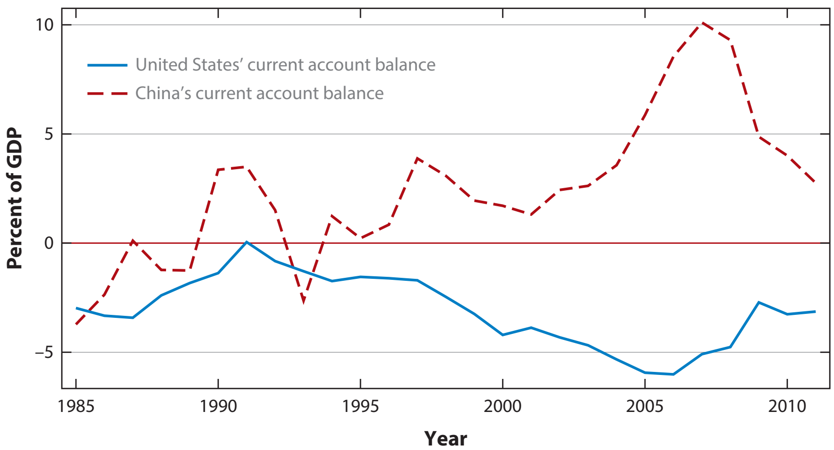

Figure 5

The United States' and China's current account balances [% of gross domestic product (GDP)] for 1985–2012. Source: World Development Indicators (**http://databank.worldbank.org/data/reports.aspx?source = world-development-indicators**).

imports today.[12] As **Figure 4** shows, few US industries saw an increase in net exports to China between 1991 and 2007. At some point in the future, Chinese savings would be expected to fall and consumption to rise, as China's net exports turned negative and US net exports turned positive. US traded output and employment would expand, and the United States would begin to repay China for its earlier borrowing. In this long-run scenario, China's rising comparative advantage would generate long-run employment losses in the US traded industries in which China enjoyed a long-run comparative advantage, whereas trade imbalances cause additional short-run US employment losses in traded industries pushed temporarily into contraction. Why has China become such a large net creditor to the rest of the world? The literature attributes current account surpluses in China to government interventions that have kept national savings at artificially high levels. One hypothesized distortion is the government's continued support for large state-owned enterprises.[13] These companies have first call on loans from state-run banks, leaving private businesses to finance investment out of retained earnings, thereby elevating the corporate savings rate (Song et al. 2011). Another, and perhaps less obviously relevant, distortion is China's one-child policy (recently relaxed), which increased male-female birth ratios and intensified competition in the marriage market (Wei & Zhang 2011). Those with sons could potentially increase their savings rate to finance real estate purchases as a means of improving their child's marriage prospects. A third distortion—advanced by think tanks and politicians in Washington, DC (see, e.g., Cline 2010)—is that China has consciously undervalued its nominal exchange rate so as to promote its exports.[14]

[12]This logic, of course, applies to a two-country world. In a many-country world, there is no necessary connection between bilateral trade and bilateral capital flows.

[13]Although the private sector has grown substantially in China, state-owned companies remain an active part of the economy (Hsieh & Song 2015), especially in banking, communications, construction, energy, and transportation.

[14]The popular sentiment notwithstanding, the academic literature has had little success in finding empirical support for systematic renminbi undervaluation (Cheung et al. 2007).

3. THEORY

Much first-generation research on trade and wages worked under the canonical version of the Heckscher-Ohlin (HO) model (e.g., Lawrence & Slaughter 1993, Borjas et al. 1997). The attraction of the HO framework, and in particular of the Stolper-Samuelson theorem, for analyzing labor-market impacts of trade is its elegant connection between industry-level shocks (manifested as externally given changes in product prices) and national factor-market outcomes (changes in wages). The simplicity of this mapping perhaps explains why economists relied on the model for so long, despite its dependence on assumptions that range from the counterfactual—countries have to remain within their initial "cone of diversification"—to the arcane—the number of final goods a country produces has to equal the number of primary factors.

Frustration with HO turned out to be a boon to research on trade and labor markets. Early approaches (Feenstra & Hanson 1997, 1999; Grossman & Rossi-Hansberg 2008) flipped the framework on its head by focusing on changes in the set of goods—or, more precisely, the set of intermediate inputs—that a country produces. Allowing for changes in specialization patterns creates a new adjustment margin between the production tasks a country performs at home and the others it offshores. Recent work has wedded HO and modern trade theories that incorporate heterogeneous firms. Burstein & Vogel (2012) embed a Melitz (2003) style model, in which firms differ according to their productivity, into an otherwise standard HO setting. Calibrating the model and allowing for more productive firms to be more intensive in the use of high-skill labor reveal that freer trade affects the wage premium for high-skill labor more through the Melitz mechanism of within-industry shifts in employment toward more productive firms than through the HO mechanism of between-industry shifts in labor demand. In many analyses of the impact of productivity growth in China on global welfare, the literature dispenses with HO entirely, relying on either a Melitz-type setting (Hsieh & Ossa 2011) or the Eaton & Kortum (2002) model of Ricardian comparative advantage (Di Giovanni et al. 2014). Gone from current literature is the sole concern of estimating the impact of trade on the wage gap between high-skill and low-skill labor, which preoccupied inquiry in the 1990s. In its place is interest in a wider array of margins through which economies adjust to trade shocks.

The sketch of a theoretical framework that we provide in this section follows the recent trend of working with trade models that have a gravity structure (Arkolakis et al. 2015). These models do not lend themselves easily to studying the impact of trade on earnings inequality. They do, however, make it tractable to allow for varying degrees of labor mobility between regions or industries (Redding 2012). The presence of frictions in worker mobility creates an abundant set of margins along which we can observe how labor markets respond to trade shocks.[15] The task of empirical research then becomes to clarify which margins of adjustment are operational, to estimate the magnitude of adjustment along each margin at different time horizons, and to determine how long it takes for full adjustment to occur.

3.1. A Bare-Bones Model

To characterize the theoretical mechanisms at work, it is sufficient to allow for a single labor-market friction, which we designate as imperfect labor mobility across regions within a country.

[15] On adjustment to trade shocks at the firm level, see Amiti & Davis (2012) and Hummels et al. (2014); on adjustment at the industry level, see Bernard et al. (2006), Ebenstein et al. (2014), and Bloom et al. (2016); and on adjustment to trade at the regional level, see Borjas & Ramey (1995), Topalova (2010), Kovak (2013), and McLaren & Hakobyan (2016).

Allowing for geographic labor immobility runs counter to the belief that US regional labor markets are integrated seamlessly. However, there is mounting evidence that the movement of labor across US cities and states in the aftermath of changes in regional labor demand is slow and incomplete (Blanchard & Katz 1992, Glaeser & Gyourko 2005, Yagan 2014) and that such incompleteness is strongest among less-educated workers (Bound & Holzer 2000, Wozniak 2010, Malamud & Wozniak 2012, Diamond 2015).[16] Recent work on the impacts of trade with China (discussed in Section 4) similarly confirms the slowness of regional labor-market adjustment.

In our model sketch, we make the extreme assumption of complete geographic labor immobility. In the Eaton & Kortum (2002) framework, one can relax this assumption by allowing for worker heterogeneity in moving costs between regions (Caliendo et al. 2015) or for a Roy-type structure with worker heterogeneity in industry productivity (Galle et al. 2015). Either setting creates an upward sloping regional labor supply curve, whose slope may be steeper in the short- or medium run than in the long run. Variation in regional exposure to foreign competition arises from differences in regional industry specialization patterns. In the Eaton & Kortum framework, these specialization patterns reflect exogenous regional differences in industry productivity. Empirical work does not take a stand on the origin of industry specialization, treating it as predetermined in some period well before the China trade shock materializes.

We begin by describing how changes in China's export supply affect US industry product demand and are subsequently transmitted to changes in traded sector output at the US regional level. If trade has a gravity structure, we can write total demand by the US aggregate economy for traded output produced in US region i as

$$X_i = \sum_k \frac{A_{ik}\tau_{ik}^{-\theta}}{\Phi_k} E_k, \tag{1}$$

where X_i is the total sales by region i in the aggregate US market; A_{ik} is the production capability of region i in industry k; τ_{ik} is the average iceberg transport cost for region i in shipping goods in industry k to the aggregate US market;[17] θ is the trade cost elasticity; E_k is US aggregate expenditure on goods in industry k, and Φ_k is the competitiveness of the aggregate US market in industry k, defined as $\Phi_k \equiv \sum_{i'} A_{i'k}\tau_{i'k}^{-\theta}$.[18]

Consider the impact on traded output in region i of changes in production capabilities in the regions that supply the United States. Totally differentiating Equation 1, and using $\hat{x} \equiv dx/x$, we obtain the following equilibrium condition for the log change in region i's output:

$$\hat{X}_i = \sum_k \phi_{ik}\hat{E}_k - \theta\hat{w}_i + \sum_k \phi_{ik}\hat{A}_k - \sum_k \phi_{ik} \sum_{i' \neq c} \rho_{i'k}\hat{A}_{i'k} - \sum_k \phi_{ik}\rho_{ck}\hat{A}_{ck}, \tag{2}$$

[16]The empirical literature has yet to resolve whether slow regional employment responses to labor demand shocks are the result of labor-market frictions (e.g., search costs) or economic distortions (e.g., social insurance programs), a distinction that matters for welfare analyses of changes in the trading environment.

[17]For expositional simplicity, we treat the aggregate US market—which is in truth a collection of distinct regional markets—as a single entity. Traded output by region i thus refers to total shipments by the industries in i (e.g., manufacturing) that sell their output outside the region. Alternative versions of the gravity model differ in terms of how A_{ik} is determined. In Eaton & Kortum (2002), this value is the product of the location parameter for the distribution of productivity for industry k in region i and unit production costs for industry k in region i.

[18]For simplicity, we ignore sales by US regions to foreign markets. Incorporating these sales is straightforward. Equilibrium conditions not shown include factor-market clearing, to which we return below, and the balance of trade, which is discussed in the previous section.

where $\phi_{ik} \equiv X_{ik}/X_i$ is the share of industry k in region i's total sales on the US market, $\rho_{ik} \equiv X_{ik}/E_k$ is the share of region i in total US purchases in industry k, and subscript c indexes China. For simplicity, we assume that $\hat{A}_{ik} = \hat{A}_k - \theta\hat{w}_i$ and that trade costs remained unchanged.[19]

Equation 2 provides a reduced-form specification for estimating the impact of trade shocks emanating from China on regional economic activity in the United States or other countries. Most empirical analyses of the China trade shock base estimation on a specification similar to Equation 2 or its industry-level counterpart (see, e.g., Autor et al. 2013a,b and Pierce & Schott 2016). Of primary interest is the rightmost term of Equation 2, which captures the impact of growth in China's productive capacity on traded output by US region i. It can be rewritten as

$$\sum_k \phi_{ik}\rho_{ck}\hat{A}_{ck} = \sum_k \phi_{ik}\left[\frac{X_{ck}\hat{A}_{ck}}{E_k}\right], \tag{3}$$

which is the weighted average exposure of region i to changes in US industry import penetration that is mandated by changes in China's production capabilities. During the 1990s and 2000s, advances in Chinese manufacturing were driven by the country's market transition, which gave its firms access to foreign capital, technology, and inputs; allowed capital to move from the public to the private sector; permitted rural-to-urban migration; and ended restrictions on direct exporting by private enterprises. The ϕ_{ik} weights in Equation 3—the share of each industry in region i's total sales on the US market—summarize differences in industry specialization patterns across US regions and thus capture variation in regional exposure to China's supply-driven export growth.

