AN EMPIRICAL INVESTIGATION OF THE EFFECTS OF NAFTA, CHINA'S ADMISSION TO THE WORLD TRADE ORGANIZATION, AND IMPORTS FROM MEXICO AND CHINA ON EMPLOYMENT IN US MANUFACTURING

Morsheda Hassan, Wiley College, Marshall, Texas
morshedat@yahoo.com

Raja Nassar, Louisiana Tech University, Ruston, Louisiana
ran1@suddenlink.net

ABSTRACT

Since the year 2000, employment in manufacturing in the US has declined at a rapid pace. Several factors have been cited as responsible for this decline. Politicians and commentators have focused on cheap imports of goods from China and Mexico. Other factors cited are the North American Free Trade Agreement (NAFTA), China's admission to the World Trade Organization (WTO), and technology in manufacturing.

There is a lack of empirical quantitative studies on what affects employment in manufacturing. In this study, we use time series analysis to determine if a relationship exists between imports of goods from China or Mexico and employment in manufacturing in the US. In addition, we determine if NAFTA or China's admission to the WTO affect US employment in manufacturing. Results show that imports from China and Mexico have a positive effect on US employment in manufacturing. China's admission to the WTO has a negative effect on US employment in manufacturing. On the other hand, NAFTA has no effect on employment in manufacturing.

INTRODUCTION

Employment in manufacturing in the United States has been on the decline for decades. In the 1960s, one in three jobs in the US was in manufacturing; in 2013 less than 9% of jobs were in manufacturing. This loss of manufacturing jobs has contributed to income inequality (Autor, Katz, & Kearney, 2008). Since 2000, the decline in manufacturing jobs has been at a rapid pace. This has been attributed to several factors: import competition from countries such as Mexico and China, NAFTA, China's admission to WTO, and technology (Autor et al., 2008; Acemoglu, Autor, Dorn, & Hanson, 2016; Krugman, 2008; Mullen & Panning, 2009). NAFTA, which was signed into law in 1994, has been blamed for loss of manufacturing jobs in the United States. The elimination of tariff on trade between Mexico and the US through NAFTA and the lower labor cost in Mexico was an inducement for manufacturing firms in the US to move across the border into Mexico.

Another factor that was blamed for loss of manufacturing is China's admittance to the WTO in 2001. Other factors mentioned are the trade deficit in the US and the increase of technology in the workplace (Edwards & Lawrence, 2013). Technological innovation in the form of robotics and IT could have had an effect on reducing jobs in manufacturing. Increase in labor efficiency, induced primarily by new technology, decreased employment in a number of industries: chemical, electric, and electronic (Kuehn & Braschler, 1986). However, according to Chang and Hong (2013), the majority of the manufacturing industries hire workers when there is improvement in technology. Contrary to common belief, technological innovation was found to create more jobs in the short and long run.

Of interest is the fact that while unemployment in manufacturing has been on the rise, there is no evidence that unemployment at the national level has been affected by loss of jobs in manufacturing. This could imply that lost jobs in manufacturing were recreated in different sectors of the economy (Jensen, 2016).

Politicians cite imports of cheap goods from China and Mexico as the cause for loss of jobs in manufacturing. There are few recent quantitative studies in the literature dealing with cause or causes for the rise of unemployment in manufacturing. In this study, we determine, using statistical time series analysis on economic data over years, if a relationship exists between employment in manufacturing in the US and the following factors: NAFTA, China's admission to the WTO, and U.S. import of goods from China and Mexico.

REVIEW OF LITERATURE

Brynjolfsson and McAfee (2011) argued that technological innovation and information technology (IT) will continue to replace workers in all sectors, but particularly in IT-intensive sectors such as manufacturing. Acemoglu et al. (2014) pointed out that IT-intensive industry show increased productivity, which could translate into reduced employment. US manufacturing data for the period 1980 – 2009 were used in their study. The authors utilized multiple linear regression relating productivity to IT. Their findings did not support the argument that IT-intensive industry show increased productivity.

