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

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February 2016

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ABSTRACT

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

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 U.S. 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, are key items on the research agenda for trade and labor economists.

JEL Classification: F16, H55, J23, J31, J63

Keywords: China, trade, labor market adjustment

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1 Introduction

Mainstream economists have long argued that international trade improves welfare. While 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 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. 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.”

Of course, introductory trade theory also teaches us that international trade is not generally Pareto improving. In their undergraduate textbook, Krugman and Obstfeld (2005, p64) 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 U.S., globalization was seen initially as a prime suspect. Yet, 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 U.S. employment in

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

manufacturing had been in decline since the end of World War II, peaking at 39.0% of U.S. nonfarm employment in January of 1944 and then falling decade over 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 U.S. and many other developed countries did not coincide closely with rising trade openness. As noted by Feenstra (1998) and Leamer (2000), the ratio of merchandise trade to GDP in the developed world rose steeply during the 1970s but stabilized thereafter, a fact that greatly weakened the case for trade causing 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 towards high-skill workers despite rising skill prices, suggesting that these industries were experiencing a skill-biased demand shift that emanated logically from the adoption of new technology (Berman, Bound and Machin, 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 and 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 U.S. (Borjas, Freeman and Katz, 1997; Krugman, 2000).³ When Richard Freeman asked in 1995 if U.S. wages were “being set in Beijing,” his answer was an emphatic no.

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

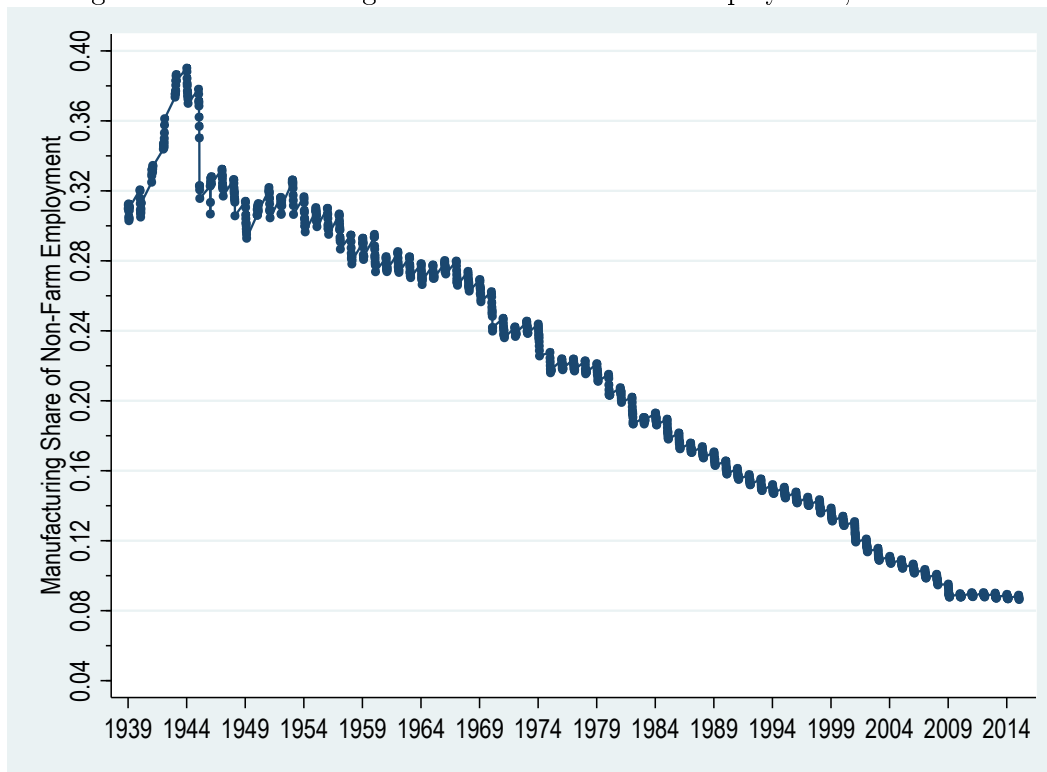
1. Trade had not in recent decades been a major contributor to declining manufacturing employment or rising wage inequality in developed countries;
2. Workers employed in regions specializing in import-competing sectors could readily reallocate to other regions if displaced by trade; and
3. Due to the ‘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.

²A 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, Bound, and Machin, 1998). We now know that either in the presence of offshoring (Feenstra and Hanson, 1997; Grossman and Rossi-Hansberg, 2008) or of heterogeneous firms and skill-technology complementarity (Burstein and Vogel, 2012; Sampson, 2014), greater economic integration between countries may cause wage inequality to rise worldwide.

³The 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 (though structurally model-specific) relationship between the factor content of trade and relative factor prices holds for a wide class of trade theories (Burstein and Vogel, 2011).

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 U.S. labor markets, even in the short- or medium-run the aggregate gains from trade in the U.S. should be positive.⁴

Figure 1: Manufacturing Share of U.S. Nonfarm Employment, 1939 - 2015



Source: FRED Economic Data <https://research.stlouisfed.org/fred2/graph/?g=1Gor>

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

⁴While these views may appear as a straw man, they are not. On point (1), see Baily and Bosworth (2014). On points (2) and (3), see Edwards and Lawrence (2010). And on the broader implications of these points, see the President's Council of Economic Advisers, *Economic Report of the President*, 2015, chapter 7.

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. While 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—it makes 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, are key items 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 essay 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, 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.

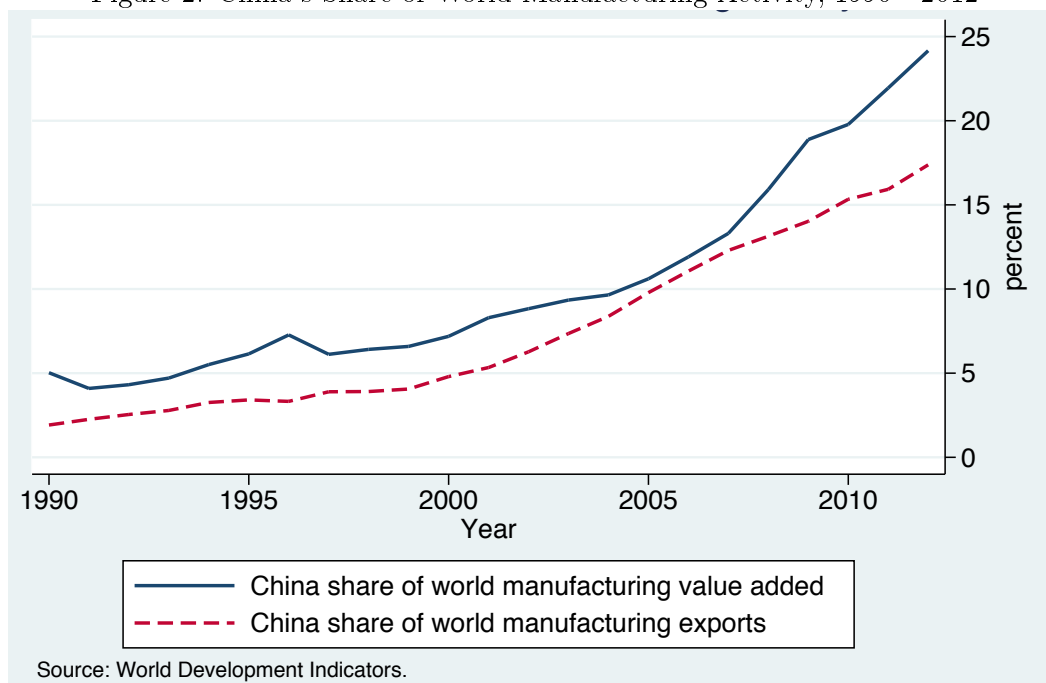
2 China's Rise

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, the newspaper

prognosticated, would fail to shake off “the stultifying bureaucracy of hard-line communism.”⁵

The *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, though far off the mark from today’s vantage point, would then have been entirely warranted.

