The "China Shock", Exports and U.S. Employment:

A Global Input-Output Analysis*

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Abstract

We quantify the impact on U.S. employment from imports and exports during 1995-2011, using the World Input-Output Database. We find that the growth in U.S. exports led to increased demand for 2 million jobs in manufacturing, 0.5 million in resource industries, and a remarkable 4.1 million jobs in services, totaling 6.6 million. Two-thirds of those service sectors jobs are due to the export of services themselves, whereas one-third is due to the intermediate demand from manufacturing and resource – or *merchandise* – exports, so the total labor demand gain due to merchandise exports was 3.7 million jobs. In comparison, U.S. merchandise imports from China led to reduced demand of 1.4 million jobs in manufacturing and 0.6 million in services (with small losses in resource industries), with total job losses of 2.0 million. It follows that the expansion in U.S. merchandise exports relative to imports from China over 1995-2011 created net demand for about 1.7 million jobs. Comparing the growth of U.S. merchandise exports to merchandise imports from *all* countries, we find a fall in net labor demand due to trade, but comparing the growth of *total* U.S. exports to total imports from all countries, then there is a rise in net labor demand because of the growth in service exports.

Key words: China, exports, employment, services, global input-output table
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1. Introduction

Arguably among the most significant event in international trade in recent decades has been the rapid rise in exports from China since its entry into the World Trade Organization (WTO) in 2001, or the "China shock". Even before that date China received the low, most-favored-nation tariffs associated with WTO membership by a vote of the U.S. Congress each year. But after China's accession to the WTO, the reduction in the uncertainty associated with that vote contributed importantly to the surge in exports to the United States. This argument is made by Pierce and Schott (2016) and by Handley and Limão (2017).[1] Pierce and Schott find that the surge in Chinese exports to the United States coincides with a substantial decline in U.S. manufacturing employment. Handley and Limão find that the welfare gain for consumers due to this increase in Chinese imports is of the same order of magnitude as the U.S. gain from new imported varieties in the preceding decade. These findings highlight the dual roles that Chinese imports play for the United States: on the one hand, they create import competition and labor-market dislocation; and on the other hand, they benefit U.S. consumers.[2]

The first of these roles is pursued in a series of papers by Autor, Dorn, and Hanson (2013, 2014, and with Song, 2015). They analyze the effect of rising Chinese import competition between 1990 and 2007 on local U.S. labor markets, exploiting the geographic differences in import exposure arising from initial differences in industry specialization. Rising import exposure increases unemployment, lowers labor force participation, and reduces wages in local labor markets. At the aggregate level, a conservative estimate is that the import surge account for one-quarter of the decline in U.S. manufacturing employment. Most recently, in joint work with

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[1] See also the confirming empirical evidence in Feng, Li and Swenson (2017).

[2] Amiti, Dai, Feenstra and Romalis (2017) argue that the consumer benefits in the United States are due more to China's reduction in its own tariffs on intermediate inputs, which led to a drop in the price of exports to the U.S., rather than the reduction in the uncertainty of tariffs in the U.S.

Acemoglu and Price, these authors find that the import surge from China also contributes to the unusually slow employment growth in the United States following the financial crisis and the Great Recession (Acemoglu, Autor, Dorn, Hanson and Price, 2016).

While these papers by Autor, Dorn, Hanson and co-authors have explored the negative impact of import competition from China on employment in the United States, some recent articles highlight the role of China as an engine of world economic growth (e.g. Vianna, 2016; IMF, 2017; World Bank, 2017). These articles speak to the second role played by China, in bringing consumer benefits as well as benefits to workers in export-oriented industries. Feenstra, Ma and Xu (2017) have examined the positive employment effects of U.S. exports using techniques similar to those in Autor, Dorn, and Hanson (2013, 2015). Depending on the estimation method, they find the employment in manufacturing industries grew by roughly the same amount due to global exports as the decline in employment due to Chinese imports. This result is perhaps not surprising given the magnitude of growth in U.S. exports as compared to total imports and imports from China. Relative to GDP, U.S. exports rose by 10 percentage points from 1995 to 2011, imports rose by 15 percentage points, and imports from China rose by 4 percentage points from a very low base; see Figure 1. So whether we focus on U.S. exports to the world or on imports from China, the magnitude of changes over this period has been large and the potential employments effects are correspondingly large.

In this paper, we quantify the employment impacts of U.S. imports and exports using a global input-output analysis.[3] Specifically, we use the World Input-Output Database (WIOD) of Timmer et al. (2014, 2015). In section 2 we follow the method of Los, Timmer and de Vries (2015, 2016), which focuses on the demand side of the labor market, to quantify the positive

[3] Wang et al. (2017) extend the regression analysis of Autor, Dorn and Hanson (2013, 2015) by using input-output variables. Feenstra and Sasahara (2017) and Wood (2017) also rely on global input-output analysis.

impact from U.S. exports on employment. We find that the growth in exports led to demand for 2 million jobs in manufacturing, 0.5 million in resource industries, and a remarkable 4.1 million jobs in services over 1995-2011, totaling 6.6 million. Two-thirds of those service sectors jobs are due to the export of services themselves, whereas one-third is due to the intermediate demand from the manufacturing and resource – or what we call *merchandise* – exports, so the total demand gains from merchandise exports are 3.7 million jobs, with 1.9 million in manufacturing, 0.45 million in natural resource industries, and 1.3 million in services. That 1.9 million jobs in manufacturing is much the same as the 1.9 million added jobs for an earlier 16 year period, 1991-2007, estimated by Feenstra, Ma and Xu (2017).

In section 3 we consider U.S. imports from China. In that case, we must specify the added U.S. production that would occur if imports from China had not grown, and we consider several possible assumptions along these lines. Our preferred estimates give reduced demand due to U.S. imports from China of 1.4 million jobs in manufacturing, and another 1 million in services (with small losses in resource industries), over 1995-2011. One-half of those job losses in services are due to increased U.S. service imports, with the other half due to intermediate demand from merchandise exports, so the total demand reduction due to merchandise (mainly manufacturing) imports are 2.0 million jobs. The import estimates are very close to those from Acemoglu, Autor, Dorn, Hanson and Price (2016), who find about 1.0 million jobs lost directly in manufacturing and another 1.0 million jobs lost through throughout the economy through input-output linkages, during the slightly shorter period 1999-2011. It follows that the expansion in U.S. merchandise exports relative to imports from China over 1995-2011 led to net demand for about 1.7 million jobs. Extending our analysis to compare the growth of U.S. merchandise exports to merchandise imports from *all* countries in section 4, we find a fall in net labor demand due to trade, but comparing the growth of *total* U.S. exports to total imports from all countries, then there is a rise in net labor demand because of the growth in service exports.

There are two limitations of the global input-output analysis. First, as we have already indicated, the employment effects are calculated from the *demand side* of the labor market, without consideration of how the labor market will clear. This limitation could be addressed by incorporating the global input-output tables into a computable model with frictional labor market clearing (e.g. Caliendo, Dvorkin and Parro, 2015), but we do not attempt that here. Second, the changes in exports or imports that are held fixed to compute their impact on employment are the *actual* changes in these trade flows, and not the *exogenous* portion of these changes that result from a specific cause. Autor, Dorn, and Hanson (2013, 2015), for example, use Chinese exports to eight other countries to instrument for Chinese exports to the U.S. In section 5 we pursue a similar approach of predicting the change in U.S. merchandise imports from China and total exports that are due to exogenous factors, including tariff changes and demand shifts. We find that nearly two-thirds of the employment impacts are explained by these factors. Conclusions are given in section 6 and additional material is gathered in the Appendixes.

2. U.S. Exports and Employment

2.1 Structure of the Global Input-Output Table

We consider a *N*-country and *S*-sector case to match with the WIOD input-output table, which has $N = 41$ countries including the rest of the world and $S = 35$ sectors. Let $x^{(i,r),(j,s)}$ denote the value of intermediate goods produced in sector *r* of country *i* and used by sector *s* of country *j*. Final good flows are also described in a similar manner: $d^{(i,r),j}$ indicates the value of final good produced in sector *r* of country *i* and demanded in country *j*. The gross value of output of sector *r* of country *i*, $y^{i,r}$, is computed as the sum of sales for intermediate and final use over all purchasing sectors and countries:

$$y^{i,r} = \sum_s \sum_j x^{(i,r),(j,s)} + \sum_j d^{(i,r),j} . \qquad (1)$$

By dividing the intermediate good flows by the gross output in the destination sector of the destination country, we find the input-output coefficients:

$$a^{(i,r),(j,s)} \equiv x^{(i,r),(j,s)} / y^{j,s} ,$$

which are arranged in the matrix,

$$\mathbf{A} \equiv \begin{bmatrix} a^{(1,1),(1,1)} & a^{(1,1),(1,2)} & \cdots & a^{(1,1),(N,S)} \\ a^{(1,2),(1,1)} & a^{(1,2),(1,2)} & \cdots & a^{(1,2),(N,S)} \\ \vdots & \vdots & \ddots & \vdots \\ a^{(2,1),(1,1)} & a^{(2,1),(1,2)} & \cdots & a^{(2,1),(N,S)} \\ \vdots & \vdots & \ddots & \vdots \\ a^{(N,S),(1,1)} & a^{(N,S),(1,2)} & \cdots & a^{(N,S),(N,S)} \end{bmatrix} .$$

With *N* countries and *S* sectors, the global input-output matrix **A** is $(N \times S) \times (N \times S)$, and it extends the Leontief (1936) matrix to include international linkages between countries.

Denote the final demand of country *j* buying from country *i* with the $S \times 1$ vector $\mathbf{d}^{i,j}$,

$$\underbrace{\mathbf{d}_t^{i,j}}_{S\times 1} = \begin{bmatrix} d^{(i,1),j} \\ d^{(i,2),j} \\ \vdots \\ d^{(i,S),j} \end{bmatrix} \quad \text{and} \quad \underbrace{\mathbf{D}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}^{1,k} \\ \sum_k \mathbf{d}^{2,k} \\ \vdots \\ \sum_k \mathbf{d}^{N,k} \end{bmatrix},$$

where **D** is the stacked vector of final demands over all countries. Likewise we denote the gross output from country *i* as the $S \times 1$ vector $\mathbf{y}^i$, and we stack these in the $(N \times S) \times 1$ vector **Y**.

Then equation (1) is written alternatively as

$$\mathbf{Y} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{D} ,$$

where $\mathbf{I}$ denotes an identity matrix. The inverse $(\mathbf{I} - \mathbf{A})^{-1}$ can be expressed as a geometric series: $(\mathbf{I} - \mathbf{A})^{-1}\mathbf{D} = \sum_{n=0}^{\infty} \mathbf{A}^n \mathbf{D}$. The first term $\mathbf{D}$ is the direct output absorbed as final goods, the second term $\mathbf{AD}$ is the intermediate goods used to produce those final goods, including imported intermediate goods, and the third term $\mathbf{A}^2\mathbf{D}$ includes the additional intermediate goods employed to produce the first round of intermediate goods $\mathbf{AD}$, etc.

The $(N \times S) \times 1$ vector of employment in each country and sector is obtained by multiplying the gross outputs by the ratio of employment to gross output in each sector, denoted by $\lambda^{(i,s)}$, with the $(N \times S) \times (N \times S)$ diagonal matrix $\mathbf{\Lambda}$, to obtain:

$$\mathbf{L} = \mathbf{\Lambda}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{D} . \tag{2}$$

We shall use the global input output table provided by WIOD (Timmer et al., 2014, 2015), which differs by year, so we henceforth add the subscript *t* to all variables. It is worth stressing that (2) holds identically in WIOD in all years, meaning that labor demand (on the right) equal supply (on the left). In our calculations we will be investigating changes to demand, but without imposing labor-market clearing.

2.2 Quantifying the Employment Effect of Export Expansion

In this section we employ the technique proposed by Los et al. (2015) to quantify the employment effect of the growth in U.S. exports to the world. Since the first year of the WIOD database is 1995, as the baseline the employment effect of export expansion is computed as:

$$\tilde{\mathbf{L}}_{1995,t}^{EX1} = \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\tilde{\mathbf{D}}_{1995,t}^{EX} , \tag{3}$$

where $\tilde{\mathbf{D}}_{1995,t}^{EX}$ is the hypothetical final demand matrix defined as follows:

$$\underbrace{\tilde{\mathbf{D}}_{1995,t}^{EX}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ \mathbf{d}_t^{US,US} + \sum_{k\neq US} \mathbf{d}_{1995}^{US,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix}.$$

From this definition, exports from the U.S. to the rest of the world are kept at the 1995 level $\sum_{i\neq US} d_{1995}^{US,i}$ while the U.S. domestic purchases from the U.S. final-good producers $d_t^{US,US}$ and trade in other countries are allowed change over time as they did.

The first term on the right of (3) measures the actual employment, while the latter term is the employment in a hypothetical world where U.S. exports stayed the same at the 1995 level. The gap between the two is interpreted as the employment effect of export expansion. A positive number means job creation while a negative number implies job destruction. Although this measure takes final good exports in the final demand matrix $\mathbf{D}_t$ into consideration, it does not take intermediate good exports in the global input-output matrix $\mathbf{A}_t$ into account. The next measure also includes changes in the exports of intermediate goods:

$$\tilde{\mathbf{L}}_{1995,t}^{EX\,2} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\tilde{\mathbf{A}}_{1995,t}^{EX})^{-1}\tilde{\mathbf{D}}_{1995,t}^{EX},$$

where,

$$\underbrace{\tilde{\mathbf{A}}_{1995,t}^{EX}}_{(N\times S)\times(N\times S)} = \begin{bmatrix} \mathbf{A}_t^{1,1} & \mathbf{A}_t^{1,2} & \cdots & \mathbf{A}_t^{1,US} \cdots & \mathbf{A}_t^{1,N} \\ \mathbf{A}_t^{2,1} & \mathbf{A}_t^{2,2} & \cdots & \mathbf{A}_t^{2,US} \cdots & \mathbf{A}_t^{2,N} \\ \vdots & \vdots & \ddots & \vdots \quad \ddots & \vdots \\ \mathbf{A}_{1995}^{US,1} & \mathbf{A}_{1995}^{US,2} & \cdots & \mathbf{A}_t^{US,US} \cdots & \mathbf{A}_{1995}^{US,N} \\ \vdots & \vdots & \ddots & \vdots \quad \ddots & \vdots \\ \mathbf{A}_t^{N,1} & \mathbf{A}_t^{N,2} & \cdots & \mathbf{A}_t^{N,US} \cdots & \mathbf{A}_t^{N,N} \end{bmatrix},$$

denotes the global input-output matrix where each of elements in the matrix is a $S\times S$ sub-matrix describing intermediate good flows from a country to another:

$$\underbrace{\mathbf{A}_t^{i,j}}_{S\times S} = \begin{bmatrix} a_t^{(i,1),(j,1)} & a_t^{(i,1),(j,2)} & \cdots & a_t^{(i,1),(j,S)} \\ a_t^{(i,2),(j,1)} & a_t^{(i,2),(j,2)} & \cdots & a_t^{(i,2),(j,S)} \\ \vdots & \vdots & \ddots & \vdots \\ a_t^{(i,S),(j,1)} & a_t^{(i,S),(j,2)} & \cdots & a_t^{(i,S),(j,S)} \end{bmatrix},$$

which is a matrix of Leontief coefficients $a_t^{(i,r),(j,s)}$ denoting the intermediate good flows from sector *r* of country *i* to sector *s* of country *j* in year t. But for the U.S. sub-matrices, $\{\mathbf{A}_{1995}^{US,k}\}_{k\neq US}$, the intermediate good flows from 1995 are employed to find the coefficients.

