EMPIRICAL STUDIES IN INTERNATIONAL TRADE

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Empirical Studies in International Trade

This study is based on the doctoral dissertation titled "**Empirical Studies in International Trade**" selected as the award-winning entry for the India Exim Bank International Economic Research Annual (IERA) Award 2020. This dissertation was written by Dr. Sanjana Goswami, currently Assistant Professor of Economics at the Lee Kuan Yew School of Public Policy, National University of Singapore. Dr. Goswami received her Ph.D. degree in Economics from the University of California, Irvine, USA, under the supervision of Prof. Antonio Rodriguez-Lopez, Prof Priyaranjan Jha, and Prof. Ying-Ying Lee, University of California, Irvine, USA.

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EXECUTIVE SUMMARY

Over the last several decades, developing countries have undergone trade liberalization and have become integrated into the global trading system. The perception that developing countries are benefiting from trade at the cost of advanced countries has prompted backlash against free trade.This study explores both the consequences of trade liberalization as well as the consequences of the backlash. The most notable example of an expansion of trade is the 'China Shock', which is a term used to describe China's rise as an export powerhouse after accession to the WTO, which in turn increases the import competition for other countries. The China Shock was large, unexpected, and can be thought of as a natural experiment. The case study of China's rise informs broader theory about global trade that can be incorporated into economic policy. The most notable episode of a backlash against international trade is the ongoing US-China trade war. Since January 2018, the U.S. administration under President Trump started trade wars along several fronts against most of U.S. trading partners, starting with "global safeguard tariffs" on imports of solar panels and washing machines, moving then to tariffs on steel and aluminum under national security grounds, and following with a full-blown trade war with China with the average tariff on Chinese imports above 24 percent, compared to an average of only 3 percent at the onset of the trade war. This trade escalation is an unprecedented move, incomparable to any previous episodes of trade disputes since the Great Depression, and therefore provides new insights regarding the effect of large tariff increases on other economic outcomes.

International trade has important distributional impacts on the labor market. Free trade has the potential to raise living standards and both the importing and exporting countries gain by engaging in trade. However, trade reallocates resources within a country, and both destroys and creates jobs, with implications for income distribution. The adverse effects of trade appear to be highly geographically concentrated and long-lasting in developing and developed countries alike. This study sheds further light on these distributional impacts by analyzing the effect of the China Shock on the distribution of occupations in the United States. It finds that the China Shock disproportionately hurt employment in occupations that were low-wage, low-education, and highly routine in nature. These losses occurin sectors that were both exposed as well as unexposed to Chinese import competition. The reason for occupations in unexposed sectors to be hurt is plausibly due to local labor market effects in combination with a heavy concentration of these lower indexed occupations in particular regions. The paper also finds evidence that Chinese import competition drives an employment expansion in high-education occupations, plausibly due to productivity effects. These findings about distributional consequences of the China Shock helps inform policy that wishes to target potential losers from trade.

This study also highlights the harmful effects of trade policy by investigating the effect of tariffs imposed by both United States and China since 2018 on regional employment in the United States. Tariffs on imports reduce import competition for domestic firms and in turn encourages more firms to enter the market or expand, therefore generating new jobs. On the other hand, retaliatory tariffs on exports hurt domestic firms and they may shrink or even exit and may therefore displace workers. Moreover, tariffs on imports of intermediate products make inputs more expensive and also hurt domestic firms and may displace workers. A trade war imposes tariffs or quotas onimports and foreign countries retaliate with similar forms of trade protectionism. As it escalates, a trade war reduces international trade, and in turn has distributional effects on the labor market. By exploiting the sudden increase in tariffs by U.S. and China, this study finds that Chinese retaliatory tariffs have had a negative effect on regional employment growth, whereas U.S. import tariffs have had no effect. This suggests that regions that are relatively more exposed to the retaliatory tariffs on exports are disproportionately hurt, whereas regions that are relatively more exposed to the import tariffs are not growing any differently than they were before the trade war. Thus, the immediate effect is that import tariffs have been unable to bring back jobs lost due to import competition inthe previous decade.

Lastly, this study explores the effects of a hypothetical trade war on past US employment. First, it notes that while the ‘China Shock’ reduced a large number of import-competing jobs, it also helped in export expansion, which created enough jobs to offset these job losses. Had there been a trade war in the 1991-2007 period, tariffs would have prevented both a reduction in import- competing jobs and an increase export sector jobs. This would be the case irrespective of the kind of retaliation imposed by China. However, a trade war between these countries would not have helped prevent import-competing jobs in the post-recession years of 2010-2016, which is more representative of the manufacturing industry composition in the United States today. It is highly unlikely that the tariffs will undo the job losses from the China Shock, because of the shift in the nature of manufacturing production towards automation and offshoring in the past decade. Instead, the workers in the exporting sector will be disproportionately hurt going forward.

1. INTRODUCTION

Economists have long recognized that free trade has the potential to raise living standards and that both the importing and exporting countries gain by engaging in trade. The growing body of empirical evidence supports the view of most theoretical trade models that trade reallocates resources within a country, and both destroys and creates jobs, with implications for income distribution. Evidence suggests that while the countries benefit overall, there are some losers as well. The adverse effects of trade appear to be highly geographically concentrated and long-lasting in developing and developed countries alike[1].

This study sheds light on these distributional effects of international trade by examining the effect of two large shocks – China's rise as an export powerhouse in the 2000s, also known as the'China Shock', and the more recent Sino-American trade war of 2018 – on labor market outcomes. In the first part, the study analyses the effect of the China Shock on occupational employment in the United States. In the second part, the study analyses the effect of tariffs imposed by the United States and China on regional employment in the United States. The China Shock captures the effect of the rise of import competition on employment, whereas the trade war tariffs capture the effect of a decline of import competition on employment. Both effects show distributional impacts of international trade.

Occupations differ along several characteristics such as their pay, degree of routineness, and required level of education. These differences should lead to heterogeneous responses of occupational employment levels to technology or international trade shocks. For example, automation is more likely to replace highly-routine occupations, and an international offshoring relationship with an unskilled-labor abundant country is more likely to replace low-skilled occupations in the source country. For the U.S., the greatest trade shock in the last few decades comes from the rise of China as the world's largest trader. In influential papers, Autor, Dorn, and Hanson (2013), Acemoglu, Autor, Dorn, Hanson, and Price (2016a), and Pierce and Schott (2016) find a large negative impact of

[1] Pavcnik (2017) surveys the empirical evidence on the distributional effects of trade in both developed anddeveloping countries

Chinese import competition on U.S. employment.[2] Contributing to this literature, the goal of this study paper is to estimate the impact of the 'China shock' on U.S. occupational employment from 2002 to 2014 by distinguishing occupations according to their wage, non-routineness, and education characteristics.

After sorting about 750 occupations from low to high wage, from routine to non-routine, and from low to high education, the first part of this study documents the decline in the share of lower- indexed occupations in total U.S. employment from 2002 to 2014, and an increase in the share of higher-indexed occupations during the same period. At the industry level, the composition of employment in the vast majority of the industries changes in favor of higher-indexed occupations. The empirical analysis confirms that Chinese import exposure is an important driver of these results, mainly through its large negative employment impact on lower-indexed occupations.

Tariffs on imports reduce import competition for domestic firms and in turn encourages more firms to enter the market or expand, therefore generating new jobs. On the other hand, retaliatory tariffs on exports hurt domestic firms and they may shrink or even exit and may therefore displace workers. Moreover, tariffs on imports of intermediate products make inputs more expensive and also hurt domestic firms and may displace workers. A trade war imposes tariffs or quotas on imports and foreign countries retaliate with similar forms of trade protectionism. As it escalates, a trade war reduces international trade, and in turn has distributional effects on the labor market. The recent trade escalation prompted by the U.S. administration under President Donald Trump since January 2018 is an unprecedented move, incomparable to any previous episodes of trade disputes since the Great Depression. The second part of this study explores these distributional impacts by studying the short-run and long-run employment consequences of the U.S-China trade war.

Although the legal justifications for these trade wars range from national security (in the caseof steel) to protection of intellectual property (in the case of China), the justification that President Trump puts forward when talking to his political base is the protection of the American worker and American jobs. This paper presents evidence that such a claim may have been credible prior to the events of the global financial crisis, but it does not hold in today's environment.

The short-term approach estimates the effects of changes in U.S. import tariffs, U.S. import tariffs that propagate downstream to buyers of intermediate inputs, and

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[2] For the 1999-2011 period, Acemoglu, Autor, Dorn, Hanson, and Price (2016a) attribute to Chinese importexposure the loss of about 2.4 million jobs

Chinese retaliatory tariffs on commuting zone-level employment growth. Using monthly data on employment, U.S-China trade and tariffs from January 2017 to March 2019, this study finds that Chinese retaliatory tariffs have had a statistically significant and negative effect on commuting zone-level employment growth, whereas U.S. import tariffs have had no effect. This suggests that commuting zones that are relatively more exposed to the export tariffs are disproportionately hurt, whereas commuting zones that are relatively more exposed to the import tariffs are not growing any differently than they were before the trade war.

The long-run approach imposes a hypothetical trade war on a well-studied phenomenon in the empirical international trade literature: the large job-reducing effects of surging imports from China, or the 'China shock', on the U.S. labor market (Autor, Dorn, and Hanson (2013), Acemoglu, Autor, Dorn, Hanson, and Price (2016a), etc) in addition to the job-creating effect of exports, which are also substantially large enough to almost offset the losses created by Chinese imports (Feenstra, Ma, and Xu, 2019). Using an industry-level specification that estimates the effect of the change in Chinese import competition, non-Chinese import competition, and U.S. export expansion on the change in manufacturing employment, counterfactual employment levels are calculated under three different scenarios of retaliation by China: (i) simple retaliation, which imposes identical restrictions on U.S. exports across all industries, (ii) political retaliation, which targets in particular those industries that have a large proportion of Trump supporters, and (iii) responsible retaliation, which minimizes the impact of retaliation on global supply chains. This exercise is conducted for two time periods: 1991-2007, where the China Shock had a large negative impact on manufacturing employment, and the post-recession period of 2010-2016, where the China Shock no longer has an effect on manufacturing employment. A trade war in this empirical model simultaneously reduces both import and export exposure, based on the type of retaliation, thereby bringing back some jobs lost due to Chinese imports while killing some jobs gained due to U.S. export expansion.

To guide this empirical exercise, this study closely follows Acemoglu, Autor, Dorn, Hanson, and Price (2016a) and Feenstra, Ma, and Xu (2019). Using an instrumental variables approach, the former estimates the effects of Chinese import penetration on U.S. employment at both the industry and commuting-zone levels, while the latter expands the approach to consider also the employment effects of U.S. exports. While both papers find that Chinese import exposure is associated with employment losses in the U.S., Feenstra, Ma, and Xu (2019) find that "export exposure" has a countervailing effect that makes up for the Chinese-induced job losses during the 1991-2007 period. The counterfactual exercise for the 1991-2007 period finds that a uniform tariff by the U.S. along with no retaliation by China would bring back enough manufacturing jobs to almost reverse the effects of the China shock. No matter the type of retaliation strategy by China, had the U.S. takena protectionist approach during this period by imposing import tariffs, manufacturing employment would have increased.

