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Michael Olabisi*

Trade shocks and youth jobs

Abstract

This paper examines the impacts of trade on youth employment in the United States. The overarching goal is to link lessons from the decline of manufacturing jobs in the past decades to future prospects for the US economy. We find higher rates of job losses with exposure to import competition for US youth, than for older workers. Our analysis uses buyer–supplier relationships between sectors of the US economy to show that the direct effects of trade on the importing sectors underrepresent the impact of trade on jobs.

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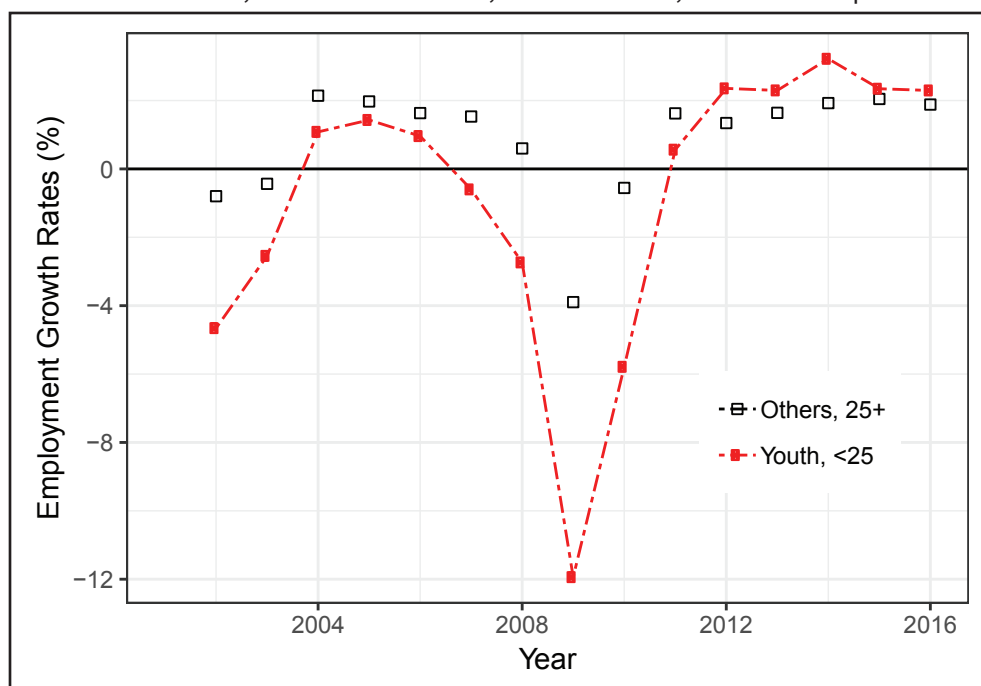
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1 Background

The US manufacturing sector has lost jobs for decades. The housing bubble of the early 2000s masked the decline, before the catastrophe of the Financial Crisis and the layoffs of the Great Recession of 2008–2009 laid the issue bare again. An estimated 6.6 million US manufacturing jobs were lost between 1977 and 2012 (Fort et al., 2018). The resulting economic transformation explains the phenomenon of shrinking cities and other social challenges in the United States. The changing job environment did not affect age groups uniformly. The total number of US jobs grew slowly from 137 million in Q2 2000 to 140 million in Q2 2010. Over the same decade, jobs held by young people *in the 16–25 age range* fell from 20.5 million to 17.2 million, a 16% drop that has not been fully reversed to date (The Bureau of Labor Statistics, 2018). The focus on youth is motivated by this employment downturn, and the dynamic implications of having fewer young people in the workforce.

