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International Trade and Labor Productivity in the United States: A NAFTA Perspective

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The North American Free Trade Agreement (NAFTA) celebrated its twentieth anniversary in 2014. The objective of NAFTA was to increase the efficiency and fairness of trade among the United States, Canada, and Mexico. This study utilizes industry-level panel data over the period 1987-2016 to evaluate labor productivity in the United States within key manufacturing industries since the United States joined NAFTA. Growth in labor productivity is an important economic driver of rising economic output and improved living standards. Results show bi-directional correlations between trade, exchange rates, and labor productivity, which underscore the impact of NAFTA on the United States' labor market.

Keywords: Trade, multilateralism, productivity, economic growth, NAFTA

Introduction

The North American Free Trade Agreement (NAFTA) was established between the United States, Canada, and Mexico in 1994. The market opening provisions of NAFTA removed all tariffs and most non-tariff barriers on goods produced and traded within North America. U.S. trade with Mexico and Canada has more than tripled since NAFTA was established. The most substantial changes took place in the textiles, apparel, automotive and agricultural industries, while also substantially impacting the financial services industry in Mexico.

Despite short term adjustment costs, most trade theories suggest that trade liberalization promotes economic growth among trade partners because producers can utilize areas in which they have a comparative advantage over competitors. Even though numerous studies have found a positive link between trade liberalization and economic growth, controversies still linger in establishing a clear connection. Panini and Antu (2007) suggest the existing empirical literature on trade and economic performance is often hindered by data problems or inadequate measurement of openness. Studies that have examined the causal effect of trade on growth at a combined or country level, have usually found a positive link between the two (Levine and Renelt, 1992; Edwards, 1998; Hanson and Harrison, 1999). However, when studies analyze the effect of trade on different regions or industries, the impact of trade liberalization can vary widely (Wall, 2002).

Relatively few trade papers focus on important measures like labor productivity specifically with industry-level data. Most of the existing papers examine aggregate data to measure the impact of NAFTA, which could hinder researchers' ability to provide clear conclusions for policymakers. This paper examines the impact of several trade-related variables on U.S. labor productivity utilizing disaggregated, industry-level data. Labor productivity is a principal economic indicator and has been used to understand and examine both recent and historical changes within the global economy (Villareal and Ferguson, 2017). The assessment of changes in labor productivity, alongside other major macroeconomic indicators, can provide a strengthened understanding of the economy.

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The paper is structured in the following way. Section 2 contains the literature review which provides a discussion of the trade and productivity literature. Section 3 highlights NAFTA and its impact on the U.S. manufacturing sector. Section 4 describes the data while Section 5 focuses on the empirical model and framework. Section 6 outlines the results of the econometric analysis and Section 7 concludes.

Literature Review

Many studies have examined the relationship between increased trade and economic performance. Moreover, there have been a number of papers specifically examining the effect of NAFTA on the trade flows of the countries involved in the treaty. Gould (1998) used a gravity model and found NAFTA to have a significant positive effect on trade flows between the United States and Mexico but an insignificant effect on the Canadian economy. Burfisher et al. (2012) found no distinct trade effect of NAFTA on the U.S. aggregate trade balance.

Funk et al. (2006) examined U.S. industry-level growth during the period following NAFTA. They used several gravity models to examine intra-NAFTA trade and found significant growth differences across states and industries, as well as variations in the impact of export growth on industries. They also found that substantial relocation of production has occurred within five sample U.S. states. Abizadeh and Tosun (2007) examined and compared the effect of trade openness on the productivity of skilled labor-intensive and unskilled labor-intensive industries for 20 OECD countries. They used panel data and the fixed-effect approach. Their results indicate that skilled workers' relative gains in productivity exceed gains of the unskilled workers.

Amiti and Konings (2005) utilized Indonesian plant-level manufacturing census data from 1991 to 2001 to study the effects of trade liberalization on plant productivity. Their study found that lower output tariffs can produce productivity gains by inducing tougher import competition, whereas cheaper imported inputs can raise productivity through learning, variety and quality effects. They also revealed that the largest productivity gains arise from decreasing input tariffs. A more current study by Goldberg and Pavcnik (2016) examined the effects of trade policy on economically important outcomes. While emphasizing the challenges associated with measuring trade policies such as non-tariff barriers, their results indicate significant effects of trade policy on trade volumes, firm and industry performance, and labor markets.

Economidou and Murshid (2008) examined the effect of trade on productivity growth using data from nine manufacturing industries within 12 OECD countries from 1978 to 1997. They constructed a panel dataset and controlled for industry specific differences. They

found that increased exposure to trade, particularly higher import volumes, has a small and positive influence on industries' productivity growth.

