Trade and American Jobs

The Impact of Trade on U.S. and State-Level Employment:

2020 Update

Prepared by Trade Partnership Worldwide LLC

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Executive Summary

As the global pandemic took hold around the world at the beginning of 2020, economic growth, global trade, and national employment collapsed. Declines in demand and economic growth are triggering a stall in trade; the stall in trade is boomeranging back to further slow economic growth. This cycle results in lost American jobs that depend on trade. Restoring trade, for example with policies that support the free and fair exchange of goods and services, can help more Americans get back to work and accelerate a U.S. economic recovery.

To spur hiring dependent on trade, it is important to understand first how important trade is to economies and jobs under "normal" circumstances. This report reviews the data of these benefits for U.S. workers *before* the global pandemic took hold. By looking at this relationship prior to the pandemic, one can better appreciate what has been lost and see the importance of adopting trade-enhancing policies that will help American workers, farmers, and families get back on their feet through the pandemic and beyond.

Based on the latest available data for this assessment (2018) and taking into account both the gains and the losses (i.e., a net estimate), trade supported over 40 million U.S. jobs in 2018. One in every five U.S. jobs was linked to exports and imports of goods and services. Two times as many jobs were supported by trade in 2018 as in 1992 – before the accelerated wave of trade liberalization that began with the implementation of the North American Free Trade Agreement (NAFTA) in 1994 – when our earlier research found that trade supported 14.5 million net jobs, or one in every ten U.S. jobs.

- U.S. trade – both exports and imports – has grown over the past two decades, caused in part by trade liberalizing international agreements as well as increasing demand, purchasing power, and growth outside the U.S. This led to the growth of the number of U.S. jobs tied to trade. Indeed, trade-dependent U.S. jobs grew four times as fast as U.S. jobs generally.

- Every U.S. state realized net employment gains directly attributable to trade in 2018.

- Trade had a positive net impact on U.S. jobs in both the services and manufacturing sectors.

- U.S. trade with our North American partners, as well as with Europe, Japan, Korea, China, and India, among others, accounted for important shares of this trade related employment. In 2018, trade with Canada supported, on net, 7.8 million jobs; Mexico, 5.0 million jobs; European Union (27), 6.2 million jobs;

China, 7.7 million jobs; Japan, 2.0 million jobs; and Korea, the UK and India, each over 1 million jobs.

In 2018, tens of millions of American jobs and U.S. economic growth depended on trade. Today, as the United States faces dual public health and economic crises, trade can be a critical driver of job restoration and economic recovery.

Trade and American Jobs
The Impact of Trade on U.S. and State-Level Employment: 2020 Update

Laura M. Baughman and Joseph F. Francois*

I. Introduction

The 2020 Trade and American Jobs report updates a series of path-breaking studies, first issued by Business Roundtable in 2007, that offer a thorough examination of the impacts of trade on U.S. jobs.[1] The report examines the impacts, positive and negative, of both exports *and* imports of goods and services on U.S. employment based on the latest available data (2018). It confirms that trade has a net positive impact on American jobs. Importantly, the positive impact of trade on U.S. employment has grown significantly during the past two decades, coinciding with the liberalization of U.S. trade both multilaterally through the World Trade Organization and bilaterally and regionally through trade agreements.

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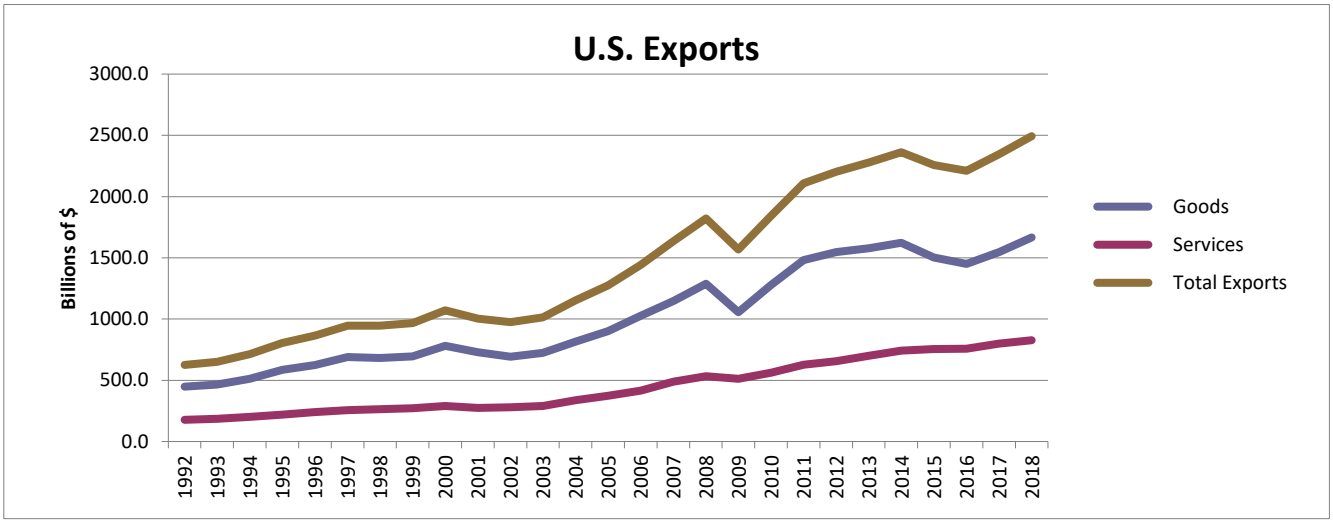
[1] Laura M. Baughman and Joseph Francois, *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment*, prepared for the Business Roundtable, February 2007; *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment, An Update*, prepared for the Business Roundtable, July, 2010; *How the U.S. Economy Benefits from International Trade and Investment* (2013), prepared for the Business Roundtable; *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment, 2014 Update*, prepared for the Business Roundtable, October 2014, *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment, 2016 Update*, prepared for the Business Roundtable, January 2016; *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment, 2018 Update*, prepared for the Business Roundtable, March 2018, and *Trade and American Jobs: The Impact of Trade on U.S. and State-Level Employment, 2019 Update*, prepared for the Business Roundtable, February 2019.

II. The Importance of Trade to the United States

Trade remains a vital part of the U.S. economy through the COVID-19 pandemic and will continue to support millions of jobs and economic growth on the other side of the outbreak. Because we are seeking to understand the impacts of trade under "normal" circumstances (i.e., absent the pandemic), we focus on data through 2018 in this report. Since the middle of the 20th century through 2018, U.S. exports and imports grew strongly and by 2018 trade reflected a large share of the nation's economic activity. From 2011-2018, total trade (exports plus imports) represented nearly 30 percent of gross domestic product (GDP), up from 10.6 percent when the General Agreement on Tariffs and Trade — the precursor to the World Trade Organization (WTO) — was launched in 1947.