Krugman (2008) pointed out that through free trade, low-wage countries had a disruptive effect on labor in high-wage countries. This effect can be quite significant as the low-wage country share of US imports increased substantially. As reported by Autor, Dorn, and Hanson (2013) low-wage country share of US imports climbed from 15% in 2000 to 28% in 2007 due largely to imports from China. The authors studied the effect of import competition between 1990 and 2007 from China, a relatively low-wage country, on the labor market in the US. The authors concluded that rising imports contributed to a decrease in employment and lower wages in the manufacturing industry. A quarter of the decline in manufacturing employment in the US was attributed to import competition.

Jensen (2016) pointed out that presidential nominees and administrations in the US love the manufacturing sector and have come up with programs to create manufacturing jobs. He argues that a rebound in manufacturing is not likely to have an impact on the national employment since manufacturing accounts for only about 8% of the labor force. The author was of the opinion that the US would benefit from focusing attention on trade in services. He presented statistics showing that global trade increased seven times during the period 1980-2010 and the US services share of this world trade increased from about 10% in 1980 to about 20% in 2010. He stated that the US had a significant opportunity for increasing economic growth through exports in business services.

Acemoglu et al. (2016) reported that imports from China after 2000 was a major contributor to the reduction in employment in manufacturing and to weak overall job growth in the US. The authors estimated that 2.0 – 2.4 million job losses in the period 1999-2011 occurred because of imports from China.

Mullen and Panning (2009) studied empirically the effect of outsourcing and investment in technology on the employment of unskilled workers in manufacturing in a sample of US manufacturing industry from 1997 to 2002. Outsourcing was measured by the imports of intermediates by the manufacturing industries. Technology investment was measured by the spending by firms on research and development (data obtained from the National Science Foundation) and by US Bureau of Economic Analysis data on the component of the total investment spending by the manufacturing firms that was allocated to information and communication technology. Results of their regression analysis showed that both outsourcing and technology investment contributed significantly to a decrease in the employment of unskilled workers in manufacturing.

Logan (2008) studied the effect of trade liberalization through NAFTA between Mexico, US, and Canada and proximity to international borders on employment and wages in the US manufacturing sector between 1980 and 2000. Results indicated that location or proximity to borders had no effect, while trade liberalization with Canada had a positive effect in the sense that it increased employment in manufacturing and contributed to wage growth. It was estimated that a 1% reduction in U.S. tariffs on imports from Canada and Mexico led to a 2.35% and a 4.31% employment growth in manufacturing, respectively. However, a 1% increase in manufacturing imports from Mexico led to a 0.16% reduction in employment growth.

Silva and Leichenko (2004) reported that trade liberalization, although it had an overall beneficial effect, had a negative effect on industries with less skilled labor.

Using US bilateral imports and exports in manufacturing for the period 1989-2001, Datta and Kouliavtsev (2009) studied the effects of labor wages, tariffs and exchange rates on the composition of US imports of textiles before and after NAFTA. The authors found little evidence of any effect of NAFTA on textile trade diversion. There was an effect on trade creation. Tariffs and exchange rates were found to have significant effects on US import composition.

Using regression methodology, Kemeny et al. (2015) examined the effect on job loss in manufacturing of trade in the form of low-wage imports, taking into consideration individual and firm characteristics, in particular adoption of technology. They found that imports from low-wage countries had a negative effect on employment of low-skilled workers, those that did not have a full high-school education. Low-wage imports had no effect on job loss for workers that had at least a Bachelor's degree. Technology was not related to job loss. It was found that investment in computer equipment was associated with job retention.

Several studies in the literature show that job loss due to plant closure and lay-offs are related to import competition or import from low-wage countries, but not to trade in intermediaries (Addison et al., 2000; Haveman, 1998; Kletzer, 2000).

Baily and Bosworth (2014) presented data, which showed that manufacturing share of the GDP in the US was stable since 1960, while employment in manufacturing was on a steady decline. The fact that manufacturing value was stable is due to improvement in productivity attributed to technology, such as computers and electronics. The authors pointed out that 90% of manufacturing firms that are not technology-intensive showed slow growth in productivity and their share of the GDP decreased substantially.

METHODS

Quarterly economic data for U.S. imports of goods from China and Mexico and employment in manufacturing in the US were obtained online from the St. Louis Federal reserve *(*https://www.stlouisfed.org*)*. Data were available for the period 1985-2016.