The goal of NAFTA was to accelerate trade liberalization among the North American countries. It was controversial when first proposed given the economic diversity among the three countries and the debate over its impact continues. Some policy experts give credit to NAFTA for increasing economic ties between the countries, forming more efficient production processes, and increasing the accessibility of lower-priced consumer goods which has contributed to living standard improvements in these countries. A further deepening of economic relations with Canada and Mexico will promote a common trade agenda which will continue to stimulate economic growth.

Opponents of NAFTA, on the other hand, claim that the agreement has caused massive worker displacement, thereby creating a downward employment trend and decline in wages in the U.S. The controversies surrounding NAFTA and other multilateral free trade agreements gained considerable momentum during the U.S. election season of 2016. President Trump often mentioned the promise to withdraw if he could not renegotiate the NAFTA agreement according to his campaign priorities. One of his central campaign promises was to renegotiate NAFTA. On November 30, 2018, President Trump signed the United States-Mexico-Canada Agreement (USMCA), which would supersede NAFTA if the agreement is ratified by the U.S. congress and the legislatures of Mexico and Canada. According the Office of the United States Trade Representative (2019), some of the major provisions of the USMCA will affect rules of origin for automobiles, agricultural trade, U.S. intellectual property protections, and establish benefits to U.S. small and medium enterprises.

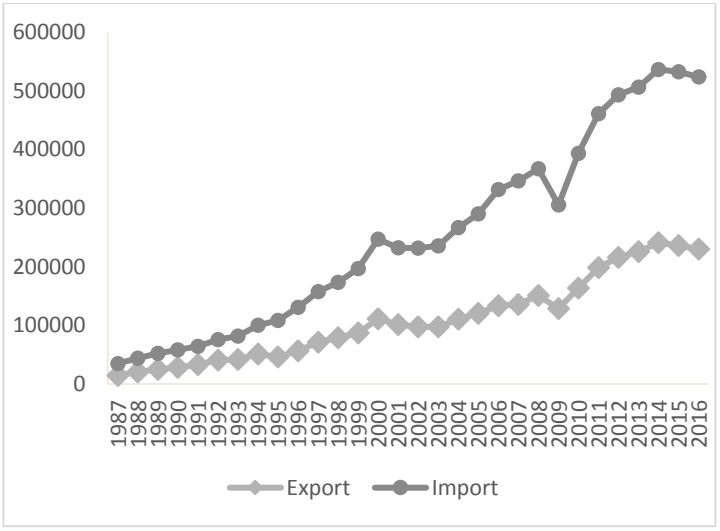
Policy issues related to NAFTA thus continue to be of critical importance and interest for congress. NAFTA incentivized a new generation of trade agreements in the Western hemisphere, resulting in altered negotiations in areas such as market access, rules of origin, intellectual property rights, foreign investment, conflict resolution, labor rights and environmental protection (Villareal and Ferguson, 2017).

NAFTA phased out all U.S. tariffs on imports from Mexico and Mexican tariffs on U.S. and Canadian products as long as they satisfied the rules of origin requirements. NAFTA gradually eliminated all tariffs and most non-tariff barriers on goods produced and traded within North America over a period of 15 years after the initiation of the treaty. Some tariffs were eliminated immediately and some were phased out in different schedules of 5 to 15 years (Economidou and Murshid, 2008).

At the time NAFTA was implemented, the U.S. – Canada Free Trade Agreement (FTA) of 1989 was already in place and U.S. tariffs on most Mexican goods were low. Some of the key NAFTA provisions included the reduction or removal of tariff and non-tariff trade barriers, rules of origin, services trade, foreign investment, intellectual property rights protection, government procurement, and dispute resolution (Villareal and Ferguson, 2017). Since the U.S. – Canada FTA was in effect, NAFTA provisions mainly resulted in the removal of U.S. tariffs and quotas applied to imports from Mexico, as well as Mexican trade barriers applied to imports from U.S. and Canada (Villarreal, 2003).

Mexico ranks second among U.S. export markets and is the third largest supplier of U.S. imports. Figure 1 highlights U.S. trade with Mexico, which has increased rapidly since NAFTA was initiated. The exports to Mexico grew by 453 percent, an increase from $41.6 billion in 1993 to $230.1 billion in 2016. Over the same period, the imports from Mexico grew by 636 percent, an increase from $39.9 billion to $293.9 billion.

