US Exports and Employment *

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September 23, 2017

Abstract

We examine the employment responses to import competition from China and to global export expansion from the United States, both of which have been expanding strongly during the past decades. We find that although Chinese imports reduce jobs, at both the industry level and the local commuting zone level, the global export expansion of US products also creates a considerable number of jobs. On balance over the entire 1991-2007 period, job gains due to changes in US global exports were slightly less than job losses due to Chinese imports. Using data at both the industry level and the commuting zones level, we find a net loss of around 0.2-0.3 million jobs. When we extend the analysis to 1991-2011, we find the net job effect of import and export exposure is roughly balanced at the commuting zone level.

JEL Codes: F14, F16, J23, R23

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Jimmy Xu provided excellent research assistance. Ma and Xu are grateful to the University of California, Davis for hosting them as visiting scholars and the China Scholarship Council for sponsoring the visit. Feenstra acknowledges financial support from the National Science Foundation. Ma acknowledges financial support from the China NSF under grant no.71673160. The full dataset used and replication code will be made available at http://www.robertfeenstra.info/papers/.

1 Introduction

Conventional wisdom in economics is that trade liberalization will have two effects on labor market outcomes. On the one hand, firms that face import competition may shrink or even exit and therefore displace workers. On the other hand, firms that gain access to foreign market should enter or expand, therefore generating numerous new jobs. Although such effects of job creation and destruction due to international trade are commonly accepted, empirical studies, particularly the recent growing literature on the 'China shock', focus on the job reducing effect of surging imports from China or other low-wage countries on the US labor market (Autor, Dorn, and Hanson, 2013; Pierce and Schott, 2016; Acemoglu et al., 2016).[1]

This paper aims to fill this research gap by providing the first account of the job creation due to the export expansion in the United States, at both the industry level and the local labor market (commuting zone) level. The United States is one of the leading exporting countries in the world trading system: in 2014, the value of its merchandise exports reached more than 1.6 trillion US dollars, second only after China. Figure 1 presents the export growth for US aggregate merchandise exports and manufacturing exports from 1991 to 2011. It shows that prior to the global financial crisis, US exports grew strongly, from less than 600 billion (in 2007 US dollars) in 1991 to more than 1.2 trillion dollars. No doubt such expansion in export value would generate increasing demand for labor. The US export expansion is certainly not evenly distributed across industries, however. Figure 2 lists the top industries that have experienced the largest increase in export value during 1991 - 2007. Among 392 revised SIC manufacturing sectors, semiconductors experienced the largest increase in export value during 1991-1999, while motor vehicles and petroleum refining have been the champion of export expansion in the period

[1] A notable exception is Dauth, Findeisen, and Suedekum (2014), who employed the German trade and labor data to show that the rise of the East (Eastern Europe and China) caused substantial job losses in regions exposed to import competition, while it also led to strong employment gains in regions that are more export oriented. More recently, Feenstra and Sasahara (2017) adopt a labor demand approach to study the impact of U.S. imports from China and U.S. exports to the world on U.S. employment, based on global input-output tables. See also the paper by Wood (2017), which uses a global input-output approach.

1999-2007.[2] These top categories reflect America's comparative advantage, and grow much faster than many other categories, some of which even saw reductions in exports, therefore creating large variations for our empirical identification.

[Figure 1 and Figure 2 here]

Empirically, however, it is not easy to have an unbiased estimation of the export expansion due to endogeneity. While increased access to foreign markets drives up demand for labor employment, domestic supply shocks such as new technology or TFP growth will promote exports, causing difficulty in identification. Uncontrolled (often unobserved) domestic shocks, either in demand or supply, may affect export value and labor employment simultaneously, thereby creating omitted variable bias in estimation. Lack of plausible instruments probably explains the lack of more balanced empirical evidence of the effect of both export and import shocks on employment.

To deal with endogeneity, we adopt two instruments. First, we follow the spirit of Autor, Dorn and Hanson (2013, henceforth ADH) to look at the export expansion of other high-income countries.[3] This is based on the assumption that these high-income countries face similar import demand shocks from other countries as does the United States. The second instrument that we adopt in this paper relies on the fact that in recent decades, substantial trade liberalization has occurred in the form of tariff reductions, particularly for emerging and developing countries. Thus, we construct a second instrument as the predicted US exports based on the tariffs that US exporters face, the tariffs that other competing countries face, and the rising foreign demand for imports of commodities (except from the US).

Our empirical results show important job gains due to US export expansion. Based on the industry level estimation, our results show that US export expansion *net of* China's import penetration actually led to a net gain of 324,000 jobs in the first period 1991-1999, while it led

[2] As a comparison, Figure A.1 in the appendix presents the top import SIC categories that have experienced the largest increase in volume from China.

[3] ADH (2013) instrument the US import penetration from China using eight other high-income countries' import penetration from China.

to a net loss of 642,000 jobs for the second period 1999-2007, or 697,000 job losses for 1999-2011. On balance over the entire 1991-2007 period or 1991-2011 periods, therefore, job gains due to changes in US global exports largely offset job losses due to China's imports, resulting in about 0.3-0.4 million job losses in net.

To account for effects of reallocation and local demand in general equilibrium, we also explore the variations across US commuting zones in their exposure to export and import. We find somewhat bigger effect of job creation and reduction of trade exposure, while the net job loss is consistently close to the results using industry level data. Quantitatively, accounting for local market effects implies increased import exposure had led to a loss of about 2.58 million manufacturing jobs in local labor market from 1999 to 2007, and another 0.97 million manufacturing job losses from 1991 to 1999 . On the other hand, increased export exposure implies a gain of 2.01 million manufacturing jobs from 1991 to 1999 and 1.34 million from 1999 to 2007. In net value, export exposure significantly offsets the reduction in jobs caused by import penetration, resulting in about 0.2 million net job losses. If we extend the analysis to the period 1991-2011, then over the full 2 decades, import exposure leads to about 4.22 million job losses, while export expansion generates about 4.24 million jobs. Thus, the net effect is roughly balanced over this longer period.

The rest of the paper is structured as follows: Section 2 presents the empirical strategy and describes our main datasets. Section 3 shows the main industry level estimations. Section 4 examines the impact of trade exposure at the commuting zone level. Section 5 concludes.

2 Empirical Strategy

We take an approach similar to Acemoglu et al. (2016), investigating the effect of export growth and import exposure on labor employment first at the industry level, and then at the local labor market level.

2.1 Measuring Trade Exposure

Acemoglu et al. (2016) measure the change in the industry level import penetration in the US from Chinese imports as

$$\Delta IP_{st} = \frac{\Delta M^{UC}_{s,t}}{Y_{s,t_0} + M_{s,t_0} - E_{s,t_0}}, \tag{1}$$

where s denotes 392 manufacturing sectors at SIC classification. $\Delta M^{UC}_{s,t}$ denotes the change in *US imports from China* (UC) in sector s for the time period t (t is either 1991-1999, or 1999-2007, and in some cases 1999-2011). To normalize, $\Delta M^{UC}_{s,t}$ is divided by the initial domestic absorption, which consists the industrial real shipment, Y_{s,t_0}, plus industry real net imports, $M_{s,t_0} - E_{s,t_0}$, both at initial year $t_0 = 1991$ and deflated by the Personal Consumption Expenditures (PCE) price index. This variable therefore measures the actual increase in import exposure by each US manufacturing industry s. Such a change in import exposure from China could be either due to a supply shock in its exports (e.g. productivity growth in China's export sectors), or caused by unobserved domestic shocks in the US demand. The latter component may affect sectoral imports and sectoral employment simultaneously and therefore contaminate trade flows. To address this endogeneity concern, ADH (2013) and Acemoglu et al. (2016) suggest using the change in import exposure from China within eight other high-income countries as an instrument:

$$\Delta IP^{OTH}_{st} = \frac{\Delta M^{OC}_{s,t}}{Y_{s,t_0} + M_{s,t_0} - E_{s,t_0}}, \tag{2}$$

where $\Delta M^{OC}_{s,t}$ measures the change in *other countries imports from China* (OC) in sector s during the period t by these eight other nations,[4] which is then normalized by the initial domestic sectoral absorption in 1988 ($t_0 = 1988$). The validity of this instrument relies on the assumption that high-income countries are similarly exposed to import competition that is driven by the supply shock in China, while the industry import demand shocks are uncorrelated between these eight countries and the United States.

[4] These countries are: Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. An additional reason that we use these eight countries is that their disaggregated HS trade data are available since 1991.

To capture the industrial export exposure, we start with an analogous measure to (1) as:

$$\Delta EP_{st} = \frac{\Delta X_{s,t}}{Y_{s,t_0}}, \tag{3}$$

where ΔEP_{st} measures changes in export exposure of sector s between t and t+1, defined as changes in US sector exports $\Delta X_{s,t}$, divided by the initial sectoral shipments Y_{s,t_0}. Thus, EP_{st} is a measure of export intensity, capturing the share of export value out of the total industrial output. Different from the measure of China-specific import shock, we are interested in measuring the total US export expansion to the entire rest of the world.

To identify the effect of import and export exposure on the industrial employment, we adopt the following empirical specification:

$$\Delta ln(L_{st}) = \beta_t + \beta_1 \Delta IP_{st} + \beta_2 \Delta EP_{st} + \gamma X_{s0} + \epsilon_{st}, \tag{4}$$

where $\Delta ln(L_{st})$ is the annual log change in employment in sector s over time period t, X_{s0} is a set of start-of-period sectoral controls, and ΔIP_{st} and ΔEP_{st} measure the annual change in import exposure from China and the annual change in export exposure, respectively. Following Acemoglu et al. (2016), we fit this equation for stacked first differences covering two subperiods 1991-1999 and 1999-2007, where in some cases we also extend the latter subperiod to 1999-2011. All variables in changes are annualized.

As described above, equation (4) is subject to endogeneity of the trade exposure measures. We should use instrumental variables that are not correlated with U.S. shocks, since those shocks (on the demand or supply side) lead to endogenous changes in employment, imports and exports. In ADH and Acemoglu et al., identification is achieved via the 'China shock', which is a supply-shock in China. To avoid have that shock correlated with U.S. shocks, they use the import exposure from China by other eight high-income economies (ΔIP_{st}^{OTH}) as instrument, which is intended to reflect the Chinese supply capacity. Admittedly, this IV will also reflect demand conditions in those eight countries, but provided that those demand conditions are not correlated with those in the U.S., that should not present a problem for the IV.

