



## Growing Together: Economic Ties between the United States and Mexico

# How Trade with Mexico Impacts Employment in the United States

A Working Paper

By Christopher Wilson

#USMXEcon



November 2016

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### Project Introduction

The impact of trade and globalization on the average American has become a core issue in this year's elections. We have heard measured, well-founded and serious critiques on the handling of issues like currency manipulation and preparing our workforce for participation in the global economy, but the conversation has also drawn many passionate and visceral responses, highlighting the intensity with which citizens feel the impact of economic change. Due to campaign rhetoric, Mexico has come to symbolize much of the U.S. encounter with globalization. Given that Mexico is the United States' second largest export market, third largest overall trading partner, and the top country of origin for immigrants living in the country, this is understandable. Nonetheless, having become a top tier issue in the presidential elections, it is more important than ever that Americans have a clear and up-to-date understanding of Mexico and, in particular, the U.S.-Mexico economic relationship.

With that in mind, the Mexico Institute is pleased to announce the launch of a new project, *Growing Together: Economic Ties between the United States and Mexico*, which explores the bilateral economic relationship in detail to understand its nature and its impact on the United States. We have commissioned original research on the employment impact of bilateral trade on the U.S. economy, performed original analysis using government and academic datasets, and have undertaken an extensive review of existing research relevant to the U.S.-Mexico economic relationship. Beginning today and continuing throughout the fall of 2016, the Mexico Institute will release the findings of our research on our website and social media, using the hashtag #USMxEcon.

Our study concludes that the economic relationship with Mexico, though not without its challenges, provides concrete benefits, strengthening the competitiveness of American firms, creating jobs in the United States, and generating savings for the average American family. Learn more about the project and its key findings at <http://bit.ly/USMxEcon>.

**Christopher Wilson**  
**Duncan Wood**

# Growing Together: How Trade with Mexico Impacts Employment in the United States

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Figure 1.



The U.S.-Mexico trade relationship is huge. The two countries trade over a half-trillion dollars in goods and services each year, which amounts to more than a million dollars in bilateral commerce every minute. With such a large volume of trade, it is not hard to believe that the number of jobs that depend on the bilateral relationship is similarly impressive. New research commissioned by the Mexico Institute shows precisely that: nearly five million U.S. jobs depend on trade with Mexico. This means that one out of every 29 U.S. workers has a job supported by U.S.-Mexico trade.

The model utilized in our study shows that if trade between the United States and Mexico were halted, 4.9 million Americans would be out of work. To be clear, trade between the United States and Mexico, like trade between any two countries, both creates and destroys jobs; our study takes this into consideration and finds a *net* gain of 4.9 million U.S. jobs as a result of bilateral trade.

These jobs are spread throughout the U.S. economy, both in terms of industries and geography. California is the state with the largest number of U.S.-Mexico trade dependent jobs, at 556,000, but there are 30 U.S. states, ranging from Washington to Florida, that each have more than 50,000 jobs supported by bilateral trade (See Table 1). The industry mix of the jobs is equally broad, including more than 200,000 net job gains in manufacturing, construction and finance, to name just a few of the industries with employment tied in important ways to the U.S.-Mexico economic relationship.

**Table 1. U.S. Jobs Supported by Trade with Mexico, by State (2014)**

State	Thousands of Jobs	State	Thousands of Jobs
		Missouri	97
Alabama	67	Montana	17
Alaska	11	Nebraska	33
Arizona	89	Nevada	44
Arkansas	42	New Hampshire	22
California	566	New Jersey	141
Colorado	88	New Mexico	27
Connecticut	61	New York	322
Delaware	15	North Carolina	152
District of Columbia	24	North Dakota	14
Florida	290	Ohio	178
Georgia	153	Oklahoma	51
Hawaii	27	Oregon	57
Idaho	23	Pennsylvania	200
Illinois	200	Rhode Island	17
Indiana	96	South Carolina	70
Iowa	53	South Dakota	15
Kansas	48	Tennessee	100
Kentucky	61	Texas	382
Louisiana	65	Utah	47
Maine	22	Vermont	11
Maryland	97	Virginia	134
Massachusetts	119	Washington	107
Michigan	138	West Virginia	23
Minnesota	93	Wisconsin	96
Mississippi	41	Wyoming	9
<b>TOTAL</b>		<b>4,853</b>	