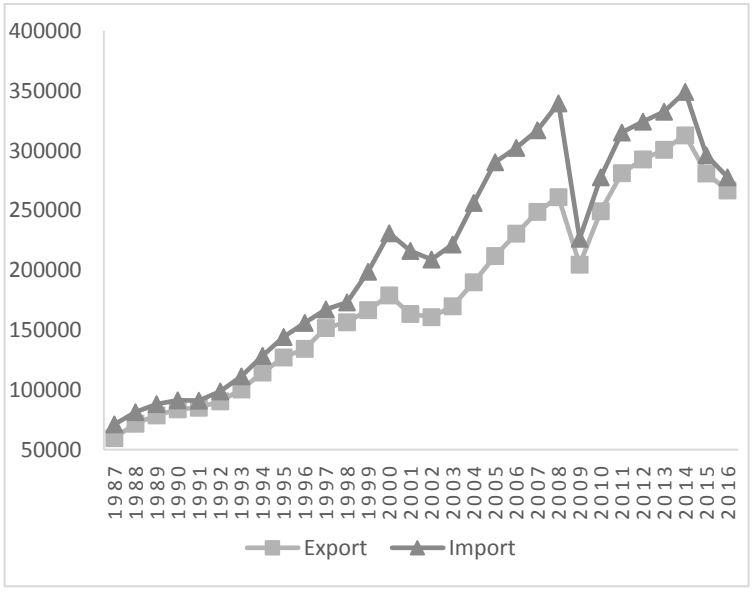
Figure 1 U.S. Merchandise Trade with Mexico ($ Millions)



Source: United States Census Bureau, U.S. International Trade Data

Canada is the United States' second largest trade partner, the largest export market for the U.S., and the third leading supplier of U.S. imports. Figure 2 shows U.S. exports to and imports from Canada. U.S. goods exports to Canada were $266.7 billion in 2016, which is more than any other country, while the U.S. imported $278 billion. The largest export to Canada is automobiles and parts. Other major manufacturing categories include petroleum products, industrial machinery, and equipment. The largest import is crude oil and gas from Canada's plentiful shale oil fields.

Figure 2 U.S. Merchandise Trade with Canada ($ Millions)



Source: United States Census Bureau, U.S. International Trade Data

The manufacturing industry is one of the key industries impacted by NAFTA. Many experts and observers have credited NAFTA for assisting U.S. manufacturing industries, especially the U.S. auto industry, which became globally competitive through the development of supply chains in Mexico (Villarreal, 2016). U.S. manufacturing

industries, including the automotive, electronics, appliances, and machinery, rely on the support of Mexican manufacturers. Changes in Mexican rules and regulations on export-oriented industries after NAFTA merged the maquiladora and Mexican local assembly-for-export factories to one program called the Maquiladora Manufacturing Industry and Export Services, which led to increased volumes of trade.

The North American aerospace and automotive industries also gained competitiveness from production sharing through NAFTA regulations. The U.S. manufacturing industry produced $2008.7 billion worth of goods in 1993 the year before NAFTA was initiated. In 2016, $3,835 billion worth of goods were produced, which is 1.86 times the initial value. Among major manufacturing industries, Petroleum, Chemical, Food, and Transportation had 3-digit growth in terms of value of production. Table 1 shows Electrical Equipment had 40 percent growth in value, while the Textile industry sustained a 29 percent decline since 1993. These changes in value occurred alongside 9 percent growth in labor productivity for the Manufacturing industry as a whole from 1993 to 2016. Overall, the chemical, transportation, and petroleum sectors experienced the steepest growth in labor productivity among all the industries. Nager (2017) suggests that such large improvements in energy production (petroleum and chemical output) are attributed to the influence of fracking technology. Figures 3 and 4 highlight these growth trends of labor productivity and the value of production among the eight sectors.

Table 1 Value of Production and Labor Productivity in the U.S.

Industry	Value of Production 2016 (in US$ B)	Growth in Value of Production (since 1993)	Growth in Labor Productivity (since 1993)
Manufacturing	3,835	85.5%	35%
Textile and Textile Products	49.2	-28.5%	22.2%
Petroleum & Coal	403.2	197.5%	38%
Machinery	323.7	75.7%	26.7%
Transportation	775.8	99.7%	38.5%
Chemical	653.8	128.8%	46.9%
Electrical	117.2	40%	0%
Food, beverage and tobacco products	782.7	101.4%	8.6%
Computer and Electronic Products	298.1	14.1%	-21.3%

Source: U.S. Bureau of Labor Statistics

Empirical Model and Framework

From the theoretical background, bilateral trade agreements such as NAFTA create competition from both imports and exports. Laprévote et al. (2015) reported that 88 percent of free trade agreements (FTAs) in operation have chapters and provisions dedicated to range of competition related issues such as promoting competition, monopoly regulations, abolishing trade defenses, competition enforcement principles, and several others.

International trade theory also suggests that the price of domestic goods could fall in domestic market if and when imported goods are sold in the domestic market, resulting in loss in profits in the affected sector. In order to increase profits in the domestic market, the affected firms or industry will have to increase sales and productivity to minimize production cost. There are several ways to increase productivity, which includes improved technology, training, and wages. Moreover, increasing employees' working efficiency is a more direct and less time-consuming approach.