In our paper, the IV should also be uncorrelated with U.S. shocks. Since we are modeling exports, we aim to identify their impact on U.S. employment from foreign demand shocks: those shocks would lead to a rise in exports and employment that is not contaminated by other shocks in the U.S. market. Our first instrumental variable for export exposure uses the export expansion of eight other high-income economies to the world except the United States:

$$\Delta EP_{st}^{OTH} = \frac{\Delta X_{s,t}^{OTH}}{Y_{s,t_0}}. \tag{5}$$

Using other advanced nations' exports to instrument for the US exports closely follows the idea of ADH (2013) and is intended to reflect foreign demand shocks in those export markets, but it must be admitted that it also reflect supply-side shocks in those eight countries themselves. That correlation with supply-side shocks will be apparent in our derivation of the export equation below. We shall also develop a second instrument that comes from a careful specification of U.S. exports in a constant-elasticity, monopolistic competition framework.

2.2 Predicting US Exports

To understand the driving forces underlying the US export growth, Caliendo et al. (2015) show that from 1990 until 2011 both MFN tariffs and the preferential tariffs have fallen by nearly nine percent, most of which was driven by substantial trade liberalization in emerging and developing economies. Notable examples include China's accession into the WTO in 2001, which lowered its average import tariff from above 15 percent to below 9 percent within just a few years; and the North American Free Trade Agreement (NAFTA), which integrated production chains and the flow of consumer goods across the continent of North America. Romalis (2007) find substantial increase in the trade volume and output among the United State, Canada and Mexico, particularly in the products that were previously highly protected.

Inspired by these observations, our second instrument for the US export expansion, denoted as ΔEP_{st}^{PRE}, is constructed as the predicted US exports due to reductions in import tariffs faced by the US exporters and their competitors in other countries. Similar to Romalis (2007), we start from a simple symmetric CES equation:

$$\frac{X^{us,j}_{svt}}{X^{i,j}_{svt}} = \left(\frac{w^{us}_{st} d^{us,j} \tau^{us,j}_{st}}{w^{i}_{st} d^{i,j} \tau^{i,j}_{st}}\right)^{1-\sigma}, \tag{6}$$

where $X^{us,j}_{svt}$ is the US exports to country j in variety v of sector s, $X^{i,j}_{svt}$ is the exports from country i. w^{us}_{st} and w^{i}_{st} are the relative marginal costs of producing varieties of sector s in the United States and country i. $\tau^{us,j}_{st}$ and $\tau^{i,j}_{st}$ are *ad valorem* import tariffs imposed by importer j on exports from the United States or from country i. Similarly, $d^{us,j}$ and $d^{i,j}$ are the bilateral distance or transport costs from the United States or exporting country i to importing country j. Finally, σ denotes the elasticity of substitution.

Suppose that there are M^{i}_{st} identical product varieties in sector s produced and exported by country i. We can re-arrange the above equation by multiplying both sides by M^{i}_{st} and summing over all countries $i \neq us$:

$$X^{us,j}_{svt} \sum_{i \neq us} M^{i}_{st} \left(w^{i}_{st} d^{i,j}\right)^{1-\sigma} = \left(w^{us}_{st} d^{us,j} \tau^{us,j}_{st}\right)^{1-\sigma} \sum_{i \neq us} M^{i}_{st} X^{i,j}_{svt} \left(\tau^{i,j}_{st}\right)^{\sigma-1}. \tag{7}$$

Multiply this equation by M^{us}_{st}, and denote the total sectoral exports from the United States and country i to country j as $X^{us,j}_{st} = M^{us}_{st} X^{us,j}_{svt}$ and $X^{i,j}_{st} = M^{i}_{st} X^{i,j}_{svt}$, respectively. After a few re-arrangements, we can get:

$$X^{us,j}_{st} = \frac{M^{us}_{st} \left(w^{us}_{st} d^{us,j} \tau^{us,j}_{st}\right)^{1-\sigma}}{\sum_{k \neq us} M^{k}_{st} \left(w^{k}_{st} d^{k,j}\right)^{1-\sigma}} \left(\sum_{k \neq us} X^{k,j}_{st}\right) \sum_{i \neq us} \frac{X^{i,j}_{st}}{\sum_{k \neq us} X^{k,j}_{st}} \left(\tau^{i,j}_{st}\right)^{\sigma-1}, \tag{8}$$

where we multiply and divide by $\sum_{k \neq us} X^{k,j}_{st}$ for convenience.

Taking logs of the above equation, we obtain:

$$\ln X^{us,j}_{st} = \beta^{us}_{st} + \ln \left(d^{us,j}\right)^{1-\sigma} + \ln(\tau^{us,j}_{st})^{1-\sigma} + \ln \left(\sum_{k \neq US} X^{k,j}_{st}\right) + \ln \left[\sum_{i \neq us} \frac{X^{i,j}_{st}}{\sum_{k \neq us} X^{k,j}_{st}} \left(\tau^{i,j}_{st}\right)^{\sigma-1}\right] + \epsilon^{j}_{st},$$

where $\beta^{us}_{st} = ln \left(M^{us}_{st} \left(w^{us}_{st}\right)^{1-\sigma}\right)$, which includes the U.S. export variety and production marginal costs. This term reflects a US supply shock and can be proxied by a set of sector and year fixed effects or their interactions.[5] Second, $\epsilon^{j}_{st} = -ln \left(\sum_{k \neq us} M^{k}_{st} \left(w^{k}_{st} d^{k,j}\right)^{1-\sigma}\right)$ is an unobserved error term, reflecting possibly the supply shocks in the source countries.

[5] A reduction in w^{us}_{st} reflects an improvement in productivity (a supply shock) that may increase exports and decrease labor employment simultaneously. While an increase in M^{us}_{st} reflects an expansion in U.S. product variety that may increase both exports and labor employment simultaneously.

Empirically, we can therefore rely on the following specification:

$$\ln X_{st}^{us,j} = \beta_{st}^{us} + \beta_1 \ln(\tau_{st}^{us,j}) + \beta_2 \ln\left(\sum_{k \neq US} X_{st}^{k,j}\right) + \beta_3 \ln(T_{st}^{j}) + \beta_4 \ln\left(d^{us,j}\right) + \epsilon_{st}^{j}. \qquad (9)$$

So from the demand side, the US exports of good s to country j is determined by four items: first, the import tariffs imposed by j on US exporters ($\tau_{st}^{us,j}$); and second, the total imports by j from all other exporters $\left(\sum_{k \neq US} X_{st}^{k,j}\right)$, which proxies for country j's *multilateral* import demand from the rest of world except the United States. Empirically our first instrument for U.S. exports, ΔEP_{st}^{OTH}, uses the export expansion of eight other high-income economies to the world except the United States, and reflects this multilateral demand. The third determinant is a measure of country j's average import tariffs on all non-US imports of good s, $T_{st}^{j} = \sum_{i \neq us} \frac{X_{st_0}^{ij}}{\sum_{k \neq us} X_{st_0}^{k,j}} \left(\tau_{st}^{i,j}\right)^{\sigma - 1}$. Empirically we use exports in the base year t_0 to construct weights. This term captures the substitution between US export products and their competitors: higher levels in T_{st}^{j} raises the demand for the US export. We expect to see $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 > 0$, and $\beta_4 < 0$. In our benchmark results, we use sigma = 7 but we have also experimented with sigma's ranging from 1 to 6 to make sure that our results are robust at different degree of substitutions. Our second instrument for U.S. exports, ΔEP_{st}^{PRE}, is constructed as the predicted US exports due to tariff changes as specified by equation (9).

2.3 Tariff and Trade Data

Equation (9) guides our estimation of US total exports using data on global trade flow and tariffs. To be more specific, we collect global trade flow data from the UN-Comtrade Database, which provides trade value by 6-digit HS and 5-digit SITC products. Tariff schedules are collected from the TRAINS and IDB databases accessed via the World Bank's WITS website, which have been complemented by mannually collected tariff schedules published by the International Customs Tariff Bureau (BITD) and made clean and available by Feenstra and Romalis (2014) and Caliendo et al. (2015). Putting these together, our empirical work is built on a comprehensive, disaagregated, annual database with trade flow and tariff schedules which are consistently matched at 5-digit SITC product classification for more than 150 countries over the period 1984 to 2011.

To facilitate the comparison with the effect of import exposure and employment changes, we construct our export exposure and the instruments for it at the revised SIC (standard industrial classification) level which was adopted by ADH (2013) and Acemoglu et al. (2016). The US export data at 6-digit HS product level could be readily converted to the revised SIC product level by adopting the crosswalk (with weights) in Acemoglu et al. (2016). We then take similar steps to construct the export value at revised SIC level by other eight advanced economies (i.e., our first instrument for US exports, ΔEP_{st}^{OTH}).

For the second instrument, there are several steps from converting US exports at 5-digit SITC products across importing countries to measuring export exposure at the revised SIC product level. First, we estimate equation (9) using the above-mentioned datasets provided by Feenstra and Romalis (2014) and Caliendo et al (2016) for US exports of product g (at SITC 5-digit) across importing countries j, which are then aggregated across export destination markets to get the US industrial exports, denoted as $\hat{X}_{gt}^{SITC}$. Second, we construct a crosswalk between SITC to SIC, following Feenstra, Romalis and Schott (2002). In the cases where one SITC code is matched to multiple SIC codes, we use the initial year export value to construct weights.[6] Thirdly, we use the crosswalk provided by Acemoglu et al (2016) to convert the 1987 SIC industry code to the revised SIC code, ending up with export values for 392 revised 4-digit SIC codes, covering each year from 1991 to 2011, which we denote accordingly as $\hat{X}_{st}^{SIC} = \sum_{g \in s} \omega_{gs,t_0} \hat{X}_{gt}^{SITC}$, where s denotes the SIC sector, while ω_{gs,t_0} is the start-of-period weights used in matching SITC product g to SIC sector s.

