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Which Caused More Job Losses in the United States: Chinese Import Competition or the Pandemic?

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ABSTRACT

Studies have found that Chinese import competition and the COVID-19 pandemic have caused loss of jobs in the United States. Using state-level panel data from 2017 to 2021, this paper finds that both Chinese import competition and COVID-19 confirmed cases have had negative impacts on US manufacturing employment, but the impact of import competition has been larger. The findings are robust to additional controls and various specifications. The effects are heterogeneous by industry. Employment in the service sector has been significantly damaged by increasingly severe COVID-19 but not directly affected by imports from China. By contrast, employment in labor-intensive manufacturing industries has been more vulnerable to both Chinese import penetration and COVID-19. The analysis finds heterogeneous impacts of the two factors in states with different economic conditions and reactions to the pandemic.

KEYWORDS: import competition; COVID-19; employment

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1. Introduction

Studies have found that import competition from China caused substantial loss of US jobs in the 2000s (Autor et al. 2013, 2016; Acemoglu et al. 2016; Pierce and Schott 2016). The US trade deficit with China has risen substantially since China's accession to the World Trade Organization and still remains at a high level.[5] Rising import exposure increases unemployment, lowers labor force participation, and accounts for at least one-quarter of the decline in US manufacturing employment (Autor et al. 2013). Imports from China pose a significant threat to employment not only in industries directly competing with Chinese products, but also those with import exposure through input-output linkages. Overall, the increase in Chinese import competition could explain the loss of about 2 million jobs in the United States from the 1990s to 2011 (Acemoglu et al. 2016; Feenstra and Sasahara 2018).

The COVID-19 pandemic shock has had a comparable effect on the US labor market. At the end of February 2022, the United States was the hardest hit country, with more than 80 million confirmed cases and 970,000 deaths from COVID-19. There is a growing literature focusing on the employment effect of the pandemic. The outbreak of COVID-19 had a drastic impact on work and employment (Hodder 2020). It increased the unemployment rate and reduced working hours and labor force participation (Béland et al. 2020). As documented by Cajner et al. (2020), US aggregate employment fell by more than 20 percent within a short time. According to the US Bureau of Labor Statistics, the number of nonfarm jobs dropped by 20.5 million in April 2022, reaching the lowest level since 2011. In April 2022, 26 million people applied for unemployment benefits from the government, and the unemployment rate soared from 4.4% in March to 14.7% in April, approaching the level of the Great Depression of the 1930s.

To understand the role of these two forces in causing job losses in the United States, in this paper, we empirically compare the job losses driven by Chinese import competition and COVID-19 to determine which cause wielded larger effects in magnitude. We examine the employment effects of the pandemic and exposure to competition from China and compare which factor has had a stronger effect on US manufacturing and service sector employment. Furthermore, we investigate whether imports from China and the pandemic have affected employment in labor-intensive and capital-intensive industries differently. Better understanding of whether import competition or the pandemic has resulted in greater loss of jobs in the United States is conducive to policy making in the context of international trade as well as the pandemic.

[5] Although the US trade deficit with China experienced a brief dip after the China-US trade conflict during 2019–20, it quickly rebounded in 2021. According to International Trade Centre statistics, the US trade deficit with China dropped to US$364.5 billion in 2019 and US$331.96 billion in 2020, from US$442.41 billion in 2018, but it rose to US$390.49 billion in 2021, close to the level before the China-US trade conflict. The share of total US imports from China rose from 9% in 2002 to 21.6% in 2018, then dropped by about 2-3 percentage points after both countries increased tariffs; the share reached 18.4% in 2021. Among all imported products from China, manufacturing products accounted for more than 96% of the total import value in the past five years.

In recent years, manufacturing employment and import volume in the United States have witnessed two important turning points, namely the China-US trade friction and the outbreak of the COVID-19 pandemic. Figure 1 shows that manufacturing employment in the United States increased slowly after 2018 compared with 2017, decreased by 10% after the onset of the COVID-19 pandemic in March 2020, and then recovered within one year. The second graph shows that after the first round of tariff increases in the China-US trade frictions, the total value of manufacturing products imported from China decreased substantially compared with the same month in 2017. It reached the lowest point after the outbreak of COVID-19, a level less than 60% of the value in the same month in 2017.

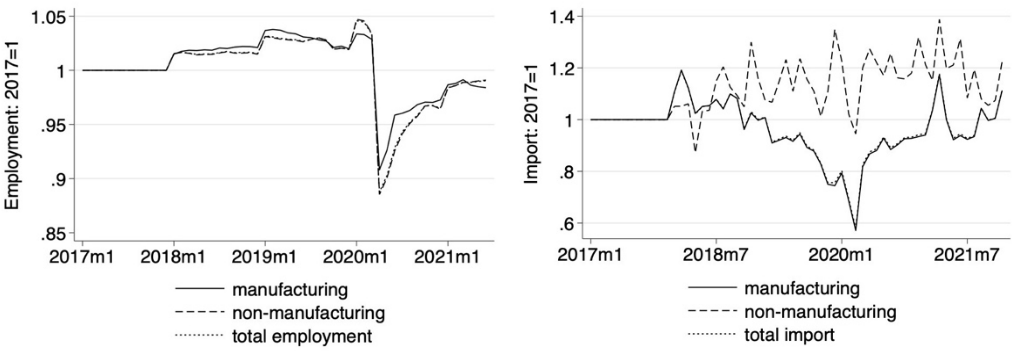

Figure 1. Changes in US employment (left) and imports from China (right) over time

Note: Each month's employment (import value) is divided by employment (import value) in the same month in 2017, with employment data from the US Bureau of Labor Statistics and import data from the US International Trade Commission WebData.

