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Wage and Employment Effects of the North American Free Trade Agreement on the U.S. Manufacturing Sector

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Wage and Employment Effects of the North American

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ABSTRACT

According to the conventional theories of international trade, trade liberalization equalizes factor prices across countries involved in trade. The North American Free Trade Agreement (NAFTA) is a newer form of regional economic integration between a developing country, Mexico, and two developed countries, the United States and Canada. Complying with proposition of conventional theories, it is rational to expect that NAFTA will lead to equalization of factor prices among theses three countries. On the other hand, the existence of a wide gap in wages between the United States and Mexico may lead to lower wages in the U.S.A. This study, however, will show that the wage and employment effects of NAFTA on the U.S. manufacturing sector is insignificant. The reason for this is because the U.S. trade with Mexico consists of a tiny amount compared to total U.S. trade volume which suggests a very insignificant effect on both wages and employment in the United States.

In order to estimate the effect of NAFTA on wage and employment in the U.S. manufacturing sector, this study develops a set of equations in two stages: two basic equations in the first stage; and three supplementary equations in the second stage. Wage and employment are the endogenous variables in the basic equations. In the supplementary equations, productivity in the U.S. manufacturing sector, a foreign direct investment ratio, and Mexican exchange rates are the endogenous variables. These are also the explanatory variables in the basic equations. To secure the effects of NAFTA on wage and employment, a pre-NAFTA trade liberalization dummy variable, D1, and a NAFTA dummy, D2, are included in the supplementary equations. The linear regression technique is applied to one of the basic as well as one supplementary equation. Also, a log linear technique is used in the

remaining basic and supplementary equations.

Estimated coefficients of D2 represent the values by which NAFTA has changed values of the explanatory variables in the basic equations. Then, these estimates are used to calculate the effects of NAFTA on the U.S. manufacturing wage and employment level.

The overall results of the regression analysis suggest a statistically insignificant impact of NAFTA on wage and employment. Only the Mexican exchange rate has been able to generate significant influence on the U.S. manufacturing employment level. However, the total effect is estimated to be a very small gain in the U.S. manufacturing employment level. Although the results seem to support the hypothesis, the insignificant NAFTA coefficients may be due to the existence of multicollinearity.

To my Mother

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Finally, I am solely responsible for any errors that remain.

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CHAPTER 1

Introduction.

Conventional theories of international trade argue for free trade on the basis of comparative advantage. According to these theories, each of the member countries of a trade agreement benefits from the agreement if it engages in the production of commodities in which it has comparative advantage. For example, in the regional economic integration between the United States and Mexico both countries benefit because the United States has a comparative advantage in capital intensive commodities, and Mexico, on the other hand, can produce labor intensive products more efficiently than the United States. Another important reason for regional economic integration is to enhance or improve the competitive advantage (see Fawcett & Sheldon, 1993) of the member countries at home and abroad. The North American Free Trade Agreement (NAFTA) is an unusual integration experiment because it is an agreement between a developing country, Mexico, and two developed countries, the United States and Canada. The North American Free Trade Agreement (NAFTA) liberalizes trade and investment relations among these three countries. It is a new kind of free trade agreement because there are few precedents for such an agreement between developed and developing countries (Hufbauer & Schott, 1992).

Developing competitive advantage requires the improvement of efficiency and productivity. Trade liberalization forces domestic industries to face competition from other countries. However, it is widely argued that regional integration like NAFTA may place some additional burden on the regional work force, especially on the U.S. workers. The intra-regional adjustment process, such as relocation of labor among sectors, may cause unskilled workers of some specific sectors, such as the manufacturing sector, to lose their jobs temporarily; however, the intensity of this effect, if any, depends on the relative size or volume of trade of the United States with Mexico. A small trade coefficient indicates [a ratio of U.S. trade volume with Mexico to U.S. trade volume with the rest of the world] that the total effect will be an insignificant one.[1]

Stable political and economic institutions of a country are considered crucial for attracting a large volume of foreign investment. A recent collapse of Mexican financial markets may be an example of unstable economic structure.[2] Two important things might have encouraged the U.S. government to form a regional trade block with Mexico. One is the existing demand for the U.S. products in Mexico and the other is lower Mexican wages.[3] It is true that the lower Mexican wage may help create some trade diversion for the United States; to be globally more competitive, however, it is necessary for a country to improve both productive efficiency and factor productivity.

1.1. Purpose and Hypothesis.

The purpose of this paper is to examine the effect of NAFTA on the U.S. manufacturing employment level and wage rates. The hypothesis is that the trade liberalization between the United States and Mexico will have an insignificant impact on manufacturing wages and the employment level in the United States in the short run. The basis of the above statement rests on the fact that the U.S. trade with Mexico consists of a small percentage of total U.S. trade volume. A small trade coefficient-that is, a ratio of U.S. trade volume with Mexico to U.S. trade volume with rest of the world-indicates an insignificant impact on the output level and thus small effect on the factors of production. Many studies have been done concerning the impact of NAFTA on employment and wages in Mexico and the U.S.. Most of these are CGE (computable general equilibrium) and Econometric models. This study, however, is a partial equilibrium analysis using regression of time series. For current purpose, statistical technique will be applied to the time series observations of some relevant variables. Then, on the basis of dummy variables, the effects of NAFTA will be separated from the pre-NAFTA trade liberalization. The basic methodology is similar to that of the econometric models such as the model used by Economic Strategy Institute (ESI), an analysis of which is based on historical observations. This study differs, however, from the ESI model in terms of its concentration on a single sector, namely the U.S. manufacturing sector, and the use of dummy variables in supplementary equations.

The most important reason why this project focuses on the manufacturing sector to examine the impact of NAFTA on employment and wage is that almost 90% of U.S. exports to Mexico consist of manufactured goods (see Harrison, 1994). Second reason is that in 1991, the manufacturing sector employed 20% of industrial employment and contributed more than 25% of the industrial payroll. In terms of per capita income, the manufacturing sector contributed the highest share to the national economy in the same year.

The structure of this paper is as follows. The remainder of chapter 1 is a review of recent works concerning labor-related issues of NAFTA and discussion of the theoretical basis of the current study. Chapter 2 presents, definition of variables, model specification and method of the current research, and an analysis of data. The analysis of the regression results and the effects of

NAFTA are presented in chapter 3. The Final chapter is a summary of results, concluding remarks and suggestions for future research.

1.2. Review of the Literature.

To date a large number of studies have been accomplished concerning the impact of North American Free Trade Agreement (NAFTA) on wages and employment both in the United States and Mexico. These studies represent a wide variety of opinions. Most of the works hold a positive view concerning the impact of NAFTA on the U.S. wage and employment. However, several studies show the opposite side of the coin, that is, they demonstrate adverse effects of NAFTA on these two variables. In his article, Rudiger Dornbush (1990) asserts that the argument against a trade deal with Mexico concerns the wide gap in the wage and productivity between the United States and Mexico. As a result of liberalizing trade, he agrees, some U.S. jobs would move to Mexico. He prefers that jobs go to Mexico rather than to Asia. He supports his view using an empirical table which suggests that U.S. manufacturing trade with the developing countries had turned to a negative value of 30.8 billion dollars in 1988 from a positive value of 28.4 billion dollars in 1981. On the other hand, the U.S.-Mexico trade balance data over the 1987-1989 period shows a slight improvement, from -5.7 billion dollars to -2.2 billion dollars. Moreover, he contends that the increase in Mexican income level should have a positive effect on Mexican imports from the United States because a large part of Mexican income is spent on the U.S. commodities. He suggests that the effect on U.S. workers would be a temporary one. Over the long period, he argues that a large volume U.S. exports to

Mexico will create a large number of jobs in the United States. The main flaws in his argument concerning job losses to Mexico lie in the empirical analysis using trade balance data. His comparison should have included the trade balance of Asian countries. Second, the overall trade balance should also have been included in the comparison scenario. Moreover, the purpose of a trade agreement with Mexico is to increase the competitive advantage of the U.S. industries in the world market-not to divert job loss from Asia to Mexico.