However, these results would no longer be true if the focus is on only the post-recession period of 2010-2016. In this case, the job-reducing effect of the China shock no longer exists. In fact, Chinese import penetration has a positive and insignificant effect on U.S. manufacturing employment. The counterfactual analysis for this period indicates that the trade war would lead to a net destructionof jobs.

While recent research suggests that the trade war of 2018 has reduced real income in the U.S., increased prices of intermediate and final goods, reduced the availability of imported varieties (Amiti, Redding, and Weinstein (2019)) as well as led to aggregate welfare loss (Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2019)), not much is known about the potential effects of trade wars on employment outcomes. This study provides both a short-term and long-term viewof these effects.

The rest of the study is organized as follows. Chapter 2 briefly describes the trade war, Chapter3 discusses data sources and presents some patterns in the data, Chapter 4 presents the empiricalfindings for the impact of Chinese import exposure on U.S. occupational employment, Chapter 5 presents the findings for the impact of the US-China trade war on U.S. regional employment, and Chapter 6 presents a counterfactual analysis involving a hypothetical trade war. Lastly, Chapter 7 concludes.

2. OVERVIEW OF THE SINO-AMERICAN TRADE WAR

First wave: In October 2017, the United States International Trade Commission found that imports of solar panels and washing machines have caused injury to the U.S. solar panel and washing machine industries and recommended that President Trump impose “global safeguard” tariffs. These tariffs of 30 percent on all solar panel imports, except for those from Canada, (worth US$ 8.5 billion) and 20 percent on washing machine imports (worth US$ 1.8 billion) went into effect in February 2018.

Second wave: In April 2017, the office of the United States Trade Representative (USTR) was authorized to investigate whether steel and aluminum imports pose a threat to national security and in March 2018, the U.S. imposed a 25 percent tariff on all steel imports (except from Argentina, Australia, Brazil, and South Korea) and a 10 percent tariff on all aluminum imports (except from Argentina and Australia). Along with some other countries, China retaliated with tariffs on U.S. aluminum waste and scrap, pork, fruits and nuts, and other US products, worth US$ 2.4 billion in export value to match the U.S. steel and aluminum tariffs covering Chinese exports worth US$ 2.8 billion. Subsidies for American farmers were then announced to provide relief from falling U.S. agricultural exports.

Third wave: In August 2017, the USTR initiated an investigation into certain acts, policies and practices of the Chinese government relating to technology transfer, intellectual property and innovation. In March 2018, after finding China guilty of unfair trade practices, the U.S. announces its China-specific import tariffs, which get implemented in three stages: (i) In June 2018, U.S. tariffs on US$ 34 billion of Chinese imports go into effect, which targets mostly intermediate inputs and capital equipment in sectors like machinery, mechanical appliances, and electrical equipment. In parallel with U.S. import tariffs, China’s tariffs on US$ 34 billion of US imports also go into effect, which mostly target U.S. transportation (vehicles, aircraft, and vessels) and vegetable products (largely soybeans). (ii) In August 2018, the U.S. imposed tariffs on another US$ 16 billion of imports from China. China immediately responded with its own revised tariffs on US$ 16 billion of US exports.

(iii) In September 2018, the largest wave of the U.S.-China trade war went into effect. U.S. tariffs on US$ 200 billion of Chinese imports take effect, along with retaliatory tariffs by China on US$ 60 billion of U.S. imports. These are tariffs on intermediate goods, capital goods, and also consumer goods.

3. DATA AND PATTERNS

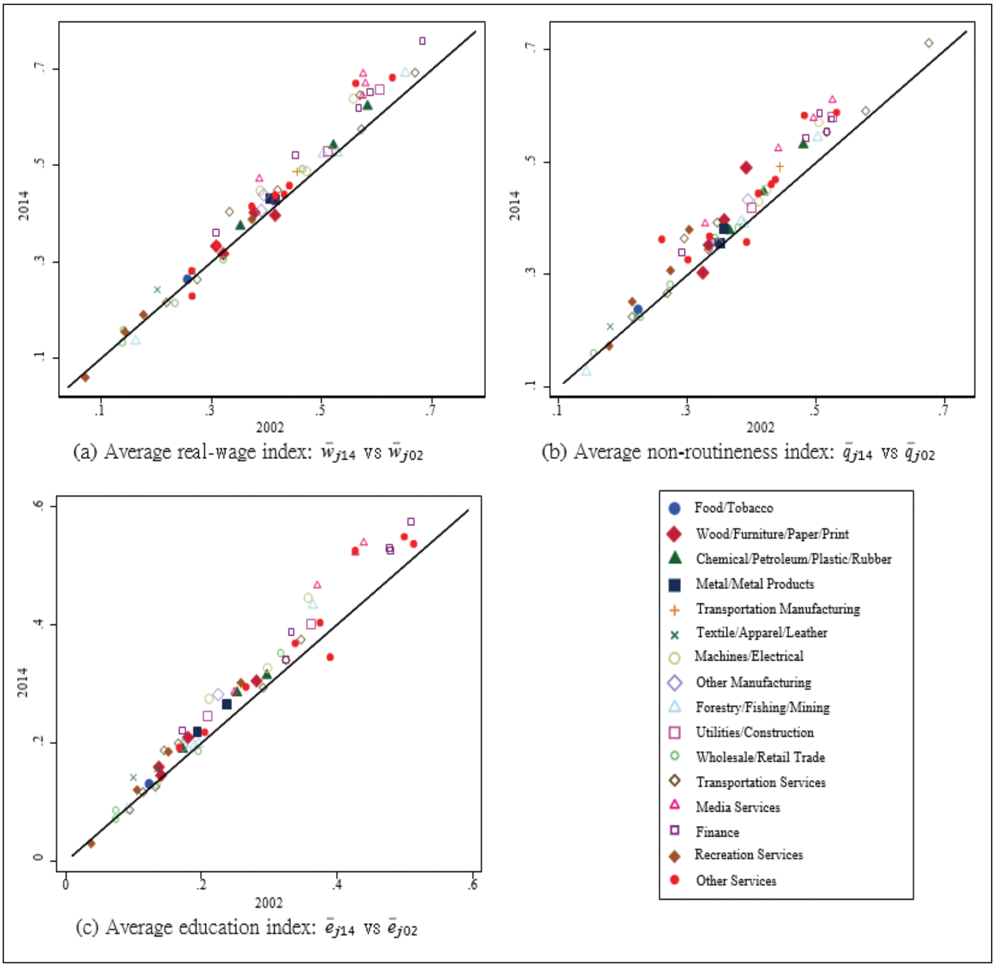
The analysis for the impact of Chinese import exposure on U.S. occupational employment relies on data from several sources: *(i)* occupational wage and employment data from the Occupational Employment Statistics (OES) database of the Bureau of Labor Statistics (BLS), *(ii)* data on occupation characteristics from the O*NET database, *(iii)* data on trade flows from the United Nations Comtrade database, and *(iv)* U.S. national and industry data from the Bureau of Economic Analysis (BEA).

The OES database provides yearly occupational employment and mean hourly wage at the four-digit NAICS level. Although the classification of occupations changes across years, the BLS provides concordance tables such that 810 occupations at the six-digit 2010 Standard Occupational Classification (SOC) can be obtained for the period 2002-2014. The data is aggregated to 60 industries according to a three-digit NAICS classification of the BEA. Time-invariant rankings of occupations along three dimensions: from low to high wage, from routine to non -routine, and from low to high education.

Figure 1 classifies 60 industries into 16 categories. This allows identification of which industries are more intensive in lower-indexed or higher-indexed occupations, and also to pinpoint similarities and differences across the three indexes. Along the three dimensions, the industries that are intensive in lower-indexed occupations are Recreation Services, Wholesale/Retail Trade, Textile/Apparel/Leather, and Food/Tobacco; the industries that are intensive in higher-indexed occupations are Finance and Media Services; and the industries that are in the middle of the pack are in general manufacturing industries such as Wood/Furniture/Paper/Print, Metal Products, Chemical/Petrolatum/Plastic/Rubber, and Machines/Electrical. On the other hand, Transportation Services is the most non-routine category, and while industries in this category have in general mid-to-high average real wages, they have low average education indexes.

Reinforcing the point of a generalized change in the composition of U.S. employment toward higher-indexed occupations, **Figure 2** shows the kernel distributions of occupational employment in 2002 and 2014 under the three sorting criteria. **Figure 2a** shows that the decline in the employment share of lower-wage occupations occurs up to the 60th percentile, while **Figure 2b** shows that the decline in the employment share of routine occupations occurs up to the 40th percentile. An interesting fact from the distributions in **Figures 2a** and **2b** is that they evolved from slightly bimodal in 2002 to distinctly bimodal in 2014. This shows that polarization in the U.S. labor market during the 2002-2014 period is mostly the result of an increase in relative employment in occupations on the right side of the distribution, rather than in occupations on the left side.

Figure 1: Average Industry-Level Composition of U.S. Occupational Employment in 2002 and 2014



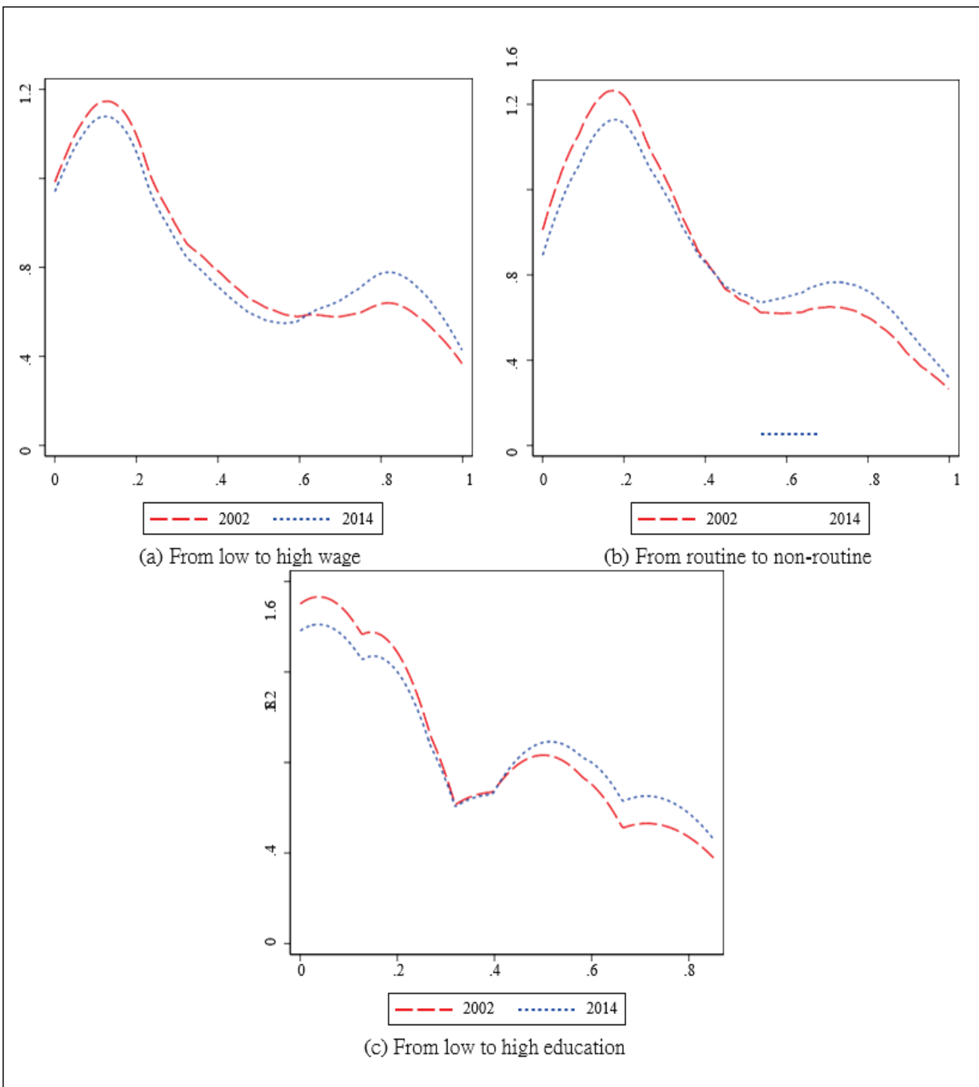
(a) Average real-wage index: $\bar{w}_{j14}$ vs $\bar{w}_{j02}$