Youth employment grew at a lower rate, or fell harder in every year between 2002 and 2011 in the United States. Some of this was due to the pre-Recession decline in manufacturing jobs. Furthermore, the 12% downturn in 2009 for youth employment was about thrice the 4% decline for the rest of the population. Figure 1 highlights the challenge, and other information sources show that it can be linked to the prevalence of manufacturing jobs. The United States lost more than 5 million manufacturing jobs between 2000 and 2010.¹

Figure 1 Employment growth rates for US youth: 2002–2016. The graph plots year-on-year employment growth for persons aged 14–24 years as linked circles on the vertical axis, and for the rest of the US population as squares. (Data from the U.S. Census Quarterly Workforce Indicators Database [QWI]). The following states were excluded because of incomplete data between 2001 and 2016: Arizona, Arkansas, District of Columbia, Massachusetts, and New Hampshire.



¹ The broad pattern of decline in manufacturing is well documented in the literature (Autor et al., 2013; Acemoglu et al., 2016; Fort et al., 2018).

The linked circles in Figure 1 represent the year-on-year growth rates for jobs held by persons aged <25 years in the United States. The square markers represent the growth rates of all jobs in the United States held by persons aged 25 years and older, for contrast. The graph shows a pattern of correlation between age groups in employment growth, but more notably, that job losses have been more severe for the youngest age group, especially before the recovery that followed the Great Recession of 2008–2009.

Imports contributed to the job losses in Figure 1. The decline of US manufacturing jobs remains the subject of debates, but nonetheless, the impacts of rising import competition and the decline of US firms that were unable to compete with low-cost imports are well-documented (Autor et al., 2013; Acemoglu et al., 2016; Fort et al., 2018). Several papers focus on imports from China specifically, given its dramatic export expansion in the past decades. The product innovation and productivity gains that enabled the expansion of Chinese exports are also well documented (Amiti and Freund, 2008; Schott, 2008; Olabisi, 2017).

For this paper, the overarching goal is to link lessons from the job losses of the past decades to future prospects for youth in the US economy. The main finding from the analysis in Section 3 is that exposure to import competition hurt jobs for youth in the United States at much higher rates than for older workers. For each job lost to import competition by 35–44-year-olds, about three jobs are lost by workers aged <25 years.

The paper has two *novel elements*. First, it focuses on the age-group differences in the pattern of employment. This dimension has been largely ignored by the China-shock literature. Second, the earlier papers in the literature considered only the direct impacts of trade, or the first-order transmission of those impacts along the manufacturing supply chain (Acemoglu et al., 2016; Asquith et al., 2019). Studying the effects of trade on related industries to the importing sector is a recent and developing area, to which this paper contributes. A note of caution from the findings is that US job woes cannot be attributed entirely to China. Figure 1 shows that the most severe US job losses came with the housing-induced Great Recession of 2009. The literature suggests that imports contributed to manufacturing sector job losses, just as they contributed to service sector job gains (e.g., Feenstra 2019; Bloom 2019).

The long-term impacts of trade on local economies matter to young workers. First, they are more vulnerable to positive or negative job shocks (Jaimovich and Siu, 2009; Dennett et al., 2013). Young employees may be fired first in a downturn because they lack experience (or social capital), and after being laid off, they may also be less able to leverage their professional and social networks to find new jobs or regain old ones. Second, the long-term effects of economic shocks are greater for the youth, as they have more years of earnings ahead of them that could be affected by a pay cut, job loss, raise, or promotion. College graduates entering the job market in a recession have been shown to have worse occupational quality matches, and persistent negative wage effects (Kahn, 2010; Oreopoulos et al., 2012; Altonji et al., 2016). Related papers show that early unemployment in a career could leave a career “scar” with a nontrivial wage penalty that lasts beyond 10–20 years (Gregg and Tominey, 2005; Mroz and Savage, 2006). There are other non-career effects, as documented in recent papers on employment and marriage (e.g., Dorn 2019; Kearney 2018).

Increasing exports could lead to more jobs, and the evidence shows a historic expansion in US exports over the past two decades (Lincoln and McCallum, 2018). This may partially

explain why, as US manufacturing jobs declined, service and related sectors expanded. Sectors exposed to import competition, like machinery, lost workers, but the food and food service sectors generated more jobs, as they used low-cost imported inputs and were less exposed to import competition (Caliendo et al., 2019). Other related papers show that the decline in US manufacturing jobs may have been more than offset by job gains in related sectors (Bloom et al., 2019; Feenstra et al., 2019).