$\tilde{\mathbf{L}}_{1995,t}^{EX1}$ and $\tilde{\mathbf{L}}_{1995,t}^{EX2}$ are both stacked $(N\times S)\times 1$ vector of the employment effects over all sectors and countries, and in either case we are particularly interested in the $S\times 1$ sub-vector for the U.S., $\tilde{\mathbf{L}}_{1995,t}^{EX,US}$. Using the sectors available in WIOD, we aggregate the U.S. employment effects into the natural resource sector (i.e. agricultural and mining, WIOD sectors 1-3), manufacturing (sectors 4-16), and services (sectors 17-35), as follows:[4]

$$\tilde{L}_{1995,t}^{EX,US}(Resource) = \sum_{s=1}^{3} \tilde{L}_{1995,t}^{EX,US}(s),$$

$$\tilde{L}_{1995,t}^{EX,US}(Manufacturing) = \sum_{s=4}^{16} \tilde{L}_{1995,t}^{EX,US}(s), \tag{4}$$

$$\tilde{L}_{1995,t}^{EX,US}(Services) = \sum_{s=17}^{35} \tilde{L}_{1995,t}^{EX,US}(s).$$

The overall employment effect in the U.S. economy is

$$\tilde{L}_{1995,t}^{EX,US}(All\ sectors) = \sum_{s=1}^{35} \tilde{L}_{1995,t}^{EX,US}(s) \tag{5}$$

The same aggregation as (4)-(5) applied to the rest of the employment effect measures presented in this paper.

[4] See Appendix A for the list of the WIOD sectors.

The results from estimating the employment effect of export expansion are shown in Table 1. Final good exports added demand for 760 thousand manufacturing jobs over 1995-2011, which is 4.5% of total manufacturing employment in 1995. By taking intermediate exports into account, the employment effect of export expansion becomes even greater – export expansion added demand for 2.0 million manufacturing jobs, and another 0.5 million jobs in resource industries. These estimates are only slightly larger than found for another 16 year period by Feenstra, Ma and Xu (2017, note 9), who find gains in manufacturing jobs of 1.9 million due to rising U.S. exports over 1991-2011. Still, considering that our input-output analysis is purely on the demand side, whereas Feenstra, Ma and Xu are using equilibrium changes in employment, and that we have not yet attempted to isolate exogenous changes in exports, there is surprising similarity between the two sets of estimates. The extent of demand creation due to U.S. exports is the greatest for the service sector, where final good exports added 0.9 million jobs while intermediate exports added another extra 3.2 million jobs– 4.1 million in total.

These total estimates for the three sectors are carried over into column (1) of Table 2. There we separate the direct plus indirect effects of manufacturing and resource exports – or what we call *merchandise* exports – from the direct plus indirect effect of service exports. We see that for the merchandise sectors, nearly the entire added labor demand is due to the exports of these industries themselves. But for the service sector, comparing columns (2) and (3) of Table 2, we find *one-third* of the job gains arise indirectly due to manufacturing and resource exports, whereas *two-thirds* of these job gains are explained by exports of final or intermediate services themselves. Our focus in this paper shall be on the exports of manufacturing and resource industries, including its intermediate demand for service jobs. From column (2), then, we see that U.S. exports led to increased demand of about 1.9 million manufacturing jobs, 0.45 resource industry jobs and 1.3 service sector jobs, or 3.7 million jobs in total during 1995-2011. These results show that U.S. labor demand has grown substantially from export opportunities.

3. Quantifying the Employment Effect of Imports from China

In order to quantify the employment effect of export expansion, in the previous section we replaced current export values with the one from benchmark year, 1995. Quantifying the employment effect of import competition from China is not as simple, however, as it is for export expansion. We will show that simply replacing the current China import values with the values from 1995 leads to a misleading estimate. In order to understand this result, we first consider a simple two-country, one-sector world, and solve for the employment effects analytically using expansions based on Johnson and Noguera (2012).

3.1 Two-Country, One-Sector Case

Suppose that there are only two countries, the U.S. and China, indicated by superscripts *US* and *C*, respectively. Each country is comprised of only one sector. The employment effect of import competition from China is estimated as the gap between the actual employment and the one in a hypothetical world where U.S. imports from China are fixed at the 1995 level:

$$\begin{pmatrix} \tilde{L}^{IM,C}_{1995,t} \\ \tilde{L}^{IM,\mathrm{US}}_{1995,t} \end{pmatrix} = \underbrace{\begin{pmatrix} \lambda^C_t & 0 \\ 0 & \lambda^{US}_t \end{pmatrix} \left[\mathbf{I} - \begin{pmatrix} a^{C,C}_t & a^{C,US}_t \\ a^{US,C}_t & a^{US,US}_t \end{pmatrix} \right]^{-1} \begin{pmatrix} d^{C,C}_t + d^{C,US}_t \\ d^{US,US}_t + d^{US,C}_t \end{pmatrix}}_{Actual\ employment}$$
$$- \underbrace{\begin{pmatrix} \lambda^C_t & 0 \\ 0 & \lambda^{US}_t \end{pmatrix} \left[\mathbf{I} - \begin{pmatrix} a^{C,C}_t & a^{C,US}_t \\ a^{US,C}_t & a^{US,US}_t \end{pmatrix} \right]^{-1} \begin{pmatrix} d^{C,C}_t + d^{C,US}_{1995} \\ d^{US,US}_t + d^{US,C}_t \end{pmatrix}}_{Hypothetical\ employment},$$

where λ^i_t is the employment-to-gross output ratio for country $i = US, C$ in year *t*; $a^{i,j}_t$ denotes the input-output coefficient describing intermediate good flows from country *i* to country *j* in year *t*; and $d_t^{i,j}$ denotes final good flows from country *i* to country *j* in year *t*.

Solving for the U.S. employment effect $\tilde{L}_{1995,t}^{IM,US}$ due to fixed imports, we obtain:

$$\begin{aligned}\tilde{L}_{1995,t}^{IM,US} &= \lambda_t^{US}\mu^{US}\left[(d_t^{US,US}+d_t^{US,C})+\frac{a_t^{US,C}}{1-a_t^{C,C}}(d_t^{C,US}+d_t^{C,C})\right] \\ &\quad -\lambda_t^{US}\mu^{US}\left[(d_t^{US,US}+d_t^{US,C})+\frac{a_t^{US,C}}{1-a_t^{C,C}}(d_{1995}^{C,US}+d_t^{C,C})\right] \\ &= \lambda_t^{US}\mu^{US}\frac{a_t^{US,C}}{1-a_t^{C,C}}(d_t^{C,US}-d_{1995}^{C,US})>0,\end{aligned}$$

where $\mu_t^{US}\equiv\left(1-a_t^{US,US}-\frac{a_t^{US,C}a_t^{C,US}}{1-a_t^{C,C}}\right)^{-1}\geq 1$ is an intermediate good multiplier that describes account the total amount of gross output from the U.S. required to produce one unit of U.S. net output. Because imports from China to the U.S are increasing over time since 1995, $d_t^{C,US}>d_{1995}^{C,US}$ for $t>1995$, it follows that $\tilde{L}_{1995,t}^{IM,US}>0$, meaning that the employment effect of imports from China becomes positive. In order to understand why this is the case, we look at the first term of the above equation carefully.

The U.S. employment which appears as the first bracketed term above has two components. The first, $\lambda_t^{US}\mu_t^{US}(d_t^{US,US}+d_t^{US,C})$, is the total number of workers employed in the U.S. to produce final goods absorbed by the U.S., $d_t^{US,US}$, and exported to China, $d_t^{US,C}$. The second component, $\lambda_t^{US}\mu_t^{US}\frac{a_t^{US,C}}{1-a_t^{C,C}}(d_t^{C,US}+d_t^{C,C})$, is the total number of workers employed in the U.S. to produce goods in China. In order to consume final goods of $d_t^{C,C}$ and export final goods of $d_t^{C,US}$, Chinese producers need to produce $(1-a_t^{C,C})^{-1}(d_t^{C,US}+d_t^{C,C})$ units of output, which requires $a_t^{US,C}(1-a_t^{C,C})^{-1}(d_t^{C,US}+d_t^{C,C})$ units of U.S. output as intermediates. In the second bracketed term above, we hypothetically hold fixed U.S. imports from China at their 1995 level. But then we find that the employment level in the U.S. is *less than* the actual employment level, because the U.S. loses intermediate demand from China. As a result, the gap between the actual and hypothetical employment, $\tilde{L}_{1995,t}^{IM,US}$, becomes positive, meaning that U.S. imports from China have a positive employment creation effect.

This counter-intuitive result occurs because we have not taken into account the impact of fixed U.S. imports from China on U.S. domestic production $d_t^{US,US}$ (and intermediate use $a_t^{US,US}$). In a hypothetical world where U.S. imports from China are fixed at their 1995 level, we would expect that U.S. domestic production should be higher than otherwise in order to meet U.S. domestic demand. Denote the hypothetical U.S. domestic final good production when imports from China are fixed as $\tilde{d}_{1995,t}^{US,US}$, which we expect is greater than $d_t^{US,US}$.With this adjusted U.S. domestic final good production, the employment effect of China is now estimated as:

$$\begin{pmatrix} \tilde{L}_{1995,t}^{IM,C} \\ \tilde{L}_{1995,t}^{IM,US} \end{pmatrix} = \underbrace{\begin{pmatrix} \lambda_t^C & 0 \\ 0 & \lambda_t^{US} \end{pmatrix} \left[\mathbf{I} - \begin{pmatrix} a_t^{C,C} & a_t^{C,US} \\ a_t^{US,C} & a_t^{US,US} \end{pmatrix} \right]^{-1} \begin{pmatrix} d_t^{C,C} + d_t^{C,US} \\ d_t^{US,US} + d_t^{US,C} \end{pmatrix}}_{Actual\ \ employment}$$

$$- \underbrace{\begin{pmatrix} \lambda_t^C & 0 \\ 0 & \lambda_t^{US} \end{pmatrix} \left[\mathbf{I} - \begin{pmatrix} a_t^{C,C} & a_t^{C,US} \\ a_t^{US,C} & a_t^{US,US} \end{pmatrix} \right]^{-1} \begin{pmatrix} d_t^{C,C} + d_{1995}^{C,US} \\ \tilde{d}_{1995,t}^{US,US} + d_t^{US,C} \end{pmatrix}}_{Hypothetical\ employment}.$$

The U.S. employment effect is now calculated as,

$$\tilde{L}_{1995,t}^{IM,US} = \underbrace{\lambda_t^{US} \mu_t^{US} (d_t^{US,US} - \tilde{d}_{1995,t}^{US,US})}_{(-)} + \underbrace{\lambda_t^{US} \mu_t^{US} \frac{a_t^{US,C}}{1 - a_t^{C,C}} (d_t^{C,US} - d_{1995}^{C,US})}_{(+)},$$

which is negative if the job loss through reduced U.S. domestic production (the first term) exceeds the job gain through China's intermediate good demand (the second term).

This simple two-country and one-sector example shows that simply replacing imports from China to the U.S. with the one from benchmark year does not lead to a reasonable result, because U.S. domestic production also needs to be adjusted. In Appendix B, we confirm that this counter-intuitive result holds quantitatively in the multi-country, multi-sector WIOD model. In the following section, we consider the general case and propose ways to find hypothetical U.S. domestic production when imports from China stay at the benchmark year level.

3.2 *N*-Country and *S*-Sector Case

The employment effect of U.S. imports from China is estimated in the general *N*-country and *S*-sector case as follows:

$$\tilde{\mathbf{L}}^{IM1}_{1995,t} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\tilde{\mathbf{D}}^{IM}_{1995,t}, \tag{6}$$

where,

$$\underbrace{\mathbf{D}_t}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{C,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{US,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix} \text{ and } \underbrace{\tilde{\mathbf{D}}^{IM}_{1995,t}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ \mathbf{d}_{1995}^{C,US} + \sum_{k\neq US} \mathbf{d}_t^{C,k} \\ \vdots \\ \tilde{\mathbf{d}}_{1995,t}^{US,US} + \sum_{k\neq US} \mathbf{d}_t^{US,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix}.$$

The first term in equation (6), $\mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t$, is the actual employment effect due to the total demand (equivalent to the total employment) while the second term, $\mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\tilde{\mathbf{D}}^{IM}_t$, is the employment effect of the total demand in a hypothetical world where an increase in imports from China since 1995 are replaced with some increase in U.S. domestic demand to U.S.

domestic producers. The hypothetical U.S. demand to final-good producers in sector *s* in year *t*, $\tilde{d}_{1995,t}^{(US,s),\,US}$, is calculated using the following three functional forms:

Functional form #1: $\tilde{d}_{1995,t}^{(US,s),US} = d_t^{(US,s),US} + \left[d_t^{(C,s),US} - d_{1995}^{(C,s),US} \right]$

Functional form #2: $$\tilde{d}_{1995,t}^{(US,s),US} = \underbrace{\frac{d_{1995}^{(US,s),US}}{\sum_{k=1}^{N} d_{1995}^{(k,s),US}}}_{Hypothetical\ share\ of\ U.S.\ producers} \times \underbrace{\sum_k d_t^{(k,s),US}}_{Total\ U.S.\ final\ good\ demand}$$

Functional form #3: $$\tilde{d}_{1995,t}^{(US,s),US} = \underbrace{\frac{d_t^{(US,s),US}}{d_{1995}^{(C,s),US} + \sum_{k \neq C} d_t^{(k,s),US}}}_{Hypothetical\ share\ of\ U.S.\ producers} \times \underbrace{\sum_k d_t^{(k,s),US}}_{Total\ U.S.\ final\ good\ demand}$$

Functional form #1 assumes that imports from China exactly replace U.S. domestic production. With Chinese imports held fixed at their 1995 level, then U.S. production increases commensurate with the growth that would have occurred in Chinese imports. Functional form #2 assumes that U.S. domestic production increases proportionately to the actual increase in the total U.S. final demand, assuming that U.S. market share in the U.S. domestic market is constant at the 1995 level, $d_{1995}^{(US,s),US} / \sum_{k=1}^{N} d_{1995}^{(k,s),US}$. This case actually accounts for changing imports from *all* countries, since it holds imports from all countries constant in the denominator of the hypothetical share term. We will see that this functional form gives the greatest employment impact. In functional form #3, we hold only imports from China constant in the share term, so we are allowing those imports to crowd out not just U.S. production but also imports from other countries, proportional to their market shares.