(b) Average non-routineness index: $\bar{q}_{j14}$ vs $\bar{q}_{j02}$

(c) Average education index: $\bar{e}_{j14}$ vs $\bar{e}_{j02}$

Figure 2c shows that the kernel distribution of occupational employment based on the education ranking is not as smooth as the distributions based on the wage and non-routineness rankings. This is simply a consequence of the O*NET "job zone" rating, which clusters in integer values from1 to 5 (corresponding to values 0, 0.05, 0.39, 0.66, and 0.85 in the percentile education rank, *e*). Nevertheless, the same story emerges: from 2002 to 2014 there has been a change in the composition of employment in favor of occupations that need a higher level of education.

Figure 2: Distribution of U.S. Occupational Employment in 2002 and 2014 (by Sorting Criterion)



Occupations vary in their degree of exposure to Chinese imports. For example, an occupationthat is mainly employed in the computer and electronics industry is more exposed to Chinese imports than an occupation mainly employed in the real estate industry. **Figure 3** shows the values in 2002 of the direct import penetration, and the combined import penetration (direct + upstream + downstream exposure), against their values in 2014. Occupations marked with a circle denote the lowest-tertile occupations (low wage, routine, low-education), those marked with a square denote the middle-tertile occupations (mid wage, mid-routine, mid-education), and those marked with a triangle denote the highest-tertile occupations (high wage, non-routine, high-education).

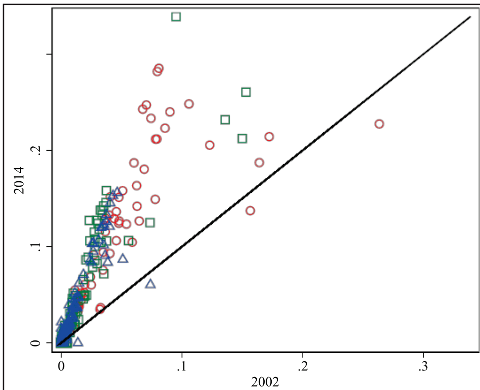
First, note that the vast majority of occupations are well above the 45-degree line for both types of Chinese import penetration (direct and combined), indicating extensive occupational exposure to Chinese imports during the period. For the combined import penetration measure, for example, only six occupations (out of 671) had a decline in Chinese import exposure from 2002 to 2014. Second, note that across the three sorting criteria and for both measures of import penetration, lowest-indexed occupations are the most exposed to Chinese import competition, while the highest- indexed occupations are the least exposed. This highlights the strong heterogeneity in the exposure of different occupations to Chinese import competition.

Table 1: Commuting Zone Level Summary Statistics

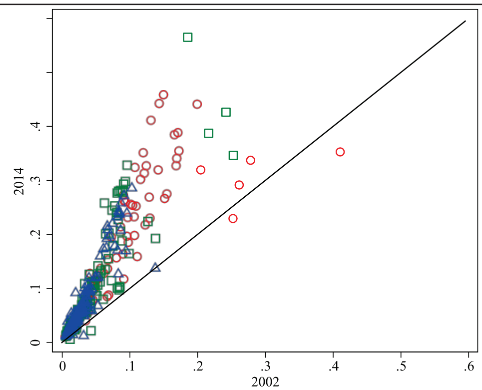
	Median	**Mean**
Change in Export tariff	0.33	1.32
Change in Import tariff	0.49	1.06
Change in Downstream import tariff	0.59	1.21
Total employment in 2017 (in thousands)	32	164
Goods employment in 2017 (in thousands)	9	29

Notes: Tariff changes are between December 2017 and December 2018.

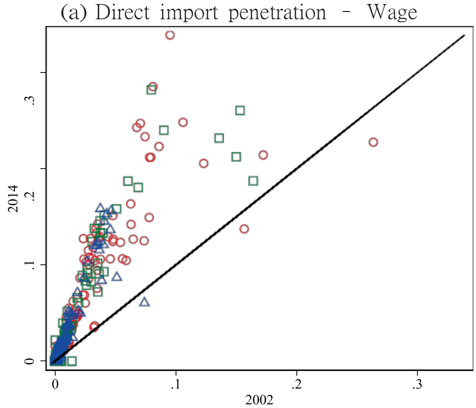
Figure 3: Occupation-Specific Import Penetration Measures in 2002 and 2014 under Three Sorting Criteria (Wage, Non-routineness, Education): Lowest Tertile in Red Circle, Middle Tertile in Green Square, Highest Tertile in Blue Triangle



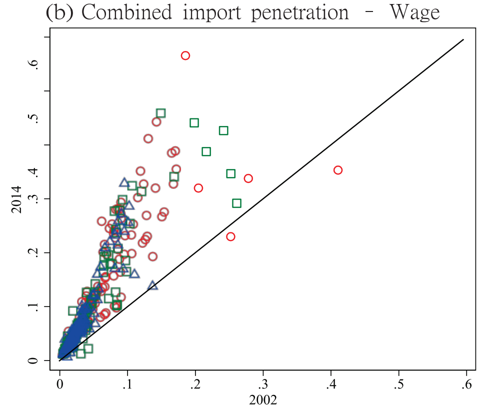
(a) Direct import penetration – Wage



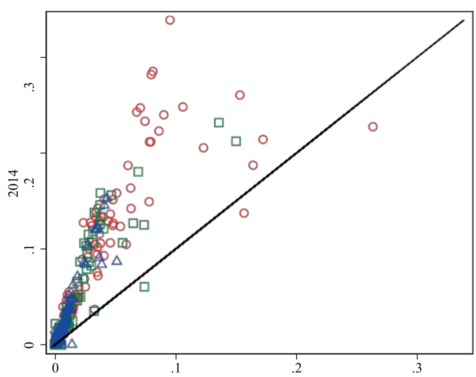
(b) Combined import penetration – Wage



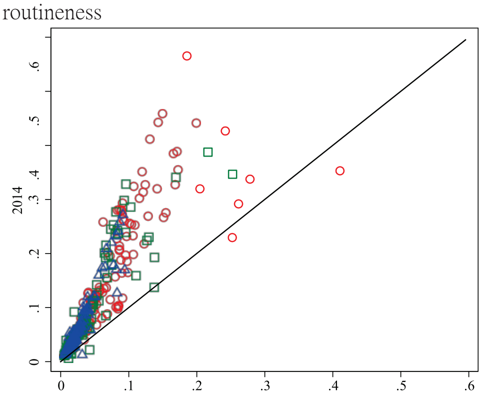
(c) Direct import penetration – Non-routineness



(d) Combined import penetration – Non-routineness



(e) Direct import penetration – Education



(f) Combined import penetration – Education

The analysis for the impact of the US-China trade war on employment relies on the following sources of data. U.S. import tariffs for the events described in Chapter 2 come from Bown and Zhang (2019), and Chinese retaliatory tariffs come from Bown, Jung, and Zhang (2019). The tariffs are converted from Harmonized System (HS) 6-digit product level to the 3-digit North American Industry Classification System (NAICS) level by taking a trade-weighted average of the tariffs. Monthly trade data for total U.S. imports, U.S. exports and China-specific imports and exports come from U.S. International Trade Data of the Census Bureau. Monthly commuting zone-level measures of import tariff exposure and Chinese retaliatory tariff exposure measures from January 2017 to March 2019 are then created by taking an employment-weighted average of the tariffs. This commuting zone level tariff captures region-specific tariffs such that if a commuting zone mostly employs workers for a certain industry which has a high tariff, then the commuting zone-level tariff will reflect the high tariff.

Table 1 reports summary statistics for the commuting zone-level change in tariffs from December 2017 to December 2018. Across 722 commuting zones, the average import tariff increased by 1.06 percent, whereas the average export tariff increased by about 1.32 percent.

While import tariffs may reduce foreign competition for import-competing firms thereby increasing domestic employment, if these import tariffs are on intermediate inputs then domestic employment may not increase. In order to study the effect of tariffs on intermediate inputs, the paper allows for downstream linkages across industries. To proxy for this, downstream import tariff exposure is calculated, which is a weighted average of the industries' import tariff exposure measure, using the 2018 input-output table from the Bureau of Labor Statistics (BLS).

