Trade Adjustment: Worker Level Evidence*

David H. Autor, MIT and NBER
David Dorn, CEMFI and IZA
Gordon H. Hanson, UCSD and NBER
Jae Song, SSA

October 2011

Abstract

In the past two decades, China's manufacturing exports have grown spectacularly. U.S. imports from China have surged, while U.S. exports to China have increased more modestly, consistent with the two countries' divergent current account imbalances. Using data on individual earnings by employer from the Social Security Administration, we examine how workers in manufacturing industries exposed to import competition from China have faired in terms of labor income, employment, job mobility, and receipt of Social Security benefits. Over the period 1992 to 2007, workers who in 1991 were employed in industries that experienced high subsequent levels of import growth have more years with zero labor earnings, lower cumulative earnings over the period, and a greater likelihood of receiving Social Security Disability Insurance as the only recorded source of income in a given year. More exposed individuals spend less time working for their intial employers, less time working in their intial two-digit manfuacturing industries, and more time working elsewhere in manufacturing. Effects on earnings and employment are much larger for women than for men, and also larger for individuals whose initial employers were relatively large, whose initial wages where below their firm's average, and who in the pre-sample period worked part time or intermittently. Individuals who work in regions more exposed to import growth (beyond their industry of employment) have more years with zero labor earnings as well. We obtain similar results using alternative measures of trade exposure. Our findings suggest that there is significant worker-level adjustment cost to import shocks and that adjustment is highly uneven across individuals according their conditions of employment in the pre-shock period.

Keywords: Trade Flows, Import Competition, Employment, Earnings, Social Security, China

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

*Autor acknowledges funding from the National Science Foundation (SES-0239538). Dorn acknowledges funding from the Spanish Ministry of Science and Innovation (CSD2006-00016 and ECO2010-16726) and from the Community of Madrid (S2007/HUM-0444).

1 Introduction

Among the most significant recent changes in the structure of the global economy is the rapid growth of China. Between 1990 and 2009, the share of world manufacturing exports originating in China grew from 2% to 13% (Figure 1). For the United States, three factors compound the impact of China's expansion. One is its industrial concentration. Four-fifths of China's exports are in manufacturing, a sector that still accounts for the majority of U.S. trade. Second is China's outward orientation. From 2000 to 2007, the growth in China's manufacturing exports were equivalent to an astounding 40% of its GDP growth. Third is a sharp imbalance between aggregate exports and aggregate imports in the two countries. During the 2000s, China's average current account surplus was 5% of GDP, a figure equal to the average U.S. current account *deficit* over the period. The U.S. industries and regions that are exposed to the increase in China's trade capacity have faced a major shift in global supply, without an offsetting shift in global demand.

In the wake of China's spectacular growth, there has been a spirited if uneven policy debate about how the United States should respond. The U.S. Congress has repeatedly threatened China with trade sanctions for alleged manipulation of its currency, while others have called for an increase in Trade Adjustment Assistance, the primary federal program that assists workers whose lose their jobs as a result of import competition.[1] Missing in the debate is hard evidence about which types of workers have been most affected by trade with China. We know that U.S. employment has declined in apparel, textiles, furniture, children's toys, and other industries in which imports from China have surged (Bernard, Jensen, and Schott, 2006). But we know little about how workers in these industries succeed in adjusting to trade shocks.

In this paper, we examine the long-run impact of exposure to trade with China on U.S. workers. We define trade exposure as the growth in U.S. imports from China over 1991 to 2007 that occurred in a worker's initial industry of affiliation. Our focus is on the extended consequences of trade shocks based on where a worker is employed at the time a shock initiates. By holding the industry constant, we avoid selection problems arising from the post-shock resorting of workers across industries. The choice of 1991 to 2007 as the sample period is dictated on the front end by the availability of disaggregated bilateral trade data and on the back end by the onset of the Great Recession. These years span much of the recent China trade shock as the early 1990s are when the country's export growth begins to accelerate (Figure 1).[2] Using individual level data from the

[1]E.g., Jennifer Steinhauer, "Senate Jabs China over its Currency," *New York Times*, October 11, 2011; Tom Barkley, "Trade Deal Clears Hurdle in Senate," *Wall Street Journal*, August 4, 2011.

[2]While China's initial opening to trade occurred in the 1980s, its emergence as an export powerhouse came in the 1990s. In Figure 1, China's share of world manufacturing exports rises unevenly from 1% in 1984 to 2% in 1991 and

Social Security Administration, we estimate the impact of exposure to China trade on cumulative employment, cumulative earnings, and receipt of Social Security benefits over the period. The data permit us to decompose worker employment spells and income by firm and industry and to examine variation in trade impacts according to a worker's demographic characteristics, initial earnings, and initial firm characteristics. To account for possible correlation between industry imports and industry domestic demand or productivity shocks, which may also affect worker outcomes, we instrument for the change in U.S. imports from China using import growth in other high income countries. Key to our analysis is that China's growth over the period appears to be largely attributable to improvements in domestic productivity arising from the dismantling of central planning, the privatization of industry, and the liberalization of trade and investment (Naughton, 2007; Hsieh and Klenow, 2009; Hsieh and Ossa, 2011), as opposed to the U.S. business cycle or other changes in U.S. demand for Chinese goods. We also use a measure of trade exposure derived from the gravity model of trade.[3]

Our work complements recent literature on trade and labor markets.[4] To identify how trade affects wages and employment, empirical research tends to take one of two very different approaches. One is to embrace general equilibrium trade theory, which shows how trade shocks affect wages in national labor markets, with shocks in one industry being transmitted to other industries through labor mobility (Feenstra and Hanson, 1999; Harrigan, 2000; Robertson, 2004; Blum, 2008). This approach is informative about how trade affects equilibrium wages but does not account for the transitional costs that workers incur in adjusting to trade shocks or for the uptake of government benefits that may accompany adjustment.[5] Moving between industries may take time or may involve a loss in firm or industry-specific human capital, either of which would imply a reduction in lifetime earnings (Neal, 1995; Parent, 2000; Polataev and Robinson, 2008). A second approach is to estimate the short or medium run effects of trade by exploiting barriers to the mobility of workers across "local" labor markets. Where it is costly for workers to change employers, switch occupations, or move to

then begins to grow rapidly, reaching 5% in 2000 and 11% in 2007. Naughton (1996) identifies 1984 as the year in which China's export growth began to take off. However, the government initially maintained many restrictions on imports, exports, and foreign direct investment. It was not until 1992, following Deng Xiaoping's famous "southern tour" (in which Deng and his reformist clique wrested power back from hardliners who had risen in prominence following the events at Tiananmen Square in 1989), that the country began to welcome FDI by encouraging the expansion of special economic zones in southern coastal cities (Naughton, 2007). The SEZs, which were later expanded nationally, lured foreign firms to set up export operations in China and allowed both foreign and domestic firms to import inputs duty free, as long as the final goods were bound for abroad. Between 1991 and 1994, alone, inward FDI in China grew from 1% to 6% of GDP.

[3]Our identification strategy is related to Bloom, Draca and Van Reenen (2011) and Autor, Dorn and Hanson (2011).

[4]For discussion of recent research, see Harrison, McLaren, and McMillan (2010).

[5]Recent literature in trade theory allows for costly worker search, which produces equilibrium variation in earnings and employment across ex ante identical individuals (Helpman and Itskhoki, 2010; Helpman, Itskhoki, and Redding, 2010). See also Davis and Harrigan (2007).

another location, trade shocks may affect wages differentially – at least in the short to medium run – at the firm, industry, or region level.[6] While this second approach uncovers the transitory effects of trade shocks, it may miss impacts that persist *after* an individual leaves his firm, abandons his industry, or relocates geographically. Further, because wage effects are estimated at the level of the local labor market, they may be contaminated by compositional changes resulting from worker exit. If, for instance, low-wage workers are those most likely to lose their jobs after an import shock, the estimated impact of trade on wages at the industry may be biased upwards (i.e., toward zero), as exiting low-wage workers push up the industry average.[7] By utilizing the long-run panel structure of the SSA data, our work is able to capture the post-shock change in earnings that workers experience at the same firm, after moving to a different firm in the same industry, or after moving to a new industry altogether.

A second body of related literature tracks the earnings of workers who are displaced from their jobs. There is considerable evidence that undesired job loss has negative long-run effects on individuals (e.g., Topel, 1990; Ruhm, 1991; Neal, 1995; Sullivan and von Wachter, 2009). A challenge in this line of work is to distinguish involuntary from voluntary worker separations from their employers. One approach uses the CPS Displaced Workers Survey (DWS), which asks workers who recently left their jobs if the separation was involuntarily. The DWS covers all types of job loss, but for each worker only records a single separation and only those within the last three years (Farber, 2005), which prevents one from investigating long-run consequences.[8] A second approach to estimate the impact of displacement is to use administrative data, such as from unemployment insurance records, which allows one to identify mass layoffs in which a firm releases a substantial fraction of its employees in a short time span (Jacobsen, LaLonde, and Sullivan, 1993). Relative to the DWS, administrative records contain more complete histories of worker earnings but lack information about why job loss occurs, leading to the convention of studying events such as large-scale separations. While both approaches find that displaced workers experience earnings loss, results using administrative data tend to find larger impacts (von Wachter, Handwerker and Hildreth, 2009).

[6]See Bernard, Jensen, and Schott (2006), Verhoogen (2008), Amiti and Davis (2011), and Hummels, Jorgensen, Munch, and Xiang (2011) on trade shocks at the firm level; Artuc, Chaudhuri, and McLaren (2010), McLaren and Hakobyan (2010), and Ebenstein, Harrison, McMillan, and Phillips (2011) on trade shocks at the industry and occupation level; and Chiquiar (2008), Kovak (2011), Topalova (2010), and Autor, Dorn, and Hanson (2011) on trade shocks at the region level.

[7]Using data on U.S. commuting zones, Autor, Dorn, and Hanson (2011) estimate large negative effects of import shocks on regional manufacturing employment but not on regional manufacturing wages. Using the CPS, Ebenstein, Harrison, McMillan, and Phillips (2011) find no effect of imports on wages at the industry level (though they do find effects for occupations). Both sets of results suggest workers may be non-randomly selected out of employment in trade-impacted industries.

[8]See Addison, Fox, and Ruhm (1995) and Kletzer (2000) for work using the DWS to examine the correlation between job loss and import competition.

Our work follows the tradition of using administrative data, which allows us to see the long-run effects of labor-market shocks. We break from this tradition by focusing on a specific type of shock, namely one related to trade with China. By identifying the source of the shock, we are able to examine all worker separations from employers and not just those associated with mass layoffs.[9]

To preview the results, we find that workers more exposed to trade with China have lower cumulative earnings, lower cumulative employment, and a higher likelihood of receiving Social Security Disability Insurance over the 1992 to 2007 period. After including a rich set of controls, the difference between an individual at the 90th percentile of industry trade exposure and one at the 10th percentile of exposure amounts to reduced earnings equal to 60% of initial yearly income, to 1.5 more months of zero labor earnings, and to half an additional month where payments from Social Security Disability Insurance are the only recorded source of income. Trade exposure increases churning across firms, industries, and sectors. More exposed workers spend less time working for their initial employer, less time working in their initial two-digit industry, and more time working elsewhere in manufacturing and outside the manufacturing sector. The consequences of trade exposure vary across demographic groups. Losses in earnings and employment are larger for women, older workers, workers whose initial wage is below their initial firm's average, and workers with relatively weak attachment to the labor force.

We interpret these results to mean that greater exposure to the China trade shock is associated with a loss in lifetime income and a greater likelihood of changing jobs, of enduring a period without work, and of receiving government transfers. These adjustment costs appear to be larger for individuals whose position in the labor market is more tenuous. Having lower earnings at one's place of work, having a history of interruptions in labor supply, or being closer to retirement age predispose an individual to greater losses from a given trade shock. The data do not allow us to say whether these effects are due to employers being more likely to fire these types of workers or to workers with these characteristics being more likely to leave their jobs when employment prospects worsen. Our finding that lower wage workers suffer more from adverse shocks is consistent with the literature on job displacement but our findings that women, older workers, and workers with less tenure suffer more is distinct from this literature (e.g., Kletzer, 1989; Jacobsen, LaLonde, and Sullivan, 1993; Neal, 1995; Chan and Stevens, 2001; von Wachter, Song, and Manchester, 2009; Farber, 2011). It may be that within affected industries, women, older workers, and newly hired workers perform tasks that are more substitutable with Chinese imports. Perhaps surprisingly it is workers in larger firms

[9] Our work is similar in spirit to von Wachter, Song, and Manchester (2009), who examine the long run effects of job loss from the 1982 recession. Relatedly, Hummels, Jorgensen, Munch, and Xiang (2011) apply the approach in Jacobsen, LaLonde, and Sullivan (1993) to examine the displacement effects of trade shocks in Denmark.

who are most likely to see employment disruptions in response to trade, a finding that goes against the Melitz (2003) model in which larger, more productive firms are better positioned to confront increased competition from abroad.[10]

We begin in Section 2 by describing the empirical approach that we use to estimate the effects of exposure to trade shocks. Section 3 provides a brief discussion of data sources and measurement. Section 4 provides our primary OLS and 2SLS estimates of the impact of trade shocks on cumulative earnings, employment, and benefit receipts. Section 5 examines variation in the consequences of trade shocks by individual characteristics and conditions of initial employment. Section 6 expands the inquiry to explore geographic exposure to trade shocks and alternative measures of trade exposure by incorporating imports from other low-income countries, using the gravity model of trade, using net imports (either in dollar terms or in factor equivalent terms) rather than gross imports, or accounting for imported intermediate inputs. Section 7 concludes.

