Explaining the Employment Effect of Exports: Value-Added Content Matters*

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Abstract

This paper estimates and decomposes the impact of export opportunities on countries' employment by using a global input-output analysis, focusing on the U.S., China, and Japan. The greater they export, the greater employment in the exporting countries. However, we first document that the number of jobs created per exports vary substantially across destination countries. Exports to some countries create more jobs than exports to other countries for the same value of exports. Results suggest that exports from sectors with higher domestic value-added contents such as natural resource, textile, and service sectors lead to a greater employment effect. As a result, cross-country differences in sectoral compositions of exports explain a large part of the variations in the employment effects across destination countries. Forward and backward linkages with other countries also affects the employment effects of exports but directions of the impact depend on exporters and their trading partners.

Key Words: Exports, Employment, Global Input-Output Table, Value-Added Content of Trade
JEL codes: E16, F14, F60, O19

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1 Introduction

Export opportunities to foreign countries create jobs in exporting countries. Previous literature finds a substantial employment creation effect of exports using an input-output analysis (e.g., Los, Timmer, and Vries, 2015, for the impact on China's employment; Feenstra and Sasahara, 2017, for U.S. employment; Feenstra and Sasahara, 2019 *forthcoming*, for employment in Asian countries). However, the employment effect per exports – roughly speaking, productivity of exports in creating employment – is not explored in the literature. The question we ask is if the size of employment generated by exports can be described by a one-to-one mapping from the size of exports. If yes, we do not necessarily have to use an input-output analysis to find employment effects of exports and we just need to look at the size of exports.

The answer we find from our analysis is that the employment effect of exports is not just the size of exports and the employment effect per exports vary substantially across destination countries. Then we further ask why some countries create more jobs per exports than others do. We find that service exports and agricultural exports lead to more jobs per dollar than manufacturing exports. This result is consistent with the recent literature on value added in trade, finding that there is a substantial amount of intermediate good trade in manufacturing industries, making domestic value-added content of manufacturing exports smaller (e.g., Johnson and Noguera, 2012). Therefore, the employment effect per exports vary across destination countries primarily due to differences in sectoral composition of exports. Because countries sell disproportionally more services domestically, domestic final demand leads to more jobs for the same value of final demand on average.

Our analyses focus on three major countries in the world, the U.S., China, and Japan where these countries account for 41% of world GDP and 26% of world merchandise trade as of 2014 (World Bank, 2017) and they have large influences on the world economy. Therefore, it is critical to understand the employment effect of exports on these countries. Comparing these three countries, we find that employment effects of foreign final demand per million dollar exports on China are very different from those on the U.S. and Japan. For example, the employment effect of foreign final demand per exports on China is increasing over the period 2000-2014 while those are declining in the U.S. and Japan. There are several explanations for this. First, domestic value-added contents in China's exports are rising as shown in previous studies (e.g., Kee and Tang, 2016; Koopman, Z. Wang, and Wei, 2012). Second, results from a regression analysis shows that rising shares of natural resource, textile, and service exports are responsible for increasing employment effects of exports because these sectors have greater domestic value-added contents of exports as shown in Koopman, Z. Wang, and Wei (2012) and Ma, Z. Wang, and Zhu (2015).

Another unique aspect of China is that its forward linkages with other countries are increasing over the period 2000-2014 and backward linkages are declining, where these trends are not present in the U.S. and Japan. We also aim to understand how forward and backward linkages

with other countries affect the employment effect of exports by distinguishing linkages with destination and all other countries as well as high-income and low-income countries. Results suggests that the impact of international production linkages on the employment effect of exports is much more complicated than implications from sectoral compositions of exports. The impact of deeper backward linkages are particularly complicated as these sometimes lead to job replacement and sometimes boost exports due to an increase in the number of available intermediate inputs from abroad (see Feng, Li, and Swenson, 2016, for the case in China; Harrison and McMillan, 2011 and Wright, 2016, for the case in the U.S.).[1]

This paper contributes to a growing body of literature on the employment effect of international trade, focusing on a positive employment creation effect of exports (e.g., Los, Timmer, and Vries, 2015, for China; Vianna, 2016, for Latin American countries; Feenstra, Ma, and Xu, 2017, Feenstra and Sasahara, 2017, Liang, 2018, and Magyari, 2017, for the U.S.; Feenstra and Sasahara, 2019 *forthcoming*, and Kiyota, 2016, for Asian countries). Among these studies, this paper is particularly related with Los, Timmer, and Vries (2015), Feenstra and Sasahara (2019), Feenstra and Sasahara (2017), and Kiyota (2016) because we also use an input-output analysis. We go beyond the literature by highlighting the fact that the employment effect per exports vary substantially across destination countries and by explaining the reasons why they differ.

Echoing recent studies investigating implications of value-added content of trade under expanding Global Value Chains (hereafter GVCs), we aim to understand how value-added contents effect the employment effect of exports. Existence of GVCs must have a significant implication on various economic indicators in this integrated world (see Feenstra, 1998; Baldwin, 2012), especially in East Asia (see Ando and Kimura, 2005). Previous studies show that GVCs and value-added contents of trade have implications on trade imbalances (Johnson and Noguera, 2012; Johnson, 2014), U.S. employment in import-competing sectors (Shen and Silva, 2018; Shen, Silva, and H. Wang, 2018)[2], business cycle synchronization (Duval et al., 2016), exchange rates (Bems and Johnson, 2017), trade policies (Blanchard, Bowen, and Johnson, 2017). This paper considers an implication of value added content of trade from a different angle. The question we ask is whether GVCs and value-added contents of trade affect the

[1] Feng, Li, and Swenson (2016) shows that an increase in intermediate good imports increased exports from China because imported intermediate inputs have higher quality and led to a positive spillover. Harrison and McMillan (2011) analyze the data from the U.S. between 1982 and 1999 and find that offshoring to low-wage countries reduced U.S. manufacturing employment. They also find that offshoring increased employment for firms doing very different tasks between home and abroad. Wright (2016) examines a direct displacement effect of offshoring, which works to reduce domestic employment, and a positive productivity effect, which increases employment. By taking these two effects into account, he finds that offshoring to China increased overall employment by 2.6% during 2001-2007 following China's accession to the WTO.

[2] Shen and Silva (2018) show that increasing value-added exports from China to the U.S. have a negative effect on employment if the import competing industry has a high degree of downstreamness while industries with a low degree of downstreamness are not affected by imports from China. Shen, Silva, and H. Wang (2018) find that exposure to value-added imports from China reduced wages earned by routine workers while it increased those for non-routine workers. These studies examine the employment effect of exposure to value-added imports from China on the U.S.

employment creation effect of exports from a country. In terms of focus, this paper is most closely related with Feenstra (2017), proposing an idea that value-added contents of trade are considered as the 'second generation' measure of offshoring and suggesting its implication on labor markets. This paper finds that domestic value-added contents of exports have striking impacts on employment effects of exports through sectoral compositions in exports and through forward and backward linkages.

The rest of the paper is organized as follows. The next section discusses the method estimating the employment effect of domestic and foreign final demands. Section 3 discusses results from the analysis. Section 4 displays results from a regression analysis investigating the determinants of the employment effect of final demands. Section 5 concludes. Details on data are summarized in Appendix.

2 The Method

2.1 Quantifying the Employment Effect of Final Demand

This section presents the technique we estimate the employment effect of exports – or final demand in general. The input-output approach has a long history since Leontief (1936) and the method we use is also employed by Los, Timmer, and Vries (2015) and Feenstra and Sasahara (2017) to quantify the employment effect of exports. We use the global input-output table from the WIOD, the 2016 release (Timmer, Dietzenbacher, et al., 2015; Timmer, Los, et al., 2016). It has $C = 44$ economies including the rest of the world as one economy and each of them consists of $N = 56$ sectors. Input-output analyses are conducted using this WIOD input-output table with $C = 44$ and $N = 56$. However, for the sake of simplicity, this section assumes that there are only two countries – country 1 and country 2, denoted with superscripts 1 and 2, respectively – and each of the two countries has two sectors – the manufacturing and service sectors, denoted with superscripts M and S, respectively. As a result, the number of countries is $C = 2$ and the number of sectors, $N = 2$. This simplifies the matrix notations and explanations. The same logic applies to a general case with an arbitrary number of countries and sectors. The input-output table is available annually from 2000 to 2014 so we introduce time subscript $t = 2000, 2001, ..., 2014$.

Table 1 shows a simplified two country $\times$ two sector input-output table. The 4×4 symmetric matrix in the left side of the table describes intermediate good flows. For example, $m_t^{(1,M),(1,M)}$ is the value of intermediate good flows from the manufacturing sector of country 1 to the same sector of the same country — domestic sales. $m_t^{(1,M),(2,S)}$ measures the value of intermediate good flows from the manufacturing sector of country 1 to the service sector of country 2 — international trade. The last two columns indicated by d's describe final good flows. For example, $d_t^{(1,M),1}$ is the value of final goods produced in country 1's manufacturing sector and purchased as final goods by country 1. $d^{(1,M),2}$ denotes the value of final goods produced in the

same sector and purchased by country 2. Using these, we can find input-output coefficients:

$$\underbrace{\mathbf{A}_t}_{(C\times N)\times(C\times N)} = \begin{bmatrix} a_t^{(1,M),(1,M)} & a_t^{(1,M),(1,S)} & a_t^{(1,M),(2,M)} & a_t^{(1,M),(2,S)} \\ a_t^{(1,S),(1,M)} & a_t^{(1,S),(1,S)} & a_t^{(1,S),(2,M)} & a_t^{(1,S),(2,S)} \\ a_t^{(2,M),(1,M)} & a_t^{(2,M),(1,S)} & a_t^{(2,M),(2,M)} & a_t^{(2,M),(2,S)} \\ a_t^{(2,S),(1,M)} & a_t^{(2,S),(1,S)} & a_t^{(2,S),(2,M)} & a_t^{(2,S),(2,S)} \end{bmatrix},$$

where

$$a^{(i,s),(j,r)} = m^{(i,s),(j,r)}/y^{j,r},$$

with gross production in sector r of country j, $y_t^{j,r} = \sum_{s=1}^{2}\sum_{i=1}^{2} m_t^{(j,r),(i,s)} + \sum_{i=1}^{2} d_t^{(j,r),i}$.

Table 1: Simplified Two Country × Two Sector Input-Output Table

	Country 1		Country 2		Country 1	Country 2
	Manuf.	Services	Manuf.	Services	Final	Final
Country 1, Manufacturing	$m_t^{(1,M),(1,M)}$	$m_t^{(1,M),(1,S)}$	$m_t^{(1,M),(2,M)}$	$m_t^{(1,M),(2,S)}$	$d_t^{(1,M),1}$	$d_t^{(1,M),2}$
Country 1, Services	$m_t^{(1,S),(1,M)}$	$m_t^{(1,S),(1,S)}$	$m_t^{(1,S),(2,M)}$	$m_t^{(1,S),(2,S)}$	$d_t^{(1,S),1}$	$d_t^{(1,S),2}$
Country 2, Manufacturing	$m_t^{(2,M),(1,M)}$	$m_t^{(2,M),(1,S)}$	$m_t^{(2,M),(2,M)}$	$m_t^{(2,M),(2,S)}$	$d_t^{(2,M),1}$	$d_t^{(2,M),2}$
Country 2, Services	$m_t^{(2,S),(1,M)}$	$m_t^{(2,S),(1,S)}$	$m_t^{(2,S),(2,M)}$	$m_t^{(2,S),(2,S)}$	$d_t^{(2,S),1}$	$d_t^{(2,S),2}$

Employment effects of final demand from a foreign country: Suppose country 1 is home and country 2 is a foreign country. We are interested in the effect of final demand from country 2 to country 1 on country 1's employment. The employment effect of that final demand is estimated as[3]

$$\mathbf{L}_t^{(1,All),2} = \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\mathbf{D}_t^{*(1,All),2}, \tag{1}$$

where

$$\underbrace{\mathbf{D}_t}_{(C\times N)\times 1} = \begin{bmatrix} d_t^{(1,M),1} + d_t^{(1,M),2} \\ d_t^{(1,S),1} + d_t^{(1,S),2} \\ d_t^{(2,M),1} + d_t^{(2,M),2} \\ d_t^{(2,S),1} + d_t^{(2,S),2} \end{bmatrix} \text{ and } \underbrace{\mathbf{D}_t^{*(1,All),2}}_{(C\times N)\times 1} = \begin{bmatrix} d_t^{(1,M),1} + 0 \\ d_t^{(1,S),1} + 0 \\ d_t^{(2,M),1} + d_t^{(2,M),2} \\ d_t^{(2,S),1} + d_t^{(2,S),2} \end{bmatrix},$$

and $\mathbf{\Lambda}_t$ is a $(C\times N)\times(C\times N)$ matrix with labor-to-gross production ratio in diagonal entries and zeros in off-diagonal entries. In the hypothetical final demand vector $\mathbf{D}_t^{*(1,All),2}$, final demands

[3]The exact approach employed by Los, Timmer, and Vries (2015) is what they call the demand-side analysis — the employment effect of exports from country 1 to country 2 is estimated as $\mathbf{\Lambda}_t(\mathbf{I}-\mathbf{A}_t)^{-1}\tilde{\mathbf{D}}_t^{(1,All),2}$ where $\tilde{\mathbf{D}}_t^{(1,All),2}$ denotes final demand flows from all sectors in country 1 to country 2. The approach we employ here is the 'hypothetical extraction' technique (e.g., Los, Timmer, and De Vries, 2016), which measures the difference between the actual employment level and the counterfactual employment when there was no foreign demand from country 2. These two approaches give different numbers in general (see Feenstra and Sasahara, 2019, for a case of the employment effect of China on Asian countries, for example) and the employment effect estimated using the latter approach is interpreted as 'domestic' employment generated by foreign demand from country 2. See section 2.2.2 of Johnson (2017) for further clarification.

from country 2 to country 1 represented in $d_t^{(1,M),2}$ and $d_t^{(1,S),2)}$ are replaced with zeros. Superscript $(1, All)$, 2 indicate that this computation leads to the employment effect generated by country 2's final demands to country 1's all sectors. The estimated employment effect $\mathbf{L}_t^{(1,All),2}$ is a $(C \times N) \times 1$ vector, $\mathbf{L}_t^{(1,All),2} = \left[L_t^{(1,M)}|_{(1,All),2}, L_t^{(1,S)}|_{(1,All),2}, L_t^{(2,M)}|_{(1,All),2}, L_t^{(2,S)}|_{(1,All),2}\right]'$. The overall employment effect of country 2's final demands to country 1 on country 1 is $L_t^{(1,M)}|_{(1,All),2} + L_t^{(1,S)}|_{(1,All),2}$, the employment effect on country 1's manufacturing sector plus the one on country 1's service sector.