We use data sets on monthly China-US trade, state-level employment, and COVID-19 cases to conduct the empirical analysis. Following Autor et al. (2013) and Acemoglu et al. (2016), we use an instrumented measure of import penetration to identify import exposure from China for each state. Variation in the severity of COVID-19 across states is measured by the change in the number of new cases per worker. We use ordinary least squares (OLS) to estimate the impacts of exposure to Chinese imports and COVID-19 on state-level employment, respectively.

Our main findings are fourfold. First, both import penetration and COVID-19 have had significant negative impacts on the share of manufacturing employment. In terms of magnitude, Chinese import competition caused a greater loss of US jobs. Second, employment in the service sector has been significantly damaged by increasingly severe COVID-19 instead of imports from China. Third, labor-intensive manufacturing industries are more vulnerable to both import penetration and COVID-19. Fourth, we find heterogeneous impacts of these factors in states with different levels of economic prosperity and reactions to COVID-19.

Our results provide policy implications. In 2018, the US Trump administration triggered a trade conflict with China by imposing higher tariffs on billions of dollars' worth of imports from China. This action may succeed in protecting manufacturing employment in the United States, but it is at the cost of consumer welfare (Yu and Zhang 2019). Moreover, to suppress the spread of COVID-19 infections, policy makers all over the world implemented nonpharmaceutical interventions, such as shutting down businesses, implementing stay-at-home orders, and banning large gatherings. However, the economic cost of city lockdowns is nonnegligible (Chen et al. 2022), so the detrimental effects on the economy from the pandemic prevention and control measures must be considered. Therefore, evidence suggesting whether the impact of Chinese import competition had a greater impact than the COVID-19 pandemic on US employment or vice versa provides information for cost-benefit analysis. Better understanding of the determinacy of the two forces may be beneficial for policy making given the current trade-off between employment and COVID-19 prevention.

The remainder of the paper is structured as follows. Section 2 reviews the literature and sheds light on the main contribution of the present paper. Section 3 describes the empirical strategy, including model specification and data description, followed by analysis of the estimation results in section 4. Section 5 provides robustness checks. Section 6 concludes.

2. Literature review

This paper is related to a rich strand of literature focusing on the employment effects of import competition from low-wage countries on importing countries. International trade affects employment in importing countries through various plausible channels. In their seminal work, Autor et al. (2013) carefully examine the impact of import competition on local labor markets in importing countries. They find that import exposure affects employment in developed countries through two channels: export supply shock and import demand shock. Export supply shock from low-income countries reduces the demand for labor in import-exposed industries in high-income countries. Workers then move from sectors with import exposure to sectors without import exposure or become unemployed. However, growth in demand for imports increases wages and employment in the tradable sectors of high-income countries. Acemoglu et al. (2016) decompose the impact of import exposure to China on US workers into four channels. First, import competition reduces scale and employment in trade-exposed industries. Second, through input-output linkages, employment tends to fall especially in upstream industries due to shrinkage in the number of customers. Third, at the local level, job losses lead to shrinking aggregate demand and in turn reduced employment in other industries. Finally, unemployed workers may flow into nonexposed industries, which is called the reallocation effect.

A large body of empirical research provides evidence that import competition has a negative impact on employment in importing countries. Using instrumented commuting zone–level Chinese import penetration as the measurement, Autor et al. (2013, 2015) find that Chinese import competition reduces the employment share and wages of the manufacturing industry in the United States. Following their method, the negative employment effect of Chinese import competition is also found in other importing countries, such as Norway, Portugal, and Indonesia (Balsvik et al. 2015; Branstetter et al. 2019; Agustina 2018). Moreover, manufacturing workers who are exposed to faster growth of Chinese import penetration have smaller cumulative income and are more likely to shift to other industries (Autor et al. 2014). Acemoglu et al. (2016) add country-industry-level empirical analysis to the local analysis by Autor et al. (2013). They find that Chinese import competition reduced US employment growth through direct competition, input-output linkages, and general equilibrium channels, resulting in the loss of more than 2 million job in the 2000s. Pierce and Schott (2016) identify the cause of the growth of exports from China as the country's most favored nation access to the US market starting in 2001, which reduced trade policy uncertainty. They find that US manufacturing industries that were more exposed to China's exports experienced larger declines in employment. There is also firm-level evidence that suggests that imports from low-wage countries impede employment growth due to trade-induced firm closure or shrinkage (Bernard et al. 2006; Mion and Zhu 2013).

Empirical evidence also finds that Chinese imports have a positive impact on employment. For example, using the World Input-Output Database, Feenstra and Sasahara (2018) quantify trade-induced changes in employment. They find that the increase in US merchandise exports relative to Chinese imports resulted in a net positive impact, creating demand for more than 1 million jobs. Intermediate imports from China have also benefited Japanese manufacturing employment (Taniguchi 2019). Moreover, China's export expansion has increased its own demand for intermediate inputs and goods, contributing to the creation of manufacturing jobs in Korea (Choi and Xu 2020).