Measure (6) quantifies the employment effect of final goods imports from China, with adjustment to U.S. production of final goods. It does not take into account, however, possible adjustments to the imports of intermediate goods. To incorporate these adjustments, we use a second measure of the employment effect:

$$\tilde{\mathbf{L}}^{IM2}_{1995,t} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\tilde{\mathbf{A}}^{IM}_{1995,t})^{-1}\tilde{\mathbf{D}}^{IM}_{1995,t}, \tag{7}$$

where $\tilde{\mathbf{A}}^{IM}_{1995,t}$ is a $(N\times S)\times(N\times S)$ global input-output matrix representing a hypothetical situation that imports from China to the U.S. are kept at the 1995 level:

$$\underbrace{\tilde{\mathbf{A}}^{IM}_{1995,t}}_{(N\times S)\times(N\times S)} = \begin{bmatrix} \mathbf{A}^{1,1}_t & \mathbf{A}^{1,2}_t & \cdots & \mathbf{A}^{1,US}_t \cdots & \mathbf{A}^{1,N}_t \\ \mathbf{A}^{2,1}_t & \mathbf{A}^{2,2}_t & \cdots & \mathbf{A}^{2,US}_t \cdots & \mathbf{A}^{2,N}_t \\ \vdots & \vdots & \ddots & \vdots \quad \ddots & \vdots \\ \mathbf{A}^{C,1}_t & \mathbf{A}^{C,2}_t & \cdots & \tilde{\mathbf{A}}^{C,US}_{1995,t} \cdots & \mathbf{A}^{C,N}_t \\ \vdots & \vdots & \ddots & \vdots \quad \ddots & \vdots \\ \mathbf{A}^{US,1}_t & \mathbf{A}^{US,2}_t & \cdots & \tilde{\mathbf{A}}^{US,US}_{1995,t} \cdots & \mathbf{A}^{US,N}_t \\ \vdots & \vdots & \ddots & \vdots \quad \ddots & \vdots \\ \mathbf{A}^{N,1}_t & \mathbf{A}^{N,2}_t & \cdots & \mathbf{A}^{N,US}_t \cdots & \mathbf{A}^{N,N}_t \end{bmatrix}.$$

Each element in this matrix is a $S\times S$ Leontief matrix. The matrix for intermediate flows from China to the U.S. is $\tilde{\mathbf{A}}^{C,US}_{1995,t}$, with elements $\tilde{a}^{(C,r),(US,s)}_{1995,t}$, describing the intermediate imports from China fixed at their 1995 level:

$$\tilde{a}^{(C,r),(US,s)}_{1995,t} \equiv x^{(C,r),(US,s)}_{1995} / y^{US,s}_t. \tag{8}$$

Correspondingly, the matrix for intermediate flows within the U.S. is $\tilde{\mathbf{A}}^{US,US}_{1995,t}$, with elements $\tilde{a}^{(US,r),(US,s)}_{1995,t}$, describes intermediate flows from sector *r* to sector *s* of the U.S. when demand has shifted towards U.S. producers:

$$\tilde{a}^{(US,r),(US,s)}_{1995,t} \equiv \tilde{x}^{(US,r),(US,s)}_{1995,t} / y^{US,s}_t.$$

The intermediates value $\tilde{x}_{1995,t}^{(US,r),(US,s)}$ sold from sector r to sector s of the U.S. are calculated using the same three functional forms as used for final goods:

Functional form #1: $\tilde{x}_{1995,t}^{(US,r),(US,s)} = x_t^{(US,r),(US,s)} + \left[x_t^{(C,r),(US,s)} - x_{1995}^{(US,r),(US,s)} \right]$

Functional form #2: $\tilde{x}_{1995,t}^{(US,r),(US,s)} = \underbrace{\frac{x_{1995}^{(US,r),(US,s)}}{\sum_{k=1}^{N} x_{1995}^{(k,r),(US,s)}}}_{Hypothetical\ share\ of\ U.S.\ producers} \times \underbrace{\sum_k x_t^{(k,r),(US,s)}}_{Total\ U.S.\ intermediate\ good\ demand}$

Functional form #3: $\tilde{x}_{1995,t}^{(US,r),(US,s)} = \underbrace{\frac{x_t^{(US,r),(US,s)}}{x_{1995}^{(C,r),(US,s)} + \sum_{k \neq C} x_t^{(k,r),(US,s)}}}_{Hypothetical\ share\ of\ U.S.\ producers} \times \underbrace{\sum_k x_t^{(k,r),(US,s)}}_{Total\ U.S.\ intermediate\ good\ demand}$

Table 3 summarizes the employment effect of imports from China estimated by adjusting the U.S. domestic production using the three functional forms above. Panels A through C show the result from using functional forms #1 through #3, respectively. Panel A shows that final good imports from China led to reduced labor demand of 0.8 million jobs in manufacturing, 40 thousand jobs in resource industries, and 350 thousand service sector jobs, or 1.2 million jobs in total. Together with intermediate goods imports from China, reduced U.S. labor demand become 1.4 million, 60 thousand, and 960 thousand in the manufacturing, resource, and the service sector, respectively, or 2.4 million jobs in total.

Panel B reports the result from using functional form #2. It predicts a greater negative employment impact in the manufacturing and the resource sectors. Final good and intermediate imports from China reduce demand for manufacturing jobs by 2.9 million and resource jobs by 0.5 million. Together with 2.5 million service sector jobs lost, the overall job losses add up to 5.9 million. Functional form #3 leads to the smallest demand reduction as shown in Panel C. Imports of final goods and intermediate goods from China led to 0.7 million job losses in manufacturing, 40 thousand job losses in resource industries, and another 0.7 million job losses in services, for overall reduced demand of 1.4 million jobs.

Our results are evidently sensitive to the assumed functional form for the implied U.S. domestic production. In the next section, we utilize the actual data to relate the market share of U.S. domestic producers to imports from China in regression framework, and propose a fourth estimate of the employment effect of these imports.

3.3 Estimating U.S. Producers' Domestic Market Share

Rather than assuming relationship between imports from China and the U.S. producers market share, we shall estimate it as:

$$\frac{d_t^{(US,s),US}}{\sum_{k=1}^{N} d_t^{(k,s),US}} = \alpha_0^s + \alpha_1 \frac{d_t^{(C,s),US}}{\sum_{k=1}^{N} d_t^{(k,s),US}} + u_t^s , \qquad (9)$$

where the dependent variable is the U.S. market share in the domestic final good market; $d_t^{(C,s),US} / \sum_{k=1}^{N} d_t^{(k,s),US}$ is the market share of China in the U.S. final good market; α_0^s denotes the sector fixed effects; and α_1 is the "pass-through" parameter from China's market share to U.S. producers' market share.

After estimating the relationship between the market share of the U.S. and imports from China, we compute a hypothetical U.S. market share by considering a situation that imports from China are fixed at the 1995 level:[5]

$$\hat{d}share_{1995,t}^{(US,s),US} \equiv \hat{\alpha}_0^s + \hat{\alpha}_1 \frac{d_{1995}^{(C,s),j}}{d_{1995}^{(C,s),j} + \sum_{k \neq C}^{N} d_t^{(k,s),US}} + \hat{u}_t^s . \qquad (10)$$

[5] The predicted U.S. producers' market share from (10) is constrained to lie between zero and unity.

Using this estimated U.S. share and the actual total U.S. final good demand $\sum_{k=1}^{N} d_t^{(k,s),US}$, we compute the hypothetical U.S. domestic production as:

$$\hat{d}_{1995,t}^{(US,s),US} \equiv \hat{d}share_{1995,t}^{(US,s),US} \sum_{k=1}^{N} d_t^{(k,s),US} \ . \tag{11}$$

Similarly, in order to find a relationship between U.S. producers' market share in the U.S. domestic intermediate good market and intermediate imports from China, we estimate:

$$\frac{x_t^{(US,r),(US,s)}}{\sum_{k=1}^{N} x_t^{(k,r),(US,s)}} = \alpha_0^{r,s} + \alpha_1^{s} \frac{x_t^{(C,r),(US,s)}}{\sum_{k=1}^{N} x_t^{(k,r),(US,s)}} + u_t^{r,s} \ , \tag{12}$$

where we estimate separate $S-1=34$ regressions for each of importing sector *s*.[6]

The results from these market share regressions are shown in Table 4. With OLS, the pass-through coefficient $\hat{\alpha}_1$ is estimated quite tightly at -1.1 for final goods, so that an increase in the Chinese market share displaces the U.S. market share by nearly the same amount. For intermediate goods, the pass-through coefficient varies over a wider range around -1. The market share equation is also estimated with a dynamic panel IV model in order to deal with possible endogeneity due to the fact that the market share of U.S. producers in the domestic market might be mechanically related with the Chinese market share in the U.S. since they have the same denominator. To overcome these issues, we employ lagged dependent variables (one and two annual lags), the first difference of the independent variable, and sector fixed effects as instruments. The result is reported in Table 4, showing that IV estimation implies slightly lower "pass-through" parameters. This suggests that OLS estimates have an upward bias due, as we would expect from the common denominator on the left and right of (9).

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[6] We are unable to estimate the market share regression for $s=35$, "Private households with employed persons" because there are no imports from China.

Given these estimates, the predicted intermediate sales of U.S. producers, $\hat{x}_{1995,t}^{(US,s),US}$, is computed like in (10) and (11):

$$\hat{x}share_{1995,t}^{(US,r),(US,s)} \equiv \hat{\alpha}_0^{r,s} + \hat{\alpha}_1^{s} \frac{x_{1995}^{(C,r),(US,s)}}{x_{1995}^{(C,r),(US,s)} + \sum_{k \neq C}^{N} x_t^{(k,r),(US,s)}} + \hat{u}_t^{r,s}, \tag{13}$$

$$\hat{x}_{1995,t}^{(US,r),(US,s)} \equiv \hat{x}share_{1995,t}^{(US,r),(US,s)} \sum_{k=1}^{N} x_t^{(k,r),(US,s)}. \tag{14}$$

We then compute the predicted job losses due to U.S. imports from China. Focusing first on the imports of final goods, the calculation in (6) is modified as:

$$\hat{\mathbf{L}}_{1995,t}^{IM1} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\hat{\mathbf{D}}_{1995,t}^{IM},$$

where,

$$\underbrace{\hat{\mathbf{D}}_{1995,t}^{IM}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ \mathbf{d}_{1995}^{C,US} + \sum_{k\neq US} \mathbf{d}_t^{C,k} \\ \vdots \\ \hat{\mathbf{d}}_{1995,t}^{US,US} + \sum_{k\neq US} \mathbf{d}_t^{US,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix}.$$

That is, the estimated domestic sales of U.S. goods, $\hat{\mathbf{d}}_{1995,t}^{US,US}$, is used from (11).

Likewise, when extending the analysis to include the imports of intermediate goods from China, (7) is replaced by:

$$\hat{\mathbf{L}}_{1995,t}^{IM2} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\hat{\mathbf{A}}_{1995,t}^{IM})^{-1}\hat{\mathbf{D}}_{1995,t}^{IM},$$

where,

$$\underbrace{\tilde{\mathbf{A}}_{1995,t}^{IM}}_{(N\times S)\times(N\times S)} = \begin{bmatrix} \mathbf{A}_t^{1,1} & \mathbf{A}_t^{1,2} & \cdots & \mathbf{A}_t^{1,US} & \cdots & \mathbf{A}_t^{1,N} \\ \mathbf{A}_t^{2,1} & \mathbf{A}_t^{2,2} & \cdots & \mathbf{A}_t^{2,US} & \cdots & \mathbf{A}_t^{2,N} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{A}_t^{C,1} & \mathbf{A}_t^{C,2} & \cdots & \tilde{\mathbf{A}}_{1995,t}^{C,US} & \cdots & \mathbf{A}_t^{C,N} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{A}_t^{US,1} & \mathbf{A}_t^{US,2} & \cdots & \hat{\mathbf{A}}_{1995,t}^{US,US} & \cdots & \mathbf{A}_t^{US,N} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{A}_t^{N,1} & \mathbf{A}_t^{N,2} & \cdots & \mathbf{A}_t^{N,US} & \cdots & \mathbf{A}_t^{N,N} \end{bmatrix}.$$

The input-output coefficients for China's sales to the U.S., $\tilde{\mathbf{A}}_{1995,t}^{C,US}$, are still calculated by holding Chinese imports fixed at their 1995 levels, as in (8). But the input-output coefficients for the U.S. are computed using the predicted U.S. sales,

$$\hat{a}_{1995,t}^{(US,r),(US,s)} \equiv \hat{x}_{1995,t}^{(US,r),(US,s)} / y_t^{US,s}.$$

The results from using predicted U.S. final and intermediate sales based on the OLS estimates are shown in Table 5a. In column (1), we report the estimated reduction in labor demand from all final good and intermediate imports from China. These are 1.4 million in manufacturing, 55 thousand in resource industries, and 1.1 million in services, for a total of 2.6 million. Within the job losses in services, about one-half (560 thousand) are due to input-output linkages with the merchandise imports (i.e. manufacturing and resource imports), and the other one-half (500 thousand) are due to competition from direct service imports. The results based on the IV estimates are summarized in Table 5b. Because the IV estimation leads to slightly smaller "pass-through" parameters, the implied negative employment effect of China is somewhat smaller than in Table 5a. It shows that there is reduced demand for 1.25 million manufacturing jobs, 50 thousand in natural resource sectors, and 900 thousand in services, totaling for 2.2 million job losses are due to import penetration from China in the U.S.

Focusing on the merchandise sector and its intermediate demand into services, column (2) shows overall job losses of 1.8-2.0 million (the former is based on IV while the latter is based on OLS). This estimate is very close to Acemoglu, Autor, Dorn, Hanson, and Price (2016), who find that import competition from China led to about 1.0 million job losses in manufacturing and another 1.0 million job losses through input-output linkages with the rest of the economy, during the slightly shorter period 1999-2011.

4. Net Employment Effects

We now compare more carefully the positive impact of U.S. exports on labor demand to the negative effect from imports, reporting the *net* impact on jobs. Table 6 summarizes our results for U.S. total exports and imports from China over 1995-2011. Panel A provides the net employment effect from trade in the merchandise sectors, including their indirect effect on services, while panel B provides the net effects from trade in all sectors. For merchandise exports and imports from China, we have found added demand of 3.7 million jobs and reduced demand of 2.0 million jobs, respectively, giving a net gain of 1.7 million jobs. That number is the final entry in column (3) of panel A, which uses the estimates from our OLS market share regressions. Alternatively, for trade in all sectors, we obtain a much larger net gain of 4.0 million jobs, the final entry in panel B, and that is because of the growth in U.S. service exports. The last column is based on our IV market share regressions, showing that merchandise trade led to demand for 0.73 million net jobs and trade in all sectors added demand for 4.4 million jobs.

In Table 6 we also include the net employment estimates obtained while using differing assumptions on the response of U.S. production to imports from China. Functional form #1 assumes that Chinese imports displace U.S. production dollar-for-dollar, and it gives results similar to the market share regressions, i.e. net job gains of 1.8 million and 4.2 million for merchandise trade and total trade, respectively. Somewhat larger estimates of net gains are obtained from functional form #3. We do not report in Table 6 the results for functional form #2 because, as we have already noted, that specification really allows for U.S. production to be responding to the imports of *all* countries.

In Table 7, we extend our earlier analysis to report results for U.S. total exports net of imports from *all* countries over 1995-2011. For merchandise trade, we obtain a net reduction in labor demand: for the three functional forms for the possible displacement of U.S. production, we obtain net job losses ranging from -3.3 to -0.5 million at the bottom of panel A.[7] We are not able to implement the market share regressions in this case because, for some trading partners, that regression is too unstable. So we simply conclude that there is a negative net impact on U.S. labor demand from merchandise trade, without being more precise about its magnitude. When we take into account trade in *all* sectors, however, in panel B, then the net impact on labor demand becomes positive 0.7 million jobs for functional forms #2 and #3, though it is still negative for functional form #1. We find the dollar-for-dollar displacement of U.S. producers, assumed in functional form #1, to be rather implausible and so we have more confidence in the results from the other two specifications. In these cases, the positive net impact of trade on labor demand is explained by the growth in U.S. service exports.[8]

5. Decomposing the Employment Effects

5.1 Decomposing the Employment Effect of Export Expansion

[7] In functional form #1, we increase U.S. production dollar-for-dollar for the difference over *all* countries between their imports each year and in 1995. Similarly, for functional form #3 we hold the U.S. imports from *all* countries fixed at their 1995 value when calculating the hypothetical share of U.S. producers.