Hufbauer and Schott's (1992) "NORTH AMERICAN FREE TRADE: Issues and Recommendation" is a comprehensive work on NAFTA. This book deals with almost every aspect of NAFTA. The authors discuss a variety of issues concerning NAFTA including the national objectives of the member nations to form a regional trade block, agenda and implications for the non-member countries, economic implications, and sectoral analysis. They argue that the implementation of NAFTA would generate economic growth in Mexico. Since 70% of Mexican imports contains U.S. goods and services, economic growth in Mexico may have a positive impact on U.S. employment in two ways. First, a strong economic growth implies an increase in Mexico's per capita income; since Mexico imports $300 per capita annually from the United States, the increase in per capita income in Mexico will generate additional demand for U.S. goods and services in Mexico and thus provide a way to potential employment gain for the U.S. industries. Second, they hold that increase in Mexican per capita income would reduce the pressure of illegal Mexican aliens on the U.S. labor force. Hufbauer and Schott, comparing a NAFTA and non-NAFTA scenario, estimate that NAFTA would generate additional U.S. exports of goods and non-factor services to Mexico of 16.7 billion dollars as well as additional imports from Mexico 7 billion dollars annually. The difference between the additional exports and additional imports would result in $9.0 billion trade surplus annually which represents an improvement in the U.S. trade balance. They further estimate that every billion dollars of trade surplus with Mexico would generate 14,500 jobs in the United States; thus some 130,000 ($9 x 14,500) additional jobs will be created by NAFTA.

A work by Hinojosa Ojeda and Sherman Robinson (1992) titled "Labor Issues in a North American Free Trade Area" is one of the most important NAFTA related research works. It surveys various studies analyzing NAFTA's effect on labor. Ojeda and Robinson consider three types of models in their surveys: (1) partial-equilibrium models based on historical extrapolations of regression analysis of key relationships; (2) single-country Computable General Equilibrium (CGE) models; and (3) multicountry CGE models.

In the first type of model, they review studies by Hufbauer and Schott of Institute of International Economics (IIE), Clyde Prestowitz , Koechlin and Meherene, and Edward Leamer. Hufbauer and Schott's study estimates a trade balance coefficient (change in employment as a function of trade balance) which indicates that, as a result of NAFTA, a positive trade surplus will generate new employment in the United States. Hinojosa and Robinson dispute the relevance of the IIE model which analyzes the long-run benefits of trade liberalization using a short-run Keynesian trade multiplier model. They further question the ability of the model to capture "any of the structural changes and gains from trade liberalization predicted by new classical trade theory."

The authors review the Economic Strategy Institute (ESI) model by Prestowitz and others from the same standpoint as they do in the IIE case.[4] The ESI model shows the macro economic impact of the formation of a FTA in terms of a number of assumptions. Hinojosa and Robinson claim that the ESI model is similar to the IIE model in economic structure. They mention that both IIE and ESI models assume a variety of fixed coefficient macroeconomic relationships and are driven by exogenous trends. However, the ESI model predicts a trade surplus for the United States until 1996-97. In 1997, surplus turns into a deficit. Hinojosa and Robinson further mention that the ESI model estimates a deficit of $30 billion by the year 1999. Given the employment-trade balance coefficient [which suggests that a one billion dollar deficit will destroy 30,000 jobs in the U.S.A and vice versa], a deficit of $30 billion would destroy more than 900,000 American jobs.

Hinojosa and Robinson mention that all the trade-focused CGE models that deal with labor-related issues of NAFTA are rooted in the new classical theory. They explain that a single country CGE model determines a set of domestic prices that clear products and factors markets as well as satisfy the balance of trade constraint for a particular country. Multicountry CGE trade models, on the other hand, determine a set of relative world prices as well as a set of real exchange rates. The relative world prices clear the world markets for traded commodities and the set of real exchange rates satisfy an equilibrium balance of trade condition for each of the trading countries included in the multicountry CGE analysis. They show that these models consider absolute prices as exogenous and include no financial variables such as money, assets or asset markets. Moreover, they are derived from the Walrasian general equilibrium model. Hinojosa and Robinson's reviews of the results from the CGE models deal with the wage, employment, and migration in Mexico.

In their review of labor related studies of NAFTA, Hinojosa and Robinson consider the International Trade Commission (ITC) model as the most stylized and closest to standard trade theory.[5] This model, they mention, indicates that trade liberalization between the United States and Mexico may cause the wages of unskilled labor to fall in the United States and to rise in Mexico. The effect on the U.S. workers, however, is shown to be very small.

In a later study replicating the scenario sketched in the ITC model, Hinojosa and Robinson estimate that the rural-urban unskilled wages in the United States would fall by a tenth of a percent; however, returns from other factors would stay unchanged. Among the other studies surveyed by Hinojosa and Robinson, the KPMG Peat Marwick model estimates a real wage rate in the U.S. under trade liberalization between the United States and Mexico.[6] This model considers forty-four sectors with only one employment category and shows that the real wage would increase only by 0.02%. Assuming a fixed wage, the model estimates a employment gain of 40,800 jobs in the Unites States. Finally, Hinojosa and Robinson's review of a study by Robinson and others shows that the supply effect of migration in the United States would result in a decline of rural-urban unskilled wages by 3-4 percent.[7] They argue that "the direct effect from the international factor movement on factor returns is larger that the indirect effect of price changes in product markets."

A review of Hinojosa and Robinson's article reveals that there is a variety of opinions concerning the wage and employment effect of NAFTA. One of the main reasons for different results lies in different kinds of assumptions used by various studies. The use of variety of economic modeling is also a reason for varied opinions. The IIE and the ESI model use the same framework for analyzing trade effects on wage and employment. Both models use trade balance to show the effect on employment. The only difference is that the IIE model by Hufbauer and Schott estimates a trade surplus which they use to show employment gain in the United States. The ESI model, on the other hand, employs the same reasoning but estimates a negative trade balance and thus a potential job loss in the United States. The CGE models that incorporated migration data suggest a decline in the (rural-urban) unskilled wages in the United States. However, in the absence of significant migration, Hinojosa and Robinson's model (replicating ITC model) estimates that the effect on the rural-urban unskilled wages is very small.

Paul Krugman (1993) in his article titled "The Uncomfortable Truth about NAFTA: It's Foreign Policy, Stupid" argues that the unskilled workers of a country comprising highly productive labor force may suffer due to a trade agreement with a country which mainly consists of low skilled workers. However, he disputes his argument by mentioning that there already exists quite low trade barriers between the United States and Mexico. If the low skilled workers are not affected already, how then, would removing trade barriers altogether affect the low skilled workers in the United States under NAFTA? He also contends that monetary policy can take care of any job loss of unskilled workers. Although suspicious about the Federal Reserve Bank, he emphasizes the Fed's role as a powerful determinant of job growth in America. He argues that by manipulating interest rates, the Federal Reserve can offset any increase in the unemployment rates. There are two problems in his relying on the Federal Reserve to offset job loss. First, his view on the Fed's role in controlling the job market originates from the Keynesian demand management policy. However, Keynesian demand management policy is effective only in the short run. Second, the Fed's action often does not work as Krugman admits. Krugman argues that NAFTA's damaging effect on the unskilled workers would be insignificant. He contends that "even the harsh critics of NAFTA rarely estimate job losses of more than 500,000-less than half of one percent of U.S. employment." He concludes that there is no evidence, so far, that supports the view of NAFTA's negative effect on employment level of low-skilled U.S. workers.