2 Empirical approach

The global context for our analysis is one in which China experiences growth in its productivity and reductions in its trade costs, which lead it to expand its exports. General equilibrium trade theory predicts how such shocks affect wages in China, the United States, and the rest of the world (e.g., Hsieh and Ossa, 2011; di Giovanni, Levchenko, and Zhang, 2011). Our focus in this paper is not on identifying such changes in equilibrium wages but on capturing the changes in earnings and employment that individual workers in exposed industries encounter when adjusting to the shock.

To consider how productivity growth in China may affect U.S. industries, we apply the Eaton and Kortum (2002) model of trade.[11] Using their framework, total output by U.S. industry j, Q_{uj}, can be written as as the sum in demand for U.S. goods across destination markets:

$$Q_{uj} = \sum_{n} \frac{T_{uj} \left(w_{uj} \tau_{nuj} \right)^{-\theta}}{\Phi_{nj}} X_{nj}, \tag{1}$$

which depends on the technological capability of U.S. industry j, (T_{uj}) , unit production costs in

[10] Our results on large firms are not anomalous. Von Wachter and Bender (2006) also find that workers displaced from large firms suffer more from job loss, in their case for a sample of young workers. Bernard, Jensen, and Schott (2006) find that plants with higher TFP (which tend to be larger establishments) have larger employment declines in response to increases in import penetration from low-wage countries. Biscourp and Kramarz (2007) show that among French importers, large firms tend to reduce employment while small firms create new jobs. And Holmes and Stevens (2010) find evidence that larger plants are more negatively affected by import growth from China, which they attribute to these plants being more specialized in the standardized goods that China tends to export.

[11] Any model of trade with a “gravity” structure, as defined in Arkolakis, Costinot, and Rodriguez-Clare (2010), would produce a similar specification.

U.S. industry j, (w_{uj}), bilateral trade costs between the United States and country n in industry j, (τ_{nuj}), expenditure in country n on industry j, (X_{nj}), and the "toughness" of competition in country n's market for outputs of industry j, $(\Phi_{nj} = \sum_h T_{hj} (w_{hj}\tau_{nhj})^{-\theta})$, which in turn is a function of productivity, production costs, and trade costs in the other countries that export to country n, including China.[12] As China experiences productivity growth in industry j or a reduction in its production or trade costs, U.S. firms face stiffer competition in the markets that they and China both serve. Totally differentiating (1), we obtain the direct effect of China productivity and cost shocks on the demand for outputs of U.S. industry j,

$$\hat{Q_{uj}} = -\sum_n \left[\frac{X_{nuj}}{Q_{uj}}\right] \left[\frac{X_{ncj}(\hat{A}_{cj} - \theta\hat{\tau}_{ncj})}{X_{nj}}\right], \tag{2}$$

where $\hat{x} \equiv d\ln x$, $\hat{A}_{cj} \equiv \hat{T}_{cj} - \theta\hat{w}_{cj}$, and X_{nuj} is initial sales by U.S. industry j in country n.[13] In (2), the first term in brackets is the share of country n in U.S. sales for industry j and the second term in brackets is the change in the import penetration ratio for industry j in country$n$ that is mandated by changes in China's productivity, production costs, and trade costs. In the empirical analysis, we will initially focus on the change in import penetration in the U.S. market due to growth in Chinese imports, as the United States is the dominant destination market for the sales of most U.S. industries (Bernard, Jensen, Redding, and Schott, 2009). Later in the analysis, we will incorporate changes in import penetration in other destination markets, as well. In (2), we see that supply-driven changes in China's exports will tend to reduce demand for U.S. industrial production.

Turning to the data, our baseline measure of trade exposure is the change in the import penetration ratio for a U.S. industry over the period 1991 to 2007, defined as,

$$\Delta IP_{jt} = \frac{\Delta M^{UC}_{jt}}{Y_{j0} + M_{j0} - E_{j0}}, \tag{3}$$

where for U.S. industry j, ΔM^{UC}_{jt} is the change in imports from China over the period and $Y_{j0} + M_{j0} - E_{j0}$ is initial absorption (measured as industry shipments, Y_{j0}, plus industry imports, M_{j0}, minus industry exports, E_{j0}). We choose 1991 as the initial year as it is the earliest period for which we have disaggregated bilateral trade data for a large number of country pairs.[14] The quantity in (3) will mirror that in (2) if the growth in U.S. imports from China is primarily the result of

[12]The parameter θ captures the dispersion in productivity across firms in the industry.

[13]In (2), we do not consider the general equilibrium effect of the China shock on global wages and expenditures. Our empirical approach implicitly allows for such effects by using the observed changes in imports from China in measuring trade exposure.

[14]Our empirical approach requires data not just on U.S. trade with China but also on the two countries' trade with other partners.

domestic supply shocks in China or changes in its trade costs. Over the period we consider, China underwent enormous changes in industrial productivity associated with TFP growth, human and physical capital accumulation, and improvements in the country's infrastructure that followed the country's transition from a centrally planned economy to a more market-oriented one, all of which contributed to its export surge (Naughton, 2007; Hsieh and Klenow, 2009).

Appendix Table 1 describes changes in import penetration, summarized at the two-digit level, for SIC manufacturing industries over the period 1991 to 2007. Data for U.S. imports are from UN Comtrade, concorded from HS product codes to four-digit SIC industries (see the Data Appendix). Data for U.S. four-digit industry shipments are from the NBER Productivity Database (Bartelsman, Becker, and Gray, 2000). There is immense variation in import growth across industries. Leather products (shoes), toys, furniture, electronics, and apparel each have increases in import penetration of more than 20 percentage points. Tobacco, petroleum, food products, chemicals, and transportation equipment each have increases in import penetration of less than 2 percentage points. The more exposed industries have in common production stages (primarily assembly) that are intensive in the use of less skilled labor; the less exposed industries have in common intensive use of natural resources (land, oil reserves) or physical capital. These patterns are consistent with China's strong comparative advantage in labor-intensive sectors (Amiti and Freund, 2010) and within these sectors in labor-intensive production activities (Feenstra and Hanson, 2005).

In the estimation, we examine changes in earnings and employment for workers over the 1992 to 2007 period that are associated with exposure to the growth in imports from China in (3). We measure a worker's exposure according to his industry of employment in the pre-shock period. For each worker, we use the import exposure measure in (3) for the industry in which the worker was employed in 1991.

It is important to recognize the labor-market impacts of trade that our approach can and cannot identify. By taking workers and their initial industry of employment as the unit of analysis, our approach isolates the long-run changes in outcomes that are associated with greater exposure to trade at the time China's export growth accelerates. Under what conditions would we fail to find evidence of worker-level adjustment? If labor markets are frictionless, such that workers can easily change their industries and obtain similar compensation levels in alternative lines of work (i.e., they do not face inter-firm or inter-industry wage differences), we will see no impacts from exposure to China trade. Even if growing imports from China cause equilibrium wages to change for entire skill groups, our approach would uncover no adjustment in earnings or employment, for wage effects would not be firm or industry specific. We *will* find trade impacts on worker outcomes if (i) it is costly for workers to change their employers or to change their industries (due, say, to the presence of firm or industry-specific human capital; e.g., Neal, 1995), (ii) costly job search or other barriers complicate obtaining another job once a worker has lost his initial employment (Rogerson and Shimer, 2011), or (iii) workers in affected industries tend to be those who are more likely to exit the labor force in response to an adverse wage shock (Blau, 1994; Peracchi and Welch, 1994).

One concern about (3) as a measure of trade exposure is that observed changes in the import penetration ratio may in part reflect domestic shocks to U.S. industries. While the primary factors driving export growth from China to the United States are likely to be internal supply shocks in China or global trade policy shocks facing China (Bloom, Draca and Van Reenen, 2011), U.S. industry import demand shocks could still contaminate observed trade flows. To capture the China supply-driven component in U.S. imports from China, we instrument for trade exposure in (3)with the variable,

$$\Delta IP_{ijt} = \frac{\Delta M^{OC}_{j-3,t}}{Y_{j-3,t-3} + M_{j-3,t-3} - X_{j-3t-3}} \tag{4}$$

where $\Delta M^{OC}_{j-3,t}$ is the growth in imports from China for eight high income countries during the period 1991 to 2007,[15] based on the industry in which the worker was employed in 1988. We use industry of employment in 1988, rather than 1991, to account for any worker sorting across industries in anticipation of future trade shocks. The denominator in (4) is initial absorption in the 1988 industry. The motivation for the instrument in (4) is that high income economies are similarly exposed to growth in imports from China that is driven by supply shocks in the country. The identifying assumption is that industry import demand shocks are weakly correlated across high-income countries.

Figure 2 plots the value in (3) against the value in (4) for all workers in our main sample, as defined below, which is equivalent to the first-stage regression in the estimation without detailed controls. The coefficient is 0.713 and the t-statistic and adjusted R squared are 8.55 and 0.41, respectively, indicating the strong predictive power of import growth in other high income countries for U.S. import growth from China. Later in the estimation, we also use the gravity model to measure trade exposure, which allows us to weaken the identifying assumptions. Additionally, we modify (3) by using in its place (i) import penetration from all low income countries rather than just China, (ii) import penetration from China in the United States and in the foreign destination markets that U.S. industries serve, (iii) net imports (rather than gross imports), measured either

[15]These countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland, which represent all high income countries for which we can obtain disaggregated bilateral trade data back to 1991.

in dollar terms or in worker equivalent units, and (iv) import penetration adjusted for imports of intermediate inputs.

3 Data sources and measurement

Our main source of data on U.S. workers is a one percent extract from the Master Earnings File (MEF) of the U.S. Social Security Administration. The MEF data provides annual earnings and an employer identification number (EIN) for each job that a worker held in the years 1978 through 2007.[16] The MEF also contains basic demographic information that stems from a worker's application for a Social Security card. Our analysis uses data on birth year, sex, race, and immigrant status (U.S. or foreign born). For 97% of employees in 1991, we are able to match the EIN of the employer to firm data that provides information on industry, firm size (measured by employment or payroll), and geographic location of the firm. The industry classification is based on firms' registration with the Internal Revenue Service (IRS). The Data Appendix provides more details.

We focus on workers who were born between 1943 and 1970 and study their outcomes over the period 1992 to 2007, during which these individuals were between 22 and 64 years old. In the estimation, we use two samples drawn from this group. The full sample includes all working-age individuals who had positive earnings (and a valid industry code) for at least one year in each of the three-year periods, 1987 to 1989 and 1990 to 1992,[17] which comprises 880,465 workers. The second sample is of workers with high labor-force attachment, which is restricted to individuals who earned at least $7,950 per year in each of the four years 1988 to 1991. The value of $7,950 (in 2007 dollars) corresponds to the earnings of a worker who was employed for 1,600 annual hours at the Federal minimum wage as of 1989. The restricted sample includes 511,792 workers.

For each worker in each year, we observe annual labor earnings, whether the worker received benefits from the Social Security Administration, and the program from which these benefits derived. Because the sample is limited to individuals of working age, the vast majority of those who report Social Security benefits receive them in the form of Social Security Disability Insurance, rather than Social Security Retirement Income (whose primary recipients are aged 65 or older) or Supplemental Security Income (whose primary recipients do not participate in the labor force on a frequent basis). The data thus allow us to observe three sets of labor-market outcomes over the sample period: total labor earnings, the number of years with positive labor earnings, and the number of years with

[16]For workers who have multiple jobs in a given year, we aggregate earnings across all jobs and retain the EIN of the employer that accounted for the largest share of the worker's earnings.

[17]Observations from the first period are necessary to construct (4) and for the second period to construct (3).

positive Social Security benefits. Appendix Table 2 describes variation in these outcomes across workers. For the sample with high labor-force attachment, the average worker had positive labor earnings in 14.2 of the 16 years, zero labor earnings with positive SSDI benefits in 0.3 years, and zero labor earnings without SSDI benefits in the remaining 1.5 years. The average worker's cumulative earnings from 1992 to 2007 amounted to 19.2 times the initial annual wage (measured as the average of the annual wages in 1988 to 1991).

4 Empirical Results

The data permit us to examine cumulative worker outcomes over the sample period as well as transitions between employers, spells of non-employment, and spells with positive income from Social Security benefits. In this section, we begin the analysis by examining the impact of trade exposure on total earnings and employment and then consider worker adjustment to trade shocks in the forms of transitions between jobs and periods of receiving benefits.

4.1 Baseline Regressions

Table 1 presents estimates of the relationship between Chinese import exposure and employment for U.S. workers. We begin by using the restricted sample of individuals with high labor-force attachment, who report positive labor earnings above minimum annual income levels in the four consecutive years, 1988 to 1991. We fit models of the following form:

$$E_{ij} = \beta_0 + \beta_1 \Delta IP_j + X'_{ij}\beta_2 + e_{ij}, \tag{5}$$

where E_{ij} is cumulative years with positive labor earnings over 1992 to 2007 for worker i employed in industry j in 1991, ΔIP_{ij} is the change in import penetration from China over 1991 to 2007 in industry j as defined in (3), and the vector X_{ij} contains controls for the worker's gender, birth year, race, foreign-born status, initial sector of employment, average log annual earnings over 1988 to 1991, job tenure as of 1991 in the primary firm in which the worker was employed in 1991, and the size of the primary firm in which the worker was employed in 1991. Standard errors are clustered at the level of the 1991 industry.