Export Trends

U.S. exports have been generally increasing over the last 25 years. For more than two decades, total U.S. exports have increased at an average *annual* rate of 5.7 percent, notwithstanding the declines experienced during the 2001-2002 and 2008-2009 recessions. Since our last report, services exports have continued to increase and by 2018 accounted for one-third of total U.S. exports. Goods exports (e.g., industrial, agricultural) still dominate total U.S. exports, accounting for just under 70 percent of the total, so their declines in 2015 and 2016 drove the overall decline in U.S. exports in those years. Growth in both goods and services exports rebounded in 2017 and 2018. (Detailed data are provided in Appendix A, Table A1.)



Source: Bureau of Economic Analysis, U.S. Department of Commerce, as detailed in Appendix Table A1.

Leading U.S. goods exports[2] in 2018 included aerospace products and parts; petroleum and coal products; oil and gas; motor vehicles and parts; basic chemicals; pharmaceuticals and medicines; measuring, electro-medical and control instruments; resins, rubber and artificial

[2] Based on four-digit North American Industrial Classification System codes.

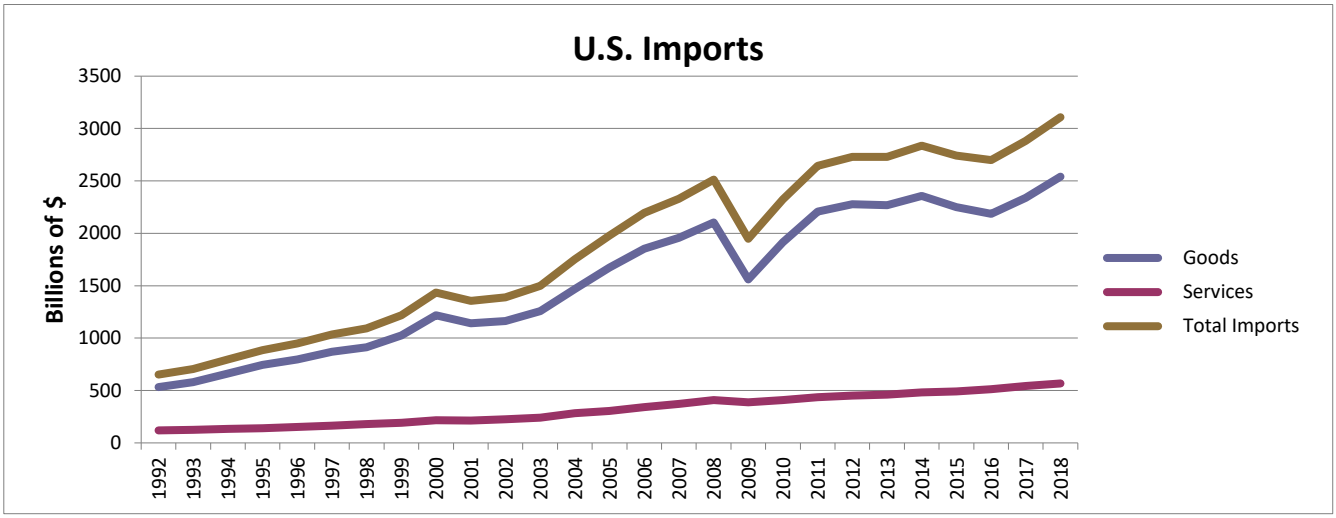
fibers; oilseeds and grains; and semiconductors. These sectors accounted for half of 2018 goods exports.

Contributing to the return to growth in the total value of goods exports from 2016-2018 (up at an average annual rate of 3.4 percent) were surges in exports of oil and gas (up 60.5 percent *per year* over that period), and petroleum and coal (up 11.6 percent per year).

Leading services exports include business; professional and technical services; royalties and license fees; and financial services.

Import Trends

U.S. imports also generally increased over the past two decades, spurred by periods of strong economic growth and curtailed by the 2001-2002 and 2008-09 recessions. (Detailed aggregate data are provided in Appendix A, Table A2.) In general, there is a positive correlation between changes in imports and changes in U.S. economic growth. This correlation makes sense given that nearly 60 percent of U.S. merchandise imports are raw materials, capital goods and industrial products used by U.S. manufacturers and farmers to produce goods in the United States. When U.S. manufacturing or agricultural output slows or contracts, producers' and farmers' need for imported raw materials and other inputs declines. Likewise, when household income drops as it does during a recession, families put off buying expensive consumer goods, including consumer goods imports which constitute about 40 percent of total goods imports. The 2016-2018 uptick in the total value of imports was thus owed in part to strong economic growth of the U.S. economy in 2017 and 2018. Increases in 2018 were likely due in part to importers seeking to get goods into the United States before they would be subject to higher tariffs imposed on imports from most foreign steel and aluminum suppliers, as well as products generally from China.



Source: Bureau of Economic Analysis, U.S. Department of Commerce, as detailed in Appendix A, Table A2.

In terms of services, key imports include business, professional, and technical services; travel; and insurance services. These are services purchased by U.S. entities, such as U.S.

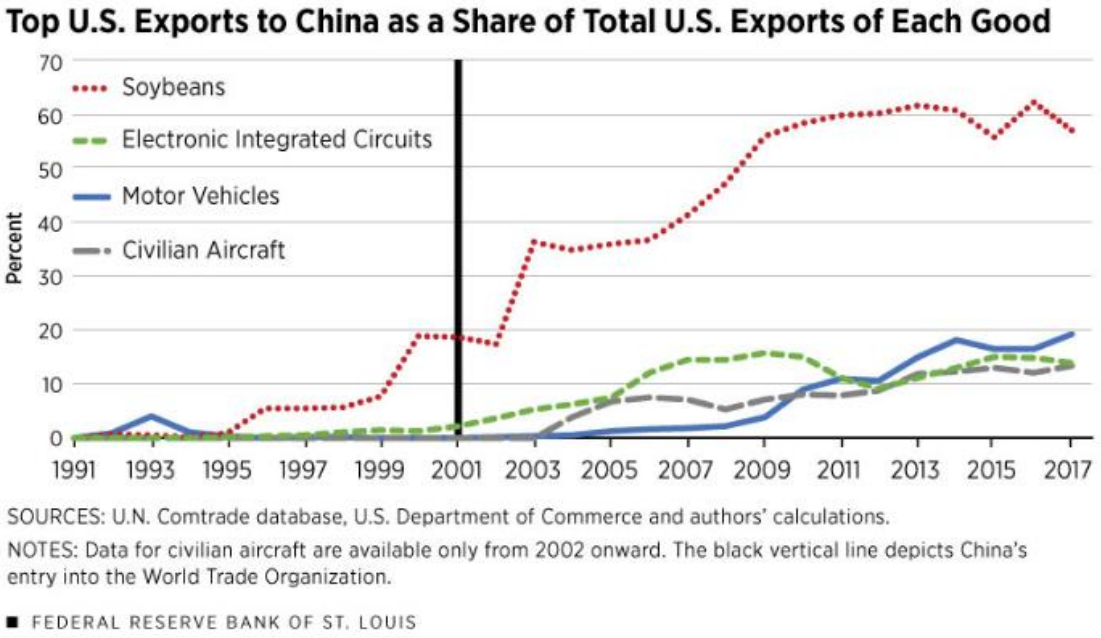
companies using foreign legal services, or U.S. tourists traveling abroad.