3.2. Identifying the Reduced-Form Impact of the China Trade Shock

To estimate the impact of the trade shock in Equation 3 on regional labor-market outcomes, it is necessary to control for the confounding factors that also affect these outcomes. These confounds are summarized in the first four terms on the right of Equation 2. Anticipating the estimation approaches that we describe in Section 4, we discuss each of these components in turn.

The first term on the right of Equation 2, $\sum_k \phi_{ik}\hat{E}_k$, is regional exposure to US industry demand shocks. Because observed changes in import penetration from China will be affected by both the first and last terms in Equation 2, they will embody changes in both US product demand and China's supply conditions. Any reduced-form regression of changes in regional outcomes on regional trade exposure may thus be contaminated by US product demand shocks. Autor et al. (2013a,b) propose using Chinese import growth in other high-income markets as an instrument for the growth in US imports from China to isolate the foreign-supply-driven component of changes in US import penetration. Specifically, they instrument the observed change in US industry-level import penetration from China with a non-US exposure variable that is constructed using data on contemporaneous industry-level growth of Chinese exports to other high-income markets (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland).

Table 1 documents the operation of the Autor-Dorn-Hanson instrumental-variables strategy. The first column of the table shows that annual US imports from China increased by 304 billion dollars between 1991 and 2007, whereas imports from China grew by 235 billion dollars across the eight other high-income countries, offering comparable trade data for the full sample period. Both the United States and the other high-income countries experienced rising imports in almost all of

[19]The first assumption implies that the change in production capability for region i in industry k can be decomposed into the exogenous change in national productivity in industry k ($\hat{A}_k$) and the change in wages in region i ($\hat{w}_i$), consistent with Eaton & Kortum (2002). We thus assume that the exogenous determinants of regional comparative advantage (e.g., the Eaton-Kortum productivity distribution location parameters) are unchanged.

Table 1 The number of Chinese imports in the United States and in eight other developed economies (1991–2007; in year 2007 billion US dollars), and their correlations with United States–China imports[a]

	Δ Chinese imports (billion US$)	Industries with import growth	Correlation with US–China imports
United States	303.8	385	1.00
Japan	108.1	368	0.86
Germany	64.3	371	0.91
Spain	23.2	377	0.68
Australia	21.5	378	0.96
Finland	5.7	356	0.58
Denmark	4.7	362	0.62
New Zealand	3.8	379	0.92
Switzerland	3.3	343	0.55
Average for eight non-US countries	234.7	383	0.92

[a]Correlations of imports across 397 four-digit industries are weighted using 1991 industry employment from the NBER Manufacturing Productivity Database.

the 397 harmonized four-digit manufacturing industries, and the pattern of import growth across industries is highly correlated between the United States and the other countries (correlation coefficient of 0.92). The remaining columns of the table show the same information separately for each of the eight other high-income countries. Remarkably, each of the comparison countries witnessed import growth in at least 343 of the 397 manufacturing industries, and industry patterns of imports are strongly correlated with the United States, with correlation coefficients ranging from 0.55 (Switzerland) to 0.96 (Australia). That China made comparable gains in penetration by detailed sectors across numerous countries in the same time interval suggests that China's falling prices, rising quality, and diminishing trade and tariff costs in these surging sectors are a root cause.

A possible threat to this supply-based explanation for Chinese export patterns is that product demand shocks are correlated across high-income countries, in which case using cross-industry variation in China's penetration of other high-income markets as an instrument for US penetration could confound import growth with unobserved components of demand. Autor et al. (2013a,b) also utilize a gravity-based strategy that replaces the growth in US imports from China with the inferred change in China's comparative advantage and market access vis-à-vis the United States. This gravity approach differences out import demand in the purchasing country, thereby retaining supply and trade-cost-driven changes in China's export performance. The residuals from this regression approximate the percentage growth in imports from China due to changes in China's productivity and trade costs relative to the United States. Gravity and IV estimates are similar, which suggests that correlated import demand shocks are not overly important for the estimation.

In the second term on the right of Equation 2, $\theta \hat{w}_i$ is the endogenous change in wages in US region i resulting from external product-market shocks. Most empirical analyses exclude wages as an independent variable. Estimating Equation 2 without wages on the right-hand side captures the reduced-form impact of trade exposure on economic activity in region i that works either directly through changes in industry output or indirectly through feedback effects from changes in local wages (see Kovak 2013 on the impact of trade shocks on wages in Brazil based on a specific factors model). Alternatively, estimating a version of Equation 2 that makes either the change in regional wages or the change in regional labor supply the dependent variable provides a test of the geographic mobility of labor in response to trade-induced labor demand shocks.

The third term on the right-hand side of Equation 2, $\sum_k \phi_{ik}\hat{A}_k$, captures exposure of region i to changes in national industry productivity. Another consequence of regions varying in their specialization patterns is that they will differ in their exposure to sector-biased technological progress. Are regions that are more subject to technology shocks also ones that tend to face greater import competition? It appears not. There is near-zero correlation between exposure to technological change and exposure to trade with China across US local labor markets (Autor et al. 2013b, 2015).[20] A related issue, to which we return in Section 4, is whether exposure to trade with low-wage countries induces firms to step up innovation, making technology endogenous to trade.

Finally, the fourth term in Equation 2, $\sum_k \phi_{ik} \sum_{i' \neq c} \rho_{i'k}\hat{A}_{i'k}$, captures changes in production capabilities in other supplying countries. These changes may be in part a response to changes in supply conditions in China. If we exclude this term from the estimation, we model changes in supply capabilities in other countries implicitly as a reduced-form function of changes in industry productivity in China.[21]

The specification in Equation 2 does not comprise an input-output structure. The presence of intermediate inputs may affect the transmission of trade shocks within the United States. Consider the case of tire production. If rising imports of Chinese tires causes US tire producers to reduce their output, demand for US-made synthetic rubber and steel fiber, which are used as inputs in domestic tire production, may decline as well. The trade shock, which began in the US tire industry, would also affect domestic demand in the industries that supply inputs to US synthetic rubber and steel fiber producers, as the shock works its way up the production chain. A full accounting of the impact of trade shocks thus requires incorporating input-output linkages between domestic industries (Pierce & Schott 2016, Acemoglu et al. 2016). A related possibility is that US synthetic rubber and steel fiber producers may benefit from access to lower-cost inputs from China. Recent literature allows for both channels of transmission, from US final goods producers to their domestic input suppliers and from Chinese input suppliers to US input buyers.

To summarize this discussion, identifying the impact of trade with China on US local labor-market outcomes requires a valid instrumental variable—or, more broadly, a source of plausibly exogenous variation—for regional exposure to import competition, controls for regional exposure to technological change, and recognition that the estimated reduced-form impact may be attenuated by labor migration between regions. An alternative approach to identification is to utilize changes in imports that result from changes in trade policy. Topalova (2010), Kovak (2013), and McLaren & Hakobyan (2016) estimate the change in local incomes or employment due to greater import competition that arises from tariff reductions mandated by trade reforms in India, Brazil, and North America, respectively. Tariff reductions are a less obvious source of the increase in imports from China by developed economies. By the early 1990s, most developed nations, including the United States, already provided China with MFN access to their markets, implying an average import tariff of less than 4%. Trade barriers in these countries did decline in the late 1990s and

[20] Autor et al. (2013b, 2015) measure regional technology exposure using an occupational composition index that captures the opportunities for substitution of computers for workplace tasks. This index is highly correlated with measures of computer adoption (Autor & Dorn 2013), but it is necessarily incomplete and would not be expected to capture industry-specific innovations that deviate from the overall pace of machine-labor substitution.

[21] China's manufacturing growth is closely related to the expansion of global production networks in East Asia (Hsieh & Woo 2005). As China has grown, so too has its demand for imported inputs, which it assembles into final outputs for shipment abroad. During the 2000s, approximately half of China's manufacturing exports were produced by export processing plants, which are dedicated solely to assembly of imported components (Yu & Tian 2012). Over time, China has begun to produce an ever greater fraction of the inputs that it uses in export production, as it diversifies away from pure processing trade (Brandt & Morrow 2014). Koopman et al. (2012) estimate that the share of domestic value added in China's total exports—the fraction of China's exports composed of value added in China—rose from 50% in 1997 to 62% in 2007.

early 2000s, as a result of the Uruguay Round of the GATT, but the average decline was less than two percentage points, except in apparel and textiles (Bloom et al. 2016). Hence, changes in applied tariffs would seem to predict no more than modest growth in China's shipments to the United States. We discuss below how the observed reduction in US MFN tariffs may not capture the full impact of changes in US trade barriers on imports from China (Pierce & Schott 2016).

4. LABOR-MARKET ADJUSTMENT TO TRADE

If we suppose that the growth in US manufacturing imports from China was triggered by a combination of productivity growth and improving foreign market access for Chinese firms, the shock that originated across the Pacific would first manifest itself in the United States in terms of more intense competition in product markets. Next, the shock would be transmitted to the regions in which competing manufacturing industries are concentrated, to the US sectors that supply these industries with inputs, and to the workers employed in manufacturing and its supplier industries. In this section, we empirically trace out the impacts of the China trade shock by examining consequences at each of these levels.

4.1. Industry Adjustment to Import Competition

The initial point of transmission of supply shocks in China to factor markets in the United States is the product market. Improvements in China's productive capabilities and reductions in its trade costs will change the intensity of competition for US goods, leading to a contraction in US industries subject to greater import exposure. Bernard et al. (2006) use data on US manufacturing plants for 1977 to 1997 to examine the consequences of increased exposure to import competition from low-wage countries, which they measure as the share of these economies in US imports, and which is largely attributable to China.[22] They find that over five-year intervals, industries facing greater increases in exposure to trade are subject to higher rates of plant exit.[23] Among the plants that survive, those in more trade-exposed sectors have larger reductions in employment and a higher likelihood of changing their primary four-digit manufacturing category.

Acemoglu et al. (2016) provide a complementary analysis to Bernard et al.'s (2006) that moves the focus to the industry level and extends the data forward in time to cover the period 1991 to 2011.[24] Consistent with the logic of Equation 2, they estimate the following model for the impact of shifts in trade exposure on manufacturing employment:

$$\Delta L_{j\tau} = \alpha_\tau + \beta_1 \Delta IP_{j\tau} + \gamma X_{j0} + e_{j\tau}. \tag{4}$$

Here, $\Delta L_{j\tau}$ is 100 times the annual log change in employment in industry j over subperiod τ, $\Delta IP_{j\tau}$ is 100 times the annual change in import penetration from China in US manufacturing

[22]This measure does not correspond to the theoretical concept of import penetration in Equation 3. However, because most of the temporal variation in the Bernard et al. measure is in the numerator—due to China's massive export growth—the share of US imports from low-wage countries and the change in US import penetration due to low-wage countries are highly correlated.