This paper is also related to a growing literature focusing on the economic consequences of epidemics. Epidemics influence the labor market through both the human capital supply channel, due to mortality and infection, and the labor demand channel, through business shutdowns and mass layoffs. Empirical evidence shows that pandemics such as the Black Death, the Great Pandemic of 1870–75, the Russian flu, and severe acute respiratory syndrome were associated with persistent decreases in employment (Pamuk 2007; Rodríguez-Caballero and Vera-Valdés 2020; Lee and Warner 2005, 2006). A body of literature examines the employment effects of COVID-19, among which a common finding is that the outbreak has had a negative impact on employment in the short term. Using weekly payroll data, Cajner et al. (2020) document that employment in the US fell by 21% from February to April in 2020 due to the pandemic shock, with small firms and low-wage workers hit the hardest. Bartik et al. (2020) use the event study method to exploit work records data.

They find that short-term job losses were mainly caused by shutdowns in low-wage service industries. The rising COVID-19 cases increased the unemployment rate and had a greater negative employment impact on less educated workers, those working in proximity to other people (Béland et al. 2020), and female workers due to social distancing restrictions and the closure of childcare institutions (Alon et al. 2020). Nonpharmaceutical interventions, such as restaurant and bar limitations, in the United States are also found to have increased the growth of unemployment (Kong and Prinz 2020).

This paper aims to contribute to the literature in two ways. First, it reexamines the impact of import penetration from China on employment in high-income countries in the new international context (the rising tide of anti-globalization and prevailing trade protectionism). Since over 96% of US imports from China during the sample study period (2017–21) were in the manufacturing sector, the paper focuses on Chinese import penetration in manufacturing industries and examines changes in employment in manufacturing and service industries. The reexamination of the employment effect of import competition provides evidence on the relationship between trade and the labor market in recent times.

Second, the paper considers the impacts of two factors—trade and the pandemic—on employment and compares the magnitudes of their effects. The existing literature focuses on the impacts of import competition and COVID-19 on the labor market, respectively. To our knowledge, few studies compare the two effects. To understand the role of the two factors in causing job loss and fill the gap in the literature to some extent, we conduct empirical research to explore and compare the employment effects of import competition and COVID-19. Instead of examining the employment effects of the two forces separately, we analyze their joint impact. We show that although both factors have had substantial effects on US employment, import competition has mattered more for job loss in the United States. Since trade protection measures such as the imposition of tariffs come with welfare loss, and nonpharmaceutical interventions to prevent COVID-19 infections also have economic effects, our findings provide policy makers evidence for cost-benefit analysis.

3. Empirical strategy

This section presents the model specification and the measures of the core explanatory variables, followed by a description of the data.

3.1 Model specification

To explore the roles of Chinese import competition and the COVID-19 pandemic in the loss of US jobs, we compare the effects of the change in imports from China and the increase in COVID-19 cases on the share of manufacturing employment in the working-age population. Following Autor et al. (2013) and Acemoglu et al. (2016), we adopt the following baseline regression:

$$\Delta L_{it}^{m} = \beta_1 \Delta Import\_PW_{it}^{US} + \beta_2 \Delta COVID\_PW_{it} + \beta_3 \mathbf{X}_{it-1}' + \delta_i + \gamma_t + \varepsilon_{it} \quad (1)$$

where t indexes time and i indexes states. Outcome variable ΔL_{it}^{m} is the change in manufacturing employment in state i, expressed as percentage points of the working-age population in state i. $\Delta Import\_PW_{it}^{US}$ represents the change in import competition per worker in state i (in US$, thousands, defined in detail later). $\Delta COVID\_PW_{it}$ is the change in newly confirmed cases of COVID-19 in state i between times t and $t-1$, divided by total employment at the start of the period. $\mathbf{X}_{it-1}'$ contains monthly state-level start-of-the-period control variables (real gross domestic product (GDP) per worker, vaccine distribution, and vaccinated population growth rate). δ_i and γ_t control for state and time fixed effects, respectively.

3.2 Measures

To exploit cross-region variation in import exposure stemming from initial differences in industry structure, following Autor et al. (2013), we apportion national imports to each state by its share in national employment in the industrial sector. Since more than 96% of imports from China are produced by manufacturing industries, we only consider manufacturing industries in the measure of Chinese import penetration, which is the change in import exposure per worker weighted by the share of national employment in the industrial sector:

$$\Delta Import_{PW}{}_{it}^{US} = \frac{1}{L_{it-1}} \sum_{j} \frac{L_{ijt-1}}{L_{jt-1}} \Delta M_{jt}^{US} \quad (2)$$

where L_{ijt-1} is the start-of-the-period employment (employment in month $t-1$) in state i, industry j; L_{jt-1} is US total employment in industry j at the start of the period (which is month $t-1$); and ΔM_{jt}^{US} is the observed change in US imports from China in industry j between the start and end of period t (month $t-1$ and month t). Variation in $\Delta Import\_PW_{it}^{US}$ across states stems entirely from different local employment structures at the start of the period.

To solve the endogeneity problem caused by reverse causality and omitted sector-specific shocks affecting both employment and trade, we leverage the exposure to Chinese imports of five North Atlantic Treaty Organization (NATO) high-income countries[6] to construct the instrumental variable for US imports from China:

$$\Delta Import_{PW}{}_{it}^{other} = \frac{1}{L_{i}^{2016}} \sum_{j} \frac{L_{ij}^{2017}}{L_{j}^{2017}} \Delta M_{jt}^{Other}. \quad (3)$$

[6] The five countries are Canada, Denmark, Germany, the Netherlands, and the United Kingdom.

Different from the state-level import penetration index in equation (3), compared with $\Delta Import\_PW_{it}^{US}$, state total employment is changed to the lagged level for the 12-month average in 2016. The change in US imports from China is replaced by the change in other high-income countries' imports from China. The state employment weights are changed to the employment share at the start of the period (January 2017) instead of the share in lagged month. The instrumental variable is valid in terms of relativity and exogeneity because these countries experience similar imports from China as the United States, but they have no direct impact on US employment. The validity of the instrumental variable is examined in section 4.