Figure 4: Chinese Retaliatory Export Tariff Exposure (Top) and U.S. Import Tariff Exposure (Bottom) by Commuting Zone

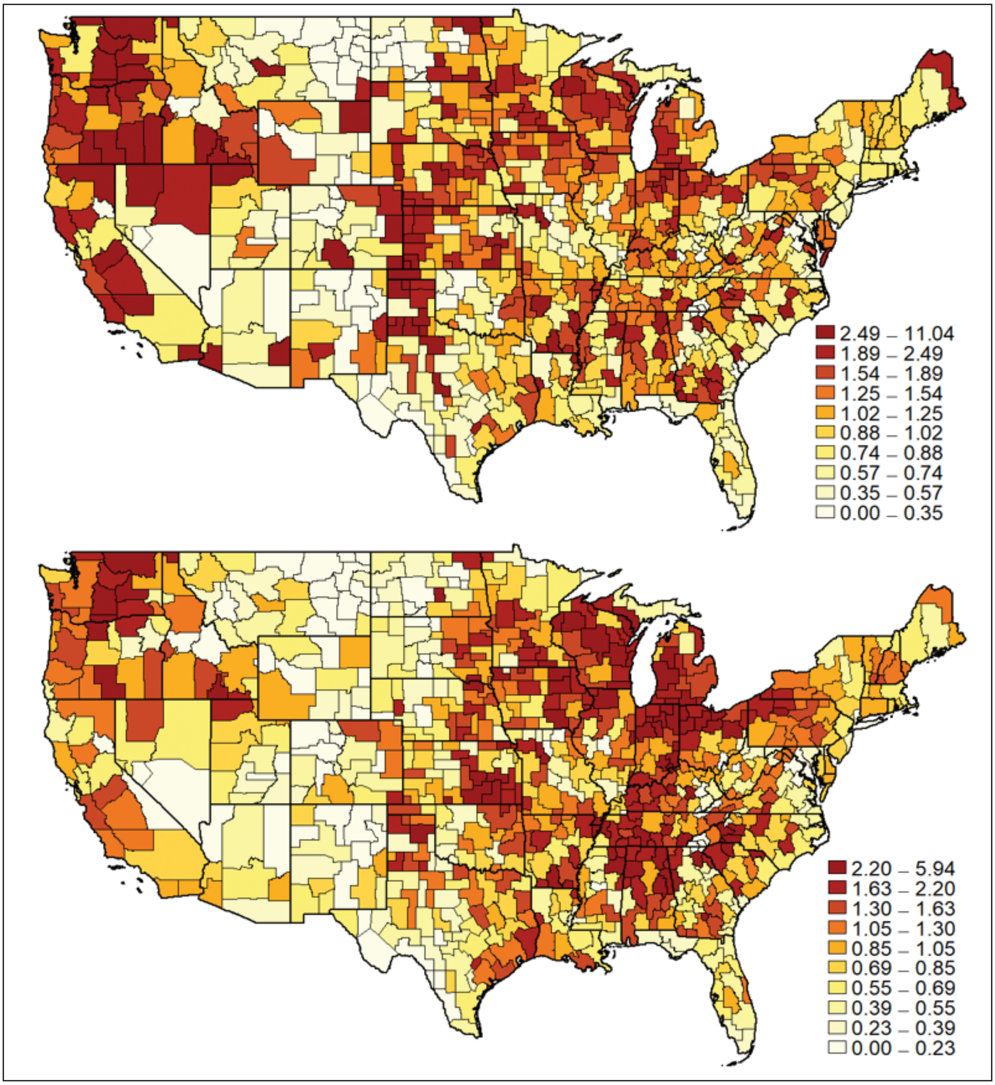


Figure 4 shows the exposure to Chinese import and export tariffs in December by region. The regions in the map are commuting zones, which are geographic units of analysis intended tomore closely reflect the local economy where people live and work. County boundaries are not always adequate confines for a local economy and often reflect political boundaries rather than an area's local economy. Exposure here is defined as the change in a commuting zone's tariff between December 2017 and December 2018. Import tariffs seem to be more concentrated in

the Rust Belt around the Great Lakes region, whereas retaliatory tariffs seem to be concentrated in the Corn Belt of the Mid-West, which is dominated by farming and agriculture and the North-West part ofthe country.

Figure 5 shows the regional distribution of U.S. import tariffs that propagate downstream to industries that purchase the products as inputs. These downstream import tariffs can be thought of as a proxy for tariffs on intermediate inputs. The regional distribution of these tariffs is similarto the import tariffs with slight variation in the degree of exposure to some regions.

Monthly county and industry level data on employment comes from the Quarterly Census of Employment and Wages (QCEW) of the Bureau of Labor Statistics (BLS), which covers about 97 percent of all employment in the U.S. The source data for the QCEW comes from the Unemployment Insurance (UI) program of the U.S. County level employment is aggregated to the commuting-zone level using concordances provided by Autor and Dorn (2013). **Table 1** shows that the average private sector employment in 2017 was 164,000 and the average private sector goods producing employment was 29,000.

In **Chapter 6**, three different hypothetical retaliation strategies are compared — simple, political, and responsible — which have varying degrees of decline in manufacturing employment due to fallingChinese export exposure. **Figure 6** shows the distribution of commuting zones according to the 2016 presidential election vote shares to the Republican party. There are commuting zones in the middle of the country that are affected more by actual Chinese retaliation, similar to the higher political concentration in this figure but the rest of the export tariff map looks different for many other parts of the country, which suggests that China is not just following a pure political retaliation strategy. Fetzer and Schwarz (2019) present evidence that Chinese retaliation was directly targetedto areas that swung to Donald Trump in 2016 but also suggest that the retaliation strategy was sub-optimal.

Figure 7 shows the distribution of commuting zones according to degree of intra-industry trade between U.S. and China in 2016. Values closer to zero denote higher level of intra-industry trade,values closer to one are for industries where the U.S. is a net exporter and values closer to negativeone are for industries where the U.S. is a net importer. The commuting zone level of this index isthen constructed as an employment weighted-average measure of the industry level index. If China would like to minimize the impact of their retaliation on global supply chains, it would target industries for which the U.S. is a net exporter and there is little intra-industry trade, i.e., a subsetof the darkest shaded commuting-zones. There is some resemblance to the export tariff map in **Figure 4** but the darker shaded regions in the figure are more geographically dispersed.

Figure 5: Downstream U.S. Import Tariff Exposure by Commuting Zone

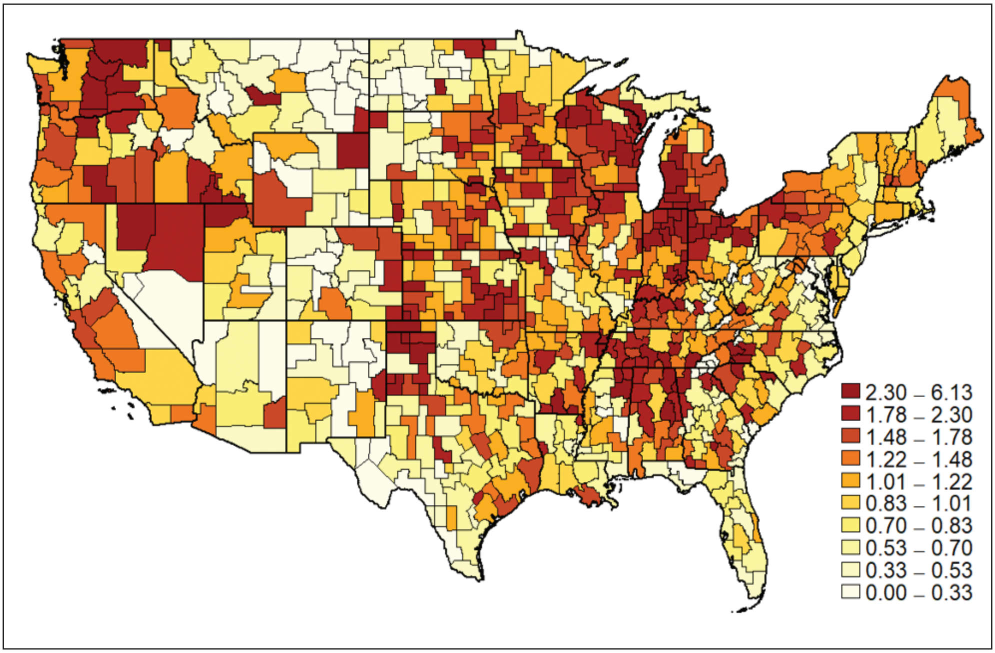


Figure 6: Share of Votes Towards the Republican Party in the 2016 Presidential Election by Commuting Zone

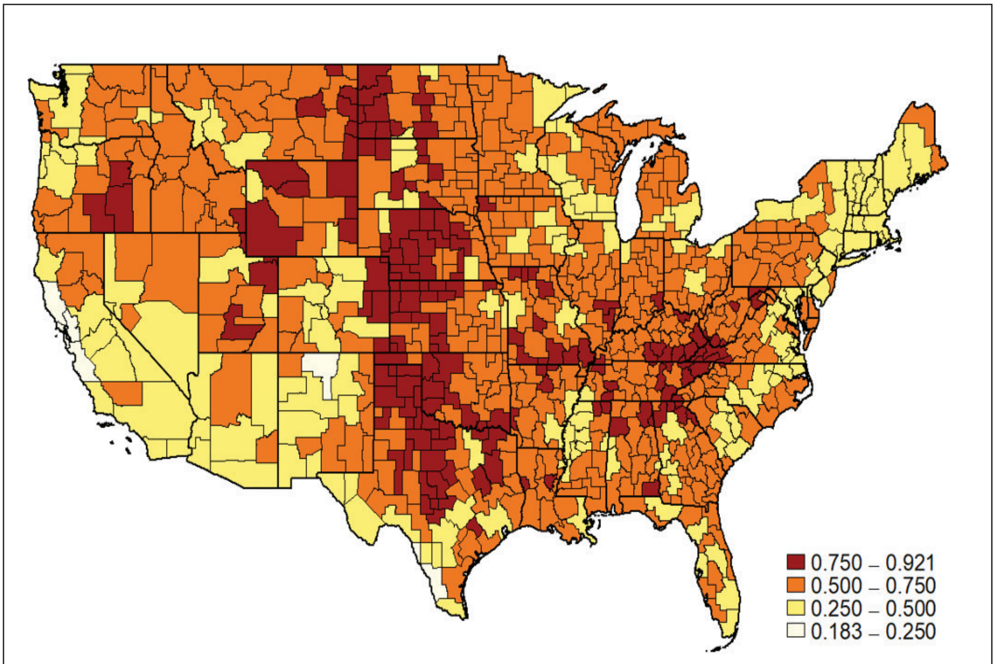
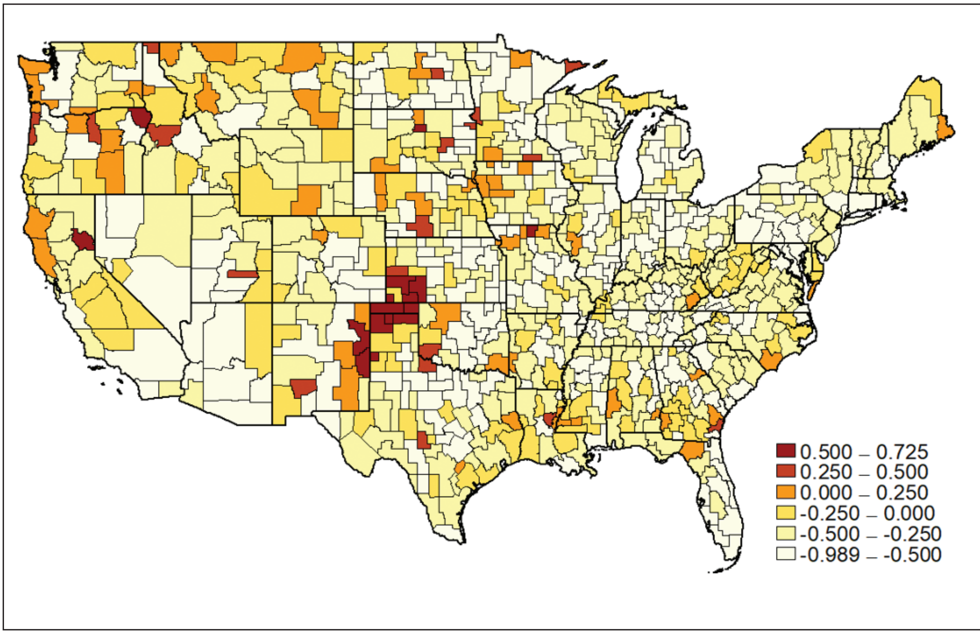


Figure 7: Distribution of a Measure of U.S. - China Intra-Industry Trade by Commuting Zone



4. IMPACT OF THE CHINA SHOCK ON U.S. OCCUPATIONAL EMPLOYMENT

The first empirical specification obtains large and negative employment effects of Chinese import exposure on U.S. occupational employment. Chinese import exposure is constructed according to Acemoglu, Autor, Dorn, Hanson, and Price (2016b). The specification to estimate the average impact of Chinese import exposure on occupational employment is

$$\Delta \ln L_{it} = \alpha_t + \beta \Delta IP_{it} + \gamma Z_i + \varepsilon_{it}, \quad (1)$$

where for occupation i and between $t-3$ and t, $\Delta \ln L_{it}$ is the annualized change in log employment, ΔIP_{it} is the annualized change in Chinese import exposure, α_t is a time fixed effect, and ε_{it} is an error term. For each occupation i, the term Z_i is a vector of time-invariant *production controls* that includes the 2002 values of the log average real wage, and the log of the ICT and non-ICT capital- stock indexes (K_i^I and K_i^N). The coefficient of interest is β, which represents the semi-elasticity of occupational employment to Chinese import exposure. **Table 3** presents the results.