Traditionally, BLS defines labor productivity as real output per labor hour, which is estimated by calculating the difference between the output growth rate and the corresponding labor hours' growth rate. For this study, labor productivity is calculated as the real value of output per labor cost for each of the chosen industries. LPit is labor productivity in industry i and year t. Therefore, equation 1 is expressed as:

$$LPit = \frac{Real\ value\ of\ output_{it}}{Price\ of\ Labor_{it}} \qquad (1)$$

A natural log of all the variables was taken and a least square dummy variable fixed effect panel model was estimated. The fixed effect model assumes that the intercept across the sectors are different and does not vary over time. Within the model, dummy variables are assumed for the eight industries used in this study. Dummy variables allow for each cross-section variable to have different intercept values, which allows for industry heterogeneity. The variance-covariance matrix is calculated using White's cross-section estimator. The advantage of the fixed effect model is that it assumes the error terms may be correlated with the individual effects among the regressors. Moreover, fixed effect panel analysis ensures that the estimated parameters are robust and the sample is unaffected by the presence of structural break level shift (Montañés and Reyes, 1999, 2000). For the data series in this study, the breaks occur in 1994, the sixth period of the series.

$$\begin{aligned}\log(\text{LPit}) = {} & b0 + b1\log(\text{IMPCAN}it) + b2\log(\text{EXPCAN}it) + \\ & b3\log(\text{IMPMEX}it) + b4\log(\text{EXPMEX}it) + \\ & b5\log(\text{EXCCAN}it) + b6\log(\text{EXCMEX}it) + \\ & b7\log(\text{TRADEWT}it) + b8\log(\text{MEXTARIFF}it) + \\ & u, \qquad (2)\end{aligned}$$

where LP is U.S. labor productivity, IMPCAN is imports from Canada, EXPCAN is exports to Canada, IMPMEX is imports from Mexico, EXPMEX is exports from Mexico, EXCCAN is the U.S.-Canada exchange rate, EXCMEX is the U.S.-Mexico exchange rate, TRADEWT is the trade-weighted exchange rate with U.S. major trading partners, and MEXTARIFF is the value of tariffs between the U.S. and Mexico. U.S.-Canada tariffs are not considered because free trade with Canada began with the Canada-U.S. Free Trade Agreement in 1987, which is the beginning of this study's sample data set. U.S.-Mexican tariffs were decreased to zero shortly after the ratification of NAFTA.

Results

The fixed effect model results are found in Table 2. Model 3.1 shows the impact of trade on labor productivity. The coefficients for these variables are generally statistically significant at the 1 percent level for trade between U.S.-Canada and U.S.-Mexico. However, the relationship between U.S. exports to Mexico and U.S. labor productivity was inverse throughout the models. This suggests that increased exporting to Mexico may result in a race to the bottom within U.S. industries.

Model 3.2 includes exchange rate variables for Canada and Mexico, in addition to the trade variables. Coefficients for these variables are both significant at the 5 and 1 percent level and have negative impacts on labor productivity. These findings support the fact that higher exchange rates for any of the U.S. trading partners will result in lower trade. As the U.S. dollar weakens against foreign trading partner currencies, exports from the U.S. increase and imports from foreign trading partners decrease, creating a relative country-to-country trade surplus. Increased production within industrial export sectors tend to create improvements in labor productivity. The need to increase production and compete with Canadian or Mexican products will create incentives to increase labor productivity. The U.S.-Mexican

exchange rate coefficient shows that a one percent increase in the price of the U.S. dollar to the Mexican peso will result in a nominal (.08) percent decrease in labor productivity in U.S.

In a multilateral, highly globalized world, the trade-weighted exchange rate can be a more useful measure than the bilateral exchange rate. An increase of the trade-weighted exchange rate means, ceteris paribus, the purchasing power of the U.S. dollar increases (the dollar strengthens against its trading partners). This may reduce the cost of imports and make exports more expensive to trading partners, thus undermining the competitiveness of exports. Model 3.3 adds the trade-weighted exchange rate, which is statistically significant and negative. The negative relationship implies U.S. labor productivity would improve as the trade-weighted exchange rate increases, because of more competition from foreign imports.

Model 3.4 contributes Mexican tariffs to the overall analysis. The tariff variable for Mexico, a trade policy tool, is negative and consistent with some studies. However, the literature is very mixed regarding tariff changes (trade liberalization) and productivity. Various studies suggest that the relationship depends on various factors, include the types of tariffs (input vs. output), the quality of inputs, and the degree of market penetration. Amiti and Konings (2005) argued that lower tariffs affect wages differently, depending on how globalized the markets among the countries tended to be. Industries that were less globalized experienced a positive relationship between lower tariffs and lower wages. Lower wages tend to correlate with lower productivity. This study's tariff coefficient shows that a one percent increase of tariffs on imports from Mexico correlate with a decrease in U.S. labor productivity by 0.01 percent; however, the coefficient is not significant.