## How the Numbers Were Calculated and What They Tell Us about the Nature of Bilateral Trade

The model used to identify the number of jobs tied to U.S.-Mexico trade calculates the net number of jobs both directly and indirectly dependent on trade with Mexico. This means that it takes into account jobs supported by the production of goods for export that would be lost if we stopped trading with Mexico; jobs that would return to the United States to produce goods we currently import; and jobs supported by the income individuals and companies save by having access to lower cost imports. Some of the net job gains associated with bilateral trade are in manufacturing and primary goods production, but the vast majority are actually in service sectors, including everything from finance to healthcare and retail. This is because the job gains directly associated with exports are more or less cancelled out by those lost through import competition, leaving the major net job gains from bilateral trade coming from the benefits associated with imports and the related economy-wide efficiency gains. This finding runs contrary to much of the public debate about trade, which treats exports as good and imports as bad. Such a mercantilist approach could not be more out of place than in discussions about the U.S.-Mexico economic relationship, which is based on a deep level of manufacturing integration that strengthens and connects industry in both countries in ways that tightly link their health and competitiveness.

Imports from Mexico support U.S. jobs in two ways. First, trade with Mexico has allowed for the creation of a highly competitive regional manufacturing platform ([See Growing Together: A Regional Manufacturing Platform](#)) that, in addition to growing exports to Mexico, has also increased the availability of competitively priced imports of inputs for U.S. businesses. In fact, U.S. industry utilizes more than \$100 billion dollars of imported Mexican inputs (Mexican companies also use more than \$100 billion in U.S. inputs each year), which improve the competitiveness of the products produced by U.S. companies.<sup>1</sup> Many times, it is the availability of cost-efficient inputs that allows U.S. companies to stay competitive enough to fend off competitors from outside the region and to grow exports in the face of fierce global competition. In this way, not just exports but also imports from Mexico help support jobs in U.S. industry. Second, trade with Mexico also gives U.S. consumers access to low cost, high quality products, which in turn frees up a portion of their income to buy other goods and services, and therefore supports jobs across the U.S. economy. For example, when an American family saves \$100 by buying a washing machine built in Mexico and uses that money to go to the movies, U.S.-Mexico trade is helping support the jobs of the ticket seller, movie theater manager, and maybe even Brad Pitt. The economic model used of course cannot tell us precisely what portion of Brad Pitt's income is supported by U.S.-Mexico trade, but it can examine those types of impacts at the aggregate level across the U.S. economy.

Laura Baughman and Joseph Francois of The Trade Partnership created and ran the economic model to calculate the number of U.S. jobs that depend on trade with Mexico for the Wilson Center's Mexico Institute. See Appendix A, written by Baughman and Francois, for a detailed description of the methodology.