Many studies have been done concerning NAFTA's negative impact on U.S. wages and employment. Edward Leamer (1991) of UCLA examines the effects of a trade agreement between the United States and Mexico. His arguments are based on the new classical theory of international trade. First, he considers free movement of capital and labor; then, on the basis of the factor price equalization theorem, he argues that free commodity trade would lead to equalization in the factor prices, even in the absence of free mobility of factors of production.[8]

A study by Timothy Koehlin and Meherene Larudee (1992) analyzes the adverse effect of NAFTA on both the U.S. and Mexico's wages and employment level. The authors argue that NAFTA would shift employment to Mexico, reduce wages, and redistribute income from wage earners to profit earners in both the United States and Mexico. They estimate that the net effect of NAFTA would be to divert investment from the United States to Mexico. This diversion would increase the existing level of unemployment in the U.S. manufacturing sector. They further argue that NAFTA will result in the diversion of both inward and outward direct foreign investment of the United States. The authors expect that diversion of inward foreign investment would be greater than the diversion of outward foreign investment. The underlying reason for their contention is that between 1981 and 1988, investment by foreign firms in the United States was two and half times greater than investment by U.S. firms abroad. They further contend that if both inward and outward investment divert at the same rate to Mexico, inward investment flows would overwhelm the outward investment flows by a factor of 2.5. Net diversion of inward investment would have an additional impact on U.S. employment and wages. Koehlin and Meherene estimate a value of $108,500 for capital-labor coefficient which they use to infer that transfer of that amount of capital would shift one U.S. job to Mexico. They also estimate that over the time period 1992-2000, $31 billion to $53 billion of U.S. capital will be transferred to Mexico. Therefore, according to their findings, 290,000 to 490,000 U.S. jobs would be lost by the year 2000.

A recent survey by Lauren Harrison (1994) indicates that during the first nine months of NAFTA, from January 1 to september 31, 1994, growth in the U.S. exports to and imports from

Mexico occurred at a greater pace than occurred during the same period in 1993. Harrison shows that since May 1994, U.S. exports to Mexico averaged $1 billion per week which was 21.7% higher than that of the same period in 1993. The total volume of exports reached $37.5 billion during the first nine months of 1994. U.S. imports from Mexico were $35.7 billion during the January-September period in 1994 which was 22.8% higher than that of the same period in 1993.

The survey indicates that U.S. exports to North America grew twice as rapidly as exports to the rest of the world. For example, U.S. exports to the rest of the world grew by 7% during the first nine months of 1994 while exports to North America grew by 14% during the same time period. The U.S. merchandise trade surplus with Mexico increased by $71 million during January-September period of 1994 compare to the same period of 1993. As the survey result shows, job dislocations were minimal and, approximately, 3.5 million jobs were created in the United States during the first nine month of 1994.

1.3. Theoretical Basis.

Before going into detailed analysis, it is necessary to present the theoretical basis of the study. The marginal productivity theory of wage and labor is considered as the theoretical underpinning of the study. In other words, this study assumes that NAFTA's impact on the wage and employment can be analyzed through the demand side of the labor market while the supply of labor is assumed to be fixed.

Many studies of NAFTA's impact on the U.S. wage and employment level argue that transferring plants to Mexico will reduce the amount of capital available for the U.S. workers. Given the assumption of flexible wages, wage rates will fall as a result of a lower capital to labor ratio in the United States. The demand for labor is the active force in sizing the wage rate down. Thus assuming full employment, less labor will be demanded at the existing wage rate.

CHAPTER 2.

2.1. Definition of the Variables.

WAGE = average hourly earnings of non supervisory manufacturing workers in the U.S.A.. (number of dollars).

LEMP = Log of manufacturing employment level by industry.

PRODTY = Labor productivity in the U.S. manufacturing sector measured as output per man hour.

EXCHGN = Mexican exchange rate (value of old peso measured in terms of U.S. dollars).

LEXCHGN = Log of EXCHGN.

DFI = Ratio of the U.S. direct foreign investment in Mexico to direct foreign investment in the U.S. manufacturing sector by the rest of the world. (measured in millions of dollars).

LDFI = Log of DFI.

K = Capital intensity (capital to labor ratio) of the manufacturing sector measured in thousands of dollars.

LK = Log of K.

TB = Mexican trade balance measured in millions of dollars.

RM = Average costs of funds in Mexico in percentage term, used as proxy for interest rates in Mexico.

LRM = Log of LM

WM = Monthly wage index in Mexico.

LWM = Log of WM.

RU = Corporate AAA bonds rate in the U.S.A. (in percentage terms, representing the proxy for interest rate in U.S.).

LRU = Log of RU.

D1 = 0 for managed trade (1955-85) and NAFTA (1992-94) period.

= 1 for pre-NAFTA trade liberalization period (1986-91).

D2 = 0 for Managed trade (1955-85) and pre-NAFTA(1986-91) liberal trade period.

= 1 for NAFTA (1992-94) period.

2.2. Model Specification and Methodology.

For the correct specification of the model, scatter plots were generated for the hypothesized relationship among relevant variables and revealed non-linear patterns in one basic and one supplementary equations. To find consistent estimates, a log-linear technique was applied to those equations.

In order to identify the effect of NAFTA, statistical analysis is done in two stages. Two basic and three supplementary equations are specified for that purpose. Wage rates and employment levels are the dependent variables in the basic equations. In the supplementary equations the dependent variables are PRODTY, DFI, and EXCHGN. The effects of PRODTY, EXCHGN, and DFI on WAGE and of EXCHGN, K, DFI, and RU on EMP are estimated in the first stage. In the second stage, the effect of NAFTA on PRODTY, EXCHGN, and DFI is estimated with the help of dummy variable, D2. Dummy D1, on the other hand, is employed to separate the effect of pre-NAFTA trade liberalization from the NAFTA effect. Some other variables such as K in PRODTY equation, TB in EXCHGN equation, and WM, RU, RM in DFI equation are the additional independent variables in the supplementary equations.

The basic equations of the current study are shown as follows:

$$WAGE = Ao + A1PRODTY + A2EXCHGN + A3DFI + \epsilon 1 \qquad (2.2.1.)$$

where,

$A1>0$; $A2>0$; and $A3<0$;

$$LEMP = Bo + B1LEXCHGN + B2LK + B3LDFI + B4LRU + \epsilon 2 \qquad (2.2.2.)$$[9]

where,

$B1>0$; $B2>0$; $B3<0$; and $B4<0$;

Both A0 and B0 are the intercept terms. The constant A0 is the expected value of WAGE when PRODTY=EXCHGN=DFI=0. The constant B0, on the other hand, is the expected value of LEMP when the independent variables in the equation are equal to zero. The variables $\epsilon 1$ and $\epsilon 2$ are the error terms for equations 2.2.1. and 2.2.2., respectively.

A positive value for A1 is expected because of the direct relationship between the workers productivity and wage. According to the marginal productivity theory of wage, an increase in the level of marginal productivity would lead to an increase in the demand for labor thereby causing wage to increase.

It is assumed that EXCHGN and WAGE maintain a positive relationship. Depreciation/Appreciation of EXCHGN would increase/decrease the demand for Mexican products in the U.S. market and may cause the production of the substitute manufacturing products to fall/rise in the United States. Reduced/increased production results in reduced/increased demand for factors, especially labor; the supply of labor is assumed to be constant. Demand for labor and the wage rate are positively related. On the basis of the above argument, it is rational to expect a positive value for A2.