The table provides the coefficient estimates for the pooled least squares estimation of equation (2) in the text. Furthermore, the variance-covariance matrix is calculated using White's cross-section estimator. The variables used in the study are: US labor productivity (*LP*), imports from Canada (*IMPCAN)*, exports to Canada (*EXPCAN*), imports from Mexico (*IMPMEX)*, exports from Mexico (*EXPMEX)*, the US-Canada exchange rate (*EXCCAN)*, the US-Mexico exchange rate (*EXCMEX)*, the trade-weighted exchange rate (*TRADEWT*), and the value of tariffs between the US and Mexico (*MEXTARIFF*). The sample size is 270 and contains data from the years 1987 – 2016, which provides a total of 30 observations per 9 industry cross-sections. All industry-level data are in annual frequency. Standard errors are in parentheses and *, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 2 Labor Productivity Model (Fixed Effects)

Model	**3.1**	**3.2**	**3.3**	**3.4**
LogIMPCAN	-0.212 (0.057)***	-0.253 (0.057)***	-0.260 (0.652)***	-0.089 (0.132)
LogEXPCAN	0.769 (0.075)***	0.629 (0.075)***	0.588 (0.079)***	0.533 (0.100)***
LogIMPMEX	-0.001 (0.050)	0.168 (0.044)**	0.199 (0.462)***	0.096 (0.081)
LogEXPMEX	-0.193 (0.052)***	-0.200 (0.038)***	-0.192 (0.034)***	-0.185 (0.035)***
LogEXCCAN		-0.094 (0.043)**	-0.010 (0.063)	-0.028 (0.055)
LogEXCMEX		-0.077 (0.026)***	-0.094 (0.026)***	-0.063 (0.035)*
LogTRADEWT			-0.117 (0.067)*	-0.056 (0.072)
LogMEXTARIFF				-0.009 (0.005)
R-Squared	0.95	0.96	0.96	0.96

Conclusion

The aim of this study was to examine the impact and importance of international trade since NAFTA on labor productivity in the U.S. using a set of 1987–2016 panel data at the industry level for eight selected industries. These industries were selected because they account for relatively high volumes of trade between these three countries. The findings show that U.S.-Canada and U.S.-Mexico trade are both significant correlates with U.S. labor productivity. Variability does exist, however, with regard to the role imports and exports play in relating to U.S. labor productivity. Additional research should uncover the extent to which the volume of imports and exports influence competition and create a learning-by-doing environment within the U.S. and thereby affect labor productivity.

Exchange rates, generally, were strongly related to U.S. labor productivity. Exchange rates were negative, while tariffs were insignificant, which is interesting because much of the literature suggests that tariffs in any form tend to reduce labor productivity despite NAFTA trade agreements. As suggested in the results, further research that disaggregates tariffs by inputs and outputs, as well as measures the degree of market penetration of firms, would help verify the overall impact of tariffs on labor productivity. This study could also benefit from access to longer time series data and data for additional industries. Longer time series will help the study examine before and after NAFTA effects within the industries. It would be of interest to evaluate similar sets of data from Canada and Mexico, so that the results can be compared and robustness tests conducted on the results. We believe these are promising areas for future research.

Regarding the USMCA, as additional years transpire, it will be interesting to measure the impact of the USMCA on these industries with particular regard to labor productivity. As part of the USMCA, 40 to 45 percent of auto parts will have to be produced by workers with a minimum wage of $16 per hour. The countries involved in this agreement can also sanction one another for labor violations. Such measures may disrupt the labor markets and accelerate automation in the industries impacted by the regulations which should alter labor productivity.

References

Abizadeh, S. and M.S. Tosun. 2007. Open Trade and Skilled and Unskilled Labor Productivity in Developing Countries: A Panel Data Analysis. *The Journal of International Trade and Economic Development* 16 (3), pp. 383 – 399.

Amiti, M. and D. Davis, 2008. Trade, Firms, and Wages: Theory and Evidence. *Review of Economic Studies* 79 (1), pp. 1-36.

Amiti, M. and J. Konings. 2005. Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia. *IMF Working Paper* 5 (146).

Board of Governors of the Federal Reserve System (U.S.), Trade Weighted U.S. Dollar Index, retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/TWEXB, June 9, 2017.

Board of Governors of the Federal Reserve System (U.S.), Canada / U.S. Foreign Exchange Rate, retrieved from FRED, Federal Reserve Bank of St. Louis. https://fred.stlouisfed.org/series/AEXCAUS, June 2, 2017.

Board of Governors of the Federal Reserve System (U.S.), Mexico / U.S. Foreign Exchange Rate, retrieved from FRED, Federal Reserve Bank of St. Louis. https://fred.stlouisfed.org/series/AEXMXUS, June 2, 2017.

Burfisher, M., R. Sherman, and K. Thierfelder. 2012. Impact of NAFTA on the United States. *Journal of Economic Perspective*, 15 (1), pp. 125-144.

Bloch, H. and J.T. McDonald. 2001. Import Competition and Labor Productivity. *Journal of Industry, Competition and Trade* 1 (3), pp. 301-319.