In order to determine if NAFTA or China's admittance to the WTO had any effects on U.S. employment in manufacturing a time series intervention analysis was used. In addition, the time series transfer function analysis was used in order to determine the relationship between imports from Mexico or China and employment in manufacturing in the U.S. The SAS software was used in the analysis. Time series analysis is the correct method of analysis for time series data where the errors are auto correlated. Regression analysis for time series data is known to give spurious results (Granger & Newbold, 1974).

Intervention Analysis

Intervention analysis (Box & Tiao, 1975) is used to study the effect of an intervention on a time series response variable, when the time (T) of the intervention is known. For instance, if the intervention is NAFTA, it is entered in the model as a step function (0 before 1994 and 1 at and after 1994). If the response due to the impact is felt b periods after the intervention at time T, the impact of the intervention on the response variable is

$$WB^{b}S_{t}^{T}, \tag{1}$$

where, b is the time delay for the impact of the intervention to be felt, w is the impact coefficient and

$$S_t^T = \begin{cases} 0, & t < T \\ 1, & t \geq T \end{cases}$$

However, if the response due to the impact is gradual, the impact can be specified, in general, as

$$wB^bS_t^T/(1\text{-}ϒB) \quad (2)$$

Where ϒ is between 0 and 1 (Wei, 2006).

The intervention model is written as

$$y_t = x_t + wB^bS_t^T \quad \text{or} \quad y_t = x_t + wB^b S_t^T/(1\text{-}ϒB) \quad (3)$$

where y_t is the observed series and x_t is the series before the intervention. The time series must be stationary. If a series is not stationary, then differencing is used to make it stationary.

Time Series Transfer Function Model

A time series transfer function model relating a stationary output series y_t to a stationary input series x_i is

$$y_t = v(B)\, x_t + a_t \quad (4)$$

where $v(B) = w(B)B^c/d(B)$.

Here, $w(B) = w_0 – w_1B - \ldots\text{-}w_sB^s$

$d(B) = 1\text{-}d_1B\text{-} \ldots \text{-}d_rB^r$.

and c represents the time delay (or lag) until the input variable x_t produces an effect on the output variable $y_{t.}$

The function v(B) with its lags is determined from the cross correlations between the pre-whitened input series x_t and filtered output series $y_{t,}$ namely the significance at a given lag and the pattern of the cross correlations over lags (Wei, 2006). For instance, if the correlation is significant at only lag 0, then Equation (2) becomes

$y_t = w_0x_t + a_t$.

Once v(B) is identified, one can express a_t in Eq. (4) as

$$a_t = y_t – v(B)\, x_t \quad (5)$$

and identify the appropriate time series model for Eq. (5). With a_t known, one can determine the final model in Eq. (4).

RESULTS

Mexico

Transfer Function Model

The best model fit from Equations (4) and (5) to the observed import data from Mexico (impm) and employment in manufacturing in the U.S. (empl) was found to be

$$(1\text{-}B)(1\text{-}B^4)empl_t = (0.048 + 0.072B + 0.043B^2)(1\text{-}B)(1\text{-}B^4)impm_t + (1+0.439 - 0.269)e_t \qquad (6)$$

Here, B is the backshift operator and e is the random error.

Equation (6) indicates that import from Mexico is positively related to employment in manufacturing in the United States. This positive relationship was significant Also, the cross correlation between the two series (impm and empl) was positive and significant. This seems to be contrary to the expectation that cheap import has a negative effect on employment. As will be explained later, if import includes raw materials and intermediate products or goods used for manufacturing, then the effect on employment can be positive.

Intervention Analysis

The cross correlation between the step function S_t^T representing NAFTA and employment in manufacturing was not significant. This implies that NAFTA was not related to employment in manufacturing in the U.S. Likewise, w in Equation (3) was not significantly different from zero indicating no effect of NAFTA on employment.

China

Transfer Function Model

The cross correlation between import of goods from China (cimport) and employment in manufacturing in the U.S. (empl) was positive and significant. The best transfer function model fit to the observed import and employment data was found to be

$$(1\text{-}B)(1\text{-}B^4)empl_t = (0.0247 + 0.0184B)(1\text{-}B)(1\text{-}B^4)cimport_t + ((1\text{-}0.61B^4)/(1\text{-}0.693B))e_t \qquad (7\ )$$

Here, B is the backshift operator and e is the random error.