A negative value is anticipated for A3 because, if the rate of change in the U.S. direct foreign investment to Mexico is greater than the rate of change in the rest of the world's direct foreign investment in the U.S. manufacturing sector, existing manufacturing employment level in the U.S. would fall due to the transfer of U.S. capital to Mexico.

A positive value for B1 is expected. An increase in the EXCHGN generates more employment in the manufacturing sector; it makes imports of Mexican goods and services expensive in the United States and exports of U.S. commodities cheaper in Mexico. Consequently, more employment is expected in the manufacturing sector. A positive value is expected for B2, because an increase in the capital intensity increases the demand for labor thereby increasing the level of employment. On the other hand, B3 is expected to be negative; it is assumed that the rate of growth of investment transfer to Mexico is greater than the rate of growth of foreign investment in the U.S. manufacturing sector. As a result of net investment transfer, fewer workers will be demanded in the U.S. manufacturing sector. A negative value for B4 is expected; It is assumed that an increase in the interest rate has a dampening effect on the investment level which, in turn, adversely affects the level of employment and vice versa.

The remaining three supplementary equations are presented as follows:

$$PRODTY = \alpha o + \alpha 1K + \alpha 2D1 + \alpha 3D2 + \epsilon 3 \qquad (2.2.3.)$$

$\alpha 1>0;$

$$EXCHGN = \beta o + \beta 1TB + \beta 2D1 + \beta 3D2 + \epsilon 4 \qquad (2.2.4.)$$

$\beta 1>0$;

$$LDFI = \delta o + \delta 1LRM + \delta 2LWM + \delta 3LRU + \delta 4D1 + \delta 5D2 + \epsilon 5 \qquad (2.2.5.)$$[10]

$\delta 1>0$; $\delta 2<0$; and $\delta 3>0$;

Three intercept terms in the supplementary equations are $\alpha 0$, $\beta 0$, and $\delta 0$. Each of the intercepts is the expected value of the corresponding dependent variable when the independent variables in the corresponding equation are equal to zero. For example, Expected value of $\alpha 0$ or $E(\alpha 0)$ is equal to PRODTY when K=D1=D2=0. Again, $E(\beta 0)$=EXCHGN, when TB=D1=D2=0 and $E(\delta 0)$=LDFI, as LRM=LWM=LRU=D1=D2=0. The variables $\epsilon 3$, $\epsilon 4$, and $\epsilon 5$ are the error terms in equations (2.2.3.), (2.2.4.), and (2.2.5.), respectively. A greater than zero value is expected for $\alpha 1$ because an increase in capital intensity increases the productivity of the labor force.

It is rational to expect a positive value for $\beta 1$; a positive value for $\beta 1$ suggests that a surplus in the trade balance increases country's exchange rate in terms of another country's currency and vice versa.

A value for $\delta 1$ is expected to be greater than zero. The Mexican market rate of interest is assumed to be directly related to the investment from the United States. A higher rate results in more investment from the United States to Mexico. A negative value for $\delta 2$ is anticipated because higher Mexican wages discourage foreign investment in Mexico. A greater than zero value is anticipated for $\delta 3$. A higher RU attracts funds both from internal as well from external sources.

The D1 and D2 parameters are assumed to have no specific a priori restrictions because their estimated values depend on the forces influencing the trade situation between the Unites States and Mexico. The explanation of the expected values of the D1 and D2 parameters can be presented as follows.

The estimates of $\alpha2$ and $\alpha3$ may contain either positive or negative values. The positive values for $\alpha2$ and $\alpha3$ may be due to an increase in U.S. exports to Mexico which, in turn, attract more investment in the U.S. manufacturing sector; given the number of employed person, an increase in investment denotes an increase in PRODTY in the same sector. The negative values, on the other hand, may generate due to a decrease in the capital to labor ratio, which may happen due to the transfer of U.S. plants to Mexico, in the U.S. manufacturing sector.

For the $\beta2$ and $\beta3$ estimates, the positive values are expected because of an increase in the demand for Mexican goods and services, meaning increase in demand for pesos by U.S. buyers of Mexican products, in the United States. Moreover, a policy induced devaluation in Mexico may also be one of the reasons for expected positive values of $\beta2$ and $\beta3$. The negative values, on the other hand, may be due to an increase in the demand for U.S. products in Mexico.

The positive values for $\theta4$ and $\theta5$ estimates are anticipated because the trade liberalization between the United States and Mexico may cause the transfers of U.S. direct foreign investment into Mexico more rapidly than the rest of the world's foreign investment into the United States and vice versa.

Finally, the effect of NAFTA on WAGE as well as on EMP is calculated multiplying the estimated D2 parameters in the supplementary equations with the coefficients of the independent variables in the basic equations.

2.3. Data.

Data for this research work is collected from various issues of the Statistical Abstract of the United States, the Statistical Abstract of the Latin America, International Financial Statistics, Monthly Labor Review, Economic Indicators, Economic Report of the President, and Surveys of Current Businesses. International Financial Statistics and Statistical Abstract of the Latin America are the principal data sources for Mexican wage rate, interest rate, trade balance, exchange rate, and the U.S. foreign direct investment in Mexico. Data on Mexican economic indicators are difficult to assemble because they are either unpublished or improperly organized. Moreover, the highly unstable nature of the data made the effort more difficult.

Data for RM and WM is unavailable for the time period 1955-1974 and 1955-1967, respectively. Extrapolation method was used to generate the missing data for RM.[11] The data of WM is found to be constant at $0.2 from the year 1968 to 1974. On the basis of this information, the data from the year 1955 to 1967 is assumed to be the same as $0.2 as in the time period 1968-74. A splicing technique was needed to change the base year of 1982=100 for PRODTY data of the 1986-1994 period to a base year of 1977=100.[12]

CHAPTER 3.

3.1. Regression Results.

WAGE Equations

The Ordinary Least Squares (OLS) method is applied to the wage equation to estimate the coefficients of the explanatory variables and a constant in the equation. The results obtained are presented in Table 3.1.1..

The estimated coefficients of the model except EXCHGN and IMM turn out to have expected signs. The coefficient for PRODTY is 0.08 and significant at the 1% level. It can be interpreted to mean that a unit increase in the productivity index would lead to an increase in the manufacturing wage rate by $0.8, holding everything else constant.

The DFI coefficient is found to be -11.96 and is also significant at the 1% level. The result suggests that a unit increase in the value of DFI, everything else assuming constant, would decrease the U.S. manufacturing wage rate by $11.96.

The coefficients for both EXCHGN and IMM are found to have unexpected signs and are insignificant at the 5% level. Any interpretation would be meaningless in this situation.

Table 3.1.1.
Regression Analysis of the WAGE Equation.

	CONSTANT	PRODTY	EXCHGN	IMM	DFI
Coefficients	1.05	0.08	-0.00014	3.38	-11.96
	(0.79)	(7.99)*	(-1.18)	(0.56)	(-5.69)*
F-stat	397.39*				
R-Squared	0.97				
Adj R2	0.97				
DW	0.52				
n	40				

*significant at the 1% level.
#numbers in parenthesis are t-statistics

An F-value of 397.39 indicates that the overall model is significant at the 1% level. A value of 0.97 for adj R2 suggests that the independent variables in the model explain 97% of the variation in the dependent variable. A DW value of 0.522 confirms the existence of first-order positive serial autocorrelation.[13]

A test for multicollinearity is performed and a summary of results is presented in table 3.1.2.. As the results in the table demonstrates, the independent variables in the equation are highly collinear.[14]

Table 3.1.2.
Correlation Coefficient Matrix.