[23]Similar effects are observed for other countries: Growing Chinese import competition increases plant exit and reduces firm growth in Mexico (Iacovone et al. 2013, Utar & Torres-Ruiz 2013) and reduces employment growth in Belgian firms (Mion & Zhu 2013), Danish firms (Utar 2014), and in a panel of firms from 12 European countries (Bloom et al. 2016).

[24]In related work, Pierce & Schott (2016) compare sectors that varied in their vulnerability to China's joining the WTO. Prior to the 2001 accession, Congress decided annually whether to rescind MFN status on China and impose much higher non-MFN tariffs. Relative to pre-2001 trends, employment declines after 2001 were greater in US manufacturing industries that had larger initial gaps between MFN and non-MFN tariffs.

Table 2 Industry-level changes in Chinese import exposure and US manufacturing employment[a]

	1991–2011		1991–1999	1999–2011	1999–2007	2007–2011
	Mean (SD)	Median	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
100 × Annual Δ in US exposure to Chinese imports	0.50 (0.94)	0.14	0.27 (0.75)	0.66 (1.33)	0.84 (1.61)	0.30 (1.68)
100 × Annual log Δ in employment (manufacturing industries)	−2.71 (3.07)	−2.05	−4.32 (3.85)	−0.30 (3.49)	−3.62 (4.15)	−5.73 (5.02)

[a]Statistics are based on 392 four-digit manufacturing industries. The change in US exposure to Chinese imports is computed by dividing 100 times the annualized increase in the value of US imports over the indicated period by 1991 US market volume in that industry. Employment changes are computed in the County Business Patterns. All observations are weighted by 1991 industry employment. Table adapted from table 1 in Acemoglu et al. (2016).

industry j over subperiod τ, β_1 is the estimated effect of exposure to import competition on industry employment, X_{j0} is a set of industry-specific start of period controls (suppressed initially), α_τ is a period-specific constant, and $e_{j\tau}$ is an error term.[25] **Table 2**, reproduced from Acemoglu et al.'s results, shows that the employment-weighted mean industry saw Chinese import exposure rise by 0.5 percentage points per year between 1991 and 2011, with more rapid penetration in the period of 1999 through 2007—during China's WTO accession—than from 1991 through 1999.[26] Growth from 2007 to 2011 indicates a marked slowdown in import expansion following the onset of the global financial crisis, which halted trade growth worldwide (Levchenko et al. 2010). **Table 2** also shows that the decline in US manufacturing employment accelerated over time: The average industry contracted by 0.3 log points per year between 1991 and 1999, by 3.6 log points per year between 1999 and 2007, and by 5.7 log points per year in the Great Recession period of 2007 to 2011.[27]

Table 3, also based on Acemoglu et al. (2016), presents estimates of Equation 4 in stacked first differences for the two time periods 1991–1999 and 1999–2011. For these results, the change in import penetration and a dummy for each time period are the only regressors. In column 1, which estimates the model without instrumentation, the import penetration variable is negative and highly significant, consistent with the hypothesis that rising import exposure lowers domestic industry employment. Nevertheless, this ordinary-least-squares point estimate could be biased because growth in import penetration is driven partly by domestic shocks. Column 2 instruments the observed changes in industry import penetration with contemporaneous changes in other-country China imports, as described above. The estimate in column 2 implies that a one-percentage-point rise in industry import penetration reduces domestic industry employment by 1.3 log points (t-ratio of 3.2). Column 3, which stacks the periods 1991–1999 and 1999–2007, shows that the coefficient of import penetration is similar if we restrict attention to the years preceding the Great Recession.

Although it is clear empirically that employment in import-competing US industries has shrunk in the face of China's rapid growth, the challenge for research is how to measure the distributional

[25]Import penetration is defined here as $\Delta IP_{j\tau} = \Delta M^{UC}_{j,\tau}/(Y_{j,91} + M_{j,91} - E_{j,91})$, where Y_j is domestic output, M_j is imports, E_j is exports, and $\Delta M^{UC}_{j,\tau}$ is the change in US imports from China.

[26]**Table 2** slightly aggregates the 397 manufacturing industries of **Figure 4** to 392 industries to improve compatibility with other industry-level data such as the Bureau of Economic Analysis (BEA) input-output tables.

[27]Ebenstein et al. (2014) describe how employment conditions change in the industries and occupations that are more exposed to US multinational companies moving production offshore. In mild contrast to the above results, they find that trade exposure affects employment not through workers' industry of employment but through their occupation of employment.

Table 3 Effect of import exposure on log employment change in US manufacturing industries (in OLS and 2SLS estimates)[a]

	Stacked first differences		
	1991–2011		1991–2007
	Without instrumentation	With instrumentation	Stacked periods 1991–1999 and 1999–2007
100 × Annual Δ in US exposure to Chinese imports	−0.81***[b] (0.16)	−1.30 (0.41)	−1.24 (0.37)
1 {1991–1999}	−0.08 (0.36)	0.05 (0.36)	0.04 (0.36)
1 {1999–2011}	−3.79*** (0.33)	−3.46*** (0.33)	
1 {1999–2007}			−2.58*** (0.38)
Estimation method	OLS	2SLS	2SLS

Abbreviations: OLS, ordinary least squares; 2SLS, two-stage least squares.
[a] $N = 784$ (392 four-digit manufacturing industries over two periods (1991–1999 and 1999–2011 or 1999–2007). Employment changes are computed in the County Business Patterns and are expressed as 100 × annual log changes. Observations are weighted by 1991 employment. Standard errors in parentheses are clustered on 135 three-digit industries. Table adapted from table 3 in Acemoglu et al. (2016).
[b] $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

consequences and the net economic costs and benefits of these labor-market impacts. The answers revolve around mechanisms that are not self-evident from the basic facts above; specifically,

1. Given the spatial concentration of manufacturing, do industry shocks translate into localized employment shocks—and if so, are they offset or amplified by local labor-market mechanisms?
2. To what extent are trade-induced industry employment contractions offset by employment gains elsewhere in the US economy, potentially outside of trade-impacted regions?
3. Do trade adjustments occur on the employment margin, the wage margin, or both? If on the employment margin, what are the costs to individual workers and to the public at large?
4. Are the costs of trade adjustment borne disproportionately by workers employed at trade-impacted firms and residing in trade-impacted local labor markets? Or do these shocks diffuse nationally, thus moderating their concentrated effects?

We consider these questions below, highlighting both what is known and what remains unanswered.

4.2. Regional Employment Impacts

To assess the distributional consequences of rising trade with China, we turn next to adjustments in local labor markets. Local exposure arises from the tendency of industries to cluster in specific regions of a country (Ellison et al. 2010). In the United States, manufacturing employment is particularly concentrated in parts of the Midwest and Southeast. Even within these manufacturing regions, there is wide variation in the industry composition of local firms. Industry composition may be affected by trade shocks, however. In measuring regional trade exposure, we follow the literature in utilizing data on regional industry specialization patterns in the preshock period, thus preempting any endogenous adjustment of industry location to contemporaneous trade shocks.

Autor et al. (2013a,b) examine the impact of Chinese competition on US commuting zones (CZs), drawing on data from the US Census, the American Community Survey, and the County Business Patterns for the years 1990 to 2007. CZs are clusters of counties that have the commuting structure of a local labor market (Tolbert & Sizer 1996, Autor & Dorn 2013). **Figure 6** shows the spatial distribution of exposure to increases in Chinese import competition from 1991 to 2007 across CZs. In the map of unconditional import exposure in panel *a*, some broad regions have greater vulnerability to imports simply because they are more specialized in manufacturing overall. For instance, Alabama and Tennessee, both strongly manufacturing oriented, have a preponderance of trade-exposed CZs. Variation of trade intensity within regions becomes larger in **Figure 6*b***, which plots import exposure conditional on the share of manufacturing in CZ employment as of 1990, thus measuring import competition for the local set of manufacturing industries. When looking within manufacturing, Tennessee, owing largely to its concentration of furniture producers, is far more exposed to trade with China than is Alabama, which has agglomerations of relatively insulated heavy industry. This variation of import exposure within local manufacturing sectors is the basis for much of the econometric analysis we discuss.

Over the period 1990 to 2007—considered either as a single long difference or as stacked changes for 1990 to 2000 and 2000 to 2007—CZs that were more exposed to increased import competition from China experienced substantially larger reductions in manufacturing employment. Columns 1 to 4 of **Table 4**, based on Autor et al. (2013a,b), show that the decline in manufacturing jobs was largely accommodated by an increasing share of a CZ's working-age population that was unemployed or out of the labor force. Specifically, a \$1,000 increase in a CZ's per-worker import exposure reduces the fraction of the working age population employed in manufacturing and nonmanufacturing, respectively, by −0.60 and −0.18 percentage points (the latter of which is not significant), and raises the fraction of unemployed and out of the labor force by 0.22 and 0.55 percentage points.[28] Autor et al. (2013a,b) further document that this finding holds for workers at all education levels. For workers with less than a college education, increased trade exposure also predicts significant reductions in CZ employment in nonmanufacturing industries, suggesting the presence of negative local demand spillovers.

Column 5 of **Table 4** further shows that import competition has modest effects on the size of the working-age population in CZs. Tracing individual workers over time, Autor et al. (2014) confirm that there is little geographic migration in response to the trade shock.[29]

Thus, the industry-level impacts of Chinese import competition seen in **Table 3** are equally visible within local labor markets. Contrary to the canonical understanding of US labor markets as fluid and flexible, trade-induced manufacturing declines in CZs are not, over the course of a decade, largely offset by sectoral reallocation or labor mobility. Instead, overall CZ employment-to-population rates fall at least one-for-one with the decline in manufacturing employment, and generally by slightly more. These results run counter to a precept of general equilibrium trade theory that the local employment effect of sectoral demand shocks should be short-lived, as the forces of wage and price arbitrage and labor mobility dissipate these shocks nationally.

[28]The import per worker measure is a variant of Equation 3 that uses data on local employment by industry to proxy for the sales and expenditure variables ϕ_{ik} and E_k. It can be interpreted as assigning national imports by industry to CZs based on CZs' shares in national industry employment, and normalizing the imports assigned to a CZ by total CZ employment. A \$1,000 increase in annual imports per worker during a decade corresponds approximately to the difference in the trade exposure between CZs at the 75th versus 25th percentile of import exposure during 1990–2007.

[29]Population responses to local trade shocks are also limited in other countries. Analyses from Germany (Dauth et al. 2014) and Spain (Donoso et al. 2014) both find weak and statistically insignificant population adjustments in local labor markets that are exposed to import competition from low-wage counties.