Studying import competition effects for linked upstream and downstream sectors is increasingly necessary, as more manufacturing jobs are tied to the supply chains of large firms, (e.g., the automotive sector). Demand from downstream in the supply chain affects how firms choose to invest in capital and to hire or fire employees (changes to the supply of inputs from upstream producers may also play a role). In addition, studying buyer–supplier relationships makes it possible to recognize that the impacts of trade go beyond the sectors directly facing import competition. One sector could see job losses because of higher imports of low-cost substitutes, while the sectors using the imported goods as inputs see higher employment because of the lower operating costs that imports provide.

There is a high degree of employment co-movement between linked sectors in the US economy, even if the underlying shocks to each sector are different. The network structure of buyer–supplier linkages among sectors means that idiosyncratic shocks to the “crucial” sectors – the sectors providing intermediate inputs for many other sectors, cannot be diversified away. The shocks, as they propagate through sectors, can contribute to aggregate GDP movements (Acemoglu et al., 2012; Olabisi, 2020).

2 Data and methods

2.1 Data

We use employment data from the US Census Quarterly Workforce Indicators (QWI) database. The primary advantage of the QWI data is the disaggregation of employment into age groups and industries. The data organize employment by NAICS 4-digit industries (which are concorded to match the 369 standard industry classifications for which import exposure is calculated). Employment is reported for age groups that we collapse to the following 10-year intervals: 14–24, 25–34, 35–44, 45–54, 55–64 and 65+. The reported employment data cover the years 2001 to 2016 for most states.²

Three reasons motivate our limiting the periods for analysis: first, as shown in Figure 1, job losses for youth were more severe than the national average before the Great Recession, after which they matched national averages in the recovery that followed. Second, it is important to highlight the effects of trade on the economy before the Great Recession began in 2008 – including the years after that may conflate trade’s effects with outcomes created by the bursting of the housing bubble – the primary trigger for the Great Recession. Third, data limitations prevent any study of the most recent years of trade exposure for the US sectors.

² Some states did not have employment data for all years and were excluded from the analysis: Massachusetts (2010–2017), District of Columbia (2005–2017), Arizona, Mississippi (2004–2017), Arkansas, New Hampshire (2003–2017).

Our measure of import exposure captures the change in US imports from China, relative to the US sector size for each of the tradable goods sectors. Formally, import exposure for a sector i in the first analysis period, $Exposure_i^{imp}$ is defined as

$$Exposure_i^{imp} = (Imports_i^{2007} - Imports_i^{2000}) / (Output_i^{2000} + Imports_i^{2000} - Exports_i^{2000})$$

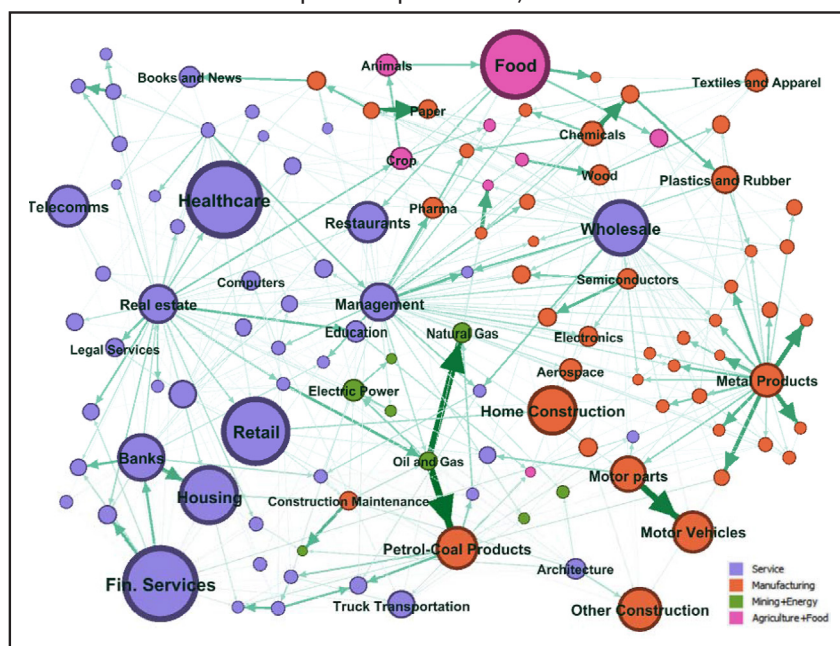
The definition recognizes import exposure as the change in imports over a time period, relative to the baseline absorption or size of the sector at the beginning of the period. The baseline absorption represents the level of US output and imports minus exports of the good. The export exposure is defined as