	Sample Correlation	P-Values
PRODTY vs EXCHGN	0.81	0.0001
PRODTY vs IMM	0.51	0.0007
PRODTY vs DFI	-0.93	0.0001
EXCHGN vs IMM	0.58	0.0001
EXCHGN vs DFI	-0.73	0.0001
DFI vs IMM	- 0.47	0.0022

The correction for first-order autocorrelation requires the use of the AR(1) technique, a form of Generalized Least Squares (GLS) method, on the SAS program.

The variable IMM is dropped due to its insignificant affect on wage. Although insignificant, variable EXCHGN is kept in the model considering its overall importance.

After re-estimation with GLS, the results obtained are presented in table 3.1.3..

The variable PRODTY is still found to be significant at the 1%. A value of 0.10 for PRODTY coefficient can be interpreted to mean that a unit increase in the U.S. manufacturing productivity index, everything else assuming constant, would lead to an increase in the manufacturing wage rate by $0.1. The results indicate that after GLS estimation, the variable DFI is turned out to be significant at the 5% level. Its estimate can be interpreted to mean that a one-million dollar increase in DFI, assuming everything else constant, would lead to a decrease in the wage rate by \$3.81. However, the estimate of EXCHGN coefficient has found to have both opposite sign and insignificant at the 5% level.

Table 3.1.3.

Regression Analysis of the WAGE Equation.

	CONSTANT	PRODTY	EXCHGN	DFI
Coefficients	-0.80	0.10	-0.00006	-3.81
	(-2.38)**	(9.73)*	(-0.54)	(-2.15)**
F-stat	124.28*			
R-Squared	0.91			
adj R-Squared	0.91			
DW	0.79			
n	39			

*significant at the 1% level.
**significant at the 5% level.
#values in the parentheses represent t-statistics.

Although displaying a lower value than before, an F-value of 124.28 suggests that the model is still significant at the 1% level. The value of the adjusted R2 falls to 0.91. However, the independent variables of the model can explain 91% of the variation in the dependent variable suggesting a quite good fit model. Although AR(1) technique has been applied to correct the problems of first-order autocorrelation, a DW value of 0.798 requires the use of AR(2) technique to correct for second-order positive serial autocorrelation.

The results generated after estimation with AR(2) technique on the SAS program are presented in table 3.1.4..

Table 3.1.4.

Regression Analysis of the WAGE Equation.

	CONSTANT	PRODTY	EXCHGN	DFI
Coefficients	7.50	-0.001	9.73	0.32
	(2.41)**	(-0.24)	(0.03)	(1.09)
F-stat	1122*			
R-Squared	0.99			
Adj R-Squared	0.99			
DW	1.82			
n	38			

*significant at the 1% level
**significant at the 5% level.
#numbers in the parentheses are t-statistics.

As it is manifested in Table 3.1.4., the signs of all the coefficients as well as the constant are turned out to be different from those were presented in Table 3.1.3.. The existence of multicollinearity may be the reason for both opposite signs and statistically insignificant values of the estimated parameters.

An adjusted R2 of 0.99 shows that the independent variables in the equation explain almost 100% of the variation in the dependent variable suggesting an impressive statistical model.

A DW value of 1.8231 suggests that the application of AR(2) technique has corrected the problems of autocorrelation.

The basic problem with the estimates of the new equation is that these estimates can not be used as reliable measures to calculate relevant NAFTA coefficients to secure the impact on the wage rate.

LEMP Equations

After estimation with the OLS method, the results from the LEMP equation are presented in Table 3.2.1..

The coefficient of LEXCHGN is estimated to be -0.009 and is insignificant at the 5% level. It has an unexpected sign. However, if we consider that the unexpected sign is due to the presence of multicollinearity, the lower t-ratio suggests (this, too, may be caused by multicollinearity) that the EXCHGN has an insignificant effect on the U.S. manufacturing employment level.

Table 3.2.1.
Regression Analysis of the LEMP Equation.

	CONSTANT	LEXCHGN	LK	LDFI	LRU	LWAGE
Coefficients	10.82	-0.009	-0.3	0.03	0.08	0.21
	(26.46)*	(-0.75)	(-2.9)*	(1.37)	(1.3)	(2.6)*
F-stat	15.96*					
R-squared	0.70					
Adj R2	0.66					
DW	0.51					
n	40					

*significant at the 1% level.
#numbers in the parentheses are t-statistics.

A value of -0.3 for LK is found to be significant at the 1% level. However, it an has unexpected sign. If we assume that it contains an expected sign with the same value, it can be interpreted to mean that a unit increase in the U.S. manufacturing capital intensity, everything else remaining constant, would lead to an increase in the employment level of the same sector by 30%.

The coefficients for the remaining three variables turn out to have unexpected signs. Of these, LDFI and LRU are found to be insignificant at the 5% level. The estimate for LWAGE coefficient is found to be 0.19 and is significant at the 1% level. However, it, too, has a wrong sign. Complying with the theoretical proposition that wage and employment maintain a direct relationship, this estimate could be interpret to mean that, everything else assuming fixed, a one dollar increase in the

LWAGE will lead to an increase in the level of LEMP by 19%.

An F-statistic of 15.96 suggests that the model is significant at the 1% level. An adjusted R2 of 0.66 indicates that the independent variables explain only 66% of the variation in the dependent variable which represents a workable fit model. A DW value of 0.511 showed the presence of positive serial autocorrelation. A test for heteroscedasticity confirms its nonexistence.

A test for multicollinearity is conducted and the results obtained are presented in Table 3.2.2..

Table 3.2.2.
Correlation Coefficient Matrix.

	Sample Correlation	P-values
LEXCHGN vs LK	0.85	0.0001
LEXCHGN vs LRU	0.48	0.0017
LEXCHGN vs LDFI	-0.90	0.0001
LEXCHGN vs LWAGE	0.85	0.0001
LK vs LRU	0.80	0.0001
LK vs LDFI	0.82	0.0001
LK vs LWAGE	-0.98	0.0001
LRU vs LDFI	-0.53	0.0005
LRU vs LWAGE	0.85	0.0001
LDFI vs LWAGE	-0.82	0.0001

As the results show, there is severe collinearity between each of the variables. Again, the AR(1) method is used for the correction of autocorrelation and the results of the GLS estimation are depicted in Table 3.2.3..

Table 3.2.3.
Regression Analysis of the LEMP Equation.

	CONSTANT	LEXCHGN	LK	LDFI	LRU
Coefficients	2.74	0.000002	-0.23	0.003	0.18
	(38.7)*	(1.64)***	(-3.5)*	(0.3)	(4.07)*
F-stat	5.07**				
R-squared	0.37				
Adj R2	0.30				
DW	1.38				
n	39				

*significant at the 1% level.
**significant at the 5% level.
***significant at the 10% level.
#values in the parentheses are t-statistics.

The variable LWAGE has been dropped from the LEMP equation because of a probable simultaneous relationship between LWAGE and LEMP variables. Both wage and employment are influenced by the demand for labor. Thus an increase/decrease in the demand for labor may lead to the increase/decrease in both wage and employment over time. The variable LEXCHGN turns out to have the expected sign. It is found to be significant at the 10% level denoting a 1% increase in LEXCHGN, everything else holding constant, will lead to an increase in the LEMP by 0.00001%.

The estimate of LK coefficient increases to -0.23 and is shown to be significant at the 1% level. However, it still has an unanticipated sign. The estimates for the LDFI and LRU coefficients have incorrect signs as before. An estimate for LDFI coefficient is found to be 0.003 and is insignificant at the 5% level. Again, the insignificant value and unexpected sign of the estimate of DFI coefficient may be due to the existence of multicollinearity. Although found to be significant at the 5% level, an estimate of LRU coefficient has the opposite sign than it was anticipated. As mentioned before, the existence of severe multicollinearity may be the reason for the opposite sign of this estimate.