Census Bureau, *North American Industry Classification System 2017* (accessed June 2, 2017). https://www.census.gov/eos/www/naics/

De Wachter, S. and Tzavalis, E. 2012. *Detection of Structural Breaks in Linear Dynamic Panel*

Data Models. *Computational Statistics & Data Analysis* 56 (11), pp. 3020–3034.

Dovis, M. and J. Milgram-Baleix. 2009. Trade, Tariffs and Total Factor Productivity: The Case of Spanish Firms. *World Economy* 32 (4), pp. 575-605.

Economidou, C. and A.P. Murshid 2008. Testing the Linkages between Trade and Productivity Growth. *Review of Development Economics* 12 (4), pp. 845 - 860.

Fernandes, A.M. 2007. Trade Policy, Trade Volumes and Plant-Level Productivity in Colombian Manufacturing Industries. *Journal of International Economics* 71 (1), pp. 52-71.

Funk, M., E. Elder, V. Yao, and A. Vibhaker. 2006. Intra-NAFTA Trade and Surface Traffic: A Very Disaggregated View. *Regional Economic Development, Federal Reserve Bank of St. Louis* (October), pp. 87 – 89.

Goldberg, P. and N. Pavcnik. 2016. The Effects of Trade Policy. *NBER Working Paper* No. 21957.

Gould, D. 1998. Has NAFTA Changed North American Trade? *Economics and Financial Policy Review* 83 (1), pp. 12-23.

Hanson, G. and A. Harrison. 1999. Trade, Technology, and Wage Inequality. *Industrial and Labor Relations Review* 52, pp. 271-288.

Kruiniger, H. 2008. Not So Fixed Effects: Correlated Structural Breaks in Panel Data. Unpublished manuscript, Queen Marry, University of London.

Laprévote, F., S. Frisch, and B. Can. 2015. Competition Policy within the Context of Free Trade Agreements. E15Initiative. *Geneva: International Centre for Trade and Sustainable Development (ICTSD) and World Economic Forum.*

Levine, R. and D. Renelt. 1992. A Sensitivity Analysis of Cross-Country Regression. *The American Economic Review* 82 (4), pp. 942 – 63.

Lodge, F. 2016. Trumping Trade: The Future of NAFTA. *The Cipher Brief*, December 16. https://www.thecipherbrief.com/trumping-trade-the-future-of-nafta

Long, H. 2018. U.S.-Mexico-Canada Agreement: Who are the Winners and Losers of the 'New NAFTA'? *The Washington Post*, October 2018. Accessed January 5, 2019.https://www.washingtonpost.com/business/2018/10/01/winners-losers-usmca-trade-deal/?utm_term=.6f9f4d619583

Montañés, A., Reyes, M., 1999. The Asymptotic Behavior of the Dickey-Fuller Tests under the Crash Hypothesis. *Statistics and Probability Letters* 42 (1), pp. 81-89.

Montañés, A., Reyes, M., 2000. Structural Breaks, Unit Roots and Methods for Removing the Autocorrelation Pattern. *Statistics and Probability Letters* 48 (4), pp. 401-409.

Nager, A. 2017. Trade vs. Productivity: What Caused U.S. Manufacturing's Decline and How to Revive It. *Information Technology and Innovation Foundation Working Paper* (February).http://www2.itif.org/2017-trade-vs-productivity.pdf

Office of the United States Trade Representative, 2019. United States-Mexico-Canada Trade Agreement. Accessed on January 26, 2019. https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement.

Oulton, N. 1989. Productivity Growth in Manufacturing 1963-85: the Roles of New Investment and Scrapping. *National Institute Economic Review* 127 (1), pp. 64 – 75.

Oulton, N. 1998. Competition and the Dispersion of Labor Productivity amongst UK Companies. *Oxford Economic Papers* 50 (1), pp. 23-38.

Pavcnik, N. 2002. Trade Liberalization, Exit and Productivity Improvements: Evidence from

Chilean Plants. *Review of Economic Studies* 69 (1), pp. 245–276.

Perron, P. 2006. Dealing with Structural Breaks. In K. Patterson and T. M*ills Handbook of Econometrics*, Vol. 1: Econometric Theory (Palgrave, London).

Topalova, P. and A. Khandelwal. 2004. Trade Liberalization and Firm Productivity: The Case of India. *The Review of Economics and Statistics* 93 (3), pp. 995-1009.

Sprague, S. 2014. What Can Labor Productivity Tell U.S. About the U.S. Economy?" *Beyond the Numbers:* Productivity 3 (12). U.S. Bureau of Labor Statistics.

