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# TRADE LIBERALIZATION AND REGIONAL ECONOMIES: NAFTA AND THE U.S. MANUFACTURING SECTOR

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TRADE LIBERALIZATION AND REGIONAL ECONOMIES: NAFTA AND THE U.S. MANUFACTURING SECTOR

A Dissertation APPROVED FOR THE
DEPARTMENT OF ECONOMICS

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## ABSTRACT

This dissertation observes the effects of increased trade liberalization between the U.S., Canada, and Mexico on the U.S. manufacturing sector between 1980 and 2000 using a panel data approach. I apply the Hecksher-Ohlin model as a framework for this analysis, basing my hypotheses on the HO predictions. The data set employed allows for the estimation of trade effects and includes county level observations for the forty-eight contiguous United States. Specifically, I estimate the effects of increased trade liberalization via international trade agreements and U.S. tariff concessions on average U.S. manufacturing employment, wage, and establishment growth. Likewise, I examine regional economies such as the states located along the U.S. international borders with Canada and Mexico, as well as the sunbelt and manufacturing belt. Lastly, I estimate the effects of increased trade on specific industries in the U.S. manufacturing sector to determine which industries benefit from trade and which industries do not. I also investigate the presence of location effects for counties located relatively close to the international border with Mexico or Canada, relative to counties located further away. The results demonstrate that positive trade and location effects are present.

# CHAPTER 1

# INTRODUCTION

## 1.1 OVERVIEW

Ben Franklin once said, "No nation was ever ruined by trade."[1] The doctrine of a global economy, promoting trade between countries of the world, emerged as early as the late 1st century A.D. This doctrine claimed "Providence deliberately scattered resources and goods around the world unequally to promote commerce between different regions" (Irwin, 1996, p.15). Similar claims can be found during the Mercantilist period of the 16th and 17th century. For example, Sir Thomas Smith's 1581 publication, *A Discourse of the Commonwealth of this Realm of England*, claimed "God has ordained that no country should have all commodities, but that that one lacks, another brings forth, and that that one country lacks this year, another has plenty thereof commonly that same year, to the intent men may know that they have need of another's help," (Irwin, 1996, p. 27).

Trade between nations has occurred throughout the ages and is increasingly common today as countries strive to improve their standards of living through economic growth. The continuously expanding global markets experienced soaring trade volumes over the past few decades. World merchandise exports grew by

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[1] Columbia world of quotations, Columbia encyclopedia, Franklin collection

approximately 70% from 1980-1990, and further increased by 87% from 1990-2000 (WTO, 2005).[2]

Integration in the form of trade agreements between countries also increased over the past several decades in Europe, Asia, South America, and North America. Along with increasing globalization, labor market fluctuations, specifically the outsourcing of domestic jobs from the U.S. to other countries offering relatively lower labor costs, have served as a source of discontent in the United States. This issue gained increasing importance, and became a topic addressed by both President George W. Bush and democratic challenger John Kerry in their 2004 presidential election campaigns. Bush discussed the growing number of U.S. companies that have transferred part of their operations overseas, and stated "Education is how to make sure that we've got a workforce that's productive and competitive," (Third Presidential Debate, p. 4). Likewise, Kerry explained that many U.S. firms receive preferential tax rates for operating overseas, and promised to stop these tax incentives through legislation. Kerry claimed, "I will make the playing field as fair as possible," (Third Presidential Debate, p. 4).

This dissertation investigates the impact of trade liberalization with Mexico and Canada on the regional economies of the United States. Recent trade agreements between the U.S., Canada, and Mexico allow for exploration of the impact of increased trade liberalization on the U.S. manufacturing sector. Sector level and industry-specific effects of increased trade are investigated in this analysis. This

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[2] The data used to calculate these growth rates are in current $U.S. and can be located at http://stat.wto.org.

dissertation shows that the trade agreements enacted among the U.S., Mexico, and Canada have significantly influenced manufacturing sector growth from 1980-2000.

This chapter provides an overview of some of the issues regarding free trade, specifically within North America. Section two provides a brief description of the various views of trade liberalization. I include background information regarding macroeconomic and historic events, such as the Canadian recession in the 1980s and the Mexican Peso Crisis in 1994, in section three to provide a better understanding of the current economic environment of the three countries involved. Section four details the recent implementation of the Free Trade Area of the Americas, as well as the emergence of the anti-globalization movement. I provide an outline of the dissertation in section five, describing the organization of the remaining chapters.

## 1.2 A BRIEF HISTORY OF TRADE

### 1.2.1 U.S. Trade Liberalization

Although only encompassing two decades, the history of trade liberalization among the U.S., Mexico and Canada is quite extensive. Mexico joined the United States as a member of the General Agreement on Tariffs and Trade, GATT, in 1985, thus agreeing to reduce tariffs on imports between the two countries. The Canada-U.S. Free Trade Agreement, or CUSFTA, came into effect on January 1, 1989. In this agreement, both countries pledged to eliminate many of the import categories subject to tariffs and gradually phase-out most of the remaining tariffs by January 1, 1998. In 1987, the average tariff on U.S. manufacturing imports into Canada was approximately 6.7% and 3.9% on Canadian manufacturing imports into the U.S.

Between 1987 and 1990, these tariff rates were reduced by 1.9% points in Canada and 1.4% points in the U.S. (Beaulieu, 2000). The implementation of this trade agreement was not very controversial. Because of the similarities between technology usage, production processes, and relative factor endowments, relatively modest effects were expected from this trade agreement. Some, however, feared that the U.S. would gain jobs at the expense of Canada, and that skilled production would relocate south into the United States with Canada evolving into a "warehouse economy" for U.S. goods (Feinberg et al., 1998, p. 750).[3]

Following the establishment of CUSFTA, Mexico and the U.S. began negotiations for the establishment of a free trade area in 1990 (NAFINA, 2004). The result of these negotiations was the creation of the North American Free Trade Agreement, or NAFTA, implemented on January 1, 1994. This trade agreement called for the gradual reduction of tariffs between Canada, Mexico, and the United States. Prior to this, the average tariff rate on imports from Mexico into the U.S. was 4%, while 10% in Mexico (Thorbecke and Eigen-Zucchi, 2002). After NAFTA, approximately half of the import categories experienced an immediate elimination of tariffs, while others were scheduled to be phased-out over a period of 5 to 15 years. National treatment was guaranteed to all member countries of NAFTA, in which no countries are allowed to apply tougher standards to imported goods than domestic goods (Thorbecke and Eigen-Zucchi, 2002). The Canada-U.S. Free Trade Agreement

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[3] The "warehouse economy" refers to a situation in which one country is "hollowed out", by engaging in trade with a larger (more productive) country. The less productive country becomes a shipping dock for the relatively larger country, which expands at the expense of the other.

was incorporated into NAFTA, thus creating a multinational trade agreement reducing or eliminating restrictions on investments, intellectual property, and cross-border migration of workers.

### 1.2.2 NAFTA: The Controversy

NAFTA is the most controversial trade agreement the U.S. has signed. For some, the reduction of trade barriers is a sign of hope while for others it represents a deepening fear of foreign competition. Opponents claim that the U.S. will lose jobs and suffer lower wages. Many of these protectionists emphasize discrepancies in the NAFTA text, arguing that Mexican firms have a "distinct competitive advantage" (Perot, 1993, p.2) in operating costs such as lower safety standards and training for employees and equipment, as well as tighter restrictions on U.S. shipping by truck into Mexico. U.S. trucks were not legally permitted inside Mexico for the first three years of the agreement, while Mexican trucks were allowed to cross into U.S. border areas (Perot, 1993, pp. 3). Opponents of free trade fear that American factories will relocate to take advantage of lower labor costs across the border. Ultimately, Ross Perot and his followers claimed that NAFTA would lead to "destructive competition that will serve to pit the workers of each nation against the other in a race to the bottom for wages and benefits" (Perot, 1993, pp. 101). This concern was demonstrated in Ross Perot's well-known depiction of U.S. jobs inevitably vanishing with a "giant sucking sound."

Two groups were predicted to lose from NAFTA, farmers and low-skilled workers (Ahn, 2003). Keith Dittrich, a corn and soybean farmer from Nebraska, gave a personal testimonial to the American Farm Growers Association regarding his own experience, which unfortunately is very common among small farmers and ranchers facing competition from abroad. Dittrich argued against legislation such as the 1985 Farm Bill in which U.S. agricultural price supports were reduced (Ahn, 2003). Dittrich explained that these large reductions in commodity prices, along with relatively static agricultural export levels "has led to the devastation of rural America" (quoted in Ahn 2003, p. 4). Multinational food processing and exporting companies are claimed to be the only winners from U.S. trade liberalization. Many family farmers, ranchers and commercial fisherman provided similar testimonies.

Low-skilled workers are another group predicted to face significant hardships from NAFTA. Petra Mata, an immigrant from Mexico who resides in southern Texas, shared her experience at an anti-NAFTA meeting by the Fuerza Unida anti-globalization organization in 2002. Mata was laid off by Levi Strauss & Company after 14 years of employment. Levi's moved its factory to Costa Rica to take advantage of lower labor costs. With only a sixth grade education, Mata was unable to find another job that could match her hourly earnings of $9.73 she had made at Levi's factory. She was then forced to seek odd jobs, often working two or three at a time to make ends meet (Ahn, 2003, p. 33). Mata states, "We sometimes say that poverty exists in Third world countries, but I now know that poverty exists here as well," (quoted in Ahn 2003, p. 34). Mata's experiences are shared by many other low-skilled workers finding themselves in a similar position.

Although trade liberalization is predicted to harm some groups, many others are believed to benefit. NAFTA promised several benefits to the United States, including greater certainty for U.S. investors in Mexico's economy and improved competitive advantage in today's expanding global market (Hansen, 1994). Advocates of free trade argue that NAFTA's implementation was in response to increasing competition from the European Union, Japan, and member countries of the MERCOSUR free trade agreement, consisting of Argentina, Brazil, Paraguay and Uruguay. For example, MERCOSUR member countries have slowly approached the formation of a customs union for over a decade, while their largest trading partner is the EU. An article in Business America claimed NAFTA will "level the playing field and open new markets" (Jacobs, 1993, p.2). In 1993 Time magazine claimed that NAFTA "will employ more of everybody and reduce prices for consumers," (Tobias, 1993, p. 47). In this case, free trade supporters argue that improving trade relations with countries such as Mexico and Canada will ensure successful growth in the country's trade sector.

NAFTA is also a topic of academic controversy. Numerous researchers have estimated the effects of international trade on both Mexico and the United States. The literature provides mixed conclusions on the effects of increased trade on employment, production, and wages. Many agree that U.S. employment and productivity levels have increased with trade liberalization. Most papers, however, predict that U.S. employment effects would be relatively small but positive, and positive and large for Mexico (Burfisher et al, 2001). This is mainly due to differences in trade dependence and tariff structure. For example, in 1993, Mexico accounted for less than 10% of U.S. imports and exports while the U.S. accounted for 83.3% of Mexico's exports and 71.2 % of imports. At this time, the average tariff for the U.S. was approximately 4% compared to 10% for Mexico (Burfisher et al, 2001). NAFTA was projected to have little effect on the Canadian labor market because the U.S. and Canada had already taken steps to liberalize trade in 1989 under the Canada-U.S. Free Trade Agreement.

Popular fears of foreign competition stealing jobs of relatively low-skilled Americans are refuted in a recent study that estimates the extent to which low-skilled workers will be affected due to firms relocating abroad, particularly Mexico. Using information provided in the OECD (1999) report, Thorbecke and Eigen-Zucchi (2002) explain that the majority of these fears are exaggerated. They explain that several factors such as relatively inefficient transportation and communication systems in Mexico, as well as higher crime rates and political instability, actually lead to unit labor costs in Mexico that are 50% higher than those in the U.S. (Thorbecke and Eigen-Zucchi, 2002, pp. 649). Although some firms engaged in high volume production with low-skilled workers will relocate, they claim that most firms will choose to remain here in the United States.

The effects of NAFTA must be distinguished from the pre-existing trend of growing trade with Mexico. Revenga (1997) argues that many of the effects now attributed to NAFTA, actually began when Mexico joined the General Agreement on Tariffs and Trade (GATT) in 1985, thus beginning its process of trade liberalization. Hanson (1998) claims that NAFTA "merely finalizes a process that has been underway for nearly a decade." If this is indeed the case, many of the effects attributed to NAFTA could actually be caused by the implementation of GATT.

Overall, NAFTA has led to several gains from trade according to many advocates. Mainly, large increases in manufacturing import and export values between the U.S. and Mexico since 1994 are attributed to NAFTA by free trade supporters, relating growing trade flows to the theory of comparative advantage. Figures 1A and 1B provide a summary of U.S. manufacturing import and export growth with Canada, Mexico, and overall trade with the world. The value of U.S. manufacturing exports to Mexico increased 128% between 1994 and 2000, while the value of imports have also increased 175% during the same period. Relatively smaller increases in trade value are observed for Canada, where increases of 59.2% in exports and 79.8% in imports are observed between 1994 and 2000. These increases in the dollar value of trade with Canada are relatively smaller than those with Mexico. Total U.S exports to all countries grew by 52.5% while overall imports have increased approximately 83.6%. Imports and exports in 2001 were 54.2% of GDP in Mexico, 19% in the U.S., and 69.3 % in Canada (World Bank).

## 1.3 RECENT EVENTS

### 1.3.1 Canada: Recessions and Macroeconomic Events

Following the implementation of the 1989 Canada-U.S. Free Trade Agreement (CUSFTA), employment levels in Canada began to fall and continued this pattern of decline until 1992. Overall 390,600 jobs were lost over this period in the tradeables sector, or approximately 19% of sector employment (Gaston and Trefler, 1997, pp. 20). Service employment, on the other hand, actually increased about 1.6%, or by 123,000 jobs (Gaston and Trefler, 1997, pp. 21). The majority of these job losses in the Canadian labor market were popularly attributed to CUSFTA, leading some industry leaders to call for renegotiations between the U.S. and Canada. They claim the trade agreement was partially the cause of this loss in employment, but that several other events played a significant role in the labor market decline such as the 1990 recession combined with a strong exchange rate for the Canadian dollar. Gaston and Trefler (1997) argue that these economic events had larger impacts on employment than CUSFTA.

### 1.3.2 Mexico: The Peso Crisis

Economic growth in Mexico did not occur immediately following the NAFTA in 1994 due to a problematic downturn in Mexico's financial market. In the early 1990's, the Mexican peso was greatly overvalued, up to as much as 40%, due to a government stabilization policy that pegged the peso to the U.S. dollar (Thorbecke and Eigen-Zucchi, 2002). In February of 1994, the U.S. Federal Reserve increased interest rates, thus reducing the flow of capital into Mexico. At this time, the Mexican central bank, Banco de Mexico, increased interest rates to combat inflation as well as maintain the value of the peso in the foreign exchange market (Mishkin, 2001). Political shocks also adversely effected Mexico during this same time. The 1994 assassination of the presidential candidate Luis Donaldo Colosio, along with the violent uprising in the southern state of Chiapas, sent the Mexican stock market into a dramatic decline as uncertainty spread amongst investors. Speculative attacks in the foreign exchange market could not be evaded by the central bank, and thus led to a devaluation of the Mexican peso on December 20, 1994, and the onset of the Mexican Peso Crisis of 1994-1995 (Mishkin, 2001).