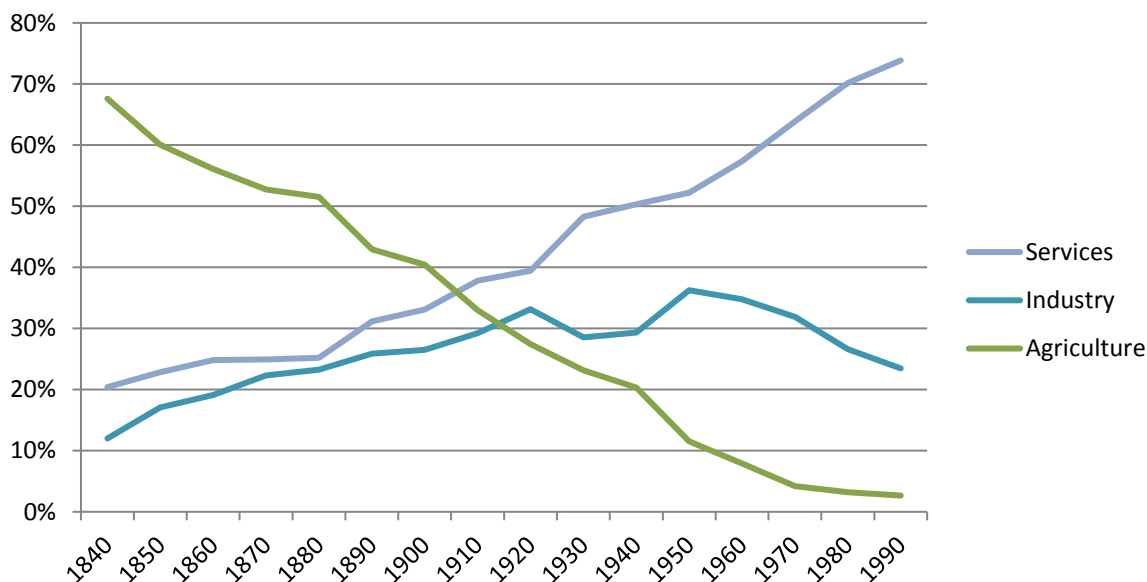
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<sup>1</sup> Author's calculations with data from the World Input-Output Database, <http://www.wiod.org/>, 2016.

## A Major Transition in the U.S. Labor Market

The United States labor market is in the process of a major, long-term economic transition driven primarily by productivity growth. Much in the way that rising productivity in agriculture slowly eliminated the need to have the majority of the U.S. workforce toiling in the fields to meet our demand for food, U.S. (and Mexican) manufacturers are becoming more efficient in building the products we need each year. As Figure 2 shows, the portion of the U.S. workforce employed in the service sector has continued to grow over the past two centuries while the percentage of U.S. workers in agriculture has declined. Manufacturing as a portion of total employment rose to a high point in the 1950s, but since then has declined. While labor productivity—the amount of labor needed to produce a certain amount of goods or services—has increased throughout the U.S. economy, manufacturing sector productivity has risen at levels significantly higher than the rest of the economy over the last two-and-a-half decades.<sup>2</sup> Technological change is the largest driver of these productivity enhancements, but trade and other factors have accelerated the resulting transition (this is documented and expanded upon below).

**Figure 2. Distribution of the U.S. Labor Force by Sector (1840-1990)**



Source: Louis D. Johnston, *The Growth of the Service Sector in Historical Perspective: Explaining Trends in U.S. Sectoral Output and Employment, 1840-1990*, Working Paper, College of Saint Benedict/Saint John's University, 2001.

There are at least two very important facets of the transition. First, increasing productivity is one of the major drivers of economic growth for the United States, particularly in the context of relatively

<sup>2</sup> U.S. Bureau of Labor Statistics, 2016, <http://www.bls.gov/lpc/prodybar.htm>.

slow population growth and an aging population moving out of the workforce.<sup>3</sup> This growth is vital to the U.S. economy and is a large part of what fuels welfare improvements across the population. Increasingly, though, there is concern about the distribution of the benefits of economic growth, with inequality on the rise.<sup>4</sup> There are of course many causes of inequality, but one very important part of the challenge has to do with the nature of U.S. productivity growth over the past several decades, which takes us to the second major aspect of the transition to a more service-oriented labor market structure: a growing gap in the wages paid to skilled vs. unskilled workers.