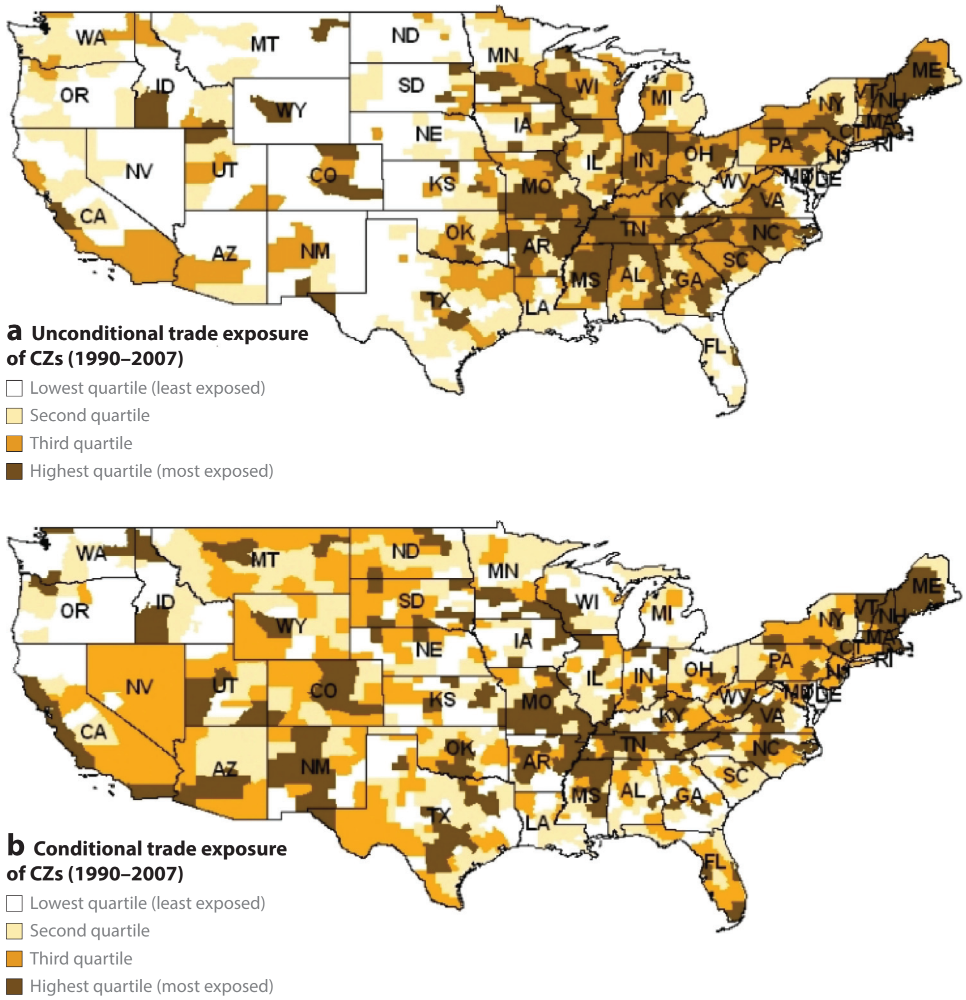

Figure 6

Geographic exposure to trade shocks at the CZ (commuting zone) level. (*a*) Quartiles of unconditional exposure. (*b*) Quartiles of exposure conditional on manufacturing employment share.

Trade-induced shocks to local manufacturing employment should affect the allocation of labor across sectors but should have no measurable impact on employment rates in directly impacted CZs relative to the national labor market. That this neoclassical prediction does not appear to hold even approximately over the span of a decade suggests that the labor-market impacts of trade shocks are likely to be amplified by slow and incomplete adjustment: Rather than modestly reducing wage levels among low-skill workers nationally, these shocks catalyze significant falls in employment rates within trade-impacted local labor markets.[30]

[30]Labor market adjustment to import competition from China may also be incomplete because the trade shock continues to accumulate over time as imports from China grow. In the case of Brazil, however, Dix-Carneiro & Kovak (2015) also find little spatial mobility and regional convergence in the years following a one-time trade liberalization shock.

Table 4 Import competition and outcomes in US local labor markets (1990–2007)[a]

a. Δ Fraction of working age population in manufacturing, unemployment, and NILF			
Employed in manufacturing	Employed in non-manufacturing	Unemployed	NILF
(1)	(2)	(3)	(4)
−0.60***	−0.18	0.22***[b]	0.55***
(0.10)	(0.14)	(0.06)	(0.15)
b. Δ Log population, log wages, annual wage, and transfer income			
Δ Log CZ population (log points)	**Δ Average log weekly wage (log points)**	**Δ Annual wage/salary income per adult (US$)**	**Δ Transfers per capita (US$)**
(5)	(6)	(7)	(8)
−0.05	−0.76***	−549.3***	57.7***
(0.75)	(0.25)	(169.4)	(18.4)

Abbreviations: CZ, commuting zone; NILF, not in labor force.
[a]$N = 1{,}444$ (722 CZs times two time periods (1990–2000 and 2000–2007). Employment, population, and income data are based on US Census and American Community Survey data; transfer payments are based on BEA Regional Economic Accounts. All regressions control for the start of period percentage of CZ employment in manufacturing, college-educated population, foreign-born population, employment among women, employment in routine occupations, average offshorability index of occupations, and Census division and time dummies. Models are weighted by start of period CZ share of the national population. Robust standard errors in parentheses are clustered on state. Table adapted from Autor et al. (2013a).
[b]$*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Regional labor-market consequences from exposure to trade with China have also been studied for countries other than the United States. Analyses for Norway (Balsvik et al. 2015) and for Spain (Donoso et al. 2014), covering periods from the late 1990s to 2007, find results that are consistent with the US evidence. Regions that face greater import competition experienced a differential decline in manufacturing employment. Lower manufacturing employment was primarily compensated by higher unemployment in Norway and by greater employment outside of manufacturing in Spain. Dauth et al. (2014) find that in Germany, Chinese import competition also had a negative impact on manufacturing employment in local labor markets. In the German case, the impact of rising Chinese import competition between 1988 and 2008 was compounded by an even more rapid growth of imports from Eastern Europe following the fall of the Iron Curtain. Distinct from the US case, German manufacturers sharply increased exports to these lower-wage countries, resulting in a more modest trade deficit with China and a trade surplus with Eastern Europe. The employment gains related to these export opportunities roughly offset the job losses from import competition in the case of China, whereas they actually raise German employment in the case of trade with Eastern Europe.

Although this review's focus is on the consequences of increased import exposure to China, this was not the only trade shock to affect local labor markets in the United States over the past two decades. The North American Free Trade Agreement, enacted in 1994, stands out as a landmark change in US trade policy, which led to the elimination of tariffs on US imports from Mexico for the large majority of manufactured products.[31] Similar to Topalova's (2010) analysis for India and Kovak's (2013) for Brazil, McLaren & Hakobyan (2016) estimate the impact of NAFTA tariff changes on wages in US regions (defined as Consistent Public Use Microdata

[31]US trade with Canada was liberalized earlier in 1989 through the Canada–United States Free Trade Agreement (Trefler 2004).

Areas) between 1990 and 2000. They allow workers to be affected by tariff reductions either directly through their industry of employment—where industries varied both in the magnitude and the speed of the tariff cuts—or indirectly through the specialization of their local labor market in NAFTA-exposed sectors. Both direct and indirect channels of transmission are important for wage outcomes. Wage growth for high-school dropouts employed in the industries that were initially the most protected, and therefore subject to the largest tariff declines, was 17 percentage points lower than for comparable workers employed in initially unprotected industries. Additionally, high-school dropouts employed in locations that were initially the most specialized in industries vulnerable to NAFTA had a wage growth that was eight percentage points lower than for similarly educated workers in locations with few protected industries. Surprisingly, the next most affected labor-market group is workers with some college education. NAFTA wage impacts for high-school educated workers are comparatively modest and for the college educated, effectively zero.

4.3. National Impacts Versus Regional Impacts

The localized impacts of import competition measure the relative effect of the China trade shock on more versus less trade-exposed regional labor markets. Should we take these results to mean that trade-impacted locations suffered employment declines in absolute terms, or simply that they benefited less relative to trade-insulated locations? This distinction between relative and absolute effects matters. The former encompasses the distributional effects of trade, whereas the latter bears on the magnitude of the net gains from trade.

Using an expanded version of Equation 4, Acemoglu et al. (2016) assess whether the seemingly adverse industry- and region-level impacts are offset by employment responses elsewhere in the economy. Looking across US manufacturing industries whose outputs compete with Chinese import goods, they estimate that had import penetration from China not grown after 1999, there would have been 560,000 fewer manufacturing jobs lost through the year 2011. Actual US manufacturing employment declined by 5.8 million workers from 1999 to 2011, making the counterfactual job loss from direct import competition amount to 10% of the realized job decline. As these results are based on the reduced-form specification of Equation 2, they may not, however, capture the full general equilibrium consequences of trade.

Negative shocks to one industry are transmitted to other industries via economic linkages between sectors. One source of such linkages is buyer-supplier relationships (Acemoglu et al. 2012). Rising import competition in apparel and furniture—two sectors in which China is strong—will cause these "downstream" industries to reduce purchases from the "upstream" sectors that supply them with fabric, lumber, and textile and woodworking machinery. Because buyers and suppliers often locate near one another, much of the impact of increased trade exposure in downstream industries is likely to transmit to suppliers in the same regional or national market. Acemoglu et al. (2016) use US input-output data to construct upstream import exposure shocks for both manufacturing and nonmanufacturing industries. Estimates from this exercise indicate negative employment effects in industries that sell outputs to directly trade-exposed industries, from which trade exposure propagates upstream in the supply chain.[32] Applying the direct plus the indirect input-output measure of exposure increases estimates of trade-induced job losses for 1999 to 2011 to 985,000 workers in manufacturing, and to 2.0 million workers in the entire economy. Interindustry linkages thus magnify the employment effects of trade shocks, almost doubling the

[32] Pierce & Schott (2016) and Federico (2014) find qualitatively similar results for the United States and Italy, respectively.

size of the impact within manufacturing and producing an equally large employment effect outside of manufacturing.[33]

Two additional sources of linkages between sectors operate through changes in aggregate demand and the broader reallocation of labor. When manufacturing contracts, workers who have lost their jobs or suffered declines in their earnings reduce their spending on goods and services. The contraction in demand is multiplied throughout the economy, depressing consumption and investment. Helping offset these negative aggregate demand effects, workers who exit manufacturing may take up jobs in the service sector or elsewhere in the economy, replacing some of the earnings lost in trade-exposed industries. Because aggregate demand and reallocation effects work in opposing directions, we can only detect their net impact on aggregate employment.