$$Exposure_i^{exp} = (Exports_i^{2007} - Exports_i^{2000}) / Output_i^{2000}$$

The data also include similar trade exposure measures for other high-income countries. The trade exposure measure for other high-income countries will be used as an instrumental variable, as mentioned in Section 2.2. The second period uses the same definition but for the years 2010–2017 (2016, if 2017 data were not available). The measure comes from publicly available replication data (Acemoglu et al., 2016).³

To motivate the concept of exposure in upstream/downstream sectors, Figure 2 shows the structure of the US economy, as a network of supplier–buyer relationships between firms across

Figure 2 Input–output linkages between US sectors. The graph shows linkages between the US sectors, to illustrate the concept of *upstream* and *downstream* sectors. The arrows show the direction of flow for materials; so for example, one can see that Electric Utilities are downstream of the coal- and oil-mining sectors. Similarly, the figure illustrates how the food manufacturing sector is upstream of restaurants but downstream of crop and animal farming (Data from the BEA 2002 Benchmark Input–Output Tables).



³ The import exposure data are available online at <https://www.ddorn.net/data.htm>.

sectors (the data used for the plot was the BEA 2002 Benchmark Input–Output Table). For example, the graph shows the centrality of wholesale and storage activities to manufacturing firms, just as it shows the strong connections between real estate services and many services sectors, including hospitals. The size of each node represents the total output from the sector, and links or edges between nodes represent shipments of a sector's output to be used as inputs in another sector. The output of the metals sector serves as inputs for the makers of motor parts, which are in turn inputs into motor vehicles. The thickness of each link represents the proportion of inputs for the sector at the end of the link that comes from the industry at the source of the link.

The linkages show both obvious and interesting patterns: agriculture is upstream of food, as expected, implying that higher imports of food lead to fewer jobs in the food sector, as well as for domestic agricultural producers *upstream* of the food sector. In comparison, it may be surprising that the real-estate sector is notably upstream for crop farming, for persons unfamiliar with the extent to which land rentals are a large part of farm production. Only linkages that exceed 5% of the flows for a sector are included in the graph, and only the largest sectors are labeled to keep the graph legible. The sectors are grouped into four broad communities, marked by different colors: [1] Services, [2] Mining, energy and utilities, [3] Agriculture and food-related sectors, and [4] Manufacturing, construction and other industrial sectors.

2.2 Methods

We adopt an instrumental variable approach to estimating the effects of trade on US jobs (we do not estimate regional job losses for this paper because of data limitations – no sources we know provide state-level imports for the years before the Great Recession). Using US-level trade patterns to explain regional job gains and losses could be misleading, because imports are not uniformly distributed throughout the country, and their effects may not be, either. The key variable and primary measure of trade shocks is import exposure – the ratio of changes to imports relative to the baseline domestic production in a US sector (we use export exposure to measure the positive job effects of US exports). Section 2.1 describes the variables and how they are constructed from the data.