"Openness" of the U.S. Economy to Trade

Trade agreements have been an important contributor to the growth in trade, particularly during the past two decades. They have increasingly reduced foreign barriers to trade, opening new markets for U.S. exports, while also opening the U.S. market to increased imports from other countries reducing costs of inputs for manufacturers and reducing prices for consumers and families.

- Significant global liberalization began between the United States and members of the WTO as the Uruguay Round was implemented in 1995.

- China joined the WTO in December 2001, starting the process of opening its market to U.S. exports of goods and services. A recent assessment of trade with China by the Federal Reserve Bank of St. Louis depicts the growing importance of U.S. exports of key products to China since 2001.[3] Further removing barriers to trade and investment in China would open additional opportunities for U.S. exporters and businesses.



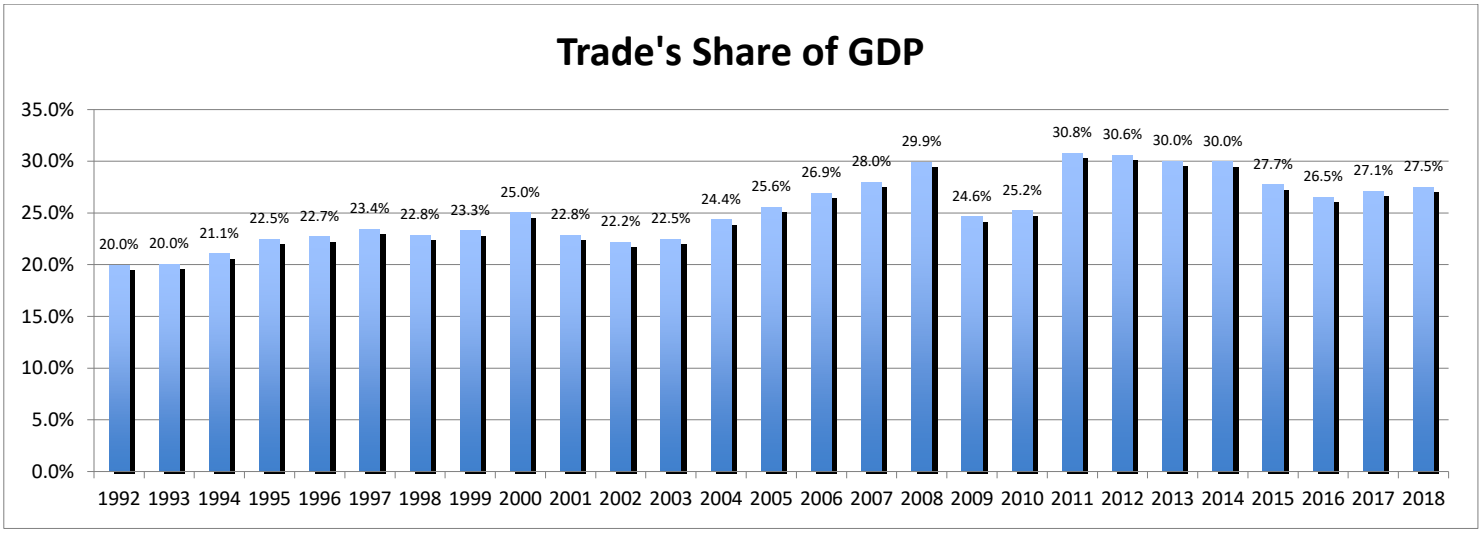
- FTAs were implemented with Mexico and Canada (NAFTA 1993), Jordan (2001), Chile and Singapore (2004), Australia (2005), Morocco (2006), Central America (2006- 2009), Bahrain (2006), Oman (2009), Peru (2009), and South Korea, Colombia and Panama (2012). Each of these agreements helped to increase total

[3] Subhayu Bandyopadhyay, Asha Bharadwaj and Suryadipta Roy, "Taking a Closer Look at U.S. Exports to China," *Regional Economist*, Federal Reserve Bank of St. Louis, September 12, 2018, https://www.stlouisfed.org/publications/regional-economist/third-quarter-2018/closer-look-exports-china.

U.S. trade, including both exports and imports. The share of total U.S. goods and services exports with bilateral or regional trade agreement partners has increased from less than 1 percent in 1992 (when the United States had just two FTA partners, Israel and Canada), to 39 percent in 2018 (when the United States had 20 FTA partners).

As U.S. manufacturers, farmers and services providers have taken advantage of the tariff and other benefits of trade agreements, the importance of global value chains to U.S. companies, farmers and their workers has increased. Companies have lowered costs through these value chains, becoming more competitive in U.S. and foreign markets and relying more than ever on suppliers in other countries for inputs to U.S. production to improve U.S. competitiveness selling goods and services at home and around the world.

Consequently, the importance of trade – both exports *and* imports – to the U.S. economy has increased significantly during the last two decades. During this period of accelerating trade liberalization, total trade (exports plus imports) rose from 20 percent of GDP in 1992 to 28 percent in 2018 (see Appendix A, Table A3 for detailed data).



Source: Derived from Bureau of Economic Analysis, U.S. Department of Commerce.

Studies have also demonstrated the correlation between growth in trade and growth of economies. They find that trade is a factor in driving economic growth.[4] Countries with higher rates of GDP growth also have higher rates of growth in trade as a share of output (e.g., the Chart above). Economic growth is supported by trade when competition with foreign firms spurs domestic firms to innovate and become more productive; when firms seek to operate on a large scale (to supply not only domestic customers but foreign as well) so they are able to lower their costs per unit produced, for example.