To adjudicate among these mechanisms, Acemoglu et al. (2016) supplement their analysis of US industries with an analysis of US CZs that adds an input-output structure to Autor et al. (2013a,b). If the reallocation mechanism is operative, then when a local industry contracts as a result of Chinese competition, some other industry in the same CZs should expand. Aggregate demand effects should also operate within local labor markets, as shown by Mian & Sufi (2014) in the context of the recent US housing bust. If increased trade exposure lowers aggregate employment in a location, reduced earnings will decrease spending on nontraded local goods and services, thus magnifying the local impact. Estimates of the net impact of aggregate demand and reallocation effects imply that import growth from China between 1999 and 2011 led to an employment reduction of 2.4 million workers. Although the employment losses are concentrated in industries that are either directly exposed to import competition or indirectly via input-output linkages, there is little evidence for substantial offsetting employment gains in local industries that are not exposed to the trade shock. The estimated employment decline is larger than the 2.0 million job loss estimate obtained for national industries, which only captures direct and input-output effects. It may still not capture the full consequences of the China shock on US employment, however, as neither the analysis for CZs nor that for national industries fully incorporates all of the adjustment channels encompassed by the other. The national industry estimates exclude reallocation and aggregate demand effects, whereas the CZ estimates exclude the national component of these two effects, as well as nonlocal input-output linkages.

Are there positive employment effects from US trade with China that the literature may be missing? One mechanism may work through the supply of imported inputs. The expanded ability of US firms to offshore production to China may raise productivity for workers in the United States (Grossman & Rossi-Hansberg 2008), lower the relative price of intermediates (Auer et al. 2013), or extend the range of final goods that firms are capable of producing (Goldberg et al. 2010). Although such benefits are plausible in theory and have been found in other national contexts, neither Pierce & Schott (2016) nor Autor et al. (2013a,b) detect evidence of positive US industry or regional employment responses to increased imported input supply. A second mechanism may be that increased competition in final goods markets alters investments in innovation. Bloom et al. (2016) show that European apparel and textile firms that faced greater competition from China following the elimination of quotas under the Multi-Fiber Arrangement produced more patents, had higher productivity growth, and boosted purchases of new technology. Although intensified product-market competition may raise the incentive for innovation, it can just as easily work in

[33] Although the employment impact of upstream import exposure is significantly negative, the impact of downstream import exposure is estimated to be small and insignificant in aggregate. Point estimates suggest that manufacturing industries may expand employment when their supplier industries become exposed to Chinese competition (consistent with lower input prices), whereas employment outside manufacturing is negatively affected by shocks that propagate downstream (e.g., reduced employment in a wholesale business that used to buy locally produced manufactures).

the opposite direction. The aggregate impact of Chinese competition on US innovation remains unknown.[34]

The reduced-form analysis suggests that the reallocation of labor across US industries and regions in response to increased competition from China does not produce an offsetting increase in employment by other US traded-good industries, as the simple logic of neoclassical trade theory would have predicted. Other indirect gains from trade with China are, in principle, still possible. One explanation for the extremely modest offsetting employment increase in nonexposed sectors in the United States may be related to the rapid contemporaneous rise in the US aggregate trade deficit, a substantial part of which reflects a growing trade imbalance with China. When faced with greater import competition, an open economy normally reallocates resources out of some tradable industries into others, at least under balanced trade. If, however, the trade shock is accompanied by a rise in the trade deficit, then the reallocation from exposed tradables into tradables not exposed to China may be delayed, shifting employment into nontradables instead. Although this reasoning still predicts a long-run employment reallocation toward nonexposed tradables, the large and growing US trade deficit during the period under study may have significantly slowed such a reallocation.

4.4. Wage and Transfer Impacts

Employment is not the only margin of labor-market response to trade shocks. Column 6 of **Table 4** shows that more trade-exposed CZs experience larger reductions in average weekly wages. Extending the analysis in Autor et al. (2013a,b) using quantile regression, Chetverikov et al. (2016) document that these wage impacts of CZ-level trade exposure are concentrated among workers in the bottom four wage deciles. The reduction in wages is not limited to manufacturing, but indeed is concentrated outside that sector. Although the shock to manufacturing industries seems to affect local wages more broadly, the presence of differential wage impacts of trade across CZs suggests that these labor markets are indeed local, as spatial mobility is not sufficiently large to equilibrate wages at the national level.[35]

The estimates of **Table 4** allow a simple calculation of the relative importance of employment and wage adjustments for the overall decline in earnings in trade-exposed CZs. Given average annual earnings of approximately \$40,000 per worker, a reduction of employment by 0.78 percentage points (sum of columns 1 and 2) per \$1,000 dollars of imports per worker lowers earnings per adult by approximately \$312 per year ($0.0078 \times 40{,}000$). The same shock reduces the average weekly wage by 0.76 log points among the approximately 70% of working-age adults who are employed, which implies an additional earnings loss per adult of \$213 per year ($0.0076 \times 0.7 \times 40{,}000$).

[34]A further issue is that measured input-output linkages may miss some positive demand effects from US exports. Consider the iPhone, whose back panel states, "Designed by Apple in California. Assembled in China." From its US headquarters, Apple offshores production to Foxconn, which employs 300,000 workers in its iPhone operations in China. If productivity in Foxconn rises, iPhone sales may expand, thereby increasing demand for design services among Apple's 50,000 US employees. However, not all of Apple's design exports to China may appear in US trade data. For tax purposes, Apple may attribute some iPhone revenues to overseas subsidiaries. These revenues would not appear in the US current account until the earnings are repatriated, possibly far in the future. A similar logic applies to US business services that may expand as a result of increased trade with China.

[35]Local labor market analyses for other developed countries find significant wage declines in response to import competition in Norway (Balsvik et al. 2015) and Spain (Donoso et al. 2014), and an insignificant wage reduction in Germany (Dauth et al. 2014). In related work on a developing economy, Costa et al. (2014) analyze the Brazilian experience of trade with China during the period 2000 to 2010, which saw rising Brazilian exports of raw materials and growing imports of manufactured goods. Whereas Brazilian regions specializing in raw materials experienced rising wages, those competing with imported Chinese manufactures suffered wage losses, especially in low-skilled occupations.

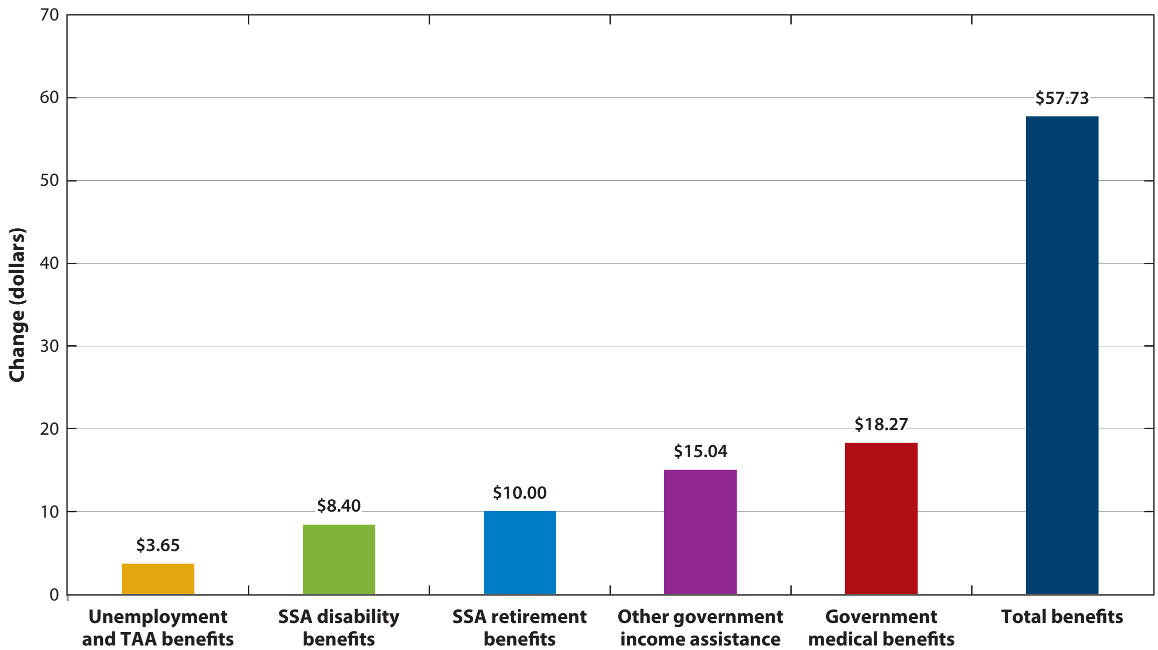

Figure 7

Effect of a $1,000-per-worker increase in imports from China on dollar change of annual government transfer receipts per capita in commuting zones (1990–2007). Abbreviations: SSA, US Social Security Administration; TAA, Trade Adjustment Assistance.

Although trade theory has typically emphasized the impact of trade shocks on wages, these results suggest that adjustments at the employment margin might have an even larger quantitative impact on workers' earnings.[36]

A direct consequence of reduced employment and wages in trade-exposed local labor markets is an increase in transfer benefits. Perhaps unsurprisingly, more trade-exposed CZs see larger increases in per capita payouts of Unemployment Insurance and Trade Adjustment Assistance (TAA) (**Figure 7**; see also Autor et al. 2013a,b), both of which are designed to assist laid-off workers. However, the impacts of trade shocks on transfer payments extend far beyond those tied to temporary downturns. Because trade-induced declines in local employment and wages appear persistent, a larger fraction of households in a CZ is likely to qualify for means-tested entitlements. As **Figure 7** documents, more trade-exposed CZs experience larger per capita growth in publicly provided medical care, consistent with more households qualifying for income-based health benefits, and in government income assistance, consistent with more households meeting the threshold for welfare payouts. Trade exposure also contributes to an increase in disability benefits, whose take-up is typically associated with permanent exit from the labor force (Autor & Duggan 2003). Retirement benefits rise in more trade-exposed CZs, suggesting that adverse labor-market shocks induce more workers to retire earlier (see Kondo 2013 for a general equilibrium analysis of the welfare consequences of trade-related employment losses, and Feler & Senses 2015

[36]This finding has precedence in the literature on labor-market responses to trade. Using data on US manufacturing industries in the 1960s and 1970s, Grossman (1987) finds that adjustment to changes in import competition occurs primarily in terms of industry employment and only secondarily in terms of wages.

for results on the impact of the China trade shock on the provision of public services across local jurisdictions).

What is striking about the impact of trade shocks on benefit take-up is not just the size of these effects—for every extra \$100 in local import exposure per worker transfer receipts rise by approximately \$6 per capita—but also their relative magnitudes across categories. TAA, the primary federal government program intended to help workers who lose their jobs as a result of foreign competition (Baicker & Rehavi 2004), is effectively inconsequential in local adjustment to trade shocks. Workers eligible for TAA receive extended unemployment benefits of up to 18 months, as long as they remain enrolled in a training program, and may obtain allowances toward relocation, job search, and healthcare.[37] Trade-exposed CZs certainly experience sharp relative growth in per capita receipts of TAA benefits. However, although TAA reacts elastically to trade exposure, it is far from the transfer category that responds most strongly in terms of dollar expenditure; the total volume of TAA spending is negligible relative to many other transfer programs. A more trade-exposed CZ (defined to be one at the 75th percentile of change in imports per worker over the period 1991–2007) would see an increased per capita take-up of TAA of only \$0.23 when compared to a less trade-exposed CZ (defined to be one at the 25th percentile of change in importers per worker); spending grows by more than \$15 per capita for each of the three categories medical benefits, federal income assistance, and Social Security retirement and disability benefits (**Figure 7**).