3.3 Data

We use COVID-19, employment, and trade data from three data sets, covering the 50 US states and Washington, DC, from January 2017 to June 2021.

First, we employ state-level US COVID-19 data obtained from the Johns Hopkins University Center for Systems Science and Engineering COVID-19 tracking program (JHU COVID-19 Database). These data cover the period from January 22, 2020, when the first case of COVID-19 was confirmed. The data are updated daily (UTC/GMT 0) by county or province COVID-19 case information in all countries and regions across the world. The data set includes the state, number of confirmed cases, deaths, recovered and active cases (which have many missing values), incident rate, and case fatality ratio.

Employment data are from the US Bureau of Labor Statistics Quarterly Census of Employment and Wages program database. This data set includes county-level, quarterly statistics on employment and wages for more than 95% of US jobs and is available from 2017 to June 2021. Variables are classified by North American Industry Classification System (NAICS) 6-digit codes (2017 version), including the number of firms within a quarter, taxable wages, average wages by state, and number employed per month.

The information on imports is from the US International Trade Commission. The data include monthly values of US general imports from China at the NAICS 6-digit level. Imports by other countries are classified by Harmonized System 6-digit codes (2017 version). Therefore, according to concordance tables taken from the Statistics Division, Department of Economic and Social Affairs, United Nations, we convert the Harmonized System codes into 386 NAICS 6-digit codes. After matching, most of the products are produced by the manufacturing industry, with a total of 329 categories.

Descriptive statistics of the main variables are reported in Table 1. There are vast variations in the employment, import competition, and COVID-19 variables.

Table 1. Descriptive statistics

Variables	Obs.	Mean	SD	Min	Max	Units
Dependent variable						
$\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	2,601	-0.001	0.141	-2.518	1.555	(%)
$\Delta\left(\frac{L_{it}^{s}}{pop_{it}}\right)$*100	2,601	-0.019	1.163	-12.796	3.862	(%)
Core variable						
$\Delta Import\_PW_{it}^{US}$	2,601	0.001	0.019	-0.120	0.118	kUSD
$\Delta new\_cases\_PW_{it}$	2,601	0.000	0.006	-0.057	0.047	
$\Delta new\_cases\_PW_{it}$(observed)	727	-0.000	0.012	-0.057	0.047	
Instrumental variable						
$\Delta Import\_PW_{it}^{other}$	2,601	0.001	0.015	-0.128	0.173	kUSD
Control variable						
$\Delta new\_cases\_PW_{it-1}$	2,601	0.000	0.006	-0.057	0.047	
$real\_GDP\_PW_{it-1}$	2,601	0.039	0.012	0.025	0.121	mUSD
$real\_GDP\_PW_{it-2}$	2,601	0.039	0.012	0.025	0.121	mUSD
$\Delta vaccine\_distribution_{it}$*100	2,601	2.194	6.973	0.000	49.362	(%)
$\Delta vaccine\_dose1_{it}$	2,601	1.020	3.592	-0.500	29.700	(%)
$\Delta vaccine\_completed_{it}$	2,601	0.886	3.406	0.000	23.500	(%)

Note: All states had zero COVID-19 cases prior to the first confirmed case.

4. Empirical results

4.1 Baseline results

Table 2 presents the basic regression results of the impacts of Chinese import competition and COVID-19 confirmed cases on US employment. First, we estimate equation (1) without instruments. Columns (1) to (4) report the results estimated by OLS, and columns (5) to (8) show the estimation results using the instrumental variable (IV) method. All the regression results are controlled for both time and state fixed effects.

Column (1) in Table 2 includes only the two core explanatory variables, import competition per worker and newly confirmed COVID-19 cases per worker. The coefficient estimate for pandemic cases is significantly negative, and the coefficient for import competition is negative but significant only at the 10% level, indicating that both import competition from China and rising COVID-19 cases reduce the share of manufacturing employment in the working-age population. Column (2) includes one- and two-month lagged real GDP per worker as a proxy to reflect macroeconomic conditions that may affect employment. If a state is more prosperous, it tends to provide a sizable labor market abundant job opportunities. Column (3) adds other pandemic-related variables that may influence employment: lagged change in newly confirmed cases and vaccinations. Vaccination covariates should be included because the widespread adoption of vaccines is induced by the progression of the pandemic, and it also serves to fuel the economy as well as the labor market. The variable

$vaccine\_distribution_{it}$ is measured as delivered doses per 100,000 census population in state i; $vaccine\_dose1_{it}$ is the percentage of the population with at least one dose [7]; and $vaccine\_completed_{it}$ represents the percentage of people who have received the complete series of vaccination.[8] If vaccination protects people from pandemic-induced death or critical illness, then the inoculation is beneficial to employment. Column (4) includes all the controls and coefficient estimates for both import competition and COVID-19 cases, which are negative, with the coefficients of pandemic cases being more significant.

Next, we estimate equation (1) using instrumented import penetration to address the endogeneity that US imports from China may cause. The weak IV test results are reported in columns (5) to (8) in Table 2. Other high-income NATO countries' imports from China serve as a valid instrumental variable for US imports. The other NATO countries are similar to the United States in terms of their trade deficits with China, and it seems unlikely that their imports would directly affect US jobs. To confirm the validity of this instrumental variable, we assume that the error term is heteroscedastic and perform endogeneity and weak instrumental variable tests. The results provide solid evidence that the instrumental variable is valid.