The first two columns of Table 1 present regressions with no controls, except for a variable that indicates whether a worker's initial sector of employment was manufacturing. The regression in column 1 is based on OLS, whereas the regression in column 2 is based on two-stage least squares, using the variable described in (4) as an instrument for the change in import penetration given in

(3). In both cases, there is a negative and statistically significant correlation between the change in import penetration and cumulative years worked between 1992 and 2007. Greater exposure to imports from China based on a worker's initial industry of employment is associated with reduced total employment over the 16-year period. To interpret the coefficient estimates, we compare a manufacturing worker at the 90th percentile of the change in trade exposure with a manufacturing worker at the 10th percentile. [18] The implied differential reduction in years with positive labor earnings for the worker at the 90th percentile is 14.4% (-0.56×(26.00 - 0.06)) of a year, or 1.7 months, in column 1, and 26.6% (-1.03×(26.00 - 0.06)) of year, or 3.2 months, in column 2. The 2SLS estimate is twice the magnitude of the OLS estimate, which is consistent with there being a positive correlation between U.S. industry import demand shocks and U.S. industry labor demand, which would contribute to an OLS estimate in column 1 that is biased toward zero. The 2SLS regressions are intended to purge such correlation from data.

In column 3 we add controls for birth year, which has minimal effect on the coefficient estimates. Column 4 adds controls for gender, race, and foreign-born status, which reduce the coefficient on import exposure by about one-fifth. Cumulative employment over the period is lower for women, non-whites (weakly), and the foreign born. Column 5 adds workers' average annual log earnings over the 1988 to 1991 period and column 6 adds controls for job tenure and the employment size of the initial firm. Not surprisingly, workers with higher initial earnings have higher cumulative employment in the ensuing two decades. The coefficients for the vector of tenure and firm size dummies (not shown in Table 1) indicate a longer employment duration for workers with higher tenure and employees of larger firms. The addition of the full set of controls produces a coefficient estimate in column 6 that is half as large as the one in column 2 but still precisely estimated. The results in column 6 imply that the differential reduction in employment for workers at the 90th versus the 10th percentile of trade exposure is 1.5 months, which amounts to a 0.9% relative reduction in years worked based on employment at the sample mean.

Since our definition of being employed is having positive labor earnings in a given year, our results for adjustment in employment are based on the extreme extensive margin. Suppose that as a consequence of the trade shock, a worker loses his job in his initial industry early in one year, spends the rest of the year without work, and finds a job with another employer in the following year. Such work-to-nonemployment-to-work transitions are missed in Table 1 because the worker has positive earnings in each year. Even at the extreme extensive margin, however, we find a negative impact of exposure to China trade on employment. Adjustment in employment at the intensive margin will

[18]Non-manufacturing workers are uninteresting as a comparison group as by definition they have zero trade exposure.

contribute to changes in earnings, which we examine next.

In panel A of Table 2, the dependent variable is cumulative earnings from 1992 to 2007 normalized by average annual earnings over 1988 to 1991, such that total labor earnings is denominated as a multiple of initial annual income. The results show that, as with employment, there is a negative and statistically significant correlation between the change in import penetration in a worker's initial industry and cumulative earnings over the period. Workers more exposed to imports from China have lower long-run income. In column 6, which includes the full set of controls, the difference in cumulative income for workers at the 90th versus the 10th percentile of trade exposure is 60.1% of an initial annual wage (-2.32×(26.00 - 0.06)), a value that is equivalent to 3.1% percent of earnings over the entire 16-year period evaluated at the sample mean.

The trade-induced reduction in earnings that is evident in panel A of Table 2 is the combined result of fewer years worked and lower average earnings per year. How does the reduction in cumulative earnings for more exposed workers decompose into these two components? Panel B of Table 2 uses as a dependent variable earnings per total years worked. By taking the ratio of the coefficient in panel B to that in panel A (within a given column), one obtains the fraction of the change in total earnings from greater import exposure that is associated with the change in earnings per year of employment. This fraction is 0.74, indicating that most of the long-run decline in income resulting from exposure to China imports is a consequence of changes in annual earnings (including changes in employment at the intensive margin), rather than changes in employment at the extreme extensive margin. Workers with greater exposure to import growth do not just spend fewer years working, they also earn less for each year that they work.

4.2 Impact of Trade Shocks on Patterns of Employment and Benefit Receipts

How do workers and employers respond to an increase in import competition? Firms may adjust labor quantities, by temporarily or permanently reducing employment. Workers who separate from their employers must then decide whether to search for a position in a similar line of work, which may reward the skills they have accumulated on the job, or to search more broadly, where their earnings potential may be less. The SSA data permit us to characterize these and other features of worker adjustment to changes in import penetration.

In Table 3, the dependent variables are years with positive labor earnings (panel A), cumulative earnings over the period (panel B), or earnings per year of employment (panel C), by firm, industry, and sector. All regression models include the full vectors of control variables from Tables 1 and 2. In column 1A, the dependent variable is total years of employment over 1992 to 2007 in the firm in which the worker was employed in 1991. The large negative and significant coefficient on import penetration indicates that workers more exposed to trade with China spent less time working at their initial employer. Because we include a dummy variable for employment in manufacturing, the comparison in column 1 is between workers within the manufacturing sector. Manufacturing workers with greater exposure to import penetration thus appear to be more likely to separate from their employers. In column 2A, the dependent variable is total years with positive labor earnings in the worker's 1991 two-digit industry but at an employer different from the initial firm. The negative and significant coefficient on import penetration indicates that workers more exposed to imports were less likely to work for a new employer within their initial industry of employment. Not only are more trade-exposed workers more likely to leave their initial jobs, they are also more likely to leave their initial industries. Between 1992 and 2007, the average worker in the high-labor-force-attachment sample spent 8.3 years working in his 1991 two-digit industry, with one-quarter of this time for a firm different from his 1991 employer. Comparing workers at the 90th versus the 10th percentile of trade exposure, the more-exposed worker spent 0.8 fewer years (-3.2×(26.0-0.06)) working for his initial firm and 1.3 total fewer years ((-3.2-1.7)×(26.0-0.06)) working in his initial two-digit industry. The trade-induced reduction of a worker's years of employment in the initial industry is hence ten times larger than the overall decline employment as measured in Table 1.

If more trade-exposed workers are shifting out of their initial industries in greater numbers, where are they going? In column 3A of Table 3, the dependent variable is total years of employment in the same sector as the 1991 employer but in a different firm and two-digit industry. For manufacturing workers, this variable measures the number of years that they spend in a two-digit manufacturing industry that is different from their initial industry. The coefficient on import penetration is positive and precisely estimated, indicating that more trade-exposed workers are relatively more likely to move to a new industry within manufacturing. The negative coefficients in columns 1A and 2A and the positive coefficient in column 3A indicate that more trade exposed workers are subject to more churning in employers and industries. To gauge whether more trade-exposed workers are more likely to exit the manufacturing sector entirely, we sum the coefficients across the first three columns of panel A, which yields a value of -2.14 (standard error 0.87). Workers more exposed to import growth from China are therefore more likely to leave manufacturing. Comparing workers at the 90th and 10th percentiles of trade exposure, more exposed workers spent 0.55 fewer years working in manufacturing over the sample period. The estimates of columns 4A and 5A imply that this reduction in manufacturing employment is only partially compensated for by additional employment in firms outside the manufacturing sector or in firms that lack an industry code in the data.[19] In the presence of firm or industry-specific human capital, such reallocations of employment across firms, industries and sectors may imply a loss in earnings.

The regressions in panel B of Table 3 reinforce the message of the employment results. Larger increases in import penetration are associated with lower total earnings at the initial employer (column 1B), lower total earnings in the initial two-digit industry (column 2B), higher total earnings elsewhere in manufacturing (column 3B), and lower total earnings in manufacturing overall (sum of columns 1B, 2B, and 3B). Additional earnings from employment outside manufacturing (column 4B) and in firms with missing industry codes (column 5B) fall short of compensating workers for the loss in earnings from manufacturing employment. The results in panel C allow us to determine the fraction of the decline in cumulative earnings that is associated with earnings per year of employment, versus years employed. In column 1 the ratio of the coefficients in panel C to panel B is 0.49. About half of reduced earnings at the initial employer resulting from exposure to import growth is due to fewer years worked at the employer and about half is due to lower earnings per year worked. Lower earnings per year result, in turn, from a combination of changes in hours worked and changes in earnings per hour, which we cannot disentangle. Columns 2 to 5 of Panel C suggest that workers with more trade exposure also experience lower earnings per year of employment once they left their initial firm and moved to other employers within or outside the manufacturing sector. These results are imprecisely estimated, however.

The churning of trade-affected workers among industries is important in light of how the U.S. government helps workers who face import competition. The primary government labor program related to imports is Trade Adjustment Assistance, which allows eligible workers who lose their jobs due to increased imports to extend unemployment benefits for an additional 18 months, as long as they spend this time in a certified training program.[20] In the literature, there is skepticism about the economic rationale for worker training programs (Heckman, LaLonde, and Smith, 1999), though there has been little formal evaluation of TAA (Decker and Corson, 1995; Baicker and Rehavi, 2004). In the case of adjustment to trade shocks, it appears that workers more exposed to import competition are more likely to end up changing their industry of employment, suggesting that they in fact may have demand for retraining.

A benefit program that is observable in our data is Social Security Disability Insurance (SSDI),

[19] A large majority of firms with missing industry code were incorporated in the years 2000 to 2007, when a new data collection process no longer facilitated information on industry. Even if one assumes that all new firms that employ former manufacturing employees operate in the manufacturing sector, there is still a sizable negative effect of trade exposure on manufacturing employment. The sum of the coefficients in columns 1, 2, 3 and 5 of Panel A implies that a worker at the 90th percentile of import exposure works at least 0.4 fewer years in manufacturing than a worker at the 10th percentile of exposure.

[20] Relocation allowances and other benefits are also available. See http://www.doleta.gov/tradeact/.

in which the federal government makes cash payments to workers who have developed a physical or mental disability that prevents them from being gainfully employed. In panel A of Table 4, column 1 has as the dependent variable total years that a worker receives labor income only, column 2 has total years with positive labor income and positive SSDI benefits, column 3 has total years with zero labor income and positive SSDI benefits, and column 4 has total years with zero labor income and zero SSDI benefits. Consistent with Table 1, column 1 of Table 4 shows a negative and significant correlation between trade exposure and years with labor earnings as the sole source of income in the data. Comparing workers at the 90th and 10th percentile of trade exposure, the more exposed worker has 0.11 fewer years with positive labor income only. In column 3, trade exposure is positively and significantly correlated with total years receiving SSDI benefits and zero labor income. For the 90th and 10th percentile comparison, the more trade-exposed worker spends 0.05 more years receiving SSDI benefits but no labor earnings. To place this magnitude in context, the average worker spends 0.26 years (standard deviation 1.4 years) over the sample period having zero labor income and positive SSDI benefits. Given trade exposure's negative correlation with years receiving only labor income and positive correlation with years receiving only SSDI, it is not surprising that in column 2 the coefficient on trade exposure for years spent receiving both labor income and SSDI is small and insignificant.

Panel B of Table 4 repeats the analysis using receipt of any type of Social Security benefit, which adds to SSDI Social Security Retirement Income and Supplemental Security Income. The results in panels A and B are nearly identical, indicating that most of the responsiveness of Social Security benefits to import penetration is coming through SSDI. This feature of the results is unsurprising, given that our sample consists of working-age individuals with high-attachment to the labor force who are unlikely to qualify for other types of Social Security payments.

Our finding that increased uptake of SSDI benefits is associated with negative labor demand shocks is consistent with other results in the literature (Black, Daniel and Sanders, 2002). The broader policy significance of uptake of SSDI comes from the fact that most workers who begin receiving benefits from the program continue to receive them until retirement or death (Autor and Duggan, 2006). Workers who exit the labor force and take up SSDI as a consequence of increased import competition therefore may receive these benefits for an extended period of time.

5 Heterogeneity in Adjustment to Trade Exposure

So far, our regression models implicitly assumed that the marginal impacts of trade exposure are uniform across individuals in the sample. Given China's strong comparative advantage in low-skill intensive production tasks, such uniformity may in fact not hold. To explore sources of heterogeneity in adjustment to trade shocks, we re-estimate the main regressions for years of employment, cumulative earnings, and years of SSDI receipt separately for individuals according to their observable characteristics.