In agreement with the positive cross correlation between employment and imports from China, equation (7) shows that imports from China have a significant positive effect on employment as indicated by the positive coefficients of the cimport independent variable. This is in agreement with the results for Mexico and can only be explained by the import of raw material and intermediate goods for use by firms in the U.S. to manufacture finished products for the market.

Intervention Analysis

The cross correlation between the step function S_t^T representing China's admittance to the WTO and employment in manufacturing in the U.S. was negative and significant. Likewise, the intervention model in Equation (3) showed a significant negative effect (w = -285.08) for S_t^T. The final estimated model is

$$empl_t = (1 + 0.494B)(1- 0.754B^4 – 0.168B^5)((e_t/(1-B)(1-B^4)) - 285.08B^2S_t^T/(1-0.885B) \qquad (8)$$

Here, e_t is the random error term and B is the backshift operator. The impact of the intervention was felt after a time delay of two quarters (b=2).

DISCUSSION

Of interest is the finding that imports of goods from China and Mexico are positively related to employment. In other words, imports from China and Mexico benefit employment in manufacturing and are good for the economy. These results can only be explained if a substantial proportion of imports are used by firms and factories to produce finished products at a competitive rate. Perry (2016), in an interesting article on imports being beneficial for US employment, states that "The lower the price of inputs for US businesses (whether sourced internationally or domestically), the more competitive those companies are, the more of their products they can sell (both internationally and domestically), the greater market share they can achieve, and the more US workers they can hire."

Perry presents data showing that more than one half of US imports are raw materials or intermediate components that are used by US firms in manufacturing and are not goods for direct consumption by households. He even makes the point that nearly all imports are inputs for US firms, retailers and factories. Perry is of the opinion that we should be reporting the total volume of trade rather than focus on trade balance. The total volume of trade is the real measure since both exports and imports help the economy. An increase in total volume of trade is indicative of an expanding economy.

Our results, based on the statistical analysis, are in agreement with Perry's conclusion that cheap imports are beneficial to employment. Perhaps future data on imports should distinguish consumer goods from raw materials and intermediate goods.

Results from the intervention analysis indicate that NAFTA has no significant effect on reducing employment in manufacturing in the US. This is in spite of the fact that some firms moved part of their operations south of the border. On the other hand, admittance of China to the WTO has a negative effect on employment in manufacturing in the US. This may be due to increased competition with US firms on the world markets.

CONCLUSION

In this study, we investigated the effects of imports from China and Mexico on the employment in manufacturing in the United States using the transfer function time series modeling approach. In addition, we ran an intervention analysis to determine if NAFTA or China's admittance to the WTO had any significant effect on employment in manufacturing in the US. Results showed that imports from Mexico and China had a positive effect on employment. This was attributed to the fact that over 50% of imports were raw materials and intermediate goods, which served as low price inputs for firms, and factories in the US and which helped them to gain a larger market share and hire more employees.

The intervention analysis did show that China's admittance to the WTO had a negative effect on employment in manufacturing in the US. In addition, there was negative cross correlation between employment and China's admittance to the WTO. This was attributed to more competition on the World markets because of China's admittance. On the other hand, the intervention analysis did not show that the creation of NAFTA had any effect on employment in manufacturing. Also, there was no significant cross correlation between NAFTA and employment.

REFERENCES

Addison, J. T., Fox, D. A., & Ruhm, C. J. (2000). Technology, trade sensitivity, and labor Displacement, *Southern Economic Journal, 66,* 682-699.

Acemoglu, D., Autor, D., Dorn, D., Hanson, G. H., & Price, B. (2014). Return of the Solow paradox? IT, productivity, and employment in US manufacturing. *American Economic Review: Papers and Proceedings, 104,* 394-399.

Acemoglu, D., Autor, D., Dorn, D., & Hanson, G. (2016). Import competition and the great US employment sag of the 2000s. *Journal of Labor Economics, 34,* 141-198.