Although the F-value falls to 5.07, the model retains its significance at the 5% level. A new adjusted R2 of 0.30 indicates that the independent variables can explain only 30% of the variation in the dependent variable which represents a very poor fit model. The lower R2 has resulted due to the exclusion of the LWAGE variable from the equation. A DW value of 1.38 indicate that the test for autocorrelation has resulted in an inconclusive decision about the existence of autocorrelation.

PRODTY Equation

The OLS method is also applied to the PRODTY equation. All variables except D2, are found to be significant at the 1% level. The results from the OLS estimation are given in table 3.3.1..

Table 3.3.1.
Regression Analysis of the PRODTY Equation.

	CONSTANT	K	D1	D2
Coefficients	17.52	0.76	15.14	7.64
	(3.7)*	(14.3)*	(4.18)*	(1.32)
F-stat	283.33			
R-Squared	0.959			
Adj R-Squared	0.956			
DW	1.06			
n	40			

*significant at the 1% level.
#values in the parentheses are t-statistics.

A coefficient for K is estimated to be 0.76 and is significant at the 1% level. It can be interpreted to mean that a one-unit increase in K, assuming everything else fixed, would lead to an increase in the manufacturing worker's productivity index by 0.76. The parameter for D1 is estimated to be 15.14 and is significant at the 1% level. This value denotes the effect of pre-NAFTA trade liberalization on the U.S. manufacturing worker's productivity meaning pre-NAFTA trade liberalization in Mexico has increased, everything else remaining constant, the index by 15.14. A value of 7.64 is estimated for D2 coefficient. However, it is found to be insignificant thus suggesting no impact of NAFTA on the U.S. manufacturing productivity index.

An F-value of 283.33 shows that the overall model to be significant at the 1% level. As a measure of goodness of fit, an adjusted R2 of 0.956 suggests that the independent variables explain almost 96% of the variation in the dependent model suggesting a quite impressive fit model. A DW value of 1.068 indicates the existence of positive serial autocorrelation. Again, a test for multicollinearity is conducted and the results are depicted in table 3.3.2..

Table 3.3.2.
Correlation Coefficient Matrix.

	Sample Correlation	P-values
K vs D1	0.47	0.0022
K vs D2	0.60	0.0001

The results shows the existence of severe multicollinearity. However, as long as the estimated parameters display the expected signs, the presence of multicollinearity is not considered a major problem.

The GLS method is sought for to correct for the problems of autocorrelation. The results secured from the GLS estimation are shown in the table 3.3.3..

Table 3.3.3.
Regression Analysis of the PRODTY Equation.

	CONSTANT	K	D1	D2
Coefficients	27.46	1.21	28.21	27.47
	(4.28)*	(9.39)*	(3.46)*	(2.42)**
F-stat	109.70*			
R-Squared	0.90			
Adj R-Squared	0.89			
DW	1.58			
n	39			

*significant at the 1% level.
**significant at the 5% level.
#number in the parentheses represent t-statistics.

The estimates of the revised model have increased in value and have the expected signs. Moreover, all of the variables are significant either at the 5% or 1% level. The estimated coefficient for D2 is 27.47 and significant at the 5% level. An estimate of 1.21 for K coefficient, which also significant at the 1% level, suggests that a one-unit increase in the capital intensity in the U.S. manufacturing sector, everything else assuming constant, would lead to an increase in the productivity index by 1.21. A coefficient for D1 is estimated to be 28.21 and significant at the 1% level. It can be interpreted to mean that the pre-NAFTA trade liberalization, everything else remaining constant, has increased the U.S. manufacturing productivity index by 28.21.

Although lower than before, an F-value of 109.7 retains the overall significance of the model at the 1% level. The adjusted R2 falls to 0.90, however, the independent variables, still, explain 90% of the variation in the dependent variable indicating an adequately fit model. Again, a DW value of 1.584 indicates an inconclusive decision regarding the presence of autocorrelation.

EXCHGN Equation

After estimation with OLS, the results found are presented in Table 3.4.1..

Table 3.4.1.
Regression Analysis of the EXCHGN Equation.

	CONSTANT	TB	D1	D2
Coefficients	34.52	-0.04	2123.96	3190.99
t-stat	(0.38)	(-2.09)**	(10.12)*	(7.557)*
F-stat	79.76			
R-Squared	0.86			
Adj R-Squared	0.85			
DW	1.54			
n	40			

*significant at the 1% level.
** significant at the 5% level.
#number in the parentheses are t-statistics.

An estimate for TB coefficient turns out to have a negative sign. Theoretically, trade balance and exchange rate maintain a positive relationship. As mentioned earlier, the change of sign may be caused by the presence of multicollinearity. The TB coefficient is estimated to be -0.04 and is significant at the 5% level.

A value for the D1 coefficient is estimated to be 2123.96 and significant at the 1% level. This value shows the effect of pre-NAFTA trade liberalization in Mexico on the country's exchange rates, that is, pre-NAFTA trade liberalization in Mexico has increased the TB by 2123.96 pesos. An estimate for D2 coefficient is found to be 3190.99 and is significant at the 1% level. This value suggests that NAFTA has, assuming everything else fixed, increased Mexican exchanged rate by 3190.99 pesos.

An F-value of 79.76 indicates that the model is significant at the 1% level. A value of 0.83 adjusted R2 denotes that the model explains 83% of the variation in the dependent variable, which suggests a well fit model. A durbin-watson statistic of 1.54 results in an inconclusive test for the autocorrelation. Again, a test of multicollinearity is conducted using Statistical Analysis System (SAS) program. The results are presented in table 3.4.2..

Table 3.4.2.
<u>Correlation Coefficient Matrix.</u>

	Sample Correlation	P-values
TB vs D1	0.23	0.1478
TB vs D2	-0.72	0.0001

The results show the existence of severe multicollinearity between TB and D2. However, it indicates no collinearity between TB and D1.

A test is also conducted for heteroscedasticity and indicates its presence.[15] The existence of heteroscedasticity requires the use of Weighted Least Squares (WLS) to correct the problems of its presence. In order to solve the problem, the equation is weighted by dividing all variables by the predicted values of the dependent variable, EXCHGN; the variances of the error terms are assumed to be unknown in the present case. The results are presented in Table 3.4.3..

Table 3.4.3.
Regression Analysis of the EXCHGN Equation.

	IPREDY	TB	D1	D2
Coefficients	4.57	-0.026	2085.55	3454.12
	(0.10)	(-1.67)	(10.60)*	(8.38)*
F-stat	63.88*			
R-Squared	0.87			
Adj R-Squared	0.86			
DW	1.50			
n	40			

*significant at the 1% level.
#values in the parentheses are t-statistics.

As it is seen from the table 3.4.3., IPREDY replaces the constant term and represents the expected value of the dependent variable when the independent variables are equal to zero.[16]

The estimate of TB coefficient is found to be almost unchanged (the new value is -0.026) and is insignificant at the 5% level. It contains a wrong sign as before.

The estimate of D1 coefficient is shown to be almost unchanged and significant at the 1% level. It retains the same interpretation as before. The value for the D2 coefficient shows no significant deviation from the previous value and is significant at the 1% level. It, too, holds the same interpretation as before.

The F-value falls to 63.88. However, the overall model is still statistically significant at the 1% level. The adjusted R2 improves by a small amount to 0.86 which means the model's explanatory power increases by a 1% point. Again, a DW value of 1.504 results in an inconclusive test for autocorrelation.

LDFI Equation

After estimation with the OLS, the results obtained are presented below in Table 3.5.1..