The instrument we use to address endogeneity for US import exposure in a given sector is the import exposure for other high-income countries in the same sector, as defined by Acemoglu et al. (2016). An earlier paper shows that this variable is a good instrument, supported by first-stage estimates (Autor et al., 2013; Appendix Table 4 in that paper shows that imports into other wealthy economies from China – the same instrument used for this paper, is correlated with US import exposure). Using the import exposure of other high-income countries as an *instrument* helps to avoid the concern that imports surged because of domestic shocks to the US economy, while taking advantage of the fact that other high-income economies are similarly exposed to trade with China, without having perfectly correlated import demand shocks with the United States. To recognize changes in the US economy unrelated to trade, the estimation approach includes controls for pre-trend and sector-specific patterns to the changes in US employment.

The reduced form of the estimation approach in this paper explains changes in the (age-specific) employment of sector i with the sector's import and export exposure, as well as other relevant job drivers for the sector:

$$\text{Log}(\text{EmploymentChange}_i^{\text{age}}) = \alpha_0 + \alpha_1 \text{Exposure}_i^{\text{imp}} + \alpha_2 \text{Exposure}_i^{\text{exp}} + \alpha_3 \mathbf{X}_i + \varepsilon_i \quad (1)$$

Employment change is the ratio of the number of jobs in each period for a given age group, and the import and export exposure variables are as defined in Section 2.1. The estimation also includes dummy variables as control for the 10 broad sector groups that make up manufacturing, to recognize that the food manufacturing employment trend, for example, does not exactly match the trend for woodwork and furniture-making. The \mathbf{X} element represents a vector of controls that include industry-level computer investments, investments in automation or high-tech equipment, and other investments in capital broadly defined. \mathbf{X} also includes production workers' share of employment in the sector, as a proxy for its dependence on management or knowledge workers, the ratio of capital to value-added, as a proxy for capital intensity and average wages in the sector. As pre-trend controls, the empirical model controls for changes in industry wages over the decade from 1990 to 2000 (or the following decade), as well as the change in the sector's share of the total US employment. The latter variables address concerns that the estimation approach conflates import exposure with long-term growth or decline trends in the US sectors (one possibility not explored in this paper is that changes to youth employment are due to labor supply, not demand).

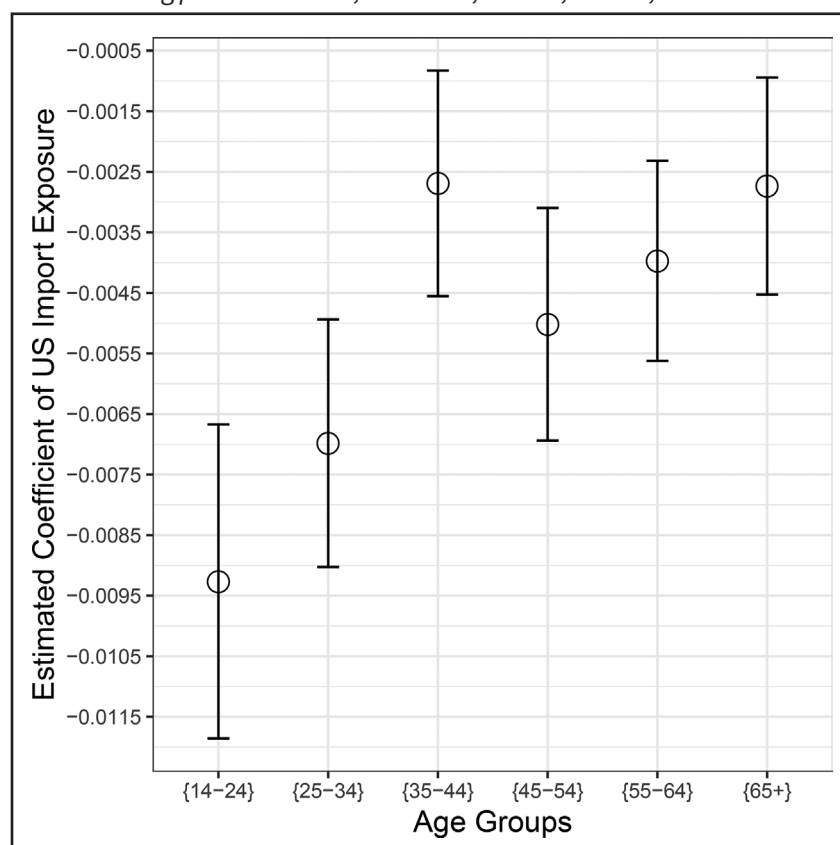
Several additional steps help to clarify the findings. First, the analysis excludes the years of the Great Recession (2008 and 2009). To address the argument that imports in a sector could affect jobs in upstream or downstream sectors, the main results use an extension of Equation 1 with average import exposure measures for each sector's upstream and downstream sectors. The instruments for these variables are, as for the main trade exposure variables, the import exposure of downstream and upstream sectors in other high-income economies, following the approach in earlier papers (Acemoglu et al., 2016; Feenstra et al., 2019). For all the estimates, the sector of employment in the year 2000 is used as regression weights, so that the coefficients are representative of the US economy for the 2000–2007 period. The period was one of declining manufacturing jobs in the midst of aggregate economic growth, leading up to the Great Recession that followed the financial crisis in 2008. We include the post-Recession economic recovery of 2010–2017, for comparison in the regression analysis.