College-educated workers tend to thrive in the current transition, able to utilize new technology to do more with less. They do well both in the higher-skilled advanced manufacturing jobs—programming, running, and repairing robots and computer-aided equipment—that have replaced several positions on the assembly line, and in the service sector, with high paid management, research, training, and other jobs. However, those without a college degree, and particularly those without a high-school degree, have had a very difficult time over the past few decades. Manufacturing workers have been particularly hard hit, with employment in the sector down 29 percent since 2000.<sup>5</sup> Importantly, and in a way that reinforces the primacy of productivity in the transition, this decline in manufacturing employment persists even as manufacturing output grows (See Figure 3). The 2008-2009 recession accentuated the skill-biased nature of the structural economic transition, accelerating many of the long-term changes underway. During the recovery, more than 95 percent of the jobs created in the United States have gone to workers with at least some college education.<sup>6</sup>

**Figure 3. U.S. Manufacturing Employment and Output, Seasonally Adjusted (July 1987-April 2016)**

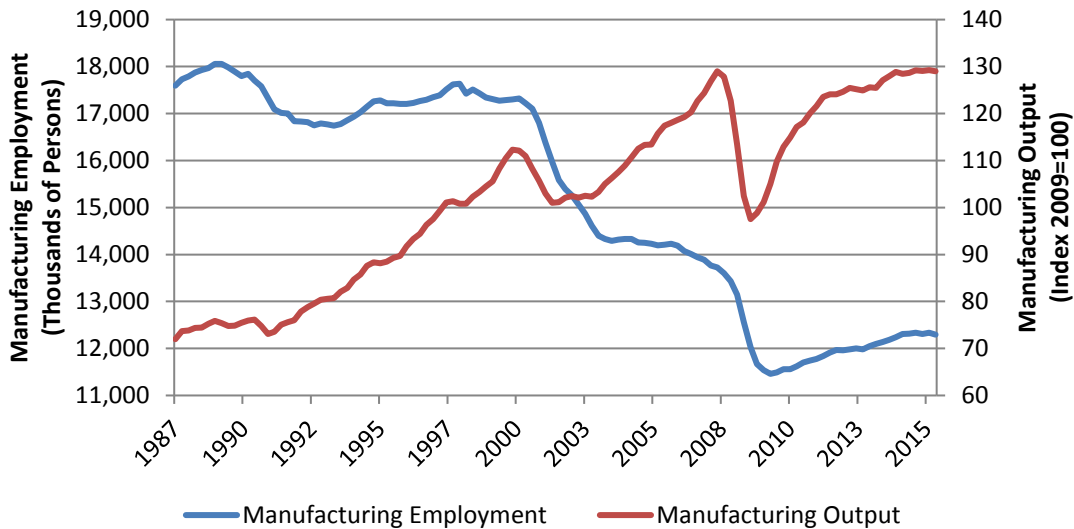
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<sup>3</sup> YiLi Chien, “What Drives Long-Run Economic Growth,” *On The Economy*, St. Louis Federal Reserve, June 1, 2015, <https://www.stlouisfed.org/on-the-economy/2015/june/what-drives-long-run-economic-growth>.

<sup>4</sup> “20 Facts about U.S. Inequality that Everyone Should Know,” Stanford Center on Poverty & Inequality, 2011, <http://inequality.stanford.edu/publications/20-facts-about-us-inequality-everyone-should-know>.

<sup>5</sup> Author’s calculation with data from Saint Louis Federal Reserve/U.S. Bureau of Labor Statistics, 2016.

<sup>6</sup> Anthony Carnevale, Tamara Jayasundera, Artem Gulish, *America’s Divided Recovery: College Haves and Have-Nots*, Washington, DC: Georgetown University Center on Education and the Workforce, 2016, <https://cew.georgetown.edu/wp-content/uploads/Americas-Divided-Recovery-web.pdf>.



Source: Saint Louis Federal Reserve, with data from U.S. Bureau of Labor Statistics, 2016.