The coefficient for D1 is estimated to be -0.06 and is found to be insignificant at the 5% level. The result suggest that there is no significant effect of pre-NAFTA trade liberalization on LDFI. The D2 parameter is estimated to be -0.77 and found to be insignificant at the 5% level. It can be interpreted to mean that NAFTA does not have significant effect on the LDFI. A coefficient for LRM is estimated to be -0.48 and is significant at the 5% level. It has an unexpected sign. Assuming an expected sign with the same value, it could be interpreted to mean that a 1% increase in the LRM would increase the LDFI by 48%. The coefficient for LWM has the expected sign as before. It has a value of -0.15 and is found to be significant at the 5% level. It can be interpreted to mean that a 1% increase in the wage index would lead to a decrease in the DFI by 0.15%. A value of 0.10 for the LRU coefficient is found to have an anticipated sign and insignificant at the 5% level.

Table 3.5.1.
Regression Analysis of the LDFI Equation.

	CONSTANT	D1	D2	LRM	LWM	LRU
Coefficients	-0.46	-0.06	-0.77	-0.48	-0.15	0.10
	(-0.97)	(-0.15)	(-1.41)	(-2.64)*	(-1.8)*	(0.42)
F-stat	37.49*					
R-squared	0.85					
Adj R2	0.83					
DW	2.14					
n	40					

*significant at the 5% level.
#values in the parentheses show t-statistics.

An F-statistic of 37.49 implies that the model is significant at the 5% level. An adjusted R2 of 0.83 indicates that the model to be a quite decent fit model. It suggests, again, that the independent variables explain 83% of the variation in the dependent variable. A DW value of 2.13 indicates that there is no positive serial autocorrelation between the error terms. However, a test for heteroscedasticity indicates its presence.

The results from a test for multicollinearity are given in Table 3.5.2..

Table 3.5.2.
Correlation Coefficient Matrix.

	Sample Correlation	P-Values
LRM vs LWM	0.70	0.0001
LRM vs LRU	0.74	0.0001
LWM vs LRU	0.50	0.0001

As the results show, there is a strong collinearity between each of the independent variables.

Estimation with the Weighted least squares (WLS) generates a new set of values which are presented in Table 3.5.3..

The estimate of D1 coefficient falls to -0.11 and is still insignificant at the 5% level. It can be interpreted to mean that the pre-NAFTA trade liberalization has an insignificant effect on the DFI, holding everything else constant. The estimated parameter for D2 is found to be unchanged and turns out to be significant at the 5% level. It shows that NAFTA has a significant effect on the DFI. In other words, NAFTA, everything else remaining constant, has reduced DFI by 77%.

Table 3.5.3.
Regression Analysis of the LDFI Equation.

	IPREDY	D1	D2	LRM	LWM	LRU
Coefficients	-0.53	-0.11	-0.77	-0.42	-0.16	0.05
	(-1.46)	(-0.40)	(-1.65)*	(-2.82)*	(-2.28)*	(0.42)
F-stat	441.89					
R-squared	0.99					
Adj R2	0.98					
DW	1.86					
n	40					

*significant at the 5% levels
#values in the parentheses represent t-statistics.

The estimates for LRM and LWM coefficients are generated to be almost unchanged. Moreover, the variables are significant at the 5% level. A value of -0.48 for LRM coefficient, still, contains the unanticipated sign. Assuming an expected sign with the same value, it can be interpreted to mean that a 1% increase in the RM would lead to an increase in the DFI by 48%. The estimate of LWM coefficient is found to have both expected sign and significant at the 5% level. It can be interpreted to mean that a 1% increase in the WM would lead to a 15% decrease in the DFI. The value for LRU coefficient drops to 0.05 and is insignificant at the 5% level. It has an anticipated sign as before.

The F-value jumps to 441.89 which indicates that the overall significance of the model increases at the 5% level.

An adjusted R2 of 0.98 indicates a quite impressive model in terms of goodness of fit. A DW value of 1.862 indicates the presence of no autocorrelation.

3.2. Effects of NAFTA.

The estimated D2 coefficients provide the tools for calculating the effects of NAFTA on the wage rate and the employment level in the U.S. manufacturing sector. Multiplying the D2 coefficients in the relevant equations with the relevant coefficients in the WAGE and the LAMP equations results in a new set of values; these values show the effects of NAFTA on the U.S. manufacturing wage rate and employment level.

The procedures to find these new values are shown below.

$$\text{WAGE} = \underset{(2.4)}{7.5} - \underset{(-0.24)}{0.001}\text{PRODTY} + \underset{(0.033)}{9.73}\text{EXCHGN} + \underset{(1.09)}{0.32}\text{DFI}$$

Estimated coefficients for D2, representing the NAFTA variable, show the effects of NAFTA on PRODTY, EXCHGN and, LDFI are presented in table 3.6..

Table 3.6.

Estimatea Coefficients of D2.

	D2 Coefficients
PRODTY	27.47
	(2.42)**
EXCHGN	3454.12
	(8.38)**
LDFI	-0.11
	(-1.65)*

*Statistically Significant at the 10% level.
**Statistically significant at the 1% level.
#numbers in the parentheses are t-statistics.

Multiplying the D2 coefficient (27.47) in the PRODTY equation with the PRODTY coefficient in the WAGE equation generates a new value which is equal to:

$$\Delta PRODTY/\Delta D2 \times \Delta WAGE/\Delta PRODTY = \Delta WAGE/\Delta D2 = -0.001 \times 27.47 = -0.027$$

(-0.24) (2.4)

A value of -0.027 represents the amount by which NAFTA has changed the wage through the manufacturing productivity. However, this value can not be taken as a reliable estimate of

NAFTA's effect on wage rate, because PRODTY is found to have an unexpected sign as well as is statistically insignificant at the 5% level. Theoretically, PRODTY and WAGE are positively related and should maintain a strong relationship.

Multiplying the D2 coefficient (3454.12) in the EXCHGN equation with the EXCHGN coefficient (9.73) in the WAGE equation provides a NAFTA coefficient that shows the effect on WAGE through EXCHGN.

$$\Delta EXCHGN/\Delta D2 \times \Delta WAGE/\Delta EXCHGN = \Delta WAGE/\Delta D2 = \underset{(8.38)}{3454.12} \times \underset{(0.03)}{9.73} = 33608.58$$

A large value of 33608.58 is due to the fact that the EXCHGN variable is measured in terms of the OLD Mexican peso per U.S. dollar. To find a consistent value, this coefficient must be converted, first, into new Mexican peso and then, into the U.S. dollar.

In 1993, old peso was converted into new a value as follows:

1000 old pesos = 1 new peso

Therefore, the old peso can be converted into new pesos in following way:

33608.58 old pesos/1000 = 33.6 new pesos

The exchange rate of new peso in terms of U.S. dollar is

3.46 new pesos = \$1

or,

33.6 new pesos/3.46 = \$9.7

The result indicates that the trade liberalization due to NAFTA would change the U.S. manufacturing wage rate by \$9.7, everything else being constant. However, the insignificant impact of EXCHGN on WAGE suggests that the impact of NAFTA on WAGE through EXCHGN is also insignificant at the 5% level.

LEMP = 2.73 + 0.00002LEXCHGN - 0.23LK + 0.003LDFI + 0.045LRU

(38.7) (1.64) (-3.5) (0.31) (4.07)

To calculate a NAFTA coefficient, LDFI coefficient in the LEMP equation is multiplied by the D2 coefficient in the LDFI. All the coefficients in the LEMP equation as well as the D2 coefficient in the LDFI equation are expressed in percentage terms. The D2 coefficient in the EXCHGN equation, on the other hand, is expressed in the number of old peso per U.S. dollar. As mentioned above, this coefficient (3454.12) shows the effects of NAFTA on EXCHGN. In other words, NAFTA has increased this coefficient by 3454.12 old pesos. The LEXCHGN coefficient, on the other hand, shows the effect of a 1% change in the exchange rate on employment level in percentage term. Taking log of 3454.12 and substituting the log transformed value into the LEMP equation will show the effect of NAFTA on the U.S. manufacturing employment level.