Column (5) in Table 2 shows that both import competition from China and COVID-19 cases significantly reduce US manufacturing employment. The estimate implies that a one standard deviation (SD) increase in the change in monthly Chinese import exposure per worker (19 $ according to Table 1) leads to a reduction of 0.054% (-2.820*0.019) in the share of manufacturing employment in the state's working-age population. However, a one SD (0.012) increase in newly confirmed COVID-19 cases per worker is associated with a decrease of 0.018% (-1.459*0.012) in the share of manufacturing employment. Therefore, in terms of a change of one SD in both explanatory variables, the negative employment effect of import competition is almost three times the impact of the COVID-19 pandemic. Columns (6) to (8) in Table 2 present the results including the same controls as in the OLS estimation and the coefficient estimations are robust.

According to previous empirical evidence, no significant employment effect of import penetration from China was detected on local nonexposed industries (Acemoglu et al. 2016). Therefore, we expect to find an insignificant coefficient of import penetration per worker on employment in the service sector. Table 3 presents the impacts of Chinese import penetration and the COVID-19 shock on the share of service sector employment in the working-age population. The significantly negative effect of COVID-19 remains robust in all the columns, implying that the pandemic substantially reduced jobs in the service sector. From column (3), a one-SD increase in the

[7] This is based on the jurisdiction where the recipient lives.
[8] People who have had a second dose of a two-dose vaccine or one dose of a single-dose vaccine are considered to have completed the vaccination.

ratio of newly confirmed cases over state total employment led to a reduction of 0.13% (-10.528*0.012) in the share of service sector employment in a state's working-age population. As expected, imports from China do not directly affect service sector employment.

Table 2 Impacts of Chinese import penetration and the COVID-19 shock on employment share in manufacturing

Dependent variable: $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) 2SLS
$\Delta Import\_PW_{it}^{US}$	-0.477*	-0.470	-0.484*	-0.476	-2.820***	-2.703**	-2.804***	-2.697**
	(0.280)	(0.288)	(0.277)	(0.285)	(1.050)	(1.017)	(1.043)	(1.016)
$\Delta new\_cases\_PW_{it}$	-1.081***	-1.095***	-1.048***	-1.076***	-1.459***	-1.442***	-1.418***	-1.417***
	(0.366)	(0.394)	(0.341)	(0.374)	(0.454)	(0.477)	(0.420)	(0.452)
$\Delta new\_cases\_PW_{it-1}$			-0.731*	-0.473			-0.831	-0.574
			(0.432)	(0.320)			(0.511)	(0.406)
$\Delta vaccine\_distribution_{it}$			0.054	0.055			0.108	0.108
			(0.150)	(0.165)			(0.177)	(0.188)
$\Delta vaccine\_dose1_{it}$			0.002*	0.001			0.002**	0.002
			(0.001)	(0.001)			(0.001)	(0.001)
$\Delta vaccine\_completed_{it}$			-0.001	-0.002			-0.003	-0.004
			(0.002)	(0.003)			(0.003)	(0.004)
$real\_GDP\_PW_{it-1}$		-12.226		-12.050		-10.949		-10.724
		(10.520)		(10.471)		(9.787)		(9.744)
$real\_GDP\_PW_{it-2}$		20.444		20.146		19.914		19.584
		(14.989)		(14.973)		(14.580)		(14.578)
IV	No	No	No	No	Yes	Yes	Yes	Yes
Kleibergen-Paap rk Wald F statistic					17.88	17.55	17.81	17.52
Kleibergen-Paap rk LM statistic					14.06	14.07	14.06	14.08
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.202	0.211	0.202	0.210	-0.077	-0.061	-0.077	-0.062
Observations	2,601	2,601	2,601	2,601	2,601	2,601	2,601	2,601

Note: Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

Table 3 Impacts of Chinese import penetration and the COVID-19 shock on employment share in the service sector

Dependent variable: $\Delta\left(\frac{L_{it}^{S}}{pop_{it}}\right)*100$	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS
$\Delta Import\_PW_{it}^{US}$	2.434	2.324	0.779	1.427
	(1.550)	(1.505)	(4.218)	(3.926)
$\Delta new\_cases\_PW_{it}$	-10.261**	-9.960***	-10.528**	-10.098***
	(3.832)	(3.501)	(4.013)	(3.650)
$\Delta new\_cases\_PW_{it-1}$		-6.390**		-6.431**
		(2.992)		(3.008)
$\Delta vaccine\_distribution_{it}$		1.716		1.737
		(2.245)		(2.263)
$\Delta vaccine\_dose1_{it}$		0.036*		0.036*
		(0.020)		(0.020)
$\Delta vaccine\_completed_{it}$		-0.041		-0.042
		(0.036)		(0.037)
$real\_GDP\_PW_{it-1}$		-47.587		-47.051
		(29.495)		(30.102)
$real\_GDP\_PW_{it-2}$		103.990***		103.763***
		(32.267)		(32.567)
IV	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			17.88	17.52
Kleibergen-Paap rk LM statistic			14.06	14.08
State FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Adjusted R-squared	0.770	0.776	-0.011	0.016
Observations	2,601	2,601	2,601	2,601

Note: Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

4.2 Further analysis on heterogeneous impacts

We perform further analysis to gain more insights into the above results, and to see whether there are different effects across labor- and capital-intensive industries and states with different economic statuses and reactions to the pandemic.