[4] For a summary see Esteban Ortiz-Ospina, "Does Trade Cause Growth?," October 22, 2018, https://ourworldindata.org/trade-and-econ-growth.

III. Trade and American Jobs

Concerns about the impact of trade on U.S. jobs remain widespread in America. Some policymakers are convinced that U.S. goods trade deficits equate to lost U.S. jobs. It is generally accepted that exports have a positive impact on U.S. jobs. However, many worry that imports have a negative impact on U.S. jobs.

A proper assessment of the impacts of trade on U.S. jobs should use an approach that captures the full range of the many ways in which those impacts are experienced by farmers, manufacturers, services providers, workers and consumers. This study uses such an approach, which is detailed in Appendix B. Briefly stated, it explores the direct and indirect effects of exports, the direct and indirect effects of imports, and the effects of additional trade-induced spending on U.S. output and consumption and, consequently, jobs. It reflects the differences in price, quantity and quality between imported goods and U.S.-produced goods. It also captures the jobs directly and indirectly related to the process of importing goods and services into the United States (e.g., jobs associated with transporting imports from the ports to warehouses, jobs at the warehouses, or retail jobs that sell the imported goods if they are finished consumer products). Finally, our methodology also considers the positive and negative effects of trade on jobs, and results reported are therefore "net" job impacts.

Briefly, the findings of this analysis are as follows:

- In 2018, an estimated 40.6 million net jobs were tied to trade.
- These jobs represented 20.2 percent of total employment, or one in five jobs.
- Employment related to trade has increased at four times the rate of employment overall. Between 1992 and 2018, trade-dependent jobs increased by 180 percent (from a net of 14.5 million[5] to 40.6 million), compared to 45 percent for employment generally.[6]
- Nearly two times as many jobs were supported by trade in 2018 (20.2 percent) as in 1992 (10.4 percent) – before the accelerated wave of trade liberalization that began with the implementation of NAFTA in 1994.[7]
- Trade has a net positive impact on U.S. jobs in both the services and manufacturing sectors.

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[5] Baughman and Francois (2007), *op cit*.

[6] Derived from U.S. Bureau of Economic Analysis, "Total full-time and part-time employment by industry," (accessed September 14, 2020).

[7] Baughman and Francois (2007), *op cit*., Table 6, p. 12.

Table 1
Net Number of U.S. Jobs Related to Trade,* 2018
(Thousands)

Total	**+40,620.1**
Good-producing sectors	**+3,402.4**
Agriculture, forestry, fishing	+647.4
Mining and energy	+260.3
Construction	+1,865.0
Manufacturing	+629.7
Services-producing sectors	**+37,217.7**
Utilities	+151.9
Wholesale and retail trade	+9,339.4
Finance	+1,242.2
Insurance	+610.9
Transportation	+1,414.2
Communications	+690.1
Business and professional services	+6,786.4
Personal and recreational services	+2,707.2
Other services (e.g. educ., health, gov't, etc.)	+14,276.3
Share of Total U.S. Employment	**20.2%**

* "Trade" = exports plus imports of goods and services.
See Appendix Table B.1 for sector descriptions
Source: Authors' estimates.

As noted above, the biggest impacts of trade are the ways in which it increases spending across the U.S. economy. But most analysts seeking to assess the impacts of trade on U.S. jobs stop with the direct and indirect impacts of exports and imports. In doing so, they miss the largest source of job-creating activity that comes from trade: the extra spending power companies, workers and consumers have in their bank accounts, spending power that generates still more job-supporting economic activity. Additional spending power comes from, for example, wages of direct and indirect workers in export-related jobs, from wages of direct and indirect workers in import-related jobs, and from consumers who take advantage of lower prices for goods and services resulting from imports, which in turn supports still more economic activity that supports even more jobs. The extra income is spent on other goods and services that are not traded internationally – like dinners out, pre-school or day care for one's child, or a home renovation project. Thus, Table 1 reports large trade-related jobs in sectors like "Construction" and "Personal and recreation services." The estimates in Table 1 reflect the increased spending that goes on throughout the economy as a result of higher incomes and lower costs due to trade. The methodology

in the report captures all these effects.[8]

It is worth noting that the bulk of the jobs associated with U.S. trade are in these other sectors not commonly thought to benefit from trade. And it is these sectors that have been hardest hit from the pandemic-triggered shut down in the U.S. economy that began in earnest in March 2019. Thus, as the economy recovers, trade begins to rebound, and employers in these sectors restart their operations, trade-induced consumer spending will be more important than ever to supporting their operations and their ability to keep workers employed.

U.S. Jobs Related to Trade with Selected Trading Partners

Table 2 and the chart detail jobs supported by trade with selected leading U.S. trading partners. Trade with Canada and Mexico together supported nearly 13 million jobs in 2018, 31 percent of all trade-related jobs. Trade with China supports a *net positive* number of U.S. jobs, over 7 million, accounting for an additional 19 percent of total U.S. trade-related jobs and 3.8 percent of all U.S. jobs. Trade with Japan, Korea, the EU (27), UK and India also add importantly to net U.S. employment rolls. Together, trade with these partners accounted for half of all U.S. trade-related jobs in 2018.

Table 2
Net Number of U.S. Jobs Related to Trade with Leading U.S. Trading Partners,* 2018
(Thousands)

	Canada	Mexico	China	Japan
Total	+7,848.0	+4,961.1	+7,698.6	+1,978.8
Good-producing	+545.7	+447.0	+621.4	+140.1
Of which, Manufacturing	+376.1	+147.4	-318.6	-124.3
Services-	+7,302.3	+4,514.1	+7,077.2	+1,838.6
Share of Total U.S. Jobs	3.9%	2.5%	3.8%	1.0%
Share of Trade-Related Jobs	19.3%	12.2%	19.0%	4.9%

	Korea	EU (27)	UK	India
Total	+1,094.1	+6,217.8	+1,148.6	+1,612.4
Good-producing	+77.8	+572.3	+165.3	+119.9
Of which, Manufacturing	-27.7	+45.1	+14.6	+70.2
Services	+1,016.3	+5,645.5	+983.4	+1,492.5
Share of Total U.S. Jobs	0.5%	3.1%	0.6%	0.8%
Share of Trade-Related Jobs	2.7%	15.3%	2.8%	4.0%

* "Trade"= exports plus imports of goods and services.
Source: Authors' estimates.