## The Role of Trade in the Economic Transition

Trade, though a much smaller driver than technology, pushes in the same direction, accelerating the structural shift toward higher-skilled service jobs. Trade between the United States and Mexico, like technological advances, increases the competitiveness of regional industries. By allowing manufacturers to spread their operations and link up their supplier networks throughout North America, trade facilitates the creation of a system that combines the comparative advantages of each nation, allowing each country to specialize in the aspects of production that it does best and make the overall production process more efficient. The auto industry, which is probably the single most integrated regional industry, is a perfect example. Without the availability of nearby Mexican plants to do the final assembly of light vehicles, it is quite possible that the vast U.S. parts producing network for these vehicles would migrate to someplace outside of the continent.<sup>7</sup> This suggests, as our model of U.S. jobs tied to trade with Mexico finds, that U.S. manufacturing jobs are in net terms boosted by bilateral trade even as the mix of employment in the industry (and in service sector positions that support the auto industry) shifts toward higher-skilled positions. This is reinforced by the work of Theodore Moran and Lindsay Oldenski, who find that investment by U.S.-based firms in Mexico is associated with employment growth in their U.S. operations, focused on the creation of higher-skilled jobs related to things like innovation, engineering, and management.<sup>8</sup>

<sup>7</sup> See, for example, Eduardo Porter, “Nafta May Have Saved Many Autoworker’s Jobs,” *New York Times*, March 29, 2016, [http://www.nytimes.com/2016/03/30/business/economy/nafta-may-have-saved-many-autoworkers-jobs.html?\\_r=0](http://www.nytimes.com/2016/03/30/business/economy/nafta-may-have-saved-many-autoworkers-jobs.html?_r=0).

<sup>8</sup> Theodore H Moran and Lindsay Oldenski, “The US Manufacturing Base: Four Signs of Strength,” Washington, DC: Peterson Institute for International Economics, June 2014; and Theodore H Moran and Lindsay Oldenski, “How US Investments in Mexico Have Increased Investment and Jobs at Home,” Washington, DC: Peterson Institute for International Economics, July 2014.



Researchers from Ball State University help provide a sense of the difference in the dimensions of the technology and trade as drivers of the economic transition underway, finding that about 87 percent of manufacturing job losses in the period from 2000 to 2010 were caused by productivity increases, while 13 percent were linked to trade.<sup>9</sup> Groundbreaking work by Autor, Dorn, and Hanson has looked at the local impacts of trade, focusing in particular on U.S. imports from China. They estimate a larger impact, finding that the large, rapid, and imbalanced growth of U.S.-China trade is responsible for one-quarter of all U.S. manufacturing job losses from 1990-2007.<sup>10</sup> Interestingly, their work finds no negative effect for U.S. imports from Mexico, which also grew significantly during the period under study but are driven by a very different set of factors. While the broad consensus in the literature on NAFTA is that the agreement did not have significant effects on the U.S. labor market, recent work by McLaren and Hakobyan has found focused negative impacts on the wages of non-college graduates in industries or locales exposed to significant import competition from Mexico after NAFTA.<sup>11</sup> Other work, however, has found that the current impact of NAFTA preferences for Mexican imports is actually slightly positive for U.S. wages (focused on skilled workers), suggesting that the NAFTA shock, where there was one, has passed while more positive impacts persist.<sup>12</sup>

A look at some of the basics of trade theory can help decipher its multiple impacts on the U.S. economy. Trade theory is clear about the benefits of trade. Trade allows nations to consume more and a wider variety of goods. Through the creation of economies of scale and the exploitation of comparative advantage, nations involved in trade become more efficient producers. We see these benefits play out clearly in U.S.-Mexico trade. The development of large, integrated manufacturing industries in North America that serve regional and even global demand are the epitome of economies of scale. The North American auto industry is the quintessential example, but the regional aerospace, electronics, medical devices, and audio-visual equipment industries also benefit enormously from cross-border, integrated value chains, to name just a few more. The two countries have each specialized, utilizing their comparative advantages. Mexico has become the main supplier of winter fruits and vegetables for U.S. consumers, while U.S. grain exports to Mexico have increased as bilateral trade has expanded and been liberalized. Trade theory makes clear that trade expands overall production and consumption, and therefore, as Krugman and Obstfeld put it in their classic textbook on international economics, “it is possible to ensure that everyone is better off as a result of trade.”<sup>13</sup>

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<sup>9</sup> Michael Hicks, Srikant Devaraj, *The Myth and the Reality of Manufacturing in America*, Ball State University, 2016, <http://conexus.cberdata.org/files/MfgReality.pdf>.