First, Table 4 presents the results on the impact of import competition and the pandemic on labor-intensive and capital-intensive manufacturing industries. The COVID-19 outbreak led to shrinking demand, causing production contraction or shutdown, thus reducing labor demand, especially in labor-intensive industries. Moreover, the pandemic has posed a threat to people's physical health, and workers have been likely to resign or be dismissed due to illness. Therefore, the impact of the pandemic may have been larger on labor-intensive manufacturing employment. In addition, a large majority of imports from China are produced by labor-intensive industries, so the impact of import exposure on workers in labor-intensive industries is expected to be more pronounced. We calculate each industry's labor intensity using industry characteristics from the National Bureau of Economic Research manufacturing database. Manufacturing industries with a labor/capital ratio above the median level are classified as labor-intensive (based on 2016 industrial total employment and capital data). As shown in Table 4, compared with capital-intensive manufacturing industries, labor-intensive industries experienced a greater and more significant decline in the employment share of the working-age population when Chinese import penetration or COVID-19 cases increased. This finding implies that employment in labor-intensive industries is more vulnerable to trade and pandemic shocks.

Table 4 Heterogeneous impacts of imports from China and COVID-19 on labor-intensive and capital-intensive industries

Dependent variable: $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Labor-intensive				Capital-intensive			
	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
$\Delta Import\_PW_{it}^{US}$	-0.265	-0.264	-1.846**	-1.740**	-0.221	-0.223	-0.916*	-0.891*
	(0.170)	(0.177)	(0.850)	(0.758)	(0.157)	(0.157)	(0.482)	(0.504)
$\Delta new\_cases\_PW_{it}$	-0.798***	-0.789***	-1.053***	-1.014***	-0.285	-0.287	-0.397*	-0.390**
	(0.224)	(0.243)	(0.338)	(0.340)	(0.200)	(0.192)	(0.199)	(0.188)
$\Delta new\_cases\_PW_{it-1}$		-0.284		-0.350		-0.188		-0.218
		(0.219)		(0.282)		(0.178)		(0.192)
$\Delta vaccine\_distribution_{it}$		0.096		0.131		-0.044		-0.028
		(0.155)		(0.172)		(0.050)		(0.056)
$\Delta vaccine\_dose1_{it}$		-0.000		0.000		0.001		0.002*
		(0.001)		(0.001)		(0.001)		(0.001)
$\Delta vaccine\_completed_{it}$		-0.002		-0.003		-0.000		-0.001
		(0.003)		(0.004)		(0.001)		(0.001)
$real\_GDP\_PW_{it-1}$		-9.748		-8.828		-2.200		-1.783
		(10.014)		(9.341)		(2.418)		(2.500)
$real\_GDP\_PW_{it-2}$		16.197		15.846		4.159		4.000
		(14.126)		(13.815)		(4.383)		(4.376)
IV	No	No	Yes	Yes	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			17.61	17.23			17.61	17.23
Kleibergen-Paap rk LM statistic			14.20	14.21			14.20	14.21
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.131	0.138	-0.058	-0.044	0.146	0.147	-0.049	-0.045
Observations	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550

***; **; * significant at the 1%, 5%, and 10% levels, respectively.

Second, we examine the relationship between state economic development and the impacts of the two forces. Since medical supplies and services are usually better in wealthier states than in less developed states, the more advanced medical facilities as well as higher level of economic vitality will enable wealthy states to be more resilient to the pandemic. At the same time, wealthy states have larger income and aggregate demand, generating more employment opportunities; therefore, they should witness less pandemic-induced job loss than their poorer counterparts. Moreover, low-skilled workers are more vulnerable to trade shocks (Balsvik et al. 2015), and the proportion of high-skilled workers in wealthy states is higher, so fewer workers are pushed out of their jobs in the face of Chinese import competition. Therefore, workers in states with higher GDP per capita are less likely to lose their jobs than those in less developed states. To test this hypothesis, we divide the states into two groups based on their real GDP per capita during the sample period: those with average monthly GDP per capita above the median are in the high-income group and otherwise in the low-income group. The regression results, as shown in Table 5, indicate that manufacturing employment is not significantly affected by imports in high-GDP states, while employment in poorer states is significantly reduced by increased Chinese import penetration. Compared with columns (3) and (4), the coefficients of the pandemic in columns (7) and (8) are more significant and slightly higher, implying that low-income states are more likely to suffer from loss of manufacturing employment due to increasing COVID-19 cases.

Table 5 Impacts of Chinese import penetration and COVID-19 on states, by level of economic prosperity

Dependent var. $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High GDP				Low GDP			
	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
$\Delta Import\_PW_{it}^{US}$	0.113	0.102	-3.696	-3.325	-0.940**	-0.944**	-2.153**	-2.122**
	(0.387)	(0.416)	(2.454)	(2.055)	(0.444)	(0.434)	(0.786)	(0.864)
$\Delta new\_cases\_PW_{it}$	-0.893***	-0.869**	-1.805*	-1.641*	-1.690**	-1.738**	-1.812**	-1.855**
	(0.311)	(0.350)	(0.924)	(0.860)	(0.777)	(0.783)	(0.725)	(0.731)
$\Delta new\_cases\_PW_{it-1}$		-0.465		-0.942		-0.329		-0.260
		(0.379)		(0.733)		(0.501)		(0.534)
$\Delta vaccine\_distribution_{it}$		0.000		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)		(0.000)
$\Delta vaccine\_dose1_{it}$		0.002		0.003*		0.001		0.001
		(0.002)		(0.002)		(0.001)		(0.001)
$\Delta vaccine\_completed_{it}$		-0.002		-0.003		-0.003		-0.005*
		(0.005)		(0.006)		(0.003)		(0.003)
$real\_GDP\_PW_{it-1}$		-15.949		-13.508		-4.719		-4.339
		(19.734)		(17.293)		(4.596)		(4.844)
$real\_GDP\_PW_{it-2}$		23.464		22.800		18.498		17.729
		(24.625)		(23.400)		(16.124)		(16.207)
IV	No	No	Yes	Yes	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			76.71	76.42			8.90	9.09
Kleibergen-Paap rk LM statistic			11.25	11.18			7.60	7.74
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.100	0.108	-0.167	-0.132	0.355	0.360	-0.046	-0.036
Observations	1,300	1,275	1,300	1,275	1,352	1,326	1,352	1,326