Employment effects of domestic final demand: The effect of domestic final demand on country 1's employment is estimated as:

$$\mathbf{L}_t^{(1,All),1} = \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t^{*(1,All),1}, \tag{2}$$

where

$$\underbrace{\mathbf{D}_t^{*(1,All),1}}_{(C\times N)\times 1} = \begin{bmatrix} 0 + d_t^{(1,M),2} \\ 0 + d_t^{(1,S),2} \\ d_t^{(2,M),1} + d_t^{(2,M),2} \\ d_t^{(2,S),1} + d_t^{(2,S),2} \end{bmatrix}.$$

While final demands from country 2 to country 1, $d_t^{(1,M),2}$ and $d_t^{(1,S),2}$, are replaced with zeros in the previous case, final demands from country 1 to country 1, $d_t^{(1,M),1}$ and $d_t^{(1,S),1}$, are replaced with zeros in the current case. Because the estimated employment effect $\mathbf{L}_t^{(1,All),1} = \left[L_t^{(1,M)}|_{(1,All),1}, L_t^{(1,S)}|_{(1,All),1}, L_t^{(2,M)}|_{(1,All),1}, L_t^{(2,S)}|_{(1,All),1}\right]'$ is a $(C \times N) \times 1$ vector, we extract the elements describing the employment effect on country 1, $L_t^{(1,M)}|_{(1,All),1} + L_t^{(1,S)}|_{(1,All),1}$, and find a sum of these as in the previous case.

Normalizing the employment effects: A greater final demand implies a greater employment effect. A question we would like to ask is whether this employment effect is merely another measure of size of final demand. If there is exact one-to-one mapping from the size of final demand to the size of employment effect, we do not have to have this formal procedure to estimate the employment effects and we just need to look at the size of domestic and foreign final demands. In order to examine if there is different employment effect depending upon destination country, we find the employment effect per export value dividing by the export value:

$$l_t^{(1,M)}|_{(1,All),k} \equiv \frac{L_t^{(1,M)}|_{(1,All),k} + L_t^{(1,S)}|_{(1,All),k}}{d_t^{(1,M),k} + d_t^{(1,S),k}}, \quad \text{for} \quad k = 1, 2$$

where $l_t^{(1,M)}|_{(1,All),2}$ is the *per final demand* employment effect of country 2's final demand to country 1 on country 1 as a whole and $l_t^{(1,M)}|_{(1,All),1}$ is the *per final demand* employment effect of country 1's final demand to country 1 on country 1 as a whole.

2.2 Quantifying Sectoral Linkages of the Employment Effect

The analysis in the previous section makes it possible to see the impact of a country's aggregate exports on employment in each sector in the exporting country. In order to see how sectoral linkages generate employment, we explore the employment effect by disaggregating the employment effects at the sector level.

Employment effects of final demand from a foreign country: For example, the employment effect of country 2's final demand to country 1's manufacturing sector is found as:

$$\mathbf{L}_t^{(1,M),2} = \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t^{*(1,M),2}, \tag{3}$$

where

$$\underbrace{\mathbf{D}_t^{*(1,M),2}}_{(C\times N)\times 1} = \begin{bmatrix} d_t^{(1,M),1} + 0 \\ d_t^{(1,S),1} + d_t^{(1,S),2} \\ d_t^{(2,M),1} + d_t^{(2,M),2} \\ d_t^{(2,S),1} + d_t^{(2,S),2} \end{bmatrix}.$$

Under this hypothetical final demand $\tilde{\mathbf{D}}_t^{(1,M),2}$, only country 2's final demand to country 1's manufacturing sector $d_t^{(1,M),2}$ is replaced with zero and country 2's final demand to country 1's service sector $d_t^{(1,S),2}$ is kept as it is. The estimated employment effect $\mathbf{L}_t^{(1,M),2}$ is a vector $\mathbf{L}_t^{(1,M),2} = \left[L_t^{(1,M)}|_{(1,M),2}, L_t^{(1,S)}|_{(1,M),2}, L_t^{(2,M)}|_{(1,M),2}, L_t^{(2,S)}|_{(1,M),2}\right]'$. The first element $L_t^{(1,M)}|_{(1,M),2}$ measures the effect of impact of country 2's final demand to country 1's manufacturing sector on country 1's manufacturing sector – the *direct* effect on its own sector. The second element $L_t^{(1,S)}|_{(1,M),2}$ quantifies the effect of impact of country 2's final demand to country 1's manufacturing sector on country 1's service sector – the *indirect* effect through input-output linkages.

Employment effects of domestic final demand: Following the same idea, the employment impact of country 1's final demand to country 1's manufacturing industry is:

$$\mathbf{L}_t^{(1,M),1} = \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t - \mathbf{\Lambda}_t(\mathbf{I} - \mathbf{A}_t)^{-1}\mathbf{D}_t^{*(1,M),1}, \tag{4}$$

where

$$\underbrace{\mathbf{D}_t^{*(1,M),1}}_{(C\times N)\times 1} = \begin{bmatrix} 0 + d_t^{(1,M),2} \\ d_t^{(1,S),1} + d_t^{(1,S),2} \\ d_t^{(2,M),1} + d_t^{(2,M),2} \\ d_t^{(2,S),1} + d_t^{(2,S),2} \end{bmatrix}.$$

In $\mathbf{D}_t^{*(1,M),1}$, country 1's final demand to country 1's manufacturing sector $d_t^{(1,M),1}$ is replaced with zero. The estimated employment effect $\tilde{\mathbf{L}}_t^{(1,M),1}$ is a $(C \times N) \times 1$ vector $\tilde{\mathbf{L}}_t^{(1,M),1} = \left[L_t^{(1,M)}|_{(1,M),1}, L_t^{(1,S)}|_{(1,M),1}, L_t^{(2,M)}|_{(1,M),1}, L_t^{(2,S)}|_{(1,M),1}\right]'$. The first element $L_t^{(1,M)}|_{(1,M),1}$ measures the effect of impact of country 1's final demand to country 1's manufacturing sector on country 1's manufacturing sector – the *direct* effect on its own sector. The second element $L_t^{(1,S)}|_{(1,M),1}$

quantifies the effect of impact of country 1's final demand to country 1's manufacturing sector on country 1's service sector – the *indirect* effect through input-output linkages.

Normalizing the employment effects: These estimated employment effects are normalized by dividing by final demand flows as follows:

$$l_t^{(1,M)}|_{(1,M),k} \equiv \frac{L_t^{(1,M)}|_{(1,M),k}}{d_t^{(1,M),k}} \quad \text{and} \quad l_t^{(1,S)}|_{(1,M),k} \equiv \frac{L_t^{(1,S)}|_{(1,M),k}}{d_t^{(1,M),k}}, \quad \text{for} \quad k = 1, 2$$

where the former is the *per final demand* employment effect of country k's final demand to country 1's manufacturing sector on country 1's manufacturing sector and the latter is the *per final demand* employment effect of country k's final demand country 1's manufacturing sector on country 1's service sector.

3 Estimated Employment Effects

3.1 Observations from Cross-Sectional Data

We first look the employment effect of exports at the destination country-level for the U.S., China, and Japan, respectively. Table 2 reports the estimated impacts of final demand from 10 contributors to U.S. employment. The first three columns report the result for U.S. total exports and the last three columns describe the ones for U.S. merchandise exports, only. Column (1) shows that final demands from Canada, China, and Mexico, contribute to the U.S. to create 624 thousand, 263 thousand, and 246 thousand jobs, respectively. These countries have greater employment effects on the U.S. because U.S. exports to these countries are greater – U.S. exports to Canada, China, and Mexico are 1 trillion, 46 billion, and 42 billion USD, respectively (see column (2)). In order to see if the size of employment effects is fully explained by the size of exports, column (3) displays the employment effect per million dollar exports. It shows that the employment effect per exports vary substantially across destination countries. For example, million dollar exports to Netherlands create 7.69 jobs while the same value of exports to France lead to only 6.16 jobs. It also shows that a million dollar domestic final demand creates 8.56 jobs on average. Foreign final demand creates, on average, 6.07 jobs per million dollar final demand. Therefore, final demands from foreign countries lead to about $100 \times (8.56 - 6.07)/8.56 = 29$ percent less jobs than U.S. domestic final demand for the same value of final demand.[4]

[4]One may ask if these numbers are reasonable. Johnson and Noguera (2012) find that the value added ratio of U.S. exports is 77% using the data from 2004. Elsby, Hobijn, and Sahin (2013) report that the labor share in the U.S. is 58.3%. These numbers imply that a million dollar exports lead to 1 million $\times$ 0.77 $\times$ 0.583 = 449 thousand dollars labor compensation. We find that a million dollar foreign final demand creates 8.46 jobs on average. The labor compensation 449 thousand dollars dividend by 8.46 persons is equal to 53.07 thousand dollars per worker. The median annual household income in 2014 was 53.66 thousand dollars (U.S. Census Bureau, 2014), which is close to our estimates, 53.07 thousand dollars. These computations confirm that our estimation results are reasonable.

However, this trend disappears once we focus on final demand to merchandise sectors only. Column (4) in Table 1 report the employment impact of merchandise final demand. The value of merchandise final demand and the employment effect per million dollar final demand are shown in columns (5) and (6), respectively. A million dollar domestic final demands to merchandise goods lead to 5.32 jobs while that from foreign countries generate 5.55 jobs on average, which is slightly greater than the domestic employment effect. The result suggests that final demand for services create more jobs and the U.S. exports merchandise goods disproportionally more than services comparing with U.S. sales to its domestic market.

Table 2: The Impact of Final Demand from Top 10 Contributors on U.S. Employment, 2014

		Final demand to all sectors			Final demand to merchandise sectors		
		Employment effect (thousand jobs) (1)	Final good demand (million USD) (2)	Employment effect per million USD (jobs) (3)	Employment effect (thousand jobs) (4)	Final good demand (million USD) (5)	Employment effect per million USD (jobs) (6)
1	Canada	624.24	104,186	5.99	542.04	94,180	5.76
		(0.42)	(0.59)		(3.75)	(3.49)	
2	China	263.37	45,595	5.78	221.17	39,680	5.57
		(0.18)	(0.26)		(1.53)	(1.47)	
3	Mexico	245.50	42,426	5.79	229.07	39,878	5.74
		(0.17)	(0.24)		(1.59)	(1.48)	
4	The U.K.	201.75	34,078	5.92	131.45	24,517	5.36
		(0.14)	(0.19)		(0.91)	(0.91)	
5	Germany	178.26	29,204	6.10	95.77	17,685	5.42
		(0.12)	(0.17)		(0.66)	(0.66)	
6	Japan	138.14	22,265	6.20	115.01	18,886	6.09
		(0.09)	(0.13)		(0.80)	(0.70)	
7	France	100.68	16,357	6.16	34.08	7,918	4.30
		(0.07)	(0.09)		(0.24)	(0.29)	
8	South Korea	90.48	13,683	6.61	52.16	8,832	5.91
		(0.06)	(0.08)		(0.36)	(0.33)	
9	Netherlands	87.50	11,375	7.69	30.06	5,562	5.40
		(0.06)	(0.06)		(0.21)	(0.21)	
10	Australia	72.79	12,356	5.89	52.02	9,198	5.66
		(0.05)	(0.07)		(0.36)	(0.34)	
	The U.S.	144,500.00	16,879,829	8.56	12,168.00	2,286,125	5.32
		(97.28)	(96.20)		(84.23)	(84.77)	
	Foreign	4,044.77	666,089	6.07	2,278.17	410,629	5.55
		(2.72)	(3.80)		(15.77)	(15.23)	

Notes: The table reports the employment effect of final demand from 10 contributors for the U.S. in 2014. Columns (1) and (2) report $\sum_{s=1}^{56} L_t^{(US,s),j}|_{(US,All),j}$ and $\sum_{s=1}^{56} d_t^{(US,s),j}$, respectively, for each of top 10 contributors j. Column (3) shows $\sum_{s=1}^{56} L_t^{(US,s),j}|_{(US,All),j} / \sum_{s=1}^{56} d_t^{(US,s),j}$. Columns (4) and (5) report $\sum_{s=1}^{22} L_t^{(US,s),j}|_{(US,\text{Merchandise}),j}$ and $\sum_{s=1}^{22} d_t^{(US,s),j}$, respectively. Column (6) displays $\sum_{s=1}^{22} L_t^{(US,s),j}|_{(US,\text{Merchandise}),j} / \sum_{s=1}^{22} d_t^{(US,s),j}$. The ten countries are shown in descending order based on the aggregate employment effect reported in column (1). The share of employment effects (or final demand) to the overall value are in parentheses.