The estimation results of regressing US exports at 4-digit SITC industry level on tariffs and import demand of destination markets across countries are provided in Table 1, where we

[6] Here we adopt the 1987 SIC classification. We use US export data in 1990 to construct weights when one SITC product is matched to multiple SIC product for years between 1990 and 2000, and similarly US exports in 2000 to construct weights for years between 2000 and 2011.Details about the structure of US export data is provided in Feenstra, Romalis and Schott (2002).

experiment with various fixed effects. Column (1) uses SITC product fixed effects, Column (2) further adds year dummies, while Column (3) uses SITC-Year fixed effects. All regression coefficient estimates have expected signs and reasonable values, and our preferred specification, column (3), includes sector times year fixed effects. With these coefficient estimates, we then construct a measure of predicted US exports,

$$\Delta EP_{st}^{PRE} = \frac{(\hat{X}_{st}^{SIC} - \hat{X}_{st_0}^{SIC})}{Y_{s,t_0}}, \tag{10}$$

which is at the revised SIC industry level and is used as the instrument for the actual US export expansion.

[Table 1 about here]

After the above steps, we end up with measures of the change in US import exposure from China and its instrument, as well as the change in US export exposure to the world and two instruments, for 392 revised SIC manufacturing sectors. We follow Acemoglu et al. (2016) in examining the long difference between 1991 and 1999, and between 1999 and 2007 or 2011. All trade values are measured in 2007 US dollars using the Personal Consumption Expenditure deflator.

2.4 US Employment

For US employment changes we use the County Business Patterns (CBP) for the years 1991, 1999, 2007, and 2011. We use the same data coverage as Acemoglu et al (2016) and follow their steps to merge the data into 392 manufacturing sectors and 87 non-manufacturing sectors by 722 commuting zones. For additional sectoral level information with the manufacturing sector (such as number of production workers and nonproduction workers, and a number of sectoral controls which we will discuss in detail in later sections), we use the NBER-CES Manufacturing Industry Database for the same years 1991, 1999, 2007.[7]

[7]NBER-CES database ends at year 2009.

Table 2 summarizes our main variables of interests, including the measures of import and export exposure, changes in labor employment, and instrument variables.

[Table 2 about here]

3 Exports Create Jobs in Manufacturing

3.1 Benchmark Industry Estimation

Table 3 takes a first look at the impact of US exports to the world, in addition to its import exposure from China. Following Acemoglu et al (2016), we adopt a stacked first-difference model for the two time periods 1991-1999 and 1999-2007. Column (1) starts with an OLS regression, where import exposure from China has a significant negative impact on the industrial employment growth, while export expansion creates a positive and significant effect on employment. More specifically, a one percentage point rise in industry import penetration reduces domestic industry employment by 0.74 percentage points, while a one percentage point rise in export expansion increases industrial employment by 0.39 percentage points.

As noted above, both estimates for the import exposure and export exposure could be biased due to simultaneous changes in domestic demand and supply. For changes in import exposure, we instrument it with contemporaneous changes in import from China by other eight high-income countries, assuming the same supply shock from China applies to the import exposure of these countries. For changes in export exposure, we use two instruments to improve the estimation efficiency. The first is analogous to the import instrument, using the contemporaneous changes in export from other eight countries to the rest of world except the United States. This is based on the assumption that these high-income countries face similar import demand shocks from other countries as does the United States. A U.S. product demand shock will bias the OLS coefficients on both import and export towards zero. An increase in U.S. demand should increase imports, reduce exports and raise employment simultaneously, therefore understating true effect of import exposure and export expansion. On the other hand, a U.S. supply shock that is labor saving will reduce employment, raise output and likely reduce imports, but raise exports. Therefore the OLS coefficient on both import shock and export shock also tend to be under-estimated towards zero.

Another scenario is when the U.S. supply shock is represented by an expansion in U.S. product variety. In this case, the variety expansion increases exports and also increases employment, therefore resulting in an over-estimated OLS coefficient for export variable. The two types of correlation between U.S. exports and supply shock are obviously observed in equation (9), in which β_{0st}^{j} consists a supply shock that will likely increase exports but reduce employment (the marginal cost term), as well as a supply shock that increases both exports and employment (the product variety term). Therefore the second instrument for export exposure is the predicted value of exports estimated from specification (9) which we discuss in detail in Section 2. Note that in the estimation, we have included various fixed effects: industry (SITC) and year fixed effects or their interactions, but they reflect various supply shocks as we have discussed. Thus to construct the instrument for export, we use the predicted value *excluding these fixed effects*.[8]

Column (2) present the results with the first instrument for U.S. exports (i.e., contemporaneous changes in export from other eight countries to the rest of world except the United States), for period 1991-2007. Column (3) further extends the sample period to 2011. After correcting the simultaneity bias, the estimates in column (2) are larger than the OLS estimates. Column (4) includes both instruments for U.S. exports, and is our preferred estimate. It implies that a one percentage point rise in industry import penetration reduces domestic industry employment by 1.3 percentage points, while a one percentage point rise in export expansion increases industrial employment by 0.69 percentage points. Column (5) extends the second sub-period to 1999-2011, and the results are similar qualitatively: import exposure reduces jobs while export expansion creates them. The coefficient on exports is smaller, probably reflecting

[8]More specifically, we adopt the estimation results by Column (3) of Table 1, but exclude the $SITC \times Year$ fixed effects β_{st}^{us} in the predicted value (while still allowing for a single constant term β_0). We present in the appendix Table A.1 the results with predicted export value *including* the $SITC \times Year$ fixed effects. As expected, including these fixed effect in the predicted exports only strengthen our results.

the volatility in exports during the global financial crisis. In the bottom panels, we report the first stage regression results for the two endogenous variables. In most cases the F-statistics for the excluded instruments well above the the Stock-Yogo weak ID test critical value.

[Table 3 about here]

Relying on the preferred estimation results in column (4) of Table 3, we can evaluate the economic magnitude of trade shocks on labor employment. From (4), and following Acemoglu et al. (2016), changes in industrial employment brought by the increase in imports and export can be expressed as:

$$\Delta L_t = \sum_s \left(L_{s,t}(1 - e^{(\hat{\beta}_1 \Delta IP_{st} + \hat{\beta}_2 \Delta EP_{st})}) \right), \tag{11}$$

where $\hat{\beta}_1$ and $\hat{\beta}_2$ are the 2SLS coefficient estimates from (4). Hypothetically, this equation calculate the difference between the actual and counterfactual manufacturing employment in year t if there are virtually no changes in import and export exposure. Applying the actual changes in import penetration (ΔIP_{st}) and export expansion (ΔEP_{st}), we calculate the net employment changes due to trade shocks. Export expansion *net of* China import penetration actually led to a net gain of 324,000 jobs in the first period 1991-1999, while it led to a net loss of 642,000 jobs for the second period 1999-2007, and 697,000 job losses for 1999-2011.[9]

Given that the observed changes in manufacturing employment over these time periods were a slight increase of 200,000 jobs in 1991-1999, and a large reduction of 3.34 million jobs in 1999-2007 (and another 2.48 million job losses from 2007 to 2011), import penetration contributed a substantial share of job losses, particularly in the second period when imports from China grew much faster. However, export expansion also created a considerable number of jobs at

[9]Two caveats are worth noting: (1) If we focus on the export channel while shut down the other (e.g. import exposure from China), then export expansion brought about 805,000 jobs in 1991-1999, and about 514,000 jobs in 1999-2007. On the other hand, if we focus on import shocks from China, the import competition led to 521,000 job losses in 1991-1999, and 1.24 million job losses in 1999-2007. (2) These quantitative predictions do not take into account the omitted variable bias due to unobserved shocks, so they may be overstating the impact of trade on manufacturing employment. Acemoglu et al. (2016) suggest using the partial R-squared from the first-stage regression to adjust the estimated coefficient of trade shocks. It becomes more complicated to do so in our case with two endogenous variables and three instruments.

the same time, without which employment in US manufacturing would have been experienced a much worse contraction. On balance over the entire 1991-2007 period, therefore, job gains due to changes in US global exports largely offset job losses due to China's imports, resulting in about 0.32 million job losses in net. And, when we extend the time period to 2011, in net there are about 0.4 million job losses.

3.2 Robustness with Additional Controls

As we have discussed above, industries subject to greater trade shocks may also be exposed to other economic fluctuations that are correlated with import and export growth. In Table 4, we add as robustness checks additional controls to address this concern. Following Acemoglu et al. (2016), we consider three groups of controls. First, column (1) includes a set of dummies for 10 one-digit broad manufacturing categories, which allows for differential trends across these one-digit sectors given our first differences specification. Column (2) considers a set of sectoral controls drawn from the NBER-CES database, including the share of production workers in sectoral employment, the log of the industrial average wage, the ratio of capital to value added (all measured in 1991), and computer and high tech equipment investment and pretrend variables in 1990 as a share of total 1990 investment. Column (3) captures the secular trend that the US manufacturing has been declining since the 1950s and the manufacturing employment has been falling since the 1980s. Such a long-standing trend predates the recent rise in trade shocks and may overstate the impact of trade exposure in the current period. Thus column (3) adds the change in the industry's share of total US employment and the change in the log of the industry average wage, both measured over 1976-1991. Then in column (4), we include all three sets of controls simultaneously.

[Table 4 about here]

Throughout columns (1) to (4), the coefficient estimates for export exposure are significant and stable in magnitude. With the full sets of controls, a one percentage point rise in industry import penetration reduces domestic industry employment by 0.81 percentage points, while a one percentage point rise in export expansion increases industrial employment by 0.63 percentage points. Finally in column (5) we include a full set of dummies for the 392 four-digit manufacturing industries. Using this full set of industry dummies in the stacked first-difference specification, the effect of trade shocks is identified by *changes* in the growth rates of industry employment and the trade exposure measures in the second period (1999-2007) relative to the first period (1991-1999). The coefficient estimates in this very demanding specification are only reduced modestly.

The last two columns (columns (6)-(7)) extend the coverage of the sample to 1991-2011. Column (6) uses full sets of industrial controls, with similar results, confirming the robustness of the job creating effect of export expansion. Column (7) uses the full set of industry dummies. In both cases, the impact of export expansion remains similar as before, while the significance and magnitude of the import coefficient are reduced in the latter case.