[8] Our methodology does not capture the number of jobs supported by foreign investments in the United States, and therefore our results **likely understate** the number of U.S. jobs tied to the international economy. We do capture the jobs at U.S. subsidiaries of foreign firms that are linked to trade (exports and/or imports). We do not capture jobs at foreign companies not engaged directly or indirectly in foreign trade.

Source: Author's estimates.

State-Level Trade-Related Employment

As demonstrated by a breakdown of the national employment estimates by state (see Table 3), every U.S. state realizes a net positive impact from trade. Not surprisingly, the largest states benefit the most.

See Appendix B for an explanation of our methodology for breaking down trade-related employment by state. As noted there, these estimates report the state-level jobs linked to *national* exports and imports.

Appendix C presents our employment results by state for each of the leading U.S. trading partners detailed in Table 2.

Table 3
Net Number of U.S. Jobs Related to Total Trade, by State, 2018
(Thousands)

Alabama	+534.6	Montana	+143.4
Alaska	+101.9	Nebraska	+270.7
Arizona	+783.5	Nevada	+376.7
Arkansas	+335.2	New Hampshire	+175.3
California	+4,874.3	New Jersey	+1,135.9
Colorado	+788.9	New Mexico	+237.0
Connecticut	+473.1	New York	+2,649.5
Delaware	+123.4	North Carolina	+1,216.6
District of Columbia	+205.2	North Dakota	+120.3
Florida	+2,563.4	Ohio	+1,396.9
Georgia	+1,269.0	Oklahoma	+475.3
Hawaii	+200.9	Oregon	+513.4
Idaho	+208.9	Pennsylvania	+1,577.9
Illinois	+1,591.2	Rhode Island	+133.3
Indiana	+746.7	South Carolina	+568.9
Iowa	+412.8	South Dakota	+124.5
Kansas	+395.5	Tennessee	+816.2
Kentucky	+504.2	Texas	+3,539.6
Louisiana	+570.5	Utah	+410.9
Maine	+176.1	Vermont	+91.0
Maryland	+788.5	Virginia	+1,107.9
Massachusetts	+994.4	Washington	+940.8
Michigan	+1,105.4	West Virginia	+190.0
Minnesota	+755.9	Wisconsin	+726.5
Mississippi	+326.2	Wyoming	+84.6
Missouri	+767.2	TOTAL	+40,620.1

Source: Authors' estimates.

IV Conclusion

Our analysis demonstrates that trade supports American jobs and the U.S. economy. As the U.S. economy has become more open and both exports and imports have grown, so too have U.S. jobs dependent on trade. To meet the public health and economic challenges from COVID-19, trade and effective trade policy can restore many trade-related American jobs and accelerate economic recovery.

Thus, policymakers and others seeking to create new jobs for unemployed Americans should focus on harnessing the opportunities afforded by trade policies, negotiations and programs that increase America's participation in the international marketplace. Trade in 2018 supported over 40 million American jobs and strengthened U.S. economic competitiveness and purchasing power for American families. In 2020 and beyond, trade can support millions more American jobs and position the U.S. economic for a strong recovery and enhance U.S. competitiveness.

Appendix A

Trade Data

Table A1
U.S. Exports to the World, 1992-2018
(Billions)

	Goods Exports	Services Exports	Total Exports
1992	$448.2	$177.3	$625.5
1993	465.1	185.9	651.0
1994	512.6	200.4	713.0
1995	584.7	219.2	803.9
1996	625.1	239.5	864.6
1997	689.2	256.1	945.3
1998	682.1	262.8	944.9
1999	695.8	271.3	967.1
2000	781.9	290.4	1,072.3
2001	729.1	274.3	1,003.4
2002	693.1	280.7	973.8
2003	724.8	290.0	1,014.7
2004	814.9	338.0	1,152.8
2005	901.1	373.0	1,274.1
2006	1,026.0	416.7	1,442.7
2007	1,148.2	488.4	1,636.6
2008	1,287.4	532.8	1,820.2
2009	1,056.0	512.7	1,568.7
2010	1,278.5	562.8	1,841.3
2011	1,482.5	627.0	2,109.5
2012	1,545.7	655.7	2,201.4
2013	1,578.4	700.5	2,278.9
2014	1,621.9	741.1	2,363.0
2015	1,503.1	755.3	2,258.4
2016	1,451.0	758.4	2,209.9
2017	1,546.5	799.0	2,345.5
2018	1,666.0	827.0	2,538.0

Source: U.S. Department of Commerce, Bureau of Economic Analysis, using "Census basis" trade data for goods.

Table A2
U.S. Imports from the World, 1992-2018
(Billions)

	Goods Imports	Services Imports	Total Imports
1992	$532.7	$119.6	$652.3
1993	580.7	123.8	704.4
1994	663.3	133.1	796.3
1995	743.5	141.4	884.9
1996	795.3	152.6	947.8
1997	869.7	165.9	1,035.6
1998	911.9	180.7	1,092.6
1999	1,024.6	192.9	1,217.5
2000	1,218.0	216.1	1,434.1
2001	1,141.0	213.5	1,354.5
2002	1,161.4	224.4	1,385.7
2003	1,257.1	242.2	1,499.3
2004	1,469.7	283.1	1,752.8
2005	1,673.5	304.4	1,977.9
2006	1,853.9	341.2	2,195.1
2007	1,957.0	372.6	2,329.5
2008	2,103.6	409.1	2,512.7
2009	1,559.6	386.8	1,946.4
2010	1,913.9	409.3	2,323.2
2011	2,208.0	435.8	2,643.7
2012	2,276.3	452.0	2,728.3
2013	2,268.0	461.1	2,729.1
2014	2,356.4	480.8	2,837.2
2015	2,248.8	492.0	2,740.8
2016	2,186.8	511.6	2,698.4
2017	2,339.9	543.9	2,883.7
2018	2,540.8	567.3	3,108.1

Source: U.S. Department of Commerce, Bureau of Economic Analysis, using “Census basis” data for goods.

Table A3
"Openness" of U.S. Economy, 1992-2018
(Billions and Percent)

	Total U.S. Trade*	Total Trade's Share of U.S.GDP
1992	$1,300.9	20.0%
1993	1,374.8	20.0
1994	1,534.3	21.1
1995	1,715.4	22.5
1996	1,831.7	22.7
1997	2,009.6	23.4
1998	2,068.7	22.8
1999	2,241.4	23.3
2000	2,567.6	25.0
2001	2,417.2	22.8
2002	2,422.8	22.2
2003	2,575.5	22.5
2004	2,974.3	24.4
2005	3,331.6	25.6
2006	3,716.1	26.9
2007	4,040.2	28.0
2008	4,397.2	29.9
2009	3,560.4	24.6
2010	4,206.5	25.2
2011	4,785.5	30.8
2012	4,951.2	30.6
2013	5,037.6	30.0
2014	5,251.1	30.0
2015	5,053.4	27.7
2016	4,960.0	26.5
2017	5,288.8	27.1
2018	5,658.8	27.5

* "Total Trade" is goods and services exports plus goods and services imports, using "balance of payments" basis data to coincide with GDP data.
Source: U.S. Department of Commerce, Bureau of the Census, National Income and Product Accounts tables.