From 2002 to 2014, the predicted employment losses are 1.05 million jobs from direct exposure, 1.51 million when considering upstream exposure, and 2.12 million when considering downstream exposure. Therefore, upstream input-output links further reduce U.S. employment by about 0.46 million jobs about 0.61 million jobs are lost due to downstream input-output linkages.

The second empirical specification considers occupational sorting under three criteria (real wage, non-routineness, and education). Occupations are arranged into tertiles (low, middle, and high) under each criteria, and the impact of Chinese import exposure is estimated on each occupational tertile—a regression is individually estimated for each occupation-sorting criteria. The estimation obtains a large negative effect of all types of Chinese exposure on lower-indexed (low wage, routine, low education) occupations, suggesting that a high content of these occupations is embodied in U.S. imports from China. **Table 2** shows the estimation for the impact of direct import exposure. Additionally, a mildly significant positive employment effect is obtained of Chinese direct import exposure on high-education occupations. These gains are either the result of *(i)* strong productivityeffects- as described by Grossman and Rossi-Hansberg (2008)-by which firms importing cheaperinputs from China increase their productivity and market shares, allowing an expansion in occupations that remain inside the firm, or *(ii)* market share reallocation effects as in Melitz (2003), bywhich contracting or dying firms are displaced by more productive firms that hire high-education workers more intensively, or *(iii)* a combination of both. The associated employment gains in high- education occupations are sufficiently large to make up for the employment losses in low-education occupations.

Table 2: Estimation of U.S. Occupational Employment Responses to Chinese Direct Import Exposure: By Tertiles based on Three Occupation-Sorting Criteria

	Wage		Non-routineness		Education	
	(1)	(2)	(3)	(4)	(5)	(6)
Direct import exposure						
Lowest tertile	-2.42***	-1.81***	-2.07***	-1.46***	-2.19***	-1.63***
	(0.60)	(0.55)	(0.52)	(0.43)	(0.52)	(0.50)
Middle tertile	0.14	0.91	-2.73***	-2.25***	-0.78	-0.04
	(0.75)	(1.01)	(0.46)	(0.71)	(0.87)	(1.12)
Highest tertile	-0.21	2.35	0.63	3.42	3.40	7.08*
	(2.16)	(2.64)	(1.80)	(2.47)	(2.85)	(4.21)
Production controls	No	Yes	No	Yes	No	Yes
Observations	2,460	2,444	2,660	2,436	2,660	2,436

*Notes: All regressions include tertile-time fixed effects (not reported). Standard errors (in parentheses) are clustered at the occupation level. The coefficients are statistically significant at the *10%, **5%, or ***1% level.*

Table 3: Estimation of U.S. Occupational Employment Responses to Chinese Import Exposure

	OLS	IV Estimation			
	(1)	(2)	(3)	(4)	(5)
Direct import exposure	-0.97*** (0.34)	-1.91*** (0.37)	-1.16*** (0.40)		
Combined import exposure I *(direct + upstream)*				-0.83** (0.38)	
Combined import exposure II *(direct + upstream + downstream)*					-0.69** (0.30)
Production controlsObservations	No 2,672	No 2,672	Yes 2,444	Yes 2,444	Yes 2,444

*Notes: All regressions include time fixed effects (not reported) and are weighted by 2002 employment. Standard errors (in parentheses) are clustered at the occupation level. The coefficients are statistically significant at the *10%, **5%, or ***1% level.*

Table 4 considers the occupational employment effects of combined import exposure. For both combined measures, the implications described from direct import exposure on lower-indexed occupations remain robust: there is Chinese-induced job destruction in low-wage, routine and mid-routine, and low-education occupations when input-output linkages across industries are considered.

The third and final empirical specification investigates the effects of Chinese import exposure on occupational employment across different sectors. After classifying industries into three sectors (Chinese-trade exposed, non-exposed tradable, and non-exposed non-tradable), this study finds large and negative employment effects of Chinese exposure on lower-indexed occupations across all sectors, with the exposed sector accounting for 55 to 63 percent of employment losses due to direct exposure. Although the losses in the exposed sector's lower-indexed occupations are expected, the losses in lower-indexed occupations in the non-exposed sector are a novel result. The most likely explanation of this result is the existence of local-labor-market effects as in Autor, Dorn, and Hanson (2013) along with a heavy regional concentration of lower-indexed occupations. Importantly, there is no evidence of Chinese-induced job reallocation of lower-indexed occupations from the exposed sector to the non-exposed sector. **Table 5** shows the results from the estimation of equation (**1**) for the impact of Chinese direct import exposure on U.S. occupational-sectoral employment.

Table 4: Estimation of U.S. Occupational Employment Responses to Chinese Combined Import Exposure: By Tertiles based on Three Occupation-Sorting Criteria

	Wage		**Non-routineness**		**Education**	
	(1)	(2)	(3)	(4)	(5)	(6)
	A. Combined import exposure I *(direct + upstream)*					
Lowest tertile	-2.00***	-1.47***	-1.69***	-1.16***	-1.72***	-1.19***
	(0.46)	(0.42)	(0.41)	(0.35)	(0.38)	(0.36)
Middle tertile	0.06	0.62	-1.86***	-1.55**	-0.24	-0.13
	(0.55)	(0.77)	(0.48)	(0.64)	(0.78)	(0.86)
Highest tertile	-0.37	1.76	0.60	3.08	1.64	4.83
	(1.62)	(2.12)	(1.45)	(2.08)	(2.03)	(3.25)
	B. Combined import exposure II *(direct + upstream + downstream)*					
Lowest tertile	-1.55***	-1.12***	-1.30***	-0.87***	-1.40***	-0.99***
	(0.37)	(0.34)	(0.31)	(0.27)	(0.32)	(0.31)
Middle tertile	-0.13	0.17	-1.51**	-1.42***	0.29	-0.09
	(0.45)	(0.60)	(0.59)	(0.52)	(0.97)	(0.65)
Highest tertile	-0.36	1.08	0.44	2.17	1.52	3.78
	(1.41)	(1.70)	(1.35)	(1.82)	(1.83)	(2.69)
Production controls	No	Yes	No	Yes	No	Yes
Observations	2,460	2,444	2,660	2,436	2,660	2,436

*Notes: All regressions include tertile-time fixed effects (not reported). Standard errors (in parentheses) areclustered at the occupation level. The coefficients are statistically significant at the *10%, **5%, or ***1%level.*

Table 5: Estimation of U.S. Occupational Employment Responses to Chinese Direct Import Exposure: By Sector Exposure under Three Occupation-Sorting Criteria

	Wage		Non-routineness		Education	
	(1)	(2)	(3)	(4)	(5)	(6)
Direct import exposure Exposed						
Lowest tertile	-2.33***	-1.47***	-1.77***	-1.07**	-2.21***	-1.21***
	(0.67)	(0.57)	(0.62)	(0.46)	(0.58)	(0.45)
Middle tertile	0.01	0.87	-2.66***	-1.54**	0.01	0.38
	(1.06)	(0.98)	(0.57)	(0.75)	(1.22)	(1.27)
Highest tertile	15.13	24.50	11.72	21.90	30.00	41.69
	(15.94)	(22.57)	(13.30)	(19.75)	(25.57)	(32.86)
Non-exposed tradable						
Lowest tertile	-1.42***	-1.00***	-1.28***	-0.88***	-1.41***	-1.00***
	(0.26)	(0.23)	(0.24)	(0.24)	(0.24)	(0.21)
Middle tertile	1.15	2.55*	-1.96***	-1.55***	2.31*	2.35*
	(1.08)	(1.35)	(0.63)	(0.58)	(1.34)	(1.30)
Highest tertile	0.94	0.60	2.17**	2.47*	2.60	2.40
	(1.31)	(1.52)	(1.09)	(1.31)	(2.51)	(2.38)
Non-exposed non-tradable						
Lowest tertile	-2.55*	-2.50*	-2.13**	-0.95	-2.42*	-1.81
	(1.33)	(1.31)	(1.04)	(0.99)	(1.26)	(1.16)
Middle tertile	2.08	1.67	-4.22***	-3.46***	-0.63	-0.31
	(1.51)	(1.39)	(1.29)	(1.14)	(1.40)	(1.30)
Highest tertile	-2.08	-0.98	1.73	2.18	-1.11	1.13
	(1.66)	(1.50)	(2.08)	(1.93)	(1.97)	(1.67)
Production controls	No	Yes	No	Yes	No	Yes
Observations	5,372	5,273	5,581	5,253	5,581	5,253

*Notes: All regressions include tertile-sector-time fixed effects (not reported). Standard errors (in parentheses) are clustered at the occupation level.The coefficients are statistically significant at the *10%, **5%, or ***1% level.*

Table 6 considers the combined measures of Chinese import exposure. Panel A shows the estimation results that use the measure that adds upstream linkages, and panel B shows the results that use the measure that adds upstream and downstream linkages. As before, the magnitudes of the coefficients are in general smaller when adding input-output linkages, but this is simply a consequence of the rescaling of the import exposure measure. The results from both panels are qualitatively similar to those discussed for direct import exposure from **Table 5**, though the previous findings for the non-exposed non-tradable sector become largely insignificant.

The only novelty for the non-exposed non-tradable sector comes from significant and negative import-exposure coefficients for high-wage occupations in both panels, which indicates Chinese- induced job destruction in high-wage occupations in this sector. This may be evidence of job reallocation of high-wage occupations from the non-exposed to the exposed sector, with the latter sector demanding more high-wage workers due to productivity effects. However, the evidence is not conclusive because in spite of very large and positive coefficients for high-wage occupations in the exposed sector (indicating a large expansion in these occupations' employment), they have large standard errors and are not statistically significant.