5.1 Variation in Adjustment by Gender, Age, Immigrant Status, and Income

Panel A of Table 5 compares results for males and females. Strikingly, the coefficients for females are large and precisely estimated, whereas those for males are small and imprecisely estimated. For females, import penetration is negatively correlated with total years worked (column 1), negatively correlated with cumulative earnings (column 2), and positively correlated with years receiving positive SSDI benefits and zero labor income (column 3). The coefficients for males preserve these signs, but with magnitudes that are one-sixth to one-ninth as large, resulting in estimates that are statistically insignificant. The results in Tables 1-4 thus appear to be driven primarily by the female workers in the sample. These findings stand in contrast to the literature on displaced workers, which tends to show that male and female workers suffer relatively similar reductions in earnings following mass layoffs (Jacobsen, LaLonde, and Sullivan, 1993).[21]

In recent decades, labor-intensive manufacturing operations in the United States have hired large numbers of immigrant workers, increasing the share of the foreign-born in industry employment (Lewis, 2011). As a consequence, one might expect that foreign-born workers are relatively exposed to import competition from low-wage countries. Panel B of Table 5 reports regressions for U.S. and foreign-born workers separately. While the two groups show similar responsiveness of cumulative earnings to trade exposure, as seen in column 2, the employment responsiveness of immigrants to trade exposure is nearly twice that for native-born workers (column 1), though the difference is not statistically significant. Where the two groups differ most sharply is in the responsiveness of SSDI benefits to trade exposure. For U.S. born workers, the coefficient in column 3, which shows the impact of import penetration on years with positive SSDI benefits and zero labor income, is nearly identical to that in column 3 of Table 4, which is based on the full sample, whereas for immigrants, the coefficient is small and imprecisely estimated. In principal, U.S. and foreign-born

[21] Using the Displaced Workers Survey, Farber (2005) does find that within three years of involuntary job loss, women are more likely than men to be employed part time, which is broadly consistent with our results on employment.

workers have identical access to SSDI, as all workers who appear in our data have valid Social Security registrations.[22] In practice, immigrant workers may lack eligibility for full benefits because of a shorter employment history in the U.S., or they may react to an unemployment shock by returning to their home countries rather than staying in the U.S. and claiming benefits.

Panel C of Table 5 presents regressions separating younger and older workers. Whereas younger workers are affected by trade exposure primarily via lower earnings, older workers experience a much larger decline in years worked, combined with a larger increase in years of SSDI receipt. Comparing two older workers (aged 35-48 in 1991 and 51-64 in 2007) at the 90th and 10th percentiles of trade exposure, the more exposed worker would have 0.22 fewer years with positive labor earnings over the sample period, a change that is twice as large as for the full sample (column 6, Table 1). For younger workers, there is effectively zero correlation between changes in trade exposure and cumulative employment. In the literature on displaced workers, there is little difference by age in the effect of job loss on earnings (Jacobsen, LaLonde, and Sullivan, 1993; von Wachter, Song, and Manchester, 2009), contrary to what we find, but older workers do tend to experience prolonged periods of non-employment after involuntary separations (Chan and Stephens, 2001; Sullivan and von Wachter, 2009), consistent with our results.[23]

The final comparison in Table 5 is by workers' initial annual earnings in the 1991 employer. We separate workers according to whether their initial earnings were above or below the mean level at their initial firm. In column 4, the impact of import penetration on cumulative employment is one-third larger for low-wage workers than for high-wage workers, though the difference is not statistically significant. Significant differences do show up regarding the impact of import penetration on cumulative earnings and years with SSDI benefits, which are three to eight times larger for low-wage workers than for high-wage workers. Comparing two low-wage workers at the 90th and 10th percentile of trade exposure, the more exposed worker would have lower cumulative earnings equal to 1.3 times initial yearly income and an additional 0.07 years spent receiving SSDI benefits and zero labor income. Previous literature on job loss focuses not on worker relative earnings at their previous employer, which tends to be unobserved in other data, but on the correlation between the post-job loss change in earnings and measures of skill. Neal (1995) finds that the post-job loss decline in earnings is uncorrelated with education and larger for workers with greater pre-displacement work experience in the initial industry of employment. Neither of these results resembles the pattern that we observe for low-wage workers in reponse to import growth.

[22]Undocumented immigrants, who may obtain jobs after presenting employers with false Social Security numbers, do not appear in our sample.

[23]See von Wachter and Bender (2006) on the impact of job loss early in workers' careers.

One interpretation of the results in Table 5 is that they reflect cross-worker variation in the responsiveness of labor supply to labor-demand shocks. A large body of evidence suggests that the labor supply of females is more responsive to changes in wages than is the labor supply of males (see, e.g., Bargain, Orsini and Peichl, 2011). Such differential responsiveness could account for the much larger adjustment coefficients that we estimate for female workers. To explore how labor-force attachment may affect the adjustment of earnings and employment to trade shocks, we expand the sample of workers to include individuals with more volatile employment in the pre-sample period. The regressions in Table 6 alternate between three samples: (i) the restricted sample of high-labor-force-attachment workers used in Tables 1-5, (ii) the restricted sample plus "part-time" workers, defined as individuals who had any positive earnings in each of the four years, 1988 to 1991, and (iii) the sample in (ii) plus "discontinuously employed" workers, defined as individuals who had positive earnings in at least one year during 1987 to 1989 and one year during 1990 to 1992. We compare results for these samples either grouping males and females together, in panel I, or considering males or females separately, in panel II.

In panel IA of Table 6, we analyze the same outcomes as in Table 4, except that years of employment with and without SSDI income are not reported separately. [24] As we move down the rows in panel I, we expand the sample to include individuals with progressively weaker attachment to the labor force in the pre-sample period. As we do so, the coefficients on how import penetration affects cumulative employment and earnings increase in absolute value. Comparing panels A and C, adding part-time workers and discontinuously employed workers increases the estimated impact of trade exposure on employment in column 1 by a factor of 1.75 and the coefficient for years of SSDI receipt in column 2 is 3.6 times larger. The employment of workers with weaker labor-force attachment therefore appears to be much more responsive to changes in trade exposure. Moreover, while workers with high labor force attachment receive SSDI benefits only during about one quarter of the trade-induced additional years of non-employment (columns 2 and 3 in panel IA), the increase in years with SSDI income among workers with low labor force attachment (column 2 of panel ID) is similarly large as the decline in employment among this group, whereas the impact of trade exposure on their years without either earnings or SSDI income is not significantly different from zero.

Do the differences in results for males and females seen in Table 5 remain once we add weak-labor-

[24] The regression models in Table 6 yield slightly larger coefficients for employment and SSDI receipt than the models in Table 4. The estimates are not identical because Table 6 uses a modified definition of import penetration and firm-specific control variables in order to have a consistent vector of regressors across the three samples. Since some workers in the broader samples do not have an employer in 1991, we average import exposure and other firm-related variables over any year in which a worker is employed during a three year interval around 1991. The instrument for trade exposure is based on employment during a three year interval around 1988.

force attachment workers to sample? In panel IIE, adding part-time and discontinuously employed males to the restricted sample of males has no discernible impact on the coefficient estimates. The same is not true for women. In panel IIF, adding part-time and discontinuously employed females to the restricted sample of females produces coefficient estimates that are substantially larger in absolute value. The greater responsiveness of employment and years of SSDI receipt to trade exposure for weak-attachment workers in panel I thus appears to be driven by the female workers in the sample. Among both high and low labor-force-attachment workers, females show greater adjustments in response to increases in import penetration from China.

Were weak labor-force attachment responsible for the difference in results between males and females in Table 5 we would expect to see differences in adjustment between high and low labor-force-attachment males in Table 6. The absence of such a pattern suggests that other factors may be contributing to the larger adjustment patterns we estimate for women. One explanation is that within manufacturing women may be more exposed to trade shocks by virtue of the industries in which they are employed, or due to gender differences in occupational structures within manufacturing industries. Of the five industries most exposed to import competition from China (Appendix Table 1), four are ones in which the share of hours worked by women is above the median in manufacturing (footwear, toys, electronics, and apparel). Of these, apparel and footwear are industries in which females accounted for more than half of total hours worked in 2000.

5.2 Variation in Adjustment by Firm Size and Firm Average Wages

There is a large literature in international trade on how firm heterogeneity affects adjustment to trade shocks. In the influential Melitz (2003) model, larger, more productive firms are more likely to export and less likely to exit production in response to a reduction in import barriers. These predictions are supported by a substantial body of evidence that documents a positive correlation between exporting and measures of firm size, TFP, average wages, skill intensity, and capital intensity (Bernard, Jensen, Redding, and Schott, 2007). We next consider whether the characteristics of firms matter for worker adjustment to changes in import penetration.

Table 7 examines the impact of trade exposure on cumulative years of employment separately for workers based on the characteristics of their initial employer. Columns 6 and 7 of panel IA repeat the main coefficient estimates for employment and earnings from Tables 1 and 2 to serve as benchmarks, while columns 1 and 4 disaggregate the employment effect into years of employment in the initial and in subsequent firms (the former coefficient corresponds to column 1 of Table 3 while the latter sums up the coefficients from columns 2 to 5 of Table 3). The Table further disaggregates the trade-induced increase in non-employment years into non-employment spells that follow employment at the initial firm (columns 2 and 3), and non-employment years that follow employment at subsequent firms.

In column 2, the dependent variable is years of non-employment after leaving an initial firm that dies within two years of the separation. The coefficient on import penetration is positive and statistically significant, indicating that workers in more-import exposed industries are more likely to have spent time without labor income after separating from an employer that was shutting down or about to shut down. Column 3 has as the dependent variable years of non-employment after leaving an initial firm that survives for at least three years following the separation. The coefficient on import penetration is effectively zero. For workers in more trade-exposed industries, time with zero labor earnings appears to follow separations related to looming plant closure rather than plant downsizing. Columns 4 and 5 have as dependent variables cumulative employment in subsequent firms and cumulative non-employment after separating from subsequent firms. In column 5, the correlation between import exposure and years without labor earnings after separating from a subsequent employer is positive, and larger than the sum of the coefficients of columns 2 and 3. The increase of non-employment among workers with high trade exposure is hence not only a direct consequence of non-employment following the separation from the initial, trade-exposed firm but it also results from a higher likelihood of becoming non-employed following spells at subsequent employers. This finding may reflect the tendency of workers to move between employers in related industries, such that workers separating from one import-exposed firm are likely to be hired by another import-exposed firm (from which later separation is relatively likely). Moreover, it is conceivable that workers who are laid off from their initial employer are forced to accept more precarious subsequent jobs.

In panel B, we divide initial firms according whether their average wage in 1991 was larger or smaller than the corresponding industry average. Perhaps surprisingly, the impact of trade exposure on cumulative years of employment with the initial firm is more negative for workers in *higher-wage* firms, as seen by comparing column 1 of panels B1 and B2. Less surprisingly, the impact of trade exposure on years of non-employment after leaving a dying firm is larger for workers initially employed in a low-wage firm. While the cumulative employment of workers in high-wage initial firms appears to be more sensitive to import penetration, it is workers in low-wage firms who are more likely to end up without a job after an import-induced plant closure. Panels C1-C4 examine variation in worker adjustment to import exposure across initial firms by employer size. Reading down column 1, we see that the impact of import exposure on years employed in the initial firm is greater in larger firms. Workers in larger establishments thus appear to be more likely to separate from their initial employers in response to an import shock. A similar pattern holds for columns 6 and 7, which show the responsiveness of total employment and earnings (across all employers) to trade exposure. Workers employed in larger firms in the pre-sample period suffer greater cumulative adjustment in earnings and employment from exposure to import penetration.

Contrary to the Melitz model, we find that in response to a given trade shock workers initially employed in large establishments are more likely to separate from their employers and to have lower long-run earnings. We are not the first to show that larger firms are more affected by import growth. Following mass layoffs, Jacobsen, LaLonde, and Sullivan (1993) and von Wachter and Bender (2006) find that earnings losses are greatest for workers separated from the largest employers. Bernard, Jensen, and Schott (2006) find that the impact of import penetration on plant-level employment growth in the United States is more negative in plants with higher levels of TFP, which is strongly positively correlated with plant size. Biscourp, and Kramarz (2007), using French data, find that in large firms (but not small firms) import growth at the firm level is positively correlated with job destruction. Holmes and Stevens (2010) obtain similar results in U.S. data, based on the calibration of a model that allows for two types of firms within an industry, those that produce standard goods and are subject to heterogeneous productivity (as in Melitz, 2003) and specialty firms that produce customized goods for particular clients. In equilibrium, standard firms are relatively large and it is they who contract most sharply in response to a surge in imports from China.

6 Alternative Specifications

To examine the robustness of our results, we extend the empirical analysis in two directions. First, we allow workers to be affected by import growth in their region of employment, as well as their industry of employment. Second, we re-estimate our main specifications using alternative measures of trade exposure.

6.1 Geographic Exposure to Trade

In the empirical approach we develop in section 2, workers are exposed to growth in imports by virtue of their industry of employment. Supply-driven growth in exports from China reduces demand for outputs produced by U.S. industries, which affects workers' employment and long-run earnings to the extent that there are barriers to moving between firms, industries, or sectors. Workers may also be exposed to import growth by virtue of the region in which they live and work (Autor, Dorn, and Hanson, 2011). A surge in U.S. furniture imports from China may contribute to a reduction in output and employment in manufacturing plants located in Greensboro, North Carolina, which specializes in furniture production. As employment and earnings in traded-goods industries in Greensboro decline, so too may local demand for non-traded goods and services, such as restaurant meals, retail purchases, business services, and home construction, possibly contributing to a reduction in employment in these sectors, as well. Workers in Greensboro employed outside of manufacturing may therefore be exposed to trade shocks that disproportionately affect the city's main manufacturing industries.

In Table 8, we modify the specification in column 6 of Table 1 by adding a variable that measures, separately for each worker of the main sample, the average change in import penetration across all other workers who are employed in the same local labor market.[25] The concept of local labor markets that we use is commuting zones (CZs), as developed by Tolbert and Sizer (1996), which are aggregates of counties characterized by strong commuting ties as measured in 1990 Census data. We use information on the county in which a worker's 1991 employer is located to assign workers to one of 722 CZs, which cover the entire mainland United States.[26] For each worker, we measure CZ-average import penetration based on the industry affiliation of all other workers who are employed in the same CZ.