The Mexican economy has greatly improved since this time. Thorbecke and Eigen-Zucchi (2002) claim that NAFTA assisted Mexico in its recovery from the 1994-1995 peso crisis because of the large increase in exports, and thus the creation of job opportunities for Mexican workers. Between 1998 and 2000, Mexican GDP increased by 11%. Foreign direct investment increased by 62.5% between 1995 and 2000. Overall employment growth was 27.6% from 1993 to 1998.[4]

### 1.3.3 Rise of the Maquiladoras

The emergence of maquiladoras, or off-shore assembly plants, located along the U.S.-Mexico border has dramatically increased economic activity in the region. The term maquiladora originated from the Spanish word maquilar, meaning "to process in exchange for a portion of the product" (Wilson, 2001). These off-shore assembly plants primarily engage in less skill-intensive production. In an effort to increase foreign investment and employment in the northern border region, the Mexican government began what they called the Border Industrialization Program (BIP) during the mid-1960s. To provide incentives for export growth, the Mexican government implemented duty-free imports of component parts such as machinery, assembly parts, and administrative equipment to maquiladoras located along the border (Baz, 1994). As a result of these policy efforts by the government, hundreds

[4] Data can be located at INEGI, *Instituto Nacional de Estadistica Geografia e Informatica. Mexico.*

of foreign-owned production facilities emerged along the U.S.-Mexico border. According to Hanson (1998), the relocation of firms within Mexico after 1980 is primarily an effect of emerging off-shore assembly facilities located along the international border.

Many of these plants engage in assembly for American manufacturing products, which are then shipped back to the U.S. as final goods to be exported abroad. In 2000, more than one million Mexicans worked at more than 3,800 maquiladoras, compared to employment in the mid-1990s of approximately 500,000 employees at 2,000 maquiladoras (Rosenberg, 2000). Assembly of component parts includes electronics, apparel, footwear, toys, and automobile parts (Wilson, 2001). Along with this rapid growth in employment, maquiladoras have stimulated rapid population migration to the border region in search of work.

### 1.3.4 U.S. Manufacturing and International Trade

Employment in the U.S. manufacturing sector declined by 1.47 million jobs (7.83%) between 1980 and 2000. During the same period, employment in the service sector increased by 61.7%. Overall U.S. employment grew by 41.2 million jobs, or 45.6%, over the same time. These figures project a dismal outlook for the U.S. manufacturing sector, demonstrating sector contraction as trade liberalization efforts increased. The post-NAFTA time period, 1994-2000, provides a different view of the U.S. labor market, particularly within the manufacturing sector. Manufacturing employment actually increased by 1.42%, approximately 242,000 jobs. Likewise, the service sector grew by 17.1% while overall employment in this period increased by

15.3%. Table 1 provides a comparison of overall U.S. employment with U.S. manufacturing and service sector employment levels.

Many have argued that the observed contraction in the U.S. manufacturing industry has mostly been absorbed by the rapid expansion of the service sector. There is an increasing trend observed in which production level jobs in the U.S. are outsourced overseas to developing countries as firms seek to take advantage of lower wages and large labor pools of eager workers. Many of these displaced U.S. manufacturing employees have found work in the service sector, thus dampening the overall effects of employment. The shifts in U.S. manufacturing and service sector employment described above support this argument of service sector absorption (Sachs and Shatz, 1994). Although job creation has been relatively high in the service industries, workers may still be worse off as a result. Average wages in the service sector are relatively lower than those found in manufacturing. This is partially due to high unionization rates in manufacturing industries (Sachs and Shatz, 1994), as well as high labor productivity and value.

U.S. manufacturing productivity growth also increased significantly throughout the past two decades. Table 2 reports observations on U.S. manufacturing output per hour. Table 3 provides the annual values of these employment shares. Productivity increased approximately 50% between 1992 and 2003, as shown in Table 2. The manufacturing share of GDP has remained stable, approximately 16% between 1987-2000. The share of U.S. manufacturing employment to total employment has decreased from 17.2% to 13.1% over this same period, while the service share of employment increased from 77% to 81.3%.

## 1.4 LOOKING FORWARD

### 1.4.1 Future Prospects for the Free Trade Area of the Americas (FTAA)

As free trade continues to expand globally, many countries are entering into trade negotiations with trading partners to avoid diminishing export volumes as international competition increases, eventually leading to customs unions and/or trading blocs. This can be seen in the Americas. CUSFTA and NAFTA have led to current negotiations for a Free Trade Area of the Americas, or FTAA. This agreement would extend the trade liberalization measures continued in NAFTA to 33 other countries throughout Central and South America. Tariffs on imports between these countries will be phased out over specified periods, such as with 1 to 10 years. Negotiations for this trade agreement began in December, 1994, in which the initial round of the Summit of the Americas was held in Miami, Florida. The subsequent summits also took place in April 1998 and April 2001. Negotiations were expected to conclude in January 1, 2005, but are currently delayed thus postponing the anticipated effective date of December 31, 2005 (FTAA website, 2004).

Although some view the implementation of the FTAA as a good thing, many anti-globalists from around the world have joined forces to protest trade liberalization between the United States and Central and South America. For example, the FTAA Resistance Organization, the Miami Activist Defense, and the Amazonian Indigenous Federation are just a few out of the many organizations currently attempting to strategically defeat the passage of the FTAA agreement. The turnout of around 30,000 protesters for the 2001 Summit of the Americas in Quebec City (Macdougall,

2001) and 20,000 protesters at the 2003 Miami Summit of the Americas (Figueras et al., 2003) demonstrates the size of the growing backlash to integration efforts throughout the Americas.

### 1.4.2 Emergence of the Anti-Trade Movement

Many oppose globalization efforts through free trade agreements and view these FTAs harmful to individual workers, farmers, and small businesses. Anti-globalization protests are often carried out in the name of labor rights, human rights, environmentalism, and freedoms of migration. Advocates of this movement view most or all of these goals as complementary to one another, together forming a comprehensive agenda touching on nearly all aspects of life. Many advocates do not necessary object to capitalism per se, but rather disagree with what they claim to be undemocratic mechanisms by which market decisions are made (Ahn, 2003). In particular, many are opposed to what is known by anti-globalists as neoliberalism, which is defined as the political philosophy that emphasizes economic growth rather than social justice (Wikipedia, 2004). In regards to the effects of NAFTA, civil rights activists Elizabeth Martinez and Arnoldo Garcia refers to neoliberalism as the "neo-colonization of North America," (Martinez and Garcia, 1997, p.2). They also claim that neoliberalism is "destroying welfare programs, attacking the rights of labor, and cutbacking [sic] on social programs," (Martinez and Garcia, 1997, p.2). For this reason, protests focus on meetings of international institutions that promote globalization such as the World Bank, the International Monetary Fund (IMF), and the World Trade Organization (WTO).

Increased trade liberalization between the U.S., Canada, and Mexico raises several other concerns. One such concern is potential damage to the environment due to pollution in Mexico, where environmental standards are far less strict than in the United States. Others are concerned about the threat to homeland security due to the perceived openness of our national borders and would prefer the U.S. to take a more closed approach. Still others argue that stricter immigration controls, in reaction to increased openness along the border, may increase fatalities of those trying to cross the border illegally (Heyman, 1998, pp. 628). These concerns are certainly valid but are outside of the scope of this dissertation.

## 1.5 OUTLINE OF THE DISSERTATION

Chapter 2 discusses the Heckscher-Ohlin model in depth, reviewing the model itself as well as several related theorems. A detailed discussion of the theoretical model, as well as a thorough explanation of the model's predictions is also included. Chapter 2 also reviews empirical literature on trade liberalization.

Chapter 3 discusses varying predictions regarding the impact of trade liberalization on the U.S. economy. I explain the possibility of location effects of U.S. manufacturing firms located relatively close to international borders with Mexico and Canada. Additionally, I discuss the potential for increased returns due to the clustering, or agglomeration, of related firms.

Chapter 4 provides details on my data set, explaining the sources of the data for the 1980-2000 period as well as definitions of the variables used. I report the variables included in this dissertation and explain their importance to the empirical analysis. I also discuss the methods entailed in the calculations of the variables considered. This discussion also explains the inclusion of dummy variables to proxy the trade agreements between 1980 and 2000. Additionally, I present summary statistics of the data set, including regional sub-samples.

Next, chapter 5 specifies the econometric models employed and presents and discusses the regression results. I observe positive effects on the U.S. manufacturing sector as trade liberalization increases. Distance from the international borders with Canada and Mexico are also shown to significantly impact U.S. manufacturing sector growth. I also estimate the same regression models including only U.S. states bordering Canada and Mexico to observe any potential proximity effects following increased trade. Additionally, I observe six specific manufacturing industries to estimate which industries have experienced the largest impact of increased trade liberalization.

Finally, chapter 6 provides a summary of the major findings of this dissertation and their potential applications. Increased trade liberalization among the U.S., Canada, and Mexico is shown to have positively impacted the U.S. manufacturing sector. As predicted, the overall manufacturing sector has been greatly affected by trade liberalization, but specific industries within the U.S. manufacturing sector have experienced significant growth rates from 1980 to 2000 while others have contracted.

# CHAPTER 2

# THE HO MODEL AND RELEVANT LITERATURE

## 2.1 INTRODUCTION

NAFTA represents a reduction of trade barriers between the U.S., Canada and Mexico, leading to greater integration of these economies. The empirical effects of increased globalization are a topic of controversy. A voluminous academic literature examines the effects of increased trade between countries, stretching across the fields of international trade, labor economics, and economic geography. This chapter provides an overall view of the economic literature relating to trade liberalization.

Studies on trade liberalization have focused on several topics as mentioned above. First, this chapter provides a detailed explanation of the Heckscher-Ohlin (HO) model, and the theorems developed from this model. Second, this chapter provides an overview of the literature regarding the effects of trade liberalization, revisiting the age-old debate between the effects of open versus closed economies. Third, this chapter reviews studies on the effects of increased trade liberalization on employment. Fourth, this chapter provides an overview of the studies examining the effects of increased trade on income inequalities. The majority of studies discussed in this portion test the predictions of the Factor Price Equalization (FPE) theorem within the HO model. Fifth, this chapter presents a synopsis of the literature regarding specific agglomerative location effects, while accounting for the implementation of international free trade agreements. In most of these cases, the presence of an international border between two or more countries engaged in trade results in significant effects on domestic variables such as employment and wages.

This chapter provides expectations concerning the effects of tariff concessions and the state of understanding on empirical studies of trade liberalization. The implications of the Heckscher-Ohlin model, specifically the Stolper-Samuelson and Factor Price Equalization theorems, provide one basis to predict the outcomes of a trade agreement between two or more countries. I provide a summary of related studies and their findings, furnishing an overall comparison of techniques employed and the various findings on these matters.

## 2.2 THE HECKSCHER-OHLIN MODEL

Two Swedish economists, Eli Heckscher (1919) and Bertil Ohlin (1933), investigated the effects of factor endowments on international trade. Their research led to the construction of the Heckscher-Ohlin (HO) model, which modern economics still employs today. This model predicts: *A country will have a comparative advantage in, and will therefore export, that good whose production is relatively intensive in the factor with which that country is relatively well endowed* (Appleyard and Field, p.124-125). In other words, if a country is more abundant in skilled labor relative to unskilled labor, that country will expand production and exports of goods that are relatively skill-intensive in their production when trade between nations is allowed.

The HO model includes several simplifying assumptions that are critical to the performance of the model in predicting the effects of increased trade on a country's factor endowments. First, the model assumes there are two countries: country *A* and country *B*. Second, the model assumes that there are two factors of production, skilled labor ($L^S$) and unskilled labor ($L^U$), which are initially fixed and relatively different between the two trading countries. For example, country *A* is assumed to be relatively abundant in $L^S$, while country *B* is assumed to be relatively abundant in $L^U$. Third, the model further assumes that there are two homogenous goods, $x_1$ and $x_2$, with relatively different factor intensities in their production. In other words, $x_1$ is relatively skill-intensive in its production, while $x_2$ is relatively less skill-intensive (Appleyard and Field, p. 118).

The HO model yields three main theorems. First, the Rybczynski theorem states: *If a country experiences an increase in the supply of one factor, ceteris paribus, it will produce more of the good intensive in the factor and less of the other* (Appleyard and Field, p. 196). For example, an increase in $L^S$ skilled labor will lead to rising production levels of $x_1$ while the production of $x_2$ will be reduced. This theorem assumes world factor prices are constant, focusing only on factor abundance and production levels.

Second is the Factor Price Equalization (FPE) theorem, which claims: *Free trade will lead to international equalization of individual factor payments within those countries* (Appleyard and Field, p. 126). This is because different relative prices in autarky create gains from trade between two countries as trade opens. Initially, wages for $L^U$ are relatively high in country *A* due to the scarcity of unskilled labor. $L^U$, however, is needed to produce $x_2$. Unskilled wages are predicted to decrease in the country *A* and rise in country *B*. Wages decline in the country *A* because as the skill-intensive sector expands, less skill-intensive industries will contract. The contraction of the less skill-intensive industries releases both skilled and unskilled labor, but in disproportionate amounts. The amount of $L^U$ released exceeds the amount of $L^S$ shifting to the skill-intensive industry, leading to lower wages to unskilled labor relative to skilled workers.

Third, the Stolper-Samuelson theorem predicts the following while assuming full employment before and after trade: *The increase in the price of the abundant factor, and the fall in the price of the scarce factor will lead to higher real incomes for the owners of the abundant factor and lower real incomes for the owners of the scarce factor* (Appleyard and Field, p. 128). This helps to explain why owners of the abundant factor are often in favor of free trade while owners of the scarce factor seek assistance through trade restrictions. This theorem is a continuation of the Rybczynski and FPE theorems described above, merely describing in more detail the winners and losers from increased trade. I estimate the effects of increased trade liberalization on relative labor content and prices in order to test the HO model predictions.

### 2.2.1 Extensions

Deardorff (2001) explains that differences in initial factor endowments between countries are very important in considering the FPE theorem using what he calls the "multi-cone version" of the HO model. In the classic two good, two country model, equalization of factor prices will be observed between two countries with similar factor endowments, with both countries' endowments of factor inputs located in the same "cone of diversification" (Deardorff, 2001, pp. 169). On the other hand, for a model including many goods and many countries, multiple equilibria arise. Countries will form two or more groups based on similarities in factor endowments, forming their own cones of diversification. Only countries located within the same cone of diversification will experience equalization of factor prices. In other words, FPE will be observed when relatively capital (labor)-abundant countries trade with other relatively capital (labor)-abundant countries.

An extension has been made to the HO model regarding trade among regions. This extension of regional trade relaxes the assumption of homogenous products and countries with relatively different factor endowments, allowing trade between similar countries that specialize in the production of similar products with the same relative factor intensities. This extension specifically refers to trade between two similar countries as having the potential to open trade without contradicting the predictions of the HO model. Theory claims that trade effects should be larger between countries with different factor endowments, allowing for larger gains through specialization and export growth. The majority of countries located north of the equator are developed while most of those located south of the equator are predominantly considered to be developing. This leads to the generalization in analyses that North countries are industrialized and will specialize in the production of relatively capital-intensive goods while countries in the South will specialize in the production of labor-intensive goods (Wood, 1998, pp. 1466). The effects of trade in North - South integration should exceed the effect of trade in a North-North or South-South integration. It has been observed, however, that most of the world's trade occurs between major OECD countries, primarily located in the North (Davis, 1997, pp.1057). This observation challenges the theory of comparative advantage and indicates that other factors, such as economies of scale, are the main driving force between the direction of trade flows among countries.