The results are estimated separately for the pre-Recession years, and the years following the Great Recession. The job losses in the first period could not have been caused by the bursting of the housing bubble. On the contrary, the large effect of the financial crisis on investment and hiring implies that results from the post-Recession years may reflect other changes in the economy not necessarily linked to trade exposure, but to the adjustments that represented the recovery from a large shock to the US economy in 2008–2009.

3 Results and discussion

Figure 3 focuses on the estimated effects of import exposure on employment for different age groups in the 2000–2007 period (pre-Recession). Using the QWI data, which reports employment for the sub-25 age group, and for all 10-year age increments through 65, a detailed picture

Figure 3 Estimated coefficients of import exposure by age group for 2000–2007. The graph shows the estimated coefficients and confidence intervals for US import trade exposure, in the simple specification that corresponds to columns 1 and 2 of Table 1. The estimates are constructed separately for each age group. T-tests of differences between the youngest age group and the others yield the following p -values: 0.175, 0.000054, 0.0099, 0.0007, and 0.000049.



of the pattern of job losses to trade emerges (the regressions presented in the figure do not include the upstream and downstream exposure variables). First, the estimated effects of import exposure are negative for all age groups. The effects are also statistically significant. Furthermore, the differences between the age groups are notable.

Figure 3 supports the findings that follow in Table 1, by reporting age-group-specific trade exposure effects for the cleaner estimates of the pre-Recession period. The larger estimated effects for trade (downstream) on the employment of youth in columns 1 and 3 of Table 1 are consistent with the pattern of greater job loss severity for youth in Figure 1. The effects of imports on jobs appear uniformly negative across all columns of the table, but the detailed coefficients in the figure illustrate the main finding clearly. Not only are the effects of imports on jobs more negative for the <25 age group, but the confidence interval for this group's estimates falls below the confidence intervals for the estimated negative effect of import exposure on the 35–44 age group, as well as workers aged >55 years. Trade had the greatest impacts, even in the short term, on the employment of youth.⁴

⁴ T-tests show that the estimated coefficient for the 14–24 age group is different from all the other age-groups, except for the 25–34 age group.