[8] See the 2.8 million service sector jobs created by those exports in Table 2.

A limitation of our above analysis is that *all* the changes in U.S. exports or import from China, and the associated changes in final goods or intermediates sold within the U.S., are used to compute that employment impacts. It would be preferable to isolate the portion of such changes that could be viewed as exogenous to the United States, as Autor, Dorn, and Hanson (2013, 2015) do when they use Chinese exports to eight other advanced countries to instrument for Chinese exports to the U.S. In this section we investigate the principal contributors leading to changes in trade flows, focusing on U.S. exports in this section and imports in the next.

As in Feenstra, Ma and Xu (2017), we start with a simple CES specification:[9]

$$\frac{d_t^{(US,s),j}}{d_t^{(i,s),j}} = \left(\frac{\tau_t^{(US,s),j}}{\tau_t^{(i,s),j}} \right)^{1-\sigma}, \tag{15}$$

where $d_t^{(i,s),j}$ is the final good flows from sector *s* of country *i* to country *j*, and $\tau_t^{(i,s),j}$ is one plus the *ad valorem* tariff rate imposed by country *j* on sector *s* products from country *i*. Multiplying the above equation by $d_t^{(i,s),j}$ and averaging over the $N-1$ countries $i \neq US$ yields:

$$d_t^{(US,s),j} = \frac{(\tau_t^{(US,s),j})^{1-\sigma}}{N-1} \left(\sum_{k \neq US} d_t^{(k,s),j} \right) \sum_{i \neq US} \frac{d_t^{(i,s),j}}{\sum_{k \neq US} d_t^{(k,s),j}} (\tau_t^{(i,s),j})^{\sigma-1}, \tag{16}$$

where we have multiplied and divided by $\sum_{k \neq US} d_t^{(k,s),j}$ for convenience.

Taking logs of this equation, we estimate:

$$\begin{aligned} \ln d_t^{(US,s),j} = \beta_0^{(US,s),j} + \beta_1 \ln \tau_t^{(US,s),j} + \beta_2 \ln MultiD_t^{(US,s),j} \\ + \beta_3 \ln Multi\tau_t^{(US,s),j} + \varepsilon_t^{(US,s),j}, \end{aligned} \tag{17}$$

[9] This simplified CES equation does not incorporate the range of product varieties sold by each country or differences in their costs of production. We relax these simplifying assumptions in Appendix C, and show how the estimating equation in (16) below is still obtained, with the range of product varieties sold by each country and differences in their costs of production incorporated into the fixed effects and the error.

where $\beta_0^{(US,s),j}$ is a destination-sector fixed effect and the variable $MultiD_t^{(US,s),j}$ is a "multilateral demand" term defined as,

$$MultiD_t^{(US,s),j} \equiv \sum_{k \neq US} d_t^{(k,s),j} , \tag{18}$$

which is the sum of final good flows from all countries besides the U.S. to country *j*. The final variable, $Multi\tau_t^{(i,s),j}$ denotes the "multilateral tariffs" applied by country *j* to trading partners other than the U.S:

$$Multi\tau_t^{(US,s),j} \equiv \frac{\sum_{i \neq US} d_t^{(i,s),j} (\tau_t^{(i,s),j})^{\sigma-1}}{\sum_{k \neq US} d_t^{(k,s),j}} , \tag{19}$$

where σ is the elasticity of substitution.[10] Comparing (16) and (17) we see that the monopolistic competition model implies that $\beta_1 = -(\sigma - 1)$, and $\beta_2 = \beta_3 = 1$.

We treat the variables in (18) and (19) as exogenous to the error term in (17), and use these variables to predict the trade flows due to each of these instruments. Specifically, after estimating (17), we compute the hypothetical final good flows from the U.S. to the rest of the world when the tariff rates imposed on U.S. exporters remain at the 1995 level as:

$$\begin{aligned} \ln \hat{d}_t^{(US,s),j} \Big|_{\tau = \tau_{1995}} \equiv \hat{\beta}_0^{(US,s),j} + \hat{\beta}_1 \ln \tau_{1995}^{(US,s),j} + \hat{\beta}_2 \ln MultiD_t^{(US,s),j} \\ + \hat{\beta}_3 \ln Multi\tau_t^{(US,s),j} + \hat{\varepsilon}_t^{(US,s),j} . \end{aligned} \tag{20}$$

Note that the tariff variable used to calculate this predicted demand is replaced with its 1995 value, $\tau_{1995}^{(US,s),j}$, and we include the estimated residual in (20) so that we will be able to determine what amount of the employment effects are due to this unexplained portion.[11] We

[10] The estimates we obtain for β_1 are as large as -5, implying σ = 6, and we shall impose that value when constructing the multilateral tariff term in (19).

[11] Note that with the *difference* between actual and estimated final demand used in (21), including the residual in (20) ensures that only the *difference* between the 1995 and actual tariffs drives the result.

also compute hypothetical final good flows when the multilateral final demand term remains at the 1995 level, $\ln \hat{d}_t^{(US,s),j}\big|_{MultiD_t = MultiD_{1995}}$, and when the multilateral tariff term remains fixed at the 1995 level, $\ln \hat{d}_t^{(US,s),j}\big|_{Multi\tau_t = Multi\tau_{1995}}$. Hereafter, the procedure to find the employment effect due to changes in tariffs will be discussed, and a similar procedure is used to compute the employment effects though changes in the multilateral final demand and the multilateral tariff term.

The employment effect of export expansion though changes in tariffs imposed on U.S. exporters is estimated as:

$$\hat{\mathbf{L}}_{1995,t}^{EX1,\tau} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\hat{\mathbf{D}}_{1995,t}^{EX,\tau} \tag{21}$$

where,

$$\underbrace{\hat{\mathbf{D}}_{1995,t}^{EX,\tau_{1995}}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ \mathbf{d}_t^{US,US} + \sum_{k\neq US}(\hat{\mathbf{d}}_{1995,t}^{US,k})^{\tau} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix} \text{ with } \underbrace{(\hat{\mathbf{d}}_{1995,t}^{US,j})^{\tau}}_{S\times 1} = \begin{bmatrix} (\hat{d}_t^{(US,1),j})\big|_{\tau=\tau_{1995}} \\ (\hat{d}_t^{(US,2),j})\big|_{\tau=\tau_{1995}} \\ \vdots \\ (\hat{d}_t^{(US,S),j})\big|_{\tau=\tau_{1995}} \end{bmatrix}.$$

In this procedure, U.S. exports to the rest of the world $\{\mathbf{d}_t^{US,j}\}_{j\neq US}$ are replaced with the estimated U.S. exports, $\{(\hat{\mathbf{d}}_t^{US,j})^{\tau_{1995}}\}_{j\neq US}$, with the tariffs imposed by trading partners held fixed at their 1995 level. The employment effect due to the multilateral final demand term, $\hat{\mathbf{L}}_{1995,t}^{EX1,MultiD_{1995}}$, and due to the multilateral tariff term, $\hat{\mathbf{L}}_{1995,t}^{EX1,Muti\tau_{1995}}$, are estimated by taking similar steps.

As in the previous sections, we also provide the counterpart taking intermediate trade into account. First of all, in order to find the determinants of intermediate good flows from the U.S. to the rest of the world, we estimate the same regression as in (17), but allowing for different regression coefficients for the intermediate goods. Then we take the predicted values of the traded intermediates as for final goods in (20), holding tariff fixed at their 1995 level, to obtain $\ln \hat{x}_t^{(US,s),(j,r)}\Big|_{\tau=\tau_{1995}}$, and likewise for $\ln \hat{x}_t^{(US,s),(j,r)}\Big|_{MultiD=MultiD_{1995}}$ and $\ln \hat{x}_t^{(US,s),(j,r)})\Big|_{Multi\tau=Multi\tau_{1995}}$, holding fixed multilateral demand and the multilateral tariff, respectively.

The employment effect of export expansion through changes in tariffs imposed to U.S. exporters is estimated as:

$$\hat{\mathbf{L}}_{1995,t}^{EX\,2,\tau} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\hat{\mathbf{A}}_{1995,t}^{EX,\tau})^{-1}\hat{\mathbf{D}}_{1995,t}^{EX,\tau},$$

where,

$$\underbrace{\hat{\mathbf{A}}_{1995,t}^{EX,\tau}}_{(N\times S)\times(N\times S)} = \begin{bmatrix} \mathbf{A}_t^{1,1} & \mathbf{A}_t^{1,2} & \cdots & \mathbf{A}_t^{1,US} & \cdots & \mathbf{A}_t^{1,N} \\ \mathbf{A}_t^{2,1} & \mathbf{A}_t^{2,2} & \cdots & \mathbf{A}_t^{2,US} & \cdots & \mathbf{A}_t^{2,N} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ (\hat{\mathbf{A}}_{1995,t}^{US,1})^{\tau} & (\hat{\mathbf{A}}_{1995,t}^{US,2})^{\tau} & \cdots & \mathbf{A}_t^{US,US} & \cdots & (\hat{\mathbf{A}}_{1995,t}^{US,N})^{\tau} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{A}_t^{N,1} & \mathbf{A}_t^{N,2} & \cdots & \mathbf{A}_t^{N,US} & \cdots & \mathbf{A}_t^{N,N} \end{bmatrix},$$

denotes the global input-output matrix with $(\hat{\mathbf{A}}_{1995,t}^{(US,r),(j,s)})^{\tau}$ denoting the intermediate good flows from sector *r* of the U.S. to sector *s* of country *j*. The elements of this matrix are obtained by dividing the estimated intermediate flows by gross output in sector *s* of country *j*:

$$(\hat{a}_{1995,t}^{(US,r),(j,s)})^{\tau} \equiv \hat{x}_t^{(US,r),(j,s)}\Big|_{\tau=\tau_{1995}} / \, y_t^{j,s},$$

where $\hat{x}_t^{(US,r),(j,s)}\Big|_{\tau=\tau_{1995}}$ is computed analogously to final goods as shown in (20). The employment effect of export expansion through a change in the multilateral demand term, $\tilde{\mathbf{L}}_{1995,t}^{EX\,2,MultiD}$, and through a change in the multilateral tariff term $\tilde{\mathbf{L}}_{1995,t}^{EX\,2,Multi\tau}$, are found using

$\hat{x}_t^{(US,s),(j,r)}\Big|_{MultiD=MultiD_{1995}}$ and $\hat{x}_t^{(US,s),(j,r)}\Big|_{Multi\tau=Multi\tau_{1995}}$, respectively. Before presenting the export results, we describe the more complex procedure for U.S. imports.

5.2 Decomposing the Employment Effect of Import Competition from China

Previous literature has found that there was policy uncertainty prior to China's accession to WTO in 2001, which had a negative effect on Chinese firm entry to the export market to the U.S. (Pierce and Scott, 2016; Handley and Limao, 2017). Accordingly, we shall introduce variables taking this policy uncertainty into account. In addition to the three components in the decomposition exercise for U.S. exports, we introduce two additional components: (1) the policy uncertainty measured by the difference between the column 2 tariff rate $\tau_{Col2}^{(C,s),US}$ and the MFN tariff rate $\tau_{MFN,t}^{(C,s),US}$, times the probability ρ that the U.S. reverts to the column 2 rate; and (2) a "multilateral uncertainty" term, which incorporates the uncertainty in China's tariff with the U.S. when calculating the exports of *other* countries to the U.S.

The starting point for our estimating equations is a simple CES equation for the relative exports of China and another country *i* to the United States in sector *s*:

$$\frac{d_t^{(C,s),US}}{d_t^{(i,s),US}} = \left(\frac{\rho\tau_{Col2}^{(C,s),US} + (1-\rho)\tau_{MFN,t}^{(C,s),US}}{\tau_t^{(i,s),US}} \right)^{1-\sigma}, \qquad (22)$$

where $\tau_{Col2}^{(C,s),US}$ and $\tau_{MFN,t}^{(C,s),US}$ are the column 2 tariff rate and the MFN rates, respectively; ρ is the probability of reverting to the column 2 rate; and $\sigma > 1$ is the elasticity of substitution. Notice that unlike (15), in the numerator of (22) we are using an *expected tariff* that applies *before* China joins the WTO, since afterwards the MFN rate $\tau_{MFN,t}^{(C,s),US}$ is guaranteed.[12]

Using similar steps to that used for the U.S. export equation, we show in Appendix D that the presence of tariff uncertainty before China's entry to the WTO leads to a system of two estimating equations for final goods, which extend those derived in the previous section:

$$\begin{aligned} \ln d_t^{(C,s),US} &= \beta_0^{(C,s),US} + \beta_1 \ln \tau_{MFN,t}^{(C,s),US} + \beta_2 \ln MultiD_t^{(C,s),US} + \beta_3 \ln Multi\tau_t^{(C,s),US} \\ &+ \beta_4 \underbrace{\left(\frac{\tau_{Col2,t}^{(C,s),US} - \tau_{MFN,t}^{(C,s),US}}{\tau_{MFN,t}^{(C,s),US}} \right)}_{Tariff\ Uncertainty} \times \mathbf{1}\{1995\text{-}2000\} + \varepsilon_t^{(C,s),US}, \end{aligned} \tag{23}$$

for trade flows from China to the U.S., and,

$$\begin{aligned} \ln d_t^{(i,s),US} &= \beta_0^{(i,s),US} + \beta_1 \ln \tau_t^{(i,s),US} + \beta_2 \ln MultiD_t^{(i,s),US} + \beta_3 \ln Multi\tau_t^{(i,s),US} \\ &+ \beta_5 \ln MultiUncert_t^{(i,s),US} \times \mathbf{1}\{1995\text{-}2000\} + \varepsilon_t^{(i,s),US} \end{aligned} \tag{24}$$

for trade flows from a non-China country $i \neq C$ to the U.S.

The terms $MultiD_t^{(C,s),US}$ and $Multi\,\tau_t^{(i,s),US}$ are the multilateral demand and multilateral tariff terms defined in (18) and (19), respectively. The new variables in the above equations are, first, the term $(\tau_{Col2}^{(C,s),US} - \tau_{MFN,t}^{(C,s),US}) / \tau_{MFN,t}^{(C,s),US}$ in (23), which measures the percentage "gap" between the column 2 and MFN rates. Second, there is a multilateral uncertainty term in (24):[13]

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[12] Previous work finds that the uncertainty due to the fact that the U.S. may revert to the column 2 tariff from the MFN rate mainly affect firms' entry to the export market (the extensive margin) rather than firms' pricing behavior (Handley and Limao, 2017). However, final good flows $d^{i,US}$ include both the extensive and intensive margins, so that our specification is not far from previous analysis.

[13] The multilateral uncertainty term in (25) assumes $\sigma = 2$ for simplicity, but in Appendix D we report the general term for any σ. Notice that this term also depends on ρ, which comes from the estimation of (24). Therefore, we estimate the regression equations iteratively, as described in Appendix D.

$$MultiUncert_t^{(i,s),US} \equiv 1 + \frac{\rho d^{(C,s),US}}{\sum_{k \neq i} d^{i,US} \tau^{i,US}} \left[\tau_{Col2}^{(C,s),US} - \tau_{MFN,t}^{(C,s),US} \right], \tag{25}$$

which measures the added exports from non-Chinese countries who do not face this tariff uncertainty. Because the uncertainty was present until 2001, when China joined the WTO, these uncertainty variables are interacted with the dummy variable $\mathbf{1}\{1995\text{-}2000\}$ which equals unity between 1995 and 2000. The regression coefficients satisfy $\beta_1 = -(\sigma - 1)$, $\beta_2 = \beta_3 = \beta_5 = 1$, and $\beta_4 = -\rho(\sigma - 1)$ from which it follows that ρ is estimated as the ratio β_1 / β_4.