Accessed on May 10, 2018. https://www.bls.gov/opub/btn/volume-3/what-can-labor-productivity-tell-U.S.-about-the-U.S.-economy.htm

United Nations International Trade Statistics Database (accessed June 25, 2017). https://comtrade.un.org

Villarreal, M.A. 2016. U.S.-Mexico Economic Relations: Trends, Issues, and Implications. University of North Texas Libraries, Digital Library report, Washington D.C. Accessed on April 2, 2018. https://digital.library.unt.edu/ark:/67531/metadc944769/m1/1/

Villarreal, M.A. and I.F. Ferguson. 2017. The North American Free Trade Agreement. Congressional Research Service 7-5700. Accessed on May 24, 2018. https://fas.org/sgp/crs/row/R42965.pdf

Wall, H. 2002. NAFTA and the Geography of North American Trade. Federal Reserve Bank of St. Louis, ICPSR 1285. Accessed on March 11, 2018. https://doi.org/10.3886/ICPSR01285.v1

Supplementary materials:

Descriptive Statistics ($ billions, 1987 – 2016)

	Food	Petro.	Transp.	Chemical	Machinery	Electrical	Textile	Computer & Electronic	Manu.
Value of Production									
Min	299.3	123.6	317.4	207.0	140.2	69.6	42.8	204.0	1628.9
1st Quartile	401.9	144.1	421.2	308.1	210.5	91.9	52.4	293.2	2240.2
Median	491.0	212.1	531.7	394.1	256.5	104.6	64.0	328.9	2767.8
3rd Quartile	651.4	494.5	598.0	627.0	320.2	115.6	69.1	369.2	3694.3
Max	789.9	789.1	789.1	692.4	377.6	122.4	78.6	459.2	4162.0
Mean	529.6	340.5	524.1	447.5	260.0	100.8	62.3	323.2	2906.9
St. Dev.	153.1	235.6	134.1	163.7	69.7	16.3	10.5	64.2	800.7
Coefficient of Variation	29%	69%	26%	37%	27%	16%	17%	20%	28%