Table 1 Main results: Employment and trade shocks

	Dependent variable: Employment change			
	(2000–2007)		(2010–2017)	
	(<25)	(Ages 25+)	(<25)	(Ages 25+)
Import exposure	−0.01*** (0.002)	−0.01*** (0.001)	−0.002 (0.002)	−0.003*** (0.001)
Import exposure (downstream)	−0.05*** (0.01)	−0.001 (0.01)	0.04*** (0.01)	0.01** (0.01)
Import exposure (upstream)	−0.01*** (0.003)	−0.01*** (0.002)	−0.0000 (0.004)	0.0004 (0.002)
Export exposure	0.08** (0.04)	0.07** (0.03)	0.05 (0.05)	0.01 (0.02)
Production workers' share	−0.45*** (0.12)	−0.33*** (0.08)	−0.22 (0.13)	−0.11* (0.06)
Computer purchase	−0.001 (0.003)	−0.002 (0.002)	−0.01*** (0.003)	−0.01*** (0.002)
High-tech investment	−0.02*** (0.01)	−0.01** (0.003)	0.001 (0.01)	−0.01** (0.002)
Capital to value-added ratio	0.003 (0.02)	−0.005 (0.01)	−0.05*** (0.02)	−0.01 (0.01)
Log wages (in year 2000)	−0.03 (0.06)	−0.14*** (0.04)	0.16*** (0.06)	−0.07** (0.03)
Change in log wages	−0.03 (0.14)	0.07 (0.09)	0.49*** (0.10)	0.11** (0.04)
Change in sector employment share	0.20 (0.29)	0.59*** (0.19)	−0.15 (0.24)	−0.10 (0.11)
Constant	0.75 (0.70)	1.70*** (0.43)	−1.11 (0.70)	1.00*** (0.31)
Observations	369	369	363	363
R^2	0.62	0.64	0.48	0.54

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 1 supports the results in Figure 3, showing that increasing imports generally led to lower employment levels in most manufacturing sectors. The instrumental variable regression estimates explain employment change for each US sector with the corresponding change in import and export exposure (the import and export exposure terms are estimated in the first stage, using the import and export exposure of similar high-income countries. This means that changes to US imports for each sector reflect how other countries became more productive and increased exports to high-income countries in general). The estimates include controls for the pre-trend state of each sector, as well as changes to the sector, for example, its share of total employment and its average wages.

Employment data from the US Census QWI Database. The instrumental regression estimates in all columns of the table use a dummy for the 10 manufacturing sector divisions, but these are not shown to conserve space.

As expected, the results show that increasing imports led to job losses, while increasing exports led to job gains. A 1% increase in imports relative to the baseline size of a sector led to an average 0.01% decrease in jobs for the sector for the two broad age groups (without counting the effect on upstream and downstream sectors). The pre- and post-Recession estimates of trade's impacts on jobs seem to differ. The post-Recession estimates for youth are not statistically significant, except for downstream exposure (explained in the next paragraph). Ordinary least squares (OLS) estimates yield similar results, not shown to save space, as well as the more robust instrumental variable specifications presented in Table 1. The results compare well with the findings in earlier papers – we find estimates of 0.01%, while Table 3 in the seminal paper reports 1.3% divided by 100 [aadhp, p. S164].

The effect of imports on jobs in linked sectors is nontrivial. Columns 1 and 3 highlight the elevated impact of trade on youth. Increasing import competition in the downstream sectors that absorb an industry's output led to job losses about four times as large on average for youth in the first period (*T*-tests for differences between the age groups are statistically significant for downstream import exposure, but not for direct import exposure). The effect switches signs to a large and positive value in the second period. One could speculate that this change is because US firms increased exports to the foreign competitors of their former US customers after the Great Recession, or increased employment to compete in the downstream space. Import competition in upstream sectors is not as meaningful for predicting employment downturns. The finding is not surprising, as employers of young employees in column 3 appear indifferent to where supplies are obtained, in selecting employment levels. On the contrary, a 1% increase in exports relative to baseline sectoral output led to a roughly 0.08% increase in jobs for youth in the average sector before the Recession. The estimated effect for workers aged >25 years is slightly lower (0.07%), with none of the post-Recession estimates being statistically significant.