3.3 Impact on Other Industrial Outcomes

Next we explore the impact of trade exposure on other outcomes. Columns (1) to (5) of Table 5 use CBP data while columns (6)-(10) use NBER-CES database. Increasing import exposure reduces employment (col. 1), the number of establishment (col. 2), average employment per establishment (col. 3), total wage bill (col. 4); it also reduces employment of both production workers (col. 6) and non-production workers (col. 7). Interestingly, increasing import exposure increases the workers' real wage rate (col. 5), and has no significant effect on real wages of production and nonproduction workers (col. 8 and col. 9). Export expansion, on the other hand, substantially increases employment (col. 1), the number of establishment (col. 2), employment per establishment (col. 3), real wage bill (col. 4), but has no significant impact on real wage rate (col. 5); it also increases employment in both production workers (col. 6) and non-production workers (col. 7), and the real wages of both types of workers (col. 8 and col.9) though the wage effects on non-production workers are not significant. Finally Column (10) shows that export expansion substantially increases the real industrial output while import competition has no significant effect.

[Table 5 about here]

3.4 Accounting for Input-Output Linkages

Trade impacts may go beyond the industry boundary and propagate upstream and downstream. Note this effect is not limited within the manufacturing sector (e.g. an automobile producer may be exposed to trade shocks in upstream steel industry, or vice versa), but trade shocks in manufacturing will also affect services and other nontradable sectors. Wang et al. (2017), for example, focus on China's position as a supplier of intermediate inputs for U.S. sectors and argue that net effect of trading with China on local employment is modestly positive.

To make our results closely comparable to ADH and Acemoglu et al., we apply the same input-output table for 1992 from the BEA to study the interindustry linkages. First, the *upstream effect* of export and import exposure measures the impact of downstream sectors' trade exposure on upstream suppliers. That is:

$$\Delta IP_{st}^{up} = \sum_{g} \omega_{gs}^{u} \Delta IP_{gt}, \qquad and \qquad \Delta EP_{st}^{up} = \sum_{g} \omega_{gs}^{u} \Delta EP_{gt}, \tag{12}$$

where ω_{gs} is the use coefficient which tells the share of product s used as input in industry g, which is derived from the 1992 BEA input-output matrix. Thus ΔIP_{st}^{up} is a weighted average of the trade shocks faced by downstream buyers of products of sector s. When a downstream sector g experiences an export expansion, it may also increase its demand for intermediate inputs from its upstream sector s.

We could similarly compute the *downstream effect* of export and import exposure, which measures the impact of upstream sectors' trade exposure on downstream buyers. When a upstream sector g experiences an export expansion, it may drive up the domestic price for g, which creates negative impact on domestic downstream users in sector s. On the other hand, export expansion may improve the productivity of upstream sector g, and therefore generate postivie downstream effects on sector s.

$$\Delta IP_{st}^{down} = \sum_{g} \omega_{sg}^{d} \Delta IP_{gt}, \qquad and \qquad \Delta EP_{st}^{down} = \sum_{g} \omega_{sg}^{d} \Delta EP_{gt}, \tag{13}$$

where ω_{sg} measures the input share of product g used as input in industry s.

Using equations (12) and (13), we can generate instruments for both the upstream and downstream exposure measures. Table 6 presents the 2SLS estimation results. Column (1) focuses on the effect of import shocks, augmented with upstream and downstream import exposure, for 392 manufacturing sectors. Besides the significant direct effect of import exposure, upstream import exposure also exerts negative impact of industrial employment, while downstream import exposure has a positive but not significant effect. Column (2) further incorporates changes in export exposure. In this case, the direct within-sector effect of export exposure is positive and significant. Furthermore, buyers' export exposure also creates significant and positive effect on the employment of upstream suppliers (as shown by the coefficient for the upstream export exposure), while the effect of downstream export exposure is not precisely estimated.

Column (3) considers only the non-manufacturing sector while columns (4) extends the sample to consider both manufacturing and non-manufacturing sectors. Although exposure at the upstream and downstream sectors exert positive effects on non-manufactuirng employment, the effects are not significant. Given that most effects come from the direct and the upstream exposure, Columns (5)-(6) sum the upstream and direct trade exposures, confirming that import exposure reduces jobs while export expansion creates them.

[Table 6 about here]

Moreover, the above equations account for the direct transmission of shocks along the intersectoral input-output linkage. Upstream and downstream effects could also take force indirectly through iteration. For example, a shock to the plastic sector may affect downstream computer industry, and further affect transportation sector that uses a lot of computers. Such iteration of impacts across sectors generate a full chain of implied responses based on the input-output matrix. Therefore we augment the results in Table 6 with the Leontief inverse of the matrix. Results using the complete Leontief matrix are similar, and so we report them in the Appendix Table A.2.

4 Export Exposure on Local Labor Markets

The industry level results compare changes in relative employment across manufacuring sectors with different exposure to import penetration and export expansion. As emphasized by Acemoglu et al (2016), this approach cannot identify the reallocation and demand effects which occur in general equilibrium. In their influential work, ADH (2013) quantify the reallocation effects by focusing on cross-regional variations in local commuting zones' response to trade shocks. In this section, we follow ADH (2013) and Acemoglu et al. (2016) and explore the geographic differences in trade shocks, based on 722 commuting zones (CZs) that cover the entire US mainland.

We begin by first constructing the Bartik measures of CZ level import and export exposure as:

$$\Delta IP_{it}^{CZ} = \sum_s \frac{L_{is,t_0}}{L_{i,t_0}} \Delta IP_{st}, \qquad and \qquad \Delta EP_{it}^{CZ} = \sum_s \frac{L_{is,t_0}}{L_{i,t_0}} \Delta EP_{st}, \tag{14}$$

where i denotes commuting zone, s denotes SIC manufacturing sectors, ΔIP_{st} and ΔEP_{st} are sectoral import and export exposure that we have used in the previous sections. So ΔIP_{it}^{CZ} and ΔEP_{it}^{CZ} denote the increase in import and export exposure respectively, by commuting zone i for time period t (either 1990-2000, or 2000-2007). Note that L_{is,t_0} is the *start of period* employment in manufacturing sector s and commuting zone i, while L_{i,t_0} is the *start of period* total employment for commuting zone i, including both manufacturing and nonmanufacturing employment. The variation in import and export exposure across commtuing zones comes entirely from the differences in local industry structure in employment in the initial year. Figure 3 presents a comparison of the regional exposure to imports and exports during the two subperiods.

[Figure 3 about here]

As with the industry measure of trade shocks, the CZ level import and export exposure are also likely to be subject to endogneity problem. Therefore we apply the Bartik formula to the industry level instrument ΔIP_{st}^{OTH}, obtaining commuting zone level instrument for import exposure. Directly applying the Bartik formula to the industrial *export exposure*, however, is subject to potential measurement error: the instruments ΔEP_{st}^{OTH} and ΔEP_{st}^{PRE} are intended to be *affine transformations* of actual US exports (up to an error) at the industry level, but not necessarily *equal to* such exports (up to an error). Because this transformation for each instrument can differ across industries, not correcting for it initially will lead to measurement error when aggregating to the commuting zone level. Accordingly, we correct for this potential error by regressing a panel of actual exports at SIC level on the predicted exports at the same industry aggregation, with industry fixed effects and year dummies: that is, $X_{st} = \alpha_t + \alpha_s + \delta \hat{X}_{st}^{SIC} + \nu_{st}$.[10] Then we apply to Bartik local employment weights to the fitted value of the above estimation, obtaining our two contructed commuting zone level instruments for ΔEP_{it}^{CZ}.

With both exposure measures and their instruments, we estimate the following specification across 722 commuting zones:

$$\Delta L_{it}^{m} = \beta_t + \beta_1 \Delta IP_{it}^{CZ} + \beta_2 \Delta EP_{it}^{CZ} + \gamma X_{it_0}^{CZ} + \gamma_r + e_{it}, \tag{15}$$

where ΔL_{st}^{m} is the annual change in *manufacturing employment share of the working age population* in commuting zone i over time period t. To be consistent with the industry level specification, we continue to stack the annualized first differences for the two periods, 1991-1999 and 1999-2007 (or in some specifications, 1999-2011). In all regressions, we also include β_t to control for different time trend between the two time periods, a set of census division dummies

[10]Running this estimation prior to the industry-level estimation won't affect these previous results in section 3 since the industry specific effects are readily controlled by the long-difference specification that we have taken, while δ does not vary across industries.

to control for regional specific trends, as well as the initial share of manufacturing workers (in 1991). All regressions are weighted by start of period (1991) commuting zone's share of national population, and the standard error is clustered at the commuting zone level.

Table 7 presents results for the manufacturing employment share. Column (1) shows that the impact of CZ level import exposure on the local manufacturing employment share is negative and significant. In particular, a 1 percentage point increase in average import exposure in the local commuting zone leads to a 1.96 percentage point reduction in the local manufacturing employment share. Export exposure, on the other hand, increases local manufacturing employment share by 0.31 percentage point.

Column (2) of Table 7 further incorporates a set of commuting zone level initial demographic and economic controls, in particular the start-of-period share of manufacturing employment. Other controls include the percentage of college-educated population, percentage of foreign-born population, percentage of employment among women, percentage of employment in routine occupations, and finally the average offshorability index of occupations. After controlling for these initial local economic and demographic conditions, the actual impact of import exposure turns out to be smaller, while that of export expansion now has a larger positive effect. More specifically, we find that an 1 percentage point increase in average export exposure in a local commuting zone generates a 0.79 percentage point increase in the local manufacturing employment share. The magnitude for the impact of import exposure is reduced by nearly one third: an 1 percentage point increase in average import exposure now leads to a 1.24 percentage point reduction in local manufacturing employment share. Furthermore, the local manufacturing employment share at the start of period has strong negative effect on manufacturing employment share.