<sup>10</sup> David Autor, David Dorn, Gordon Hanson, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States,” National Bureau of Economic Research Working Paper 18054, Cambridge, MA: NBER, May 2012, pp. 20-21, <http://www.nber.org/papers/w18054>.

<sup>11</sup> John McLaren and Shushanik Hakobyan, “Looking for Local Labor Market Effects of NAFTA,” National Bureau of Economic Research Working Paper 16535, Cambridge, MA: NBER, November 2010, <http://www.nber.org/papers/w16535>.

<sup>12</sup> Justino De La Cruz, David Riker, “The Impact of NAFTA on U.S. Labor Markets,” Office of Economics Working Paper No. 2014-06A, U.S. International Trade Commission, June 2014.

<sup>13</sup> Paul Krugman and Maurice Obstfeld, *International Economics: Theory & Policy*, Eighth Edition, Boston: Pearson Addison-Wesley, 2009, 73.

Trade, like most economic policies, impacts income distribution. This means that within nations there are winners and losers. Specifically, “Owners of a country’s abundant factors gain from trade, but owners of a country’s scarce factors lose.”<sup>14</sup> In the United States, this means that higher skilled workers tend to benefit from trade, and lower skilled workers—in the absence of offsetting social programs—lose. Empirical studies confirm this, finding that between 1980 and 1995 trade with less developed countries played a modest role in driving down wages of workers without a high school diploma and in increasing the wage premium paid to workers with a college degree.<sup>15</sup> It should be noted, however, that the study finds that other factors, such as skill-biased technological change, have been much more important in driving the wage improvements of higher-skilled workers and the challenges facing lower-skilled workers in the United States. Recent work has shown that these impacts persist in the period of 2001-2014.<sup>16</sup>

## Too Many Scapegoats—Too Few Solutions

Technological innovation may be a bigger driver of the structural change that involves major losses in manufacturing employment, but trade liberalization, as a policy choice, has become a part of electoral politics in a way that technology never will. As a result, policy debates over trade end up being the principal public space in which those who have been left behind by the structural changes underway in the U.S. economy are able to voice their frustrations. Americans understand that there are important opportunities for the nation to engage with the global economy, but they are also skeptical about the impact of trade agreements. Public opinion shows that Americans generally support increased trade with Mexico, but they believe NAFTA has been bad for the U.S. economy.<sup>17</sup> Within trade, Mexico in particular has been unfairly targeted. The work of Autor, Dorn and Hanson cited above calls this into question, finding that trade with China has played by far the largest role in accelerating the decline of manufacturing employment in the United States.<sup>18</sup>

Misperception and scapegoating has certainly played a role in creating the current negative political environment around trade (including the opposition to the Trans-Pacific Partnership by

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<sup>14</sup> Ibid., 68.

<sup>15</sup> George Borjas, Richard Freeman, and Lawrence Katz, “How Much Do Immigration and Trade Affect Labor Market Outcomes?,” *Brookings Papers on Economic Activity*, 1997, <https://www.hks.harvard.edu/fs/gborjas/publications/journal/Brookings1997.pdf>.

<sup>16</sup> David Autor, David Dorn, Gordon Hanson, Presentation at Peterson Institute for International Economics, Washington, DC, May 5, 2016, [https://piie.com/system/files/documents/autor-hanson20160505ppt\\_0.pdf](https://piie.com/system/files/documents/autor-hanson20160505ppt_0.pdf).