Despite the responsiveness of local transfer payments to local import exposure, on the whole there appears to be limited regional redistribution of trade gains from winners to losers. Comparing again the residents of CZs at the 75th and 25th percentile of import exposure, those in the more exposed location experience a reduction in annual household wage and salary income per adult of \$549, whereas per capita transfer income rises by approximately \$58, thereby offsetting just a small portion of the earnings loss (see columns 7 and 8 of **Table 4**).[38]

4.5. Worker-Level Impacts

The evidence above suggests that trade adjustment is a slow-moving process, and that its costs fall heavily on trade-exposed local markets rather than being dispersed nationally. What these analyses do not answer is to what degree costs are born specifically by workers employed at trade-impacted firms rather than more broadly among comparably skilled workers in a locality. If, within industries and local labor markets, adverse trade effects are dispersed among workers of comparable skills, the person-level costs of these shocks will be moderated. Alternatively, if, due to labor-market frictions or skill specificity, the impact falls disproportionately on workers directly employed at import-competing establishments—and even more so on relatively low-skill workers within these establishments—the adverse distributional consequences of trade exposure may be larger still.

Trade theory identifies a wide range of mechanisms through which trade shocks will have differential effects across individuals. HO reasoning suggests that the impacts of freer trade on real incomes will vary according to an individual's skill level. In a frictionless labor market, rapid mobility of workers across firms, industries, and regions guarantees that wages adjust uniformly

[37]To qualify for TAA, workers must show that their employer cut back production because of import competition, relocated production to a country with which the US has a trade agreement, or lost business with a buyer or supplier that is TAA certified.

[38]However, household income is measured per adult (given only adults generate income), whereas transfer income is measured per capita including children (given some transfers are based on the presence of children). A household with children might thus offset somewhat more than 10% of its earnings loss.

within skill groups in response to a trade shock, even if only a subset of industries or regions are directly exposed to trade. Under imperfect worker mobility across jobs, trade shocks can have heterogeneous impacts within skill groups. Several recent models of labor-market adjustment to trade incorporate switching costs for workers who wish to move across sectors. Structural estimates of these models suggest that those costs may amount to several months or even several years of a worker's earnings (Artuç et al. 2010, Dix-Carneiro 2014, Pessoa 2016, Ashournia 2015).[39] Labor-market frictions may also stem from search costs for firms (Helpman et al. 2010). These frictions tie worker outcomes to changes in foreign competition in the initial firm, industry, or region of employment. Until recently, there has been little evidence on how individual workers adjust to trade shocks.[40]

Autor et al. (2014) examine the impact of import competition from China on the careers of individual workers using longitudinal data from the US Social Security Administration. Their analysis contrasts the labor-market outcomes of workers who were ex ante observationally similar except for their initial industry of employment.[41] Workers whose 1991 industry subsequently became exposed to higher import penetration accumulate substantially lower earnings over the period of 1992 to 2007, compared to their peers with similar demographic characteristics and previous labor-market outcomes. These workers also experience greater job churning. They spend fewer years working for their initial firm, more years working outside their initial industry, and more years receiving Social Security Disability Insurance (SSDI). This trade-induced job mobility is however not sufficient to equilibrate career earnings between more and less trade-exposed workers.

Why don't employment transitions allow initially trade-exposed workers to fully recoup declines in earnings with the initial employer? The literature on job loss provides one potential answer (e.g., Neal 1995): Displacement destroys industry-specific human capital, leaving affected workers in positions for which they are poorly suited relative to nondisplaced workers. A parallel explanation is that workers' specific skills cause them to seek positions in which they remain exposed to import competition, notwithstanding the predilection of trade-impacted workers to exit their original two-digit sector. **Figure 8** provides insight into this latter mechanism by depicting the correlation between workers' trade exposure at their initial employers and at their current employers for each year between 1991 and 2007.[42] In the years immediately following 1991, few workers had separated from their original firms, and hence the correlation remains close to 1. Over time, the correlation between initial and current firm trade exposure falls, as job transitions proceed apace, but remains strongly positive, leveling off at 0.43 in the final year (2007). As a benchmark against which to evaluate the persistence of trade exposure, the figure also plots counterfactual correlations in which trade exposure at any new employer is set to zero, such that the reported series summarizes the cumulative likelihood of having left the initial firm after the number of years indicated on the horizontal axis. Logically, this counterfactual correlation also declines over

[39]Allowing for switching costs across both industries and occupations, Artuç & McLaren (2015) also find substantial costs of occupational reallocation.

[40]Hummels et al. (2014) use data for Denmark to analyze the impacts of increased firm-level imports on within-job spell earnings for workers.

[41]There may, of course, be unobserved factors that affect how workers sort themselves across industries. Sorting based on unobservables would matter for the analysis if workers who were predisposed to lower lifetime earnings growth disproportionately selected themselves into industries subject to future import competition from China.

[42]The correlations compare the 1991–2007 growth of import penetration between the industry that employed a worker in 1991 and the industry that employed a worker in the subsequent year indicated on the x-axis. This correlation is 1.0 in 1991 by construction.

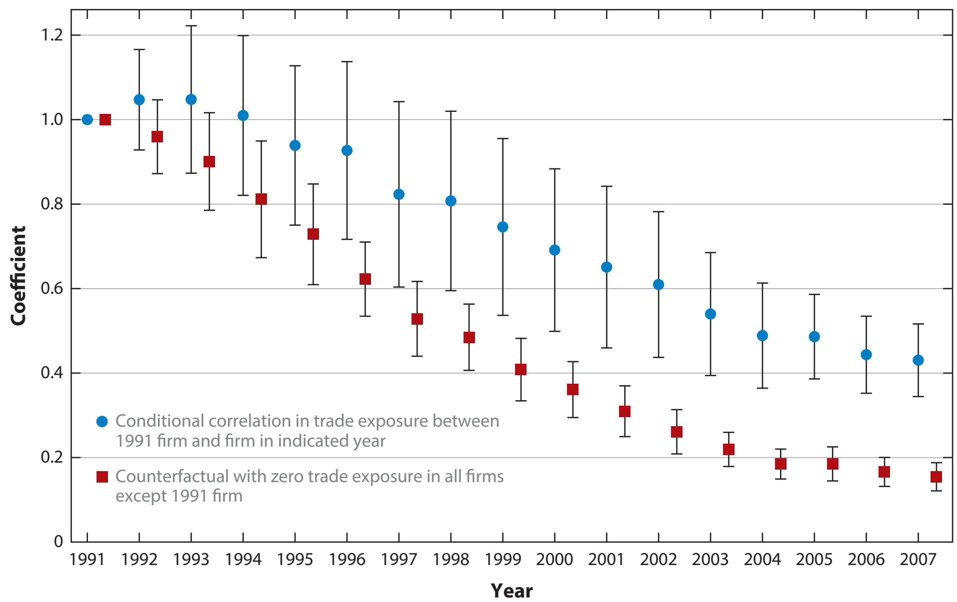

Figure 8

Persistence of trade exposure since 1991. The figure plots regression coefficients and 90% confidence intervals obtained from 2 × 16 regressions that relate the 1991–2007 trade exposure of a worker's industry in the year indicated on the *x*-axis to the 1991–2007 trade exposure of the worker's initial 1991 industry. The counterfactual data series sets trade exposure to 0 for all firms except the worker's initial employer. It refers to a hypothetical scenario in which no worker joins a trade-exposed firm after separating from their initial firm; as such, the persistence in trade exposure results from workers who have not separated from their initial firm.

time, reflecting the rising likelihood of having departed from the original place of work. But the counterfactual decline is far more rapid than the actual series and ends up at the much lower level of 0.17 in 2007. By implication, were trade-exposed workers to exit manufacturing immediately after the first job separation, their net subsequent exposure would be 60% lower than in the actual data. Thus, even after changing employers, initially trade-exposed workers appear likely to remain in high-exposure industries, which are subject to further trade shocks.

Although trade shocks disrupt the careers of both high-wage and low-wage individuals, there is also substantial heterogeneity in patterns of adjustment. Workers whose preperiod wage falls in the top earnings tercile of their birth cohort react to the trade exposure of their initial firm primarily by relocating to firms outside the manufacturing sector. They do not experience an earnings loss relative to their peers who started out in less trade-exposed industries. By contrast, workers in the bottom tercile of preperiod earnings relocate primarily within the manufacturing sector, and often remain in industries that are hit by subsequent increases in import competition. These low-wage workers suffer large differential earnings losses, as they obtain lower earnings per year both while working at the initial firm and after relocating to new employers.[43] Labor-market adjustment to trade further varies according to workers' initial labor-force attachment. Among

[43]Conditional on similar initial annual earnings and other observable conditions of employment, men and women experience similar consequences from an increase in exposure to import competition. Within manufacturing, women are disproportionately likely to hold low-wage jobs. Therefore, unconditional on other observables, women within the sector are more adversely affected by the trade shock than are men.

lower-attachment workers (but not among higher-attachment workers), greater trade exposure results in fewer calendar years in which their main income comes from earnings, and more calendar years where SSDI is the main source of recorded income.

Patterns of worker-level adjustment to Chinese import competition have also been studied for numerous European countries. Pessoa's (2016) analysis for the United Kingdom shows that workers whose initial industries became exposed to Chinese import competition accumulated significantly lower earnings over the period 2000 to 2007. This earnings differential results both from fewer years of employment and from lower hourly earnings while employed. For the case of Denmark, Ashournia et al. (2014) similarly find a negative impact of the China shock on workers' earnings accumulation between 1997 and 2008, whereas Utar (2015) shows adverse earnings and employment outcomes for workers whose industries were subject to the removal of MFA quotas. As in the United States, earnings losses are concentrated among low-skill workers.[44] Both these reduced-form results and structural estimates of models with sectoral switching costs suggest that workers in import-competing sectors bear differential adjustment costs in reaction to the China trade shock.

5. (RE)ASSESSING THE GAINS FROM TRADE

China's economic growth has lifted hundreds of millions of individuals out of poverty. The resulting positive impacts on the material well-being of Chinese citizens are abundantly evident. Beijing's seven ring roads, Shanghai's sparkling skyline, and Guangzhou's multitude of export factories—none of which existed in 1980—are indicative of China's success. What makes China so interesting to economists, in part, is that the timing of this growth was dictated by forces internal to the country and was therefore hard for outsiders to forecast. To maintain power, Mao was willing to subject China to a state of near perpetual political and economic upheaval, beginning with the collectivization of agriculture (1950–1953), continuing on to the Great Leap Forward (1958–1961), and culminating in the Cultural Revolution (1966–1976). At each successive juncture, China fell further behind the rest of the world economically. Its reversal of fortune under Deng began tenuously before consolidating into the most rapid accumulation of wealth in human history.