Table 3 shows results from China as an exporter. Column (1) shows that final demands from the U.S., Japan, and Russia, contribute to the U.S. to create 13 million, 7 million, and 4

Table 3: The Impact of Final Demand from Top 10 Contributors on China's Employment, 2014

		Final demand to all sectors			Final demand to merchandise sectors		
		Employment effect (thousand jobs) (1)	Final good demand (million USD) (2)	Employment effect per million USD (jobs) (3)	Employment effect (thousand jobs) (4)	Final good demand (million USD) (5)	Employment effect per million USD (jobs) (6)
1	The U.S.	13,844	217,064	63.78	13,644	213,094	64.03
		(1.74)	(2.06)		(4.58)	(5.51)	
2	Japan	7,099	105,415	67.35	7,025	104,379	67.30
		(0.89)	(1.00)		(2.36)	(2.70)	
3	Russia	4,345	48,015	90.49	4,336	47,853	90.62
		(0.55)	(0.45)		(1.46)	(1.24)	
4	Germany	2,873	46,635	61.61	2,815	45,619	61.70
		(0.36)	(0.44)		(0.94)	(1.18)	
5	The U.K.	2,104	29,836	70.52	2,040	29,279	69.68
		(0.26)	(0.28)		(0.68)	(0.76)	
6	South Korea	1,824	27,685	65.87	1,772	26,806	66.10
		(0.23)	(0.26)		(0.59)	(0.69)	
7	Canada	1,732	24,497	70.69	1,566	23,155	67.61
		(0.22)	(0.23)		(0.53)	(0.60)	
8	Australia	1,634	25,067	65.20	1,560	24,222	64.39
		(0.21)	(0.24)		(0.52)	(0.63)	
9	France	1,267	19,579	64.71	1,137	17,345	65.58
		(0.16)	(0.19)		(0.38)	(0.45)	
10	India	1,264	19,670	64.27	970	17,996	53.87
		(0.16)	(0.19)		(0.33)	(0.47)	
	China	715,680	9,347,750	76.56	228,800	2,786,059	82.12
		(90.10)	(88.51)		(76.77)	(72.01)	
	Foreign	78,622	1,213,131	64.81	69,231	1,082,778	63.94
		(9.90)	(11.49)		(23.23)	(27.99)	

Notes: The table reports the employment effect of final demand from 10 contributors for China in 2014. Columns (1) and (2) report $\sum_{s=1}^{56} L_t^{(US,s),j}|_{(CHN,All),j}$ and $\sum_{s=1}^{56} d_t^{(CHN,s),j}$, for each of top 10 contributors j. Column (3) shows $\sum_{s=1}^{56} L_t^{(CHN,s),j}|_{(CHN,All),j} / \sum_{s=1}^{56} d_t^{(CHN,s),j}$. Columns (4) and (5) report $\sum_{s=1}^{22} L_t^{(CHN,s),j}|_{(US,\text{Merchandise}),j}$ and $\sum_{s=1}^{22} d_t^{(CHN,s),j}$, respectively. Column (6) displays $\sum_{s=1}^{22} L_t^{(CHN,s),j}|_{(US,\text{Merchandise}),j} / \sum_{s=1}^{22} d_t^{(CHN,s),j}$. The ten countries are shown in descending order based on the aggregate employment effect reported in column (1). The share of employment effects (or final demand) to the overall value are in parentheses.

million jobs, respectively. In terms employment effects per million dollar final demand, Russia creates the largest number of jobs, 90.49, and the U.S. has the smallest number, 63.78, among the top 10 countries.[5] A million dollar final demand from foreign countries as a whole creates 64.81 jobs while the same value of domestic final demand leads to 76.56 jobs. Hence, final demands from foreign countries lead to about $100 \times (76.56 - 64.81)/64.81 = 18$ percent less

[5]China has relatively large numbers of employment effect per million dollar final demand. A million dollar domestic final demand creates 8.56 jobs in the U.S. while the same value of domestic final demand in China leads to 76.56 jobs, which is 13 times greater than that of the U.S. There are two reasons for this. First, income per capita is lower in China compared with the U.S. According to the data from PWT (Feenstra, Inklaar, and Timmer, 2015), GDP per capita in the U.S. is five times greater than that of China in 2014. Second, Chinese economy is more labor intensive than the U.S. The data from the WIOD show that the labor-to-output ratio in China is four times greater than that of the U.S. in 2014.

Table 4: The Impact of Final Demand from Top 10 Contributors on Japan's Employment, 2014

		Final demand to all sectors			Final demand to merchandise sectors		
		Employment effect (thousand jobs) (1)	Final good demand (million USD) (2)	Employment effect per million USD (jobs) (3)	Employment effect (thousand jobs) (4)	Final good demand (million USD) (5)	Employment effect per million USD (jobs) (6)
1	The U.S.	546	59,912	9.11	536	59,057	9.07
		(0.96)	(1.30)		(5.96)	(7.17)	
2	China	449	45,056	9.96	435	44,014	9.88
		(0.79)	(0.98)		(4.84)	(5.34)	
3	Taiwan	96	9,176	10.50	85	8,306	10.18
		(0.17)	(0.20)		(0.94)	(1.01)	
4	Russia	93	10,640	8.75	93	10,624	8.75
		(0.16)	(0.23)		(1.03)	(1.29)	
5	Rep. of Korea	80	8,301	9.67	76	8,054	9.42
		(0.14)	(0.18)		(0.84)	(0.98)	
6	Germany	80	7,980	9.97	75	7,629	9.88
		(0.14)	(0.17)		(0.84)	(0.93)	
7	Australia	68	8,279	8.26	68	8,244	8.24
		(0.12)	(0.18)		(0.75)	(1.00)	
8	Canada	43	4,657	9.24	42	4,566	9.15
		(0.08)	(0.10)		(0.46)	(0.55)	
9	Mexico	36	3,718	9.76	35	3,638	9.56
		(0.06)	(0.08)		(0.39)	(0.44)	
10	The U.K.	35	3,518	10.04	31	3,258	9.41
		(0.06)	(0.08)		(0.34)	(0.40)	
	Japan	53,661	4,285,776	12.52	6,534	561,858	11.63
		(94.38)	(92.93)		(72.67)	(68.20)	
	Foreign	3,194	326,213	9.79	2,458	261,974	9.38
		(5.62)	(7.07)		(27.33)	(31.80)	

Notes: The table reports the employment effect of final demand from 10 contributors for Japan in 2014. Columns (1) and (2) report $\sum_{s=1}^{56} L_t^{(US,s),j}|_{(US,All),j}$ and $\sum_{s=1}^{56} d_t^{(JPN,s),j}$, for each of top 10 contributors j. Column (3) shows $\sum_{s=1}^{56} L_t^{(JPN,s),j}|_{(JPN,All),j} / \sum_{s=1}^{56} d_t^{(JPN,s),j}$. Columns (4) and (5) report $\sum_{s=1}^{22} L_t^{(JPN,s),j}|_{(US,\text{Merchandise}),j}$ and $\sum_{s=1}^{22} d_t^{(JPN,s),j}$, respectively. Column (6) displays $\sum_{s=1}^{22} L_t^{(JPN,s),j}|_{(JPN,\text{Merchandise}),j} / \sum_{s=1}^{22} d_t^{(JPN,s),j}$. The ten countries are shown in descending order based on the aggregate employment effect reported in column (1). The share of employment effects (or final demand) to the overall value are in parentheses.

jobs than U.S. domestic final demand for the same value of final demand. This result is similar to the one from the U.S.

Columns (4)-(6) show the employment effect of final demand to merchandise sectors. Contrary to the U.S. case, the gap between domestic and foreign employment creation effect is still present even after restricting our focus on the merchandise sectors. Interestingly, the gap between the two becomes even greater. A million dollar domestic final demand to China's merchandise sectors create 82.12 jobs while foreign final demand to the same sectors leads to 63.94 — the gap is $100 \times (82.12 - 63.94)/63.94 = 28$ percent. This implies that service sectors in China do not have much greater value added content and/or service sectors are less labor-intensive in China. Furthermore, there should be some merchandise sectors that create more

jobs and sell disproportionally more to abroad.

Lastly, Table 4 shows results from Japan. The U.S., China, and Taiwan are top three contributors for Japan — leading to 59 thousand, 45 thousand, and 9 thousand jobs, respectively. In terms of the number of jobs per million dollar final demand, Taiwan has the greatest number, 10.50, and Australia has the smallest number, 8.26, among the top 10 contributors. A million dollar final demand from foreign countries as a whole leads to 9.79 jobs while that from Japan creates 12.52 jobs. The gap is $100 \times (12.52 - 9.79)/9.79 = 28$ percent. Restricting our focus on merchandise sectors makes the gap smaller but the gap does not become zero — $100 \times (11.63 - 9.38)/9.38 = 24$ percent. Overall, the results reported in Tables (2)-(4) lead to the following statements.

Observation 1*: Employment creation effects per million dollar final demand varies substantially across destination countries. Domestic final demand leads to 20-30% more jobs than final demand from foreign countries if all sectors are taken into account.*

Observation 2*: By restricting our focus on merchandise sectors, the gap between employment creation effects of domestic final demand and foreign final demand ...*

- *becomes almost zero for the U.S.*
- *becomes greater for China.*
- *becomes smaller but non-zero for Japan.*

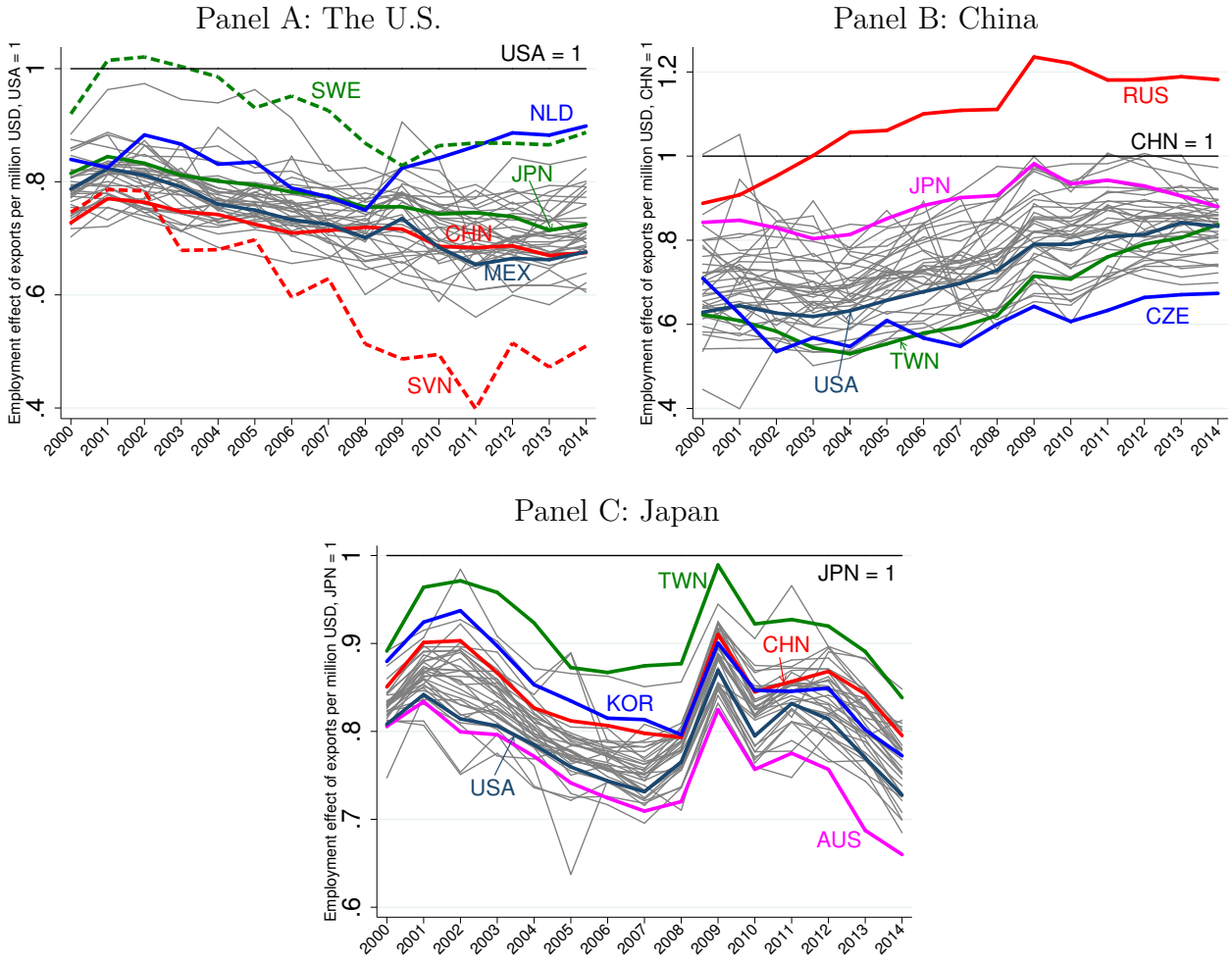
Guided by Observation 2, we look at the employment effects of final demand at the country-sector level. Before going to that direction, we show how the employment effect of final demand from various countries evolved over the period 2000-2014 because the previous results only come from static cross-sectional observations in 2014.

3.2 Observations from Panel Data

Figure 1 describes the employment effects of final demand from various countries between 2000 and 2014 for the U.S. (Panel A), China (Panel B), and Japan (Panel C). The employment effects of country j on country i are first normalized by dividing by the value of final demand from country j to country i, $\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j} / \sum_{s=1}^{N} d_t^{(i,s),j}$. This measure varies over time due to various factors such as inflation because input-output tables are constructed in nominal values. In order to eliminate the effect of inflation, $\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j} / \sum_{s=1}^{N} d_t^{(i,s),j}$ is divided by the impact of domestic final demand, $\sum_{s=1}^{N} L_t^{(i,s),i}|_{(i,All),i} / \sum_{s=1}^{N} d_t^{(i,s),i}$. As a result, the impacts of final demand from the U.S., China, and Japan are normalized as one in Panels A, B, and C, respectively.