Appendix B

Methodology

We applied a multi-sector multi-country computable general equilibrium (CGE) model of the U.S. economy to estimate the impacts of trade on U.S. employment. CGE models use regional and national input-output, employment and trade data to link industries in a value-added chain from primary goods to intermediate processing to the final assembly of goods and services for consumption. Inter-sectoral linkages may be direct, like the input of steel in the production of transport equipment, or indirect, via intermediate use in other sectors (e.g., energy used to make steel that is used in turn in the transport equipment sector). Our CGE model captures these linkages by incorporating firms' use of direct and intermediate inputs. The most important aspects of the model can be summarized as follows: (i) it covers all world trade and production; and (ii) it includes intermediate linkages between sectors within each country.

The Model

The specific model used was the Global Trade Analysis Project (GTAP) model (see Hertel 2013). The model and its associated data are developed and maintained by a network of researchers and policymakers coordinated by the Center for Global Trade Analysis at the Department of Agricultural Economics at Purdue University. Guidance and base-level support for the model and associated activities are provided by the GTAP Consortium, which includes members from government agencies (e.g., the U.S. Department of Commerce, U.S. Department of Agriculture, U.S. Environmental Protection Agency, and U.S. International Trade Commission, European Commission), international institutions (e.g., the Asian Development Bank, Organization for Economic Cooperation and Development, the World Bank, United Nations and the World Trade Organization), the private sector and academia. Dr. Francois is a member of the Consortium.

The model assumes that capital stocks are fixed at a national level. Firms are assumed to be competitive, and employ capital and labor to produce goods and services subject to constant returns to scale.[9] Products from different regions are assumed to be imperfect substitutes in accordance with the so-called "Armington" assumption. Armington elasticities are taken directly from the GTAP v. 10 database, as are substitution elasticities

[9] Compared to dynamic CGE models and models with alternative market structures, the present assumption of constant returns to scale with a fixed capital stock is closest in approach to older studies based on pure input-output modeling of trade and employment linkages. In the present context, it can be viewed as generating a lower-bound estimate of effects relative to alternative CGE modeling structures.

for value added.[10]

We are interested in the impact of trade on the U.S. and state economies given the U.S. wage structures in 2018 (i.e., given the prevailing wage structure of the labor force in a given year, how many jobs in the U.S. economy and in each state's economy were linked either directly or indirectly to trade?). As such, the model employs a labor market closure (equilibrium conditions) where wages are fixed at prevailing levels, and employment levels are forced to adjust. This provides a model-generated estimate of the U.S. jobs supported, at current wage levels, by the 2017 level of trade.

Data

The model incorporates data from a number of sources. Data on production and trade are based on input-output, final demand, and trade data from the GTAP database (see Aguiar, Narayanan & McDougall 2016). These data provide important information on cross-border linkages in industrial production, related to trade in parts and components. For the 2018 simulation, social accounting data are drawn directly from the most recent version of the GTAP dataset, version 10. Trade data (both exports and imports) exclude re-exports.[11] This dataset is benchmarked to 2014 and includes detailed national input-output, trade, and final demand structures for 140 countries across 56 sectors (see Table A-1). We have updated the trade and national accounts data to 2018.

The basic social accounting and trade data are supplemented with data on tariffs and non-tariff barriers from the World Trade Organization's integrated database and from the UNCTAD/World Bank WITS dataset. All tariff information has been concorded to GTAP model sectors within the version 10 database. For the purposes of the modeling exercise, the aggregation of the GTAP database includes 110 regions and 27 sectors.[12]

The GTAP model sectors were concorded to state-level employment data from the Commerce Department's Bureau of Economic Analysis (BEA). This allowed us to map nationwide effects to individual states. It is important to emphasize that we distribute the employment impacts of trade at the national level to employment at the state level. We are therefore reporting state-level employment related to trade nationally. We are not reporting the state level employment impacts of state-level trade. Based on the availability of employment data as well as the size of some of the sectors, we expanded some sectors (e.g., "Finance and Insurance" its "Finance" and "Insurance" components) and collapsed

[10] Technically we work with what is known as a "non-nested" version of the trade demand equation in the GTAP model. As such, in this case the model also corresponds analytically to a recent type of model known as an Eaton-Kortum model. See Bekkers et al (2017) for further technical discussion and derivations.

[11] See https://www.gtap.agecon.purdue.edu/databases/contribute/reexports.asp.

[12] The GTAP database includes relatively more detail in sectors, particularly in agricultural, primary production, and processed foods than we can use here when mapping model results by sector to state employment data by sector. State employment data for most of these sectors are not available.

others (e.g., individual food products into one sector, "Food Products," or individual transportation modes into one sector, "Transportation"). BEA does not disclose state-level employment data for certain sectors for confidentiality reasons. For some of these sectors, we were able to use Moody's Analytics state-level employment estimates to estimate the missing national employment to undisclosed sectors in these states. However, because we mixed employment data from two sources (BEA and Moody's), the sum of the employment effects for the states may not add perfectly to the total for the United States.

For purposes of the modeling exercise here, the 110 countries/regions in the standard GTAP model were placed in eight distinct groupings of trading partners for the purpose of examining the impact of U.S. trade with those countries: Canada, Mexico, China, Japan, Korea, the European Union (excluding the UK), the United Kingdom, India and rest-of-world. We also aggregated the standard GTAP model sectors into those shown in Table B-1.