If one had to project the impact of China's momentous economic reform for the US labor market with nothing to go on other than a standard undergraduate international economics textbook, one would predict large movements of workers between US tradable industries (say, from apparel and furniture to pharmaceuticals and jet aircrafts), limited reallocation of jobs from tradables to nontradables, and no net impacts on US aggregate employment. The reality of adjustment to the China trade shock has been far different. Employment has certainly fallen in US industries more exposed to import competition; however, overall employment in the local labor markets in which these industries were concentrated has as well. Offsetting regional employment gains either in export-oriented tradables or in nontradables has been difficult to detect in the data. Input-output linkages between sectors appear to have magnified rather than dampened the employment effects of trade both within regions and nationally.

How should labor-market responses to trade with China change the way that economists think about the gains from trade for the US and other developed countries? One way is by recharacterizing the sets of individuals who are likely candidates for opposing distributional consequences

[44]In other work, Donoso et al. (2015) study year-to-year labor market transitions in Spain over the period 1997 to 2011 and find that import competition from China increases the likelihood that workers transition from employment to unemployment and from employment in manufacturing to employment outside that sector.

from economic integration. The literature is perhaps too comfortable with characterizing factor markets in terms of just two national skill types, such that the essential margin of adjustment is the relative wage of more- and less-skilled labor.[45] Without question, a worker's position in the wage distribution is indicative of her exposure to import competition. In response to a given trade shock, a lower-wage employee experiences larger proportionate reductions in annual and lifetime earnings, a diminished ability to exit a job before an adverse shock hits, and a greater likelihood of exiting the labor market, relative to her higher-wage coworker. However, the intensity of action along other margins of adjustment means that we will misrepresent the welfare impacts of trade shocks unless we also account for a worker's local labor market, initial industry of employment, and starting employer.

The importance of location for evaluating trade gains depends on how long it takes for regional adjustment to occur. A presumption that US labor markets are smoothly integrated across space has long made regional equilibration the starting point for welfare analysis. The US experience of trade with China makes this starting point less compelling. Labor-market adjustment to trade shocks is stunningly slow, with local labor-force participation rates remaining depressed and local unemployment rates remaining elevated for a full decade or more after a shock commences. The persistence of local decline perhaps explains the breadth of public transfer programs whose uptake increases in regions subject to rising trade exposure. The mobility costs that rationalize slow adjustment imply that short-run trade gains may be much smaller than long-run gains and that spatial heterogeneity in the magnitudes of the net benefits may be much greater than previously thought. Using a quantitative theoretical model, Caliendo et al. (2015) find that in the immediate aftermath of a trade shock, constructed to mimic the effects of growth in US imports from China, US net welfare gains are close to zero. The ultimate and sizable net gains are realized only once workers are able to reallocate across regions to move from declining to expanding industries. Establishing the speed of regional labor-market adjustment to trade shocks should capture considerably more attention from trade and labor economists.

In a modern gravity-type trade model, moving from autarky to freer trade expands the set of product varieties to which consumers have access and thereby raises real income in inverse proportion to the change in the share of spending a country devotes to domestically produced goods (Arkolakis et al. 2012).[46] Labor immobility amends this logic and gives local comparative advantage a central role in the analysis of trade gains. If workers cannot move between local labor markets easily or quickly and local patterns of comparative advantage are fixed—at least temporarily—the national gains from trade will depend both on the standard gravity mechanism of changing expenditure shares and on how easily workers within localities can re-sort into new industries. Galle et al. (2015) demonstrate that in the limiting case where worker re-sorting is infeasible—such that both regional and worker comparative advantages are locked in—a trade shock of the same magnitude as the China surge would yield geographic dispersion in welfare gains whose standard deviation across regions equals twice the national mean. As the literature develops a clearer picture of the permanence of local comparative advantage, economic models will be better equipped to quantify the spatial dispersion in net benefits from trade within a country.

The great China trade experiment may soon be over, if it is not already. The country is moving beyond the period of catch up associated with its market transition and becoming a middle-income

[45]Analyses based on the specific-factors model (e.g., Kovak 2013) are of course immune to this criticism.

[46]Even in this seemingly benign setting, any individual country could lose from China's rise. Although productivity growth in China would necessarily raise welfare by expanding the product varieties to which a country has access, it may also—depending on the sectors affected—depress national incomes by attenuating home-market effects or deteriorating the terms of trade (Hsieh & Ossa 2015).

nation. Rapidly rising real wages indicate that the end of cheap labor in China is near (Li et al. 2012). Its comparative advantage in the future will likely be less about its labor abundance and random initial industry prowesses, and more about the endogenous responses of business and government to the global economic environment. Although the China of the future will surely look different than the China of the past, the exceptional nature of its progression from Mao to Deng to today provides a rich vein for analysis that economists have far from exhausted.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

LITERATURE CITED

Acemoglu D, Autor DH, Dorn D, Hanson GH, Price B. 2016. Import competition and the Great U.S. Employment Sag of the 2000s. *J. Labor Econ.* 34(S1):S141–98

Acemoglu D, Carvalho VM, Ozdaglar A, Tahbaz-Salehi A. 2012. The network origins of aggregate fluctuations. *Econometrica* 80(5):1977–2016

Alder S, Shao L, Zilibotti F. 2013. *The effect of economic reform and industrial policy in a panel of Chinese cities*. CEPR Discuss. Pap. 9748

Amiti M, Davis D. 2012. Trade, firms, and wages: theory and evidence. *Rev. Econ. Stud.* 79(1):1–36

Amiti M, Freund C. 2010. The anatomy of China's export growth. In *China's Growing Role in World Trade*, ed. R Feenstra, S-J Wei, pp. 56–61. Cambridge: NBER

Anders G. 2014. How we saw the future in 1989. *The Wall Street Journal*, July 8, p. R13

Arkolakis C, Costinot A, Rodriguez-Clare A. 2012. New trade models, same old gains? *Am. Econ. Rev.* 102(1):94–130

Arkolakis C, Costinot A, Donaldson D, Rodriguez-Clare A. 2015. *The elusive pro-competitive effects of trade*. NBER Work. Pap. 21370

Artuç E, Chaudhuri S, McLaren J. 2010. Trade shocks and labor adjustment: a structural empirical approach. *Am. Econ. Rev.* 100:1008–45

Artuç E, McLaren J. 2015. Trade policy and wage inequality: a structural analysis with occupational and sectoral mobility. *J. Int. Econ.* 97:278–94

Ashournia D. 2015. *Labor market effects when mobility is costly*. Discuss. Pap. 751, Dep. Econ., Oxford Univ., Oxford, UK

Ashournia D, Munch J, Nguyen D. 2014. *The impact of Chinese import penetration on Danish firms and workers*. Discuss. Pap. 8166, Inst. Study Labor, Bonn, Ger.

Auer RA, Degen K, Fischer AM. 2013. Low-wage import competition, inflationary pressure, and industry dynamics in Europe. *Eur. Econ. Rev.* 59(C):141–66

Autor DH, Dorn D. 2013. The growth of low-skill service jobs and the polarization of the US labor market. *Am. Econ. Rev.* 103(5):1553–97

Autor DH, Dorn D, Hanson GH. 2013a. The China syndrome: local labor market effects of import competition in the United States. *Am. Econ. Rev.* 103(6):2121–68

Autor DH, Dorn D, Hanson GH. 2013b. The geography of trade and technology shocks in the United States. *Am. Econ. Rev.* 103(3):220–25

Autor DH, Dorn D, Hanson GH. 2015. Untangling trade and technology: evidence from local labor markets. *Econ. J.* 125(584):621–46

Autor DH, Dorn D, Hanson GH, Song J. 2014. Trade adjustment: worker level evidence. *Q. J. Econ.* 129(4):1799–860

Autor DH, Duggan M. 2003. The rise in disability rolls and the decline in unemployment. *Q. J. Econ.* 118(1):157–205

Bai X, Krishna K, Ma H. 2015. *How you export matters: export mode, learning and productivity in China*. NBER Work. Pap. 21164

Baicker K, Rehavi MM. 2004. Policy watch: trade adjustment assistance. *J. Econ. Perspect.* 18(2):239–55

Baily MN, Bosworth BP. 2014. US manufacturing: understanding its past and its potential future. *J. Econ. Perspect.* 28(1):3–26

Balsvik R, Jensen S, Salvanes KG. 2015. Made in China, sold in Norway: local labor market effects of an import shock. *J. Public Econ.* 127:137–44

Berman E, Bound J, Machin S. 1998. Implications of skill-biased technological change: international evidence. *Q. J. Econ.* 113(4):1245–79

Bernard AB, Jensen JB, Schott PK. 2006. Survival of the best fit: exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants. *J. Int. Econ.* 68(1):219–37

Bhagwati J. 1989. *Protectionism*. Cambridge, MA: MIT Press

Blanchard O, Katz L. 1992. Regional evolutions. *Brookings Papers Econ. Act.* 23(1):1–76

Bloom N, Draca M, Van Reenen J. 2016. Trade induced technical change? The impact of Chinese imports on innovation, IT, and productivity. *Rev. Econ. Stud.* 83:87–117

Borjas GJ, Freeman RB, Katz LF. 1997. How much do immigration and trade affect labor market outcomes? *Brookings Pap. Econ. Act.* 1:1–90

Borjas GJ, Ramey VA. 1995. Foreign competition, market power, and wage inequality. *Q. J. Econ.* 110(4):1075–110

Bound J, Holzer H. 2000. Demand shifts, population adjustments, and labor market outcomes during the 1980s. *J. Labor Econ.* 18(1):20–54

Brandt L, Ma D, Rawski TG. 2014. From divergence to convergence: reevaluating the history behind China's economic boom. *J. Econ. Lit.* 52(1):45–123

Brandt L, Morrow P. 2014. *Tariffs and the organization of trade in China*. Unpublished manuscript, Univ. Toronto, Toronto, ON

Brandt L, Van Biesebroeck J, Zhang Y. 2012. Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing. *J. Dev. Econ.* 97(2):339–51

Burstein A, Vogel J. 2011. *Factor prices and international trade: a unifying perspective*. NBER Work. Pap. 16904

Burstein A, Vogel J. 2012. *International trade, technology, and the skill premium*. Unpublished manuscript, Univ. Calif., Los Angel.

Caliendo L, Dvorkin M, Parro F. 2015. *The impact of trade on labor market dynamics*. NBER Work. Pap. 21149

Chetverikov D, Larsen B, Palmer C. 2016. IV quantile regression for group-level treatments, with an application to the distributional effects of trade. *Econometrica* 84(2):809–33

Cheung Y-W, Chinn MD, Fujii E. 2007. The overvaluation of Renminbi undervaluation. *J. Int. Money Finance* 25(5):762–85

Cline WR. 2010. *Renminbi undervaluation, China's surplus, and the US trade deficit*. Policy Brief PB 10–20, Peterson Inst. Int. Econ.