The hypothetical final good flows from China to the U.S. when tariff levels remain at the 1995 are found by plugging $\tau_{MFN,1995}^{(C,s),j}$ into the regression result from (23):

$$\begin{aligned} \ln \hat{d}_t^{(C,s),US}\Big|_{\tau=\tau_{1995}} \equiv{}& \hat{\beta}_0^{(C,s),US} + \hat{\beta}_1 \ln \tau_{MFN,1995}^{(C,s),US} + \hat{\beta}_2 \ln MultiD_t^{(C,s),US} + \hat{\beta}_3 \ln Multi\tau_t^{(C,s),US} \\ &+ \hat{\beta}_4 \left(\frac{\tau_{Col2,t}^{(C,s),US} - \tau_{MFN,t}^{(C,s),US}}{\tau_{MFN,t}^{(C,s),US}} \right) \times \mathbf{1}\{1995\text{-}2000\} + \hat{\varepsilon}_t^{(C,s),US}. \end{aligned} \tag{26}$$

The hypothetical imports from China when each of the other factors were fixed at the 1995 level, $\ln d_t^{(C,s),US}\Big|_{MultiD=MultiD_{1995}}$, $\ln d_t^{(C,s),US}\Big|_{Multi\tau=Multi\tau_{1995}}$, and $\ln d_t^{(C,s),US}\Big|_{Uncert=Uncert_{1995}}$ are found by replacing each of the variables with the one from 1995, and likewise for the U.S. imports from China of intermediate goods.

With these regression results, we then calculate the employment effect of U.S. imports from China. For example, the employment effect of imports from China when tariff levels are fixed at their 1995 level is:

$$\hat{\mathbf{L}}_{1995,t}^{IM1,\tau} = \mathbf{\Lambda}_t (\mathbf{I} - \mathbf{A}_t)^{-1} \mathbf{D}_t - \mathbf{\Lambda}_t (\mathbf{I} - \mathbf{A}_t)^{-1} \hat{\mathbf{D}}_{1995,t}^{IM,\tau}$$

where,

$$\underbrace{\hat{\mathbf{D}}_t^{IM,\tau_{1995}}}_{(N\times S)\times 1} = \begin{bmatrix} \sum_k \mathbf{d}_t^{1,k} \\ \sum_k \mathbf{d}_t^{2,k} \\ \vdots \\ (\hat{\mathbf{d}}_t^{C,US})^{\tau_{1995}} + \sum_{k\neq US} \mathbf{d}_t^{C,k} \\ \vdots \\ (\hat{\mathbf{d}}_t^{US,US})^{\tau_{1995}} + \sum_{k\neq US} \mathbf{d}_t^{US,k} \\ \vdots \\ \sum_k \mathbf{d}_t^{N,k} \end{bmatrix}$$

is the hypothetical final demand vector when tariff levels imposed by the U.S. were fixed at their 1995 level. Elements of $(\hat{\mathbf{d}}_t^{C,US})^{\tau_{1995}}$ are obtained from (26), and the corresponding estimates of $(\hat{\mathbf{d}}_t^{US,US})^{\tau_{1995}}$ are obtained by using $(\hat{\mathbf{d}}_t^{C,US})^{\tau_{1995}}$ in (10) and (11). The effect through multilateral final demand $\hat{\mathbf{L}}_{1995,t}^{IM1,MultiD}$, the multilateral tariff $\hat{\mathbf{L}}_{1995,t}^{IM1,Multi\tau}$, and the uncertainty measure $\hat{\mathbf{L}}_{1995,t}^{IM1,Uncert}$ are estimated by taking similar steps.

The employment effect of imports of final *and* intermediate goods from China through a change in tariffs imposed by the U.S. is estimated as:

$$\hat{\mathbf{L}}_{1995,t}^{IM2,\tau} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\hat{\mathbf{A}}_{1995,t}^{IM,\tau})^{-1}\hat{\mathbf{D}}_{1995,t}^{IM,\tau},$$

where the elements of $\hat{\mathbf{A}}_{1995,t}^{IM,\tau}$ for China's sales to the U.S. use the prediction like in (26), but for intermediates, to obtain:

$$(\hat{a}_{1995,t}^{(C,r),(US,s)})^{IM,\tau} = \hat{x}_t^{(C,s),(US,r)}\Big|_{\tau=\tau_{1995}} / \, y_t^{US,s}.$$

Then the input-output coefficients for the U.S. are computed using the predicted value of Chinese sales $\hat{x}_t^{(C,s),(US,r)}\Big|_{\tau=\tau_{1995}}$ within the market share regressions (13) and (14). The same computation procedure applies to the effect though the multilateral final demand $\hat{\mathbf{L}}_{1995,t}^{IM2,MultiD}$, the multilateral tariff $\hat{\mathbf{L}}_{1995,t}^{IM2,Multi\tau}$, and the uncertainty measure $\hat{\mathbf{L}}_{1995,t}^{IM2,Uncert}$.

5.3 Trade Flow Regression Results

The trade flow regressions are estimated over industries in the merchandise sector.[14] The first two columns in Table 8 report the estimates of (17) for U.S. exports, while the last two columns estimate (23) and (24) for U.S. imports. Odd number columns use the log of bilateral final good flows as the dependent variable, while even number columns use the log of bilateral intermediate flows. All coefficients have the expected signs: the log of tariffs have negative signs, meaning that tariff cuts have been contributing to increase the U.S. exports as well as U.S. imports. The multilateral final demand term has positive signs, indicating that final demand of trading partners increases U.S. exports and final demand of the U.S. also works to increase U.S. imports. The multilateral tariff term has the expected positive sign, so a reduction of tariffs imposed by other countries on their trading partners will reduce U.S. exports.

In addition to these three variables, the uncertainty measure and the multilateral uncertainty term are introduced in predicting U.S. imports. The uncertainty measure interacted with the dummy variable (taking the value one during 1995-2000) is negative and highly significant, meaning that U.S. imported less from China less due to policy uncertainty before its WTO entry. The multilateral uncertainty term has a positive sign, implying that other countries besides China were able to export to the U.S. more due to the policy uncertainty on Chinese tariffs in the U.S. After China's accession to WTO in 2001, the policy uncertainty is eliminated.

[14] One of the reasons we do not attempt to model service exports or imports, is that these can reflect the headquarters activities of multinational firms located in a third country, which are explicitly considered in Markusen (1984) and Ekholm, Forslid and Markusen (2007). For example, U.S. firms make earnings by selling a product designed in the U.S. to the rest of the world, which are recorded in the balance of payments as U.S. exports. However, it can be the case that some of the earnings are actually going to a multinational firm located in a third-country, say Ireland. This implies that there is a possibility that a part of our estimates of the service sector job gains include job gains that should be attributed to multinational firms located in a third country.

As a result, China's exports to the U.S. increased and exports from other countries to the U.S. decreased. As discussed in the previous section, the probability to reverting to the column 2 rate is estimated as the ratio $\hat{\beta}_1 / \hat{\beta}_4 =$ -0.42/-2.79 = 0.15 for final goods and $\hat{\beta}_1 / \hat{\beta}_4 =$ -0.64/-2.87 = 0.22 for intermediate good flows. These estimates are close to the probability of the column 2 tariff as estimated by Handley and Limao (2017).

The predicted values from these regressions are used in order to find hypothetical trade flows in situations that each of these variables are kept at the 1995 level. The regression results from columns (1) and (2) are used to decompose the employment effect of export expansion, while the results from columns (3) and (4) are used to decompose the employment effect of imports from China.

5.4 Results from the Decomposition Exercises

Table 9 reports the decomposition results for the employment effect of export expansion. Panel A takes in account only final good exports, while the panel B considers both final good and intermediate exports. Panel A, columns (2) and (3) shows that in the manufacturing industry, 8.7% and 60.3% of the added labor demand from export expansion are due to tariff cuts by trading partners of the U.S. and their final demand, respectively. The multilateral tariff in column (4) explains a small negative portion (-2.5%), so in total, *two-thirds* of the added labor demand is explained by these exogenous factors. The remaining *one-third* is unexplained, as shown in column (5), and is due to the residual in the estimated export equation.

Scanning down column (5) of panel A, we see that somewhat more than one-third of the employment effect of exports is left unexplained in the natural resource and service sectors, but in panel B when intermediates are included, this unexplained portion is less than 40%. There are many other factors that could account for U.S. exports that we have not taken account of: for example, Feenstra, Ma and Xu (2017) include the bilateral exports of the same eight industrial countries used by Autor, Dorn, and Hanson (2013, 2015), but now to explain U.S. exports, and they find that this additional instrument makes a difference. Evidently, our “multilateral demand” variable that we have included in the export equation is not capturing the same information. More generally, the R^2 values on our trade flow regressions in Table 8 are not high enough to expect these variables to fully account for export flows.

Table 10 report the decomposition results for the fall in labor demand due to U.S. imports from China based on the IV estimation result of the market share regression.[15] The variable in the import flow regression that accounts for the overwhelming portion of the is the fall in demand in policy uncertainly associated with China’s WTO accession: eliminating the “gap” between the column 2 and the MFN tariffs in column (5) accounts for 47-50% of the manufacturing job losses. These estimates are consistent with previous literature investigating the impact of elimination of policy uncertainty due to China’s accession to WTO in 2001. For example, Pierce and Schott (2016) demonstrate that a change in U.S. policy uncertainty related with the U.S.-China Normal Trade Relation gap has a statistically significant impact on the decline of manufacturing employment in the U.S. Also, many other work find the sizable impact of China’s accession to WTO on the growth of China’s exports (Feng, Li, and Swenson, 2017; Crowley, Song, and Meng, 2016; Handley and Limao, 2017).[16] Handley and Limao (2017) show that the reduction of policy uncertainty can explain 22-30% of China’s export growth to the U.S. between 2001 and 2005.

[15] See Appendix E for the decomposition result based on the OLS estimates. The results are very similar to those based on the IV estimates.

[16] Feng, Li, and Swenson (2017) show that at the product level, the reduction in tariff uncertainty due to China’s accession to WTO increased the entry of Chinese firms for export to the U.S. market. Crowley, Song, and Meng (2016) find that 36% of new entrants per year after 2011 are explained by China’s entry into the WTO.

Our estimates of the 47-50% contribution of the policy uncertainty reduction on the decline of manufacturing employment are somewhat greater than Handley and Limao's finding. There are at least three reasons for our higher estimates. First, we explain the job losses during 1995-2011 while Handley and Limao (2017) use the data from 2001-2005. As was shown in Figure 1, there is a sizable increase in Chinese exports to the U.S. after 2005. Therefore, this difference in the data period is partially responsible for the difference between our estimates and theirs. Second, Handley and Limao's estimates are based on a general equilibrium model, which includes a feedback from the labor market equilibrium. In contrast, we do not attempt to close the model and only focus on a change in the demand-side of the labor market. Third, we use the 35 sectoral data from the WIOD database while Handley and Limao (2017) use the HS-6 digit level data from the NBER Harmonized System Imports by Commodity and Country. In other words, our estimates are based on a more aggregated macro dataset while Handley and Limao (2017) employ a micro dataset.

The direct reduction in MFN tariffs on China (column 2) accounts for only a small effect, as does the change in multilateral tariffs (column 4). The multilateral final demand variable (column 3) explains a significant portion of the job losses only in the natural resource sector. Overall, from column (6) we see that the unexplained portion of the job losses are somewhat higher than one-third, but less than 40% when intermediate goods are included in the analysis. Like we have argued for U.S. exports, there are many other factors that can explain the rise in merchandise imports from China that we have not included in our trade flow regressions, which would appear in the unexplained residual.[17]

[17] As mentioned in note 2, Amiti, Dai, Feenstra and Romalis (2017) find that the growth in U.S, imports from China (and the accompany consumer benefits in the United States) are due more to China's reduction in its own tariffs on intermediate inputs than the reduction in the uncertainty of tariffs in the U.S.

6. Conclusions

This paper has examined the employment effect of U.S. exports, imports, and imports from China on the U.S. labor market by applying an input-output analysis. We find that the growth in U.S. merchandise exports over 1995-2011 led to demand for 1.9 million jobs in manufacturing, 0.45 million in resource industries, and 1.3 million jobs in services, totaling 3.7 million. In comparison, U.S. merchandise imports from China over 1995-2011 led to reduced labor demand of 1.4 million jobs in manufacturing and 0.6 million in services (with small losses in resource industries), for total job losses of 2.0 million. It follows that the expansion in U.S. merchandise exports relative to imports from China over 1995-2011 led to the net demand for about 1.7 million jobs. Comparing the growth of U.S. merchandise exports to merchandise imports from *all* countries, we find a fall in net labor demand due to trade, but comparing the growth of *total* U.S. exports to total imports from all countries, then there is a rise in net labor demand because of the growth in service exports.

It is surprising that our estimates of the job impacts of trade are not that different from existing literature, which uses industry (or commuting zone) regressions to infer the *equilibrium* impact on employment. The added demand for 1.9 million jobs in U.S. manufacturing exports that we have found much the same as the equilibrium increase of 1.9 million jobs for a 12 year period, 1999-2011, estimated by Feenstra, Ma and Xu (2017). That added demand for manufacturing jobs explains about one-half of the overall demand increase of 3.7 million jobs due to merchandise exports. The offsetting reduction in labor demand of 2.0 million jobs due to imports from China, mainly manufactures, is very close to Acemoglu, Autor, Dorn, Hanson and Price (2016), who find about 1.0 million manufacturing jobs lost in equilibrium during 1999-2011, and another 1.0 million jobs lost by intermediate demand throughout the economy.

Because the input-output analysis relies exclusively on the demand side of the labor market, one might have expected to get considerably larger shifts in demand that would then be offset by upward-sloping labor supply curves to obtain the (smaller) equilibrium changes. Instead, our findings are that the demand shifts from the input-output analysis are similar to the equilibrium changes in employment identified by regression analysis. There are two possible explanations for this result. The first is that there are near-horizontal labor supply curves at the regional level, reflecting movement in and out of unemployment or labor force participation, or movement between regions. But that is an unrealistic explanation: generally there is limited mobility across regions, except for immigrants who do respond to wages difference across regions (Caneda and Kovak, 2016) . A different explanation for this finding is that regions with negative employment shocks from imports also have positive shocks from exports, so that the net shocks in regions are smaller than the gross (export and imports) shocks. That explanation is explored further in Feenstra, Ma and Xu (2017). Caliendo, Dvorkin and Parro (2015) and Dix-Carneiro and Kovak (2017) also incorporate careful specifications of the employment decisions and regional movement of individuals.

While we have not attempted to close our model with labor market equilibrium, we have begun to address another criticism of input-output analysis, namely, that the changes in the trade and production values as well as the input-output coefficients are all *endogenou*s since they are equilibrium values each year. That criticism is of the first-order when using regressions since the coefficient estimates are then biased, and it is addressed with instrumental variables. We have attempted here to address the same issue here, within input-output analysis, by breaking up the total change in the endogenous trade values into exogenous portions due to various causes. In particular, we have tried to exploit the changes in bilateral tariffs – including the reduction in the uncertainly on U.S. tariffs facing China after it joined the WTO – to predict the changes in trade flows. We have been only partially successful in this attempt. Using our structural equation for U.S. exports and imports to identify the exogenous portion of these changes, we explain nearly two-thirds of the measured employment impacts for both U.S. exports and for imports from China. It should be recognized that explaining even that amount in an input-output framework is an achievement: Caliendo, Dvorkin and Parro (2015) also use WIOD, for example, and they rely on an assumed *productivity shock* in China rather than the tariff changes to explain the surge in exports. It can be hoped that the identification of exogenous factors leading to changes in trade and the associated labor demand, and their incorporation into a general equilibrium framework, can be improved in future work.