Figure 2: China’s Share of World Manufacturing Activity, 1990 - 2012



China’s 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 and Tian, 2012; Alder, Shao and Zilibotti, 2013). As reformers retook the helm, China embraced global markets more fully, pushing the number of SEZs from 20 in 1991 to

⁵George Anders, “How We Saw the Future in 1989,” *The Wall Street Journal*, July 8, 2014, p. R13.

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).⁶

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 post-reform manufacturing surge. When and how China became “the global factory” is important for defining the scope and intensity of the China trade shock. Then, 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 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 U.S. Congress to approve the pact.⁷ The treaty’s passage, which contributed to a further expansion in foreign direct investment, was arguably induced at least in part by the earlier FDI. In the 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.⁸

Three features of China’s experience help to overcome these challenges in identifying the casual 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.

⁶See Storesletten and Zilibotti (2014) on the factors that have shaped China’s development process.

⁷See, e.g., Joshua Mills, “Business Lobbying for Trade Pact Appears to Sway Few in Congress,” *New York Times*, November 12, 1993.

⁸See McLaren and Hakobyan (2015) on the local labor market effects of NAFTA in the United States.

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, a full decade and a half 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, Ma, and Rawski, 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.⁹ 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 ignited a phase of transitional growth that was governed largely by the country’s accumulated productivity gap with the developed world (Song, Storesletten, and Zilibotti, 2011).¹⁰

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.¹¹ 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

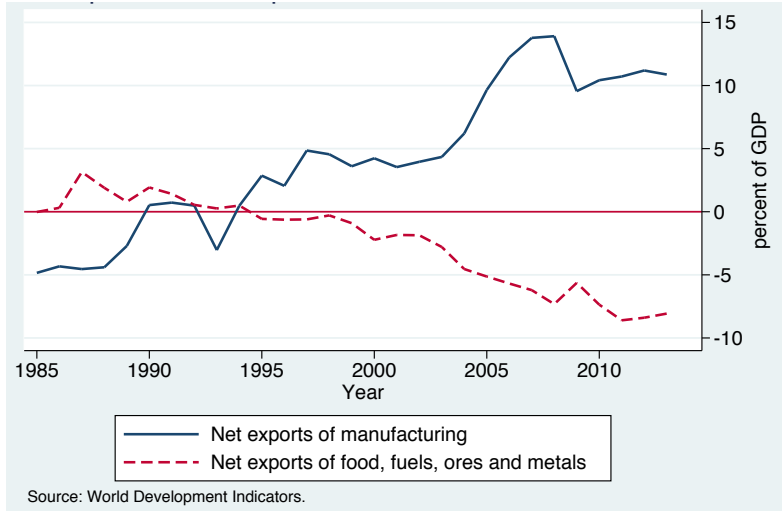
⁹These ranks are of GDP at constant national prices (in 2005 U.S. dollars) from the Penn World Tables 8.0.

¹⁰This period of transitional growth will of course come to an end ultimately and indeed may have ended already. See Eichengreen, Park and Shin (2013) for a discussion.

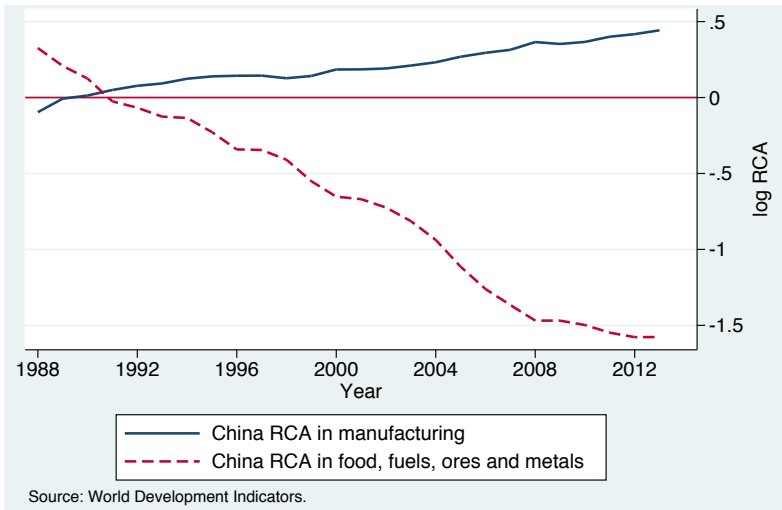
¹¹Over time, China has become even more specialized in manufacturing. Between 1990 and 2007, the share of manufacturing in China’s merchandise exports rose from 72% to 93%, a level at which it has since stabilized.

Figure 3: The Evolution of China's Imports and Exports

A. Exports Minus Imports as a Share of GDP for China



B. Revealed Comparative Advantage for China



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 3A). Its true strength in the sector emerged only in the 1990s. Figure 3B 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.¹² It was not until 1992 that China moved from disadvantage to advantage

¹²The denominator in China's RCA index is the country's share of world merchandise exports. Following World

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 and 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 manner of labor-intensive production (Li, Li, Wu, and Xiong, 2012). Yet, factor abundance cannot be the whole story behind the country’s specialization. Its advantage is far from uniform across labor-intensive industries (Autor, Dorn, Hanson, and Song, 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 U.S. manufacturing industries.¹³ We group industries into 10 sectoral aggregates, which share a common marker in the figure. That few points in Figure 4 show a negative change in net import penetration over the period reveals how U.S. 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.¹⁴ 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 total employment of 0.85. Still, the industries within this sector diverge sharply in their changes in import penetration. In some (e.g., women’s non-athletic footwear, waterproof outerwear), the increase in penetration approaches or even exceeds 100 percent, which indicates that the 1991 to 2007 growth in imports from China is nearly equal to or greater than initial domestic spending on 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).¹⁵