Costa FJM, Garred J, Pessoa JP. 2014. *Winners and losers from a commodities-for-manufactures trades boom*. Discuss. Pap. 1269, Cent. Econ. Perform., London

Crino R, Epifani P. 2014. Trade imbalances, export structure and wage inequality. *Econ. J.* 576:507–39

Dauth W, Findeisen S, Suedekum J. 2014. The rise of the East and the Far East: German labor markets and trade integration. *J. Eur. Econ. Assoc.* 12(6):1643–75

Diamond R. 2015. *The determinants and welfare implications of U.S. workers' diverging location choices by skill: 1980–2000*. Work. Pap. 3143, Stanford Univ., Stanford, CA

Di Giovanni J, Levchenko A, Zhang J. 2014. The global welfare impact of China: trade integration and technological change. *Am. Econ. J.: Macroecon.* 6(3):153–83

Dix-Carneiro R. 2014. Trade liberalization and labor market dynamics. *Econometrica* 82(3):825–85

Dix-Carneiro R, Kovak BK. 2015. *Trade reform and regional dynamics: evidence from 25 years of Brazilian matched employer-employee data*. NBER Work. Pap. 20908

Donoso V, Martín V, Minondo A. 2014. Do differences in exposure to Chinese imports lead to differences in local labour market outcomes? An analysis for Spanish provinces. *Reg. Stud.* 49:46–64

Donoso V, Martín V, Minondo A. 2015. Does competition from China raise the probability of becoming unemployed? An analysis using Spanish workers' micro-data. *Soc. Indicators Res.* 120:373–94

Eaton J, Kortum S. 2002. Technology, geography, and trade. *Econometrica* 70(5):1741–79

Ebenstein A, Harrison A, McMillan M, Phillips S. 2014. Estimating the impact of trade and offshoring on American workers using the current population survey. *Rev. Econ. Stat.* 96(3):581–95

Edwards L, Lawrence RZ. 2013. *Rising tide: Is growth in emerging economies good for the United States?* Washington, DC: Peterson Inst. Int. Econ.

Eichengreen B, Park D, Shin K. 2013. *Growth slowdowns redux: new evidence on the middle-income trap*. NBER Work. Pap. 18673

Ellison G, Glaeser E, Kerr W. 2010. What causes industry agglomeration? Evidence from coagglomeration patterns. *Am. Econ. Rev.* 100(3):1195–213

Feenstra RC. 1998. Integration of trade and disintegration of production in the global economy. *J. Econ. Perspect.* 12(4):31–50

Feenstra RC, Hanson GH. 1997. Foreign direct investment and relative wages: evidence from Mexico's maquiladoras. *J. Int. Econ.* 42:371–94

Feenstra RC, Hanson GH. 1999. The impact of outsourcing and high-technology capital on wages: estimates for the United States, 1979–1990. *Q. J. Econ.* 114(3):907–40

Feenstra RC, Hanson GH. 2003. Global production and inequality: a survey of trade and wages. In *Handbook of International Trade*, ed. EK Choi, J Harrigan, pp. 146–85. Hoboken, NJ: Blackwell

Federico S. 2014. Industry dynamics and competition from low-wage countries: evidence on Italy. *Oxf. Bull. Econ. Stat.* 76(3):389–410

Feler L, Senses M. 2015. *Trade shocks and the provision of local public goods*. Unpublished manuscript, Johns Hopkins Univ., Baltim., MD

Freeman R. 1995. Are your wages set in Beijing? *J. Econ. Perspect.* 9(3):15–32

Galle S, Rodríguez-Clare A, Yi M. 2015. *Slicing the pie: quantifying the aggregate and distributional effects of trade*. Unpublished manuscript, Univ. Calif., Berkeley

Glaeser EL, Gyourko J. 2005. Urban decline and durable housing. *J. Pol. Econ.* 113(2):345–75

Goldberg P, Khandelwal A, Pavcnik N, Topalova P. 2010. Imported intermediate inputs and domestic product growth: evidence from India. *Q. J. Econ.* 125(4):1727–67

Goldberg P, Pavcnik N. 2007. Distributional effects of globalization in developing countries. *J. Econ. Lit.* 45(1):39–82

Grossman GM. 1987. The employment and wage effects of import competition in the United States. *J. Int. Econ. Integr.* 2(1):1–23

Grossman GM, Rossi-Hansberg E. 2008. Trading tasks: a simple theory of offshoring. *Am. Econ. Rev.* 98(5):1978–97

Handley K, Limao N. 2014. *Policy uncertainty, trade and welfare: theory and evidence for China and the U.S.* Unpublished manuscript, Univ. Michigan

Hanson G, Lind N, Muendler M-A. 2015. *The dynamics of comparative advantage*. NBER Work. Pap. 21753

Harrison A, McLaren J, McMillan M. 2011. Recent perspectives on trade and wage inequality. *Annu. Rev. Econ.* 3:261–89

Helpman E, Itskhoki O, Redding S. 2010. Inequality and unemployment in a global economy. *Econometrica* 78:1239–83

Hsieh C-T, Ossa R. 2011. *A global view of productivity growth in China*. NBER Work. Pap. 16778

Hsieh C-T, Song Z. 2015 . *Grasp the large, let go of the small: the transformation of the state sector in China*. NBER Work. Pap. 21006

Hsieh C-T, Woo KT. 2005. The impact of outsourcing to China on Hong Kong's labor market. *Am. Econ. Rev.* 95(5):1673–87

Hummels D, Jorgensen R, Munch J, Xiang C. 2014. The wage effects of offshoring: evidence from Danish matched worker-firm data. *Am. Econ. Rev.* 104(6):1597–629

Iacovone L, Rauch F, Winters AL. 2013. Trade as an engine of creative destruction: Mexican experience with Chinese competition. *J. Int. Econ.* 89(2):379–92

Katz LF, Autor D. 1999. Changes in the wage structure and earnings inequality. In *Handbook of Labor Economics*, Vol. 3A, ed. O Ashenfelter, D Card, pp. 1463–555. Amsterdam: Elsevier Sci.

Kondo IO. 2013. *Trade reforms, foreign competition, and labor market adjustments in the U.S.* Discuss. Pap. 1095, Int. Finance, Fed Reserve Board

Koopman R, Powers W, Wang Z, Wei S-J. 2012. Estimating domestic content in exports when processing trade is pervasive. *J. Dev. Econ.* 99(1):178–89

Kovak B. 2013. Regional effects of trade reform: What is the correct measure of liberalization? *Am. Econ. Rev.* 103(5):1960–76

Krugman P. 1997. What should trade negotiators negotiate about? *J. Econ. Lit.* 35(1):113–20

Krugman P. 2000. Trade, technology, and factor prices. *J. Int. Econ.* 50(1):51–71

Krugman PR, Obstfeld M. 2008. *International Economics: Theory and Policy*. New York: Pearson. 8th ed.

Lawrence RZ, Slaughter MJ. 1993. International trade and American wages in the 1980s: giant sucking sound or small hiccup? *Brookings Papers Econ. Act.: Microecon.* 1993(3):161–26

Leamer EE. 2000. What's the use of factor contents? *J. Int. Econ.* 50(1):17–49

Levchenko AA, Lewis LT, Tesar LL. 2010. The collapse of international trade during the 2008–2009 crisis: in search of the smoking gun. *IMF Econ. Rev.* 58(2):214–53

Li H, Li L, Wu B, Xiong Y. 2012. The end of cheap Chinese labor. *J. Econ. Perspect.* 26(4):57–74

Malamud O, Wozniak A. 2012. The impact of college education on geographic mobility. *J. Hum. Resour.* 47:913–50

Manova K, Zhang Z. 2012. *Multi-product firms and product quality*. NBER Work. Pap. 18637

McLaren J, Hakobyan S. 2016. Looking for local labor market effects of NAFTA. *Rev. Econ. Stat.* In press

Melitz MJ. 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71(6):1695–725

Mian A, Sufi A. 2014. What explains the 2007–2009 drop in employment? *Econometrica* 82(6):2197–223

Mills J. 1993. Business lobbying for trade pact appears to sway few in Congress. *The New York Times*, Nov. 12

Mion G, Zhu L. 2013. Import competition from China: A curse or a blessing for firms? *J. Int. Econ.* 94(1):85–101

Naughton B. 2007. *The Chinese Economy: Transitions and Growth*. Cambridge, MA: MIT Press

Neal D. 1995. Industry-specific human capital: evidence from displaced workers. *J. Labor Econ.* 13:653–77

Pessoa JP. 2016. *International competition and labor market adjustment*. Discuss. Pap. 1411, Cent. Econ. Perform., London

Pierce JR, Schott PK. 2016. The surprisingly swift decline of U.S. manufacturing employment. *Am. Econ. Rev*. In press

President's Council of Economic Advisers. 2015. *2015 Economic Report of the President*. Annu. Rep., White House, Washington, DC

Redding S. 2012. *Goods, factor trade, mobility, and welfare*. NBER Work. Pap. 18008

Sampson T. 2014. Selection into trade and wage inequality. *Am. Econ. J.: Microecon.* 6(3):157–202

Song Z, Storesletten K, Zilibotti F. 2011. Growing like China. *Am. Econ. Rev.* 101(1):196–233

Storesletten K, Zilibotti F. 2014. China's great convergence and beyond. *Annu. Rev. Econ.* 6:333–62

Tolbert CM, Sizer M. 1996. *U.S. commuting zones and labor market areas: a 1990 update*. Staff Pap. 9614, Rural Econ. Div., Econ. Res. Serv., US Dep. Agric.

Topalova P. 2010. Factor immobility and regional impacts of trade liberalization: evidence on poverty from India. *Am. Econ. J.: Appl. Econ.* 2:1–41

Trefler D. 2004. The long and short of the Canada-U.S. Free Trade Agreement. *Am. Econ. Rev.* 94(4):870–95

Utar H. 2014. When the floodgates open: "Northern" firms' response to removal of trade quotas on Chinese goods. *Am. Econ. J.: Appl. Econ.* 6(4):226–50

Utar H. 2015. *Workers beneath the floodgates: impact of low-wage import competition and workers' adjustment*. Work. Pap. 12-2014, Dep. Econ., Univ. Bielefeld

Utar H, Torres-Ruiz L. 2013. International competition and industrial evolution: evidence from the impact of Chinese competition on Mexican maquiladoras. *J. Dev. Econ.* 105:267–87

Vogel J. 2011. Spatial price discrimination with heterogeneous firms. *J. Ind. Econ.* 59(4):661–76

Wei S-J, Zhang X. 2011. The competitive saving motive: evidence from rising sex ratios and savings rates in China. *J. Pol. Econ.* 119(3):511–64

Wozniak A. 2010. Are college graduates more responsive to distant labor market opportunities? *J. Hum. Resour*. 45:944–70

Yagan D. 2014. *Moving to opportunity? Migratory insurance over the Great Recession*. Presented at NBER Conf. Tax Policy Econ., Cambridge, MA

Yu M, Tian W. 2012. *China's firm-level processing trade: trends, characteristics, and productivity*. Work. Pap. E2012002, China Cent. Econ. Res., Peking Univ., Beijing, China

Zhu X. 2012. Understanding China's growth: past, present, and future. *J. Econ. Perspect.* 26(4):103–24