Panel A shows that almost all countries have a smaller employment creation effect relative to the U.S. — one exception is Sweden in early 2000's. It shows that Sweden and Netherlands

Figure 1: Employment Effect of Final Good Demand by Destination Country

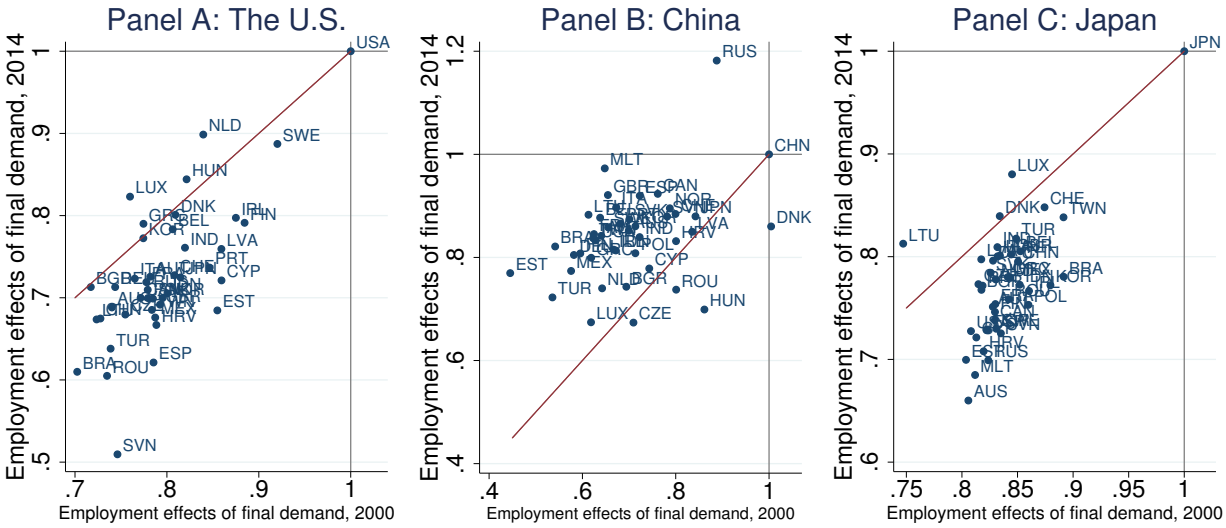


Notes: The figure displays the employment effect of aggregate final demand per value of final demand on the U.S., $\sum_{s=1}^{N} L_t^{(US,s),j}|_{(US,All),j} / \sum_{s=1}^{N} d_t^{(US,s),j}$ relative to that due to U.S. final demand $\sum_{s=1}^{N} L_t^{(US,s),US}|_{(US,All),US} / \sum_{s=1}^{N} d_t^{(US,s),US}$ for Panel A. Panels B and C show the ones for China and Japan, respectively.

have relatively greater employment creation effects and Slovenia has an exceptionally lower employment creation effect for the U.S. — the employment effect of Slovenia is 50% less than that of U.S. domestic final demand for the same value of final demand in 2014. Overall, there is a slight downward trend in the employment effects of foreign demand relative to the U.S. This upward trend in the foreign employment effects is probably driven by a rise in domestic value added in China's exports as documented in previous studies (e.g., Kee and Tang, 2016; Xikang et al., 2012).

Time-series changes of employment effects on China are presented in Panel B. Contrary to the U.S., there is an upward trend. The median gap between domestic and foreign employment effect was 30% in early 2000's but it is now 20% in 2014. Russia has an exceptionally high employment effect on China — even greater than the effect of China's domestic final demand and Czech Republic has the lowest employment effect for China.

Figure 2: Employment Effect of Final Good Demand by Destination Country, Comparison between 2000 and 2014



Notes: Panel A compares the employment effect of aggregate final demand per value of final demand on the U.S., $\sum_{s=1}^{N} L_t^{(US,s),j}|_{(US,All),j} / \sum_{s=1}^{N} d_t^{(US,s),j}$ relative to that due to U.S. final demand $\sum_{s=1}^{N} L_t^{(US,s),US}|_{(US,All),US} / \sum_{s=1}^{N} d_t^{(US,s),US}$ in 2000 and 2014. The solid upward-sloping lines are 45 degree lines. Panels B and C show the ones for China and Japan, respectively.

Panel C shows results from Japan. It shows that there is a slight declining trend in foreign employment effects, which is similar to the result from the U.S. Also, contrary to the U.S. and China, the employment effects on Japan are strongly affected by the 2008-09 Great Trade Collapse — there is a temporary hike in the foreign employment effects in 2009.[6]

Figure 2 plots the employment effect per final demand from 2014 in the vertical axis and the one from 2000 in the horizontal axis. Panels A, B, and C show scatter plots from the U.S., China, and Japan, respectively. Because the employment effects are normalized by dividing by the ones from domestic final demand, the U.S., China, and Japan are on the $(1, 1)$ coordinate in Panels A, B, and C, respectively. First, most of foreign countries lead to a smaller employment effect in 2000 and 2014 because almost all dots are on the left-bottom side from the $(1, 1)$ coordinate — only exception is Russia for China (see Panel B). Second, there are many countries above the 45 degree in Panel B, meaning that foreign employment effects have become greater for China relative to China's domestic employment effect. On the other hand, most of the observations are located below the 45 degree line in Panels A and C, suggesting that foreign employment effects have become relatively smaller for the U.S. and Japan relative to U.S. and Japan's domestic final demand, respectively. These results are summarized as follows:

[6]There are two possible explanations for this. First, exports from all sectors declined substantially but there was not much adjustment in employment, resulting in a substantial hike in employment-to-output ratio. Second, probably there was a disproportional decline in exports from sectors with greater value added content.

Observation 3*: There are substantial time-series variations in the employment effect of final demand from foreign countries relative to the employment effect of domestic final demand.*

Observation 4*: Foreign employment effects on China have become greater relative to the employment effect of China's domestic final demand during 2000-2014. Foreign employment effects on the U.S. and Japan have become smaller relative to the one due to domestic final demand during the same period.*

3.3 Employment Effects and Sectoral Linkages

The last set of analyses in this section is to look at the employments effect at the sectoral level and clarifies sectoral linkages to see if there are some differences between the employment effects of domestic and foreign final demands. The input-output table from the WIOD has 56 sectors but we aggregate the 56 sectors to three broad sectors, the natural resource (sectors 1-4) the manufacturing sector (sectors 5-22) and the service sector (sectors 23-56).[7]

Table 5: The Impact of Final Demand on U.S. Employment and Sectoral Linkages, 2014

Panel A: Domestic Final Demand

Employment creation in	Resource	Manuf.	Services	Total	Final demand	
	(jobs)	(jobs)	(jobs)	(jobs)	(million USD)	(share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	2.57	0.27	1.47	4.31	239,806	0.01
Manufacturing	0.51	2.78	2.15	5.44	2,046,319	0.12
Services	0.05	0.26	8.76	9.07	14,593,704	0.86
Total					16,879,829	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 8.56$						

Panel B: Foreign Final Demand

Employment creation in	Resource	Manuf.	Services	Total	Final demand	
	(jobs)	(jobs)	(jobs)	(jobs)	(million USD)	(share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	5.66	0.40	1.47	7.53	14,280	0.02
Manufacturing	0.30	3.10	2.07	5.47	396,349	0.60
Services	0.03	0.19	6.69	6.92	255,460	0.38
Total					666,089	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 6.07$						

Notes: The table reports the employment effect of domestic final demand (Panel A), foreign final demand (Panel B) on the U.S. in 2014. The input-output computation is done using the original WIOD input-output table with 56 sectors and 44 economies, and then the employment effects in the WIOD 56 sectors are aggregated into the three aggregate sectors: the natural resource sector, the manufacturing sector, and the service sector.

Table 5 reports results from the U.S. where Panels A and B display the employment effects of domestic final demand and foreign final demand, respectively. Panel A shows that, for example, a million dollar domestic final demand to natural resources leads to 2.57 jobs, 0.27 jobs, and 1.47 jobs in the natural resource, manufacturing, and service sectors, respectively,

[7]We conduct input-output computation using the original disaggregated data and then estimation results are aggregated after the input-output computation.

Table 6: The Impact of Final Demand on China's Employment and Sectoral Linkages, 2014

Panel A: Domestic Final Demand

Employment creation in	Resource (jobs)	Manuf. (jobs)	Services (jobs)	Total (jobs)	Final demand (million USD)	Final demand (share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	149.18	4.19	6.65	160.02	453,306	0.05
Manufacturing	27.51	23.01	16.47	66.99	2,332,753	0.25
Services	9.11	8.54	56.55	74.20	6,561,691	0.70
Total					9,347,750	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 76.56$						

Panel B: Foreign Final Demand

Employment creation in	Resource (jobs)	Manuf. (jobs)	Services (jobs)	Total (jobs)	Final demand (million USD)	Final demand (share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	114.46	4.65	8.02	127.13	11,926	0.01
Manufacturing	15.83	30.93	16.48	63.23	1,070,852	0.88
Services	6.02	4.74	61.29	72.05	130,353	0.11
Total					1,213,131	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 64.81$						

Notes: See the notes on Figure 5.

Table 7: The Impact of Final Demand on Japan's Employment and Sectoral Linkages, 2014

Panel A: Domestic Final Demand

Employment creation in	Resource (jobs)	Manuf. (jobs)	Services (jobs)	Total (jobs)	Final demand (million USD)	Final demand (share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	31.45	1.23	2.23	34.91	28,263	0.01
Manufacturing	2.01	5.58	2.82	10.40	533,595	0.12
Services	0.22	0.76	11.67	12.66	3,723,918	0.87
Total					4,285,776	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 12.52$						

Panel B: Foreign Final Demand

Employment creation in	Resource (jobs)	Manuf. (jobs)	Services (jobs)	Total (jobs)	Final demand (million USD)	Final demand (share)
A million dollar final demand to	(1)	(2)	(3)	(4)	(5)	(6)
Resource	11.85	0.83	2.23	14.90	914	0.003
Manufacturing	0.20	6.07	3.10	9.36	261,060	0.800
Services	0.12	0.51	10.84	11.47	64,239	0.197
Total					326,213	1
Weighted average of the employment effects, $\sum_{s=1}^{3} \text{Col}(4)_s \times \text{Col}(6)_s = 9.79$						

Notes: See the notes on Figure 5.

totaling 4.31 jobs. It shows that there are considerable linkages from the natural resource sector to the service sector, and from the manufacturing sector to the service sector.[8] However, there is little linkages from the service sector to the other two sectors.

Comparing with Panels A and B, sectoral job creation effects of final demands are not very different between domestic and foreign final demand — a million dollar domestic final demand

[8]This is consistent with Kiyota (2016)'s finding that service sectors' employment is largely depending upon other tradable sectors in the context of employment effects of exports on China, Japan, Indonesia, and Korea.

leads to 4.31, 5.44, and 9.07 jobs in the natural resource, manufacturing, and service sectors, respectively, while a million dollar foreign final demand create 7.53, 5.47, and 6.92 jobs in the same sectors, respectively. However, the sectoral composition of domestic final demand and foreign final demand is strikingly different — 86% of domestic final demand goes to the service sector while 60% of foreign demand are for the manufacturing sector (see column (6)). Because service sectors have greater value added content (Johnson and Noguera, 2012; Johnson, 2014), which leads to a greater employment creation effect there, differences in sectoral composition of final demand are responsible for the gap between domestic and foreign employment effects.

Table 6 displays sectoral employment effects in China — where Panels A and B show the employment effects from domestic final demand and foreign final demand, respectively. Comparing column (6) in the two panels, again there is a stark difference in sectoral compositions in the final demand from domestic and foreign markets — 70% of the domestic final demand goes to the service sector while 88% is going to the manufacturing sector. This is partly responsible for the gap between the domestic and foreign employment effects. Another interesting observation is that a million dollar domestic final demand to the natural sector create a significantly greater jobs in the same sector compared with foreign final demand — 149.18 jobs versus 114.46.[9] This gap is the reason why there is a large difference between the employment effect of domestic and foreign final demands in China even after restricting our focus on merchandise sectors.

Sectoral employment effects in Japan are presented in Table 7. Comparing column (4) in Panels A and B, there is no big difference in the employment effects in the manufacturing and the service sector across domestic and foreign final demands. However, there is a large gap in the employment effects in the natural resource sector between domestic and foreign demand — 34.91 versus 14.90. This is similar to the case from China. These considerations are summarized as follows.

Observation 5*: Domestic final demands are concentrated in the service sector while majority of foreign final demands go to the manufacturing sector, which is responsible for heterogeneity in employment effects of final demand across destination countries.*

Observation 6*: There are large difference in the employment effect of domestic and foreign final demands in the natural resource sector in China and Japan, which is responsible for the gap between domestic and foreign merchandise employment effects.*

[9]This is because China's domestic demand is concentrated in labor-intensive less non-tradable natural resource sectors such as mining.

4 Explaining the Employment Effects

The result from the previous section shows that the employment effect per final demand differ across destination countries and source sectors. Furthermore, there are substantial inter-sectoral linkages, especially from the manufacturing to the service sector, and from the natural resource sector to the service sector. Guided by these results, this section investigates the determinants of the employment effect of exports by focusing on sectoral share of final demands and by using a number of variables capturing forward and backward linkages.

4.1 Regressions with Country Level Data

4.1.1 Regression Model

The purpose of this paper is to understand different employment effects of exports across destination countries. Therefore, we restrict our focus on exports and we drop observations from domestic final demands now. The sectoral export shares are simply calculated as aggregate sectoral export shares from sector s of country i to country j:

$$\begin{aligned} EX(Res)_t^{i,j} &\equiv x_t^{(i,\text{Agriculture}),j} / \sum_{s=1}^{N} x_t^{(i,s),j}, \\ EX(Tex)_t^{i,j} &\equiv x_t^{(i,\text{Textile}),j} / \sum_{s=1}^{N} x_t^{(i,s),j}, \\ EX(Ser)_t^{i,j} &\equiv x_t^{(i,\text{Service}),j} / \sum_{s=1}^{N} x_t^{(i,s),j}, \end{aligned}$$

where $x_t^{(i,s),j}$ denotes the final and intermediate good flows from sector s of country i to country j. Instead of the share of exports from manufacturing sectors as a whole, we use the share of textile exports because it appears to be related with employment effects of exports in China.[10]

Sectoral linkages are measured using variables constructed based on Rasmussen (1956). We use coefficients $\theta_t^{(i,s),(j,r)}$ — measuring sectoral linkages from in country i's sector s to country j's sector r — to construct forward/backward linkages. The coefficients come from the following matrix:

$$\underbrace{(\mathbf{I}-\mathbf{A}_t)^{-1}}_{(C\times N)\times(C\times N)} = \begin{bmatrix} \theta_t^{(1,1),(1,1)} & \theta_t^{(1,1),(1,2)} & \dots & \theta_t^{(1,1),(j,r)} & \dots & \theta_t^{(1,1),(C,N)} \\ \theta_t^{(1,2),(1,1)} & \theta_t^{(1,2),(1,2)} & \dots & \theta_t^{(1,2),(j,r)} & \dots & \theta_t^{(1,2),(C,N)} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \theta_t^{(i,s),(1,1)} & \theta_t^{(i,s),(1,2)} & \dots & \theta_t^{(i,s),(j,r)} & \dots & \theta_t^{(i,s),(C,N)} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \theta_t^{(C,N),(1,1)} & \theta_t^{(C,N),(1,2)} & \dots & \theta_t^{(C,N),(j,r)} & \dots & \theta_t^{(C,N),(C,N)} \end{bmatrix}.$$

[10] The share of exports from other manufacturing sectors as a whole is omitted due to perfect multicollinearity.