Columns 3 and 4 of Table 8 show that there is a negative and statistically significant impact of average import exposure at the local labor market level on cumulative employment of workers. Using the results in column 4, which include the full vector of worker-level controls from earlier tables, we compare the difference in cumulative employment for two workers, one at the 90th percentile of growth in CZ import penetration (2.01 percentage points) and another at the 10th percentile of growth in CZ import penetration (0.26 percentage points). The more exposed worker has 0.07 (-3.8×(2.01-0.26)) fewer years with positive labor earnings. The effect is smaller than that for import penetration at the industry level, owing in part to the fact that variation in changes in CZ average import penetration is much less than variation at the industry level.

In column 5 we include industry import penetration and CZ-average import penetration together in the regression. The two series are positively correlated, as a result of the tendency for import-exposed industries to cluster geographically. Adding industry import penetration reduces the coefficient on CZ-average import penetration by one third, yielding a result that remains significant at the 10% level. The results show that shocks to import penetration lead to job loss directly through an impact on workers who are employed in affected industries and indirectly through a

[25] Additionally, we add as a control the initial share of employment in manufacturing in a worker's locality.

[26] Valid data on firm location is missing for 31% of the workers in our main sample. The regressions in Table 8 include a dummy variable for those workers whose location is unobserved in the data.

negative demand shock in regions in which these industries are located.

Columns 6 and 7 of Table 8 further disaggregate the employment results into changes in years of employment at the initial firm (column 6) and employment at other, subsequent employers (column 7). Consistent with the results of Tables 3 and 7, we find that workers who are initially employed in a trade-exposed industry experience a substantial reduction in employment years with the initial firm that is partly compensated for by additional employment with other firms. The sign pattern for the measure of local labor market exposure is exactly opposite, though the coefficients are estimated with low precision. These results are consistent with the interpretation that employment duration at the initial firm is primarily affected by the trade exposure of that firm, while the broader exposure of the local labor market may affect a worker's ability to find subsequent employment after a separation from the initial firm.

6.2 Alternative Measures of Trade Exposure

In this section, we describe alternative measures of industry exposure to import growth from China. Using these measures, we re-estimate the regressions for cumulative employment and earnings from Tables 1 and 2. Table 9 contains the results.

Our strategy for identifying the impact of trade exposure as measured in (3) is based on the assumption that growth in imports from China in high income countries is due to supply shocks in China, or global changes in trade policy toward China, rather than to import demand shocks in these countries. As an alternative approach, we use import growth from China as predicted by the gravity model of trade. Using data on bilateral imports by high income countries at the industry level, we estimate a gravity model in which the dependent variable is log imports from China minus log imports from the United States and the regressors are dummy variables for the importing country, dummy variables for the industry, and controls for trade costs. Changes in the residuals from this regression represent the change in China's comparative advantage and trade costs in an industry relative to the United States. As described in an appendix, we use these residuals to construct an alternative measure of import growth. This approach, shown in panel I of Table 9, allows us to estimate the impacts of trade exposure under weaker identifying assumptions.

We modify the measure of trade exposure in (3) in other ways as well, all of which are defined in Autor, Dorn and Hanson (2011). First, we add to imports from China imports from all other low-income countries, as in Bernard, Jensen, and Schott (2006). Grouping low-income countries together accounts for possible displacement effects, in which growth in U.S. imports from China may be offset by reduced imports from other countries that compete with China in the U.S. market. Results for this measure appear in panel II of Table 9. Second, we expand the definition of import penetration to include not just the U.S. market but other destination markets to which U.S. industries export goods. Expanding import penetration, shown in panel III, allows China to displace sales of U.S. goods both at home and abroad. Third, we measure trade exposure using *net* imports rather than gross imports, which allows U.S. exports to China to offset the loss in production from greater import penetration. Because U.S. manufacturing imports from China are six times larger than U.S. manufacturing exports to China, this change has only a modest effect on the exposure measure. The results appear in panel IV. Fourth, we measure net imports not in dollar terms but in worker equivalent units, using direct and indirect labor usage in the production of industry outputs, based on the 1992 U.S. input-output table. Imports in worker equivalent units, results for which are shown in panel V, account for variation in labor intensity across sectors which is not caputred by imports in dollar terms. And fifth, we adjust total industry imports for imports of intermediate inputs. Growth in exports by China represents not just greater competition for U.S. producers but also greater supply of inputs they use in production. Results using the input-adjusted measure appear in panel VI.

Table 9 documents that each of these alternative measures of trade exposure has a significant negative impact on total years with positive labor earnings and cumulative labor earnings of workers, consistent with the main results in Tables 1 and 2.

7 Conclusion

China's spectacular export growth in recent decades provides a unique opportunity to examine how economies adjust to trade shocks. Changes in trade flows typically have myriad causes and are jointly determined with other outcomes of interest. In the case of China, its highly backward state at the time the country began to open to foreign trade and investment meant that its subsequent export growth would be driven by the convergence of its economy toward the global technology frontier, rather than by idiosyncratic shocks in its trading partners. We exploit this feature of recent Chinese history to examine how U.S. workers adjust to a surge in imports in their initial industries of employment.

Working in an industry more exposed to import growth is associated with lower long-run earnings, more years of non-employment, and greater reliance on government transfers. These adjustments are concentrated among females, low-wage workers, and workers with weak attachment to the labor force; a pattern that reflects a combination of these workers having more elastic labor supply and industries subject to greater import competition being more intensive in the use of their skills. While it has long been noted that apparel, footwear, and other labor-intensive industries in the United States employ relatively large numbers of women, previous research has not established a link between female labor intensity and exposure to trade shocks.

There is heterogeneity in worker strategies for adjusting to import competition. In response to higher import growth, U.S.-born workers increase uptake of Social Security Disability Insurance, whereas foreign-born workers do not. Older workers are more likely to experience non-employment, while younger workers are more likely to have a decline in earnings. Low-wage workers see relatively large reductions in cumulative earnings but not in cumulative employment. Such heterogeneity in adjustment may be important for the design of Trade Adjustment Assistance, or other programs that provide help to workers who lose their jobs as a result of import competition.

Exposure to trade induces workers to move between employers and between industries. Workers separate from their initial employers much more because these employers shut down rather than because they scale back operations. While in normal times workers frequently move between employers in similar industries, import penetration disrupts such mobility, pushing workers to move further afield in manufacturing, or into jobs outside the manufacturing sector.

We focus on import growth from China while recognizing that China actively participates in global production networks. Goods exported by China use inputs produced in other developing economies and in high-income countries. Still, China's enormous size means that its own growth has been a major impulse for the expansion of global production networks in recent decades. Our findings do not preclude a role for other countries in the recent growth in U.S. imports of labor-intensive manufactures.

References

Addison, John T., Douglas A. Fox, and Christopher J. Ruhm. 1995. "Trade and Displacement in Manufacturing." *Monthly Labor Review*, 118(April): 58-67.

Amiti, Mary, and Donald Davis. 2009. "Trade, Firms, and Wages: Theory and Evidence." NBER Working Paper No. 14106.

Amiti, Mary, and Caroline Freund. 2010. "An Anatomy of China's Export Growth." In Robert Feenstra and Shang-Jin Wei, eds., *China's Growing Role in World Trade*, Chicago: NBER and University of Chicago Press, 35-62.

Arkolakis, Costas, Arnaud Costinot, and Andres Rodriguez-Clare. 2010. "New Trade Models, Same Old Gains?" Mimeo, Yale University.

Artuc, Erhan, Shubham Chaudhuri, and John McLaren. 2010. "Trade Shocks and Labor Adjustment: A Structural Empirical Approach." *American Economic Review*, 100(3), 1008-1045.

Auer, Rafael, and Andreas Fischer. 2008. “The Effect of Trade with Low Income Countries on U.S. Industry.” Mimeo, Swiss National Bank.

Autor, David H. and David Dorn. 2009. “This Job is “Getting Old”: Measuring Changes in Job Opportunities using Occupational Age Structure.” *American Economic Review Papers and Proceedings*, 99(2), 45-51.

Autor, David H. and David Dorn. 2011. “The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market.” Mimeo, June.

Autor, David H. and Mark Duggan. 2003. “The Rise in the Disability Rolls and the Decline in Unemployment.” *Quarterly Journal of Economics*, 118(1), February, 157-206.

Autor, David H. and Mark Duggan. 2006. “The Growth in the Social Security Disability Rolls: A Fiscal Crisis Unfolding.” *Journal of Economic Perspectives*, 20(3), Summer, 71-96.

Autor, David H., Lawrence F. Katz, and Melissa S. Kearney. 2008. “Trends in U.S. Wage Inequality: Revising the Revisionists.” *Review of Economics and Statistics*, 90(2), 300-323.

Baicker, Katherine, and M. Marit Rehavi. 2004. “Policy Watch: Trade Adjustment Assistance.” *Journal of Economic Perspectives,* 18(2): 239-255.

Bargain, Olivier, Kristian Orsini and Andreas Peichl. 2011. “Labor Supply Elasticities in Europe and the US.” IZA Discussion Paper No. 5820.

Bartelsman, Eric J., Randy A. Becker, and Wayne B. Gray. 2000. “The NBER Manufacturing Industry Database.” Mimeo, NBER.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, Peter K. Schott, 2007. "Firms in International Trade." *Journal of Economic Perspectives*, 21(3): 105-130.

Bernard, Andrew B., J. Bradford Jensen and Peter K. Schott. 2006. “Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants.” *Journal of International Economics*, 68(1), 219-237.

Bertrand, Marianne. 2004. “From the Invisible Handshake to the Invisible Hand? How Import Competition Changes the Employment Relationship.” *Journal of Labor Economics*, 22(4), 722-765.

Biscourp, Pierre and Francis Kramarz. 2007. “Employment, Skill Structure and International Trade: Firm-level Evidence for France.” *Journal of International Economics*, 72(1), 22-51.

Black, Dan, Kermit Daniel and Seth Sanders. 2002. “The Impact of Economic Conditions on Participation in Disability Programs: Evidence from the Coal Boom and Bust.” *American Economic Review*, 92(1), 27-50.

Blau, David M. 1994. “Labor Force Dynamics of Older Men.” Econometrica 62:117-156.

Bloom, Nicholas, Mirko Draca, and John Van Reenen. 2011. “Trade Induced Technical Change? The Impact of Chinese Imports on Diffusion, Innovation, and Productivity.” Mimeo, Stanford University.

Blum, Bernardo. 2008. “Trade, Technology, and the Rise of the Service Sector: the Effects on US Wage Inequality.” *Journal of International Economics*, 74(2), 441-458.

Bound, John and Harry J. Holzer. 2000. “Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s.” *Journal of Labor Economics*, 18(1), 20-54.

Broda, Christian, David Weinstein. 2006. “Globalization and the Gains from Variety.” *Quarterly Journal of Economics*, 121(2), 541-585.

Burstein, Ariel, and Jonathan Vogel. 2011. “Factor Prices and International Trade: A Unifying Perspective.” NBER Working Paper No. 16904.

Card, David. 2001. “Immigrant Inflows, Native Outflows, and the Local Labor Market Impacts of Higher Immigration.” *Journal of Labor Economics*, 19(1), 22-64.

Chan, Sewin, and Ann Huff Stevens. 2001. “Job Loss and Employment Patterns of Older Workers.” *Journal of Labor Economics*, 19(2): 484-521.

Chen YuYu, Ginger Zhe Jin, and Yang Yue. 2010. “Peer Migration in China.” NBER Working Paper No. 15671.

Chiquiar, Daniel. 2008. “Globalization, Regional Wage Differentials, and the Stolper-Samuelson Theorem: Evidence from Mexico.” *Journal of International Economics*, 74(1), 70-93.

Davis, Donald R., and James Harrigan. 2007. “Good Jobs, Bad Jobs, and Trade Liberalization.” NBER Working Paper No. 13139.

Decker, Paul T. and Walter Corson. 1995. "International Trade and Worker Displacement: Evaluation of the Trade Adjustment Assistance Program." *Industrial and Labor Relations Review*, 48(4): 758-74.

di Giovanni, Julian, Andrei Levchencko, and Jing Zhang. 2011. “The Global Welfare Impact of China: Trade Integration and Technological Change.” Mimeo, University of Michigan.

Dorn, David. 2009. “Essays on Inequality, Spatial Interaction, and the Demand for Skills.” Dissertation University of St. Gallen no. 3613, September.

Eaton, Jonathan, and Samuel Kortum. 2002. “Technology, Geography, and Trade.” *Econometrica*, 70(5), 1741-1779.

Ebenstein, Avraham, Ann Harrison, Margaret McMillan, and Shannon Phillips. 2011. “Estimating the Impact of Trade and Offshoring on American Workers Using the Current Population Surveys.” Mimeo, UC Berkeley.

Farber, Henry S. “What do we know about Job Loss in the United States? Evidence from the Displaced Workers Survey, 1981-2004." *Economic Perspectives*, Federal Reserve Bank of Chicago (Second Quarter, 2005), pp. 13-28.

Farber, Henry S. 2011. ”Job Loss in the Great Recession: Historical Perspective from the Displaced Workers Survey.” NBER Working Paper No. 17040.

Feenstra, Robert C. 2010. “Offshoring in the Global Economy: Microeconomic Structure and Macroeconomic Implications.” Cambridge, MA: MIT Press.