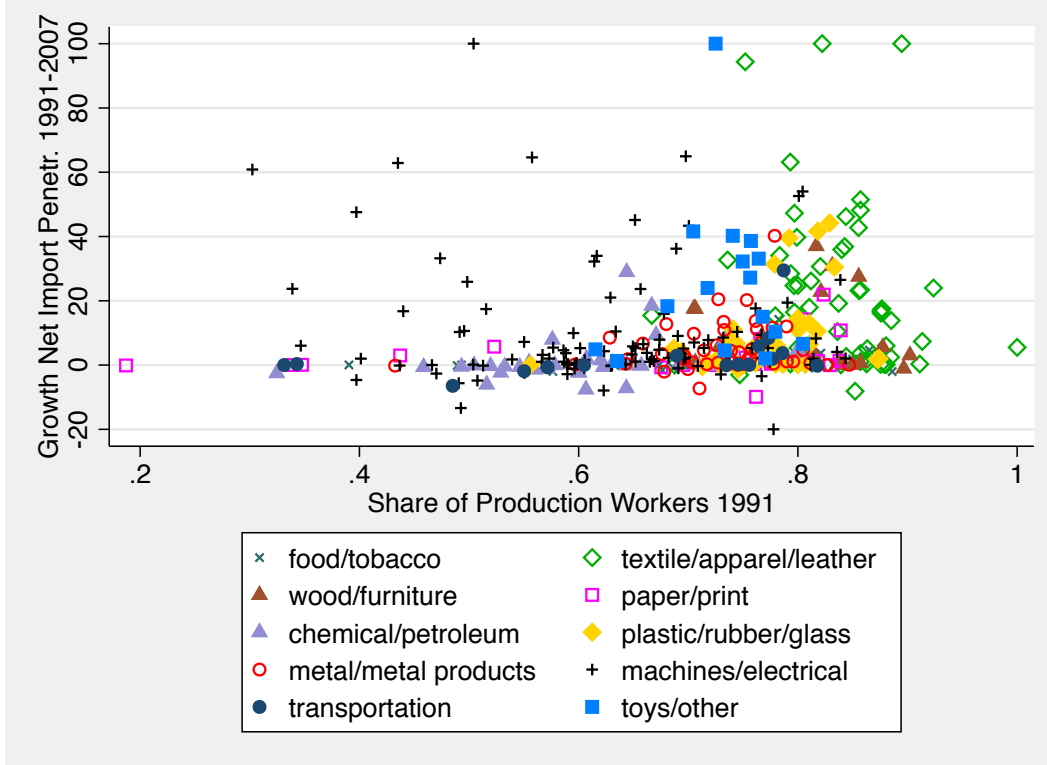
Bank definitions, manufacturing includes SITC sectors 5 (chemicals), 6 (basic manufactures except for division 68), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods). Food, fuels, ores and metals include SITC sectors 0 (food and live animals), 1 (beverages and tobacco), 2 (crude materials), 3 (mineral fuels), and 4 (animal and vegetable oils and fats), and division 68 (non-ferrous metals).

¹³The change in import penetration is the 1991 to 2007 change in U.S. imports from China divided by 1991 U.S. 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.

¹⁴Employment of production workers is a standard, but not problem free, measure of industry intensity in low-skill labor. See Katz and Autor (1999) on the relation between production worker intensity and skill intensity.

¹⁵An industry-level regression of the change in net import penetration between 1991 and 2007 on 10 subsector

Figure 4: Δ China-U.S. Net Import Penetration in Detailed Manufacturing Industry, 1991 - 2007



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 a relatively small number of products dominate exports (Hanson, Lind, and Muendler, 2015). Because of this skewness, U.S. 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 very 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 World Trade Organization (Figure 2). On first consideration, it is puzzling why WTO accession should have mattered much for China's trade. Europe and the U.S. 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 pace of 8% per year (Brandt, Van Biesebroeck, and Zhang, 2012).

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.

Although the literature has yet to 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 towards 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 and 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, Krishna, and Ma (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 than they were. Along with greater ease in exporting, WTO membership gave Chinese manufacturers greater access to imported intermediate inputs (Brandt and Morrow, 2014), which were an added boon to productivity (Manova and Zhang, 2012). A further consequence of China's WTO entry regards the insecurity of its earlier MFN access to the U.S. market. Prior to 2001, China's MFN status in the U.S. was subject to annual reauthorization by Congress. Pierce and Schott (2015) and Handley and Limao (2014) argue that the lurking prospect of a return to non-MFN tariffs, which averaged 37.0% in 1999 and compared to average MFN tariffs of only 3.4% in that year, dissuaded Chinese firms from investing in exporting to the U.S.. WTO accession removed this uncertainty, and encouraged China-U.S. trade.

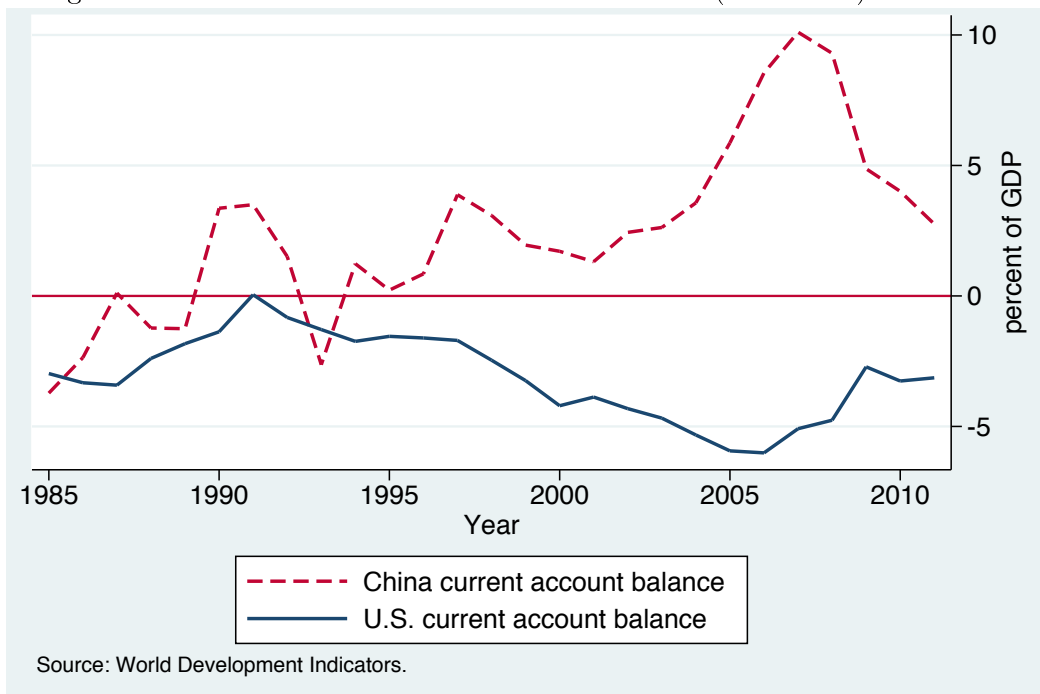
2.3 The Global Macroeconomic Context

The impact of China's recent growth on the global economy is not just about the country's long-run comparative advantage. Also important for the near-term labor-market consequences of its trade expansion is that China's trade surplus widened 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 U.S. 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 U.S. 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. While 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 U.S. workers to reallocate from one traded industry to another but it would not cause them necessarily to exit the traded sector altogether.

Figure 5: U.S. and China Current Account Balances (% of GDP) 1985 - 2012



Trade imbalances complicate matters by introducing a temporal dimension into sectoral employment adjustment.¹⁶ Suppose that policy distortions in China—such as the excess absorption of credit by state-owned enterprises (Song, Storesletten, and Zilibotti, 2011)—induce the country to run a trade surplus and the U.S. to run a trade deficit. Growth in China's manufacturing sector due to enhanced productivity arising from its market transition would cause employment in U.S. traded industries to contract, pushing workers either into non-traded jobs or out of work entirely. In effect, China would be loaning the U.S. the funds that it needs to enjoy positive net imports today.¹⁷ In Figure 4, few U.S. industries saw an increase in net exports to China between 1991

¹⁶See Crino and Epifani (2014) on how changes in trade balances affect labor-market outcomes in a North-South trade model.

¹⁷This 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.