**2.3 OPEN VS. CLOSED?**

Adam Smith's argument for mutual gains through specialization and trade, and the Ricardian model of comparative advantage, produced the original case for trade. These legendary economists introduced the formal concept of *mutual gains from trade*, providing an explanation that economic trade among nations was beneficial to all trade partners, allowing each country to specialize domestic production on the good in which they had a comparative advantage, or lower opportunity cost, to produce. More recent studies such as Katz and Summers (1989), and Thorbecke (1995) agree with this generalization of benefits from free trade, but point out the importance of strengthening the rules and institutions that administer this free trade such as the enforcement of private property rights and contracts. Slaughter (1998) claims that trade liberalization should encompass all domestic industries and that selective trade liberalization is inefficient. He explains that protectionist policies for low-skilled industries that are often unable to compete in open markets, incur high costs on society, potentially lowering world welfare. Slaughter (1998) establishes the importance of multi-sector trade liberalization rather than selective trade liberalization in a country's pursuit for economic growth. Lastly, Krueger (1998) discusses the inefficiencies associated with import substitution compared to the large growth potential provided to countries that engage in trade liberalization, implying an emphasis on the expansion of exporting sectors. She warns, however, that sustained growth can be achieved only through the adoption of a "truly outer-oriented" economic policy, which provides incentives for production expansion within the tradeables sector of that country (Krueger, pp. 1521). Krueger (1998) supports policies aimed at expanding export sectors while also explaining the adverse effects of import substitution for a country's trade policy. Each of these studies support the progression towards free trade as a key ingredient to achieving economic growth.

Several studies in this literature agree to some of the benefits proposed from international trade, but are apprehensive about free trade and include qualifications and stipulations addressing their concerns. Dornbusch (1992) claims "selective trade liberalization" is optimal since it allows for the protection of certain infant industries that may develop to be quite competitive in the future export sector. Wonnacott (1996) claims that free trade agreements have the potential to increase world welfare only when trade creation exceeds diversion and the countries involved in the agreement do not form a "hub and spoke" system. Other studies emphasize the negative effects of increased trade liberalization. For example, Viner (1950), Meade (1955), Ozga (1955), and Vanek (1964) show that in a bilateral trading arrangement, the complete elimination of a tariff and thus the formation of a customs union, "has the potential to lower world welfare due to trade diversion" (Kowalski 1996, pp. 4). McLaren (1997) proposes a similar argument in which he claims that large countries often gain at the expense of small countries in bilateral trade negotiations due to larger countries having stronger bargaining powers in negotiations.

Spener and Capps (2001) provide an overview of the effects of NAFTA on the U.S. garment industry to demonstrate some of the adverse effects of trade liberalization observed between the U.S. and Mexico. They explain the loss of U.S. jobs in this industry is primarily due to producers shifting their operations south to Mexico in order to take advantage of low-wage workers after the implementation of NAFTA. This negative effect on the U.S. garment industry is exacerbated by increased immigration controls at the U.S.-Mexico border, restricting the movement of Mexican workers across this border.

## 2.4 TRADE EFFECTS ON EMPLOYMENT

The HO model serves as a framework for organizing a test to estimate the effects of globalization on employment in Sachs and Shatz (1994). In this study, they classify the 131 three-digit U.S. manufacturing subsectors based on the "skill intensity of production," which is calculated by dividing the number of production workers in the subsector by total employment in the subsector. This provides a measure of factor content between non-production (skilled) workers and production (unskilled) workers. A higher ratio implies a lower skill level in the subsector. The subsectors are then indexed in deciles between 1 and 10 according to their calculated skill intensity of production, with 1 being the most skill-intensive subsectors and 10 being the least skill-intensive. Periodicals, for example, are in decile 1 while apparel and footwear are in decile 10. Production workers comprised 41.2% of workers for classifications in decile 1 compared to 86.7% in decile 10. Patterns in U.S. trade by decile were also estimated by calculating the ratio of net exports to total trade flows. They find that the U.S. primarily exports skill-intensive products while the majority of imports consist of non-skill-intensive products, consistent with the predictions of the HO model.

Sachs and Shatz (1994) then test the proposed relationship between increased trade and reduced employment in the U.S. manufacturing industry by assuming that imports as a percentage of final demand did not change after 1978. Under this assumption, domestic output and employment would have increased to satisfy the larger market demand in the U.S. The difference between increased employment in the counterfactual case and actual employment is their estimate of the number of manufacturing jobs lost due to increases in net imports between 1978 and 1990. The loss of employment due to rising net imports is statistically significant. Changes in trade with developed countries had a modest impact on U.S. manufacturing employment with an overall negative effect of 0.2%, while increased trade with developing countries reduced manufacturing employment by 5.7% (specifically, production employment falls by 6.7% while non-production employment falls by 4.3%). Increased trade led to a larger reduction in jobs in low-skilled subsectors relative to high-skilled subsectors. Overall, Sachs and Shatz (1994) claim that reductions in U.S. manufacturing employment between 1978 and 1990 are primarily due to lower demand for low-skilled workers following the reduction of trade barriers with developing countries such as China, Brazil and Mexico, consistent with the predictions of the HO model.

Wood (1995) provides further evidence of the adverse effect of increased trade on unskilled workers. He estimates the effect of increased trade between developed and developing countries on U.S. manufacturing wage fluctuations as predicted by the HO model. Wood uses a measure of factor content similar to Sachs and Shatz (1994), but makes three adjustments to correct for what he claims is a downward bias in their calculation of the labor content of imports. First he replaces domestic employment levels with estimates from developing country trade partners, because they are the primary producers of these products. Then he adjusts these observations to allow for the higher wages seen in developed countries. Finally, he further adjusts the estimates to control for the higher prices that would be observed if these imported goods had been produced domestically. Wood estimates a 21.5% reduction in labor demand for unskilled workers in developed countries and a 21.8% reduction in relative demand for unskilled workers (unskilled – skilled workers), significantly larger estimates than Sachs and Shatz findings of 6.2% and 1.9% reductions, respectively. Wood concludes that new entry into the world market by low-skill-intensive manufacturers bears little threat for relatively unskilled workers in developed countries because these types of goods, such as footwear and apparel, are no longer produced in developed countries. On the other hand, increased competition for "middling-skill-intensive manufactures" poses a major threat to the industrial sector. Wood explains this result in terms of "defensive innovation," in which firms remain competitive in global markets through improvements in technology (Wood, pp. 67). These technological advances, then, reduce demand for unskilled workers. His results support the predictions of the HO model.

Trefler (2004) estimates the impact of CUSFTA on Canadian employment growth for the pre-FTA period 1980-1986 and the FTA period 1989-1996. Using data from 213 4-digit Canadian manufacturing industries and 3,801 Canadian plants, he regresses the differenced average annual log change in Canadian employment growth between the two periods on U.S. and Canadian tariff reductions and industry controls for Canada's three largest trading partners: U.S., Japan, and the United Kingdom. Using OLS, Trefler finds that Canadian tariff concessions on U.S. imports reduced Canadian manufacturing industry employment by 14%. Likewise, plant-level employment growth fell by 12%. Next, he regresses Canadian employment growth on the joint effect of U.S. and Canadian tariff concessions, finding an 8% and 4% reduction at the industry level and plant level respectively. Trefler (2004, p. 879) explains this reduction in Canadian employment indicates the short run "transition costs of moving out of low-end, heavily protected industries," as trade liberalization efforts increase. Separating employment into production, or unskilled workers, and non-production, or skilled workers, Trefler estimates that Canadian tariff concessions reduced unskilled employment growth by 12% while the effect on skilled employment growth is insignificant. He explains that this result along with an observed increase in the ratio of non-production to production Canadian workers as evidence of "skill upgrading" due to CUSFTA (Trefler, 2004, pp. 884). Furthermore, he claims this "skill-upgrading" demonstrates the long run gains of increased trade liberalization efforts (Trefler, 2004, pp. 888). His findings support the HO model predictions.

The popular criticism of increased foreign competition resulting in lost jobs for low-skilled workers and ultimate slowdown of real GDP growth is examined and disregarded by Krugman and Lawrence (1994). They estimate the impact of trade on domestic sales of manufactures using U.S. manufacturing trade balance observations between 1970 and 1990. Krugman and Lawrence find that "international factors have played a surprisingly small role in the country's economic difficulties." Rather, domestic changes, such as increased automation, fewer consumer purchases of manufactured goods, and slowing productivity growth explain the overall reduction in demand for unskilled workers in the U.S. manufacturing industry. They explain that although the adjustment patterns in the U.S. manufacturing sector indeed follow the predictions of the HO model, increased trade does not appear to be the driving force.

Tamor (1987) questions the political applications of the HO model and argues that this model fails to provide an explanation of the composition of manufacturing activity and instead only explains the level of manufacturing activity. He tests this argument by regressing production levels, measured by industry sales per country, on factor supplies such as industry employment, as well as land and capital usage using weighted least squares. Data for 15 OECD countries and 23 three-digit ISIC industries in 1980 are used in this analysis. He finds that the model performs poorly in this case and that the resulting coefficients do not support HO model predictions. In other words, unskilled employment does not experience the large reduction relative to skilled employment as expected.

Several studies investigating the relationship between increased trade liberalization and employment emphasize specific free trade agreements in their analysis. Gaston and Trefler (1997) examine effects of CUSFTA on the Canadian labor market. They estimate changes in employment and earnings from 1980 to 1993 with reduced-form equations using OLS. Explanatory macro variables such as interest rate spreads and exchange rates, along with U.S. employment as a control, combine with industry-specific observations on tariffs, trade levels and domestic consumption. Gaston and Trefler (1997) find a modest yet significant relationship between tariff reductions and the observed decline in tradeables sector employment. They claim that these negative effects on the Canadian labor market are partially due to CUSFTA as well as a combination of economic events during this period. First, the recession of 1990 led to the reduction in Canadian employment, particularly in the manufacturing sector. Second, a strong exchange rate for the Canadian dollar due to the Bank of Canada's anti-inflationary policies between 1986 and 1988 resulted in declining overall exports due to higher relative prices (Gaston and Trefler, 1997). Their findings support the HO predictions.

Comparisons among various Canadian industries indicate that most high-tariff industries have relatively low skill-intensities according to Beaulieu (2000). Beaulieu argues that this is an indication of potential endogeneity in tariff policy and uses an instrumental variable (IV) technique to address this concern. Changes in industry employment and earnings from 1983-1996 are regressed on changes in industry characteristics such as production employment shares, relative wages, and changes in trade levels. An instrument is derived for Canadian tariff rates in which he estimates predicted values of the 1988 tariff levels as a function of industry characteristics such as the employment share of production workers, percentage change in imports and the percentage change in wages. Then he uses a five-year phase-in period and a ten-year phase-in period along with the estimated 1988 tariff level. According to Beaulieu, both instruments yield similar results. Beaulieu (2000) finds that production workers bear nearly all of the effects of bilateral tariff reductions. The results for the IV estimates show a significant correlation between Canadian tariff reduction and reductions in production employment. Changes in tariff rates, however, have very little impact on changes in earnings in this analysis. Beaulieu (2000) then distinguishes between skill-intensive industries and low-skill-intensive industries. Reductions in tariff rates are shown to have a negative and significant effect on employment levels in low-skill-intensive industries but almost no effect on employment levels (production and/or non-production) in the relatively high-skill-intensive industries. These findings support the predictions of the HO model.

Hinojosa et al. (2000) estimate the impact of Mexican imports on U.S. employment using a partial equilibrium model. Employment data consists of annual employment levels for each U.S. 4 digit SIC industry between 1990-1997. They estimate that U.S. average employment declined by 37,000 jobs per year for rising Mexican imports and 57,000 per year for increased imports from Canada. To put this number in perspective, they explain "the U.S. economy creates over 200,000 jobs per month and causes the separation of about 400,000 workers per month from their jobs," (Hinojosa-Ojeda et al., 2000, pp. 64) thus increased trade with Mexico modestly effected U.S. employment between 1990 and 1997. They claim that the most important determinant of U.S. employment during this period is the recurrence of macroeconomic instability in Mexico, such as the 1994-1995 Peso crisis. Their data set is limited to only eight years, possibly reducing the explanatory power of their findings after the U.S labor market experiences the full effects of NAFTA.

Thorbecke (1995) claims the HO model provides a good explanation for U.S. representatives' voting patterns on the November 17, 1993 NAFTA vote. He uses a public choice framework in which political representatives seek to redistribute wealth rather than to improve efficiency. If the predictions of the HO model hold, trade liberalization should benefit capital-intensive industries and harm labor-intensive industries. This hypothesis is explored using a probit analysis of a representative's vote on NAFTA (1 if yes, 0 if no) in 1993. Several socioeconomic variables such as the percentage of workers employed in service, farm, and export industries, education, median income, age, state proximity to Mexico, and political preferences such as voting for Perot in 1992 were included for each Congressional district. Thorbecke (1995) finds positive and significant coefficients on education and state proximity to Mexico. Thorbecke claims that geographical and electoral constituencies determine the voting patterns of representatives and explains the "weak party allegiance produced in the NAFTA vote" (Thorbecke, pp. 242).

## 2.5 TRADE EFFECTS ON WAGES

Sachs and Shatz (1994) examine the relationship between increasing net imports and the widening wage gap between skilled and unskilled workers in the U.S. to test the HO model predictions. They claim that if increased net import levels result in large employment changes, income inequalities will increase if and only if there are "significant differences in the employment consequences for low-skilled and high-skilled workers" (Sachs and Shatz, pp. 33-34). In other words, if increased trade levels have a larger effect on low- skilled employment relative to high-skilled employment within manufacturing, the wage gap between the two widens. For increased trade to affect wages, it must first affect relative output prices (Sachs and Shatz, 1994). Domestic price deflators reported by the U.S. Bureau of Economic Analysis are used as an estimate for relative output prices. These price changes are regressed on the skill intensity measures (deciles 1 to 10) described previously. They find the effect on the relative price of non-skill intensive goods is negative and statistically significant at the 5% level during most of the 1980's, but not for the entire period. From these findings they conclude that relative prices have indeed been affected in the predicted direction, but the magnitude of this effect is uncertain. Using the same data set from 1979-1990, Sachs and Shatz (1996) re-estimate the effect of increased trade on the widening wage gap between skilled and unskilled workers in the U.S. manufacturing industry. Once again, they find that trade increases lower relative prices for non-skill intensive goods, but this effect is not significant for the entire period. They claim that both trade and technology reduced demand for unskilled workers, widening the wage gap. These findings, although insignificant, are consistent with the predictions of the HO model.

Beyer, Rojas and Vergara (1999) attempt to find an empirical link between trade liberalization and wage inequality in Chile. A cointegration technique is used to regress Chile's skill premium on openness, textile prices, and education from 1960-1996. Openness is measured as the percentage of GDP devoted to net exports. Textile prices are included as a measure of factor payments under the assumption that

Chile is relatively abundant in unskilled labor. The education variable is the percentage of the workforce with a college degree. An Augmented Dickey Fuller test is used to check for the presence of unit roots. The null hypothesis of no cointegration is rejected in each case, demonstrating that a long run relationship exists between the variables presented. The coefficient estimate for education, as expected, is positive and significant, indicating that increasing education levels reduces the gap while a negative coefficient on textile prices demonstrates that falling prices of unskilled production tends to increase the wage gap. The resulting coefficient for openness is positive and significant, showing that increased trade widens the wage gap between skilled and unskilled workers. They provide two possible explanations for this surprising result. First, they claim technology may have been biased toward skilled labor over this time period. Secondly, production structures have evolved over time, increasing the relative demand for skilled labor.