Other estimated coefficients fit the expectations. Sectors with high levels of automation, as measured by high-tech investments or investments in computers experience job losses. (In the second period, the effect of hi-tech investments disappears in a statistical sense for youth employees, which may suggest that young employees hired to support automated work may be offsetting the ones laid off due to automation.) In the same period, high capital-to-value-add ratios predicted fewer jobs for youth. The share of employment in each sector represented by production workers (compared with supervisory and support employees), also consistently predicts the pattern of jobs losses seen in the data for the pre-Recession period.

Several control variables do not yield statistically significant estimates. The rate of wage growth over time does not predict the pattern of job losses, except for youth jobs in the post-Recession recovery, where one would expect the youth to find more jobs in high-wage and wage-growth sectors. Furthermore, sectors' share of the total US employment do not predict the pattern of job losses, except in the specification for older workers pre-Recession, which suggests that growing sectors also tend to have job gains for that group, and vice versa. There are statistically significant differences between broad industry groups in terms of job losses. These are captured using a categorical variable for the 10 broad manufacturing sector divisions, but these are not shown to conserve space. The divisions follow the pattern in earlier papers (Acemoglu et al., 2016).

4 Conclusion

We show that the effect of increasing imports on employment is not uniform across age groups. Young workers are disproportionately affected by import-stimulated job losses, and this calls for concern and further inquiry, given how the unemployment created by those job losses has long-term consequences over a career. For each percentage increase in the US import exposure between 2000 and 2007, the estimated percentage drop in employment is about 0.0025% for the 35–44 and 65+ age groups, while it is roughly 0.009% for youths aged <25 years, more than triple the effect for the 35–44 age group (see Figure 3). The estimates also suggest that increasing exports create more job opportunities for youth, relative to the rest of the US workforce. These findings are consistent with previous papers that suggest greater employment volatility for youth, while calling for further inquiry into how the long-term adverse effects of the “scar” of youth unemployment could be avoided.⁵

The effects of trade on jobs are magnified when considering the networked nature of production, or simply put, the supply chain effects of trade. While a 1% change in import exposure for a sector is expected to yield a 0.01% decrease in employment, based on pre-Recession data, the same change in import exposure for downstream sectors – the industries buying the sectors’ output, is expected to lead to a notably larger relative decline in jobs, at 0.05%. This means that while imports of cars may lead to a loss of car-assembly jobs for example, the impact of car imports is much greater on average, for the industries supplying brakes, tires, and other components to the auto-assembly sector. These results are expected to change over time, as the structure of US employment changes, but the pattern of larger employment effects on youth is expected to persist.

The findings are relevant to the economy of the US manufacturing sector, which remains linked through buyer–supplier linkages to some of the largest sectors in the US economy. Its agricultural sector is linked to some of the largest food manufacturers, just as its metals and materials production serves many of the largest manufacturing operations in the world. Wholesale trade and other supply chain operations also account for a notable share of the US economic output, which effectively links the global economy to the imports of other sectors and jobs in the United States.

The findings matter for the *trade war* between the United States and China. They suggest, as a policy recommendation, steps toward resuming trade in ways that support exports – as export exposure predicts job gains for youth. Furthermore, the findings are consistent with proposals to enhance trade adjustment programs that enable youth to transition away from jobs in sectors with high import exposure. As exports and imports command a greater share of the U.S. economy, there is much to learn about how trade will affect jobs in the coming years. Early indications from the trade war are that tariffs and retaliation from trade partners are costing US jobs (Fajgelbaum et al., 2019) and US consumers (Amiti et al., 2019). How these tariffs and the retaliation from the country’s trade partners will affect the US economy in the long run deserves to be the subject of a future study.

⁵ This finding resonates with earlier papers that document racial disparities in hiring and firing, in testing the theory that African-Americans are fired first and hired last (Freeman et al., 1973; Browne, 1997; Couch and Fairlie, 2020). Further research could examine the intersection of race and youth in the impacts of trade on employment.

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