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 U.S. net exports turned positive. U.S. 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 U.S. traded industries in which China enjoyed a long-run comparative advantage, while trade imbalances cause additional short-run U.S. employment losses in traded industries pushed temporarily into contraction. Why has China become such a large a 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.¹⁸ These companies have first call on loans from state-run banks, leaving private businesses to finance investment out of retained earnings and thereby elevating the corporate savings rate (Song, Storesletten, and Zilibotti, 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 and Zhang, 2011). Households whose one child is a son may have increased 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, D.C. (see, e.g., Cline, 2010)—is that China has consciously undervalued its nominal exchange rate so as to promote its exports.¹⁹

3 Theory

Much first-generation research on trade and wages worked under the canonical version of the Heckscher-Ohlin model (e.g., Lawrence and Slaughter, 1993; Borjas, Freeman, and Katz, 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 upon 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 to the number of primary factors.

¹⁸Although the private sector has grown substantially in China, state-owned companies remain an active part of the economy (Hsieh and Song, 2015), especially in banking, communications, construction, energy, and transportation.

¹⁹The popular sentiment notwithstanding, the academic literature has had little success in finding empirical support for systematic renminbi undervaluation (Cheung, Chinn, and Fujii, 2007).

Frustration with HO turned out to be a boon to research on trade and labor markets. Early approaches (Feenstra and Hanson, 1997 and 1999; Grossman and 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 countries produce. 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 married HO with modern trade theories that incorporate heterogeneous firms. Burstein and 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, reveals that freer trade affects the wage premium for high-skill labor primarily through the Melitz mechanism of within-industry shifts in employment toward more productive firms rather 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 either on a Melitz-type setting (Hsieh and Ossa, 2015) or on the Eaton and Kortum (2002) model of Ricardian comparative advantage (Di Giovanni, Levchenko, and Zhang, 2014). Gone from current literature is the singular concern with 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, Costinot, and Rodriguez-Clare, 2012). 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.²⁰ 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.

²⁰On adjustment to trade shocks at the firm level, see Amiti and Davis (2012) and Hummels, Jorgensen, Munch and Xiang (2014); on adjustment at the industry level, see Bernard, Jensen, and Schott (2006), Ebenstein, Harrison, McMillan and Phillips (2014), and Bloom, Draca and Van Reenen (forthcoming); and on adjustment to trade at the regional level see Borjas and Ramey (1995), Topalova (2010), Kovak (2013), and McLaren and Hakobyan (2015).

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. Allowing for geographic labor immobility runs counter to the belief that U.S. regional labor markets are integrated seamlessly. Yet there is mounting evidence that the movement of labor across U.S. cities and states in the aftermath of changes in regional labor demand is slow and incomplete (Blanchard and Katz, 1992; Glaeser and Gyourko, 2005; Yagan, 2014) and that such incompleteness is strongest among less-educated workers (Bound and Holzer, 2000; Wozniak, 2010; Malamud and Wozniak, 2012; Diamond, 2015).²¹ Recent work on the impacts of trade with China, discussed in section 4, likewise confirms the slowness of regional labor-market adjustment.

In our model sketch, we make the extreme assumption of complete geographic labor immobility. In an Eaton and Kortum (2002) framework, one can relax this assumption by allowing for worker heterogeneity in moving costs between regions (Caliendo, Dvorkin, and Parro, 2015) or for a Roy-type structure with worker heterogeneity in industry productivity (Galle, Rodriguez-Clare, and Yi, 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 Eaton and Kortum, 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 pre-determined in some period well before the China trade shock materializes.

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

$$X_i = \sum_k \frac{A_{ik} \tau_{ik}^{-\theta}}{\Phi_k} E_k \quad (1)$$

where X_i is total sales by region i in the aggregate U.S. 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 U.S. market,²² θ is the trade cost elasticity, E_k is U.S. aggregate

²¹The 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.

²²For expositional simplicity, we treat the aggregate U.S. 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

expenditure on goods in industry k , and Φ_k is the competitiveness of the aggregate U.S. market in industry k , defined as $\Phi_k \equiv \sum_{i'} A_{i'k} \tau_{i'k}^{-\theta}$.²³

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

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

where $\phi_{ik} \equiv X_{ik}/X_i$ is the share of industry k in region i 's total sales on the U.S. market, $\rho_{ik} \equiv X_{ik}/E_k$ is the share of region i in total U.S. 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.²⁴

Equation (2) provides a reduced-form specification for estimating the impact of trade shocks emanating from China on regional economic activity in the U.S. or other countries. Most empirical analyses of the China trade shock base estimation on a specification like (2) or its industry-level counterpart.²⁵ Of primary interest is the final term on the right of (2), which captures the impact of growth in China's productive capacity on traded output by U.S. region i . It can be rewritten as,

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

which is the weighted average exposure of region i to changes in U.S. 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 (3)—the share of each industry in region i 's total sales on the U.S. market—summarize differences in industry specialization patterns across U.S. regions and thus capture variation in regional exposure to China's supply-driven export growth.

of how A_{ik} is determined. In Eaton and 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 .

²³For simplicity, we ignore sales by U.S. 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, discussed in the previous section.

²⁴The 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 and Kortum (2002). We thus assume that the exogenous determinants of regional comparative advantage (e.g., the Eaton-Kortum productivity distribution location parameters) are unchanged.

²⁵See, e.g., Autor, Dorn, and Hanson (2013) and Pierce and Schott (2015).

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. Helpfully, these confounds are summarized in the first four terms on the right of (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 (2), $\sum_k \phi_{ik} \hat{E}_k$, is regional exposure to U.S. industry demand shocks. Because *observed* changes in import penetration from China will be affected by both the first and last terms in (2), they will embody changes both in U.S. product demand and in China's supply conditions. Any reduced-form regression of changes in regional outcomes on regional trade exposure may thus be contaminated by U.S. product demand shocks. Autor, Dorn and Hanson (2013) propose using Chinese import growth in *other* high-income markets as an instrument for the growth in U.S. imports from China in order to isolate the foreign-supply-driven component of changes in U.S. import penetration. Specifically, they instrument the observed change in U.S. industry-level import penetration from China with a *non*-U.S. exposure variable that is constructed using data on contemporaneous industry-level growth of Chinese exports to other high-income markets.²⁶

Table 1 documents the operation of the Autor-Dorn-Hanson instrumental-variables strategy. The first column of the table shows that annual U.S. imports from China increased by 304 billion dollars between 1991 and 2007, while 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 U.S. and the other high income countries experienced rising imports in almost all of the 397 harmonized four-digit manufacturing industries, and the pattern of import growth across industries is highly correlated between the U.S. 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 U.S., with correlation coefficients ranging from 0.55 (Switzerland) to 0.96 (Australia). The fact that China made comparable gains in penetration by detailed sector 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.

²⁶These countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland.

Table 1: Imports from China and Other Developed Economies 1991 – 2007 (in Billions of 2007\$), and their Correlations with U.S.-China Imports

	United States	Japan	Germany	Spain	Australia
Δ Chinese Imports (Bil\$)	303.8	108.1	64.3	23.2	21.5
No. Industries with Import Growth	385	368	371	377	378
Correlation w/ U.S.-China Imports	1.00	0.86	0.91	0.68	0.96
	8 Non-US Countries	Finland	Denmark	New Zealand	Switzerland
Δ Chinese Imports (Bil\$)	234.7	5.7	4.7	3.8	3.3
No. Industries with Import Growth	383	356	362	379	343
Correlation w/ U.S.-China Imports	0.92	0.58	0.62	0.92	0.55

Correlations of imports across 397 4-digit industries are weighted using 1991 industry employment from the NBER Manufacturing database.