Trefler (1993) examines the relationship between factor price differentials and international differences in productivity. Specifically, this model predicts that in free trade, factor A participation rates will equal the factor A endowments plus the share of world consumption times the sum all other factor endowments in a particular country. Recall the FPE theorem predicts wages between trading partner countries will equalize through the implementation of free trade. He tests this prediction using a cross-sectional data set of 33 countries for 1983 and calculates factor participation rates by dividing factor contents by net exports in each country. Hourly earnings and constant price investment flows are used for factor price estimates. The data fails to conform to this strict identity of factor endowments and prices. Trefler then includes a measure proposed by Leontif (1953), which claims that including "productivity-equivalent units" of labor, in which a parameter between zero and one is included to account for human capital, is a more appropriate measure to use. Productivity-equivalent factor endowments are calculated as the product of the human capital parameter and existing factor endowment levels. Trefler (1993) also includes a new estimate of factor content, allowing for technology within country A. He provides an identity in productivity-equivalent units where factor participation rates in country A equal factor endowments minus the product of country A's share of world consumption and the factor endowments of the rest of the world. With the inclusion of this productivity-equivalent parameter, the identity holds under the assumptions of the FPE theorem. Trefler explains that these findings demonstrate that country-specific "endowment levels must be adjusted to reflect international productivity differences" (Trefler, p. 981).

Davis et al. (1997) investigates the impact of increased trade on wage inequalities using international and Japanese regional data. They use observations on employment, wages, education, average household consumption estimates, trade volumes, net exports as a percentage of GDP, and output levels for 10 regions in Japan for 1989-1993. Assuming that all countries engaged in trade have equal levels of technology and that FPE holds for the Japanese regions, Davis et al (1997) find that factor content of trade is positively and significantly affected by education and trade volumes. With the inclusion of a few strict assumptions, the findings in this study support the FPE predictions.

Davis and Weinstein (2001) predict that the difference between a country's initial endowment and the average endowment in the world for a country that size will provide a measure of that country's net exports of factor services. They construct a model to estimate trade specification levels for 34 industries in 10 OECD countries from 1985 - 1995. Control variables include industry-specific inputs and outputs, intermediate input usage estimates, and trade volumes for each country. Regressing endowment levels on growth in trade volumes and growth in endowments, they fail to accurately predict the magnitude of trade effects. Technology differences between countries, however, significantly affect a country's change in trade levels over time. Their findings fail to support the FPE predictions.

Feenstra and Hanson (2000) investigate the poor performance of the FPE theorem in explaining the relationship between relative factor contents and prices, arguing this may be due to an aggregation bias, thus disaggregation of industry data into four-digit rather than two-digit classifications can help to avoid this bias. Using U.S. industry observations from 1982 to 1994, they compare the estimated effects on production and non-production workers from increased U.S. exports. Their findings show that this proposed aggregation bias is substantial. Using the four-digit data, both production and non-production labor participation in 1982 net exports increased where estimates using two-digit data show that non-production labor participation declined over this time. Using the four-digit data changed the magnitude of labor participation by over 20% (Feenstra and Hanson, pp. 159). They find little evidence, however, that factor contents are influential in the increasing income gap between skilled and unskilled workers. This finding does not support the FPE predictions of the model.

Revenga (1997) examines the effects of trade liberalization on the manufacturing industry in Mexico. A wage premium is calculated for each sector by differencing wages of skilled and unskilled workers controlling for education levels and unionization and reductions rates for quotas and tariffs. This wage premium is then regressed on aggregate industry data observations from 1984-1990 for employment, real sales, inputs costs, capital rents per worker estimates, and tariff rates using two-stage least squares. The resulting coefficient for real sales is positive and significant, indicating that trade liberalization reduced real sales. Coefficient estimates for capital rents and tariffs rates were positive and significant in each case, indicating that trade liberalization, along with falling rent prices, have led to a reduction in the demand for unskilled labor and a widening of the wage gap. These findings contradict the predictions of the FPE theorem.

## 2.6 DOES LOCATION MATTER?

The majority of papers in this field concentrate on aggregate effects of trade openness on individual countries and ignore the location of industries within countries. Bernat (1998) attempts to answer the long asked question of why such geographical variation in relative wages is observed here in the United States using component economic areas (CEA's) provided by the Bureau of Economic Analysis. These geographical variations have often been thought to be due to agglomeration of establishments in one centralized area to take advantage of the close proximity of numerous suppliers and other important contacts. Bernat uses OLS to regress 1996 manufacturing earnings per job on worker characteristics (education, gender, and race), regional amenities (based on average temperatures, precipitation levels and crime rates) and demand factors such as unemployment rates, population densities, and industry mix. He also includes regional dummy variables to account for regional differences not captured by the control variables. As expected, industry mix, population, education and crime are positive and significantly related to earnings. Bernat claims that the significance of the industry mix coefficient can be viewed as a signal of agglomeration, or specifically "localization economies". He explains that certain CEA's exhibiting evidence of agglomerative behavior will have significantly higher earnings relative to those without these beneficial agglomeration effects.

A few papers examine the regional, or border, effects of increased trade. McCallum (1995) attempts to examine the importance of the international border between the U.S. and Canada using a gravity model. A gravity model is useful for his study due to its ability to estimate the transfer of goods between two geographical areas by accounting for distance between these two areas. He regresses the shipments of goods on GDP, distance, and a dummy variable describing if trade is inter-provincial or intra-provincial for each region in 1988 using 30 U.S. states (10 of which are located along the international border) and the 10 provinces of Canada. He finds a negative and significant relationship between trade volumes and distance variables between regions. As distance from the U.S.-Canadian border increases, trade values decline by 1.42%. He demonstrates that proximity to the border benefits trade between these two similar countries, thus a border between two less similar countries should exhibit the same effects on trade as well (McCallum, 1995).

Holmes (1996) explores the process of firm migration. This study assumes there are two possible locations for firms, north and south, and a continuum of product types. Holmes further assumes that the south has a natural climate for the production of a specific good but due to some "historical accident" or lock-in, industry is primarily located in the north. Holmes also allows for firms to have different values regarding their proximity to other similar agents. He explains that if the migration of firms will indeed take place, the process would likely be as follows. Low quality producers, having extremely low values for local suppliers, will migrate south to take advantage of the superior climate. The number of low-quality producers expands as more firms migrate south, resulting in the emergence of a network of suppliers to meet the rising demand from local producers in the south. As this process continues, firms with higher values for local suppliers will be attracted to the south as the supplier base grows. Eventually, the entire industry will migrate south, and overcome the "lock-in" of the north (Holmes, 1996, p.3). Holmes (1996) then considers the case in which the south has a smaller natural advantage due to a less superior climate. He explains that firms with low values for local producers will always migrate south. The firms with higher values, however, may resist the small advantage of a better climate and remain in the north. As a result, the south would primarily consist of low quality producers with a relatively small supplier base. He tests these location-specific predictions by examining the U.S. cotton textile industry. Although U.S. production in cotton textiles occurred primarily in New England throughout most of the 19th century, most of the industry migrated south to the Piedmont region between 1880 and 1930 (Holmes, 1996, p. 5). As expected, migration occurred in stages, beginning with the lowest quality producers. Holmes explains that the next stage is conditional on two things: (1) the portion of the market consisting of the low-quality producers that migrate, and (2) the extent to which the south has a natural advantage. If the initial stage of migration is too small to impose a significant increase in demand from local suppliers, the higher-quality producers will remain in the north. Also, if the natural advantage possessed by the north is relatively weak, firms will not migrate from the north thus foregoing the agglomeration effects of the proximity to similar producers. His findings support predicts of location effects for firms.

Hanson (1995) examines the effect of the increase in offshore assembly firms, or maquiladoras, in Mexico on manufacturing activity in neighboring U.S. border cities from 1974 to 1989. Many of these offshore assembly plants engage in complementary manufacturing activities with component parts designed and produced in the U.S. and shipped south of the border for assembly. Hanson explains that after the reduction in trade barriers between the U.S. and Mexico, U.S. firms will locate to U.S. border cities in order to reduce transportation costs among these complementary manufacturing activities. These U.S. border cities include metropolitan statistical areas (MSAs) such as El Paso, Laredo, and San Diego. Hanson constructs a simple OLS and IV logarithmic reduced-form model for the labor market in which annual observations of MSA manufacturing industry employment is regressed on total state income, total U.S. national industry employment, and employment in maquiladoras located in Mexican border cities. In each case, the coefficient on maquiladora employment in Mexican border cities was positive and significant at the 1% level. Hanson's results are robust to the use of lagged values of the log of maquiladora employment as an instrument to control for endogeneity between maquiladora activity in Mexico and employment shocks in U.S. border cities.

Hanson (1998) estimates employment growth in U.S. border cities as a function of growth in export production in neighboring border cities in Mexico between 1980-1995. He finds a correlation between economic integration and increased production in border regions. Hanson states that since 1980, many firms in Mexico have relocated from industrial centers, such as Mexico City, to northern states on the U.S.-Mexico border. He claims that in the absence of trade restrictions, the U.S. will have a comparative advantage in component production while Mexico will have a comparative advantage in assembly due to relative factor abundance in each country. These complementary manufacturing operations provide an incentive for U.S. firms to locate near the border. Hanson estimates effects on industry employment for cities in the border regions of both the U.S. and Mexico using average wages, personal income per state, and total industry employment data from both countries. Hanson finds a strong positive correlation between export production in Mexican border cities and increased employment for neighboring U.S. border cities within a specific industry. According to his estimates, a 10% increase in export manufacturing in a Mexican border city will lead to an employment increase of approximately 2% in the U.S. neighboring border city.

Yoskowitz et al (2002) investigated the effects of NAFTA on employment, unemployment and per capita personal income between 1990 and 1997 in seven counties located in southern Texas. They claim that this is the first study using empirical evidence to examine the effect of NAFTA on the socio-economic variables included in their analysis, and explain that this particular region in southern Texas has the highest level of trade on the U.S.-Mexican border. Employment, Unemployment, and income were initially regressed separately on a time trend for the period, containing four years in the pre-NAFTA period as well as four years in the post-NAFTA period. According to their findings, employment growth appears to have been significantly larger in the pre- NAFTA period.[5] These socio-economic variables were then regressed separately on trade volumes between the U.S. and Mexico for the same given time period. They find that annual employment growth slowed from 4,586 in the pre-NAFTA period to 573 new jobs following NAFTA's implementation in 1994. Perhaps this result indicates that growth along the U.S. border with Mexico was actually due to the Mexico joining the GATT in 1985 rather than NAFTA. They also explain the results may imply that the final destinations of goods transported into the U.S. may be further inland in cities such as Houston while counties located in the southern-most region of Texas are simply passed through. These findings fail to support the predictions of the HO model. Their study is unique because it focuses on effects within the southern Texas border region.

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[5] A reduction in immigration is one possible explanation for decreased county employment growth. For the purpose of this dissertation, immigration patterns are not considered. Future research on the subject, however, should consider the inclusion of an immigration control variable.

Grumwald and Flamm (1985) claim that recent labor market trends in developing countries show that relatively labor-intensive industries are shifting from vertical domestic production to product assembly for foreign firms. Hanson (1994) defines this shift toward product assembly as a "regional production network" and uses it to describe the shifts in factor contents and prices between the U.S. and Mexico due to increased trade. Hanson (1994) develops a model of regional production networks where there are two stages of production: design, which is relatively skill-intensive and exhibits increasing returns to scale, and assembly, a low skill-intensive stage exhibiting constant returns to scale. Hanson claims that agglomeration of firms within an industry center allows for the transfer of knowledge and technology. Due to these location-specific external economies, agglomeration in an industry center leads to increased demand for skilled workers, resulting in higher wages for these skill-intensive industries while driving less skill-intensive firms into outlying regions. Mexico City is assumed to be the industry center while the U.S. border region is the outlying region. Hanson explains that this shift toward regional production networks has been underway since Mexico began to liberalize trade with their entrance into the GATT in 1985. He examines the apparel industry due to its variation in skill-intensities between both production stages. Hanson tests his predictions using a log-linear equation in which the ratio of apparel wages per region to apparel wages in the industry center is regressed on the distance from each specific region to Mexico City, the industry center. He uses Mexican data on apparel wages for five years (1970, 1975, 1980, 1985, 1988), as well as 95 firm-level interviews conducted in the Mexican apparel industry between 1990-1991. He also includes a dummy variable, border, equaling 1 if the Mexican region is located adjacent to the international border and 0 otherwise, as well as a dummy variable for 1988, the only year in the sample after trade liberalization began in Mexico. In each case, the resulting coefficient on distance was negative and significant, indicating that wages declines as one moves further away from the industry center. Next, he includes an interaction term between distance and border in the regression. The coefficient is positive and significant in each case, implying that free-trade zones established in the 1960's included a large number of maquiladoras that specialized in production and component part assembly for foreign firms. Agglomeration effects are observed for the border region as Mexican apparel firms move their operations to this region. Hanson explains that the establishment of the free-trade zones in the border region has acted as a buffer between apparel producers in the border area and apparel industries located in Mexico City. These findings are consistent with the predictions of Hanson's model.

The historical location of the U.S. manufacturing belt is examined in Krugman (1991). He explains that the majority of manufacturing firms are located from a relatively small portion of the Northeast, expanding into the eastern part of the Midwest. The persistence of this manufacturing belt can be observed since the mid-19$^{th}$ century. As late as 1957, 64% of U.S. manufacturing employment was located within this area. The longstanding persistence of this manufacturing belt demonstrates the presence of external economies according to Krugman. He explains that with increasing returns to scale in manufacturing processes since the second half of the 19$^{th}$ century, a virtuous cycle was created in regards to the tendency of manufacturing firms to locate along the belt. Firms will locate to areas with a large local market in order to minimize transportation costs. Local markets, and thus local demand, will mainly locate near the manufacturing firms for employment prospects and access to goods. This creates a virtuous cycle, or "circularity" (Krugman, 1991, pp. 81), that will continue to reinforce itself and remain persistence over time. Krugman explains that this has led to a "lock-in", or path dependence on manufacturing firms to remain in this belt. Perhaps, however, this path dependence could change as trade liberalization occurs. If the findings of Hanson are correct, proximity to international borders is yet another source to meet the demands of large local markets as well as reduce transportation costs further.

Robertson (2000) examines labor market integration between the U.S and Mexico. He claims that convergence of wage differentials between the two countries are "affected by borders, geography, and demographics" (Robertson, 2000, pp. 742). His study uses a model of aggregate labor supply and demand and controls for demographic characteristics such as gender, age, and education. Quarterly data from three U.S. metropolitan areas (San Diego, El Paso, and San Antonio) and six major Mexican metropolitan areas, four of which are considered to be in the "border region" while the other two are in the "interior region" is used for the period 1987:1 to 1997:4. Household survey data is collected on wage and employment information in all of these areas. He finds that U.S. and Mexican labor markets are strongly correlated, although large wage differentials do exist. He shows that this correlation between labor markets was much larger before the implementation of NAFTA, implying that the recent liberalization of trade has had little impact on converging relative wage rates. Robertson (2000) finds that wages in the border region experienced larger effects from shocks and tended to exhibit faster convergence of wage differentials between the two countries.

## 2.7 SUMMARY

The specific purpose of this dissertation is to examine the effect of the increased trade liberalization between North American countries on the regional economies of the United States. GATT, NAFTA, and CUSFTA provide a natural experiment to test the effects of trade on manufacturing employment and earnings in these regional economies. In this chapter I discussed the HO model and several related theorems and reviewed empirical studies of the impact of economic integration on employment and wages. From the research findings presented in Table 4, there are three main results that I investigate in this dissertation.

First, there is a strong relationship between increased international trade liberalization and employment levels. As shown in Table 4A, seven of the eight analyses reviewed support HO predictions of increased trade liberalization on employment. This finding implies that the HO model performs relatively well in explaining the effects of increased trade on employment.