Quantitatively, accounting for local market effects implies increased import exposure led to a loss of about 2.58 million manufacturing jobs in local labor market from 1999 to 2007, and another 0.97 million manufacturing job losses from 1991 to 1999 . On the other hand, increased export exposure implies a gain of 2.01 million manufacturing jobs from 1991 to 1999 and 1.34 million from 1999 to 2007. In net, export exposure substantially offsets the reduction in jobs caused by import penetration, although it does not eliminate them, leaving about only 0.2 million net job losses.

Columns (3)-(4) examine the longer period 1991-2011. The effect of export expansion on manufacturing employment is increased: now an 1 percentage point increase in average export exposure in a local commuting zone generates a 0.92 percentage point increase in the local manufacturing employment share. The effect of import exposure from China remains similar to the early period. Applying these estimated coefficients to actual trade values, then increased import exposure led to a loss of about 1.01 million manufacturing jobs in the first period (1991-1999) in local labor market, and 3.21 million manufacturing jobs during the longer period 1999-2011, while increased export exposure implies a gain of 2.33 manufacturing jobs in 1991-1999, and 1.91 million manufacturing jobs from 1999 to 2011. So over the full 2 decades, import exposure leads to about 4.22 million job losses, while export expansion generates about 4.24 million jobs. The net effect is roughly balanced over this longer period.

[Table 7 about here]

In Figure 4 we report the percentage job losses due to import competition from China, and percentage job gains due to U.S. exports, by commuting zones. These maps have much the same pattern as was shown for the changes in import and export exposure in Figure 3, and indeed, the percentage job changes are obtained by just multiplying those exposure-changes by their respective coefficients in regression (15). The highest job losses in any zone are 1.2% per year during 1991-1999 and 0.9% per year during 1999-2011, while the highest job gains are 1.0% during 1991-1999 and 2.1% per year during 1999-2011. There is an apparent correlation in Figure 4 between job losses and job gains across CZ's, though that correlation is not as strong as it appears visually: the correlation between the percentage changes in job lost and job gained is 0.49 for the 1991-1999 period and 0.20 for the 1999-2011 period.[11]

[Figure 4 about here]

5 Conclusions

The work of Autor, Dorn, and Hanson (2013), Pierce and Schott (2016), and Acemoglu et al. (2016) has alerted us to impact of the 'China shock' on US employment and unemployment. As exports from that country grew rapidly following its WTO accession in 2001, there was a marked fall in US manufacturing employment, and in particular a geographic correlation between the inflow of goods from China and the fall in employment within regions formerly producing those goods. What has not received the same degree of attention in the literature is the potential for a rise in employment within regions that produce and benefit from growing U.S. exports. To be sure, Autor, Dorn, and Hanson (2013) experimented with using net manufacturing imports from China, or the difference between US imports and exports (per worker) by commuting zone, but that did not give results that were greatly different from what they obtained with gross imports from China.

In this paper, we have re-examined the employment impact of US exports, using exports to the world rather than just exports to China. We believe that this is a better way to evaluate the employment impact of US exports: the growth in Chinese demand as compared to the growth in demand from other countries for US goods are of equal interest when evaluating the employment impact, so there is no reason to focus on Chinese demand alone.[12] But demand for US exports is endogenous, as we must correct for. Just like the 'China shock' created a

[11] If instead we compute the correlation across commuting zones between the absolute number of jobs lost due to competition from China and jobs gained due to U.S. exports, we obtain 0.93 for the 1991-1999 period and 0.84 for the 1999-2011 period. These correlations are much higher because larger zones can have bigger job losses and bigger gains.

[12] For symmetry, one might argue that the employment impact of imports should be compared to that of exports with the same countries. Dauth, Findeisen, and Suedekum (2014) take that approach when they ask how the rise of the East, i.e. Eastern Europe and China, affected jobs in Germany. In order to retain such symmetry for the United States, one might ask how total imports and total exports have impacted employment, as analyzed by Feenstra and Sasahara (2017) using a global input-output approach.

compelling supply-side instrument for Chinese exports to the US, i.e. by using its exports to other industrial countries, so too we have had to develop good instruments for US exports to the world. In addition to using the exports of other industrial countries to foreign markets, we have derived a gravity-like specification for US exports that uses those exports of other countries along with the tariffs charged in foreign countries, and distance. The derivation of this equation showed that the sector-year fixed effects would like reflect US supply shocks, so we have omitted those fixed effects when constructing this second instrument.[13]

Our results fit the 'textbook story' that job opportunities in exports make up for jobs lost in import-competing industries, or nearly so. At the industry level, the US export of manufactured goods created enough jobs to offset all but 0.3-0.4 million of the jobs lost due to imports from China, over the entire 1991-2011 period. When we shift to considering CZ's, then the net job loss over 1991-2007 is still about 0.2 million jobs, but over the longer period 1991-2011 the job losses are just balanced with the job gains. There is also a positive geographic correlation between those losses and gains, so that CZ's with higher percentage losses are also more likely to have higher percentage gains. This result helps to explain how local labor markets reached equilibrium even in the absence of strong mobility across regions.[14] It would be desirable to further explore the job losses and gains beyond the CZ level, such as within sector and within broader counties rather than CZ, to understand the equilibrating mechanism in local labor markets.

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[14] Kovak and Cadena (2016) show that low-skilled native-born workers have limited mobility between regions and will suffer a wage or employment loss due to an adverse demand shock, whereas low-skilled immigrants and high-skilled workers are more likely to move.

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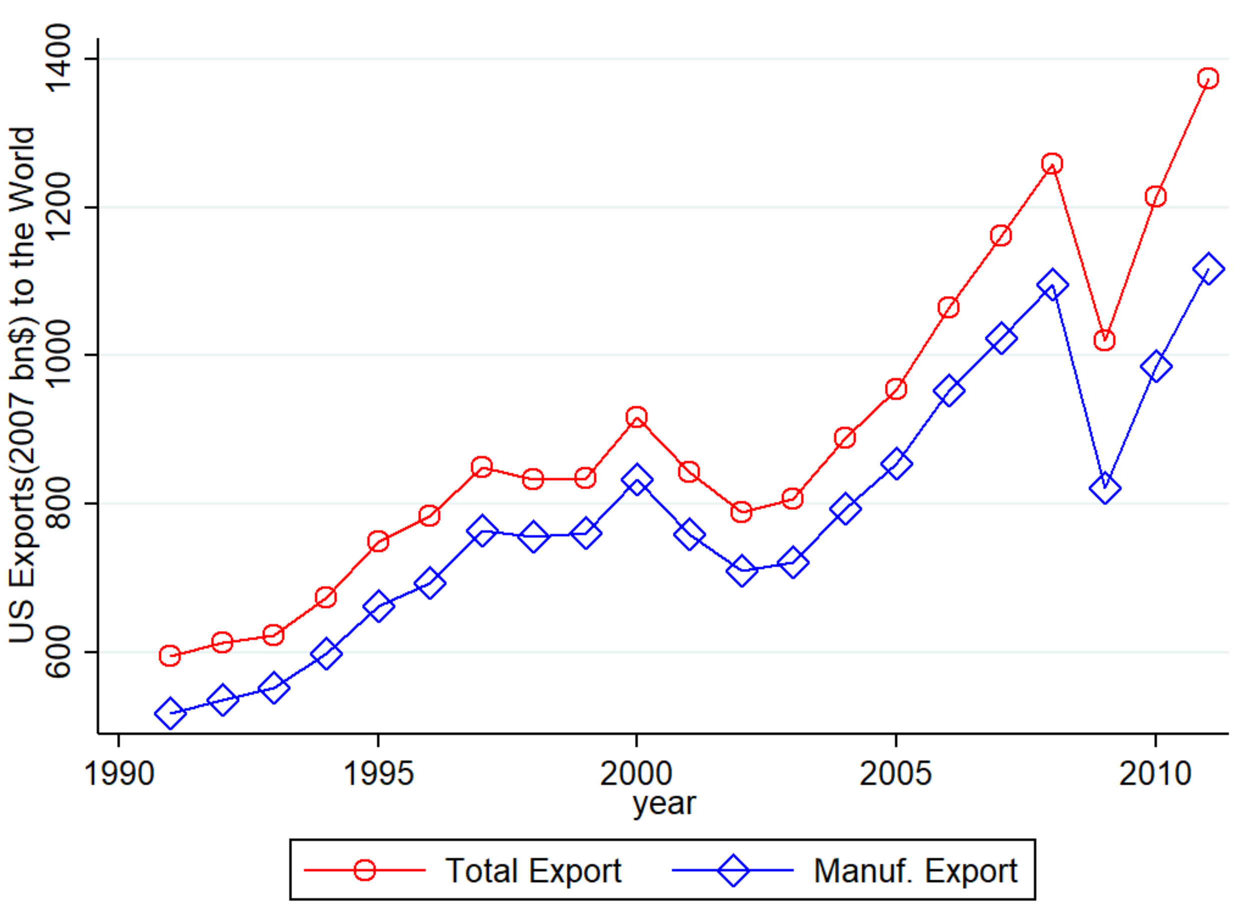
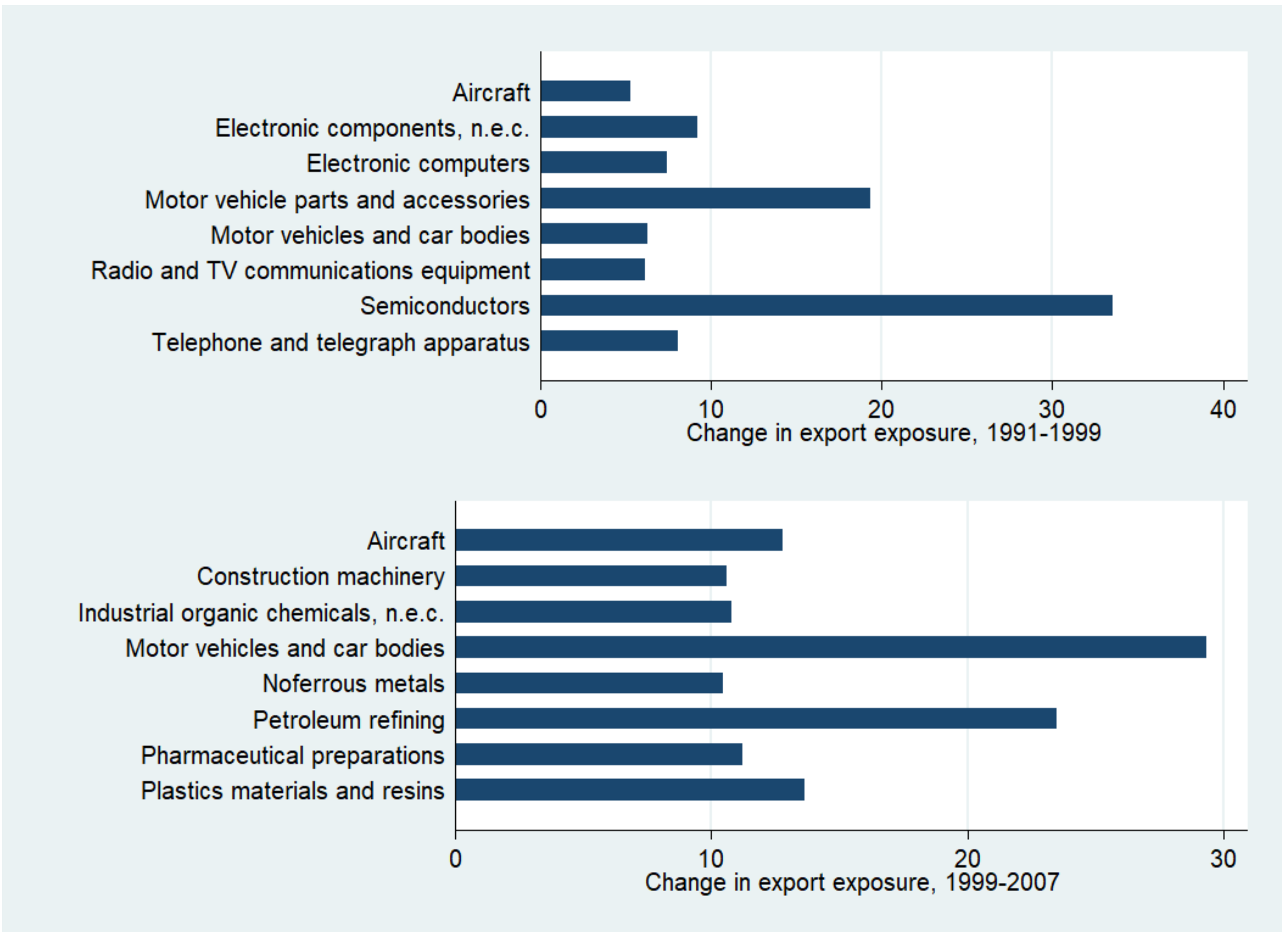
Figure 1: US Export: 1991-2011