Table B1
Model Sectors

Primary agriculture	Electronic equipment
Forestry	Other machinery
Fishing	Other goods
Oil/gas, other mining	Construction
Processed Foods	Utilities
Beverages and tobacco	Air transport
Textiles	Water transport
Clothing	Other transport
Footwear, leather	Trade and distribution (Wholesale, retail,
Wood, paper	accommodation and food services)
Paper products, publishing	Communications (Information, postal,
Petroleum and coal products	delivery services)
Chemicals, rubber, plastics	Financial services
Primary metals	Insurance
Metal products	Business and professional services
Mineral products	Personal and recreational services (Arts,
Motor vehicles and parts	entertainment, and recreation services)
Other transport equipment	Other services (Education, health care,
	social assistance, government services)

Model-based Simulations

The simulation conducted with the GTAP model involved imposing changes in U.S. trade, in this instance a hypothetical elimination of all U.S. exports and imports of goods and services by imposing prohibitive duties against goods trade with the United States across

the board, and prohibitive trade costs against services trade with the United States.[13]

Our results tell us how much U.S. and state output and employment would decline were the United States to cease exporting and importing goods and services, tracing changes at the border as they work through the U.S. economy. The net negative (or positive, in some cases) impacts on output and jobs from an absence of trade serve as a proxy for the opposite: the net positive (or negative) impacts on U.S. output and employment *because* of trade. We report the results from this second perspective in this paper.

References

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[13] We have modeled an extreme shock to the economy to show the extent to which sectors of the economy are tied to trade. We are not suggesting that a prohibitive tariff is a policy option that has been proposed by anyone. It is useful to understand the job impact of complete elimination of both exports and imports, in order to quantify the opposite scenario: the job impact of actual U.S. trade in the experiment years.

Appendix C

Employment Impacts by State and Country

Table C1
Net Number of U.S. Jobs Related to Trade with Canada, by State, 2018
(Thousands)

Alabama	+102.8	Montana	+25.7
Alaska	+20.3	Nebraska	+50.9
Arizona	+152.8	Nevada	+74.4
Arkansas	+62.5	New Hampshire	+36.0
California	+966.1	New Jersey	+226.9
Colorado	+146.8	New Mexico	+40.4
Connecticut	+92.3	New York	+520.3
Delaware	+24.2	North Carolina	+241.4
District of Columbia	+38.3	North Dakota	+19.0
Florida	+502.6	Ohio	+274.2
Georgia	+251.0	Oklahoma	+74.6
Hawaii	+38.5	Oregon	+100.2
Idaho	+39.4	Pennsylvania	+305.5
Illinois	+317.4	Rhode Island	+26.6
Indiana	+148.5	South Carolina	+112.1
Iowa	+79.0	South Dakota	+23.1
Kansas	+69.5	Tennessee	+160.4
Kentucky	+95.0	Texas	+640.1
Louisiana	+102.9	Utah	+80.3
Maine	+36.4	Vermont	+17.3
Maryland	+153.1	Virginia	+212.1
Massachusetts	+200.8	Washington	+177.6
Michigan	+220.2	West Virginia	+32.4
Minnesota	+150.0	Wisconsin	+144.1
Mississippi	+61.2	Wyoming	+13.2
Missouri	+147.4	TOTAL	+7,848.0

Source: Authors' estimates.

Table C2
Net Number of U.S. Jobs Related to Trade with Mexico, by State, 2018
(Thousands)

Alabama	+65.6	Montana	+16.5
Alaska	+9.3	Nebraska	+31.4
Arizona	+96.5	Nevada	+46.5
Arkansas	+39.9	New Hampshire	+21.4
California	+584.1	New Jersey	+141.6
Colorado	+97.9	New Mexico	+29.2
Connecticut	+58.6	New York	+328.0
Delaware	+15.4	North Carolina	+150.7
District of Columbia	+25.4	North Dakota	+14.7
Florida	+310.7	Ohio	+171.1
Georgia	+157.8	Oklahoma	+60.1
Hawaii	+23.6	Oregon	+59.0
Idaho	+24.1	Pennsylvania	+194.9
Illinois	+194.3	Rhode Island	+16.1
Indiana	+92.1	South Carolina	+70.9
Iowa	+47.2	South Dakota	+13.9
Kansas	+48.3	Tennessee	+99.2
Kentucky	+59.9	Texas	+466.9
Louisiana	+69.9	Utah	+51.3
Maine	+18.8	Vermont	+10.4
Maryland	+97.0	Virginia	+135.9
Massachusetts	+121.8	Washington	+110.8
Michigan	+136.6	West Virginia	+24.3
Minnesota	+91.3	Wisconsin	+86.2
Mississippi	+39.3	Wyoming	+10.8
Missouri	+91.8	TOTAL	+4,961.1

Source: Authors' estimates.

Table C3
Net Number of U.S. Jobs Related to Trade with China, by State, 2018
(Thousands)

Alabama	+103.5	Montana	+28.9
Alaska	+19.1	Nebraska	+54.5
Arizona	+147.3	Nevada	+71.5
Arkansas	+65.7	New Hampshire	+29.4
California	+888.2	New Jersey	+211.9
Colorado	+151.3	New Mexico	+46.8
Connecticut	+90.0	New York	+493.8
Delaware	+23.0	North Carolina	+222.4
District of Columbia	+38.9	North Dakota	+25.4
Florida	+491.4	Ohio	+266.4
Georgia	+241.7	Oklahoma	+97.6
Hawaii	+39.0	Oregon	+93.5
Idaho	+40.1	Pennsylvania	+296.8
Illinois	+266.2	Rhode Island	+24.2
Indiana	+144.1	South Carolina	+107.9
Iowa	+80.8	South Dakota	+25.1
Kansas	+80.6	Tennessee	+158.8
Kentucky	+102.0	Texas	+689.4
Louisiana	+112.4	Utah	+76.7
Maine	+31.2	Vermont	+16.7
Maryland	+148.4	Virginia	+213.0
Massachusetts	+176.2	Washington	+184.9
Michigan	+211.7	West Virginia	+38.0
Minnesota	+135.6	Wisconsin	+133.6
Mississippi	+64.0	Wyoming	+17.4
Missouri	+148.6	TOTAL	+7,698.6

Source: Authors' estimates.

Table C4
Net Number of U.S. Jobs Related to Trade with Japan, by State, 2018
(Thousands)

Alabama	+23.2	Montana	+8.1
Alaska	+5.3	Nebraska	+14.7
Arizona	+38.4	Nevada	+18.4
Arkansas	+17.3	New Hampshire	+8.1
California	+246.3	New Jersey	+56.4
Colorado	+41.0	New Mexico	+13.1
Connecticut	+20.7	New York	+131.1
Delaware	+6.2	North Carolina	+58.8
District of Columbia	+10.2	North Dakota	+7.0
Florida	+128.0	Ohio	+59.4
Georgia	+61.6	Oklahoma	+26.1
Hawaii	+10.4	Oregon	+26.5
Idaho	+11.5	Pennsylvania	+75.4
Illinois	+75.2	Rhode Island	+6.2
Indiana	+27.2	South Carolina	+25.0
Iowa	+21.0	South Dakota	+6.8
Kansas	+20.0	Tennessee	+36.5
Kentucky	+22.2	Texas	+185.1
Louisiana	+29.4	Utah	+20.4
Maine	+8.7	Vermont	+4.6
Maryland	+39.4	Virginia	+54.1
Massachusetts	+48.4	Washington	+45.2
Michigan	+41.3	West Virginia	+9.7
Minnesota	+37.8	Wisconsin	+33.5
Mississippi	+15.7	Wyoming	+5.0
Missouri	+37.2	TOTAL	+1,976.8

Source: Authors' estimates.