Second, studies to date have had less success documenting an effect of trade on wages. As shown in Table 4B, four of the seven studies discussed failed to find a significant relationship between trade and wages. These findings indicate that the HO model, and more specifically the FPE theorem, performs poorly in explaining the shifts in relative factor prices.

Third, research findings reviewed present evidence of proximity effects when examining the impact of increased trade liberalization. Furthermore, positive effects of agglomeration among firms in a specified location are also discussed as a potential result of firms located near international borders. Eight of the nine studies find a significant relationship between proximity to the international border and economic growth in border cities. A summary of these findings is provided in Table 4C.

Chapter 3 discusses the contrasting predictions regarding the impact of trade on the U.S. manufacturing sector. I discuss the dependent variables employed and provide specific predictions for potential effects between the U.S., Canada, and Mexico as well as possible border effects.

# CHAPTER 3

# PREDICTIONS

## 3.1 INTRODUCTION

This chapter provides a detailed discussion of predictions of the effects of trade liberalization on the U.S. manufacturing sector, including the spatial dimension of trade effects. The first section provides a detailed explanation of the specific predictions of the HO model regarding the implementation of GATT, CUSFTA, and NAFTA among Mexico, Canada, and the United States. The following section provides a brief review of the research findings, specifying what is and is not a consensus among researchers regarding the effects of increased trade liberalization on U.S. manufacturing employment, wage, and establishment growth. Next, this chapter discusses the role of transportation costs and their potential effects on the location decisions of firms. I then explain the potential effects of agglomeration, or clustering of firms.

## 3.2 PREDICTIONS OF THE HO MODEL

The predictions of the HO model regarding economic integration depend on the factor endowments of the various countries. The U.S. and Canada are assumed to be relatively abundant in skilled labor (Gaston and Trefler, 1997) while Mexico is assumed to be relatively abundant in less skilled labor (Hanson, 1995). According to the HO model, skill-intensive industries should expand in the United States and Canada, while less skill-intensive industries should expand in Mexico. U.S.

manufacturing employment change, manufacturing wage change, and fluctuations in the number of U.S. manufacturing establishments serve as outcome measures in this dissertation. I expect to observe a relatively larger increase in U.S. manufacturing employment and establishment growth for skill-intensive industries.

The Factor Price Equalization (FPE) theorem describes the adjustment process of factor prices due to trade liberalization. Trade induced labor market adjustments are expected to reduce manufacturing wages most drastically in relatively low-skilled industries relative to skill-intensive industries. Although manufacturing is considered relatively skill-intensive, relative skill intensities within this sector range from low, such as apparel, to high, such as periodicals. Therefore, the FPE theorem predicts that wages in less skilled manufacturing will decline in the U.S. and Canada because these industries will contract while relatively skilled workers are expected to experience higher wages as these industries expand. Mexico, on the other hand, should experience the opposite adjustment in their domestic labor market. Mexican industries employing largely unskilled-labor should expand, while high-skilled manufacturing will contract.

The HO model further predicts that gains from trade between countries with similar factor endowments will be smaller relative to gains for countries with different factor endowments (Davis, 1997). This is often referred to as North-North versus North-South Trade. Similar factor endowments between the U.S. and Canada imply smaller benefits from U.S.-Canada trade than U.S.-Mexico trade. For this reason, I expect larger percentage effects on U.S. employment and earnings due to increased trade between the U.S. and Mexico versus similar effects from increases in U.S.-Canada trade liberalization.

The HO model does not predict spatial implications for economic integration. The location of trade effects is an important research topic. Regional dispersion of impacts has received little attention in the international trade literature. Some regions will be impacted to a greater extent depending on that region's share of manufacturing activity. Identifying the distribution of trade effects across U.S. regions will provide a clearer picture of the specific impacts of free trade agreements.

### 3.3 THE ROLE OF TRANSPORTATION COSTS

The HO model, like most international trade theories, ignores location and transportation costs (Mundell, 1957). Transportation costs are understandably greater than zero, violating this restrictive assumption (Ruiz-Mier, 1990). Suppliers consequently will consider transportation costs in locating their production facilities. If transportation costs are relatively high, exporting firms would be more likely to locate their establishments in close proximity to the trading partner. Thus trade liberalization between the U.S., Mexico, and Canada should particularly impact the border regions.

Hanson (1998) establishes a link between increased trade liberalization between the U.S. and Mexico, and the relocation of U.S. firms closer to the international border. He explains that in response to increased foreign demand from Mexico, U.S firms relocate closer to the border to acquire increased access to foreign markets and reduce transportation costs. Trade agreements do not directly influence the cost of exporting goods. However, increased trade liberalization should result in firms exporting a larger percentage of production. Therefore, locating closer to the border results in larger cost savings. If these transportation costs are significant, firms may choose to locate in the U.S. border regions. For this reason, I expect to observe a larger impact of trade on U.S. manufacturers located near the U.S.-Mexico border relative to firms located elsewhere.

Recall Hanson's (1995) use of the term "regional production network." In this case production is split between two stages, first is a relatively skill-intensive stage in which research and design occurs, along with a relatively low skill-intensive second stage in which component part assembly occurs. I assume Canada and the U.S. primarily engage in stage 1 production, while I assume Mexico specializes in stage 2 production. For this reason, U.S. manufacturing firms will not locate beyond the border region into Mexico because factor endowments would not satisfy the input requirements of first stage production. The presence of these regional production networks would appear as a positive relationship between increased trade and manufacturing sector expansion. Although the U.S. and Canada are assumed to have similar factor endowments, some localized comparative advantages could exist. Therefore, trade liberalization could lead to small-scale regional production networks in some industries. This suggests the possibility of positive trade effects, however these are expected to be small in magnitude relative to their counterparts along the U.S.-Mexico border.

The prospect of lower transportation costs and increased market access may potentially increase profit opportunities. For firms with sufficient market concentration, reduced input costs and/or revenue effects could outweigh relocation costs. If this is the case, there should be a relatively large increase in the number of U.S. manufacturing firms, and thus employment, located within regions relatively close to the international border.

A second possible explanation for location effects following increased trade may depend on the presence of a major transportation route within a U.S. county. The transportation of goods across borders is conducted in three primary ways: airplanes, waterway shipping, and trucking. Perhaps firms choose to locate near these major transportation routes, leading to clustering in areas near these transportation routes. To the extent that economies of agglomeration are present in counties located near these major transportation routes, increased trade liberalization would cause a greater increase U.S. manufacturing employment and wage growth in these counties.

### 3.4 AGGLOMERATION

Economies of agglomeration describe the benefits that firms obtain when locating near each other (O'Sullivan, 2003). As an increasing number of related firms cluster in close proximity, overall production costs are reduced and market access is enlarged due to network effects. This can result in a virtuous cycle for the clustered firms, as well as the surrounding city or metropolitan area, as the number of potential suppliers increases (O'Sullivan, 2003). Increased economic activity may lead to large growth rates in employment and production increases as both intra-industry and inter-industry activity expands.

Economies of agglomeration could produce lock-in, as Krugman (1991) argues, and lock-in can render industry responses to external shocks uncertain and complicated, as Holmes' (1996) analysis shows. For trade liberalization and manufacturing, consider manufacturing locked in the rustbelt, the historical center of U.S. manufacturing. If transportation costs are significant, firms will be more likely to locate their production facilities in closer proximity to the international border. However, if transportation costs are relatively insignificant in the location decision of suppliers, and agglomeration effects are strong in the manufacturing belt area, most manufacturing firms will choose not to locate in border regions but will remain within the historical rustbelt. If this is the case, the border region between the U.S. and Mexico should not experience the industry expansion predicted. Furthermore, if the balance of transportation costs and agglomeration effects are right, the migration of the industry exceeds that of trade liberalization alone.

Empirical results for manufacturing employment and establishments together will demonstrate regional adjustments in the U.S. manufacturing sector. If employment increases in U.S. border states while the number of establishments show little change, perhaps existing firms are expanding rather than new firms entering the market. Likewise, increases in manufacturing employment and establishment growth would signal market entry in the border region.

### 3.5 TRENDS IN THE SUNBELT AND RUSTBELT REGIONS

Figures 2A and 2B compare manufacturing employment and wages between the sunbelt and manufacturing belt regions. Figure 2A demonstrates the dramatic increase in sunbelt manufacturing employment (as a percentage of overall U.S. manufacturing employment) between 1980 and 2000. Manufacturing employment within the rustbelt region, however, experienced a large decrease between 1980 and 1983, but has not declined much further since that time. Figure 2B indicates the wages between the two geographical regions are converging, thus average manufacturing wages for the sunbelt increased while wages have fallen or remained stagnant throughout most of the period in the manufacturing belt. Perhaps this implies that economies of agglomeration are indeed present in the sunbelt region as increased trade leads to increased market demand in the sunbelt states.

## 3.6 SUMMARY

The HO model predicts that free trade agreements will affect manufacturing employment, wage and establishment growth in member countries. This dissertation analyzes these effects on the U.S and sub-country regions. This chapter outlines the expected differences in trade effects across these regions. To summarize these predictions, I provide a table displaying the expected coefficient signs for trade agreement and distance variables. The trade agreement variables are $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ while the distance to the international borders with Mexico and Canada is represented by $Distance^M$ and $Distance^C$, respectively. I present the predicted effects of these three types of variables in the table below.

**Expected Coefficient Signs:**

| | Δ in Mfg Employment | Δ in Mfg Wages | Δ in Mfg Establishments |
|---|---|---|---|
| $GATT_t$ | + | + | + |
| $CUSFTA_t$ | + | + | + |
| $NAFTA_t$ | + | + | + |
| $Distance^M$ | - | - | - |
| $Distance^C$ | - | - | - |

The relationship between a county's distance to Mexico and manufacturing employment growth is expected to be negative, implying the presence of positive proximity effects. I also expect the same negative relationship with both manufacturing wage growth the number of U.S. manufacturing establishments. Furthermore, I predict this effect will be larger in counties near the U.S.-Mexico border region. I make the same predictions for a county's distance to Canada, but the proximity effects on wages are predicted to be larger for counties located in sunbelt and Mexican border states relative to counties located elsewhere.

Assuming the U.S. manufacturing sector is relatively skill-intensive, the HO model predicts that increased trade will lead to increased manufacturing employment and establishment growth. U.S. manufacturing wages are predicted to increase in the relatively skill-intensive manufacturing sector also due to labor market adjustments discussed in chapter 2. Furthermore, I expect to observe relatively larger gains from trade in the U.S.-Mexico border and sunbelt regions relative to counties located elsewhere due to economies of agglomerations and reduced transportation costs.

The variables discussed here are generalizations of the data employed. A more detailed explanation of the specific variables, as well as predicted coefficient signs are presented in the following chapter. Chapter 4 also provides summary statistics and regional comparisons of U.S. manufacturing activity.

# CHAPTER 4

# SAMPLE SELECTION AND DATA SET OVERVIEW

## 4.1 INTRODUCTION

This chapter discusses the empirical framework employed and provides a detailed variable definitions and their relevance to predictions of the HO model. This chapter is divided into four sections. The first section describes the data set and provides detailed variable definitions. Section two provides summary statistics over the primary variables of interest and discusses their implications for economic growth. Next, section three provides regional comparisons of manufacturing activity over the period of study. A summary discussing the findings of this chapter is given at the end.

## 4.2 THE DATA

This dissertation focuses on changes in the U.S. manufacturing sector due to increased trade liberalization. U.S. manufacturing is one of the largest sectors in the economy, comprising over 20% of national employment in 1980. Manufacturing is also the sector most commonly studied in this literature (Sachs and Shatz, 1994).

I use a panel data set of annual observations between 1980-2000 of all U.S. counties (excluding counties located in Alaska and Hawaii) with populations exceeding 20,000 in 1980. County-specific observations on population, employment, wages, and the number of establishments can be located at the County Business Patterns database of the Geospatial and Statistical Data Center (http://fisher.lib.virginia.edu). I include several county-specific data series from the manufacturing sector to provide a detailed understanding of market fluctuations. These variables include manufacturing employment, manufacturing wages, and the number of manufacturing establishments. For some counties, one or more annual data points were missing, so I used linear interpolation to calculate these values.[6] Each of these three variables will be used as dependent variables in the analysis. These observations were entered by hand from the data source. This data source does not report data for counties with little manufacturing, therefore I use a population limit of 20,000 to conserve data gathering and lose few usable data points. A total of 1,584 counties are included, representing 90.5% and 91.4% of the total U.S. population and manufacturing employment in 1980, respectively.

Manufacturing employment within each county is included to provide information on the impact of trade liberalization via tariff concessions. Observing manufacturing employment for each county provides a view of the current changes in overall U.S. manufacturing activity. This is consistent with several studies reviewed in chapter 2 which used manufacturing employment as a dependent variable.

Annual county level real manufacturing wages (in 1998 U.S. dollars) are also included to represent the adjustment of relative factor prices during trade-induced labor market fluctuations. This data series reports the annual total payroll for manufacturing employees within each county. Observing manufacturing wages over the sample period allows me to estimate the impact of trade liberalization on wages

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[6] If there were ten or more missing observations for a particular county, that county was omitted from the data set.

using an HO model framework. Several studies reviewed in chapter 2 also use manufacturing wages in their analyses.

I employ the number of manufacturing establishments per county to observe any clustering, or agglomeration effects occurring within a specific geographical region. If producers are attracted to the border regions, observations regarding the number of establishments in these counties will demonstrate locational adjustments by manufacturers. None of the studies reviewed previously observe trade's impact on the number of establishments. I include the number of manufacturing establishments as an alternative measure of manufacturing activity. With increasing productivity, the number of workers may not increase much, while the number of establishments grows.

In addition to totals for the entire U.S. manufacturing sector, I also use time series of employment, wages, and the number of establishments for six different manufacturing industries. The industries include: Printing and publishing (SIC 27), Chemicals and allied products (SIC 28), Food and kindred spirits (SIC 20), Primary metals (SIC 33), Transportation equipment (SIC 37), and Leather and leather products (SIC 31). This information is located at the Geospatial and Statistical Data Center with the County Business Patterns (CBP) data set. These six industries were selected for two reasons. First, industries were chosen due to their closeness in matching between the two classifications systems. Second, the six industries were selected to provide a random assortment of relatively high skill-intensive industries and relatively low skill-intensive industries. The inclusion of individual industries helps disaggregate industry specific effects, which may cancel out when aggregated.

Some manufacturing industries might benefit, while others may be hurt by trade liberalization. County specific data observations are categorized under the Standard Industrial Classification system (SIC) from 1977-1997, with 1998-present observations categorized according to the North American Industry Classification System (NAICS).

I calculate the difference of the log of the series for each of the manufacturing variables observed. The same calculations are conducted for the industry specific observations as well. I denote the logged differences of manufacturing employment, wages, and establishments in each county *i* for each year *t* by $\Delta memp_{it}$, $\Delta mwgs_{it}$, and $\Delta mests_{it}$ respectively.

Several control variables are included to account for non-manufacturing fluctuations. A time trend ($time_t$), assigning numbers 1-20 to the years 1981 to 2000 respectively, is included to control for time-related fluctuations that are unrelated to the explanatory variables. I also employ the logged difference of population levels ($\Delta pop_{it}$) to control for large population growth differences between counties in the data set. Population growth measures are used as control variables in several of the studies reviewed in chapter 2. Additionally, annual state unemployment rates ($unemp_{st}$) are included to account for cyclical upswings and downturns in the U.S. economy between 1980-2000, independent of trade policy and manufacturing sector adjustments.[7] I also use county educational attainment rates ($ed_{it}$) as a control variable in this analysis. Observations are reported by the census for 1980, 1990, and

[7] This information is located at the Bureau of Labor statistics website, http://www.bls.gov.