Feenstra, Robert C., and Gordon H. Hanson. 1999. “The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the U.S., 1979-1990.” *Quarterly Journal of Economics*, 114(3), 907-940.

Feenstra, Robert C., and Gordon H. Hanson. 2003. “Global Production and Inequality: A Survey of Trade and Wages,” in E. Kwan Choi and James Harrigan, eds., Handbook of International Trade, Blackwell, 2003, pp. 146-185.

Gruber, Jonathan. 2010. “Public Finance and Public Policy.” 3rd edition, New York: Worth Publishers.

Harrigan, James. 2000. “International Trade and American Wages in General Equilibrium, 1967-1995.” In Robert C. Feenstra, ed., *The Impact of International Trade on Wages.* Chicago: NBER and University of Chicago Press.

Harrison, Ann, John McLaren, and Margaret McMillan. 2010. “Recent Findings on Trade and Inequality.” NBER Working Paper No. 16425.

Harrison, Ann and Margaret McMillan. 2010. “Offshoring Jobs? Multinationals and U.S. Manufacturing Employment.” *Review of Economics and Statistics*, forthcoming.

Heckman, James J., Robert J. LaLonde, and Jeffrey A. Smith. 1999. “The Economics and Econometrics of Active Labor Market Programs.” In Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics, Volume 3A,* Amsterdam: Elsevier Science, 1865-2097.

Helpman, Elhanan, and Oleg Itskhoki. 2010. “Labor Market Rigidities, Trade and Unemployment.” *Review of Economic Studies,* 77: 1100-1137.

Helpman, Elhanan, Oleg Itskhoki, Stephen Redding. 2010. “Inequality and Unemployment in a Global Economy.” *Econometrica,* 78: 1239-1283.

Holmes, Thomas J. and John J. Stevens. 2010. “An Alternative Theory of the Plant Size Distribution with an Application to Trade.” Mimeo, University of Minnesota.

Hsieh, Chang-Tai, and Peter J. Klenow. 2009. “Misallocation and Manufacturing TFP in China and India.” *Quarterly Journal of Economics*, 124(4): 1403-1448.

Hsieh, Chang-Tai, and Ralph Ossa. 2011. “A Global View of Productivity Growth in China.” NBER Working Paper No. 16778.

Hummels, David, Rasmus Jorgensen, Jakok Munch, and Chong Xiang. 2010. “The Wage and Employment Effects of Outsourcing: Evidence from Danish Matched Worker-Firm Data.” Mimeo, Purdue University.

Jacobson, Louis S., Robert LaLonde, and Daniel G. Sullivan. 1993. ”Earnings Losses of Displaced Workers.” *American Economic Review*, 83(4): 685-709.

Katz, Lawrence F., and David Autor. 1999. “Changes in the Wage Structure and Earnings Inequality,” in Orley Ashenfelter and David Card, eds., Handbook of Labor Economics, Vol. 3A, Amsterdam: Elsevier Science, 1463-1555.

Kletzer, Lori G. 1989. “Returns to Seniority after Permanent Job Loss.” *American Economic Review*, 79(3): 536-543.

Kletzer, Lori G. 2000. ”Trade and Job Loss in US. Manufacturing, 1979-1994.” In Robert C. Feenstra, ed., *The Impact of International Trade on Wages*, Chicago: NBER and University of Chicago Press, 349-396.

Koopmans, Robert, William Powers, Zhi Wang, and Shang-Jin Wei. 2010. “Giving Credit where Credit Is Due: Tracing Value Added in Global Production Chains.” NBER Working Paper No. 16426.

Kovak, Brian K. 2011. “Local Labor Market Effects of Trade Policy: Evidence from Brazilian Liberalization.” Mimeo, Carnegie Mellon University.

Lemieux, Thomas. 2006. “Increased Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill.” *American Economic Review*, 96, 461-498.

Lewis, Ethan. 2011. “Immigration, Skill Mix, and Capital Skill Complementarity.” *Quarterly Journal of Economics,* 126(2): 1029-2069.

Liu, Runjuan, and Daniel Trefler. 2008. “Mucho Ado about Nothing: American Jobs and the Rise of Service Outsourcing to China and India.” NBER Working Paper No. 14061.

McLaren, John, and Shushanik Hakobyan. 2010. “Looking for Local Labor Market Effects of NAFTA.” NBER Working Paper No. 16535.

Melitz, Marc J. 2003. “The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity.” *Econometrica*, 71(6): 1695-1725.

Michaels, Guy. 2008. “The Effect of Trade on the Demand for Skill: Evidence from the Interstate Highway System.” *The Review of Economics and Statistics*, 90(4), 683-701.

Naughton, Barry. 1996. “China’s Emergence and Prospects as a Trading Nation.” *Brookings Papers on Economic Activity,*2: 273-344.

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

Neal, Derek. 1995. “Industry-Specific Human Capital: Evidence from Displaced Workers.” *Journal of Labor Economics*, 13(4), 653-677.

Notowidigdo, Matthew J. 2010. “The Incidence of Local Labor Demand Shocks.” MIT working paper, January.

Poletaev, Maxim, and Chris Robinson. 2008. “Human Capital Specificity: Evidence from the Dictionary of Occupational Titles and Displaced Worker Surveys, 1984-2000.” *Journal of Labor Economics*, 26(3), 387-420.

Parent, Daniel. 2000. "Industry-Specific Capital and the Wage Profile: Evidence from the National Longitudinal Survey of Youth and the Panel Study of Income Dynamics." *Journal of Labor Economics*, 18(2), 306-323.

Peracchi, Franco, and Finis Welch. 1994. "Trends in Labor Force Transitions of Older Men and Women." *Journal of Labor Economics*, 12(2): 210-242.

Pierce, Justin R. and Peter Schott. 2009. "A Concordance between Ten Digit Harmonized System Codes and SIC/NAICS Product Classes and Industries." NBER Working Paper No. 15548.

Robertson, Raymond. 2004. "Relative Prices and Wage Inequality: Evidence from Mexico." *Journal of International Economics*, 64(2), 387-409.

Rogerson, William, and Robert Shimer. 2011. "Search in Macroeconomic Models of the Labor Market." In Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics, Vol 4A*, Amsterdam: Elsevier, 619-700.

Romalis, John. 2007. "NAFTA's and CUSTA's Impact on International Trade." *Review of Economics and Statistics*, 89(3), 416-435.

Ruggles, Steven, Matthew Sobek, Trent Alexander, Catherine A. Fitch, Ronald Goeken, Patricia Kelly Hall, Miriam King, and Chad Ronnander. 2004. *Integrated Public Use Microdata Series: Version 3.0* [Machine-readable database]. Minneapolis, MN: Minnesota Population Center [producer and distributor].

Ruhm, Christopher J. 1991. "Are Workers Permanently Scarred by Job Displacements?" *American Economic Review*, 81(1): 319-24.

Smith, Christopher L. 2010. "The Polarization of the U.S. Adult Labor Market and its Effects on the Demand for Teenage Labor." Federal Reserve Board of Governors Working Paper, June.

Sullivan, Daniel, and Till von Wachter. 2009. "Job Displacement and Mortality: An Analysis Using Administrative Data." *Quarterly Journal of Economics*, 124(3): 1265-1306.

Topalova, Petia. 2010. "Factor Immobility and Regional Impacts of Trade Liberalization: Evidence on Poverty from India." *American Economic Journal: Applied Economics*, 2, 1-41.

Topel, Robert. 1990. "Specific capital and unemployment: Measuring the costs and consequences of job loss." *Carnegie-Rochester Conference Series on Public Policy*, 33(1): 181-214.

United States Social Security Administration. Various years. *Annual Statistical Supplement to the Social Security Bulletin.* Washington, DC: U.S. Government Printing Office.

Verhoogen, Eric. 2008. "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector." *Quarterly Journal of Economics*, 123(2), 489-530.

von Wachter, Till, and Stefan Bender. 2006. "In the Right Place at the Wrong Time: The Role of Firms and Luck in Young Workers' Careers." *American Economic Review*, 96(5): 1679-1705.

von Wacther, Till, Elizabeth W. Handwerker, and Andrew K.G. Hildreth. 2009. "Estimating the True Cost of Job Loss: Evidence Using Matched Data from California 1991-2000." Mimeo, Columbia University.

von Wacther, Till, Jae Song, and Joyce Manchester. 2009. "Long-Term Earnings Losses due to Mass Layoffs During the 1982 Recession: An Analysis Using U.S. Administrative Data from 1974 to 2004." Mimeo, Columbia University.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, Massachusetts: MIT Press.

Data appendix

Social Security Data

Our main source of data is a one percent extract from the Master Earnings File (MEF) of the U.S. Social Security Administration. The MEF data provides annual earnings and an employer identification number (EIN) for each job that a worker held in the years 1978 through 2007. For workers who have multiple jobs in a given year, we aggregate earnings across all jobs and retain the EIN of the employer that accounted for the largest share of the worker's earnings. Earnings data is inflated to 2007 using the Personal Consumption Expenditure Index, and annual earnings are winsorized at the 99th percentile of each year's wage distribution in order to mitigate the impact of outliers on the empirical analysis. The MEF also contains basic demographic information that stems from a worker's application for a Social Security card. Our analysis uses data on birth year, sex, race, and immigrant status (U.S. or foreign born). We code race as non-white if the race indicator is missing in the data, which is the case for about 3.5% of all observations.

For about 97% of all employees in 1991, we are able to match the EIN of the employer to firm data that provides information on industry, firm size (measured by employment and payroll), and geographic location of the firm. The industry classification is based on firms' registration with the Internal Revenue Service (IRS). Coders at the Social Security Administration transform the write-in information from the IRS form to a four-digit SIC code, or to a three-digit or two-digit SIC code if the description of firm activity is not sufficiently detailed to permit a preciser classification. The IRS switched from a paper-based application for obtaining an EIN to an online application procedure in the year 2000. For new firms that have been incorporated as of this year, we are no longer able to observe industry or other firm-level characteristics.

Our main sample comprises workers who were born between 1943 and 1970. We use this sample to study outcomes during the period 1992 to 2007 when these workers were between 22 and 64 years old. The sample is restricted to workers who were earning at least $7,950 per year in each of the four years 1988 to 1991, prior to the outcome period. The value of $7,950 (in 2007 dollars) corresponds to the earnings of a worker who was employed during 1,600 annual hours at the Federal minimum wage of 1989. The sample size of this main sample is 511,792. We also show additional results for a more sample that includes workers with a weaker labor force attachment. This alternative sample comprises the 880,465 workers who had positive earnings (and a valid industry code) during at least one year in each of the three-year periods 1987 to 1989 and 1990 to 1992.

Matching trade data to industries

Data on international trade for 1991 to 2007 are from the UN Comrade Database (*http:// comtrade.un.org/db/default.aspx*), which gives bilateral imports for six-digit HS products. To concord these data to four-digit SIC industries, we proceed as follows. First, we take the crosswalk in Pierce and Schott (2009), which assigns 10-digit HS products to four-digit SIC industries (at which level each HS product maps into a single SIC industry) and aggregate up to the level of six-digit HS products and four-digit SIC industries (at which level some HS products map into multiple SIC industries). To perform the aggregation, we use data on US import values at the 10-digit HS level, averaged over 1995 to 2005. The crosswalk assigns HS codes to all but a small number of SIC industries. We therefore slightly aggregate the four-digit SIC industries so that each of the resulting 397 manufacturing industries matches to at least one trade code, and none is immune to trade competition by construction. We also aggregate the trade data to three-digit and two-digit SIC industries in order to construct measures of import exposure for firms whose industry is not identified at the four-digit level in the Social Security Administration data. Details on our industry classification are available on request. Second, we combine the HS-SIC crosswalk with six-digit HS Comrade data on imports for the United States (for which Comrade has six-digit HS trade data from 1991 to 2007) and for all other high-income countries that have data covering the sample period (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland) and then aggregate up to SIC industries. All import amounts are inflated to 2007 US$ using the Personal Consumption Expenditure deflator.