Table 6: Estimation of U.S. Occupational Employment Responses to Chinese Combined Import Exposure: By Sector Exposure under Three Occupation-Sorting Criteria

	Wage		Non-routineness		Education	
	(1)	(2)	(3)	(4)	(5)	(6)
A. Combined import exposure I *(direct + upstream)*						
Exposed						
Lowest tertile	-1.90***	-1.18***	-1.26***	-0.72*	-1.73***	-0.90***
	(0.51)	(0.44)	(0.46)	(0.38)	(0.43)	(0.34)
Middle tertile	0.18	0.85	-1.96***	-1.01	0.19	0.54
	(0.82)	(0.84)	(0.49)	(0.69)	(0.88)	(0.94)
Highest tertile	14.47	21.77	10.92	19.12	26.31	33.97
	(13.68)	(17.88)	(11.52)	(16.00)	(20.04)	(23.43)
Non-exposed tradable						
Lowest tertile	-1.21***	-0.86***	-1.09***	-0.75***	-1.16***	-0.82***
	(0.23)	(0.21)	(0.22)	(0.22)	(0.21)	(0.20)
Middle tertile	1.37*	2.32**	-1.26**	-0.90	1.86*	1.90*
	(0.82)	(0.95)	(0.56)	(0.55)	(1.08)	(1.06)
Highest tertile	1.12	0.89	1.93**	2.21**	2.76*	2.48
	(0.98)	(1.14)	(0.84)	(1.00)	(1.63)	(1.61)
Non-exposed non-tradable						
Lowest tertile	-1.44	-1.18	-2.22**	-1.22	-1.15	-0.38
	(1.39)	(1.37)	(1.03)	(0.98)	(1.32)	(1.28)
Middle tertile	0.64	0.49	-3.02*	-1.60	-1.30	-0.99
	(1.15)	(1.14)	(1.59)	(1.64)	(1.11)	(1.07)
Highest tertile	-2.81**	-1.78	1.65	2.52	-2.25	-0.58
	(1.35)	(1.21)	(2.02)	(2.03)	(1.69)	(1.47)

B. Combined import exposure II *(direct + upstream + downstream)*						
Exposed						
Lowest tertile	***-1.70	***-1.18	***-1.14	**-0.74	***-1.54	***-0.92
	(0.48)	(0.44)	(0.41)	(0.34)	(0.40)	(0.33)
Middle tertile	0.08	0.58	***-1.70	*-0.99	0.06	0.27
	(0.67)	(0.68)	(0.43)	(0.57)	(0.72)	(0.75)
Highest tertile	11.62	17.18	8.83	15.18	21.96	27.96
	(11.27)	(14.49)	(9.62)	(13.20)	(16.97)	(19.57)
Non-exposed tradable						
Lowest tertile	***-0.93	***-0.68	***-0.82	***-0.59	***-0.89	***-0.64
	(0.19)	(0.17)	(0.19)	(0.19)	(0.17)	(0.17)
Middle tertile	*1.22	**1.93	**-0.99	-0.72	*1.56	*1.55
	(0.71)	(0.81)	(0.44)	(0.44)	(0.86)	(0.85)
Highest tertile	1.20	1.02	***1.85	***2.10	*2.25	2.05
	(0.79)	(0.93)	(0.61)	(0.77)	(1.32)	(1.29)
Non-exposed non-tradable						
Lowest tertile	0.20	0.24	-0.82	-0.32	-0.31	0.12
	(1.39)	(1.41)	(0.72)	(0.78)	(1.25)	(1.26)
Middle tertile	-0.03	-0.09	*-3.29	-1.90	-0.55	-0.38
	(1.12)	(1.11)	(1.69)	(1.70)	(0.86)	(0.88)
Highest tertile	**-2.53	*-1.80	2.10	2.62	-1.85	-0.70
	(1.11)	(1.04)	(2.32)	(2.45)	(1.41)	(1.26)
Production controls	No	Yes	No	Yes	No	Yes
Observations	5,372	5,273	5,581	5,253	5,581	5,253

*Notes: All regressions include tertile-sector-time fixed effects (not reported). Standard errors (in parentheses) are clustered at the occupation level. The coefficients are statistically signifi-cant at the *10%, **5 %, or ***1% level.*

5. IMPACT OF U.S.- CHINA TRADE WAR ON U.S. REGIONAL EMPLOYMENT

The section closely follows Waugh (2019) to study the effect of import and export tariffs on employment growth using the following specification:

$$\Delta \ln L_{ct} = \beta_c + \beta_t + \beta_m \Delta \ln(1 + \tau_{ct}^m) + \beta_d \Delta \ln(1 + D\tau_{ct}^m) + \beta_x \Delta \ln(1 + \tau_{ct}^x) + \epsilon_{ct}, \quad (2)$$

where $\Delta \ln L_{ct}$ is the 12-month log difference in employment in commuting zone c, $\Delta \ln(1 + \tau m_{ct}^{m})$ is the 12-month log differenced import tariff rate, $\Delta \ln(1 + D\tau_{ct}^{m})$ is the 12-month log differenced downstream import tariff rate and $\Delta \ln(1 + \tau^{x}_{ct})$ is the 12-month log differenced export tariff rate. β_m measures the effect of a commuting zone's exposure to U.S. import tariffs on its employment, β_d measures the effect of a commuting zone's exposure to U.S. downstream import tariffs on its employment whereas β_x measures the effect of a commuting zone's exposure to Chinese retaliatory tariffs on its employment. This specification includes commuting zone fixed effects, which control for commuting zone specific growth and time fixed effects. Standard errors are clustered at the commuting zone level and regressions are weighted by the commuting zone employment in 2017.

Table 7 reports results from the specification in (2). The coefficients on imports tariffs are statistically insignificant across all specifications, implying that import tariffs haven't yet had an impact on employment growth in the short run. The coefficients on downstream imports tariffs are also statistically insignificant. The coefficient on export tariffs is negative across all specifications, implying that relatively more export tariff exposed commuting zones experienced reductions in employment growth.

The result that export tariffs led to a decline in employment growth in the short-run is robust across all specifications. These retaliatory tariffs affected domestic firms and displaced workers in the local labor markets where these tariffs were the largest. On the other hand, import tariffs did not encourage domestic firms to increase hiring. Moreover, import tariffs on intermediate goods, also did not lead to any increased hiring or firing by domestic firms that use these tariffed products as their inputs. Therefore, the net employment consequences of the current U.S.-China trade warsare negative so far.

Table 7: Effect of Tariffs on Short-term Employment Growth

	Total Employment		*Goods Employment*	
	(1)	(2)	(3)	(4)
Δ Export Tariffs	-0.19**	-0.37**	-0.43*	-0.88**
	(0.07)	(0.14)	(0.19)	(0.29)
Δ Import Tariffs	0.07	0.27	0.13	0.40
	(0.06)	(0.24)	(0.19)	(0.60)
Δ Downstream Import Tariffs		0.002		-0.06
		(0.31)		(0.72)

*Notes: The time period is January 2017 to March 2019. Regressions are weighted by commut- ing zone's population in 2017 (Source: U.S. Census Bureau). Standard errors are clustered at the commuting zone level. The coefficients are statistically significant at the *10%, **5%, or ***1% level.*

6. COUNTERFACTUAL ANALYSIS OF A HYPOTHETICAL U.S.- CHINA TRADE WAR ON PAST U.S. EMPLOYMENT

This chapter examines how a hypothetical trade war would have changed manufacturing employment in the past. The specification used by Feenstra, Ma, and Xu (2019) (henceforth, FMX) to study the effect of import and export exposure on net employment changes in U.S. manufacturing is closely followed:

$$\Delta \ln L_{j\tau} = \beta_{\tau} + \beta_{m1}\Delta IP^{C}_{j\tau} + \beta_{m2}\Delta IP^{ROW}_{j\tau} + \beta_{x}\Delta EP_{j\tau} + \eta Z_{j} + \varepsilon_{j\tau}, \tag{3}$$

where for industry j during subperiod τ, $\Delta \ln L_{j}\tau$ is the annual change in log employment, and ΔIP^{C}, ΔIP^{ROW}, and ΔEP are the changes in Chinese import penetration, non-Chinese import exposure from the rest of the world (ROW), and U.S. export exposure respectively. The term $\beta\tau$ denotes a subperiod fixed effect, and $\varepsilon j\tau$ is the error term. Z_j is a vector of time-invariant industry-level controls, which includes the share of production and non-production workers in each industry, the log of average industry wage, the ratio of capital to value-added, computer and high- tech equipment investment (all measured in the initial year of 1991), and 10 one-digit sectoral dummies which allows for differential trends in these broad manufacturing categories. Z_j also includes pretrend variables measures over 1976-1991, which are change in industry's share of total employment, and the change in log average wage. This equation is fitted for stacked first differences covering two subperiods: 1991-1999, and 1999-2007. The employment data used in all specifications is from the County Business Patterns (CBP) database of the U.S. Census Bureau, which has data on number of employees, establishments, and payroll for the universe of all businesses at the detailed industry level. **Table 8** presents the industry-level results for the manufacturing sector.

Column (1) starts with an OLS regression, where import exposure from China has a significantly negative impact on the industrial employment growth, while import exposure from the rest of theworld has a positive and significant effect and export expansion has a positive but insignificant effect on employment. More specifically, a one percentage point rise in industry Chinese import penetration reduces domestic industry employment by 0.51 percentage points, while a one percent- age point rise in import penetration from ROW increases industrial employment by 0.23 percentage points.

Table 8: Estimation of U.S. Manufacturing Employment

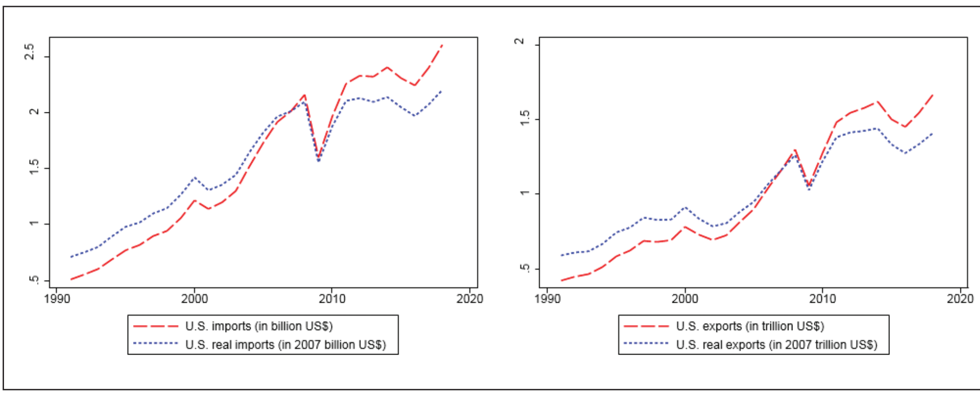
	(1)	(2)	(3)	(4)	(5)
Δ Chinese imports	-0.51***	-0.77***	-0.74***	-0.71***	1.81
	(0.10)	(0.15)	(0.15)	(0.17)	(0.97)
Δ Non-Chinese imports	0.23**	0.11	0.08	0.04	-0.18
	(0.09)	(0.12)	(0.10)	(0.16)	(0.51)
Δ Exports	0.23	0.59***	0.61***	0.61*	0.13
	(0.15)	(0.19)	(0.18)	(0.26)	(0.13)
Estimation method	OLS	2SLS	2SLS	2SLS	2SLS
FMX instruments		Both	OTH	OTH	OTH
Time period	1991-2007	1991-2007	1991-2007	1991-2011	2010-2016

Estimates for the import exposure and export exposure could be biased due to simultaneous changes in domestic demand. Thus, starting from column (2), results that use two-stage least squares (2SLS) are presented. Based on the results in column (2), using both types of FMX instruments, a one percentage point rise in industry Chinese import penetration reduces domestic industry employment by 0.77 percentage points, while a one percentage point rise in export expansion increases industrial employment by 0.59 percentage points. Both of these effects are larger in absolute terms with 2SLS than with OLS. For a positive domestic demand shock that increases domestic employment, the OLS coefficient on imports is biased up since both imports and employment are increasing, and the OLS coefficient on exports is biased down since exports are decreasing while employment is increasing.