2000. I interpolated the remaining years using the initial observations, thus constructing a time series of the variable. This variable is important to the analysis because it controls for differences in education and skill levels of workers between counties.

Two approaches are used to capture trade liberalization. My first approach employs dummy variables to indicate the implementation of GATT in 1985, CUSFTA in 1989, and finally NAFTA in 1994. Specifically, the dummy variable for GATT assigns a 1 to the years 1985-1988 and a 0 elsewhere. The CUSFTA dummy assigns a 1 to the years 1989-1993 and a 0 otherwise, while the NAFTA dummy assigns a 1 from 1994-2000 and a 0 for 1980-1993. First, I perform analysis for the overall U.S. manufacturing sector, then examine the states bordering Mexico and Canada respectively. Border regions are observed individually to account for any specific locational effects for firms located within a particular region. Finally, I examine the sunbelt and rustbelt regions independently to investigate potential location effects present in these areas.

Trade agreement dummy variables measure a one-time shift in the mean of the dependent variable, occurring immediately after the passage of the free trade agreement. While such a dummy variable approach has been employed by other papers examining the effects of trade (McCallum, 1995, Yoskowitz et al., 2002), this method ignores the fact that only a handful of tariffs were reduced in the initial year of an agreement, and most tariffs were not reduced to zero immediately. The lack of impact of NAFTA estimated in Yoskowitz et al. (2002) may be due to the use of dummy variables, especially since their sample ended in 1997.

Tariff reductions for member countries were outlined in the drafting of the GATT, CUSFTA, and NAFTA. Although the tariff reductions in GATT and CUSFTA have been completed, NAFTA tariff reductions were still in progress at the end of the sample period. As in other trade agreements, tariffs were not reduced immediately after NAFTA, but were subjected to a series of reductions over a specified time period. There are four main staging categories for tariff eliminations under NAFTA, denoted as A, B, C, and D (. The staging category for A specifies that tariffs are eliminated immediately between NAFTA countries, while category B represents a tariff reduction phase-in period of five equal annual stages from January 1994 to January 1998. Category C denotes a phase-in period of 10 equal annual tariff reduction stages from January 1994 to January 2004. Lastly, category D includes all industries in which U.S. tariffs were already classified as a most favored nation rate for Canada and Mexico.

The phase-in categories described above suggest that the effect of trade liberalization might be gradual, with the full potential impact of trade agreements observed only after a lag. If this is the case, the dummy variable approach may fail to find a statistically significant effect of trade liberalization, but only because it misspecifies the impact of the trade agreements over time. An alternative approach, allowing the agreements to more gradually affect trade, would be advisable. As various tariff phase-outs are enacted, tariff concessions provide a gradual way to observe if trade liberalization affects U.S. manufacturing.[8]

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[8] Alternatively, either the inclusion of a lagged NAFTA variable or a measure of post-agreement years could also be employed, but tariff rates should be sufficient.

Despite the tariff phase-outs inherent in trade agreements, the dummy variable approach may still accurately capture the agreements' effect. This is because forward looking manufacturers, knowing that an agreement has been passed and tariffs will be reduced in the future, may start to shift their operations before tariff rates decline to zero. This possibility could be particularly relevant since this dissertation employs differenced manufacturing variables, thus changes in growth rates might occur immediately even if the stock of manufacturing takes longer to adjust. If the agreement is not completely credible and manufacturers think that somehow the future reductions will be reversed, this argument would not hold.[9] Additionally, lags between investment and increased production may delay the initial effects of tariff concessions. It is not clear which representation of trade agreements is appropriate, so I will employ both.

I include averaged manufacturing tariff rates on imports from Canada and Mexico. These tariff rates are then differenced to provide annual U.S. tariff concessions on Canadian and Mexican imports, and are represented by $\Delta avgtar^{C}_{t}$ and $\Delta avgtar^{M}_{t}$, respectively. A more detailed discussion of these averaged tariff rates and their relationship to the implementation of trade agreements is provided later in this chapter.

In order to test the contention by Hanson (1995) and others that transportation costs and proximity to the border are significant when investigating the impact of trade liberalization, I include the distance, in miles, from each county's seat to the

[9] Likewise, if the agreement is credible and manufacturers anticipate it will pass, the agreement could have an effect before passing.

nearest border crossing between the U.S., Mexico, and Canada.[10] These variables, denoted by $miles_i^M$ and $miles_i^C$, represent the distance from each U.S. county to the nearest Mexican and Canadian border crossings respectively. Interaction terms between distance variables and trade agreement dummies are then constructed for proximity to both the Canadian and Mexican borders. The following interaction terms are constructed: $miles_i^M \times GATT_t$, $miles_i^C \times CUSFTA_t$, $miles_i^M \times NAFTA_t$, and $miles_i^C \times NAFTA_t$. They provide information regarding the location of U.S. manufacturers and examine possible correlation between border proximity and effects of trade liberalization in the manufacturing sector.

In addition to distance, transportation costs will also depend on transportation infrastructure. The transportation infrastructure provides another test of the impact of locational effects on international trade. I include two variables that describe transportation infrastructure. First, I employ a dummy variable to control for the presence of a high priority NAFTA corridor ($hpc_i$) within each county. This dummy variable assigns a 1 to counties where a High Priority Corridor exists and a 0 otherwise. The 1991 Intermodal Surface Transportation Efficiency ACT (ISTEA) was implemented to identify the need to improve road conditions in the U.S., creating efficient north-south and east-west routes for the shipment of goods across the borders of the U.S., Canada, and Mexico (Bradbury, 2000). This act was expanded further in the National Highway System Designation Act (NHS) of 1995 and the

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[10] Distance observations between county seats and the nearest international border crossings were located at www.expedia.com.

Transportation Equity Act for the 21st Century (TEA-21). These two plans together specified the planned improvements of designated interstate highways, such as resurfacing and increasing the number of lanes, as well as expanding the list of corridors to be included. Construction of these HPCs began in 1993, therefore I use the interaction term $hpc_i$ x $NAFTA_t$ to measure the effect of these HPCs following NAFTA in 1994. There are 44 HPCs, many of which have been improved since 1995 although some are currently undergoing construction.[11]

Second, I account for the presence of major U.S. seaports using the dummy variable $sea_i$.[12] This dummy variable controls for the transportation of goods by ship among the three countries observed. $sea_i$ assigns a 1 to U.S. counties with a major seaport and a 0 otherwise. Furthermore, $sea_i$ is multiplied by $NAFTA_t$, creating the interaction term $sea_i$ x $NAFTA_t$. This interaction term captures NAFTA related trade liberalization benefits in counties with a major seaport. Firms are hypothesized to lower transportation costs by locating closer to emerging markets. If seaports are a preferred point of access to the new markets, firms are predicted to locate near seaports. Additionally, these counties could be subject to significant agglomeration effects.

I also include the interaction terms $sea_i$ x $NAFTA_t$ and $hpc_i$ x $NAFTA_t$ in the industry specific analyses. The importance of proximity to transportation infrastructure could conceivably differ by industry. Including these interaction terms

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[11] A list of these high priority corridors can be located at www.aaroads.com/high-priority/.

[12] A comprehensive list of U.S. seaports can be found at www.worldhistory.com/wiki/L/List-of-seaports.htm

for each industry allows for an estimation of trade-induced location effects by industry.

This dissertation employs other related variables to measure the effect of trade flows. I use the logged differences of U.S. manufacturing exports and imports with Canada and Mexico from 1980 to 2000. This includes U.S. manufacturing export growth to Mexico ($\Delta mexex_t$) and Canada ($\Delta canex_t$), as well as U.S. manufacturing import growth from Mexico ($\Delta mexim_t$) and Canada ($\Delta canim_t$). These variables allow the analysis to directly measure the effects of increasing trade values between the U.S., Mexico and Canada on manufacturing employment, wage and establishment growth in the United States. Logged differences of industry-specific trade growth variables are included as well. U.S. industry export and import growth with Canada and Mexico allow the estimations to observe the effects of increased trade liberalization on each of the six industries included here.

### 4.2.1 Specific Industries and Their Skill Intensities

Although the U.S. manufacturing sector is assumed to be relatively skill-intensive, specific industries within the manufacturing category vary in their skill-intensity. To approximate this skill level within industries, I estimate the "intensity of low-skilled production," based on the method provided in Sachs and Shatz (1994). The measure equals the ratio of production employment to overall employment in a particular industry, or the production share of the industry. Production workers are assumed in Sachs and Shatz (1994) to be relatively low skilled while non-production workers are assumed to be relatively high skilled. Thus relatively high production shares imply that industry is relatively less skill-intensive, while industries with low production shares are relatively skill-intensive. The production share is calculated for each of the six industries listed in the previous section.

The skill intensity estimates for each industry, along with the production and total employment levels are shown in Table 5. The data used to calculate the skill intensities of Sachs and Shatz (1994) covers the period 1958-1996.[13] As shown in the table, printing and publishing (SIC 27) has the lowest production share, approximately 57%, and thus is the most skill-intensive industry included in the analysis. Leather and leather products (SIC 31), in contrast, has the highest production share, 87.5%, and is the least skill-intensive industry observed in this analysis. The six industries are then categorized in ranking order and are given an identification number of 1 to 6 with 1 representing the most skill-intensive and 6 the least skill-intensive industry.

### 4.2.2 Average U.S. Tariff Rates

I provide a generalized corresponding tariff rate reduction category for each of the six industries examined below. Tariff reduction schedules are given at the 6-digit level according to the Harmonized Tariff System (HTS). Observations in this analysis are at the 2-digit level, thus these categories are generalized representations of each manufacturing industry's average staging category. Each category accounts for a positive percentage of tariff reductions in most industries. Therefore,

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[13] This information can be located from the NBER-CES Manufacturing Industry Database at www.nber.org/nberces/nbprod96.htm.

categorization is assigned according to the category that counts for the most goods in each industry. Because of this, changes in actual tariff levels for some 2-digit industries do not show the same pattern of tariff reductions as specified in the general staging category described above. These observations are only for 6-digit industry product tariff reductions specified in the preliminary NAFTA Tariff Phasing Schedule.[14] Because of this, some industry products are not reported in the tariff schedule yet are still traded among North American countries. The following table presents the reported industry totals as well as an industry breakdown of these totals into the four main staging categories.

| Industry | Total | A | B | C | D |
|---|---|---|---|---|---|
| Food and kindred products | 170 | 92 | 15 | 36 | 27 |
| Printing and publishing | 33 | 11 | 0 | 0 | 22 |
| Chemicals and allied products | 94 | 58 | 3 | 2 | 31 |
| Leather and leather products | 88 | 56 | 4 | 14 | 14 |
| Primary Metal Industries | 181 | 16 | 4 | 143 | 18 |
| Transportation Equipment | 64 | 48 | 0 | 0 | 16 |
| Industry Total | 630 | 281 | 26 | 195 | 128 |
| Percentage for each category | 100% | 44.6% | 4.1% | 31% | 20.3% |

As shown above, Printing and publishing (SIC 27) is assigned to the D category while Primary Metals (SIC 33) is assigned to the C category. Leather and leather products (SIC 31), Transportation Equipment (SIC 37), Food and kindred spirits (SIC 20), and Chemicals and allied products (SIC 28) are assigned to the A category. Additionally, category A has the highest percentage of observations, indicating that almost half of the NAFTA tariff reductions reported were eliminated

[14] This tariff schedule is located at www.totse.com/en/politics/economic_documents/naftarif.

immediately following January 1, 1994. However, nearly a third of the reported tariff reductions are in the C category in which tariffs are phased out in equal annual stages for ten years following the passage of NAFTA. This mix of tariff reduction phase-in schedules demonstrates the differences that exist even in a single industry.

I calculate the average tariff rates for the six 2-digit manufacturing industries listed above. This calculation divides the annual U.S. tariff duties collected for each industry by the overall value of the imports from Canada and Mexico.[15] I provide the total number of products included in this calculation for each industry in the table below. Because U.S.-Canada and U.S.-Mexico trade volumes differ, I include the total number of industry products used to calculate the average tariff rates for both Canada and Mexico.

| Industry | Canada | Mexico |
|---|---|---|
| Food and kindred products | 324 | 198 |
| Printing and publishing | 49 | 47 |
| Chemicals and allied products | 327 | 147 |
| Leather and leather products | 131 | 139 |
| Primary Metal Industries | 403 | 169 |
| Transportation Equipment | 131 | 72 |

I then compute an averaged tariff rate for each industry using an unweighted average of the 6-digit observations. For each industry *k*, I denote the change in the average tariff rates $\Delta cantar_{kt}$ and $\Delta mextar_{kt}$ for Canada and Mexico respectively. This captures the effects of gradual tariff concessions as well as immediate reductions

[15] Tariff information can be located at http://data.econ.ucdavis.edu/international for 1989-2000 as provided by Peter Schott of Yale University. Chris Magee of Bucknell University provided the tariff data used for 1980-1988.

of tariffs. These variables are included as an alternative to the dummy variable approach in measuring the impact of trade liberalization on U.S. manufacturing activity.

Tables 6A and 6B show the average industry tariff rates on imports from Canada and Mexico, $cantar_{kt}$ and $mextar_{kt}$, to provide a more detailed view of the tariff elimination process in the six industries. The industries are organized by low to high initial tariff rates, starting with the printing industry and ending with the leather industry. Likewise, figures 3A and 3B graphically illustrate the reduction in U.S. industry tariff rates on imports from Canada and Mexico. In 1980, tariffs on Canadian leather and chemical imports were the highest at 9.3% and 9.7% respectively. Leather and food manufactures, however, received the highest tariff rates on imports from Mexico in 1980. As shown, most of the tariff reductions occurred prior to the 1994 implementation of NAFTA. Following NAFTA, the leather industry had the highest tariff rate on imports from both Canada and Mexico, approximately 5%, out of the six industries observed. The leather industry tariff rates have continued to decline on imports from both countries, reaching approximately 0.5% on Canadian imports and 2.6% on Mexican imports in 2000. Because industries with relatively high levels of trade protection are those most opposed to free trade, I expect to see a larger negative trade impact in manufacturing industries with high initial tariff rates.

I then calculate an overall average manufacturing tariff rate, which is an aggregate of the six individual industries discussed above. These average tariff rates on manufacturing imports are presented in Table 6C. The tariff rates are then differenced, providing an annual change in the average tariff rate denoted as $avgtar^{C}_{t}$ and $avgtar^{M}_{t}$ respectively. These tariff variables provide an alternative measure of the relationship between trade liberalization and fluctuations in U.S. manufacturing activity.