References

Acemoglu, Daron, David Autor, David Dorn, Gordon H. Hanson and Brendan Price, 2016, "Import Competition and the Great U.S. Employment Sag of the 2000s," *Journal of Labor Economics*, 34(S1), S141 - S198.

Amiti, Mary, Mi Dai, Robert Feenstra and John Romalis, 2017, "How Did China's WTO Entry Benefit U.S. Consumers?" NBER Working Paper no. 23487.

Autor, David H., David Dorn, and Gordon H. Hanson, 2013, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, 103(6), 2013, 2121-68.

Autor, David H., David Dorn and Gordon H. Hanson, 2015, "Untangling Trade and Technology: Evidence from Local Labor Markets," *Economic Journal*, 125(584), May, 621–646.

Autor, David H., David Dorn, Gordon H. Hanson and Jae Song, 2014. "Trade Adjustment: Worker-Level Evidence," *Quarterly Journal of Economics*, 129(4), 1799-1860.

Caliendo, Lorenzo, Maximiliano Dvorkin and Fernando Parro, 2015, "The Impact of Trade on Labor Market Dynamics," NBER Working Paper no. 21149.

Caliendo, Lorenzo, Robert Feenstra, John Romalis and Alan M. Taylor, 2016, "Tariff Reductions, Entry, and Welfare: Theory and Evidence for the Last Two Decades," NBER Working Paper No. 21768.

Cadena, Brian C. and Brian Kovak, 2016, “Immigrants Equilibrate Local Labor Markets: Evidence from the Great Recession,” *American Economic Journal: Applied Economics*, 8(1), 257-290

Crowley, Meredith A., Huasheng Song, and Ning Meng (2016) “Tariff Scares: Trade Policy Uncertainty and Foreign Market Entry by Chinese Firms”, University of Cambridge and Zhejian University.

Dix-Carneiro, Rafael and Brian Kovak, 2017, “Trade Liberalization and Regional Dynamics” *American Economic Review*, forthcoming.

Ekholm, Karolina, Rikard Forslid, and James R. Markusen (2007) “Export-Platform Foreign Direct Investment,” *Journal of European Economic Association*, 5 (4), 776-795.

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer, 2015, “The Next Generation of the Penn World Table,” *American Economic Review*, 105 (10), pp. 3150-3182.

Feenstra, Robert C. and Akira Sasahara, 2017, “The ‘China Shock’ in Trade: Consequences for ASEAN and East Asia,” University of California, Davis, and University of Idaho.

Feenstra, Robert C., Hong Ma and Yuan Xu, 2017, “U.S. Exports and Employment,” University of California, Davis and Tsinghua University, Beijing.

Feng, Ling, Zhiyuan Li and Deborah L. Swenson, 2017, “Trade Policy Uncertainty and Exports: Evidence from China's WTO Accession,” *Journal of International Economics,* 106, 20-36.

Handley, Kyle and Nuno Limão, 2017, “Policy Uncertainty, Trade and Welfare: Theory and Evidence for China and the U.S.,” *American Economic Review*, forthcoming.

International Monetary Fund, 2017, *World Economic Outlook Update: A Shifting Global Economic Landscape*, January 2017, Washington D.C.

Johnson, Robert and Guillermo Noguera, 2012, “Accounting for Intermediates: Production Sharing and Trade in Value Added,” *Journal of International Economics*, 86 (2), 224-236.

Leontief, Wassily W., 1936, “Quantitative Input-Output Relations in the Economic System of the United States,” *Review of Economics and Statistics*, 18 (3), pp. 105-125.

Los, Bart, Marcel P. Timmer and Gaaitzen J. de Vries, 2015, “How Important are Exports for Job Growth in China? A Demand-side Analysis,” *Journal of Comparative Economics*, 43(1), 19-32.

Los, Bart, Marcel P. Timmer, Gaaitzen J. de Vries, 2016, “Tracing Value-Added and Double Counting in Gross Exports: Comment,” *American Economic Review*, 106 (7), 1958-1966.

Markusen, James R. (1984) “Multinationals, Multi-Plant Economies, and the Gains from Trade,” *Journal of International Economics*, 16 (3-4), 205-226.

Pierce, Justin R. and Peter K. Schott, 2016, "The Surprisingly Swift Decline of U.S. Manufacturing Employment," *American Economic Review*, 106(7), 1632-62.

Romalis, John, 2007, "NAFTA's and CUSFTA's Impact on International Trade," *Review of Economics and Statistics*, 89(3), August, 416-35.

Timmer, Marcel P., Abdul Azeez Erumban, Bart Los, Robert Stehrer, and Gaaitzen J. de Vries, 2014, "Slicing Up Global Value Chains," *Journal of Economic Perspectives*, 28 (2), 99-118.

Timmer, Marcel P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J., 2015, "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production," *Review of International Economics* 23, 575–605.

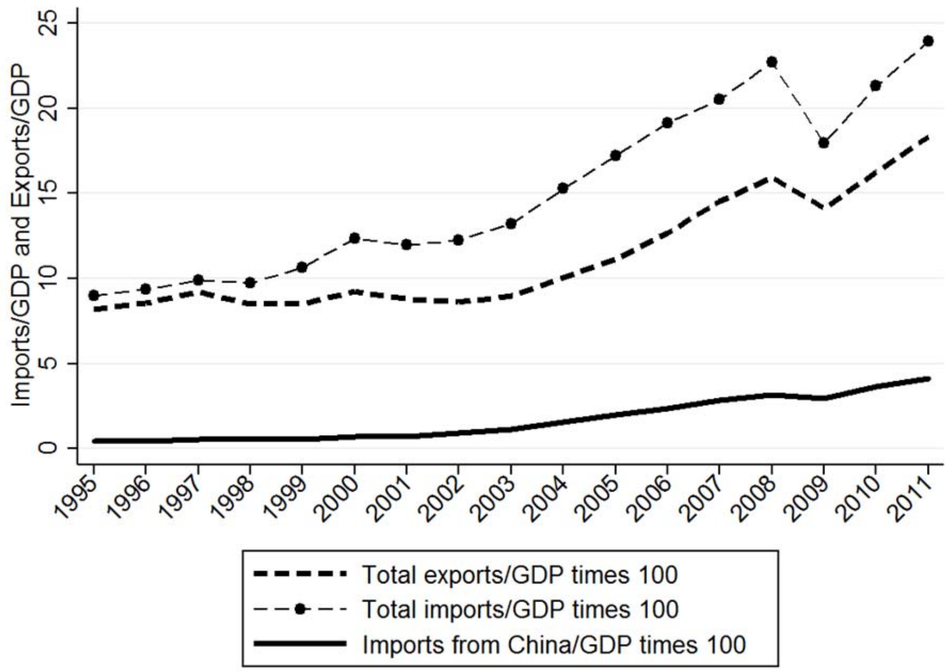
Vianna, Andre C., 2016, "The Impact of Exports to China on Latin American Growth," *Journal of Asian Economics*, 47 (1), 58-66.

Wang , Zhi, Shang-Jin Wei, Xinding Yu, and Kunfu Zhu, 2017, "Re-examining the Impact of the China Trade Shock on the US Labor Market: A Value-Chain Perspective," University of International Business and Economics, Beijing, and Columbia University.

Wood, Adrian, 2017, "The 1990s Trade and Wages Debate in Retrospect," University of Oxford.

World Bank, 2017, "Where We Work: China Overview", World Bank, Washington D.C., available at http://www.worldbank.org/en/country/china/overview.

Figure 1: Import and Export Shares in the U.S.



Notes: The figure shows the U.S. aggregate export value, the U.S. aggregate import value, and the U.S. import value from China as a share of U.S. GDP. The data on exports and imports are from the WIOD Input-Output Table where both final goods and intermediate goods are included.

Table 1: Employment Effect of U.S. Exports, 1995-2011 (million workers)

	Through final good imports only	Through final good and intermediate imports	Employment in 1995
Manufacturing	0.76	1.99	16.8
	(4.5%)	(11.9%)	
Resource	0.17	0.46	5.2
	(3.3%)	(8.9%)	
Services	0.92	4.11	112.0
	(0.8%)	(3.7%)	
All Sectors	1.85	6.57	134.0
	(1.4%)	(4.9%)	

Notes: Numbers without parentheses are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. Numbers in parentheses are the ratio of the employment effect to the total employment in the benchmark year 1995. The 35 WIOD sectors are aggregated into three broad sectors: the natural resource sector (sectors 1-3), the manufacturing sector (sectors 4-16), and the service sector (sectors 17-35), and the last row reports the sum of employment effects in all 35 sectors.

Table 2: Employment Effect of U.S. Merchandise versus Service Exports, 1995-2011 (million workers)

		Decomposition	
	The impact of final good and intermediate exports from *all* sectors	The impact of final good and intermediate exports from *merchandise* sectors	The impact of final good and intermediate exports from *service* sectors
Manufacturing	1.99	1.94	0.053
Resource	0.46	0.45	0.015
Services	4.11	1.34	2.78
All Sectors	6.57	3.73	2.85

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 3: Employment Effect of Imports from China while Adjusting U.S. Production, 1995-2011 (million workers)

Panel A: Functional form #1

	Through final good imports only	Through final good and intermediate good imports
Manufacturing	-0.80	-1.37
Resource	-0.040	-0.060
Services	-0.35	-0.96
All Sectors	-1.18	-2.39

Panel B: Functional form #2

	Through final good imports only	Through final good and intermediate good imports
Manufacturing	-1.16	-2.85
Resource	-0.16	-0.52
Services	-0.71	-2.50
All Sectors	-2.03	-5.86

Panel C: Functional form #3

	Through final good imports only	Through final good and intermediate good imports
Manufacturing	-0.37	-0.70
Resource	-0.027	-0.041
Services	-0.21	-0.69
All Sectors	-0.60	-1.44

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 4: Estimation Result from the U.S. Domestic Market Share Regression
Dep. Var. = U.S. Producers' Market Share in the U.S. Domestic Market

		OLS				IV		
		"Pass-through" parameters				"Pass-through" parameters		
		coefficient	s.e.	Obs.	R-sq.	coefficient	s.e.	Obs.
(0)	Final goods	-1.103***	(0.276)	595	0.56	-1.077***	(0.000)	525
	Intermediate goods							
(1)	Agriculture, hunting, forestry, and fishing	-0.967	(0.607)	593	0.37	-1.564***	(0.001)	523
(2)	Mining and quarrying	-2.512***	(0.367)	579	0.40	-1.719***	(0.011)	510
(3)	Food, beverages and tobacco	-0.924**	(0.434)	595	0.42	-0.490***	(0.001)	525
(4)	Textiles	-1.251***	(0.229)	584	0.57	-1.098***	(0.006)	512
(5)	Lather and footweare	-0.882***	(0.156)	514	0.45	-0.646***	(0.023)	448
(6)	Wood and cork	-1.162***	(0.148)	561	0.68	-0.803***	(0.001)	495
(7)	Pulp, paper, printing and publishing	-0.961***	(0.316)	595	0.36	-0.841***	(0.000)	525
(8)	Coke, refined petroleum and nuclear fuel	-0.969**	(0.469)	562	0.06	-1.730***	(0.010)	488
(9)	Chemicals	-0.622	(0.491)	595	0.21	-0.270***	(0.005)	525
(10)	Rubber and plastics	-1.445***	(0.207)	595	0.22	-1.131***	(0.002)	525
(11)	Other non-metallic mineral	-1.102***	(0.107)	571	0.72	-1.022***	(0.000)	495
(12)	Basic metals and fabricated metals	-0.150	(0.113)	595	0.05	-0.060***	(0.000)	525
(13)	Machinery, nec	-0.961**	(0.360)	595	0.23	-0.264***	(0.000)	525
(14)	Electrical and optical equipment	-0.783**	(0.351)	595	0.31	-0.371***	(0.001)	525
(15)	Transport equipment	-0.778**	(0.364)	595	0.26	-0.756***	(0.004)	525
(16)	Manufacturing nec; recycling	-1.104**	(0.468)	581	0.28	-1.234***	(0.003)	509
(17)	Electricity, gas and water supply	-2.044***	(0.359)	571	0.11	-1.852***	(0.012)	498
(18)	Construction	-1.278***	(0.316)	595	0.33	-0.720***	(0.001)	525
(19)	Sale, maintenance and repair of motor vehicles	-0.649**	(0.264)	579	0.10	-0.581***	(0.000)	509
(20)	Wholesale trade and commission trade	-2.266***	(0.297)	595	0.73	-1.999***	(0.003)	525
(21)	Retail trade, except of motor vehicles	-1.583***	(0.170)	595	0.40	-1.080***	(0.001)	525
(22)	Hotels and restaurants	-1.411***	(0.367)	595	0.32	-1.120***	(0.000)	525
(23)	Inland transport	-1.517***	(0.127)	580	0.41	-1.011***	(0.000)	510
(24)	Water transport	-1.282***	(0.136)	525	0.05	-1.049***	(0.012)	454
(25)	Air transport	-0.767	(0.899)	556	0.02	-0.977***	(0.002)	488
(26)	Supporting and auxiliary transport activities	-1.306***	(0.143)	560	0.30	-1.200***	(0.001)	492
(27)	Post and telecommunications	-1.739***	(0.316)	595	0.62	-1.359***	(0.001)	525
(28)	Fiscal intermediation	-0.496*	(0.275)	594	0.13	-0.682***	(0.004)	522
(29)	Real estate activities	-0.516***	(0.110)	594	0.26	-0.924***	(0.000)	522
(30)	Renting and other business activities	-1.378***	(0.150)	595	0.59	-1.235***	(0.001)	525
(31)	Public admin and defence, and social security	-1.266**	(0.515)	595	0.40	-1.157***	(0.000)	525
(32)	Education	-2.586***	(0.446)	582	0.78	-1.993***	(0.000)	511
(33)	Health and social work	-1.405***	(0.378)	595	0.35	-1.093***	(0.001)	525
(34)	Other community, social and personal services	-1.895***	(0.274)	595	0.49	-1.412***	(0.001)	525

Notes: All OLS regressions include a constant term and sector fixed effects. All IV regressions include a constant term, lagged dependent variable, and sector fixed effects. The first stage regression includes lagged dependent variable (lag 1 and lag 2), the first difference of Chinese market share, and sector fixed effects. Row (0) reports the result from estimating equation (9). Rows (1)-(34) show the result from estimating equation (12) for each of importing sectors in the U.S. All regressions include exporting sector fixed effects. Standard errors are clustered at the exporting sector level. The sample period is from 1995 to 2011. The market share regression for WIOD sector 35: "Private households with employed persons" is not estimated because there are no imports from China. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively.