<sup>17</sup> Pew Research Center, “Americans Are of Two Minds on Trade,” November, 2010, <http://www.pewresearch.org/2010/11/09/americans-are-of-two-minds-on-trade/>; and more recently on NAFTA, John McCormick and Terrence Dopp, “Free-Trade Opposition Unites Political Parties in Bloomberg Poll,” *Bloomberg Politics*, March 24, 2016, <http://www.bloomberg.com/politics/articles/2016-03-24/free-trade-opposition-unites-political-parties-in-bloomberg-poll>.

<sup>18</sup> David Autor, David Dorn, Gordon Hanson, “The China Syndrome: Local Labor Market Effects of Import Competition in the United States,” National Bureau of Economic Research Working Paper 18054, Cambridge, MA: NBER, May 2012, pp. 20-21, <http://www.nber.org/papers/w18054>.

both candidates in the 2016 presidential election campaigns), but so has the very real failure of U.S. policymakers to adequately address the challenges facing middle-class Americans. So, if trade provides gains to the overall U.S. economy, which it does, but causes losses for low-skilled workers, which again it does, then in order to make trade promoting policies good for all people in the country, supplementary policies are needed to do two things. First, efforts are needed to move as many workers as possible from the side of those suffering losses to the side of those experiencing gains. This means helping those negatively impacted by trade (or better yet, everyone who needs it) access educational and worker training programs. Second, protections are needed for those who experience job or wage loss as a result of trade, certainly in the form of short-term support as workers transition to new jobs and industries but possibly also in the form of longer-term wage insurance.

The United States has for decades, and under various iterations, administered the Trade Adjustment Assistance program in order to assist workers whose jobs were lost due to increased import competition or outsourcing, but it is a small program with limited success aside from perhaps helping policymakers support trade promoting policies. Within the program, which is really a combination of various unemployment insurance supplements and types of support for worker training, outcomes were positive when recipients received training for a specific field and then found work in that field.<sup>19</sup> This suggests that the challenge of effectively linking education and workforce training programs to specific industry and employer needs is very important to address (as it is in the broader education system). Trade Adjustment Assistance's limits and temporary nature give rise to the use of alternative social programs to mitigate trade impacts. For example, areas in the United States with significant manufacturing job losses related to increased Chinese imports experienced growth in per capita payouts of Social Security Disability Insurance (SSDI, a permanent support for workers who become disabled) 30 times greater than Trade Adjustment Assistance payouts.<sup>20</sup> Ultimately, given the size of the challenge to train and retrain the U.S. workforce so that it is prepared for the needs of the 21st Century, a much broader, whole-of-government strategy is urgently needed. It is no longer sufficient to provide assistance to workers who have lost their jobs due to imports from other countries. Instead, we need to face the fact that the structural shift in the U.S. economy requires an economic adjustment program, a more holistic take on smoothing the negative effects on American workers that takes into account the multiple dimensions of the transformation.

## Conclusion

The impact of U.S.-Mexico trade on the U.S. economy is positive and widespread. Workers throughout the United States have jobs that depend on U.S.-Mexico trade in both direct and indirect ways. U.S. industry is made more competitive through its trading interactions with Mexican companies and the subsidiaries of U.S. companies with operations in Mexico. The growth of U.S.-

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<sup>19</sup> Ronald D'Amico, Peter Schochet, The Evaluation of the Trade Adjustment Assistance Program: A Synthesis of Major Findings, prepared by SPR and Mathematica for the U.S. Department of Labor, December 2012.

<sup>20</sup> David Autor, David Dorn, Gordon Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," National Bureau of Economic Research Working Paper 18054, Cambridge, MA: NBER, May 2012, pp. 20-21, <http://www.nber.org/papers/w18054>.

Mexico trade has facilitated the emergence of a regional manufacturing platform that enhances the competitiveness of the entire region and as a result supports workers in both the United States and Mexico.