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 in other high-income markets as an instrument for U.S. penetration could confound import growth with unobserved components of demand. Autor, Dorn and Hanson (2013) also utilize a gravity-based strategy that replaces the growth in U.S. imports from China with the inferred change in China’s comparative advantage and market access vis-a-vis the U.S. 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 U.S.. Gravity and IV estimates turn out to be similar, which suggests that correlated import demand shocks are not overly important for the estimation.

Moving to the second term on the right of equation (2), $\theta \hat{w}_i$ is the endogenous change in wages in U.S. region i resulting from external product-market shocks. Most empirical analyses exclude wages as an independent variable. Estimating (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.²⁷ Alternatively, estimating a version of (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 of (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

²⁷See Kovak (2013) on the impact of trade shocks on wages in Brazil based on a specific factors model.

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 U.S. local labor markets (Autor, Dorn, and Hanson 2013b, 2015).²⁸ 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 (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.²⁹

The specification in (2) does not comprise an input-output structure. The presence of intermediate inputs may affect the transmission of trade shocks *within* the U.S. Consider the case of tire production. If rising imports of Chinese tires causes U.S. tire producers to reduce their output, demand for U.S.-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 U.S. tire industry, would also affect domestic demand in the industries that supply inputs to U.S. 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 and Schott, 2015; Acemoglu, Autor, Dorn, Hanson, and Price, 2016). A related possibility is that U.S. 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 U.S. final goods producers to their domestic input suppliers and from Chinese input suppliers to U.S. input buyers.

To summarize this discussion, identifying the impact of trade with China on U.S. 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

²⁸Autor, Dorn and Hanson (2013b and 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 and 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.

²⁹China's manufacturing growth is closely related to the expansion of global production networks in East Asia (Hsieh and 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 and 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 and Morrow, 2014). Koopman, Wang, and Wei (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.

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 and Hakobyan (2014) 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 U.S., already provided China with MFN access to their markets, implying an average import tariff of under four percent. Trade barriers in these countries did decline in the late 1990s and 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, Draca, and Van Reenen, 2015). Hence, changes in applied tariffs would seem to predict no more than modest growth in China’s shipments to the U.S. We discuss below how the observed reduction in U.S. MFN tariffs may not capture the full impact of changes in U.S. trade barriers on imports from China (Pierce and Schott, 2015).

4 Labor Market Adjustment to Trade

If we suppose that the growth in U.S. 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 U.S. 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 U.S. 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 U.S. is the product market. Improvements in China’s productive capabilities and reductions in its trade costs will change the intensity of competition for U.S. goods, leading to a contraction in U.S. industries subject to greater import exposure. Bernard, Jensen, and Schott (2006) use data on U.S. 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 U.S. imports and which is

attributable in large account to China.³⁰ They find that over five-year intervals, industries facing greater increases in exposure to trade are subject to higher rates of plant exit.³¹ 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, Autor, Dorn, Hanson and Price (2016) provide a complementary analysis to Bernard, Jensen, and Schott (2006) that moves the focus to the industry level and extends the data forward in time to cover the period 1991 to 2011.³² Consistent with the logic of equation (2), they estimate the following model for the impact of shifts in trade exposure on manufacturing employment:

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

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 U.S. manufacturing 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.³³ Table 2, reproduced from their 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 1999.³⁴ 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, Lewis, and Tesar, 2010). Table 2 also shows that the decline in U.S. manufacturing employment accelerated over time: the average industry contracted by 0.3 log points per year between 1991 and 1999 and 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 2011.³⁵

³⁰This measure does not correspond to the theoretical concept of import penetration in equation (3). However, because most of the temporal variation in the Bernard, Jensen, and Schott measure is in the numerator—due to China’s massive export growth—the share of U.S. imports from low-wage countries and the change in U.S. import penetration due to low-wage countries are highly correlated.

³¹Similar effects are observed for other countries: Growing Chinese import competition increases plant exit and reduces firm growth in Mexico (Iacovone, Rauch and Winters, 2013; Utar and Torres-Ruiz, 2013) and reduces employment growth in Belgian firms (Mion and Zhu, 2013), Danish firms (Utar, 2014), and in a panel of firms from twelve European countries (Bloom, Draca, and Van Reenen, 2015).

³²In related work, Pierce and Schott (2015) compare sectors that varied in their vulnerability to China’s joining to the WTO. Prior to the 2001 accession, the U.S. 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 U.S. manufacturing industries that had larger initial gaps between MFN and non-MFN tariffs.

³³Import penetration is defined here as $\Delta IP_{j\tau} = \Delta M_{j,\tau}^{UC} / (Y_{j,91} + M_{j,91} - E_{j,91})$, where Y_j is domestic output, M_j is imports, E_j is exports, and $\Delta M_{j,\tau}^{UC}$ is the change in U.S. imports from China.

³⁴Table 2 slightly aggregates the 397 manufacturing industries of Figure 4 to 392 industries in order to improve compatibility with other industry-level data such as the BEA input-output tables.

³⁵Ebenstein, Harrison, McMillan, and Philips (2014) describe how employment conditions change in the industries and occupations that are more exposed to U.S. multinational companies moving production offshore. In mild contrast

Table 2: Industry-Level Changes in Chinese Import Exposure and U.S. Manufacturing Employment, 1991 - 2011

	<u>1991-2011</u>		<u>1991-1999</u>	<u>1999-2011</u>	<u>1999-2007</u>	<u>2007-2011</u>
	Mean/SD	Median	Mean/SD	Mean/SD	Mean/SD	Mean/SD
100 x Annual Δ in U.S. 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 x Annual Log Δ in Emp. (Manufacturing Industries)	-2.71 (3.07)	-2.05	-0.30 (3.49)	-4.32 (3.85)	-3.62 (4.15)	-5.73 (5.02)

Statistics are based on 392 4-digit manufacturing industries. The change in U.S. exposure to Chinese imports is computed by dividing 100 x the annualized increase in the value of U.S. imports over the indicated period by 1991 U.S. market volume in that industry. Employment changes are computed in the County Business Patterns. All observations are weighted by 1991 industry employment.

Table 3: Industry-Level Changes in Chinese Import Exposure and U.S. Manufacturing Employment, 1991 - 2011

	<u>Stacked First Differences</u>		
	<u>1991-2011</u>		<u>1991-2007</u>
	(1)	(2)	(3)
100 x Annual Δ in U.S. Exposure to Chinese Imports	-0.81*** (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

N = 784 (392 4-digit manufacturing industries x 2 periods 1991-1999 and 1999-2011 or 1999-2007). Employment changes are computed in the County Business Patterns and are expressed as 100 x annual log changes. Observations are weighted by 1991 employment. Standard errors in parentheses are clustered on 135 3-digit industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3, also based on Acemoglu, Autor, Dorn, Hanson and Price (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 to the above results, they find that trade exposure affects employment not through workers' industry of employment but through their occupation of employment.

lowers domestic industry employment. Nevertheless, this OLS 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.

While it is clear empirically that employment in import-competing U.S. industries has shrunk in the face of China’s rapid growth, the challenge for research is how to measure the distributional consequences and the net economic costs and benefits of these labor-market impacts. The answers turn on 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 U.S. 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?