The forward linkage measure is

$$FL_t^{i,j} \equiv \sum_{s=1}^{N} \frac{GO_t^{i,s}}{\sum_{s=1}^{N} GO_t^{i,s}} \sum_{r=1}^{N} \theta_t^{(i,s),(j,r)},$$

which is a weighted average of the sectoral forward linkage with destination country j, $\sum_{r=1}^{N} \theta_t^{(i,s),(j,r)}$ where the weights are sectoral share of country i's sector s's gross production $GO_t^{i,s} / \sum_{s=1}^{N} GO_t^{i,s}$ obtained from the WIOD SEA database. The backward linkage is constructed in a similar manner:

$$BL_t^{i,j} \equiv \sum_{s=1}^{N} \frac{GO_t^{i,s}}{\sum_{s=1}^{N} GO_t^{i,s}} \sum_{r=1}^{N} \theta_t^{(j,r),(i,s)}.$$

Our dependent variable is natural log of employment effect of aggregate exports from country i to country j divided by the value of aggregate exports from country i to country j, $\ln\left(\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j} / \sum_{s=1}^{N} d_t^{(i,s),j}\right)$. As a result, our regression equation is:

$$\begin{aligned} \ln\left(\frac{\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j}}{\sum_{s=1}^{N} d_t^{(i,s),j}}\right) &= \alpha_t^0 + \alpha_t^1 FL_t^{i,j} + \alpha_t^2 BL_t^{i,j} \\ &\quad + \alpha_t^3 EX(Res)_t^{i,j} \alpha_t^4 EX(Tex)_t^{i,j} + \alpha_t^5 EX(Ser)_t^{i,j} + u_t^{i,j}, \end{aligned} \tag{5}$$

where $\alpha_t^0 - \alpha_t^5$ are parameters to be estimated and $u_t^{i,j}$ denotes the error term. We estimate this cross-sectional regression equation for each period $t = 2000, 2001, ..., 2014$ but we report a result from 2014 only. We also estimate panel regressions in order to examine how time-series changes in explanatory variables are associated with time-series changes in the dependent variable.

$$\begin{aligned} \ln\left(\frac{\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j}}{\sum_{s=1}^{N} d_t^{(i,s),j}}\right) &= \beta^{s,j} + \beta_t + \beta^1 FL_t^{i,j} + \beta^2 BL_t^{i,j} \\ &\quad + \beta^3 EX(Res)_t^{i,j} \beta^4 EX(Tex)_t^{i,j} + \beta^5 EX(Ser)_t^{i,j} + \epsilon_t^{i,j}, \end{aligned} \tag{6}$$

where $\beta^{s,j}$ indicates source sector-destination country fixed effects controlling for all time-invariant factors in each cross-sectional observation; β_t denotes year fixed effects controlling for macroeconomic shocks; $\epsilon_t^{i,j}$ is the error term; and $\beta^1 - \beta^5$ are parameters to be estimated. Equations (5) and (6) are estimated for each i of the three exporters, the U.S., China, and Japan.

We expect the coefficient for the measure of forward linkages to be positive because it would lead a greater intermediate good demand from foreign countries. One may expect the coefficient for backward linkages to be negative because greater intermediate inputs from abroad reduce domestic value-added contents. However, the direction of the effect is nontrivial. For exmple, Feng, Li, and Swenson (2016) find that an increase in intermediate good imports in China increased China's exports due to quality upgrading caused by better intermediate inputs. If there are such channels, deeper backward linkages may increase the employment

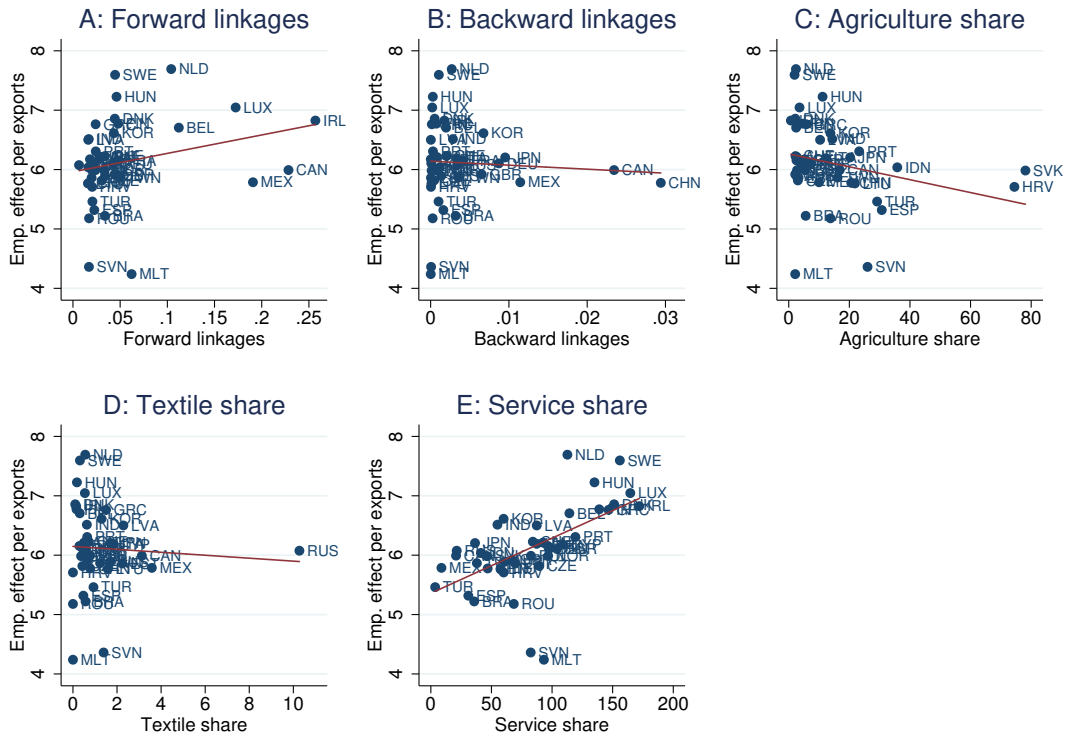
effect of exports. Sectoral export shares in the natural resource, textile, and service sectors are expected to have positive signs because these sectors have greater domestic value-added contents in exports (see Johnson and Noguera, 2012, for the case in the U.S.; Koopman, Z. Wang, and Wei, 2012, Ma, Z. Wang, and Zhu, 2015, and Xikang et al., 2012, for the case in China).

4.1.2 Brief Description of Data

Before discussing regression results, we look at cross-sectional relationships between our dependent variable — the employment effect of foreign final demand (relative to the one due to domestic final demand) — and various variables expected to have a correlation with the dependent variable using the data from the latest year 2014.

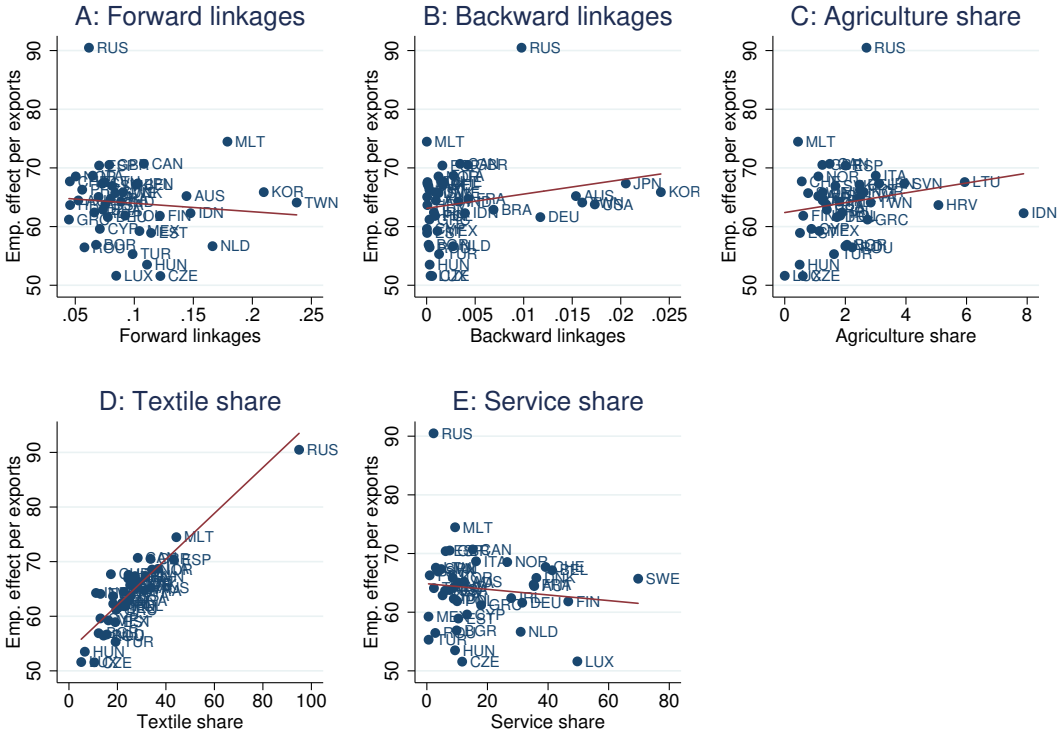
Figure 3: Explaining the Employment Effect of Exports, 2014

Panel I: The U.S.

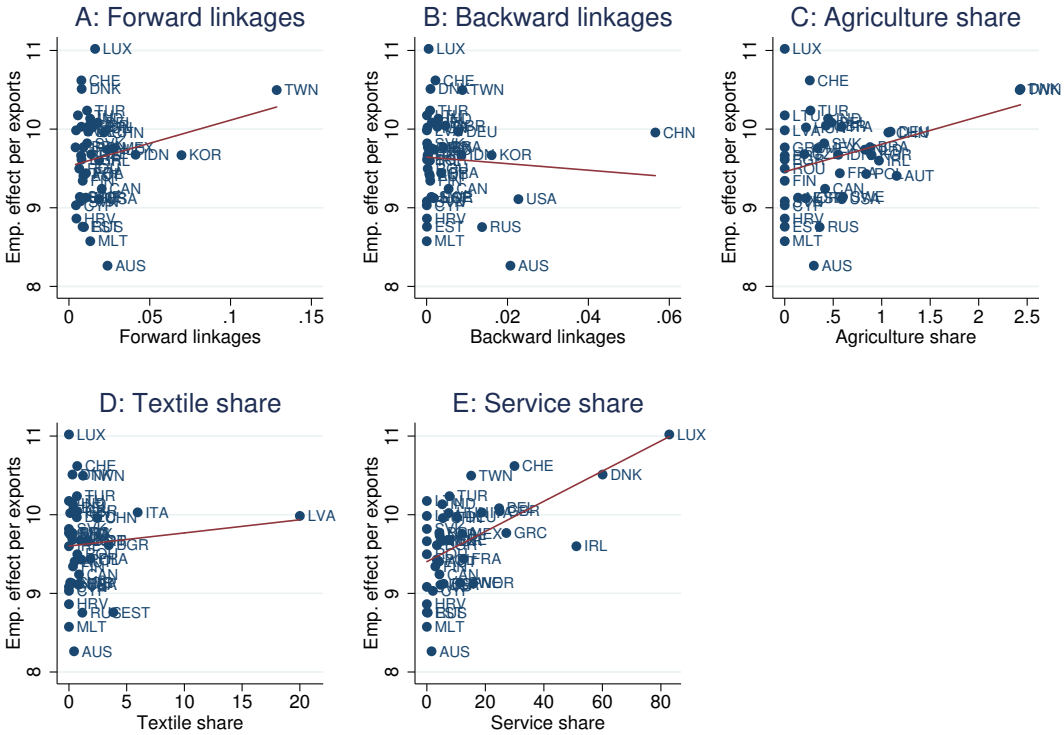


Panel I of Figure 3 shows scatter plots from the U.S. as an exporter. Forward linkages and the service export share have positive slope and other variables have negative slopes. Among these, the service export share reported in Panel E seems to have the best fit. This is consistent with empirical observations from Johnson and Noguera (2012) that service sectors have greater value added content in the U.S. As a result, greater exports from the service sectors are associated with greater employment effects.