To observe the relationship between the trade dummies and the average U.S. manufacturing tariff rates, I calculate the covariance between the two using regression analysis. The covariance is calculated to compare the explanatory power of the trade dummy variables, $GATT_t$, $CUSFTA_t$, and $NAFTA_t$, with average U.S. manufacturing tariff rates $avgtar^{C}_{t}$ and $avgtar^{M}_{t}$. I also include an overall constant and the time trend $time_t$, as well as a five year tariff phase-in variable for each of the three trade agreements. The tariff phase-in for GATT, $trend^{G}_{t}$, displays a 1 for 1985, counting upward to 5 between 1986 and 1989, with zeros elsewhere. The trade trend for CUSFTA, $trend^{C}_{t}$, has a 1 for 1989, counting from 2-5 for the years 1990-1993 with zeros included for the remaining years. Lastly, the trade trend for NAFTA, $trend^{N}_{t}$, provides a 1-5 for years 1994-1998 and zeros otherwise. I report the resulting coefficients and the related t-statistics in the following table:

| | C | $time_t$ | $GATT_t$ | $CUSFTA_t$ | $NAFTA_t$ | $trend^{G}_{t}$ | $trend^{C}_{t}$ | $trend^{N}_{t}$ |
|---|---|---|---|---|---|---|---|---|
| $avgtar^{C}_{t}$ | 0.06817 | -0.00245 | - | -0.01049 | -0.01815 | - | -0.00167 | -0.00050 |
| | (3247.43) | (-627.16) | - | (-272.95) | (-328.07) | - | (-152.56) | (-72.35) |
| $avgtar^{M}_{t}$ | 0.06011 | -0.00268 | 0.00604 | - | -0.00183 | -0.00079 | - | -0.00084 |
| | (1655.64) | (-629.84) | (139.55) | - | (-30.11) | (-67.28) | - | (-66.46) |

The results in the table above display the expected signs for both simple dummy variables and tariff phase-in variables.[16] They indicate significant immediate reductions in tariffs with the passage of each trade agreement. In addition, tariffs continue to fall by smaller, yet statistically significant amounts for the next four years.

### 4.3 DESCRIPTIVE STATISTICS

Table 7 reports sample statistics for the variables used in this dissertation. Table 7A presents sample statistics for the entire data set including all counties within the continental U.S. with populations exceeding 20,000. Table 7B provides statistics for counties in states located along the U.S. border with Mexico while Table 7C provides statistics for counties in states along the U.S.-Canada border. Likewise Tables 7D and 7E report descriptive statistics for counties located in the U.S. sunbelt and rustbelt regions respectively. In order to identify patterns of change within the manufacturing sector, regional shares of employment, annual wages, and the number of establishments are provided for counties in states bordering Mexico and Canada. These figures are presented as a percentage of overall U.S. observations. Table 8 provides these comparative ratios for the years 1980, 1990, and 2000. The various regions examined here allow for an overall view of the regional distribution of current manufacturing activity.

[16] The resulting adjusted $R^2$ for the regressions with $avgtar^M_t$ and $avgtar^C_t$ as the dependent variables were 0.98 and 0.99, respectively.

Differing rates of average growth in manufacturing employment between regions imply that the sunbelt and U.S.-Mexico border region are both experiencing faster manufacturing sector growth in production and employment relative to the rest of the country. For example, the mean of $\Delta memp_{it}$ was 0.009 in for counties in states bordering Mexico compared to 0.0007 and 0.005 for counties in states bordering Canada and the entire sample respectively. Likewise, the mean of $\Delta memp_{it}$ was 0.007 and 0.004 for counties in the sunbelt and rustbelt regions respectively. Additionally, regional manufacturing employment as a percentage of U.S. manufacturing employment steadily increased from 15.9% to 18% between 1980 and 2000 for counties in the states located along the U.S.-Mexican border. For counties in states located along the U.S. border with Canada, however, the share of overall manufacturing employment has decreased from 17.5% to 15.5% over the same time period.

Changes in manufacturing wage growth, however, over the sample period are quite similar in each case. The mean of $\Delta mwgs_{it}$ was 0.041 for the overall sample, compared to 0.043 and 0.036 in states bordering Mexico and Canada respectively. Additionally, the sunbelt and rustbelt regions experienced an average change in manufacturing wage growth of 0.043 and 0.037 respectively. The share of wages increased consistently from 16% to 19.6% between 1980 and 2000 for states located in the U.S.-Mexican border region. Over the same period, this share steadily declined from 19.4% to 16.9% for states located in the U.S.-Canadian border region. The relatively higher increase in $\Delta mwgs_{it}$ for states bordering Mexico and the sunbelt region may indicate that as industries expand in these regions, demand for labor has also increased slightly more than in states located elsewhere, thus driving up wages for manufacturing workers in these regions.

The expansion of the manufacturing sector is also highest in the states bordering Mexico relative to states located along the Canadian border and the entire sample. The mean of $\Delta mests_{it}$ was 0.0158 in states bordering Mexico, compared to 0.0102 in states bordering Canada and 0.0099 for the entire data set. The resulting mean of $\Delta mests_{it}$ was 0.0104 and 0.0094 in the sunbelt and rustbelt regions respectively. Counties in states located in the U.S.-Mexico border region exhibit a persistent increase in the share of overall manufacturing establishments, growing from 19.3% to 21.7% between 1980 and 2000 while counties in states located in the U.S.-Canadian border region incurred a reduction in manufacturing share from 19.9% to 17.6%. This further implies that both the sunbelt and U.S.-Mexican border states experience slightly higher growth rates and relatively larger manufacturing sector expansion.

Although manufacturing sector expansion is highest in the Mexican border and sunbelt regions, state unemployment rates, $unemp_{st}$, in these regions modestly exceed those in states located elsewhere. Average unemployment rates are 6.71% in U.S. states bordering Mexico compared to 5.9% and 6.4% in the Canadian border states and the entire sample respectively. Sunbelt and rustbelt average unemployment rates are 6.93% and 6.9% respectively.

The difference of logged population estimates vary for each of the border regions and the entire sample. The mean of $\Delta pop_{it}$ was 0.018 for counties in states located along the U.S. border with Mexico, and 0.008 for counties in states located along the international border with Canada. Average population growth for the entire sample increased by 0.009, surpassing the U.S. counties in Canadian border states, yet significantly lower than population growth of U.S. counties in states bordering Mexico. Average population growth has also increased by 0.015 and 0.004 in the sunbelt and rustbelt regions respectively. These findings indicate that average population growth in both the U.S.-Mexico border region and the sunbelt region increased more than three times faster than average population growth of counties located elsewhere.

Significance tests using a standard t-distribution table were run on the differenced manufacturing sector variables mentioned above to observe if the regional fluctuations differ significantly from the U.S. mean. In every case, I failed to reject the null hypothesis of no difference from the U.S. mean. This finding implies that there is a relatively uniform growth rate in the manufacturing sector and that this growth rate does not have a significant regional variance from the U.S. as a whole.

I also include regional comparisons of manufacturing employment, wages, and the number of establishments for the six industries observed. Table 9 presents these regional comparisons as a percentage of U.S. manufacturing for the years 1980, 1990, and 2000. The inclusion of these industry-specific regional comparisons allows for an overall view of the regional distribution of current manufacturing activity for each of the six industries observed.

Manufacturing employment in U.S. states bordering Mexico increased from 15.10% to 17.35% and 8.98% to 18.92% in the chemical and leather industry respectively. However, the primary metals and transportation equipment manufacturing industries experienced a decline in manufacturing employment, falling from 9.85% to 9.60% and 21.36% to 14.16% respectively. For states in the sunbelt region, manufacturing employment displays similar growth patterns. Manufacturing employment grew from 25.31% to 28.30% and 13.09% to 25.60% in the chemical and leather industry respectively. This region also experienced a decline in transportation equipment employment from 29.49% to 22.89%. Because the sunbelt includes the four states adjacent to Mexico, the similar findings are not surprising here.

Manufacturing shares for the U.S.-Canada border region show a different trend. The food and printing industries observed a decline in employment of 14.66% to 13.29% and 21.45% to 16.09% respectively. Leather industry employment also fell from 25.86% to 23.47% in the U.S.-Canadian border region. The chemical industry, however, increased its percentage of manufacturing employment from 11.49% to 12.81%. U.S. rustbelt states, however, experienced employment share increases from 22.23% to 23.07%, 12.78% to 16.71%, and 34.32% to 37.57% in the printing, leather, and transportation equipment industries respectively while the food employment share fell from 21.57% to 18.29%. The common finding of declining industry employment shares in U.S. states adjacent to the Canadian border implies that location effects may not be present in this region, perhaps due to similar factor contents of production between the two countries. However, the increase in industry employment shares in the rustbelt region indicates that agglomeration effects may be larger here, thus retaining manufacturing activity for three of the six industries observed.

Non-border states experienced employment increases from 63.08% to 69.50% and 53.65% to 62.88% in the printing and transportation equipment industries respectively. On the other hand, employment decreased in the chemical and leather industries from 73.41% to 69.85% and 65.16% to 57.61% respectively.

The percentage of wages earned in each region as a percentage of U.S. industry wages tells a different story from employment shares. The manufacturing wage share in U.S. states located along the border with Mexico increased from 10.10% to 15.43% in the leather industry while it decreased from 9.09% to 8.66% in the primary metal industry. States located in the sunbelt region, however, experienced an increased in manufacturing wage share from 21.06% to 23.95% and 13.55% to 20.24% in the printing and leather industries respectively. Transportation equipment wage shares fell, on the other hand, from 31.30% to 22.26% over the same period.

Several industry wage shares also declined in states located along the U.S. border with Canada. Industry wage shares decreased from 15.14% to 13.96% and 23.74% to 15.91% in the food and printing industries respectively. Likewise, wage shares also decreased from 28.49% to 23.93% in the leather industry. The chemical industry, however, experienced an increase in industry wage share from 11.08% to 12.32% over the time period. States located in the U.S rustbelt region observed declining wage shares from 23.89% to 20.61%, 21.71% to 16.79%, and 53.82% to 48.83% in the food, leather and primary metal industries respectively. Transportation equipment, however, experienced an increase in industry wage share from 35.66% to 40.66%.

Non-border states observed an increase in wage shares from 66.66% to 68.48% and 61.02% to 70.27% in the food and printing industries respectively. Transportation equipment also experienced an increase in wage share from 48.58% to 58.84%. Over the same period, chemical industry wage shares declined in these states from 72.80% to 70.27%.

Establishment shares in five of the six industries increased in states located along the U.S.-Mexico border. The largest increases include 17.68% to 21.02% and 16.10% to 25.63% in the food and leather industries. Transportation equipment, on the other hand, experienced a decline in establishment share from 26.10% to 21.14%. The U.S. sunbelt states display a similar pattern of establishment share changes, with food and leather industry shares increasing from 27.90% to 29.80% and 21.09% to 33.65% respectively. Likewise, transportation equipment experienced a decline in establishment share from 39.32% to 33.02% over the same period.

Four of the six industries experienced a decline in establishment share in states located along the U.S. border with Canada. For example, establishment share declined from 21.14% to 16.89% and 30.41% to 23.22% in the printing and leather industries respectively. Food and transportation equipment industries, however, observed an increase in establishment share from 17.21% to 19.74% and 17.24% to 18.52% respectively. The rustbelt states experienced a decline in establishment share from 22.53% to 20.64% and 36.32% to 33.51% in the chemicals and primary metal industries respectively. However, transportation equipment increased its establishment share from 21.65% to 25.30% over the same period.

Lastly, non-border states observed ups and downs in the establishment shares of the six industries observed. For example, establishment shares declined from 65.11% to 59.24% and 53.48% to 51.15% in the food and leather industries respectively. Printing and primary metals, however, observed an increase in establishment shares from 60% to 62.73% and 65.29% to 66.89% respectively.

The sunbelt region experienced the largest increase in employment shares, with five of the six industries observed experiencing employment share growth over the time period, with only the transportation equipment industry employment share decreasing. Notice these five expanding industries vary from skill-intensive to less skill-intensive production. This finding implies a growing attraction of a diverse group of manufacturers to the sunbelt region.

The U.S. rustbelt experienced the largest decline in wage share between 1980 and 2000 while the largest increases in wage share occurred in non-border states. Five of the six industries observed experienced as decline in manufacturing wage share. Observe that the three skill-intensive industries are among those declining in wage share, thus implying a fall in demand for skilled labor in the rustbelt. These results are very similar to those found for the states located along the U.S. border with Canada.

Manufacturing establishment shares experienced the largest increases in the U.S.-Mexico border region and sunbelt. Five of the six industries, including the three skill-intensive industries, observed an increase in establishment share over the time period. However, states located in the U.S.-Canada border region and rustbelt experienced the largest decline in establishment share, with four of the six industries contracting.

These findings indicate that the U.S.-Mexico border region and sunbelt have experienced relatively large manufacturing sector expansion relative to states located elsewhere. The following chapter examines the link between these growth patterns and trade liberalization during the sample period.

## 4.4 SUMMARY

This chapter presented regional comparisons of summary statistics and manufacturing shares for manufacturing employment, wages and establishments, allowing for comparisons between characteristics of U.S. counties in states located along the Mexican and Canadian border. The U.S.-Mexico border and sunbelt regions exhibit higher growth rates in these variables relative to counties located elsewhere. Population growth is also higher in the U.S.-Mexico border region and sunbelt. But the differences from the U.S. mean are not statistically significant in any case, implying there is a relatively uniform growth across the individual regions.

In summation, differences in employment, wage, and establishment growth were all observed for counties in states adjacent to the U.S. border with Mexico, but the same trend is also observed for the sunbelt region as a whole. These changes may be due to regional attributes and not trade liberalization. I now turn to econometric analyses to see if manufacturing growth can be explained by trade liberalization and border proximity. This will help to determine if trade liberalization is a driving force behind U.S. manufacturing fluctuations over the period.

# CHAPTER 5

# ESTIMATION RESULTS

## 5.1 INTRODUCTION

This chapter provides regression analysis regarding the effect of trade liberalization on the regional economies of the United States. Initially, I describe the econometric model employed to examine the effects of increased trade liberalization via trade agreements on the overall U.S. manufacturing sector. Next, I include restricted samples of states, those located along the Mexican and Canadian borders and in the sunbelt and rustbelt regions, to estimate any specific effects, or trends, in a particular region. Lastly, I disaggregate the analysis to observe six manufacturing industries with varying skill-intensity levels to estimate the industry specific effects of increased trade liberalization between the U.S, Canada and Mexico.

## 5.2 THE MODEL

This analysis observes the effects of trade liberalization with Mexico and Canada on the U.S. manufacturing industry by applying a reduced form technique to three individual equations using the manufacturing variables as regressands. This method allows me to individually observe changes in manufacturing employment, wages, and the number of establishments, providing a more comprehensive view of the regional effects of trade liberalization.

### 5.2.1 North American Trade

Following the model employed in Gaston and Trefler (1997), I include three individual equations, with each specification including international trade variables and distance interaction terms for both Canada and Mexico. This provides an overall view of the effects of intra-continental trade between the three countries of interest in this analysis. The reported results are followed by the significance level in brackets for brevity. The specifications are presented below:

(1) $\Delta memp_{it} = \alpha_1 + \alpha_2\, time_t + \alpha_3 \Delta pop_{it} + \alpha_4 unemp_{st} + \alpha_5\, GATT_t + \alpha_6 CUSFTA_t + \alpha_7 NAFTA_t + \alpha_8 miles_i^M xGATT_t + \alpha_9 miles_i^C xCUSFTA_t + \alpha_{10} miles_i^M xNAFTA_t + \alpha_{11} miles_i^C xNAFTA_t + \alpha_{12} \Delta mexex_t + \alpha_{13} \Delta mexim_t + \alpha_{14} \Delta canex_t + \alpha_{15} \Delta canim_t + \alpha_{16} sea_i\, x\, NAFTA_t + \alpha_{17} hpc_i\, x\, NAFTA_t + \alpha_{18} ed_{it} + \varepsilon_{it},$

(2) $\Delta mwgs_{it} = \beta_1 + \beta_2 time_t + \beta_3 \Delta pop_{it} + \beta_4 unemp_{st} + \beta_5\, GATT_t + \beta_6 CUSFTA_t + \beta_7 NAFTA_t + \beta_8 miles_i^M xGATT_t + \beta_9 miles_i^C xCUSFTA_t + \beta_{10} miles_i^M xNAFTA_t + \beta_{11} miles_i^C xNAFTA_t + \beta_{12} \Delta mexex_t + \beta_{13} \Delta mexim_t + \beta_{14} \Delta canex_t + \beta_{15} \Delta canim_t + \beta_{16} sea_i\, x\, NAFTA_t + \beta_{17} hpc_i\, x\, NAFTA_t + \beta_{18} ed_{it} + \mu_{it},$

(3) $\Delta mests_{it} = \delta_1 + \delta_2 time_t + \delta_3 \Delta pop_{it} + \delta_4 unemp_{st} + \delta_5\, GATT_t + \delta_6 CUSFTA_t + \delta_7 NAFTA_t + \delta_8 miles_i^M xGATT_t + \delta_9 miles_i^C xCUSFTA_t + \delta_{10} miles_i^M xNAFTA_t + \delta_{11} miles_i^C xNAFTA_t + \delta_{12} \Delta mexex_t + \delta_{13} \Delta mexim_t + \delta_{14} \Delta canex_t + \delta_{15} \Delta canim_t + \delta_{16} sea_i\, x\, NAFTA_t + \delta_{17} hpc_i\, x\, NAFTA_t + \delta_{18} ed_{it} + \phi_{it},$

An F-test of group significance was used, comparing the restrictive results of equations (1)-(3) in which there is an overall constant, and equations (1)-(3) with county specific effects to allow for unspecified differences among the 1584 counties included. The null hypothesis that both specifications are the same is rejected at the 99% confidence level, indicating that fixed effects are significant in equation (1). The test failed to reject the null hypothesis, however, for equations (2) and (3).[17] The results are presented in Table 10 with county fixed effects included for equations (1-3) while Table 11 provides results from the restricted analysis in which there are no county fixed effects and an overall constant is used.