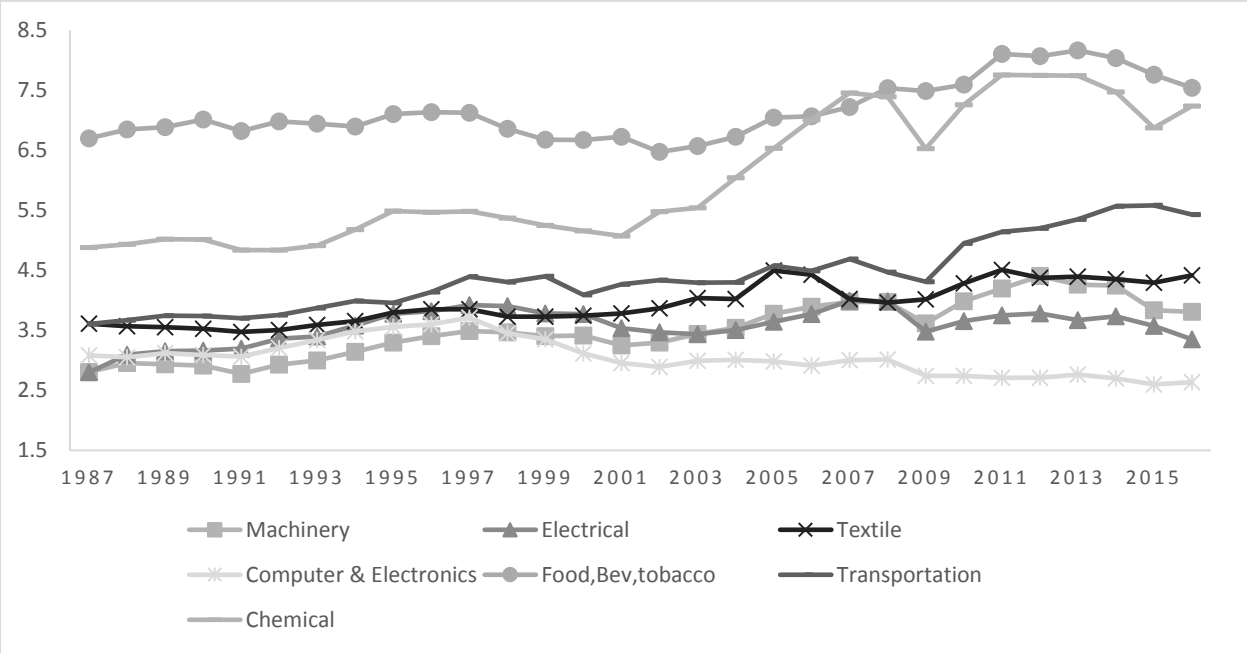
Source: U.S. Bureau of Labor Statistics

Unit Root Test for Series Stationarity

Variable	Notation	ADF Statistic	DW Statistic	Ho: Unit Root
Labor Productivity (Food, Beverage, and Tobacco)	LP_FBT	4.2507***	1.9876	Accept
Labor Productivity (Manufacturing)	LP_MAN	4.158***	1.9759	Accept
Labor Productivity (Textile)	LP_TXT	4.0568***	2.0693	Accept
Labor Productivity (Petroleum and Coal)	LP_PET	4.7072***	1.9501	Accept
Labor Productivity (Machinery)	LP_MAC	4.7715***	1.9725	Accept
Labor Productivity (Transportation)	LP_TRA	6.119***	2.0527	Accept
Labor Productivity (Chemical)	LP_CHEM	4.3639***	1.9239	Accept
Labor Productivity (Computer and Electronics)	LP_COMP	3.8832***	1.9514	Accept
Labor Productivity (Electronic Appliances and Components)	LP_EAP	4.5080***	1.9165	Accept
Exports to Canada	log(EXPCAN)	4.8729***	1.9935	Accept
Exports to Mexico	log(EXPMEX)	5.5713***	2.0952	Accept
Imports from Canada	log(IMPCAN)	5.2479***	1.9886	Accept
Imports from Mexico	log(IMPMEX)	4.3189***	1.9782	Accept
U.S.-Canada Exchange Rate	log(EXCCAN)	3.1978**	1.9413	Accept
U.S.-Mexico Exchange Rate	log(EXCMEX)	5.2376***	1.8672	Accept
U.S. Tariff on Mexico	log(MEXTARIFF)	5.1088***	2.0019	Accept
Trade Weighted Exchange Rate	log(TRADEWT)	4.0643***	1.7881	Accept

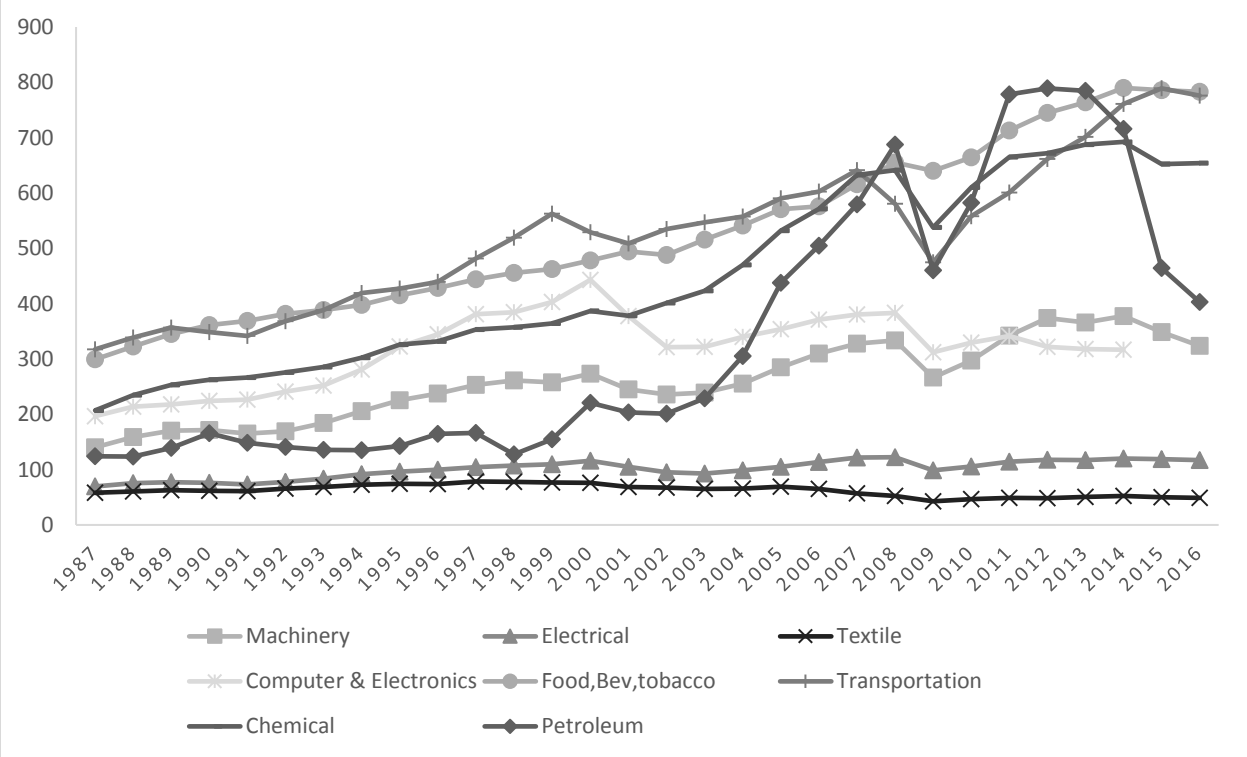
*, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Labor Productivity in U.S. by Major Industry



Source: U.S. Bureau of Labor Statistics

Value of Production in U.S. by Major Industry ($ Billions)



Source: U.S. Bureau of Labor Statistics