The effect of import penetration from ROW is still positive but insignificant. Column (3) uses only the first type of instrument, where a one percentage point rise in industry import penetrationreduces domestic industry employment by 0.74 percentage points and a one percentage point risein export expansion increases industrial employment by 0.61 percentage points. The results from using only the first instrument is similar to using both instruments of FMX. Column (4) include 2 stacked periods, with the final period ending in 2011. This is the time period most commonly used in the “China shock” literature. The general result that Chinese import exposure reduces jobswhile export expansion creates them holds across columns (1)-(4).

The specification is estimated again for only the post-recession period of 2010-2016 using two stacked periods (2010-2013 and 2013-2016) and using the level of employment in 2010 as weights, 2010 start-of-period controls, and trade exposure measures with industry shipments from 2010 in the denominator. The effect of the “China Shock” disappears in this period (column (5)). The coefficient on export exposure is found to be insignificant. There has been some evidence of a decline in U.S. export value in recent years, which may be responsible for this result. The International Trade Administration, which keeps a database of jobs supported by the export sector, has calculated that approximately 500,000 jobs supported by goods exports were lost between 2014 and 2016 and this decline was due to the fall in the value of exports. **Figure 8** shows a decline in both imports and exports around the year 2015.

Figure 8: U.S. Imports and Exports Over Time



A “trade war” in this empirical model is captured by simultaneous reductions in import exposure (which reflects the U.S. protectionist policy) and export exposure (which reflects retaliation responses of U.S. trading partners). It is reasonable to expect both imports and exports to decline due to tariff increases. Using a monthly panel dataset of tariffs and trade data up to November 2018, Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2019) estimate the immediate effects of the trade war and find that imports from targeted countries declined 31.5 percent within products, while targeted U.S. exports fell 11.0 percent.

Three different scenarios of retaliation from China are considered as follows:

(i) *simple retaliation*, which imposes identical restrictions on U.S. exports to China across all industries. A 10 percent uniform import tariff increase is met by a 10 percent uniform export tariff increase across all industries, adjusted by the trade cost elasticity (from Caliendo and Parro (2015)). For instance, the trade cost elasticity in the Food sector is 2.62. A 10 percent increase in trade costs (which includes tariffs) in this sector would decrease both import and export exposure by 26.2 percent.

(ii) *political retaliation*, which targets in particular those industries that have a large proportion of people that voted for Donald Trump in the 2016 presidential election. Using 2016 presidential election data[3], the share of Trump supporters are approximated in each industry.

(iii) *responsible retaliation*, which minimizes the impact of retaliation on global supply chains. Based on the Grubel-Lloyd index of intraindustry trade, under the responsible-retaliation scenario

China will target U.S. export value for higher indexed industries, for which the U.S. is a net exporter and there is little intraindustry trade, i.e., $GL_{US,C} > 0.5$.

Column (1) of **Table 9** shows predicted net employment changes from the specification in column (3) of **Table 8**. U.S. export expansion net of import penetration led to a net gain of 542,000 jobs inthe U.S. manufacturing sector during 1991-2007. 671,000 jobs were lost due to import penetration and 1,198,000 jobs were also gained due to export expansion. Export expansion created enough jobs to offset job losses due to Chinese import penetration.[4]

Table 9: Predicted Changes in Manufacturing Employment (in thousands) due to an Unbalanced Trade War between U.S. and China (1991-2007)

	No Trade War	No Retaliation	Simple Retaliation	Political Retaliation	Responsible Retaliation
	(1)	(4)	(3)	(4)	(5)
1991-1999					
Imports	-124	103	103	103	103
Exports	735	735	710	730	734
Net	613	823	799	818	822
1999-2007					
Imports	-547	-104	-104	-104	-104
Exports	463	463	418	455	458
Net	-71	368	323	360	364
1991-2007					
Total Imports	-671	-1	-1	-1	-1
Total Exports	1,198	1,198	1,128	1,185	1193
Total Net	**542**	**1191**	**1,122**	**1,178**	**1186**

[3] Compiled by Tony McGovern from The Guardian and townhall.com.

[4] This is the key result of FMX

Column (2) reports the calculations of predicted employment changes for 1991-2007 under the scenario where the U.S. imposed 10 percent uniform tariffs on all Chinese imports and there is noretaliation by China. The number of jobs gained due to reduction in import competition is around 670,000 jobs, which is about the same amount that were lost due to Chinese import competition during this time period. This implies that had the U.S. imposed uniform import tariffs during thistime, the “China shock” would not have occurred. The tariffs would not have allowed Chinese imports to rapidly increase the way they did in the 2000s.

Columns (3)-(5) report calculations for three different retaliation scenarios. All scenarios of retaliation make the U.S. better off and that the net outcomes are not that much worse compared to the scenario with no retaliation. The number of jobs gained due to the import tariffs is very large and the number of jobs lost due to retaliatory tariffs is very little. The U.S. is able to take advantage of the huge trade deficit with China.

Table 10: Predicted Changes in Manufacturing Employment (in thousands) due to a Balanced Trade War between U.S. and China (1991-2007)

	All U.S. trade				*U.S.-China trade*			
	No Trade War	Simple Retaliation	Political Retaliation	Responsible Retaliation	No Trade War	Simple Retaliation	Political Retaliation	Responsible Retaliation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1991-1999								
Imports	-124	-76	-106	-118	-281	-231	-262	-274
Exports	735	710	730	734	39	9	34	38
Net	613	633	625	618	-240	-222	-227	-236
1999-2007								
Imports	-547	-450	-509	-534	-631	-534	-593	-619
Exports	463	418	455	458	75	31	66	70
Net	-71	-21	-42	-63	-553	-502	-525	-545
1991-2007								
Total imports	-671	-526	-615	-653	-912	-764	-855	-893
Total exports	1,198	1128	1,185	1,193	114	39	99	108
Total Net	**542**	**612**	**583**	**555**	**-794**	**-724**	**-752**	**-781**

Table 10 shows calculations for a balanced trade war between U.S. and China under three different retaliation scenarios. Column (5) shows that the employment decrease due to import competition is mostly driven by Chinese

import competition, whereas the employment increase due to export expansion is mostly driven by exports to countries other than China. The net effect on employment from Chinese trade alone is negative and quite large ($\approx$ 800,000 jobs).

Columns (2) and (6) report the calculations of predicted employment changes based on the scenario of simple retaliation. Both U.S. and China target similar trade volumes in this case ($27 billion in 2007 dollars). The simple trade war leads to a net increase in employment relative to the no-trade-war scenario. This is because the jobs gain due to falling import exposure is more than the jobs lost due to falling export exposure, which is driven by the larger negative effect of Chinese import competition relative to the positive effect of U.S. export expansion.

A balanced trade war with political retaliation by China also gives a net gain of manufacturing jobs compared to the no-trade-war scenario. The net effect is slightly worse than the simple retaliation case, since the retaliation by China is on a subset of industries. Some characteristics of Trump industries are highlighted in **Table 11**. Industries with a higher share of Trump supportersare fewer in number (165 out of 392), have a lower average trade cost elasticity (5.97 versus 7.71 for non-Trump industries), and a lower share of total manufacturing employment (39 percent on average). Trump industries also export more globally than they import from China.

Responsible retaliation focuses only on those industries where U.S. is a net exporter and there is little intra-industry trade between the U.S. and China. Responsible retaliation by China also gives a net increase in employment compared to the no-trade-war scenario. **Table 12** presents a summary of some characteristics of these industries. There is a very low share of employment in these industries to begin with.

Table 11: Characteristics of Trump Manufacturing Industries (1991-2007)

Number of industries	165
Average trade cost elasticity	5.97
Share of employment in 1991	0.37
Share of employment in 2007	0.40
Share of Chinese imports in 1991	0.16
Share of Chinese imports in 2007	0.28
Share of non-Chinese imports in 1991	0.44
Share of non-Chinese imports in 2007	0.48
Share of exports in 1991	0.42
Share of exports in 2007	0.44

Table 12: Characteristics of Industries where the U.S. is a Net Exporter and there is very little Intra-Industry Trade with China (1991-2007)

Number of industries	38
Average trade cost elasticity	6.65
Share of employment in 1991	0.08
Share of employment in 2007	0.09
Share of imports from China in 1991	0.01
Share of imports from China in 2007	0.004
Share of exports to China in 1991	0.10
Share of exports to China in 2007	0.34

Overall, it appears that the U.S. seems to gain in net employment no matter how the partner countries retaliate. This is also driven by the fact that the negative effect of Chinese import exposure is much larger than the positive effect of U.S. export exposure, which in turns makes the job creating effect of import tariffs larger.

The China Shock of the 2000s may not be relevant in 2018 as a motivation for protectionism. Import tariffs now are unlikely to bring back manufacturing jobs that were labor-intensive in the 1990s and 2000s but are now replaced by automation and offshoring. Using U.S. Census micro data, Bloom, Handley, Kurman, and Luck (2019) find strong manufacturing employment impacts of Chinese imports from 2000 to 2007, but nothing from 2008 to 2015. Moreover, they find that find almost all of the manufacturing job losses were in large, multinational firms that were offshoring manufacturing jobs while simultaneously expanding in services and that there is no evidence that Chinese import competition generated net job losses.

Given this insight, this study focuses on only the post-recession period of 2010-2016 to see how the long-run employment consequences of the trade war might actually turn out. Note from **Figure 9** that although manufacturing employment has been unable to return to pre-China shock levels, there has been a steady increase in these jobs in the past decade.