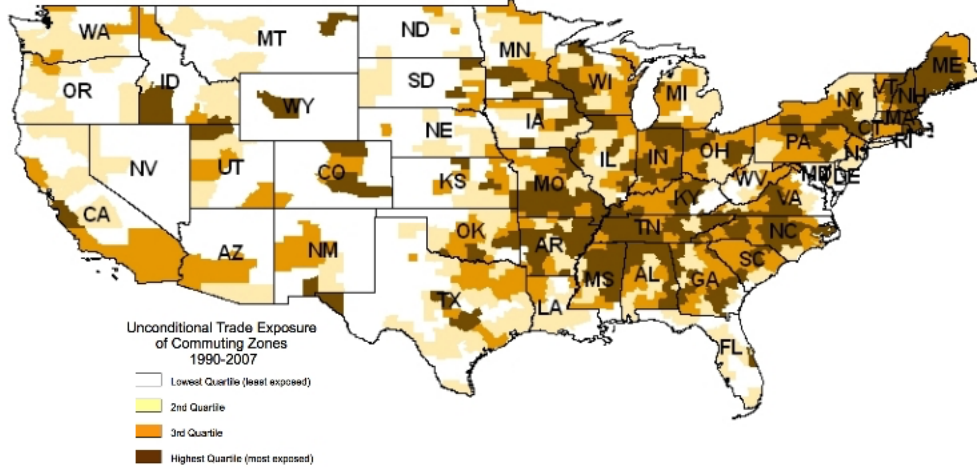
We consider these questions below, highlighting both what is known and what remains unanswered.

4.2 Regional Employment Impacts

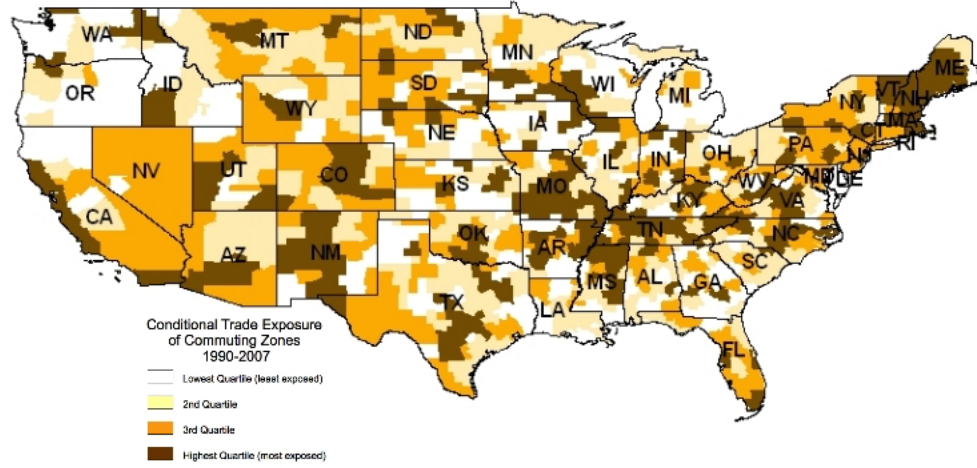
To assess the distributional consequences of rising trade with China, we turn next to adjustments in local labor markets. Local exposure arises from the tendency of industries to cluster in specific regions of a country (Ellison, Glaeser and Kerr, 2010). In the U.S., manufacturing employment is particularly 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 pre-shock period, thus preempting any endogenous adjustment of industry location to contemporaneous trade shocks.

Figure 6: Geographic Exposure to Trade Shocks at the Commuting Zone (CZ) Level

A. Quartiles of Unconditional Exposure



B. Quartiles of Exposure Conditional on Manufacturing Employment Share



Autor, Dorn, and Hanson (2013) examine the impact of Chinese competition on U.S. commuting zones (CZs), drawing on data from the U.S. 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 and Sizer, 1996; Autor and 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 commuting zones. Variation of trade intensity within regions becomes larger in

Figure 6B, 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.

Table 4: Import Competition and Outcomes in U.S. Local Labor Markets, 1990 - 2007

<u>A. Δ Fraction of Working Age Population in Manufacturing, Unemployment, NILE</u>			
Employed in Manufacturing (1)	Employed in Non- Manufacturing (2)	Unemployed (3)	Not in Labor Force (4)
-0.60*** (0.10)	-0.18 (0.14)	0.22*** (0.06)	0.55*** (0.15)
<u>B. Δ Log Population, Log Wages, Annual Wage and Transfer Income</u>			
Δ Log CZ Population (log pts) (5)	Δ Avg Log Weekly Wage (log pts) (6)	Δ Annual Wage/Salary Inc per Adult (US\$) (7)	Δ Transfers per Capita (US\$) (8)
-0.05 (0.75)	-0.76*** (0.25)	-549.3*** (169.4)	57.7*** (18.4)

N=1444 (722 commuting zones x 2 time periods 1990-2000 and 2000-2007). Employment, population and income data is based on U.S. Census and American Community Survey data, while transfer payments are based on BEA Regional Economic Accounts. All regressions control for the start of period percentage of 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 commuting zone share of national population. Robust standard errors in parentheses are clustered on state. * p < 0.10, ** p < 0.05, *** p < 0.01.

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, Dorn and Hanson (2013), 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 non-manufacturing, respectively, by -0.60 and -0.18 percentage points (the latter of which is not significant), and raises the fraction unemployed and out of the labor force by 0.22 and 0.55 percent-

age points.³⁶ Autor, Dorn, Hanson (2013) 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 *non-manufacturing* industries, suggesting the presence of negative local demand spillovers.

Column 5 of Table 4 further shows that import competition has very modest effects on the size of the working-age population in CZs. Tracing individual workers over time, Autor, Dorn, Hanson and Song (2014) confirm that there is little geographic migration in response to the trade shock.³⁷

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 U.S. 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. In the limit, 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.³⁸

Regional labor-market consequences from exposure to trade with China have also been studied for countries other than the U.S.. Analyses for Norway (Balsvik, Jensen and Salvanes, 2015) and for Spain (Donoso, Martin and Minondo, 2014), covering periods from the late 1990s to 2007, find

³⁶The 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 vs. 25th percentile of import exposure during 1990-2007.

³⁷Population responses to local trade shocks are also limited in other countries. Analyses from Germany (Dauth, Findeisen and Suedekum, 2014) and Spain (Donoso, Martin and Minondo, 2014) both find weak and statistically insignificant population adjustments in local labor markets that are exposed to import competition from low-wage countries.

³⁸Labor market adjustment to import competition from China may be 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 and Kovak (2015) also find little spatial mobility and regional convergence in the years following a one-time trade liberalization shock.

results that are consistent with the U.S. 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, Findeisen and Suedekum (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 U.S. 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, while actually raising German employment in the case of trade with Eastern Europe.

Though this paper’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 U.S. over the last two decades. The North American Free Trade Agreement, enacted in 1994, stands out as a landmark change in U.S. trade policy, which led to the elimination of tariffs on U.S. imports from Mexico for the large majority of manufactured products.³⁹ Similar to the analyses in Topalova (2010) for India and Kovak (2013) for Brazil, McLaren and Hakobyan (2015) estimate the impact of NAFTA tariff changes on wages in U.S. regions (defined as Consistent Public Use Microdata 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. And high-school dropouts employed in locations that were initially the most specialized in industries vulnerable to NAFTA had a wage growth that was 8 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 are effectively zero.

³⁹U.S. trade with Canada was liberalized earlier in 1989 through the Canada-U.S. Free Trade Agreement (Trefler, 2004).