Note: Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

The third heterogenous effect that we check is related to people's expectations. The direct mechanism through which import penetration form China reduces US employment is straightforward, mainly through the competition effect (Acemoglu et al. 2016). One of the channels through which

COVID-19 decreases employment is people's fear of the pandemic. Apart from nonpharmaceutical interventions, traffic and economic activities are also impaired by fear of the infection, and the panic level is closely related to the number of deaths (Goolsbee and Syverson 2021), thus exerting a negative impact on employment. We construct a measurement of state panic level using search frequencies of the keyword "COVID-19 deaths" across states after the COVID-19 outbreak (January 2020 to June 2021), obtained from Google Trends.[9] States are divided into two groups by the median. As shown in Table 6, the increase in confirmed COVID-19 cases significantly reduces the share of manufacturing employment in the panic group, while the non-panic group is unaffected by the COVID-19 shock, which supports the above arguments.

Table 6 Impacts of Chinese import penetration and COVID-19 on states, by level of COVID-19 panic

Dependent variable: $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panic				Non-panic			
	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
$\Delta Import\_PW_{it}^{US}$	-0.351	-0.341	-2.799	-2.090	-0.828*	-0.842*	-2.974***	-2.956***
	(0.326)	(0.361)	(2.046)	(1.544)	(0.425)	(0.436)	(1.015)	(1.000)
$\Delta new\_cases\_PW_{it}$	-1.420**	-1.210**	-1.969**	-1.578**	-0.411	-0.446	-0.753	-0.761
	(0.541)	(0.513)	(0.807)	(0.750)	(0.504)	(0.481)	(0.622)	(0.584)
$\Delta new\_cases\_PW_{it-1}$		-0.662		-0.898		-0.034		0.030
		(0.456)		(0.573)		(0.531)		(0.581)
$\Delta vaccine\_distribution_{it}$		0.000		0.000		-0.000		-0.000
		(0.000)		(0.000)		(0.000)		(0.000)
$\Delta vaccine\_dose1_{it}$		0.002		0.002		-0.001		-0.000
		(0.003)		(0.002)		(0.002)		(0.002)
$\Delta vaccine\_completed_{it}$		-0.006		-0.009		0.001		0.001
		(0.007)		(0.010)		(0.001)		(0.003)
$real\_GDP\_PW_{it-1}$		-28.601		-26.838		-1.335		-0.781
		(24.291)		(22.470)		(3.083)		(3.063)
$real\_GDP\_PW_{it-2}$		9.226		9.735		-1.147		-0.406
		(12.562)		(11.858)		(3.414)		(3.931)
IV	No	No	Yes	Yes	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			19.22	20.07			15.47	16.02
(Kleibergen-Paap rk LM statistic			6.67	6.71			7.74	7.86
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.140	0.154	-0.093	-0.049	0.388	0.390	-0.127	-0.128
Observations	1,352	1,300	1,352	1,300	1,300	1,250	1,300	1,250

Note: Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

[9] According to Google Trends, the states with search frequency of "COVID-19 deaths" higher than the median level from January 2020 to June 2021 are Washington, Minnesota, Montana, Oregon, Colorado, Vermont, Alaska, Maine, Wyoming, Wisconsin, Michigan, California, New Hampshire, South Dakota, Massachusetts, Idaho, Illinois, Arizona, Hawaii, Missouri, Pennsylvania, New Jersey, Ohio, Virginia, Utah, and North Dakota.

5. Robustness checks

The estimates in Table 2 include all manufacturing products to measure import competition from China. Here we use an alternative measure to see whether our baseline results are still robust. Considering that the sample period in Table 2 covers a five-year period with several major events that may have affected the impacts of trade and the pandemic, we change the sample period to check the credibility of the baseline results.

First, we change the measurement of the core explanatory variable. We exclude COVID-19-related medical supplies from imported products. Medical supplies imported from China helped the United States to carry out COVID-19 prevention and treatment, which may have protected workers from the pandemic. Meanwhile, industries exposed to rising imports of medical supplies faced intensified import competition, which may have had a negative impact on employment. To identify and compare the employment impacts of trade and the pandemic, we exclude COVID-19-related imports from the construction of the import competition measurement. Table 7 presents the estimation results. As can be seen, the baseline results firmly hold.