Table C5
Net Number of U.S. Jobs Related to Trade with Korea, by State, 2018
(Thousands)

Alabama	+13.2	Montana	+4.3
Alaska	+2.7	Nebraska	+8.2
Arizona	+21.2	Nevada	+10.1
Arkansas	+9.6	New Hampshire	+4.4
California	+136.1	New Jersey	+30.8
Colorado	+21.8	New Mexico	+6.9
Connecticut	+12.4	New York	+71.2
Delaware	+3.4	North Carolina	+32.3
District of Columbia	+5.5	North Dakota	+3.7
Florida	+69.6	Ohio	+34.3
Georgia	+34.2	Oklahoma	+13.9
Hawaii	+5.6	Oregon	+14.3
Idaho	+6.2	Pennsylvania	+41.7
Illinois	+42.2	Rhode Island	+3.5
Indiana	+16.2	South Carolina	+14.4
Iowa	+12.0	South Dakota	+3.7
Kansas	+11.7	Tennessee	+21.0
Kentucky	+13.0	Texas	+98.7
Louisiana	+15.6	Utah	+10.9
Maine	+4.8	Vermont	+2.5
Maryland	+21.2	Virginia	+30.0
Massachusetts	+26.3	Washington	+26.5
Michigan	+24.6	West Virginia	+5.2
Minnesota	+20.8	Wisconsin	+19.3
Mississippi	+9.0	Wyoming	+2.6
Missouri	+21.1	TOTAL	+1,094.1

Source: Authors' estimates.

Table C6
Net Number of U.S. Jobs Related to Trade with the EU (27), by State, 2018
(Thousands)

Alabama	+80.5	Montana	+22.9
Alaska	+15.6	Nebraska	+41.1
Arizona	+120.2	Nevada	+57.4
Arkansas	+51.4	New Hampshire	+27.4
California	+761.2	New Jersey	+170.4
Colorado	+124.2	New Mexico	+38.7
Connecticut	+70.5	New York	+405.9
Delaware	+18.9	North Carolina	+185.8
District of Columbia	+32.1	North Dakota	+19.8
Florida	+390.3	Ohio	+206.7
Georgia	+190.3	Oklahoma	+78.7
Hawaii	+31.0	Oregon	+81.2
Idaho	+33.0	Pennsylvania	+239.6
Illinois	+236.7	Rhode Island	+20.2
Indiana	+107.5	South Carolina	+84.6
Iowa	+62.5	South Dakota	+19.3
Kansas	+61.2	Tennessee	+121.3
Kentucky	+75.5	Texas	+557.3
Louisiana	+88.9	Utah	+62.6
Maine	+26.8	Vermont	+14.4
Maryland	+121.2	Virginia	+169.6
Massachusetts	+152.7	Washington	+144.1
Michigan	+161.4	West Virginia	+30.1
Minnesota	+116.3	Wisconsin	+108.9
Mississippi	+49.6	Wyoming	+14.1
Missouri	+116.3	TOTAL	+6,217.8

Source: Authors' estimates.

Table C7
Net Number of U.S. Jobs Related to Trade with the UK, by State, 2018
(Thousands)

Alabama	+15.5	Montana	+4.6
Alaska	+5.8	Nebraska	+7.5
Arizona	+20.9	Nevada	+11.1
Arkansas	+10.1	New Hampshire	+5.2
California	+136.0	New Jersey	+30.4
Colorado	+22.1	New Mexico	+7.4
Connecticut	+11.0	New York	+70.4
Delaware	+3.2	North Carolina	+34.8
District of Columbia	+5.6	North Dakota	+3.8
Florida	+70.6	Ohio	+38.9
Georgia	+34.9	Oklahoma	+14.8
Hawaii	+6.2	Oregon	+16.1
Idaho	+6.4	Pennsylvania	+44.4
Illinois	+43.1	Rhode Island	+3.9
Indiana	+21.8	South Carolina	+15.9
Iowa	+11.7	South Dakota	+3.7
Kansas	+10.5	Tennessee	+23.0
Kentucky	+14.6	Texas	+103.2
Louisiana	+18.8	Utah	+11.3
Maine	+6.9	Vermont	+2.7
Maryland	+22.4	Virginia	+30.1
Massachusetts	+28.5	Washington	+25.7
Michigan	+30.8	West Virginia	+6.0
Minnesota	+21.6	Wisconsin	+21.1
Mississippi	+9.8	Wyoming	+2.9
Missouri	+21.0	TOTAL	+1,148.6

Source: Authors' estimates.

Table C8
Net Number of U.S. Jobs Related to Trade with India, by State, 2018
(Thousands)

Alabama	+21.6	Montana	+5.5
Alaska	+3.8	Nebraska	+10.7
Arizona	+31.2	Nevada	+14.9
Arkansas	+13.4	New Hampshire	+7.2
California	+193.9	New Jersey	+45.0
Colorado	+30.8	New Mexico	+9.1
Connecticut	+19.2	New York	+105.1
Delaware	+4.9	North Carolina	+48.0
District of Columbia	+7.9	North Dakota	+4.6
Florida	+100.3	Ohio	+57.1
Georgia	+49.9	Oklahoma	+18.1
Hawaii	+7.9	Oregon	+20.7
Idaho	+8.2	Pennsylvania	+63.6
Illinois	+64.5	Rhode Island	+5.3
Indiana	+31.3	South Carolina	+22.6
Iowa	+16.9	South Dakota	+5.0
Kansas	+15.6	Tennessee	+32.6
Kentucky	+20.4	Texas	+137.0
Louisiana	+21.6	Utah	+16.2
Maine	+6.9	Vermont	+3.6
Maryland	+30.7	Virginia	+43.0
Massachusetts	+39.7	Washington	+37.0
Michigan	+45.1	West Virginia	+7.5
Minnesota	+30.9	Wisconsin	+30.2
Mississippi	+13.0	Wyoming	+3.2
Missouri	+30.7	TOTAL	+1,612.4

Source: Authors' estimates.