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, Autor, Dorn, Hanson and Price (2016) assess whether the seemingly adverse industry and region-level impacts are offset by employment responses elsewhere in the economy. Looking across U.S. 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 thousand fewer manufacturing jobs lost through the year 2011. Actual U.S. manufacturing employment declined by 5.8 million workers from 1999 to 2011, making the counterfactual job loss from direct import competition amount to 10 percent of the realized job decline. As these results are based on the reduced-form specification of equation (2), they may however not 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, Carvalho, Ozdaglar and Tahbaz-Salehi, 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, Autor, Dorn, Hanson and Price (2016) use U.S. input-output data to construct upstream import exposure shocks for both manufacturing and non-manufacturing 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.⁴⁰ Applying the direct plus the indirect input-output measure of exposure increases estimates of trade-induced job losses for 1999 to 2011 to 985 thousand workers in manufacturing, and to 2.0 million workers in the entire economy. Inter-industry linkages thus magnify the employment effects of trade shocks, almost doubling the size of the impact within manufacturing and producing an equally large employment

⁴⁰Pierce and Schott (2015) and Federico (2014) find qualitatively similar results for the U.S. and Italy, respectively.

effect outside of manufacturing.⁴¹

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, Autor, Dorn, Hanson and Price (2016) supplement their analysis of U.S. industries with an analysis of U.S. commuting zones that adds an input-output structure to Autor, Dorn and Hanson (2013). If the reallocation mechanism is operative, then when a local industry contracts as a result of Chinese competition, some other industry in the same commuting zone should expand. Aggregate demand effects should also operate within local labor markets, as shown by Mian and Sufi (2014) in the context of the recent U.S. housing bust. If increased trade exposure lowers aggregate employment in a location, reduced earnings will decrease spending on non-traded 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. While 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 U.S. employment, however, as neither the analysis for commuting zones nor 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 commuting-zone estimates exclude the national component of these two effects, as well as non-local input-output linkages.

Are there positive employment effects from U.S. trade with China that the literature may be missing? One mechanism may work through the supply of imported inputs. The expanded ability of

⁴¹While 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), while 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).

U.S. firms to offshore production to China may raise productivity for workers in the U.S. (Grossman and Rossi-Hansberg, 2008), lower the relative price of intermediates (Auer, Degen, and Fischer, 2013), or extend the range of final goods that firms are capable of producing (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010). Granting that such benefits are plausible in theory, and have been found in other national contexts, neither Pierce and Schott (2015) nor Autor, Dorn and Hanson (2013) detect evidence of positive U.S. 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, Draca and Van Reenen (2015) 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 the opposite direction. The aggregate impact of Chinese competition on U.S. innovation remains unknown.⁴²

The reduced-form analysis suggests that the reallocation of labor across U.S. industries and regions in response to increased competition from China does not produce an offsetting increase in employment by other U.S. 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 non-exposed sectors in the U.S. may be related to the rapid contemporaneous rise in the U.S. 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 non-tradables instead. While this reasoning still predicts a *long-run* employment reallocation towards non-exposed tradables, the large and growing U.S. trade deficit during the period under study may have significantly slowed such a reallocation.

⁴²A further issue is that measured input-output linkages may miss some positive demand effects from U.S. exports. Consider the iPhone, whose back panel states, “Designed by Apple in California. Assembled in China.” From its U.S. 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 U.S. employees. However, not all of Apple’s design exports to China may appear in U.S. trade data. For tax purposes, Apple may attribute some iPhone revenues to overseas subsidiaries. These revenues would not appear in the U.S. current account until the earnings are repatriated, possibly far in the future. A similar logic applies to U.S. business services that may expand as a result of increased trade with China.

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, Dorn, and Hanson (2013) using quantile regression, Chetverikov, Larsen, and Palmer (2015) 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. While 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.⁴³

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 about \$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 about \$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 ($0.0076 \times 0.7 \times 40,000$). While 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.⁴⁴

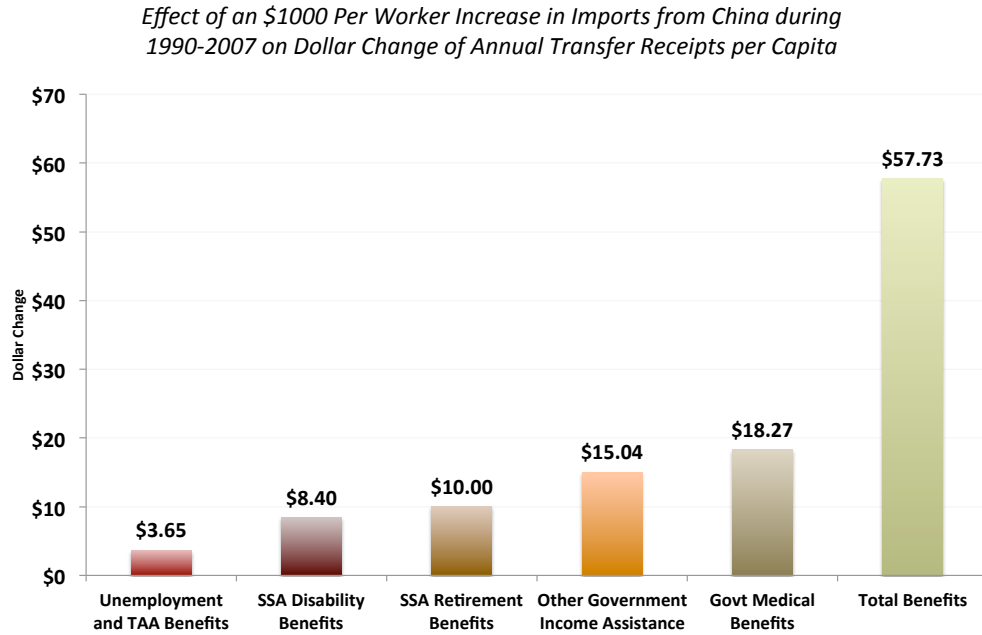
A direct consequence of reduced employment and wages in trade-exposed local labor markets is an increase in transfer benefits. Perhaps unsurprisingly, more trade-exposed CZs see larger increases in per capita payouts of Unemployment Insurance and Trade Adjustment Assistance (Figure 7, based on Autor, Dorn and Hanson, 2013), both of which are designed to assist laid-off workers. Yet, 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

⁴³Local labor market analyses for other developed countries find significant wage declines in response to import competition in Norway (Balsvik, Jensen and Salvanes, 2015) and Spain (Donoso, Martin and Minondo, 2014), and an insignificant wage reduction in Germany (Dauth, Findeisen and Suedekum, 2014). In related work on a developing economy, Costa, Garred and Pessoa (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 specialized in raw materials experienced rising wages, those competing with imported Chinese manufactures suffered wage losses, especially in low-skilled occupations.

⁴⁴This finding has precedence in the literature on labor-market responses to trade. Using data on U.S. 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.

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 and Duggan, 2003). Retirement benefits rise in more trade-exposed CZs, suggesting that adverse labor-market shocks induce more workers to retire earlier.⁴⁵

Figure 7: Imports from China and Induced Government Transfer Receipts in Commuting Zones, 1990 - 2007



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 their relative magnitudes across categories. Trade Adjustment Assistance, the primary federal government program intended to help workers who lose their jobs as a result of foreign competition (Baicker and 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.⁴⁶ Trade-exposed CZs certainly experience sharp

⁴⁵See Kondo (2013) for a general equilibrium analysis of the welfare consequences of trade-related employment losses and Feler and Senses (2015) for results on the impact of the China trade shock on the provision of public services across local jurisdictions.