Panel II: China



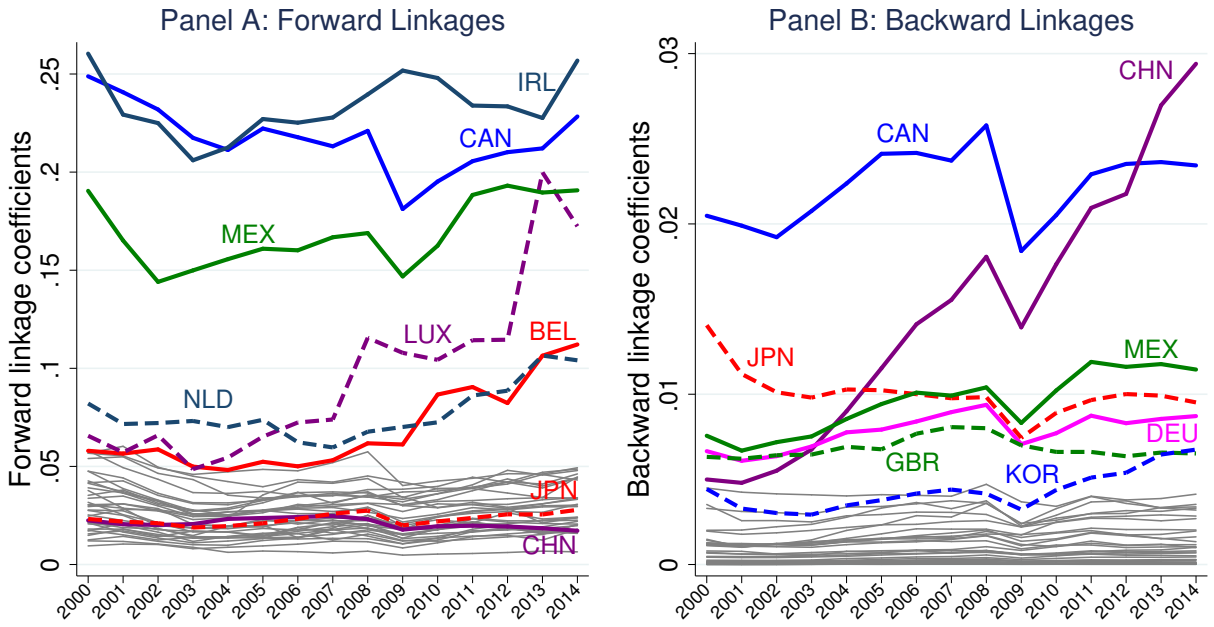
Panel III: Japan



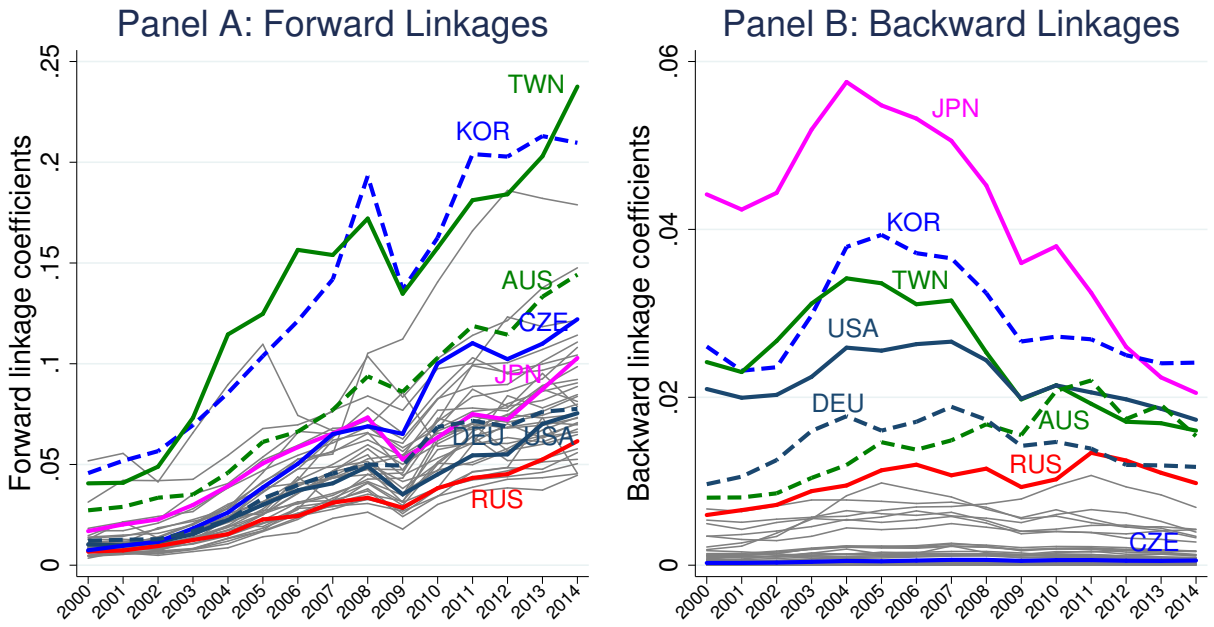
Notes: The figure shows cross-sectional relationships between the employment effect of final good exports per million dollar exports and various variables shown in each panel.

Figure 4: Forward and Backward Linkages, 2000-2014

Panel I: The U.S.

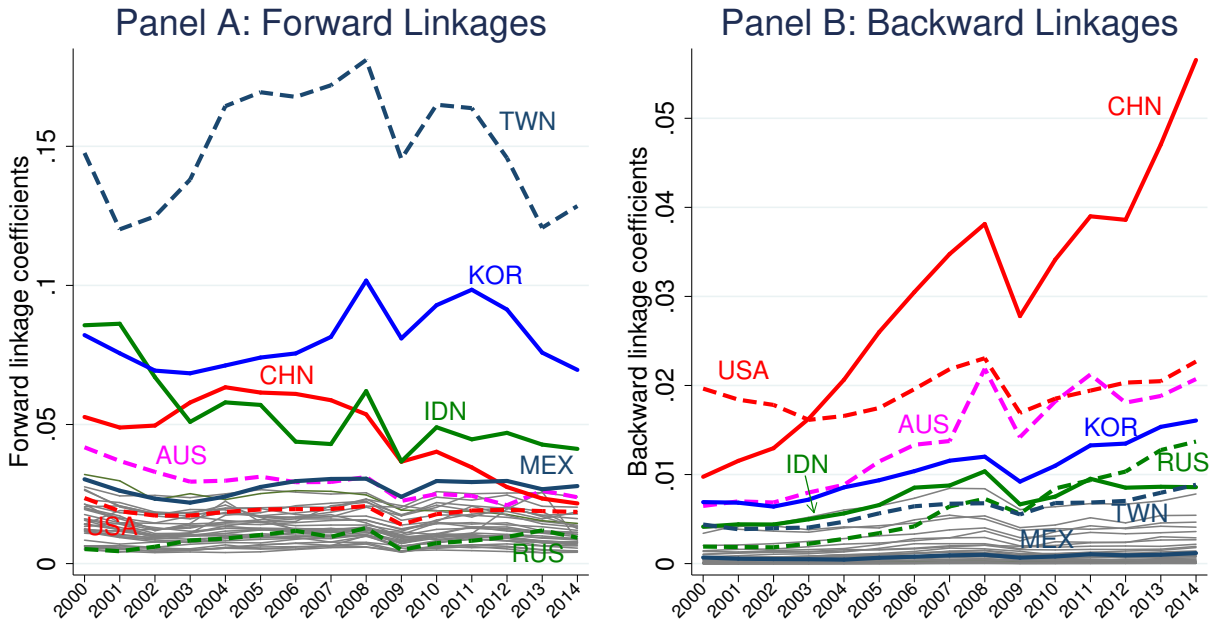


Panel II: China



Scatter plots from China are shown in Panel II of Figure 3. Contrary to the case from the U.S., the service sector share does not seem to be related with the employment effects of exports but there is a striking positive relationship between the textile export share and the employment effect of exports (see Panel E). The backward linkage measure and the agriculture share also seem to be positive related with the employment effect but the correlations are not

Panel III: Japan



Notes: The figure shows time-series variations in forward and backward linkages with trading partners. The forward/backward linkage measures are based on Rasmussen (1956).

very strong (see Panels B and C).

Panel III shows scatter plots from Japan as an exporter. The agricultural export share and the service export share are positively related (see Panels C and E). The forward linkage also has a positive slope but it is probably due to Taiwan, which might be considered as an outlier. Based on these scatter plots, China and Russia are considered as outliers for the U.S., Russia is an outlier for China, and China, Taiwan, and Latvia are outliers for Japan. These are omitted from regressions for robustness checks.

Figure 4 displays how forward and backward linkages have evolved during 2000-2014 for the U.S. (Panel I), China (Panel II), and Japan (Panel III). For the U.S., there is no clear trend in forward linkages. Forward linkages to Luxembourg, Belgium, and Netherlands are increasing after 2009 but this trend is not present with other countries. Forward linkages with most countries — shown in the bottom of Panel A — are declining during 2000-2014. Backward linkages with other countries are almost constant during the period with one exception: China. Backward linkages with China is continuously increasing over time except for the period of the 2008-09 Global Financial Crisis.

Panel II of Figure 4 describes forward and backward linkages for China. It shows that China's forward linkages with other countries are increasing over time. This is consistent with previous results documented in Kee and Tang (2016). They find that trade and FDI liberalization in China led to deeper input-output linkages and positive spillovers, which increased the number of available domestic input varieties. Contrary to forward linkages, China's back-

ward linkages with other countries are declining after the peak around 2004. These increasing forward linkages and declining backward suggest that China has become an intermediate good supplier for countries in the world and it is moving down the global supply chains.

Production linkages for Japan are shown in Panel III. Forward linkages with most countries are constant over the period but those with major trading partners, Taiwan and Korea, are declining after 2011. Japan's backward linkages are slightly increasing over the period and those with China is especially skyrocketing. Overall, time-series trends in forward and backward linkages are very different across the three countries. We investigate how these trends in production linkages are associated with the employment effect of exports by running regressions.

4.1.3 Regression Results

In order to examine if there are statistically significant relationships between our dependent variable and the five variables we are interested, we estimate regressions. Results from cross-sectional and panel regressions are reported in Panels A and B of Table 8, respectively. Odd number columns report the result from full sample, 42 destination countries,[11] even number columns drop outliers.

Column (1) of Panel A shows a result from the U.S. with full sample. As expected from the scatter plots, the service sector share is positively related with the employment effect of exports — a 1% point increase in the service export share raises the employment effect by 0.195%. The textile export share also has a positive coefficient in column (1) but it becomes insignificant once we drop outliers in column (2). Forward/backward linkages do not have significant explanatory powers for the U.S.

Columns (3) and (4) show results from China. Natural resource and textile export shares have statistically significant coefficients. According to the result without outliers in column (4), a 1% point increase the natural resource export share raises the employment effect by 1.035%. The same increase in textile export share increases the employment effect by 0.764%. As in the case for the U.S., forward/backward linkages do not have significant coefficients.

Results for Japan are summarized in columns (5) and (6). In column (5), the textile and service export shares have statistically significant coefficients, but significance for the textile export share is gone once we drop outliers in column (6). Contrary to the previous two countries, the measure of forward linkages has significant positive coefficients and backward linkages are negatively associated with the employment effect.

Although the results from the cross-sectional regressions are informative, we are also interested in how time-series changes in explanatory variables are associated with changes in the dependent variable. In order to answer this, Panel B presents results from panel regressions. Forward linkages are positively related with the employment effect of exports in the

[11] The 2016 release of the WIOD has 44 economies including the rest of the world as one economy. We drop the rest of the world and one observation from the domestic market. As a result, the total number of countries is 44 - 2 = 42.

Table 8: Results Regressions with Country Level Data, Dep. Var. $= \ln\left(\frac{\sum_{s=1}^{N} L_t^{(i,s),j}|_{(i,All),j}}{\sum_{s=1}^{N} d_t^{(i,s),j}}\right)$, the Employment Effect of Exports per Million Dollar Exports

Panel A: Cross-Sectional Regressions, 2014

	The U.S.		China		Japan	
	Full sample	Outliers dropped	Full sample	Outliers dropped	Full sample	Outliers dropped
	(1)	(2)	(3)	(4)	(5)	(6)
Forward linkages	0.125	-0.148	-0.059	-0.087	0.415*	1.054**
	(0.193)	(0.266)	(0.252)	(0.226)	(0.213)	(0.409)
	[0.005]	[-0.006]	[-0.002]	[-0.004]	[0.017]	[0.044]
Backward linkages	3.534	9.110*	1.399	1.492	-0.565	-4.016**
	(2.567)	(4.591)	(1.201)	(0.972)	(1.114)	(1.717)
	[0.025]	[0.064]	[0.010]	[0.010]	[-0.004]	[-0.028]
Resource export share	0.059	0.083	1.051**	1.035**	1.621	1.611
	(0.089)	(0.103)	(0.496)	(0.408)	(1.220)	(1.263)
Textile export share	1.584**	1.738	0.595***	0.764***	0.376***	0.293
	(0.744)	(2.677)	(0.085)	(0.095)	(0.101)	(0.616)
Service export share	0.195***	0.226***	0.054	0.048	0.183***	0.169***
	(0.039)	(0.054)	(0.052)	(0.046)	(0.039)	(0.041)
# of obs.	42	40	42	41	42	39
R-squared	0.356	0.381	0.765	0.717	0.401	0.455
F-stat.	10.09	11.04	11.55	14.85	8.64	5.56
p-val. (F-stat.)	0.000	0.000	0.000	0.000	0.000	0.000

Panel B: Panel Regressions, 2000-2014

	The U.S.		China		Japan	
	Full sample	Outliers dropped	Full sample	Outliers dropped	Full sample	Outliers dropped
	(1)	(2)	(3)	(4)	(5)	(6)
Forward linkages	2.048*	1.984*	-0.770	-0.736	0.242	0.246
	(1.163)	(1.124)	(0.616)	(0.633)	(0.303)	(0.440)
	[0.085]	[0.083]	[-0.032]	[-0.031]	[0.010]	[0.010]
Backward linkages	1.134	5.392	0.504	0.267	-1.267	-5.379***
	(2.164)	(7.480)	(2.335)	(2.422)	(1.233)	(1.116)
	[0.008]	[0.038]	[0.004]	[0.002]	[-0.009]	[-0.038]
Resource export share	0.231*	0.240*	0.459**	0.461*	0.042	0.040
	(0.122)	(0.125)	(0.222)	(0.228)	(0.033)	(0.029)
Textile export share	0.937*	0.915	0.545***	0.556***	0.052***	0.062***
	(0.513)	(0.548)	(0.070)	(0.073)	(0.013)	(0.016)
Service export share	0.266**	0.281**	0.584***	0.581***	0.064*	0.060*
	(0.109)	(0.112)	(0.180)	(0.182)	(0.036)	(0.035)
Country fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓
# of obs.	630	600	630	615	630	585
R-squared	0.930	0.930	0.983	0.983	0.961	0.963
F-stat.	1.43	1.53	19.08	19.11	3.82	7.12
p-val. (F-stat.)	0.2331	0.2024	0.000	0.000	0.006	0.000

Notes: China and Russia are dropped as outliers in (2). Russia is dropped as an outlier in (4). China, Taiwan, and Latvia are dropped as outliers in (6). ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the country-sector level, are in rounded parentheses. Numbers in square brackets are the impact of a one standard deviation change.

U.S. and backward linkages have a negative effect in Japan. There is no statistically significant relationship between production linkages in the employment effect in China.