The overall impact of bilateral trade growth on U.S. wages appears to be quite small, and, in general terms, positive. There are, however, specific communities and industries whose workers (particularly those without a college degree) have experienced job and wage losses, and while Trade Adjustment Assistance has supported workers in many of those communities, the United States has not been fully successful in supplementing trade liberalization policies with worker and educational support programs to ensure that the gains of trade are distributed throughout the economy and to address the reinforcing nature of trade and productivity enhancing technological change. Millions of American workers already benefit from the U.S.-Mexico economic relationship. With the right approach by decision-makers on both sides of the border, those benefits can be expanded and extended to millions more. The United States and Mexico depend on each other more than ever for our economic well-being and competitiveness.

## Appendix A

### *Methodology*<sup>21</sup>

By Laura Baughman and Joseph Francois

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.

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<sup>21</sup> The model to calculate the number of U.S. jobs supported by trade with Mexico was run for the Mexico Institute by The Trade Partnership, and this note on the methodology utilized was written by Laura Baughman and Joseph Francois of The Trade Partnership.

## ***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.<sup>22</sup> 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. 9 database, as are substitution elasticities for value added.

We are interested in the impact of trade on the U.S. and state economies given the U.S. wage structures in 2014 (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 2014 level of trade.

## ***Data***

The model incorporates data from a number of sources. Data on production and trade are based on national social accounting data linked through trade flows (see Reinert and Roland-Holst 1997). For the 2014 simulation, social accounting data are drawn directly from the most recent version of the GTAP dataset, version 9. Trade data (both exports and imports) exclude re-exports.<sup>23</sup> This dataset is benchmarked to 2011 and includes detailed national input-output, trade, and final demand structures for 140 countries across 56 sectors (see Table A-1). We updated the trade and national account data to 2014.

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

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<sup>22</sup> 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.

<sup>23</sup> See <https://www.gtap.agecon.purdue.edu/databases/contribute/reexports.asp>.

Bank WITS dataset. All tariff information has been concorded to GTAP model sectors within the version 9 database.

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. Based on the availability of employment data as well as the size of some of the sectors, we expanded some sectors (e.g., "Trade" into its "Wholesale" and "Retail" components) and collapsed 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.

The 140 GTAP countries/regions are aggregated into seven groupings: the United States, Canada, Japan, Mexico, other TPP countries, the European Union and rest-of-world.

### **GTAP Model Sectors**

Paddy rice*	Wood products
Wheat*	Paper products, publishing
Cereal grains*	Petroleum and coal products
Vegetables, fruits, and nuts*	Chemicals, rubber, plastics
Oil seeds*	Mineral products
Sugar cane*	Ferrous metals
Plant-based fibers*	Non-ferrous metals
Other crops*	Metal products
Cattle, sheep, goats, and horses*	Motor vehicles and parts
Other animals*	Other transport equipment
Raw milk*	Electronic equipment
Wool, silk-worm cocoons*	Other machinery and equipment
Forestry	Other manufactures
Fisheries	Electricity
Coal	Gas manufacture, distribution
Oil	Water
Gas	Construction
Other minerals	Wholesale and retail trade**
Bovine meat products	Water transport
Other meat products	Air transport
Vegetable oils and fats	Other transport
Dairy products	Communication services
Processed rice	Financial services
Sugar	Insurance services
Other food products	Other business services

Beverages and tobacco  
Textiles  
Wearing apparel  
Leather products

Recreational and other services  
Government, education, health  
services\*\*

\* While GTAP has data for subsectors of agriculture, the U.S. Department of Commerce does not publish total U.S. employment for agricultural subsectors, so we were forced to look at these sectors in the aggregate.

\*\* GTAP does not break these categories down further.

### **Modeling Simulation**

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, and prohibitive trade costs against services trade with the United States.<sup>24</sup> We do this for trade with each of the countries and groupings noted above, and the total U.S. impact is the sum of the impacts for each of the countries/country groupings (including “rest of world”).

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 to/from each of the countries/country groupings, and in total, 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.

### **References**

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<sup>24</sup> 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.