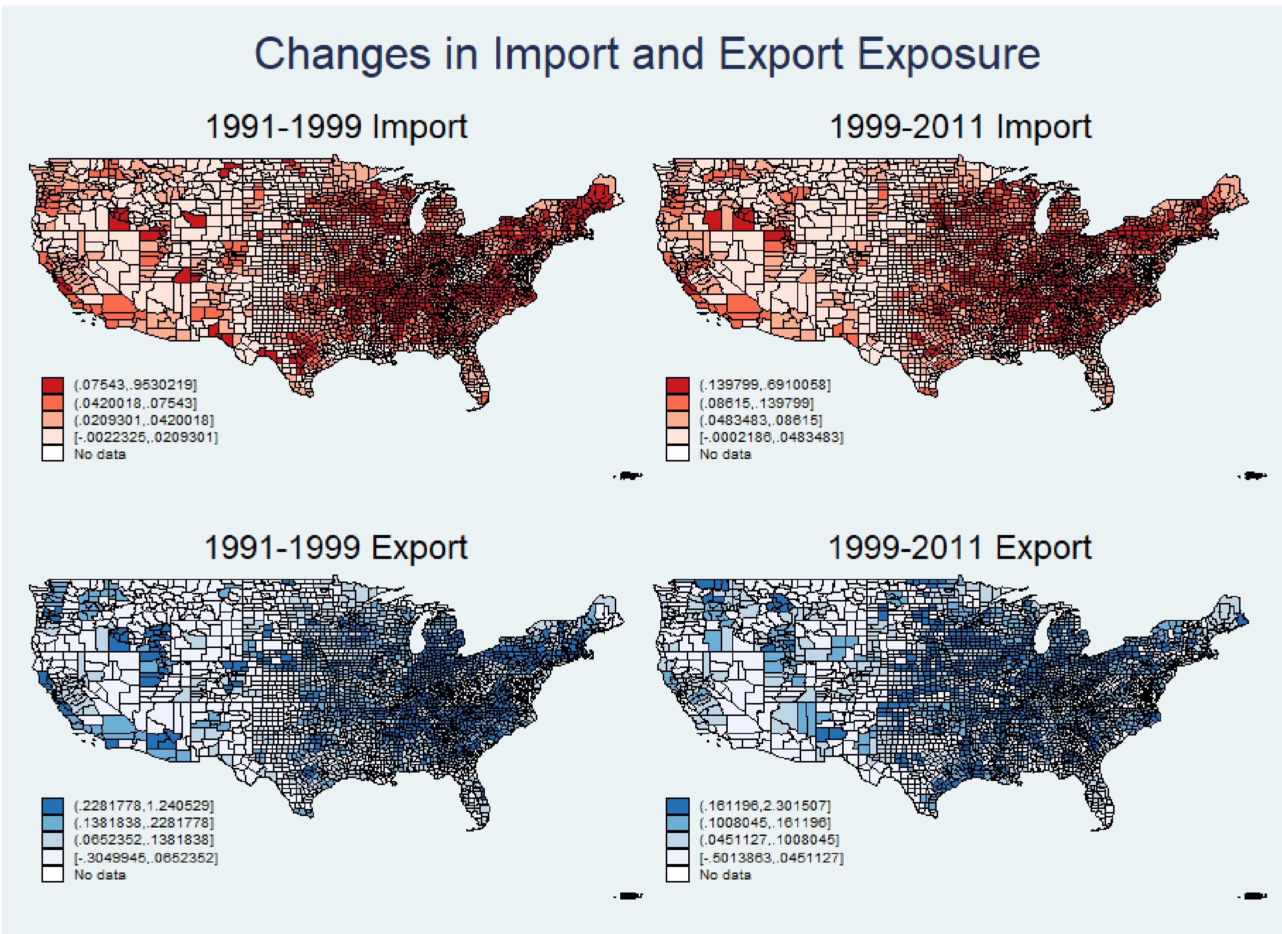
Note: Red line shows the aggregate export of the United States, while the blue line shows the manufacturing exports. All values are in billion US$, deflated to 2007 US dollars using the PCE price index. Data source: UN-Comtrade

Figure 2: Changes in US Industry Real Exports: 1991-2007



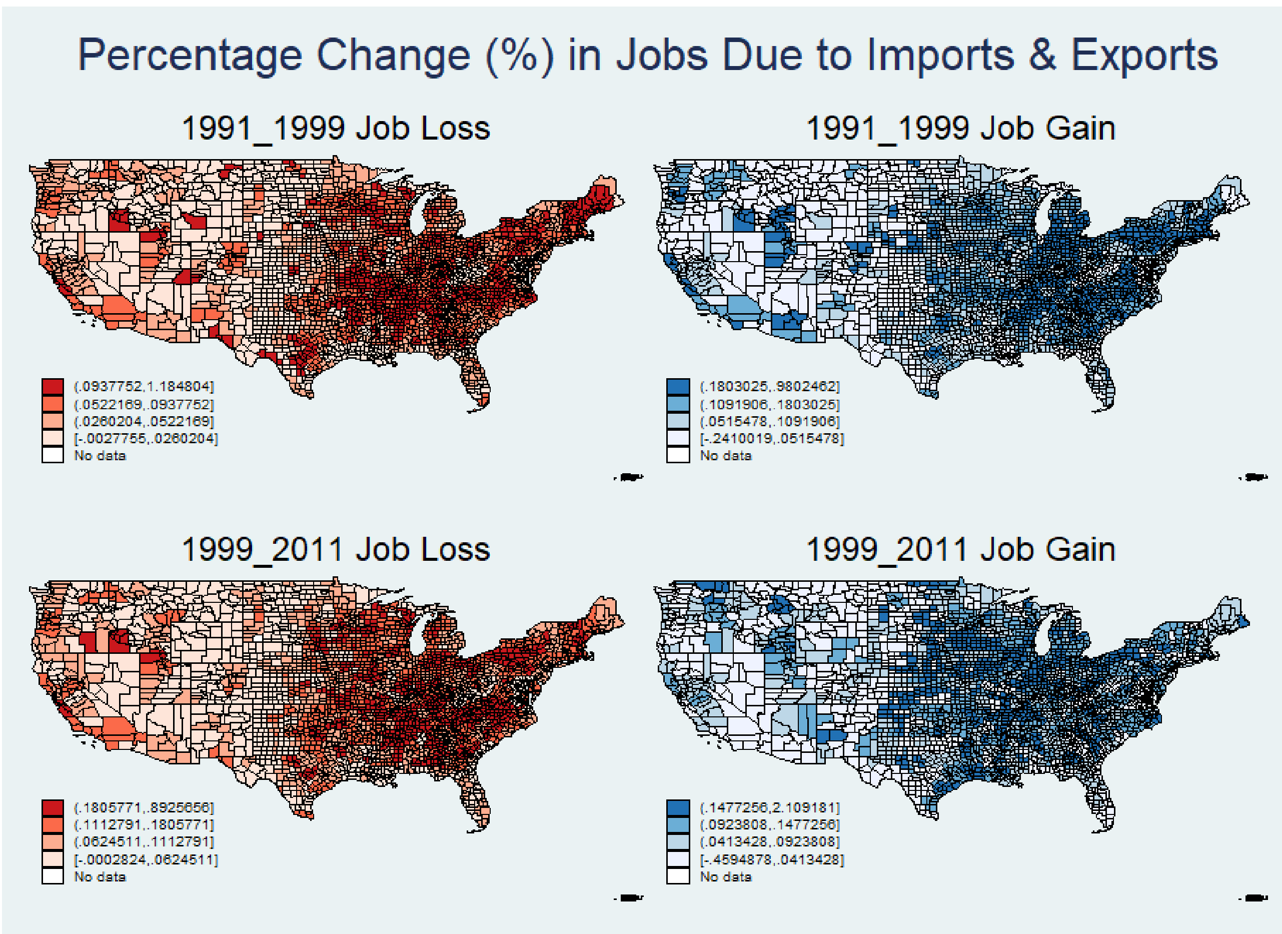
Note: This figure shows the top 8 SIC products in US exports, in terms of changes in real export value for two subperiods 1991-1999 and 1999-2007. All values are in billion US$, deflated to 2007 US dollars using the PCE price index. Data source: UN-Comtrade