Sectoral export shares have much more explanatory powers. For example, for the U.S., greater resource exports and greater service exports are related with the greater employment effect of exports — according to column (2), a 1% point increase in the resource export share raises the employment effect by 0.24% and the same increase in the service export share increases it by 0.28%. The textile share also has a significant coefficient in column (1) but it turns to be insignificant after dropping outliers. Column (4) shows that greater resource, textile, and service exports are related with more employment effects in China. The magnitudes are greater than those for the U.S. — a 1% point increase in the resource export share, the textile share, and the service share raises the employment effect by 0.45%, 0.55%, and 0.58%, respectively. Previous studies find that China's textile sector has a greater domestic value added content compared with other sectors in China (e.g., Koopman, Z. Wang, and Wei, 2012; Ma, Z. Wang, and Zhu, 2015).[12] Xikang et al. (2012) estimate domestic value added contents in Chinese exports and show that, using the data from 2002, domestic value-added contents account for 81.7% and 57.2% of final demand in the agriculture and the textile sectors while the country average is 46.6%. Results from column (6) suggest that the textile export share and the service export share are related with the greater employment effect of exports in Japan but the magnitude is much smaller compared with China.

4.2 Regressions with Country-Sector Level Data

Country-level regressions are informative to capture overall relationship between variables, but we further investigate the determinants of employment effects of exports by employing the destination country-source sector level observations. Because the unit of observations is country-sector now, we extend the measures of forward/backward linkages to distinguish the impact of forward/backward linkages with a destination country, home country, and all other countries besides the destination and home.

Forward linkages: Consider an exporter i and its trading partner j (i.e., a destination country). All of the following measures are for exporting country i's exporting sector s's point of view. Forward linkages with destination country j, with the home country i, and other

[12] Koopman, Z. Wang, and Wei (2012) finds that, using the data from 2007 and by taking processing and non-processing trade into consideration, domestic value added contents account for 82.4% of gross production in China's textile industry while the overall average in China is 60.6%. Ma, Z. Wang, and Zhu (2015) further distinguish foreign-owned and state-owned enterprises to estimate domestic value-added contents and show that these figure become 81.2% and 59.2%, respectively. These two studies show that domestic value-added contents are greater in the textile sector than other sectors in China.

countries $(-i,-j)$ are

$$\begin{aligned}
(FL^{\text{Destination}}) : FL_t^{(i,s),j} &\equiv \sum_{r=1}^{N} \theta_t^{(i,s),(j,r)}, \\
(FL^{\text{Home}}) : FL_t^{(i,s),i} &\equiv \sum_{r=1}^{N} \theta_t^{(i,s),(i,r)}, \\
(FL^{\text{Others}}) : FL_t^{(i,s),-i,-j} &\equiv \frac{1}{C-2} \sum_{\substack{k\neq i \\ k\neq j}}^{C} \sum_{r=1}^{N} \theta_t^{(i,s),(k,r)},
\end{aligned}$$

Backward linkages: Consider importer i and its trading partner j (i.e., a source country). All of the following measures are for importing country i's importing sector s's point of view.

Backward linkages with destination country j, with the home country i, and other countries $(-i,-j)$ are

$$\begin{aligned}
(BL^{\text{Destination}}) : BL_t^{(i,s),j} &\equiv \sum_{r=1}^{N} \theta_t^{(i,r),(j,s)} \\
(BL^{\text{Home}}) : BL_t^{(i,s),i} &\equiv \sum_{r=1}^{N} \theta_t^{(i,r),(i,s)}, \\
(BL^{\text{Others}}) : BL_t^{(i,s),-i,-j} &\equiv \frac{1}{C-2} \sum_{\substack{k\neq i \\ k\neq j}}^{C} \sum_{r=1}^{N} \theta_t^{(k,r),(i,s)},
\end{aligned}$$

respectively. **Backward-and-forward linkages with its own sector in its own country** is just a coefficient from its own sector in the same country:

$$(OwnLinkages) : OwnLinkage_t^{i,s} \equiv \theta_t^{(i,s),(i,s)}.$$

We employ natural log of country-sector level employment effect resulting from total exports of country i to country j, $\ln\left(L_t^{(i,s)}|_{(i,All),j}\right)$, as the dependent variable. Explanatory variables include natural log of final good exports from country j's sector s to country j, $\ln\left(d_t^{(i,s),j}\right)$, final good exports from other sectors in country i to country j, $\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$; a vector of forward/backward linkages $\mathbf{X}_t^{Linkages}$ including $FL^{Destination}$, FL^{Home}, FL^{Others}, $BL^{Destination}$, BL^{Home}, BL^{Others}, and $OwnLinkage$, which are based on Rasmussen (1956); another vector of variables $\mathbf{X}_t^{Controls}$ including variables controlling for source country - source sector characteristics, the capital-to-output ratio and the labor-to-output ratio. As a result, the regression equation is:

$$\begin{aligned}
\ln\left(L_t^{(i,s)}|_{(i,All),j}\right) = \gamma^{s,j} + \gamma_t + \quad & \gamma_0 \ln\left(d_t^{(i,s),j}\right) + \gamma_1 \ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right) \\
& + \mathbf{X}_t^{Linkages\prime}\boldsymbol{\gamma}_3 + \mathbf{X}_t^{Controls\prime}\boldsymbol{\gamma}_4 + e_t^{s,j},
\end{aligned}$$

where $\gamma^{s,j}$ are source sector-destination country fixed effects; γ_t denotes year fixed effects controlling for macroeconomic shocks including changes in price levels; and $e_t^{s,j}$ is the error term; γ_0, γ_1, $\boldsymbol{\gamma}_3$, and $\boldsymbol{\gamma}_4$ are (scalar and vectors of) coefficients to be estimated. We estimate this regression for each of the three source countries, the U.S., China, and Japan. Contrary to the previous country-level regressions, this regression controls for time-invariant omitted factors and sectoral variations in the employment effect generated from a country's aggregate exports.

Guided by previous work distinguishing offshoring to low-income and high-income countries (e.g., Harrison and McMillan, 2011), we also construct forward/backward linkage measures based on income levels of trading partners. Forward and backward linkages with high-income countries are:

$$(FL^{\text{High-income}}) : FL_t^{(i,s),High} \equiv \frac{1}{n(\Omega^{High} \setminus \{i\})} \sum_{j \in \Omega^{High} \setminus \{i\}} \sum_{r=1}^{N} \theta_t^{(i,s),(j,r)},$$

$$(BL^{\text{High-income}}) : BL_t^{(i,s),High} \equiv \frac{1}{n(\Omega^{High} \setminus \{i\})} \sum_{j \in \Omega^{High} \setminus \{i\}} \sum_{r=1}^{N} \theta_t^{(j,r),(i,s)},$$

where Ω^{High} is a set of high-income countries based on GDP per capita in 2000 obtained from the Penn World Table 9.0 (Feenstra, Inklaar, and Timmer, 2015).[13] We exclude exporting country i from the set Ω^{High} if country i is a high-income country. $n(\Omega^{High} \setminus \{i\})$ denotes the number of high-income countries besides country i. Similarly, forward/backward linkages with low-income countries are

$$(FL^{\text{Low-income}}) : FL_t^{(i,s),Low} \equiv \frac{1}{n(\Omega^{Low} \setminus \{i\})} \sum_{j \in \Omega^{Low} \setminus \{i\}} \sum_{r=1}^{N} \theta_t^{(i,s),(j,r)},$$

$$(BL^{\text{Low-income}}) : BL_t^{(i,s),Low} \equiv \frac{1}{n(\Omega^{Low} \setminus \{i\})} \sum_{j \in \Omega^{Low} \setminus \{i\}} \sum_{r=1}^{N} \theta_t^{(j,r),(i,s)},$$

where Ω^{Low} is a set of low-income countries.

Table 9 shows baseline regression results. Columns (1) and (2) report results from the U.S. as an exporter and those from China and Japan are shown in columns (3)-(4) and columns (5)-(6), respectively. Odd number columns show results from all sectors. Even number columns display results from restricting the sample to merchandise sectors only, which deals with possible bias due to the fact that some service sectors have small values of exports. Exports from that sector and from other sectors, $\ln\left(d_t^{(i,s),j}\right)$ and $\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$, have positive signs and statistically significant. It shows that a 1% increase in exports from that sector raises the employment effect by 0.112%, 0.179%, and 0.089%, respectively. The impact of exports from other sectors is a half of the impact of exports from its own sector for the U.S. but the former is even greater

[13] The 43 countries are divided into two groups of countries, high-income and low-income countries based on the 50th percentile of GDP per capita in 2000. We apply the same definition of high-income and low-income countries over the period 2000-2014. See Appendix for a list of the two groups of countries.

Table 9: Results from Panel Regressions with Country-Sector Level Observations, 2000-2014
Dep. Var. = $\ln\left(L_t^{(i,s)}|_{(i,All),j}\right)$, Baseline

	The U.S.		China		Japan	
	All sectors	Merchandise sectors only	All sectors	Merchandise sectors only	All sectors	Merchandise sectors only
	(1)	(2)	(3)	(4)	(5)	(6)
Exports						
$\ln\left(d_t^{(i,s),j}\right)$	0.112***	0.113***	0.179***	0.243***	0.089***	0.116***
	(0.005)	(0.007)	(0.009)	(0.010)	(0.006)	(0.010)
$\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$	0.056***	0.063***	0.222***	0.266***	0.091***	0.090***
	(0.004)	(0.007)	(0.014)	(0.016)	(0.006)	(0.008)
Forward linkages						
$FL^{Destination}$	0.220***	0.245**	0.147	0.161	0.153	0.131
	(0.070)	(0.123)	(0.137)	(0.157)	(0.267)	(0.276)
	[0.015]	[0.016]	[0.010]	[0.011]	[0.010]	[0.009]
FL^{Home}	-0.001	-0.103***	0.099***	0.068***	0.076***	-0.056**
	(0.014)	(0.023)	(0.013)	(0.018)	(0.021)	(0.028)
	[-0.001]	[-0.095]	[0.091]	[0.063]	[0.070]	[-0.052]
FL^{Others}	0.129	0.817	0.394	2.065***	1.054	0.532
	(0.418)	(0.629)	(0.403)	(0.484)	(1.297)	(1.513)
	[0.003]	[0.018]	[0.008]	[0.045]	[0.023]	[0.012]
Backward linkages						
$BL^{Destination}$	10.27***	9.200***	6.998***	5.750***	5.515***	4.640***
	(1.104)	(1.331)	(1.528)	(1.229)	(0.793)	(0.937)
	[0.090]	[0.081]	[0.062]	[0.051]	[0.049]	[0.041]
BL^{Home}	0.068***	-0.098***	-0.200***	-0.043	-0.023	-0.104***
	(0.023)	(0.038)	(0.041)	(0.061)	(0.019)	(0.032)
	[0.030]	[-0.044]	[-0.089]	[-0.019]	[-0.010]	[-0.046]
BL^{Others}	-29.10***	-22.72***	-55.23***	-52.73***	-16.89***	-16.15***
	(2.861)	(4.167)	(6.397)	(7.970)	(1.934)	(2.794)
	[-0.077]	[-0.060]	[-0.147]	[-0.140]	[-0.045]	[-0.043]
Forward/backward linkages with its own country-sector						
Own linkage	0.332***	0.506***	-0.403***	-0.009	-0.037	0.221***
	(0.084)	(0.137)	(0.083)	(0.127)	(0.065)	(0.081)
	[0.040]	[0.074]	[-0.059]	[-0.001]	[-0.005]	[0.032]
Source country-sector characteristics						
Labor-to-output ratio	0.629	9.536**	0.213***	-0.126***	4.036***	0.843
	(1.955)	(4.331)	(0.047)	(0.049)	(0.975)	(1.190)
Capital-to-output ratio	0.519	0.766	-3.807***	14.88***	0.020	0.732
	(0.473)	(2.137)	(1.296)	(2.164)	(0.340)	(0.468)
Country-sector fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓
# of obs.	34,650	13,860	29,610	13,860	32,130	13,860
# of cross-sectional obs.	2,310	924	1,974	924	2,142	924
R-squared	0.329	0.326	0.466	0.626	0.264	0.314
F-stat.	51.01	23.74	145.40	133.63	34.79	20.00
p-val. (F-stat.)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the country-sector level, are in rounded parentheses. Numbers in square brackets are the impact of a one standard deviation change. Observations from domestic final demand and the rest of the world are dropped from the sample. The unit of observations is source sector-destination country. All regressions include a constant term, country-sector fixed effects, and year fixed effects.