Autor, D., Katz, L., & Kearney, M. (2008). Trends in US wage inequality: Revising the revisionists. *The Review of Economics and Statistics*, *90,* 300–23.

Autor, D. H., Dorn, D., & Hanson, G. H. (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review 103,* 2121–2168.

Baily, M. N., & Bosworth, B. P. (2014). US manufacturing: Understanding its past and its potential future. *Journal of Economic Perspectives, 28,* 3–26.

Box, G. E. P., & Tiao, G. C. (1975). Intervention analysis with applications to economic and environmental problems. *Journal of the American Statistical Association, 70,* 70-79.

Brynjolfsson, E, & McAfee, A. (2011). *Race against the machine*. Lexington, MA: Digital Frontier Press

Chang, Y., & Hong, J. H. (2013). Does technology create jobs. *SERI Quarterly*, 45-53.

Datta, A. & Kouliavtsev, M. (2009). NAFTA and the realignment of textile and apparel trade: Trade creation or trade diversion? *Review of International Economics, 17*, 172-186.

Edwards, L., & Lawrence, R. Z. (2013). *Rising tide: Is growth in emerging economies good for the United States?* Washington, DC: Peterson Institute for International Economics.

Granger, C. W. J., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics, 2*, 111-120.

Haveman, J. B. (1998). The influence of changing trade on displacement of labor. *The International Trade Journal*, *12*, 259-292.

Jensen, J. B. (2016), Overlooked opportunity: Trade is services. *Economists' Voice, 13,* 1-7.

Kemeny, T. K., Rigby, D., & Cooke, A. (2015). Cheap imports and the loss of US manufacturing jobs. *The World Economy*, *38*, 1555-1573.

Kletzer, L. G. (2000). Trade and job loss in US manufacturing 1979-1994. In K Hari (Ed.), *The Impact of International Trade on Wages* (pp. 349-396). Chicago: University of Chicago Press.

Krugman, P. R. (2008). Trade and Wages, Reconsidered. *Brookings Papers on Economic Activity*, *39,* 103–38.

Kuehn, J. A., & Braschler, C. (1986). Technology and foreign trade impacts on U.S. manufacturing employment 1975–80. *Growth and Change Journal*, *17*, 46-60.

Logan, J. (2008). Belted by NAFTA? A look at trade's effect on US manufacturing belt. *Regional Studies, 42,* 675–687.

Mullen, J. K., & Panning, J. (2009). Foreign sourcing of intermediate inputs: Impacts on unskilled labor in US manufacturing industries. *Eastern Economic Journal*, *35,* 160–173.

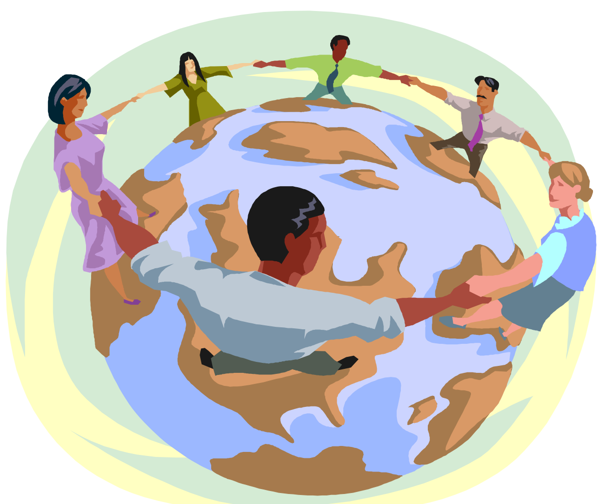
Perry, M. J. (2016). Nearly all imports, even consumer goods, are inputs for US firms, retailors, and factories. Retrieved from https://www.aei.org

Silva, J. A., & Leichenko, R. (2004). Regional income inequality and international trade. *Economic Geography*, *80,* 261–286.

Wei, W. S. (2006). *Time series analysis: Univariate and multivariate methods.* New York: Addison-Wesley.

Journal of International Business Disciplines

Volume 13, Number 1 May 2018



Published By:
Eastern Washington University and the International Academy of Business Disciplines

ISSN 1934-1822 WWW.JIBD.ORG