Figure 3: US Commuting Zone Export and Import Exposure: 1991-2011



Note: This figure shows the changes in export and import exposure across US commuting zones, for two subperiods 1991-1999 and 1999-2011. Data source: UN-Comtrade

Figure 4: US Commuting Zone Percentage Job Changes due to Global Exports and Imports from China: 1991-2011



Note: This figure shows the annualized percentage changes in job gains due to exports and job losses due to imports across US commuting zones, for two subperiods 1991-1999 and 1999-2011. Data source: UN-Comtrade

Table 1: Predicting US Exports: 1990-2011

	(1)	(2)	(3)
$\ln(1+\tau_{st}^{us,j})$	-6.780***	-7.058***	-7.124***
	(0.044)	(0.044)	(0.044)
$\ln(\sum_{k\neq US} X_{st}^{k,j})$	0.752***	0.759***	0.763***
	(0.001)	(0.001)	(0.001)
$\ln(T_{st}^{j})$	7.063***	6.899***	6.953***
	(0.044)	(0.043)	(0.043)
$\ln Dist^{j}$	-1.951***	-1.944***	-1.951***
	(0.004)	(0.004)	(0.004)
Observations	1,256,201	1,256,201	1,255,646
R-squared	0.560	0.565	0.574
SITC FE	YES	YES	
YEAR FE		YES	
SITC-YEAR FE			YES

Note: We use the total export by other countries (excluding the US) to measure the global demand of the given products; The weights in calculating the average tariff faced by other countries (excluding the US) are fixed in year 1990. Robust standard errors are clustered at country-year level and reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 2: Descriptive Statistics

	N	Mean	S.D.	Median	Min	Max
			1991-1999			
100 × annual Δ in US import exposure	392	0.27	0.75	0.04	-0.25	12.15
Instrument for Δ in US import exposure	392	0.18	0.44	0.04	-1.51	6.62
100 × annual log Δ in manufacturing employment	392	-0.30	3.49	0.36	-18.15	14.18
100 × annual log Δ in non-manufacturing employment	87	2.46	2.38	1.79	-11.80	11.75
100 × annual Δ in US export exposure	392	0.89	1.53	0.41	-1.80	21.65
Instrument for Δ in US export exposure (PR method)	392	0.74	1.59	0.27	-8.22	7.84
Instrument for Δ in US export exposure (OT method)	392	0.49	1.83	0.21	-28.67	11.26
			1999-2007			
100 × annual Δ import exposure	392	0.84	1.61	0.25	-1.52	19.69
Instrument for Δ import exposure	392	0.60	1.07	0.22	-0.27	14.15
100 × annual log Δ manufacturing employment	392	-3.62	4.15	-2.74	-47.50	9.00
100 × annual log Δ non-manufacturing employment	87	1.54	1.59	1.24	-8.97	16.90
100 × annual Δ export exposure	392	0.61	2.40	0.17	-8.82	93.38
Instrument for Δ export exposure (PRE)	392	0.50	2.31	0.07	-20.34	16.64
Instrument for Δ export exposure (OTH)	392	3.02	4.66	1.56	-14.25	55.12
			1999-2011			
100 × annual Δ import exposure	392	0.66	1.33	0.20	-2.88	14.03
Instrument for Δ import exposure	392	0.60	1.07	0.22	-0.69	13.34
100 × annual log Δ manufacturing employment	392	-4.32	3.85	-3.63	-58.63	7.56
100 × annual log Δ non-manufacturing employment	87	0.57	1.56	0.29	-9.27	11.04
100 × annual Δ export exposure	392	0.43	2.53	0.15	-6.06	104.37
Instrument for Δ export exposure (PRE)	392	0.37	2.69	0.14	-14.39	17.27
Instrument for Δ export exposure (OTH)	392	2.42	4.36	1.22	-9.67	76.19

Note: For each manufacturing industry, the change in US import (or export) exposure,is computing by dividing 100 × the annualized increase in the value of US imports (exports) over the indicated periods by 1991 US market value (1991 US industry output) in that industry. All observations are weighted by 1991 industry employment.

Table 3: US Trade Exposure and Manufacturing Employment

Dep var: 100 × annualized log change in industrial employment	(1)	(2)	(3)	(4)	(5)
	1991-2007	1991-2007	1991-2011	1991-2007	1991-2011
	OLS	2SLS	2SLS	2SLS	2SLS
Δ Imports	-0.74***	-1.30***	-1.41***	-1.30***	-1.41***
	(0.16)	(0.31)	(0.40)	(0.32)	(0.41)
Δ Exports	0.39**	0.83***	0.79***	0.69***	0.65***
	(0.15)	(0.22)	(0.17)	(0.17)	(0.17)
1{1991-1999}	-0.44	-0.69	-0.63	-0.56	-0.49
	(0.40)	(0.45)	(0.41)	(0.44)	(0.42)
1{1999-2007}	-3.24***	-3.04***		-2.96***	
	(0.38)	(0.42)		(0.39)	
1{1999-2011}			-3.75***		-3.69***
			(0.36)		(0.34)

First Stage Results	(2)	(3)	(4)	(5)
Dep. var: Δ Imports				
Δ $Imports^{OTH}$	1.215***	1.008***	1.215***	0.992***
	(0.146)	(0.148)	(0.147)	(0.140)
Δ $Exports^{OTH}$	-0.016	-0.022	-0.016	-0.026
	(0.015)	(0.015)	(0.020)	(0.016)
Δ $Exports^{PRE}$			-0.000	0.028
			(0.068)	(0.041)
R-squared	0.682	0.642	0.682	0.642
F-test	41.91	30.17	28.00	23.04
Dep. var: Δ Exports				
Δ $Imports^{OTH}$	-0.293***	-0.064	-0.633***	-0.417*
	(0.110)	(0.120)	(0.239)	(0.239)
Δ $Exports^{OTH}$	0.287***	0.249***	0.212***	0.169***
	(0.041)	(0.047)	(0.048)	(0.053)
Δ $Exports^{PRE}$			0.534***	0.622***
			(0.203)	(0.212)
R-squared	0.314	0.243	0.375	0.314
F-test	36.22	20.97	27.06	15.56

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The sample includes 392 SIC manufacturing sectors during different periods. All regressions are weighted by start-of-period employment share of the sector. Lower panels present the first stage regression results and F statistics for excluded instruments.

Table 4: US Trade Exposure and Manufacturing Employment: Robustness Checks

	Dep var: 100 × annualized log change in industrial employment						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			1991-2007			1991-2011	
Δ Imports	-0.83***	-1.16***	-1.31***	-0.81***	-0.68***	-0.77***	-0.41
	(0.20)	(0.30)	(0.33)	(0.20)	(0.24)	(0.23)	(0.28)
Δ Exports	0.60***	0.61***	0.82***	0.63***	0.44***	0.57***	0.48**
	(0.11)	(0.16)	(0.18)	(0.11)	(0.14)	(0.13)	(0.19)
1{1991-1999}	-0.61*	-0.53	-0.68	-0.64**		-0.60*	
	(0.34)	(0.39)	(0.41)	(0.30)		(0.32)	
1{1999-2007}	-3.30***	-3.03***	-3.03***	-3.33***	-2.82***		
	(0.30)	(0.41)	(0.37)	(0.29)	(0.38)		
1{1999-2011}						-14.57	-3.65***
						(14.70)	(0.46)
Sector controls	Yes	No	No	Yes	No	Yes	No
Production controls	No	Yes	No	Yes	No	Yes	No
Pretrend controls	No	No	Yes	Yes	No	Yes	No
Industry fixed effects	No	No	NO	No	Yes	No	Yes
Observations	784	784	784	784	784	784	784
First-stage F for Δ Imports	25.17	28.01	28.79	25.74	41.58	22.99	14.19
First-stage F for Δ Exports	18.83	20.73	25.22	18.79	6.40	12.13	4.65

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The sample includes 392 SIC manufacturing sectors during different periods. All regressions are weighted by start-of-period employment share of the sector. First stage F-test for excluded instuments are reported in bottom. Detailed first stage results are available upon request.

Table 5: US Trade Exposure and Other Labor Market Outcomes

	Dep var: 100 × annualized log change in industrial outcome									
	County Business Patterns Dataset				NBER-CES Dataset					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Emp.	Num Estabs.	Emp Per Estab.	Real Wage Bill	Real Wage	Prod. Emp.	Non-Prod. Emp.	Real Prod. Wage	Real Non-Prod. Wage	Real shipments
Δ Imports	-0.83***	-0.24***	-0.59***	-0.69***	0.13**	-0.93***	-0.72***	0.11	-0.07	-0.24
	(0.20)	(0.08)	(0.18)	(0.18)	(0.07)	(0.22)	(0.19)	(0.11)	(0.08)	(0.35)
Δ Exports	0.60***	0.34***	0.25**	0.67***	0.07	0.63***	0.57***	0.13**	0.12	1.07**
	(0.11)	(0.11)	(0.11)	(0.12)	(0.05)	(0.13)	(0.17)	(0.06)	(0.08)	(0.52)
11991-1999	-0.61*	0.17	-0.78***	0.94***	1.55***	-0.26	-0.72**	1.04***	1.71***	3.04***
	(0.34)	(0.20)	(0.28)	(0.32)	(0.09)	(0.39)	(0.34)	(0.06)	(0.11)	(0.57)
11999-2007	-3.30***	-1.21***	-2.08***	-2.92***	0.37***	-3.54***	-2.52***	0.37***	0.08	-0.87**
	(0.30)	(0.22)	(0.24)	(0.31)	(0.12)	(0.33)	(0.33)	(0.08)	(0.12)	(0.35)
Observations	784	784	784	784	784	768	768	768	768	768
R^2	0.545	0.198	0.406	0.508	0.628	0.558	0.385	0.436	0.437	0.408
First-stage F for Δ Imports	27.62									
First-stage F for Δ Exports	17.40									

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The sample includes 392 SIC manufacturing sectors during two subperiods (1991-1999 and 1999-2007), the NBER-CES database excludes 8 industries due to missing data. All regressions are weighted by start-of-period employment share of the sector. First stage F-test for excluded instuments are reported in bottom. Detailed first stage results are available upon request.