⁴⁶To qualify for TAA, workers must show that their employer cut back production because of import competition, relocated production to a country with which the U.S. has a trade agreement, or lost business with a buyer or supplier

relative growth in per-capita receipts of TAA benefits. However, while 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 1991-2007) would see 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), while 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, while per capita transfer income rises by about \$58, thereby offsetting just a small portion of the earnings loss (Table 4, columns 7 and 8).⁴⁷

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. Heckscher-Ohlin 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 within skill groups in response to a trade shock, even if only a subset of industries or

that is TAA certified.

⁴⁷Note, however, that household income is measured per adult (since only adults generate income), while transfer income is measured per capita including children (since some transfers are based on the presence of children). A household with children might thus offset somewhat more than 10 percent of its earnings loss.

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 desire 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 (Artuc, Chaudhuri and McLaren, 2010; Dix-Carneiro, 2014; Pessoa, 2014; Ashournia, 2015).⁴⁸ Labor-market frictions may also stem from search costs for firms (Helpman, Itskhoki, and Redding, 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.⁴⁹

Autor, Dorn, Hanson and Song (2014) examine the impact of import competition from China on the careers of individual workers using longitudinal data from the U.S. 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.⁵⁰ 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. 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 non-displaced 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 2007.⁵¹ In the years immediately following 1991, few workers have yet separated from their

⁴⁸Allowing for switching costs across both industries and occupations, Artuc and McLaren (2015) also find substantial costs of occupational reallocation.

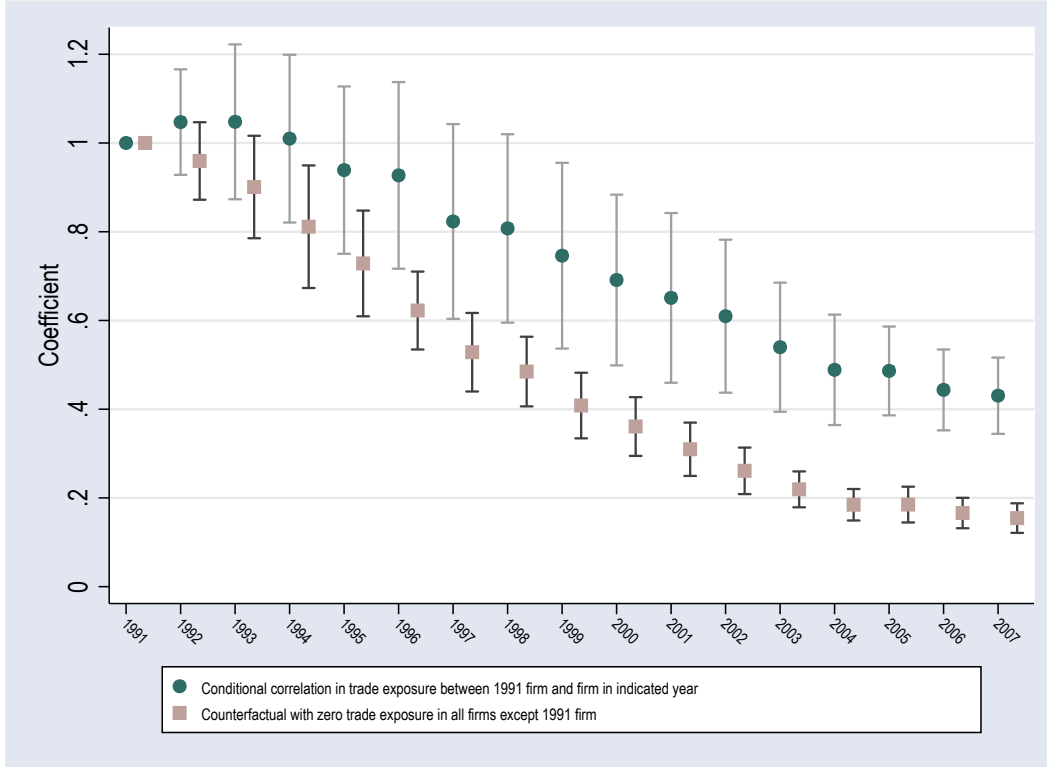
⁴⁹Hummels, Jorgenson, Munch, and Xiang (2014) use data for Denmark to analyze the impacts of increased firm-level imports on within-job spell earnings for workers.

⁵⁰There 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.

⁵¹The 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

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 as of a given year. Logically, this counterfactual correlation also declines over 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 percent 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.

Figure 8: Persistence of Trade Exposure since 1991



The graph 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, and so all persistence in trade exposure is due to workers who have not separated from their initial firm.

correlation is 1.0 in 1991 by construction.

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 pre-period 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 pre-period 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.⁵² Labor-market adjustment to trade further varies according to workers' initial labor-force attachment. Among 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 Social Security Disability Insurance (SSDI) is the main source of recorded income.

Patterns of worker-level adjustment to Chinese import competition have also been studied for a number of European countries. Pessoa's (2014) 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, Munch and Nguyen (2014) similarly find a negative impact of the China shock on workers' earnings accumulation between 1997 and 2008, while Utar (2015) shows adverse earnings and employment outcomes for workers whose industries were subject to the removal of MFA quotas. As in the U.S., earnings losses are concentrated among low-skill workers.⁵³ 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

⁵²Conditional 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.

⁵³In other work, Donoso, Martin and Minondo (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.

seven ring roads, Shanghai’s sparkling skyline, and Guangzhou’s multitude of export factories—none of which existed in 1980—are testimony to 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 U.S. labor market with nothing to go on other than a standard undergraduate international economics textbook, one would predict large movements of workers between U.S. tradable industries (say, from apparel and furniture to pharmaceuticals and jet aircraft), limited reallocation of jobs from tradables to non-tradables, and no net impacts on U.S. aggregate employment. The reality of adjustment to the China trade shock has been far different. Employment has certainly fallen in U.S. industries more exposed to import competition. But so too has overall employment in the local labor markets in which these industries were concentrated. Offsetting regional employment gains either in export-oriented tradables or in non-tradables have 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 U.S. and other developed countries? One way is by recharacterizing the sets of individuals who are likely candidates for opposing distributional consequences 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.⁵⁴ 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. Yet, 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.

⁵⁴Analyses based on the specific-factors model (e.g., Kovak, 2013) are of course immune to this criticism.

The importance of location for evaluating trade gains depends on how long it takes for regional adjustment to occur. A presumption that U.S. labor markets are smoothly integrated across space has long made regional equilibration the starting point for welfare analysis. The U.S. 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, Dvorkin, and Parro (2015) find that in the immediate aftermath of a trade shock, constructed to mimic the effects of growth in U.S. imports from China, U.S. net welfare gains are close to zero. The ultimate and sizable net gains are realized only once workers are able to reallocate across regions in order 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, Costinot, and Rodriguez-Clare, 2013).⁵⁵ 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 resort into new industries. Galle, Rodriguez-Clare, and Yi (2015) demonstrate that in the limiting case where worker resorting is infeasible—such that both regional and worker comparative advantages are locked in—a trade shock of the magnitude of 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.

⁵⁵Even 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-markets effects or deteriorating the terms of trade (Hsieh and Ossa, 2015).

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 nation. Rapidly rising real wages indicate that the end of cheap labor in China is at hand (Li, Li, Wu and Xiong, 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. While the China of the future will surely look very 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.

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