Table 5a: Employment Effect of U.S. Merchandise versus Service Imports from China, while Estimating U.S. Production, OLS, 1995-2011 (million workers)

		Decomposition	
	The impact of final good and intermediate imports from *all* sectors	The impact of final good and intermediate imports from *merchandise* sectors	The impact of final good and intermediate imports from *service* sectors
Manufacturing	-1.44	-1.43	-0.006
Resource	-0.055	-0.053	-0.002
Services	-1.06	-0.56	-0.50
All Sectors	-2.56	-2.04	-0.51

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 5b: Employment Effect of U.S. Merchandise versus Service Imports from China, while Estimating U.S. Production, IV, 1995-2011 (million workers)

		Decomposition	
	The impact of final good and intermediate imports from *all* sectors	The impact of final good and intermediate imports from *merchandise* sectors	The impact of final good and intermediate imports from *service* sectors
Manufacturing	-1.25	-1.24	-0.006
Resource	-0.05	-0.05	-0.002
Services	-0.90	-0.47	-0.43
All Sectors	-2.20	-1.76	-0.44

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 6: Net Employment Effects of U.S. Total Exports and U.S. Imports *from China*, 1995-2011 (million workers)

	Functional Form #1	Functional Form #3	Market Share Regression, OLS	Market Share Regression, IV
Panel A: Trade in merchandise sectors				
Manufacturing	0.58	1.24	0.50	0.00
Resource	0.39	0.41	0.40	0.13
Services	0.80	1.03	0.78	0.59
All Sectors	1.77	2.68	1.68	0.73
Panel B: Trade in all sectors				
Manufacturing	0.63	1.29	0.55	0.75
Resource	0.40	0.42	0.41	0.12
Services	3.15	3.42	3.05	3.22
All Sectors	4.18	5.13	4.01	4.38

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 7: Net Employment Effects of U.S. Total Exports and U.S. *Total Imports*, 1995-2011 (million workers)

	Functional Form #1	Functional Form #2	Functional Form #3
Panel A: Trade in merchandise sectors			
Manufacturing	-1.67	-0.90	-0.11
Resource	-0.55	-0.06	-0.25
Services	-1.04	-0.37	-0.11
All Sectors	-3.25	-1.32	-0.48
Panel B: Trade in all sectors			
Manufacturing	-1.64	-0.86	-0.08
Resource	-0.55	-0.05	-0.25
Services	-0.05	1.62	1.03
All Sectors	-2.24	0.71	0.70

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. See notes to Table 1 for the sector definitions.

Table 8: Predicting Trade Flows

Exporter(s) Importer(s)	United States All other countries		All other countries United States	
	ln(Final good flows) (1)	ln(Intermediate good flows) (2)	ln(Final good flows) (3)	ln(Intermediate good flows) (4)
ln(Tariff)	-1.16***	-2.90***	-2.79*	-2.87***
	(0.42)	(0.18)	(1.46)	(0.31)
ln(Multilateral Final Demand)	0.55***	0.47***	0.87***	0.55***
	(0.032)	(0.010)	(0.07)	(0.02)
ln(Multilateral Tariff)	0.93***	1.28***	0.57	1.20***
	(0.22)	(0.10)	(1.18)	(0.43)
Uncertainty × 1{1995-2001}			-0.42***	-0.64***
			(0.13)	(0.03)
Multi. Uncertainty × 1{1995-2001}			1.96**	3.06***
			(0.94)	(0.14)
Cross Sectional Fixed Effect	Yes	Yes	Yes	Yes
R-sq.	0.218	0.206	0.252	0.253
# of obs.	8,252	134,197	8,309	149,512
# of cross sectional obs.	515	10,057	527	10,922
Observations are characterized by…				
Exporting countries			Yes	Yes
Exporting sectors		Yes	Yes	Yes
Importing countries	Yes	Yes		
Importing sectors	Yes	Yes		Yes
# of sectors = 16, # of trading partners for the U.S. = 37, the period = 1995-2011				

Notes: The table reports the regression result predicting U.S. exports (columns 1 and 2) and U.S. imports (columns 3 and 4). Columns 3 and 4 include year fixed effects after 2001 in order to identify the uncertainty measure by capturing year-to-year macroeconomic shocks common to all exporters to the U.S. Robust standard errors, clustered at the cross sectional unit level, are in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level, respectively. The data on trade flows come from the WIOD International Input-Output Table. The data on tariffs come from Caliendo et al. (2017). The sample includes 37 countries out of 40 WIOD countries where Belgium and Luxenberg are dropped due to missing tariff observations.

Table 9: Explaining the Employment Effect of Merchandise Exports, 1995-2011 (million workers)

		Decomposition			
		Tariff Cuts	**Multilateral Final Demand**	**Multilateral Tariff**	**Residuals**
	The overall effect of exports	The effect through a reduction of tariffs imposed by trading partners on the U.S.	The effect through an increase in multilateral demand term	The effect through a decrease of the multilateral tariff term	The unexplained part
	(1)	(2)	(3)	(4)	(5)
		Panel A: Through final good exports only			
Manufacturing	0.753	0.065	0.454	-0.019	0.253
		[8.7%]	[60.3%]	[-2.5%]	[33.6%]
Resource	0.169	0.016	0.080	-0.005	0.079
		[9.3%]	[47.1%]	[-2.9%]	[46.6%]
Services	0.517	0.040	0.287	-0.012	0.203
		[7.7%]	[55.5%]	[-2.4%]	[39.2%]
All Sectors	1.440	0.121	0.821	-0.036	0.535
		[8.4%]	[57.0%]	[-2.5%]	[37.1%]
		Panel B: Through final good and intermediate exports			
Manufacturing	1.937	0.293	1.063	-0.062	0.643
		[15.2%]	[54.9%]	[-3.2%]	[33.2%]
Resource	0.449	0.092	0.187	-0.006	0.177
		[20.4%]	[41.7%]	[-1.4%]	[39.4%]
Services	1.339	0.185	0.670	-0.032	0.516
		[13.8%]	[50.0%]	[-2.4%]	[38.5%]
All Sectors	3.725	0.570	1.920	-0.101	1.336
		[15.3%]	[51.5%]	[-2.7%]	[35.9%]

Notes: Numbers without brackets are the employment effect measured in million workers. Positive numbers mean increased labor demand while negative numbers indicate reduced labor demand. Numbers in square brackets are the ratio of each component of the employment effect to the overall employment effect. See notes to Table 1 for the sector definitions.

Table 10: Explaining the Employment Effect of Merchandise Imports from China, IV, 1995-2011 (million workers)

		Decomposition				
		Tariff Cuts	**Multilateral Final Demand**	**Multilateral Tariffs**	**Policy Uncertainty**	**Residuals**
	The overall effect of imports	The effect through a reduction of U.S. tariffs on China	The effect through an increase in multilateral demand term	The effect through a decrease of multilateral tariff term	The effect through a reduction of tariff "gap" uncertainty	The unexplained part
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Through final good imports only						
Manufacturing	-0.761	-0.027	0.013	0.018	-0.374	-0.391
		[3.5%]	[-1.7%]	[-2.3%]	[49.2%]	[51.4%]
Resource	-0.037	0.003	-0.008	0.002	-0.018	-0.016
		[-9.5%]	[21.4%]	[-6.0%]	[49.4%]	[44.6%]
Services	-0.272	0.008	-0.017	0.024	-0.128	-0.158
		[-2.8%]	[6.3%]	[-8.7%]	[47.1%]	[58.1%]
All Sectors	-1.069	-0.015	-0.012	0.044	-0.521	-0.565
		[1.4%]	[1.1%]	[-4.1%]	[48.7%]	[52.9%]
Panel B: Through final good and intermediate imports						
Manufacturing	-1.239	-0.034	-0.020	0.036	-0.636	-0.584
		[2.8%]	[1.6%]	[-2.9%]	[51.3%]	[47.1%]
Resource	-0.047	0.005	-0.009	0.004	-0.027	-0.019
		[-9.7%]	[19.4%]	[-8.4%]	[58.0%]	[40.7%]
Services	-0.470	0.019	-0.031	0.047	-0.232	-0.274
		[-4.0%]	[6.5%]	[-10.0%]	[49.3%]	[58.2%]
All Sectors	-1.756	-0.011	-0.060	0.087	-0.895	-0.876
		[0.6%]	[3.4%]	[-5.0%]	[51.0%]	[49.9%]

Notes: Numbers without brackets are the employment effect measured in million workers. A positive number means increased labor demand while a negative number indicates reduced labor demand. Numbers in square brackets are the ratio of each component of the employment effect to the overall employment effect. Residuals include year-to-year macroeconomic shocks captured in year fixed effects after 2001, which are included in order to identify the policy uncertainty effect. See notes to Table 1 for the sector definitions.

Appendices

Appendix A: List of WIOD Sectors and Countries

Each country in the WIOD input-output table is comprised of 35 sectors. The list of the sectors is as follows. It also shows the definition of the agriculture, manufacturing and service sectors that we employ to aggregate the sectoral employment effect.

Table A1: List of 35 WIOD Sectors and the Definition of Aggregate Sectors

No.	WIOD Sector	Aggregation
1	Agriculture, hunting, forestry, and fishing	Agriculture (the primary sector)
2	Mining and quarrying	
3	Food, beverages and tobacco	
4	Textiles	Manufacturing (the secondary sector)
5	Lather and footweare	
6	Wood and cork	
7	Pulp, paper, printing and publishing	
8	Coke, refined petroleum and nuclear fuel	
9	Chemicals	
10	Rubber and plastics	
11	Other non-metallic mineral	
12	Basic metals and fabricated metals	
13	Machinery, nec	
14	Electrical and optical equipment	
15	Transport equipment	
16	Manufacturing nec; recycling	
17	Electricity, gas and water supply	Services (the tertiary sector)
18	Construction	
19	Sale, maintenance and repair of motor vehicles and motorcycles	
20	Wholesale trade and commission trade, except of motor vehicles	
21	Retail trade, except of motor vehicles and motorcycles	
22	Hotels and restaurants	
23	Inland transport	
24	Water transport	
25	Air transport	
26	Supporting and auxiliary transport activities; activities of travel agencies	
27	Post and telecommunications	
28	Fiscal intermediation	
29	Real estate activities	
30	Renting and other business activities	
31	Public admin and defence, and compulsory social security	
32	Education	
33	Health and social work	
34	Other community, social and personal services	
35	Private households with employed persons	

Notes: The table shows the list of 35 WIOD sectors and the definition of the three aggregate sectors in the main text.

Crosswalk between WIOD Sectors and SITC Code

The tariff data obtained from Caliendo et al. (2017) are in SITC 4 digit level. We match this tariff dataset to WIOD sectors. We collapse the SITC 4 digit level tariff data by taking simple averages using the correspondence show in Table A2.

Table A2: Crosswalk between WIOD Sectors and 2-digit SITC Code

No.	WIOD Sector	SITC code
1	Agriculture, hunting, forestry, and fishing	00-03, 21-22, 29
2	Mining and quarrying	Not included in regressions
3	Food, beverages and tobacco	04-09, 11, 12, 41-43
4	Textiles	26, 27, 65, 66
5	Lather and footweare	61, 62, 85
6	Wood and cork	24, 63
7	Pulp, paper, printing and publishing	25, 64
8	Coke, refined petroleum and nuclear fuel	32-34
9	Chemicals	51-56, 59
10	Rubber and plastics	23, 57, 58
11	Other non-metallic mineral	68
12	Basic metals and fabricated metals	28, 67, 69, 96, 97
13	Machinery, nec	71-76
14	Electrical and optical equipment	35, 77, 88
15	Transport equipment	78, 79
16	Manufacturing nec; recycling	81-84, 87, 89, 91, 93
17	Electricity, gas and water supply	
18	Construction	
19	Sale, maintenance and repair of motor vehicles and motorcycles	
20	Wholesale trade and commission trade, except of motor vehicles	
21	Retail trade, except of motor vehicles and motorcycles	
22	Hotels and restaurants	
23	Inland transport	
24	Water transport	
25	Air transport	
26	Supporting and auxiliary transport activities; activities of travel agencies	Not included in regressions
27	Post and telecommunications	
28	Fiscal intermediation	
29	Real estate activities	
30	Renting and other business activities	
31	Public admin and defence, and compulsory social security	
32	Education	
33	Health and social work	
34	Other community, social and personal services	
35	Private households with employed persons	

Crosswalk between WIOD Sectors and HTS Code

The data on the column 2 rate and the MFN tariff rate applied by the U.S. to China are available at the HTS (Harmonized Tariff Schedule) 8 digit level (from Amiti, et al., 2017). We match this tariff dataset with the WIOD sectors. The correspondence between the WIOD sectors and the HTS code are summarized in Table A3.

Table A3: Crosswalk between WIOD Sectors and HTS Code

No.	WIOD Sector	HTS code
1	Agriculture, hunting, forestry, and fishing	01, 06
2	Mining and quarrying	Not included in regressions
3	Food, beverages and tobacco	02-05, 07-25
4	Textiles	50-67
5	Lather and footweare	41-43
6	Wood and cork	44, 45
7	Pulp, paper, printing and publishing	47-49
8	Coke, refined petroleum and nuclear fuel	27, 33, 34, 36
9	Chemicals	28-32, 38
10	Rubber and plastics	39, 40, 46
11	Other non-metallic mineral	68-70
12	Basic metals and fabricated metals	26, 72-76, 78-81
13	Machinery, nec	84
14	Electrical and optical equipment	37, 85, 90
15	Transport equipment	86, 87, 88, 89
16	Manufacturing nec; recycling	35, 82, 83, 91-97
17	Electricity, gas and water supply	
18	Construction	
19	Sale, maintenance and repair of motor vehicles and motorcycles	
20	Wholesale trade and commission trade, except of motor vehicles	
21	Retail trade, except of motor vehicles and motorcycles	
22	Hotels and restaurants	
23	Inland transport	
24	Water transport	
25	Air transport	
26	Supporting and auxiliary transport activities; activities of travel agencies	Not included in regressions
27	Post and telecommunications	
28	Fiscal intermediation	
29	Real estate activities	
30	Renting and other business activities	
31	Public admin and defence, and compulsory social security	
32	Education	
33	Health and social work	
34	Other community, social and personal services	
35	Private households with employed persons	

In the final demand matrix, each of the destination countries consist of five final demand categories, as follows:

1. Final consumption expenditure by households
2. Final consumption expenditure by non-profit organizations serving households (NPISH)
3. Final consumption expenditure by government
4. Gross fixed capital formation
5. Changes in inventories and valuables

In input-output calculation, we compute the sum of these.

List of Countries

The list of 40 countries in WIOD is as follows.

> Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, Spain, Sweden, Taiwan, Turkey, United Kingdom, and United States

In addition to these, the input-output tables include the rest of the world as one economy.

Appendix B. The Employment Effect of Imports from China

We replace the current imports from China with the one from the benchmark year, 1995, but *without* replacing U.S. production with hypothetical values. As the two-country example suggests, the employment effect of imports from China is positive, meaning that China has an employment creation effect. Table B1 summarizes the results. It shows that exports from China to the U.S. creates 15 and 13 thousand U.S. manufacturing jobs though final good trade and intermediate trade, respectively, from intermediate demand for U.S. imports within China. Therefore 28 thousand jobs are added in the manufacturing sector overall. In the natural resource sector and the service sector, final good and intermediate exports from China to the U.S. added 4 thousand jobs and 43 thousand jobs in total, respectively. In total, exports from China to the U.S. added 75 thousand jobs during 1995-2011. We obtain this result because we do not adjust U.S. domestic production.

Table B1: Employment Effect of Imports from China *without* Adjusting U.S. Production, 1995-2011 (million workers)

	Through Final Good Imports Only	Through Final and Intermediate Good Imports
Manufacturing	0.015	0.028
Resource	0.002	0.004
Services	0.022	0.043
All Sectors	0.039	0.075

Notes: Numbers reported are the employment effect measured in million workers. Positive numbers mean added labor demand while negative numbers indicate reduced labor demand.