Table 7 Impacts of Chinese import penetration and COVID-19 on manufacturing employment share (excluding COVID-19-related products)

Dependent variable: $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS
$\Delta Import\_PW_{it}^{US}$	0.029	0.035	-2.734**	-2.647**
	(0.169)	(0.179)	(1.231)	(1.184)
$\Delta new\_cases\_PW_{it}$	-1.002***	-0.881***	-1.471***	-1.307***
	(0.317)	(0.274)	(0.452)	(0.378)
$\Delta new\_cases\_PW_{it-1}$		-0.617*		-0.693*
		(0.343)		(0.391)
$\Delta vaccine\_distribution_{it}$		0.141		0.207
		(0.174)		(0.202)
$\Delta vaccine\_dose1_{it}$		-0.001		-0.001
		(0.002)		(0.002)
$\Delta vaccine\_completed_{it}$		-0.001		-0.002
		(0.002)		(0.003)
$real\_GDP\_PW_{it-1}$		-1.755		-0.512
		(4.068)		(3.708)
$real\_GDP\_PW_{it-2}$		6.526		5.773
		(6.155)		(5.940)
IV	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			12.12	12.29
Kleibergen-Paap rk LM statistic			11.88	12.12
State FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Adjusted R-squared	0.287	0.292	-0.240	-0.215
Observations	2,652	2,601	2,652	2,601

Note: The dependent variable is the change in the share of manufacturing employment over working-age population, $\Delta\left(\frac{L_{it}^{m}}{pop_{it}}\right)$*100. Vaccine dose 1 and vaccine completed are omitted. Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

Second, we change the time period for the regression to see whether the estimations reported in Table 2 still hold for shorter sample periods. The baseline empirical analysis uses US import data, state employment, and COVID-19 data from January 2017 to June 2021. However, on March 22, 2018, the US government requested the US Trade Representative to impose tariffs on imports from China, totaling an estimated $60 billion worth of goods. In December 2020, when the COVID-19 vaccine became available, vaccines were distributed widely to all states to mitigate the COVID-19 infection. Both events may affect the estimation of our two key variables. Therefore, we shortened the sample period to the post–trade conflict period (March 2018 to June 2021) and the period between the outbreak of COVID-19 and mass injection of vaccines (January 2020 to December 2020). As shown in Table 8, the baseline results are still robust.

Table 8 Impacts of Chinese import penetration and COVID-19 on manufacturing employment share in different time periods

Dependent var. $\Delta\left(\frac{L_{it}^m}{pop_{it}}\right)$*100	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Post trade conflicts				Post COVID-19			
	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
$\Delta Import\_PW_{it}^{US}$	-0.148	-0.165	-2.572***	-2.496**	-0.648***	-0.750***	-3.567***	-3.440***
	(0.141)	(0.145)	(0.951)	(0.939)	(0.183)	(0.199)	(1.151)	(1.204)
$\Delta new\_cases\_PW_{it}$	-1.321***	-1.186***	-1.751***	-1.568***	-1.300***	-1.003***	-2.000***	-1.540***
	(0.360)	(0.306)	(0.449)	(0.368)	(0.378)	(0.326)	(0.568)	(0.489)
$\Delta new\_cases\_PW_{it-1}$		-0.610*		-0.607		-0.553		-0.080
		(0.359)		(0.414)		(0.445)		(0.554)
$\Delta vaccine\_distribution_{it}$		0.134		0.203		-0.767		-0.684
		(0.191)		(0.215)		(0.689)		(0.623)
$\Delta vaccine\_dose1_{it}$		-0.000		-0.000		-		-
		(0.002)		(0.002)				
$\Delta vaccine\_completed_{it}$		-0.001		-0.003		-		-
		(0.002)		(0.003)				
$real\_GDP\_PW_{it-1}$		-0.750		1.024		7.291*		10.228*
		(3.765)		(3.614)		(3.985)		(5.095)
$real\_GDP\_PW_{it-2}$		8.156		8.066		9.948		11.034*
		(6.713)		(6.601)		(6.688)		(6.534)
IV	No	No	Yes	Yes	No	No	Yes	Yes
Kleibergen-Paap rk Wald F statistic			14.21	13.82			13.33	12.91
Kleibergen-Paap rk LM statistic			18.44	18.45			16.81	16.66
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.387	0.393	-0.204	-0.179	0.534	0.551	-0.221	-0.152
Observations	2,040	2,040	2,040	2,040	612	612	612	612

Note: Vaccine dose 1 and vaccine completed are omitted in columns (6) and (8) since vaccination was not conducted in the period defined. Robust standard errors in parentheses are clustered at the state level. ***; **; * significant at the 1%, 5%, and 10% levels, respectively.

6. Conclusion

This paper examined and for the first time compared the impacts of Chinese import competition and the COVID-19 pandemic on US manufacturing employment as well as service sector employment, using an instrumental variable method approach. With state-level employment and COVID-19 infection data and nation-industry-level trade data from Jan 2017 to June 2021, we found empirical evidence of the negative employment effect of import competition and COVID-19.

The results consistently indicate that for manufacturing employment, both import competition and confirmed cases of COVID-19 caused significant job losses in the United States. Moreover, in terms of magnitude, a one standard deviation increase in import competition reduces the employment share three times as much as the reduction caused by a one standard deviation rise in newly confirmed cases of COVID-19. In addition, compared with capital-intensive manufacturing industries, labor-intensive industries are more vulnerable to the trade and pandemic shocks, both in significance and magnitude. By contrast, for service industries, import competition suggests insignificant effects but the pandemic plays a major role in job losses. Last, heterogeneity analysis suggests that states with lower real GDP per worker are less resilient to the negative employment effect exerted by trade and the pandemic. The analysis found that the heterogeneous effects on state employment were due to different reactions to the pandemic.

Our results contribute to the growing literature on the relationship between COVID-19 and employment as well as trade and the labor market. By analyzing the two forces together, we were able to explore the determinacy of the effects of import competition and the pandemic on US employment. The paper also provided policy implications for a better understanding of the employment impact of trade with China and the COVID-19 pandemic, and to figure out which force matters more for job losses in the United States.

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