Log(3454.12) = 3.54

Multiplying 3.54 by 0.00002 yields a value of 0.00007 (=0.00002 x 3.54) which represents the amount by which NAFTA has changed the employment level in the U.S. manufacturing sector. Although t-values for both LEXCHGN (significant at the 10% level) and D2 (significant at the 1% level) estimates indicate a significant impact of NAFTA on employment level, the NAFTA coefficient represents a very small number which suggest that the total effect would generate a very small gain in employment in the U.S. manufacturing sector.

CHAPTER 4

Conclusion.

4.1. Summary of Results.

In order to capture the effects of NAFTA on the U.S. manufacturing wage and employment, a statistical analysis has been attempted in two stages: 1) regression on the basic equations; and 2) regression on the supplementary equations. The independent variables of various equations show high collinearity with one another. As a result of multicollinearity, in most cases, the estimates of different equations are found to have both unexpected signs and insignificant t-values. It is important to note that the D2 coefficients in all the three supplementary equations indicate significant impact of NAFTA on EXCHGN, DFI, and PRODTY. The estimates showing impact of NAFTA on EXCHGN as well as on PRODTY suggest that NAFTA has increased the values of those two variables by 27.47 millions of dollars and 3454.12 old mexican pesos respectively. The effect of NAFTA on DFI is found to be negative. This contradicts the widely held view that NAFTA would result in a net transfer of U.S. capital to Mexico. The negative impact implies that the rate of growth of foreign direct investment into the U.S. manufacturing sector exceeds the rate of growth of U.S. direct investment in Mexico. Net results should indicate an increase in the overall U.S. capital stock. Estimates in the wage equation are found to show an unrealistic picture. As mentioned before, the coefficients for PRODTY and DFI have unexpected signs. Moreover, both of them have insignificant t-values. It is very realistic to assume that the productivity and wage rate maintain a significant positive relationship. In this situation, multiplying the D2 coefficient in the PRODTY equation with the PRODTY coefficient in the WAGE equation hardly makes any sense because it generates a value containing insignificant t-statistic which, in turn, suggests that the NAFTA has an insignificant impact on the U.S. manufacturing wage rate through manufacturing productivity.

The trade liberalization effect on the Mexican exchange rate is shown to have quite reasonable estimates. The positive estimates of D1 and D2 indicate to the scenario of devaluation during the trade liberalization era. However, the exchange coefficient in the WAGE equation suggests an insignificant impact on the U.S. manufacturing wage rate. As a consequence, the NAFTA coefficient is insignificant in explaining any effect on wage.

The overall results of the LEMP equation are found to be very disappointing with a very low adjusted R2 and unexpected signs of LK, LDFI, and LRU. However, the EXCHGN parameter is estimated to have a significant effect on the employment level at the 10 percent level suggesting significant impact of NAFTA on the U.S. manufacturing employment level. The variables K and RU in the LEMP equation are included to improve the explanatory powers of the model.

4.2. Concluding Remarks and Suggestions for Further Research

This study begins with the hypothesis that the trade liberalization between the United States and Mexico will have an insignificant impact on the manufacturing wages and employment level in the United States. The method applied to this research introduces two dummy variables and three supplementary equations. The overall findings do indeed suggest an insignificant effect of NAFTA on the wage and employment in the United States which seems to support the hypothesis of this study. However, the presence of multicollinearity raises doubt concerning the reliability of the estimates. For example, the PRODTY coefficient in WAGE equation indicates an unusual pattern of relationship. On the other hand, the estimate of the D2 coefficient in the PRODTY equation denotes NAFTA's significant impact on PRODTY. As mentioned before, workers' productivity and wages should maintain a strong and significant relationship. The unusual results may very well be due to the unavailability and unstable nature of the Mexican Economic Indicators (MEI). In the future, however, availability of more consistent and reliable data on MEI may be helpful for further research employing the same method used in this project. Also, since it is difficult to obtain past yearly data of MEI, quarterly and monthly data may be useful in time series analysis of wage and employment effect of NAFTA.

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Endnotes

1. U.S. merchandise trade with Mexico consists of 43.2 billion dollars of exports or 9.6% of total U.S. imports and 6.6% of total U.S. imports from the rest of the world. see Hufbauer and Schott (1992).

2. After a sudden decision by Mexican government to float peso against the U.S. dollars on December, 1994, Mexican peso devalued by 30% and reset to 3.46 pesos per U.S. dollars.

3. More than 70% of the Mexican imports consists of U.S. products, see Hufbauer and Schott (1992). In 1990, Mexican manufacturing wage was $1.9 per hour, see Dornbush (1990).

4. For reference see, Clyde V. Prestowitz., and Others."The New North American Order: A Win-Win Strategy for U.S.-Mexican Trade". (Washington: Economic Strategy Institute,1991).

5. For detail analysis, see U.S. International Trade Commission, "Economy-Wide Modeling of the Economic Implication of a FTA with Mexico and a NAFTA with Canada and Mexico", Preliminary Report on Investigation 332-317 under section 332 of the Tariff Act of 1930, Washington, February, 1992).

6. KPMG Peat Marwick, "The Effects of a Free Trade Agreement between the U.S. and Mexico", paper produced for the U.S. Council of the Mexico-U.S. Business Committee, 1991.

7. See, Hinojosa and Robinson, "Alternative Scenarios"; and Robinson and Others, Agricultural Policies and Migration in a U.S.-Mexico Free Trade Area: A Computable General Equilibrium Analysis", Working Paper 617 (University of California, Berkeley, Department of Agricultural and Resources Economics, 1991).

8. Free international trade leads to equalization of not only goods prices but also factor prices. In this manner, international trade is a substitute for international factor mobility, see for detail discussion, Paul A. Samuelson, "International Trade and Equalization of Factor Prices", Economic Journal 58 (1949), 165-184.

9. Relationship between dependent and independent variables seems to be of log linear type from the scatter plot. The interpretation of the estimates of transformed equations are expressed in percentage terms rather than value terms.

10. Ibid.

11. xt-s=axt-s-1, or xt-s-1=xt-s/a, where, a=1+b. The parameter b is a measure of the rate of growth of RM. It is calculated, first, by taking average of three years observations, (x0=1975, x1=1976, and x2=1977) and, second, using the average value to calculate the growth parameter, b. The way to calculate b can be shown as follows:
(x0+x1+x2)/3=x*; (x*-xt-s)/xt-s=b.

12. [Sum of 1986-88 values (1977=100)]/[Sum of 1986-88 values (1982=100)].

13. Positive autocorrelation exists when the consecutive error terms usually have the same sign, for example, a positive et-1 is followed by a positive et and so on. Where, et-1 and et are error terms.

14. The P values in the table stand as the measure of severity of multicollinearity. A P-statistic of greater than 0.1 indicates no multicollinearity; a P-statistic of greater than 0.05 but less than 0.1 shows moderate presence of multicollinearity; finally, a P-statistic of less than 0.05 denotes the presence of severe multicollinearity.

15. Following test is applied to detect heteroscedasticity. A hypothesis of equal variances of the error terms, et, is set-up against a alternative hypothesis that their variances depend on the expected value of the original equation. On the basis of stated hypothesis, Ordinary Least Squares method is applied to a simple equation. In that equation, dependent variable is the square of the residuals- that is, et2-and the independent variable is the predicted value of the dependent variable in the original equation.

16. IPREDY defined as the inverse of the predicted values of the dependent variables, in the present case IPREDY is the inverse of the predicted values of the variable EXCHGN.