Appendix C: Theoretical Foundation for the U.S. Export Regression

In (15)-(16) of the main text we provide a simplified derivation of the U.S. export regression that does not incorporate the range of product varieties sold by each country or differences in their costs of production. We improve that derivation here using a homogeneous firm monopolistic competition model. Sector subscripts *s* and time subscripts *t* are dropped to simplify notation, but we add the subscript *z* to denote individual product varieties. We follow Romalis (2007) and use the symmetric CES equation:

$$\frac{d_z^{US,j}}{d_{z'}^{i,j}} = \left(\frac{w^{US} g^{US,j} \tau^{US,j}}{w^i g^{i,j} \tau^{i,j}} \right)^{1-\sigma},$$

where $d_z^{US,j}$ and $d_{z'}^{i,j}$ are the value of exports of a typical variety from the U.S. and country *i* to country *j*, respectively; the varieties from country *i* are produced with the marginal cost w^i and face the transport costs of $g^{i,j}$ and one plus the *ad valorem* tariff of $\tau^{i,j}$; and $\sigma > 1$ is the elasticity of substitution between varieties. Suppose that there are M^i identical product varieties produced and exported by country *i*. Moving $d_{z'}^{i,j}$ to the right of this equation and $w^i g^{i,j}$ to the left, we can multiply by M^i and then take the sum over all countries $i \neq US$, to obtain:

$$d_z^{US,j} \sum_{i \neq US} M^i (w^i g^{i,j})^{1-\sigma} = (w^{US} g^{US,j} \tau^{US,j})^{1-\sigma} \sum_{i \neq US} M^i d_{z'}^{i,j} (\tau^{i,j})^{\sigma-1}.$$

Multiplying this equation by M^{US}, we note that $d^{US,j} \equiv M^{US} d_z^{US,j}$ is the total value of exports from the U.S. to country *j*, and likewise for $d^{i,j} \equiv M^i d_{z'}^{i,j}$. We multiply and divide by $\sum_{k \neq US} d^{k,j}$ for convenience, to obtain:

$$d^{US,j} = \frac{M^{US} (w^{US} g^{US,j} \tau^{US,j})^{1-\sigma}}{\sum_{k \neq US} M^k (w^k g^{k,j})^{1-\sigma}} \left(\sum_{k \neq US} d^{k,j} \right) \sum_{i \neq US} \frac{d^{i,j}}{\sum_{k \neq US} d^{k,j}} (\tau^{i,j})^{\sigma-1}.$$

Taking logs, this is equivalent to the estimating equation (17) by defining the fixed effect:

$$\beta_0^{US,j} \equiv \ln \left[M^{US} (w^{US} g^{US,j})^{1-\sigma} \right],$$

and the error term:

$$\varepsilon^{US,j} \equiv -\ln \left[\sum_{k \neq US} M^k (w^k g^{k,j})^{1-\sigma} \right].$$

In the main text, equation (17), we add back the time subscript and the sector superscript to the estimating equation.

Appendix D: Theoretical Foundation for the U.S. Import Regression

This section provides theoretical foundation on the trade flow equations we estimate in order to find the determinants of final good and intermediate flows. Sector subscripts *s* and time subscripts *t* are dropped to simplify notation. We focus on final good flows in this section and similar theoretical foundation applies to intermediate good flows. We start with a symmetric CES demand equation U.S. imports from China, where before China's WTO entry we use the *expected value* of the tariff:[18]

$$\frac{d^{C,US}}{d^{i,US}} = \left(\frac{\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}}{\tau^{i,US}} \right)^{1-\sigma}, \qquad \text{(D1)}$$

where $d^{C,US}$ and $d^{i,US}$ denote final good flows from China to the U.S. and those from country *i* to the U.S., respectively; $\tau_{Col2}^{C,US}$ and $\tau_{MFN}^{C,US}$ are the column 2 tariff and the MFN rate for China, respectively; $\tau^{i,US}$ indicates the tariff rate applied by the U.S. to country $i \neq C$ (the MFN or bilateral preferential rate); ρ denotes the probability of reverting to the column 2 rate; and $\sigma > 1$ is the elasticity of substitution. Multiply the above equation by $d^{i,US}$ and average over the $N-1$ countries $i \neq C$ to obtain:

$$d^{C,US} = \frac{[\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}]^{1-\sigma}}{N-1} \left(\sum_{k \neq C} d^{k,US} \right) \sum_{i \neq C} \frac{d^{i,US}}{\sum_{k \neq C} d^{k,US}} (\tau^{i,US})^{\sigma-1},$$

where we have multiplied and divided by $\sum_{k \neq C} d^{k,US}$ for convenience. Taking natural logs, rewrite the tariff term as $\ln\left[\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}\right] = \ln(\tau_{MFN}^{C,US}) + \ln\left[1 + \rho(\tau_{Col2}^{C,US} - \tau_{MFN}^{C,US}) / \tau_{MFN}^{C,US}\right]$,

and apply the log approximation $\ln(1+\rho x) \cong \rho x$ for a small number ρ, to obtain:

$$\ln d^{C,US} = \ln\left(\frac{1}{N-1}\right) + (1-\sigma)\ln \underbrace{(\tau_{MFN}^{C,US})}_{MFN\ Tariff} + \rho(1-\sigma) \underbrace{\left(\frac{\tau_{Col2}^{C,US} - \tau_{MFN}^{C,US}}{\tau_{MFN}^{C,US}} \right)}_{Uncertainty\ Measure}$$

$$+ \ln \underbrace{\left[\sum_{k \neq C} d^{k,US} \right]}_{\substack{Multilateral \\ Final\ Demand}} + \ln \underbrace{\left[\sum_{i \neq C} \frac{d^{i,US}}{\sum_{k \neq C} d^{k,US}} (\tau^{i,US})^{\sigma-1} \right]}_{Multilateral\ Tariff}. \qquad \text{(D2)}$$

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[18] As in our derivation of the export equation from (15), this simplified CES equation does not incorporate the range of product varieties sold by each country or differences in their costs of production. But as shown in Appendix C, these simplifying assumption can be relaxed so that range of product varieties sold by each country and differences in their costs of production are incorporated into the fixed effects and the error term.

For trade flows from a country $j \neq C$ to the U.S., we again start with the CES equation:

$$\frac{d^{j,US}}{d^{i,US}} = \left(\frac{\tau^{j,US}}{E\tau^{i,US}} \right)^{1-\sigma},$$

where the expected tariff is $E\tau^{i,US} = \tau^{i,US}$ for countries $i \neq C$, and is as appears in (D1) for China. Multiplying above equation by $d^{i,US}$ and averaging over the $N-1$ countries $i \neq C$ yields:

$$d^{j,US} = \frac{(\tau^{j,US})^{1-\sigma}}{N-1} \left(\sum_{k \neq j} d^{k,US} \right) \sum_{i \neq j} \frac{d^{i,US}}{\sum_{k \neq j} d^{k,US}} (E\tau^{i,US})^{\sigma-1},$$

where we have multiplied and divided by $\sum_{k \neq US} d^{k,j}$ for convenience. We expand the last term to make it clear that there is an uncertainty part for the trade flows from China to the U.S.:

$$d^{j,US} = \frac{(\tau^{j,US})^{1-\sigma}}{N-1} \left(\sum_{k \neq j} d^{k,US} \right) \left[\frac{d^{C,US}}{\sum_{k \neq j} d^{k,US}} [\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}]^{\sigma-1} + \sum_{\substack{i \neq j \\ i \neq C}} \frac{d^{i,US}}{\sum_{k \neq j} d^{k,US}} (\tau^{i,US})^{\sigma-1} \right]$$

$$= \frac{(\tau^{j,US})^{1-\sigma}}{N-1} \left(\sum_{k \neq j} d^{k,US} \right) \left[\frac{d^{C,US}}{\sum_{k \neq j} d^{k,US}} \left\{ [\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}]^{\sigma-1} - (\tau_{MFN}^{C,US})^{\sigma-1} \right\} + \sum_{i \neq j} \frac{d^{i,US}}{\sum_{k \neq j} d^{k,US}} (\tau^{i,US})^{\sigma-1} \right],$$

where we have added and subtracted the term $\tau_{MFN}^{C,US}$, which is denoted by $\tau^{C,US}$ in the final summation. Taking natural logs and applying the formula $\ln(a+b) = \ln(a) + \ln(1+\frac{b}{a})$, we find:

$$\ln d^{j,US} = \ln\left(\frac{1}{N-1} \right) + (1-\sigma) \underbrace{\ln(\tau^{j,US})}_{Country\ j\ Tariff} + \ln \underbrace{\left[\sum_{k \neq C} d^{k,US} \right]}_{\substack{Multilateral \\ Final\ Demand}}$$

$$+ \ln \underbrace{\left[\sum_{i \neq j} \frac{d^{i,US}}{\sum_{k \neq j} d^{k,US}} (\tau^{i,US})^{\sigma-1} \right]}_{Multilateral\ Tariff} + \ln \underbrace{\left[1 + \frac{d^{C,US} \left\{ [\rho \tau_{Col2}^{C,US} + (1-\rho)\tau_{MFN}^{C,US}]^{\sigma-1} - (\tau_{MFN}^{C,US})^{\sigma-1} \right\}}{\sum_{i \neq j} d^{i,US} (\tau^{i,US})^{\sigma-1}} \right]}_{Multilateral\ Uncertainty}. \quad \text{(D3)}$$

When $\sigma = 2$, then the multilateral uncertainty term in (D3) simplifies as,

$$1+\frac{d^{C,US}\left\{[\rho\tau_{Col2}^{C,US}+(1-\rho)\tau_{MFN}^{C,US}]^{\sigma-1}-(\tau_{MFN}^{C,US})^{\sigma-1}\right\}}{\sum_{i\neq j}d^{i,US}(\tau^{i,US})^{\sigma-1}}=1+\frac{\rho d^{C,US}\left(\tau_{Col2}^{C,US}-\tau_{MFN}^{C,US}\right)}{\sum_{i\neq j}d^{i,US}(\tau^{i,US})}.$$

For convenience, we will use the assumption $\sigma = 2$ when we reporting this term in the main text and in the estimating equation (D5), below. When constructing the multilateral tariff term, however, we instead use $\sigma = 6$. We have found that the more complex version of the multilateral uncertainty term, as shown in (D3) for $\sigma = 6$ or for other values of σ, does not perform much differently in the estimation than the simplified version of that term with $\sigma = 2$.

We replace the theoretical coefficients of each variable with regression coefficients to be estimated, including country-pair-sector fixed effects. We also introduce the indicator variable **1**{1995-2000} on the uncertainty terms for the years 1995-2000, before China's WTO entry. Then from (D2) and (D3) we obtain the equations:

$$\ln d^{C,US}=\beta_0^{(C,s),US}+\beta_1\underbrace{\ln\tau_{MFN}^{C,US}}_{MFN\ Tariff}+\beta_2\underbrace{\ln\left[\sum_{k\neq C}d^{k,US}\right]}_{\substack{Multilateral\\ Final\ Demand}}$$
$$+\beta_3\underbrace{\ln\left[\sum_{i\neq C}\frac{d^{i,US}}{\sum_{k\neq C}d^{k,US}}(\tau^{i,US})^{\sigma-1}\right]}_{Multilateral\ Tariff}+\beta_4\underbrace{\left(\frac{\tau_{Col2}^{C,US}-\tau_{MFN}^{C,US}}{\tau_{MFN}^{C,US}}\right)}_{Uncertainty\ Measure}\times\mathbf{1}\{1995\text{-}2000\},\tag{D4}$$

$$\ln d^{j,US}=\beta_0^{(j,s),US}+\beta_1\underbrace{\ln\tau^{j,US}}_{Country\ j\ Tariff}+\beta_2\underbrace{\ln\left[\sum_{k\neq j}d^{k,US}\right]}_{\substack{Multilateral\\ Final\ Demand}}$$
$$+\beta_3\underbrace{\ln\left[\sum_{i\neq j}\frac{d^{i,US}}{\sum_{k\neq j}d^{k,US}}(\tau^{i,US})^{\sigma-1}\right]}_{Multilateral\ Tariff}+\beta_5\underbrace{\ln\left[1+\frac{\rho d^{C,US}(\tau_{Col2}^{C,US}-\tau_{MFN}^{C,US})}{\sum_{i\neq j}d^{i,US}\tau^{i,US}}\right]}_{Multilateral\ Uncertainty}\times\mathbf{1}\{1995\text{-}2000\}.\tag{D5}$$

These two equations are stacked and estimated for merchandise sectors, where we also include traded intermediate goods. In the main text, equations (23) and (24), we add back the time subscript and the sector superscript.

We estimate the probability of reverting to the column 2 rate as the ratio of coefficients for the tariff and the uncertainty measure: from (D2) and (D4), $\beta_4 = \rho\beta_1 \Rightarrow \rho = \beta_4 / \beta_1$. In the first step, ρ is set to one for the multilateral uncertainty term in (D5). In the second step, the estimated ρ from the first step of (D4) is plugged into the multilateral uncertainty term in (D5), and we re-estimate the two regressions. We iterate until ρ converges to a certain value, and we find that only two steps in the iteration leads to convergence.

Appendix E: Decomposition of the Employment Effect of Import Penetration from China based on the Market Share Regression with OLS

Table E1: Explaining the Employment Effect of Merchandise Imports from China, OLS, 1995-2011 (million workers)

		Decomposition				
		Tariff Cuts	**Multilateral Final Demand**	**Multilateral Tariffs**	**Policy Uncertainty**	**Residuals**
	The overall effect of imports	The effect through a reduction of U.S. tariffs on China	The effect through an increase in multilateral demand term	The effect through a decrease of multilateral tariff term	The effect through a reduction of tariff "gap" uncertainty	The unexplained part
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Through final good imports only						
Manufacturing	-0.805	-0.045	0.009	0.024	-0.463	-0.330
		[5.6%]	[-1.1%]	[-3.0%]	[57.5%]	[41.0%]
Resource	-0.037	0.004	-0.009	0.002	-0.023	-0.012
		[-11.0%]	[23.3%]	[-5.5%]	[61.4%]	[31.8%]
Services	-0.289	0.001	-0.021	0.027	-0.162	-0.135
		[-0.4%]	[7.2%]	[-9.5%]	[55.9%]	[46.8%]
All Sectors	-1.131	-0.040	-0.020	0.054	-0.647	-0.477
		[3.6%]	[1.8%]	[-4.7%]	[57.2%]	[42.2%]
Panel B: Through final good and intermediate imports						
Manufacturing	-1.432	-0.077	-0.057	0.061	-0.863	-0.496
		[5.4%]	[4.0%]	[-4.3%]	[60.3%]	[34.6%]
Resource	-0.053	0.005	-0.012	0.004	-0.037	-0.012
		[-8.6%]	[22.4%]	[-7.8%]	[70.9%]	[23.1%]
Services	-0.558	0.001	-0.055	0.060	-0.329	-0.234
		[-0.3%]	[9.9%]	[-10.7%]	[59.1%]	[42.0%]
All Sectors	-2.042	-0.071	-0.124	0.124	-1.230	-0.742
		[3.5%]	[6.1%]	[-6.1%]	[60.2%]	[36.3%]

Notes: Numbers without brackets are the employment effect measured in million workers. A positive number means increased labor demand while a negative number indicates reduced labor demand. Numbers in square brackets are the ratio of each component of the employment effect to the overall employment effect. See notes to Table 1 for the sector definitions.