Table 10: Results from Panel Regressions with Country-Sector Level Observations, 2000-2014 Dep. Var. $= \ln\left(L_t^{(i,s)}|_{(i,All),j}\right)$, Forward/Backward Linkages are Based on Income Levels of Destination Countries

	The U.S.		China		Japan	
	All sectors	Merchandise sectors only	All sectors	Merchandise sectors only	All sectors	Merchandise sectors only
	(1)	(2)	(3)	(4)	(5)	(6)
Exports						
$\ln\left(d_t^{(i,s),j}\right)$	0.119***	0.124***	0.177***	0.238***	0.094***	0.119***
	(0.006)	(0.008)	(0.009)	(0.010)	(0.006)	(0.010)
$\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$	0.063***	0.070***	0.230***	0.273***	0.095***	0.096***
	(0.004)	(0.007)	(0.014)	(0.016)	(0.006)	(0.009)
Forward linkages						
$FL^{High-income}$	-0.625**	-1.039*	-2.116***	3.035***	0.817	2.026*
	(0.285)	(0.558)	(0.678)	(0.737)	(0.980)	(1.165)
	[-0.015]	[-0.026]	[-0.052]	[0.075]	[0.020]	[0.050]
FL^{Home}	0.025*	-0.096***	0.110***	0.089***	0.075***	-0.055**
	(0.014)	(0.023)	(0.013)	(0.018)	(0.021)	(0.025)
	[0.023]	[-0.088]	[0.101]	[0.082]	[0.069]	[-0.050]
$FL^{Low-income}$	0.935	2.237***	3.460***	0.766	0.481	-0.716
	(0.587)	(0.806)	(0.580)	(0.542)	(0.993)	(1.207)
	[0.020]	[0.048]	[0.074]	[0.016]	[0.010]	[-0.015]
Backward linkages						
$BL^{High-income}$	15.61***	12.19***	24.08***	-2.659	-7.034***	-9.765***
	(3.279)	(4.612)	(7.012)	(7.003)	(2.468)	(3.488)
	[0.052]	[0.041]	[0.080]	[-0.009]	[-0.023]	[-0.032]
BL^{Home}	0.034	-0.089**	-0.195***	-0.069	-0.024	-0.098***
	(0.022)	(0.039)	(0.041)	(0.061)	(0.018)	(0.031)
	[0.015]	[-0.039]	[-0.087]	[-0.031]	[-0.011]	[-0.044]
$BL^{Low-income}$	-23.89***	-19.96***	-141.6***	-66.98***	-4.757**	-2.122
	(3.194)	(5.046)	(15.310)	(13.760)	(2.380)	(3.424)
	[-0.053]	[-0.044]	[-0.313]	[-0.148]	[-0.011]	[-0.005]
Forward/backward linkages with its own country-sector						
Own Linkage	0.0544	0.259*	-0.407***	-0.128	-0.0216	0.244***
	(0.089)	(0.143)	(0.085)	(0.129)	(0.066)	(0.081)
	[0.008]	[0.038]	[-0.060]	[-0.019]	[-0.003]	[0.036]
Source country-sector characteristics						
Labor-to-output ratio	3.376*	11.36**	0.252***	-0.132***	4.095***	0.573
	(2.045)	(4.658)	(0.047)	(0.048)	(0.948)	(1.110)
Capital-to-output ratio	0.778	-0.956	-5.253***	13.67***	0.0319	0.871*
	(0.508)	(2.139)	(1.286)	(2.161)	(0.361)	(0.506)
Country-sector fixed effects	✓	✓	✓	✓	✓	✓
Year fixed effects	✓	✓	✓	✓	✓	✓
# of obs.	34,650	13,860	29,610	13,860	32,130	13,860
# of cross-sectional obs.	2,310	924	1,974	924	2,142	924
R-squared	0.285	0.278	0.464	0.617	0.224	0.265
F-stat.	45.01	20.08	148.20	129.84	33.29	17.73
p-val. (F-stat.)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See the notes on Table 9.

than the latter for China and Japan (see coefficients for $\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$). It captures the greater sectoral linkages in China and Japan.

The result also shows that deeper forward linkages with destination countries are associated

with a greater employment effect in the U.S. — a one standard deviation change increases the employment effect by 1.5% and 1.6% in all sectors and merchandise sectors, respectively. Forward linkages with destination countries are not statistically significant for China and forward linkages with home country are positive and significant — a one standard deviation change increases the employment effect by 9.1% and 6.3% in all sectors and merchandise sectors, respectively. For Japan, the coefficient from forward linkages with home is positive and significant for all sectors but the sign turns to be negative once we restrict the sample to merchandise sectors.

Overall, there is no systematic relationship between forward linkages and the employment effect of exports that is common to all of the three exporters. However, the impact of backward linkages with destination countries is common to all of them. Looking at the results from all sectors (odd number columns), a one standard deviation increase in backward linkages with destination countries raises the employment effect by 9%, 6.2%, and 4.9% in the U.S., China, and Japan, respectively. Coefficients for $BL^{Destination}$ in even number columns are also similar. On the other hand, backward linkages with other countries (all countries besides exporting country and its trading partner), BL^{Others}, have negative signs. A one standard deviation increase in backward linkages with other countries reduces the employment effect by 7.7%, 14.7%, and 4.5% in the U.S., China, and Japan, respectively (see odd number columns).

The coefficients from BL^{Others} are intuitive while those from $BL^{Destination}$ are counterintuitive. We have expected that greater backward linkages would lead to smaller employment effects of exports because stronger backward linkages work to reduce value added content of exports. This conjecture is only true if intermediate goods are not coming from its destination country and are coming from other countries. There are two possible reasons for this. First, it presumably captures the nature of input-output linkages. The employment effects are estimated based on the input-output table. If a country purchases more intermediate goods from its destination country, final good demand from the destination country has a greater impact on the exporting country through intermediate good demand from the destination country. Second, there might be some positive externalities thorough intermediate good purchases from the destination country, and the positive effect becomes greater when the exporting country sells goods to the destination country.

Table 10 presents the results with forward/backward linkage measures based on income-levels of trading partners. For the United States, forward linkages with high-income countries seem to have a negative effect but those with low-income countries have positive signs. Interestingly, an opposite pattern is observed from backward linkages — backward linkages with high-income countries have positive effects while those with low-income countries have negative impacts. A similar result is found from China (see column (3)). This result is consistent with Harrison and McMillan (2011) where they find that offshoring to low-income countries is job-reducing. Positive signs from $BL^{High-income}$ are presumably capturing positive spillover effects embedded in better intermediate inputs. This pattern is not observed from Japan —

both $BL^{High-income}$ and $BL^{Low-income}$ have negative signs.

5 Conclusions

This paper has examined the employment effect of exports by comparing employment effects generated by the same value of exports from various countries. We go beyond the existing literature by highlighting the new fact that the employment effect per exports vary greatly depending upon destination countries. The result from our country-sector level analysis suggests that this is because service and agricultural final demands create more jobs per dollar and exports to other countries are largely concentrated in manufacturing goods, which create a fewer jobs per dollar. We have also estimated regressions to investigate the determinants of employment effect of exports. The results show that sectoral compositions of exports explain the employment effects of exports while the impact of forward and backward linkages depends on exporters and their trading partners.

Our analyses suggest several implications. First, a recent trend in expanding vertical linkages across countries may work to increase or decrease the employment effect of trade because deepening of forward and backward linkages works in different directions sometimes. Second, as suggested in the literature on value added in trade (e.g., Johnson and Noguera, 2012; Johnson, 2014), gross export values are not identical to value added in trade. Therefore, policy discussions based on gross exports would lead to a misleading conclusion. Third, liberalizing agricultural and service sectors would lead to more jobs in exporting countries domestic value-added contents are greater in those sectors.

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Appendix

6 Dataset

This section summarizes details on the global input-output table from the WIOD (Timmer, Dietzenbacher, et al., 2015; Timmer, Los, et al., 2016).

6.1 List of Countries

The list of 44 economies in the WIOD global input-output table is as follows.

Australia (AUS), Austria (AUT), Belgium (BEL), Brazil (BRA), Bulgaria (BGR), Canada (CAN), China (CHN), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), India (IDN), Indonesia (IND), Ireland (IRL), Italy (ITA), Japan (JPN), Republic of Korea (KOR), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Mexico (MEX), Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT), Romania (ROU), Russia (RUS), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Taiwan (TWN), Turkey (TUR), United Kingdom (GBR), United States (USA) and the rest of the world (ROW)

6.2 List of WIOD Sectors

Each country in the WIOD input-output table is comprised of 56 sectors. The list of the sectors is as follows. It also shows aggregation of the 56 sectors.

Table 11: WIOD 56 Sectors

#	WIOD Sectors	Aggregation
1	Crop and animal production, hunting and related service activities	Natural resources
2	Forestry and logging	Natural resources
3	Fishing and aquaculture	Natural resources
4	Mining and quarrying	Natural resources
5	Manufacture of food products, beverages and tobacco products	Manufacturing
6	Manufacture of textiles, wearing apparel and leather products	Manufacturing
7	Manufacture of wood and of products of wood and cork	Manufacturing
8	Manufacture of paper and paper products	Manufacturing
9	Printing and reproduction of recorded media	Manufacturing
10	Manufacture of coke and refined petroleum products	Manufacturing
11	Manufacture of chemicals and chemical products	Manufacturing
12	Manufacture of basic pharmaceutical products	Manufacturing
13	Manufacture of rubber and plastic products	Manufacturing
14	Manufacture of other non-metallic mineral products	Manufacturing
15	Manufacture of basic metals	Manufacturing
16	Manufacture of fabricated metal products	Manufacturing
17	Manufacture of computer, electronic and optical products	Manufacturing
18	Manufacture of electrical equipment	Manufacturing
19	Manufacture of machinery and equipment n.e.c.	Manufacturing
20	Manufacture of motor vehicles, trailers and semi-trailers	Manufacturing
21	Manufacture of other transport equipment	Manufacturing
22	Manufacture of furniture; other manufacturing	Manufacturing

WIOD 56 Sectors, continued

#	WIOD Sectors	Aggregation
23	Repair and installation of machinery and equipment	Services
24	Electricity, gas, steam and air conditioning supply	Services
25	Water collection, treatment and supply	Services
26	Sewerage; waste collection, treatment and disposal activities	Services
27	Construction	Services
28	Wholesale and retail trade and repair of motor vehicles and motorcycles	Services
29	Wholesale trade, except of motor vehicles and motorcycles	Services
30	Retail trade, except of motor vehicles and motorcycles	Services
31	Land transport and transport via pipelines	Services
32	Water transport	Services
33	Air transport	Services
34	Warehousing and support activities for transportation	Services
35	Postal and courier activities	Services
36	Accommodation and food service activities	Services
37	Publishing activities	Services
38	Motion picture, video and television programme production	Services
39	Telecommunications	Services
40	Computer programming, consultancy and related activities	Services
41	Financial service activities, except insurance and pension funding	Services
42	Insurance, reinsurance and pension funding	Services
43	Activities auxiliary to financial services and insurance activities	Services
44	Real estate activities	Services
45	Legal and accounting activities; activities of head offices	Services
46	Architectural and engineering activities	Services
47	Scientific research and development	Services
48	Advertising and market research	Services
49	Other professional, scientific and technical activities	Services
50	Administrative and support service activities	Services
51	Public administration and defence; compulsory social security	Services
52	Education	Services
53	Human health and social work activities	Services
54	Other service activities	Services
55	Activities of households as employers; undifferentiated goods	Services
56	Activities of extraterritorial organizations and bodies	Services

6.3 List of Final Demand Categories

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.

6.4 List of High-income and Low-income Countries

In the regression analysis using the country-sector level data, the sample of countries is divided into two groups, high-income countries and low-income countries, based on the data on GDP per capita in 2000 obtained from the Penn World Table 9.0 (Feenstra, Inklaar, and Timmer, 2015). The list of high-income countries (above median) is as follows:

> Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, Norway, Spain, Sweden, Switzerland, Taiwan, the United Kingdom, and the United States

The list of low-income countries (below median) is as follows:

> Brazil, Bulgaria, China, Croatia, Czech Republic, Estonia, Greece, Hungary, India, Indonesia, Rep. of Korea, Latvia, Lithuania, Mexico, Poland, Portugal, Romania, Russian Federation, Slovak Republic, Slovenia, and Turkey

7 Summary Statistics

Summary statistics of the country level and the country-sector level samples are presented in Tables 12 and 13, respectively.

Table 12: Summary Statistics of the Country Level Sample

	Sample size	Mean	Std. Dev.	Minimum	Maximum
$\ln\left(\sum_{s=1}^{N} L_t^{(i,s)}\vert_{(i,All),j}\right)$	1,890	3.361	2.610	-4.502	10.112
$\ln\left(\sum_{s=1}^{N} d_t^{(i,s),j}\right)$	1,890	7.116	2.126	0	12.317
$\ln\left(\frac{\sum_{s=1}^{N} L_t^{(i,s)}\vert_{(i,All),j}}{\sum_{s=1}^{N} d_t^{(i,s),j}}\right)$	1,890	3.152	1.397	1.286	6.784
Forward linkages	1,890	0.038	0.042	0.003	0.260
Backward linkages	1,890	0.004	0.007	0	0.058
Resource export share	1,890	0.049	0.087	0	0.786
Textile export share	1,890	0.103	0.160	0	1.115
Service export share	1,890	0.402	0.410	0	1.943

Notes: $\ln\left(\sum_{s=1}^{S} L_t^{(i,s)}\vert_{(i,All),j}\right)$ denotes natural log of employment effect of country i's aggregate exports to country j on country i. $\ln\left(\sum_{s=1}^{S} d_t^{(i,s),j}\right)$ is natural log of aggregate final good exports from country i to country j. $\ln\left(\frac{\sum_{s=1}^{N} L_t^{(i,s)}\vert_{(i,All),j}}{\sum_{s=1}^{N} d_t^{(i,s),j}}\right)$ denotes the employment effect of exports from country i to country j on country i per million dollar exports.

Table 13: Summary Statistics of the Country-Sector Level Sample

	Sample size	Mean	Std. Dev.	Minimum	Maximum
$\ln\left(L_t^{(i,s)}\vert_{(i,All),j}\right)$	105,840	0.622	1.071	0	8.855
$\ln\left(d_t^{(i,s),j}\right)$	105,840	8.650	2.370	3.871	16.658
$\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$	105,840	8.644	2.371	3.401	16.658
$FL^{Destination}$	105,840	0.025	0.066	0	2.240
FL^{Home}	105,840	0.808	0.921	0	5.843
FL^{Others}	105,840	0.025	0.022	0	0.231
$BL^{Destination}$	105,840	0.003	0.009	0	0.210
BL^{Home}	105,840	0.808	0.444	0	2.143
BL^{Others}	105,840	0.003	0.003	0	0.016
Own Linkage	105,840	1.107	0.147	1	1.851
$FL^{High-income}$	105,840	0.030	0.025	0	0.179
$FL^{Low-income}$	105,840	0.020	0.021	0	0.286
$BL^{High-income}$	105,840	0.004	0.003	0	0.022
$BL^{Low-income}$	105,840	0.003	0.002	0	0.015
Capital-to-output ratio	96,390	0.014	0.019	0	0.139
Labor-to-output ratio	105,840	0.030	0.095	0	1.162

Notes: $\ln\left(L_t^{(i,s)}\vert_{(i,All),j}\right)$ denotes natural log of employment effect of country i's aggregate exports to country j on sector s of country i. $\ln\left(d_t^{(i,s),j}\right)$ is natural log of final good exports from sector s of country i to country j. $\ln\left(\sum_{r\neq s}^{N} d_t^{(i,r),j}\right)$ indicates natural log of exports from all sectors besides sector$s$ of country i to country j.