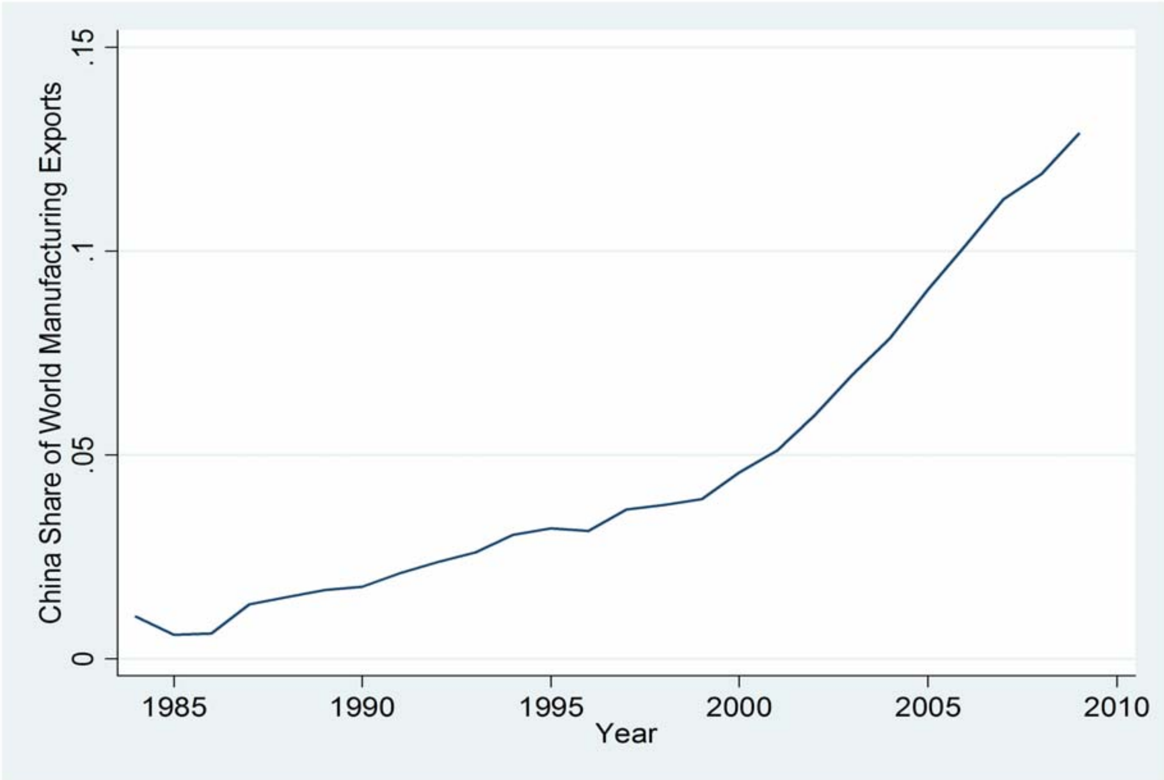

Figure 1.
China Share of World Manufacturing Exports, 1984-2009.

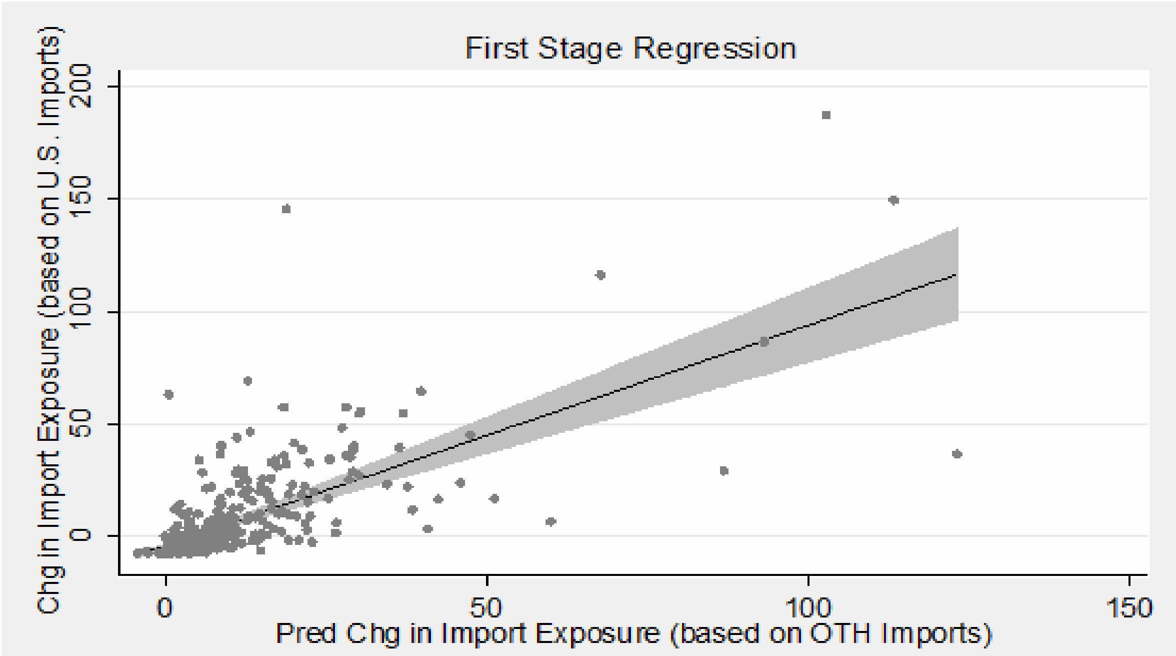

Figure 2.
2SLS First Stage Regression.

Notes: The graph corresponds to the first stage regression for the model in column 2 of Table 1 (coefficient 0.713, s.e. 0.083), and partials out a dummy variable for workers employed in manufacturing industries. The shaded area indicated a 95% confidence interval around the fitted regression line. The scatterplot is displayed only for workers who did not change their industry of employment between 1988 and 1991.

Table 1. Imports from China and Cumulative Years of Employment, 1992-2007: OLS and 2SLS Estimates.

Dependent Var: 100 x Cumulative Years of Employment 1992-2007

	OLS		2SLS									
	(1)		(2)		(3)		(4)		(5)		(6)	
(Δ Imports from China to US)/US Consumption_{91}	-0.555	**	-1.025	**	-0.983	**	-0.778	*	-0.565	*	-0.478	*
	(0.184)		(0.292)		(0.326)		(0.310)		(0.237)		(0.219)	
Employment in $\text{manufacturing}_{91}$	12.294		15.922	*	17.178	~	13.293		8.907		2.967	
	(8.001)		(8.054)		(9.133)		(8.544)		(7.706)		(6.063)	
Female							-18.344	**	-0.915		-5.800	
							(6.870)		(6.864)		(5.578)	
Non-white							-0.351		5.981	**	-0.564	
							(1.754)		(1.719)		(1.674)	
Foreign born							-37.818	**	-38.113	**	-33.613	**
							(6.133)		(5.459)		(5.074)	
Average log $\text{wage}_{88\text{-}91}$									0.581	**	0.486	**
									(0.057)		(0.051)	
Birth year dummies	No		No		Yes		Yes		Yes		Yes	
Tenure and firm size	No		No		No		No		No		Yes	

Notes: N=511,792. All regressions include a constant. The models in columns 4-6 contain a dummy for each birth year, and the models in column 7 include dummies for firm tenure (0-1, 2-5, 6-10, 11+ years) and firm size (1-99, 100-999, 1000-9999, 10000+ employees). The coefficient estimate of the 2SLS first stage is 0.713 (s.e. 0.083) for the model in column 2, and 0.710 (s.e. 0.083) for the model in column 6. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 2. Imports from China and Cumulative or Average Earnings in Multiples of Initial Permanent Annual Wage, 1992-2007: 2SLS Estimates.
Dep Vars: 100 x Cum. Earnings 1992-2007/Average Earnings 1988-1991; 100 x Earnings per 16 Years of Employment 1992-2007/Average Earnings 1988-1991

	(1)		(2)		(3)		(4)		(5)	
	A. Cumulative Earnings (in Initial Annual Wage*100)									
(Δ Imports from China to US)/US Consumption$_{91}$	-3.716	**	-2.615	*	-1.995	*	-2.106	*	-2.315	*
	(1.084)		(1.023)		(0.990)		(0.994)		(0.906)	
Employment in manufacturing$_{91}$	-112.2	**	-95.3	**	-118.8	**	-118.9	**	-118.4	**
	(26.9)		(29.0)		(29.6)		(29.7)		(26.9)	
Female					-125.1	**	-123.3	**	-131.6	**
					(19.7)		(19.7)		(18.8)	
Non-white							-60.4	**	-78.0	**
							(5.8)		(6.0)	
Foreign born							65.9	*	65.5	*
							(27.5)		(26.0)	
Birth year dummies	No		Yes		Yes		Yes		Yes	
Tenure and firm size	No		No		No		No		Yes	
	B. Earnings per 16 Years of Emp (in Initial Annual Wage*100)									
(Δ Imports from China to US)/US Consumption$_{91}$	-2.793	**	-1.690	~	-1.110		-1.341		-1.716	~
	(1.089)		(0.977)		(0.971)		(0.968)		(0.880)	

Notes: N=511,792 in Panel A, N=509,961 in Panel B. All regressions include a constant. The models in columns 2-5 contain a dummy for each birth year, and the models in column 5 include dummies for firm tenure (0-1, 2-5, 6-10, 11+ years) and firm size (1-99, 100-999, 1000-9999, 10000+ employees). The models in Panel B include the same control variables as the models of the same columns in Panel A. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 3. Imports from China and Cumulative Employment and Earnings by Firm, Industry and Sector, 1992-2007: 2SLS Estimates.
Dep Vars: 100 x Cumulative Years of Employment; 100 x Cumulative Earnings or 100 x Earnings per 16 Years of Employment in Multiples of Initial Annual Wage, 1992-2007

	I. Same Sector						II. Oth Sect	III. N/A	
Same 2-digit Industry?	Yes		Yes		No		No	N/A	
Same Firm?	Yes		No		No		No	No	
	(1)		(2)		(3)		(4)	(5)	
	A. Cumulative Employment (in Years*100)								
(Δ Imports from China to US)/US $Consumption_{91}$	-3.173	**	-1.651	*	2.680	**	1.111	0.555	**
	(0.908)		(0.658)		(0.628)		(0.739)	(0.156)	
	B. Cumulative Earnings (in Initial Annual Wage*100)								
(Δ Imports from China to US)/US $Consumption_{91}$	-4.816	**	-2.618	**	4.175	**	0.313	0.630	*
	(1.333)		(0.998)		(0.992)		(1.162)	(0.262)	
	C. Earnings per 16 Yrs of Emp (in Initial Annual Wage*100)								
(Δ Imports from China to US)/US $Consumption_{91}$	-2.360	**	-2.757		-0.497		-2.268	-2.236	
	(0.888)		(2.099)		(1.685)		(1.642)	(1.875)	

Notes: N=511,792 in Panels A and B. N=426,424/157,114/265,691/113,037/121,119 in column 1-5 of Panel C. Column 5 measures employment and earnings in firms with missing industry information. A large majority of these firms are new firms that have been incorporated between the years 2000 and 2007. All regressions in panel A include the full vector of control variables from column 6 of Table 1, and all regressions in panels B and C include the full vector of control variables from column 5 of Table 2. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 4. Imports from China and Cumulative Years of Employment and Earnings/Social Security Benefit Receipt Status, 1992-2007: 2SLS Estimates.
Dependent Var: 100 x Cumulative Years of Indicated Status 1992-2007

	I. Years with Income from			
	Earnings only	Earnings+ SSDI	SSDI Inc only	Neither
	(1)	(2)	(3)	(4)
(Δ Imports from China to US)/US Consumption$_{91}$	-0.426 *	-0.053	0.180 *	0.298
	(0.187)	(0.080)	(0.089)	(0.198)
	II. Years with Income from			
	Earnings only	Earnings+ any SS Inc	SS Inc only	Neither
(Δ Imports from China to US)/US Consumption$_{91}$	-0.386 *	-0.092	0.187 *	0.291
	(0.180)	(0.102)	(0.090)	(0.190)

Notes: N=511,792. Panel I distinguishes income from earnings and Social Security Disability Insurance (SSDI) income. Panel II distinguished income from earnings and income from any of the three large benefits programs of the Social Security Administration (SSA): Social Security Disability Insurance, Social Security Retirment Insurance, and Supplemental Security Income. All regressions include a constant and the full vector of control variables from column 6 of Table 1. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 5. Imports from China and Cumulative Years of Employment, Earnings, and SSDI Receipt by Subgroup of Workers: 2SLS Estimates.
Dependent Var: 100 x Cumulative Years of Employment/Earnings/SSDI Receipt, 1992-2007

	I. Effects by Gender and Nativity						II. Effects by Age and Initial Wage					
	Cum. Yrs Employ-ment		Cumul Earn/Avg Wage 88-91		Cum. Yrs SSDI Receipt		Cum. Yrs Employ-ment		Cumul Earn/Avg Wage 88-91		Cum. Yrs SSDI Receipt	
	(1)		(2)		(3)		(4)		(5)		(6)	
	A1. Males						C1. Age 37-50 in 2007					
(Δ Imports China to US)/US $Cons_{91}$	-0.129		-0.507		0.051		0.086		-3.489	*	0.078	
	(0.220)		(1.038)		(0.094)		(0.228)		(1.523)		(0.088)	
	A2. Females						C2. Age 51-64 in 2007					
(Δ Imports China to US)/US $Cons_{91}$	-0.880	**	-4.937	**	0.361	**	-0.837	**	-2.539	**	0.139	
	(0.307)		(1.210)		(0.141)		(0.315)		(0.764)		(0.128)	
	B1. US Born						D1. Initial Wage≥Firm Average					
(Δ Imports China to US)/US $Cons_{91}$	-0.423	~	-2.948	**	0.183	~	-0.426	~	-1.539		0.036	
	(0.225)		(0.936)		(0.101)		(0.249)		(1.067)		(0.096)	
	B2. Foreign Born						D2. Initial Wage<Firm Average					
(Δ Imports China to US)/US $Cons_{91}$	-0.837	~	-2.568		-0.022		-0.571	~	-5.043	**	0.291	*
	(0.460)		(1.855)		(0.203)		(0.310)		(1.264)		(0.136)	

Notes: Each cell of the Table reports the coefficient of a separate regression of the variable indicated at the column heading on import exposure and control variables. N=291,063/220,729 in Panels A1/A2; N=472,383/39,409 in Panels B1/B2; N=238,637/273,155 in Panels C1/C2; N=353,328/158,464 in Panels D1/D2. Regressions in columns 1, 3, 4 and 6 include a constant and the full vector of control variables from column 6 of Table 1, regressions in columns 2 and 5 include a constant and the full vector of control variables from column 5 ot Table 2. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 6. Imports from China and Cum. Years of Employment and SSDI Receipt by Worker Sample: 2SLS Estimates.
Dep Vars: 100 x Cum. Years of Employment, and 100 x Cum. Years of Non-Employment with or without SSDI Income, 1992-2007.