Table 6: US Trade Exposure and Employment: Inter-sectoral Linkages

Dep var: 100 × annualized log change in industrial employment						
	(1)	(2)	(3)	(4)	(5)	(6)
Direct Import Exposure	-1.15**	-1.14***		-1.13***		
	(0.45)	(0.37)		(0.34)		
First-Order Upstream Import Exposure	-2.63***	-2.86**	-13.84**	-3.34**		
	(0.96)	(1.21)	(5.60)	(1.40)		
First-Order Downstream Import Exposure	0.97	0.96	0.26	1.53		
	(2.94)	(2.57)	(3.41)	(1.89)		
Direct Export Exposure		0.42***		0.39***		
		(0.15)		(0.15)		
First-Order Upstream Export Exposure		1.97**	5.55	1.27		
		(0.89)	(4.69)	(0.98)		
First-Order Downstream Export Exposure		-0.00	4.09	1.13		
		(1.16)	(2.71)	(1.14)		
Combined Direct/Upstream Import Exposure					-1.32***	-1.37***
					(0.30)	(0.38)
Combined Direct/Upstream Export Exposure					0.74***	0.43**
					(0.22)	(0.21)
Observations	784	784	174	958	958	784

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The sample includes 392 SIC manufacturing sectors and 87 non-manufacturing sectors during different periods. All regressions are weighted by start-of-period employment share of the sector. All regressions have sector (manufacturing/nonmanufacturing) × year fixed effects. Detailed first stage results are available upon request.

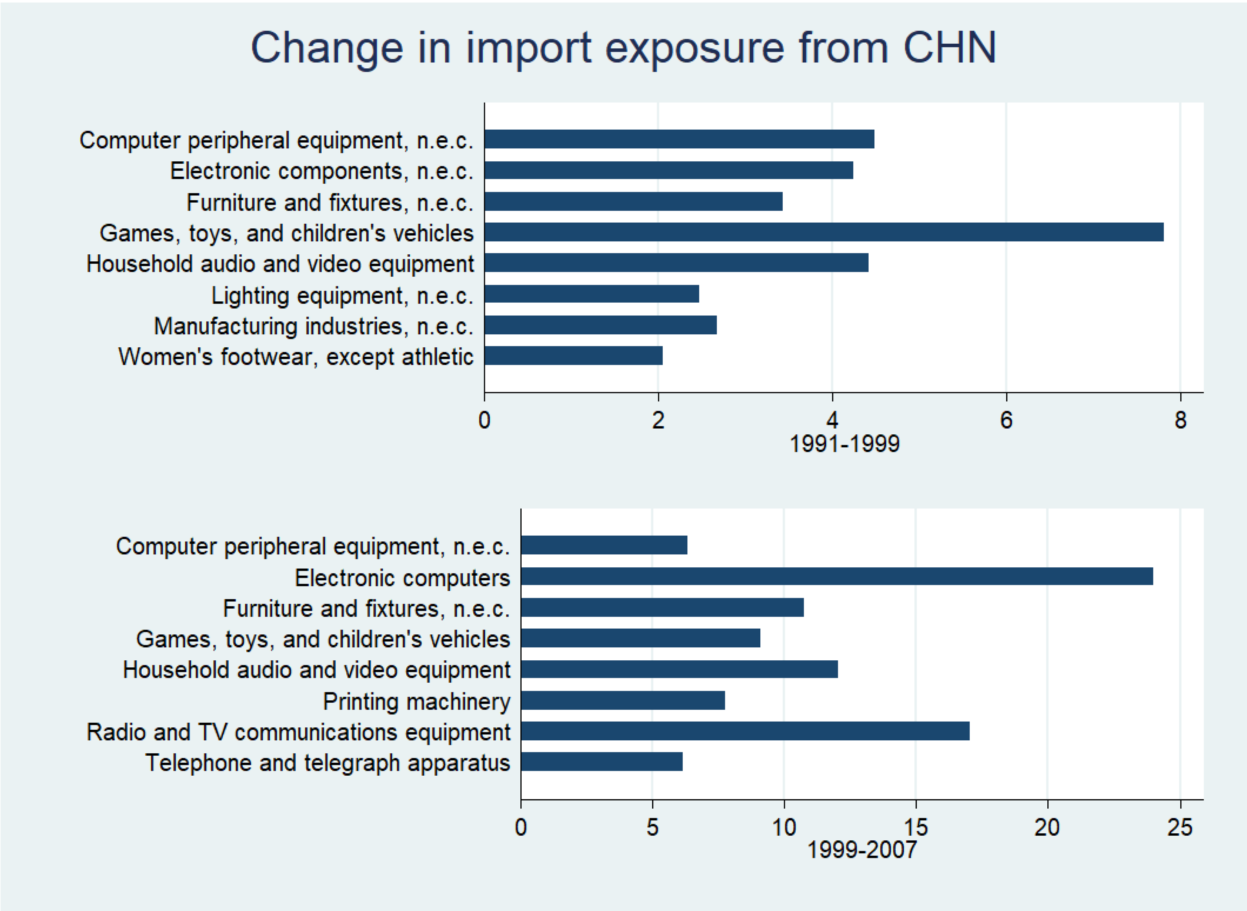
Table 7: US Exports and Manufacturing Employment Share at Commuting Zone level

Dep. var: changes in mfg employment-workingage population ratio				
	(1)	(2)	(3)	(4)
	1991-2007		1991-2011	
Δ Imports	-1.955***	-1.243***	-2.270***	-1.292***
	(0.172)	(0.208)	(0.255)	(0.267)
Δ Exports	0.313*	0.790***	0.333*	0.916***
	(0.180)	(0.279)	(0.193)	(0.275)
share of mfg employment t-1		-1.130***		-1.218***
		(0.287)		(0.235)
Perc of college-educated t-1		-0.004**		-0.002
		(0.001)		(0.001)
Perc of foreign-born t-1		0.001		0.000
		(0.001)		(0.001)
Perc of emp among women t-1		0.002		-0.001
		(0.002)		(0.002)
Perc of emp in routine occupation t-1		-0.017**		-0.020***
		(0.007)		(0.006)
Ave. offshorability index of occupation t-1		-0.041		-0.000
		(0.039)		(0.036)
Constant	-0.043	0.543**	-0.029	0.802***
	(0.029)	(0.213)	(0.027)	(0.191)
Observations	1444	1444	1444	1444
Kleibergen-Paap rk Wald F stat	24.03	13.25	17.06	10.57

Note: Robust standard errors in parentheses, clustered on commuting zones. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
The sample includes 722 commuting zones over two stacked subperiods (1991-1999, and 1999-2007). All regressions are weighted by start-of-period population. All regressions have US census regions dummies and a time dummy for the second period. Detailed first stage results are available upon request.

Appendix

Figure A.1: US Industry Import Exposure: 1991-2007



Note: This figure shows the top 8 SIC products in US imports, in terms of changes in real import value for two subperiods 1991-1999 and 1999-2007. All values are in billion US$, deflated to 2007 US dollars using the PCE price index. Data source: UN-Comtrade

Table A.1: Benchmark Table3: including SITC-Year Fixed effect in predicted export value

Dep var: 100 × annualized log change in industrial employment					
	(1)	(2)	(3)	(4)	(5)
	1991-2007	1991-2007	1991-2011	1991-2007	1991-2011
	OLS	2SLS	2SLS	2SLS	2SLS
Δ Imports	-0.74***	-1.30***	-1.41***	-1.31***	-1.40***
	(0.16)	(0.31)	(0.40)	(0.31)	(0.42)
Δ Exports	0.39**	0.83***	0.79***	0.80***	0.40*
	(0.15)	(0.22)	(0.17)	(0.19)	(0.21)
1{1991-1999}	-0.44	-0.69	-0.63	-0.66	-0.28
	(0.40)	(0.45)	(0.41)	(0.44)	(0.37)
1{1999-2007}	-3.24***	-3.04***		-3.02***	
	(0.38)	(0.42)		(0.39)	
1{1999-2011}			-3.75***		-3.58***
			(0.36)		(0.36)

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: US Trade Exposure and Employment: Inter-sectoral Linkages - Leontief Full Matrix

	Dep var: 100 × annualized log change in industrial employment					
	(1)	(2)	(3)	(4)	(5)	(6)
Direct Import Exposure	-1.18***	-1.13***		-1.09***		
	(0.45)	(0.36)		(0.33)		
Full Upstream Import Exposure	-1.96***	-2.38**	-10.55***	-2.68**		
	(0.71)	(1.03)	(4.03)	(1.17)		
Full Downstream Import Exposure	0.80	0.80	-0.19	0.80		
	(2.27)	(1.91)	(2.70)	(1.47)		
Direct Export Exposure		0.40***		0.39***		
		(0.14)		(0.14)		
Full Upstream Export Exposure		1.43**	5.06	1.18		
		(0.67)	(3.21)	(0.76)		
Full Downstream Export Exposure		0.31	2.24	1.01		
		(0.96)	(1.88)	(0.87)		
Combined Direct/Upstream Import Exposure					-1.32***	-1.36***
					(0.30)	(0.38)
Combined Direct/Upstream Export Exposure					0.72***	0.43**
					(0.22)	(0.19)
Observations	784	784	174	958	958	784

Note: Robust standard errors in parentheses, clustered on three digit SIC industries. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The sample includes 392 SIC manufacturing sectors and 87 non-manufacturing sectors during different periods. All regressions are weighted by start-of-period employment share of the sector. All regressions have sector (manufacturing/nonmanufacturing) × year fixed effects. Detailed first stage results are available upon request.