Figure 9: Average U.S. Manufacturing Employment Over Time (in millions)

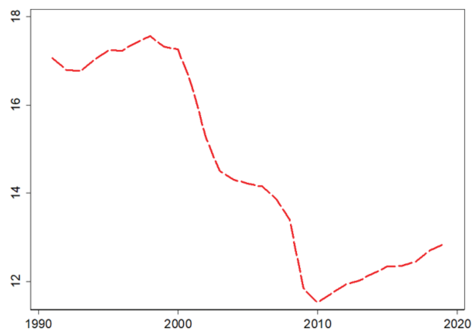


Table 13: Predicted Changes in Manufacturing Employment (in thousands) due to an Unbalancedtrade War between U.S. and China (2010-2016)

	No Trade War	No Retaliation	Simple Retaliation	Political Retaliation	Responsible Retaliation
	(1)	(4)	(3)	(4)	(5)
2010-2013					
Imports	103	6	6	6	6
Exports	44	44	42	43	43
Net	145	50	48	49	49
2013-2016					
Imports	71	6	6	6	6
Exports	-31	-31	-30	-31	-31
Net	40	-25	-24	-24	-25
2013-2016					
Total Imports	174	12	12	12	12
Total Exports	13	13	12	12	12
Total Net	**185**	**25**	**24**	**24**	**24**

Table 8 column (5) shows that neither Chinese import penetration nor U.S. export expansionhave any significant effect on manufacturing employment. In fact, even the sign for the coefficienton Chinese import exposure changes. This supports previous evidence that the China shock is nolonger prevalent since the Great Recession of 2008.

The actual predicted net change in employment due to import and export exposure during 2010-2016 is positive **(Table 13)**. Because Chinese imports no longer have a negative effect on employment, any kind of retaliation scenario would lead a reduction in jobs compared to the no-trade-war scenario. Had there been protectionism during this post-recession period even with no retaliation by China, the

U.S. would have lost more manufacturing jobs. This is completely opposite to the result for the China shock period.

The result that U.S. import tariffs would have reversed the loss of manufacturing jobs due to Chinese import competition between 1991-2007 is what one would expect. Much of the U.S. political debate focuses on the huge number of manufacturing jobs lost due to trade with China and other factors, such as technological advancement. However, trade with China has led to many positive outcomes. Not only do cheaper Chinese products make American consumers better off, American producers also benefit a lot from access to the Chinese consumer market. Companies like KFC and General Motors sell more of their products in China than they do in the U.S. Moreover, although the number of manufacturing jobs plummeted, manufacturing output continued to grow, except during the 2008 recession. The result that after the Great Recession, there was no effect of Chinese import competition on manufacturing jobs combined with the fact that manufacturing output has continued to grow, suggests that production patterns have shifted already during this time towards more automation and offshoring and import tariffs might bring back some jobs but is unlikely to reopen factories and cause a reversal of the manufacturing decline. The jobs that were lost were more labor-intensive and using older technology and are unlikely to be revived.

The ongoing trade war also creates a lot of uncertainty, which may slow down or delay major business investment decisions both for exporting and importing firms. With no end to the trade war in sight, companies may be already looking to shift production to other countries, such as Vietnam. The short-term effects of the ongoing trade war on employment suggest that import tariffs are not yet causing a change in the employment growth, but export tariffs are already having a negative impact. China is already able to hurt U.S. employment, but the tariffs imposed by the U.S. itself is not having any immediate impact.

There have been studies on other short-run outcomes, which all estimate mostly negative effects. Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2019) estimate annual consumer and producer losses from higher cost of imports to be US$ 68.8 billion, which is 0.37 percent of GDP. The aggregate welfare loss was found to be US$ 7.8 billion (0.04 percent of GDP). They also find that tradable- sector workers in heavily Republican counties were the most negatively affected by the trade war. Amiti, Redding, and Weinstein (2019) find that the burden of U.S. import tariffs fall on domestic consumers, with a reduction in U.S. real income of $1.4 billion per month in 2018.

7. CONCLUSION

Chinese import exposure has a differential impact in employment across occupations. After sorting occupations according to their real wages, degree of non-routineness, and education requirements, the study finds that employment losses from occupational-level Chinese import exposure are concentrated in low-wage, routine, low-education occupations. These losses occur in both Chinese-trade exposed and non-exposed sectors. Although the result of negative employment effects in the exposed sector's lower-indexed occupations is expected—these U.S. occupations would be the most adversely affected in the influential offshoring models of Feenstra and Hanson (1996) and Grossman and Rossi-Hansberg (2008)—the finding of employment reductions in lower-indexed occupations in the non-exposed sectors is novel and does not have a straightforward interpretation.

The argument for the latter result is that it is a consequence of local labor market effects à la Autor, Dorn, and Hanson (2013), in combination with a heavy concentration of lower-indexed occupations in particular regions. In support of this interpretation, exploratory analysis conducted by Van Dam and Ma (2016) using the Chinese import-exposure data of AADHP and Autor, Dorn, and Hanson (2013) shows that the U.S. areas most affected by the China Shock were "less educated, older and poorer than most of the rest of America."[5]

In a related paper, Asquith, Goswami, Neumark, and Rodriguez-Lopez (2019) find that deaths of establishments account for most of the Chinese-induced job destruction in the United States. In conjuction with this paper's findings, this implies that establishments that die due to the China Shock have a larger proportion of workers in lower-indexed occupations than surviving establishments. Although this issue requires further investigation, previous work from Abowd, McKinney, and Vilhuber (2009) shows evidence in that direction. Using Longitudinal Employer-Household Dynamics (LEHD) data, they find that firms that employ more workers from the lowest quartile of the human capital distribution are much more likely to die, while firms that employ workers from the highest quartile of the distribution are less likely to die.

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[5] See http://graphics.wsj.com/china-exposure/ and http://chinashock.info/.

There is also mild evidence that direct Chinese exposure drives an employment expansion in high-education occupations. This suggests the existence of productivity effects as in Grossman and Rossi-Hansberg (2008), by which the replacement of low-wage employment with imports from China allows U.S. firms to reduce marginal costs and expand their markets shares; consequently, this leads to higher employment in occupations that remain inside U.S. firms. Another possibility is the existence of effects à la Melitz (2003), by which low-productivity firms exposed to Chinese competition die, with market shares being reallocated toward more productive firms that use high- education occupations more intensively. Disentangling these effects is another relevant research topic spanning from these findings.

While Chinese import competition reduced a large number of U.S. manufacturing jobs, export expansion has also been very large for the U.S., thereby creating enough jobs to offset the job losses due to Chinese imports between 1991-2007. The reverse would have happened if there was a trade war during this period since U.S. import tariffs would limit the job reducing effect of Chinese import competition, while retaliatory tariffs on U.S. exports would reduce the job creating effect of U.S. export expansion. This study calculates the effect of a hypothetical trade war on employment under three different retaliation scenarios and finds that the United States would have experienced a net gain in jobs relative to the actual no-trade-war scenario between 1991-2007 irrespective of the kind of retaliation imposed by China. This is because the job creating effect of import tariffs turnout to be much larger than the job destroying effect of retaliatory tariffs. However, the opposite is true when the post-recession period of 2010-2016 is considered, which is more representative of the manufacturing industry composition in the United States today.

The 2018 trade war between the U.S. and its trading partners will have distributional consequences across industries, and across regions with different patterns of comparative advantage. The kind of retaliation executed by partner countries will determine the extent of the distributional impacts of the trade war. The immediate effects of the Chinese retaliatory tariffs from the ongoing U.S.-China trade war on commuting zone-level employment growth is negative and statistically significant, whereas there is no significant effect of U.S. import tariffs. The commuting zones that were more exposed to the retaliatory tariffs have been disproportionately hurt. These results combined together suggest that the employment consequences of the U.S.- China trade wars are negative in the short-run and are unlikely to be largely positive in the long-run either because of the shift in the nature of manufacturing production towards automation and offshoring in the past decade.

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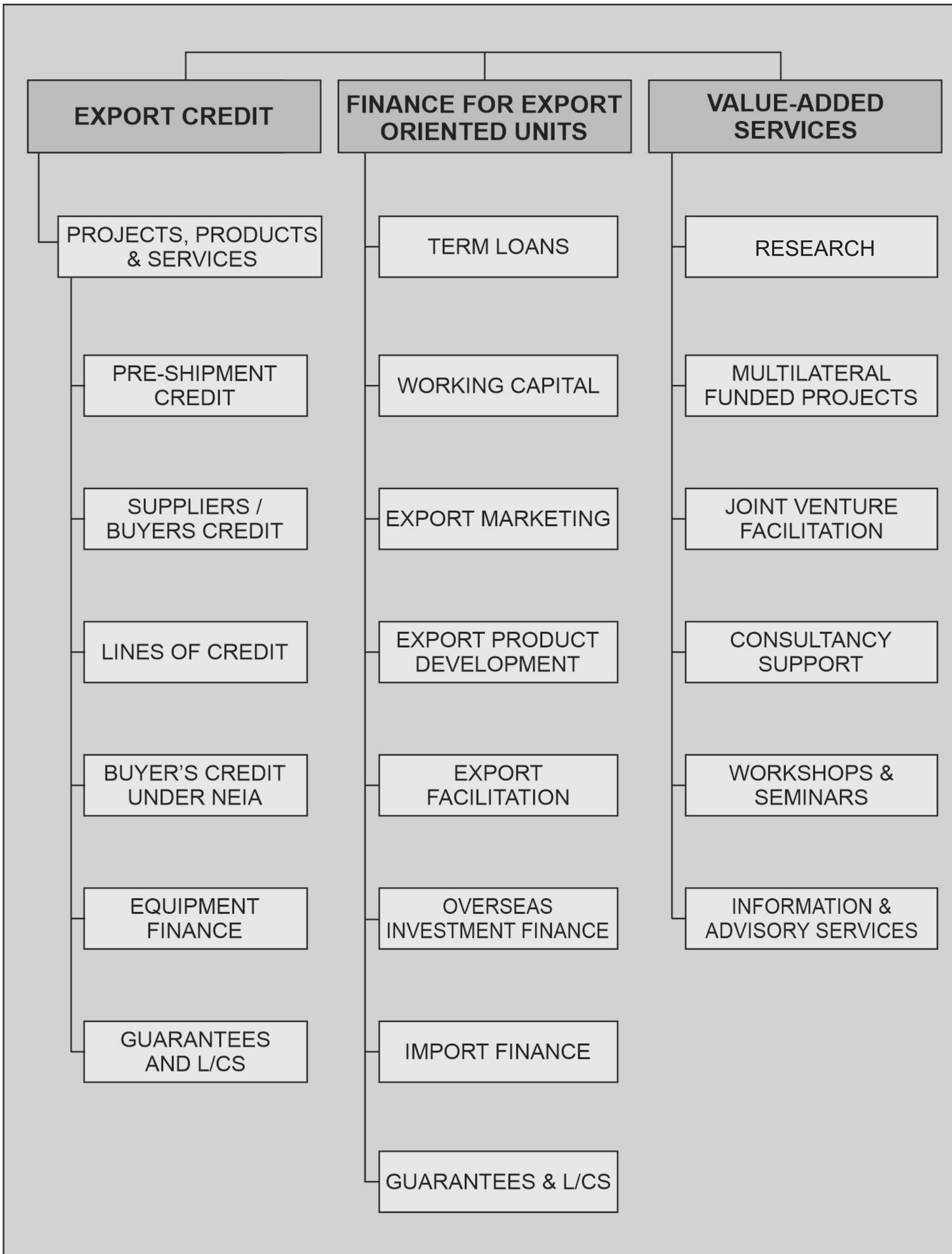

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