	I. Both Genders			II. Males vs Females		
	Cumulative Years of			Cumulative Years of		
	Employ-ment	No Employment		Employ-ment	No Employment	
		w/ SSDI	w/o SSDI		w/ SSDI	w/o SSDI
	(1)	(2)	(3)	(1)	(2)	(3)
	A. Main Sample			E1. Main Sample, Males only		
[(Δ Imp from China) /US $Cons_{1991}]_{ind(1991\pm1)}$	-0.661 **	0.154 ~	0.507 *	-0.235	0.035	0.201
	(0.221)	(0.082)	(0.199)	(0.220)	(0.085)	(0.197)
	N=511,792			N=291,063		
	B. Main+Part-Time Workers			E2. Full Sample, Males only		
[(Δ Imp from China) /US $Cons_{1991}]_{ind(1991\pm1)}$	-0.783 **	0.407 **	0.376 ~	-0.160	0.089	0.071
	(0.252)	(0.125)	(0.211)	(0.266)	(0.125)	(0.228)
	N=723,034			N=426,076		
	C. Main+Part-Time+Discont Emp			F1. Main Sample, Females only		
[(Δ Imp from China) /US $Cons_{1991}]_{ind(1991\pm1)}$	-1.169 **	0.560 **	0.609 *	-1.130 **	0.321 *	0.809 **
	(0.374)	(0.163)	(0.289)	(0.294)	(0.129)	(0.258)
	N=880,465			N=220,729		
	D. Part-Time+Discont Emp Only			F2. Full Sample, Females only		
[(Δ Imp from China) /US $Cons_{1991}]_{ind(1991\pm1)}$	-1.519	1.860 **	-0.341	-1.885 **	0.918 **	0.967 **
	(0.960)	(0.460)	(0.834)	(0.450)	(0.216)	(0.351)
	N=368,673			N=378,729		

Notes: Panel A includes workers who earned at least $7,950 in each of the four years 1988 to 1991. Panel B includes all workers who had any positive earnings in each of the four years 1988 to 1991. Panel C includes workers who had positive earnings in at least one year during 1987-1989 and one year during 1990-1992. Each cell of the Table reports the coefficient of a separate regression of the variable indicated at the column heading on import exposure and control variables. All regressions include the full vector of control variables from colum 7 of Table 1. The control variables for manufacturing employment, firm tenure and firm size are averaged over 1990-1992. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 7. Imports from China and Cumulative Years of Employment and Earnings by Type of Initial Employer. 2SLS Estimates.
Dependent Var: 100 x Cumulative Years of Employment/Earnings, 1992-2007

	I. Initial Firm			II. Subsequent Firms		II. All Firms	
	Yrs Employ-ment	Yrs Non-Emp after leaving		Yrs Employ-ment	Yrs Non-Emp after leaving	Yrs Employ-ment	Cumul Earn/Avg Wage 88-91
		Dying F.	Surviv. F.				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				A. Any Initial Firm			
(Δ Imports China to US)/US $Cons_{91}$	-3.17 **	0.17 *	0.02	2.70 **	0.29 *	-0.48 *	-2.32 *
	(0.91)	(0.08)	(0.13)	(0.81)	(0.14)	(0.22)	(0.91)
				B1. Avg Firm Wage<Industry Avg			
(Δ Imports China to US)/US $Cons_{91}$	-1.89 *	0.23 *	-0.11	1.71 *	0.08	-0.18	-3.37 **
	(0.84)	(0.12)	(0.18)	(0.83)	(0.18)	(0.26)	(1.07)
				B2. Avg Firm Wage≥Industry Avg			
(Δ Imports China to US)/US $Cons_{91}$	-4.03 **	0.09	0.14	3.23 **	0.50 *	-0.80 **	-2.62 *
	(1.42)	(0.09)	(0.19)	(1.26)	(0.20)	(0.30)	(1.13)
				C1. 1-99 Employees			
(Δ Imports China to US)/US $Cons_{91}$	-1.63 *	0.34	-0.35	2.01 **	-0.32	0.38	-1.51
	(0.81)	(0.24)	(0.21)	(0.68)	(0.28)	(0.42)	(1.18)
				C2. 100-999 Employees			
(Δ Imports China to US)/US $Cons_{91}$	-2.61 **	0.14	0.05	1.95 **	0.45 *	-0.66 *	-2.39 *
	(0.65)	(0.09)	(0.14)	(0.60)	(0.20)	(0.26)	(0.98)
				C3. 1000-9999 Employees			
(Δ Imports China to US)/US $Cons_{91}$	-3.65 **	0.12	0.09	2.97 *	0.44 ~	-0.67 *	-3.59 **
	(1.35)	(0.10)	(0.22)	(1.25)	(0.24)	(0.31)	(1.37)
				C4. 10000+ Employees			
(Δ Imports China to US)/US $Cons_{91}$	-7.92 ~	-0.02	0.20	6.89 ~	0.75 ~	-1.03	-4.86
	(4.05)	(0.09)	(0.49)	(3.75)	(0.45)	(0.83)	(3.77)

Notes: Each cell of the Table reports the coefficient of a separate regression of the variable indicated at the column heading on import exposure and control variables. N=511,792 in Panel A; N=256,192/N=255,600 in Panels B1/B2; N=118,699/121,593/125,596/145,904 in Panels C1/C2/C3/C4. Column 2 measures years of non-employment that follow the separation from an initial employer which died at most 2 years after the separation. Column 3 measures years of non-employment following the separation from a firm that survived during at least three more years after the separation. Column 5 measures years of non-employment that follow the separation from an employer other than the initial one. All employment regressions include a constant and the full vector of control variables from column 6 of Table 1, and all earnings regressions include a constant and the full vector of control variables from column 5 of Table 2. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 8. Effect of Exposure to Chinese Imports at the Industry and Commuting Zone Level on Employment: 2SLS Estimates.
Dep Var: 100 x Cumulative Years of Employment by Employer, 1992-2007

	Cumulative Years of Employment at						
	I. Any Firm					II. Initial Firm	III. Oth. Firms
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Δ Imports from China to US)/US Consumption$_{91}$	-0.478 *	-0.434 *			-0.400 *	-3.078 **	2.678 **
	(0.219)	(0.215)			(0.166)	(0.697)	(0.623)
CZ Avg of (Δ Imports from China to US)/US Consumption$_{91}$			-4.430 **	-3.816 ~	-3.470 ~	3.715	-7.185
			(1.654)	(2.187)	(2.086)	(17.752)	(16.054)
Worker X's	Yes	Yes	No	Yes	Yes	Yes	Yes
CZ Mfg Emp Sh+Division dummies	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: N=511,792. The first row of the table measures the import exposure of a worker's 1991 industry while the second row captures the average import exposure of all other workers in the commuting zone. All regressions include a constant. Worker X's comprise the full vector of control variables from column 6 of Table 1. All models in columns 2 to 5 also control for the share of a commuting zone's workers that are employed in manufacturing in 1991, a full set of Census Division dummies and a dummy for the 31% of observations for which geography information is missing. Robust standard errors in parentheses are clustered on start-of-period industry in columns 1 and 2, clustered on states in columns 3 and 4, and two-way clustered on start-of-period industry and state in columns 5 to 7. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Table 9: Alternative Measures of Import Exposure: 2SLS Estimates.
Dep Vars: 100 x Cum. Years of Emp or Cum. Earnings as Multiple of Initial Annual Earnings, 1992-07

Alternative Measure of Trade Exposure	Employ-ment (1)		Earnings (2)		*Alternative Measure of Trade Exposure*	Employ-ment (1)		Earnings (2)	
	I. Reduced From OLS					IV. 2SLS (Instr: Chn-OTH Tr.)			
Δ China-US Productivity Differential (Gravity Residual)	-1.01	~	-2.88	~	Δ *Net* Import Penetration, using China Imports	-0.98	**	-3.92	**
	(0.55)		(1.69)			(0.29)		(0.96)	
	II. 2SLS (Instr: Chn-OTH Tr.)					V. 2SLS (Instr: Chn-OTH Tr.)			
Δ Import Penetration, using all Low-Income Country Imports	-0.45	*	-2.26	**	Δ *Net* Imports from China in Worker-Equivalent Units	-1.02	**	-4.06	**
	(0.20)		(0.80)			(0.25)		(0.83)	
	III. 2SLS (Instr: Chn-OTH Tr.)					VI. 2SLS (Instr: Chn-OTH Tr.)			
Δ Import Penetration, using China Imports to U.S. and other Markets	-0.39	*	-1.72	*	Δ Import Penetration, using China Imports, adjusted for Imported Inputs	-0.57	*	-2.47	**
	(0.20)		(0.82)			(0.25)		(0.89)	

Notes: N=511,792. The mean (and standard deviation) of trade exposure among manufacturing workers is 1.24 (4.14) in Panel I, 8.56 (14.98) in Panel II, 8.62 (15.25) in Panel III, 6.12 (14.01) in Panel IV, 5.90 (13.93) in Panel V, 5.77 (12.72) in Panel VI. All models in columns 1 and 3 include the full vector of control variables from column 6 of Table 1 and all models in column 2 and 4 include the full vector of control variables from column 5 of Table 2. Robust standard errors in parentheses are clustered on start-of-period industry. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Appendix Table 1. Growth of Import Exposure 1991-2007 and Labor Intensity 1991 by 2-Digit Manufacturing Industry

	2-Digit Manufacturing Industries Ranked by Import Exposure	Chg Import Exposure	Share Prod Workers
1	Leather and leather products	**62.6**	**0.84**
2	Misc. manufacturing ind. (incl. toys)	**32.6**	0.72
3	Furniture and fixtures	**29.6**	**0.79**
4	Electronic and other electric equipm.	**22.2**	0.63
5	Apparel and other textile products	**20.1**	**0.85**
6	Industrial machinery and equipment	**14.9**	0.62
7	Rubber and misc. plastics products	**7.0**	**0.77**
8	Stone, clay and glass products	**6.9**	**0.76**
9	Fabricated metal products	**6.8**	**0.73**
10	Instruments and related products	**4.7**	0.50
11	Primary metal industries	**4.7**	**0.76**
12	Lumber and wood products	**4.7**	**0.83**
13	Paper and allied products	2.4	**0.77**
14	Textile mill products	2.2	**0.86**
15	Transportation equipment	1.7	0.65
16	Chemicals and allied products	1.6	0.57
17	Printing and publishing	1.0	0.53
18	Food and kindred products	0.6	0.72
19	Petroleum and coal products	0.5	0.65
20	Tobacco products	0.0	0.72

Notes: The table indicates the average growth of import exposure during 1991-2007 (in %pts of 1991 consumption), and the share of production workers in 1991 for each 2-digit manufacturing industry. Numbers in bold type exceed the employment-weighted sample medians for all manufacturing industries. All statistics are weighted by 1991 industry employment according to the NBER manufacturing database.

Appendix Table 2. Descriptive Statistics.

	A. Main Sample: High LF Attachment	B. Alternative Sample: High+Low LF Attachm.
Sample Size	N=511,792	N=880,465
	I. Trade Exposure, 1991-2007	
	Individual Exposure of Mfg. Workers (in %pts)	
(Δ Imports from China to US)/US $Consumption_{91}$	7.72 (13.88)	6.77 (12.31)
P90, P10 Interval	[26.00, 0.06]	[20.11, 0.04]
	Comm. Zone Exposure of All Workers (in %pts)	
CZ Avg of (Δ Imports from China to US)/US $Consumption_{91}$	1.24 (1.04)	n/a
P90, P10 Interval	[2.01, 0.26]	n/a
	II. Main Outcome Variables, 1992-2007	
100*Cumulative Years of Employment	1421.77 (342.60)	1325.96 (428.33)
100*Cum. Years of Non-Emp with SSDI Receipt	25.91 (141.34)	34.53 (170.70)
100*Cum. Years of Non-Emp w/o SSDI Receipt	152.32 (316.51)	239.51 (403.30)
100*Cumulative Wage /Avg Wage 1988-1991	1920.13 (1175.53)	n/a
	III. Worker Characteristics in 1991	
Female	0.431	0.475
Non-White	0.207	0.236
Foreign-Born	0.077	0.085
Emp in Manufacturing Sector	0.207	0.173
Tenure 0-1 Years	0.271	0.416
Tenure 2-5 Years	0.366	0.299
Tenure 6-10 Years	0.166	0.124
Tenure 11+ Years	0.197	0.162
Firm Size 1-99 Employees	0.232	0.257
Firm Size 100-999 Employees	0.238	0.231
Firm Size 1000-9999 Employees	0.245	0.210
Firm Size 10000+ Employees	0.285	0.302
Average Wage 1988-1991	41657.69	29217.32

Notes: Individual import exposure is reported for all manufacturing workers while geographic import exposure at the Commuting Zone level is reported for the 354,334 workers for whom the data provides geographical information. The alternative sample in column 2 includes workers with low labor force attachment which may not have been employed in 1991. Trade exposure for this sample is thus computed as the average exposure of any industry in which the worker was employed during 1990 to 1992, and the control variables for employment in manufacturing, tenure, and firm size are also averaged over these three years.