Also, I employ White's test for heteroskedasticity of residuals on the resulting error terms for each specification. In each case, heteroskedasticity as found at the 99.5% confidence level.[18] For this reason, White heteroskedasticity consistent standard errors are included in each of the specifications to address this finding.

### 5.2.1.1 Unrestricted Specifications: County Fixed Effects

*Employment Effects*

Column (1a) of Table 10 reports the estimation of employment effects. U.S. manufacturing employment growth is significantly correlated with the implementation of free trade agreements in this time period. The implementation of the GATT in 1985 is associated with a 6.74% increase [significant at 1%] in U.S. manufacturing employment growth. Manufacturing employment growth rises by 6.48% [significant at 1%] following CUSFTA in 1989 and 9.13% [significant at 1%]

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[17] Refer to Green (p.562) for test specification. The resulting test statistic was 1.382 for equation (1) with a critical value of 1.16. The resulting test statistics for equations (2) and (3) were 0.745 and 0.648 respectively with the same critical value of 1.16.

[18] Refer to Green (p.508) for formula. The residuals from equation (1) resulted in a test statistic of 638.89 with a critical value of 66.77. Likewise, the residuals from equations (2) and (3) resulted in test statistics of 303.51 and 1023 respectively.

after NAFTA in 1994. The NAFTA coefficient had the largest estimated impact on U.S. manufacturing employment growth of the three trade variables. These findings support earlier predictions that trade liberalization benefits the manufacturing sector in terms of job creation as the market area of exporting firms expanded.

The trade-distance coefficient estimates are insignificant here. The coefficient for $miles_i^M x\ GATT_t$ is negative while the other three interaction terms are positive. The inconsistency of the resulting coefficient signs on the trade-distance interaction terms precludes me from making a strong conclusion here.

Increased trade growth between the U.S. and Canada positively influenced U.S. manufacturing employment growth. A 1% increase in Canadian import growth is related to a 0.39% increase [significant at 1%] in U.S. manufacturing employment growth. U.S. manufacturing export growth to both Canada and Mexico is positive but insignificant. Additionally, the coefficient on $\Delta mexim_t$ is negative and insignificant. Three of the four findings support HO predictions of increased trade resulting in U.S. manufacturing sector expansion. Furthermore, perhaps the positive coefficient for $\Delta canim_t$ suggests the strengthening of regional production networks between the U.S. and Canada, thus leading to higher U.S. manufacturing employment growth as Canadian imports increase.

The coefficient for $sea_i x\ NAFTA_t$ implies that counties in which a major seaport is included experienced a 0.98% [significant at 10%] decline in manufacturing employment growth following NAFTA. The result for $sea_i x\ NAFTA_t$ may imply that ocean shipping is not the primary method of transporting goods between the U.S., Mexico and Canada, thus counties in which a seaport is located experienced relatively slower manufacturing employment growth. The resulting coefficient for $hpc_i \times NAFTA_t$ is also negative but insignificant. These findings do not support earlier predictions that transportation infrastructure should spur manufacturing employment growth following trade liberalization.

Lastly, rising educational attainment rates are negatively correlated with U.S. manufacturing employment growth. The resulting coefficient on education indicates that as a county's education rate increases by 1%, U.S. manufacturing employment growth falls by 0.104% [significant at 5%]. This result implies that either workers seek employment other than manufacturing as education rises, or that manufacturing is growing in counties with poorly educated workforces.

Table 10 displays the goodness of fit for column (1a). The adjusted $R^2$ demonstrates an explanatory power of 0.1147. The resulting sum of squared errors for this specification is 188.04. The Durbin-Watson statistic of 1.78 indicates that some positive serial correlation among the disturbance terms is present. This specification performs relatively well in estimating the employment effects of trade liberalization.

*Wage Effects*

Column (2a) of Table 10 displays the estimation of wage effects. Trade liberalization was positively associated with increased U.S. manufacturing wage growth. The implementation of the CUSFTA increased wage growth for manufacturing workers by 4.58% [significant at 10%], while NAFTA increased wage growth by 10.1% [significant at 5%]. These findings are consistent with the estimated employment effects described previously, and support HO predictions of trade liberalization leading to rising wages in the skill-intensive manufacturing sector. The larger impact of NAFTA relative to CUSFTA further indicates that the similarities in factors of production between the U.S. and Canada may hamper the potential increase in wage growth due to increased trade between these two countries.

The four trade-distance coefficients are insignificant here. However, the resulting signs on the coefficients are still of interest to the analysis. The coefficients for $miles_i^M \, x \, GATT_t$ and $miles_i^C \, x \, CUSFTA_t$ are positive while $miles_i^M \, x \, NAFTA_t$ and $miles_i^C \, x \, NAFTA_t$ are negative. This implies that NAFTA is weakly correlated with a slightly higher increase in U.S. manufacturing wage growth for firms located relatively close to the international border with either Canada or Mexico. The inconsistency of the coefficients prohibits me from making a strong conclusion here.

Rising trade with Canada significantly increased U.S. manufacturing wage growth. A 1% increase in U.S. manufacturing import growth from Canada is associated with a 0.325% increase [significant at 1%] in U.S. manufacturing wage growth. The estimated coefficients for U.S. manufacturing export growth to Canada and Mexico, as well as import growth from Mexico are positive and insignificant in equation (2a). These results indicate that the U.S. manufacturing sector has experienced relatively higher wage growth following increased trade liberalization with Canada. This finding supports HO predictions of higher manufacturing wages following free trade.

The construction of high priority NAFTA corridors is significantly correlated with U.S. manufacturing wage growth. The coefficient on the interaction term $hpc_i \, x$

$NAFTA_t$ implies that U.S. countries with an HPC experienced a 0.8% reduction [significant at 1%] in manufacturing wage growth. On the other hand, the presence of a seaport following NAFTA is positive and insignificant. The results contradict the expectation of significant manufacturing sector expansion and thus increased wage growth in counties with a major transportation route.

Increased education rates do not significantly impact U.S. manufacturing wage growth. Although insignificant, the resulting coefficient on $ed_{it}$ is positive. This finding implies that there is little relationship between educational attainment rates and U.S. manufacturing wages.

Table 10 displays the goodness of fit for column (2a). The adjusted $R^2$ is demonstrates a low explanatory power of 0.0283. This result is slightly lower than most of the related studies discussed in Chapter 2. For example, Sachs and Shatz (1994) and Trefler (2004) find an adjusted $R^2$ for similar specifications of 0.03 and 0.032 respectively, while Gaston and Trefler (1997) had an adjusted $R^2$ of 0.047. The Durbin-Watson statistic of 2.12 suggests that some negative autocorrelation among the error terms is present.

*Establishment Growth*

Table 10 presents the estimated effect on the number of manufacturing establishments in column (3a). The trade liberalization variables are all insignificant in this regression. Although the estimated impacts are insignificant in each case, the coefficient on $GATT_t$ is negative while $CUSFTA_t$ and $NAFTA_t$ display positive coefficients. The magnitudes of these coefficients range between 1% and 6%. The negative coefficient for $GATT_t$ is inconsistent with the results presented for equation (1a). The inconsistency of the resulting coefficients here preclude me from making a strong conclusion regarding the effects of increase trade liberalization on U.S. manufacturing establishment growth.

Distance to an international border is associated with increases in the number of U.S. manufacturing establishments. The coefficient for $miles_i^M \, x \, GATT_t$ implies that for each additional 100 miles that a county seat is located from the international border with Mexico following GATT, U.S. manufacturing establishment growth increases by 0.303% [significant at 1%]. The coefficients for $miles_i^C \, x \, CUSFTA_t$ and $miles_i^M \, x \, NAFTA_t$ are negative and insignificant here. Lastly, the coefficient for $miles_i^C \, x \, NAFTA_t$ indicates that after NAFTA's finalization, the change in the number of U.S. manufacturing establishments decreased by 0.346% [significant at 5%] for every additional 100 miles that a U.S. county seat is located away from the international border with Canada. The negative NAFTA-trade coefficient may suggest the presence of weak proximity effects after 1994. However, the failure to find a negative and significant relationship between distance to a border and establishment growth following trade liberalization contradicts earlier predictions.

Increased trade significantly influences U.S. manufacturing establishment growth. A 1% increase in manufacturing import growth from Mexico leads to an increase in the growth of the number of manufacturing establishments of 0.215% [significant at 1%]. Likewise, a 1% increase in U.S. manufacturing export growth to Canada leads to a 0.099% [significant at 1%] increase in U.S. manufacturing establishment growth. Although the association is insignificant, U.S. manufacturing export growth to Mexico is negatively correlated with U.S. manufacturing establishment growth while the relationship is positive for Canadian import growth. The positive coefficients for $\Delta canim_t$ and $\Delta mexim_t$ may indicate the presence of regional production networks between the three countries. The estimated coefficients on the Mexican trade terms have the opposite signs of those estimated in equation (1a). The results weakly support earlier predictions of manufacturing sector expansion following increased trade liberalization.

The presence of a major seaport does not significantly affect U.S. manufacturing establishment growth. However, the resulting coefficient on $sea_i x\ NAFTA_t$ is positive. On the other hand, construction of an HPC is negatively related to U.S. manufacturing establishment growth. The resulting coefficient on the interaction term $hpc_i x\ NAFTA_t$ indicates that U.S. countries through which a high priority corridor passes experienced a 0.37% reduction [significant at 5%] in manufacturing establishment growth. These results indicate that counties with an HPC did not experience an increase in establishment growth after 1994, thus contradicting earlier predictions.

U.S. manufacturing establishment growth is not significantly correlated with increased education rates. The resulting coefficient on $ed_{it}$ is negative and insignificant in this case, just as it was negative in equation (1a). This finding suggests that overall U.S. manufacturing establishment growth experiences modest declines as county education levels rise.

Table 10 displays the goodness of fit for column (3a). The adjusted $R^2$ is demonstrates a modest explanatory power of 0.097. The Durbin-Watson statistic is

2.32, indicating that some negative serial correlation is present among the residuals. This specification performs weakly compared to equation (1a), implying that employment growth may be a better estimate of trade's impact on U.S. manufacturing activity.

I conduct joint significance tests between the trade liberalization variables, distance variables, and trade growth variables using a Wald test. The Wald tests are conducted under the null hypothesis that each of the coefficients for the variables in the group is equal. First, I use a Wald test for the trade liberalization variables $GATT_t$, $CUSFTA_t$, and $NAFTA_t$, in which the null hypothesis restricts the coefficients by setting them all equal to each other. I fail to reject the null hypothesis that the coefficients are equal. On the other hand, conducting the same restrictive Wald test on the resulting coefficients for the distance variables $miles_i^M$ and $miles_i^C$, I reject the null hypothesis at the 1% level. Lastly, I use a Wald test for the trade growth variables $\Delta canex_t$, $\Delta canim_t$, $\Delta mexex_t$, and $\Delta mexim_t$. I reject the null hypothesis at the 1% level.[19] Overall, the trade dummy variables, consisting only of zeros and ones, are the only observations showing a strong correlation, thus indicating there may be some problems in isolating the effects of the individual trade agreements.

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[19] Refer to Green (p.152-154) for test formula. The resulting F statistic for the trade dummy variables $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ was 1.23 with a 5% critical value of 2.6, while it was 82.5 for the distance terms $miles_i^M$ and $miles_i^C$ (critical value of 3) and 15.04 for the trade growth variables $\Delta canex_t$, $\Delta canim_t$, $\Delta mexex_t$, and $\Delta mexim_t$ (critical value of 2.37).

#### 5.2.1.2 Restricted Specifications: No County Fixed Effects

Table 11 presents results for the models estimated without county fixed effects. These specifications show larger trade effects on U.S. manufacturing employment and wage growth relative (1a) and (2a). Additionally, the resulting coefficients for the NAFTA-distance interaction terms are negative and relatively larger than those shown in Table 10. The impact of trade growth is smaller, however, on U.S. manufacturing wage growth relative to equation (2a). Lastly, equations for U.S. manufacturing wage and establishment growth have a better goodness of fit compared to the results reported in Table 10.

*Employment Effects*

Column (1b) of Table 11 reports the estimation results of employment effects. Trade liberalization is significantly correlated with U.S. manufacturing employment growth. The implementation of the GATT increased U.S. manufacturing employment growth by 7.3% [significant at 1%]. Manufacturing employment growth increased by 6.6% [significant at 1%] following CUSFTA and 14.3% [significant at 1%] after NAFTA. Notice that in each case, the impact of trade liberalization on manufacturing employment growth exceeds the resulting coefficients from specification (1a). These findings support earlier predictions that increased trade benefits the manufacturing sector in terms of job creation.

Distance from the border is significantly related to U.S. manufacturing employment growth following the implementation of trade agreements. The coefficient for $miles_i^M x\ GATT_t$ implies that for each additional 100 miles that a county seat is located from the Mexican border following GATT, U.S. manufacturing employment growth falls by 0.12% [significant at 5%]. The coefficient for $miles_i^C$ *x* $CUSFTA_t$, however, implies that for each 100 miles that a U.S. county is located from the Canadian border following CUSFTA, U.S. manufacturing employment growth increases by 0.12% [significant at 1%]. On the other hand, $miles_i^M$ *x* $NAFTA_t$ demonstrates that for the same additional 100 miles from the Mexican border, U.S. manufacturing employment growth declines by 0.21% [significant at 1%] following NAFTA, while U.S. manufacturing employment growth falls by 0.32% [significant at 1%] for each 100 miles that a U.S. county is located from the Canadian border. Three of the four resulting coefficients display a negative sign, supporting earlier predictions of proximity effects following trade agreements. Although the resulting coefficients were positive and insignificant in equation (1a), the two NAFTA coefficients are negative and relatively large here, indicating proximity effects for manufacturers located near an international border.

Increased trade growth between the U.S. and Mexico did not significantly influence U.S. manufacturing employment growth. The resulting coefficients for $\Delta mexex_t$ and $\Delta mexim_t$ are positive and negative respectively. Likewise, growth in manufacturing exports to Canada fails to significantly impact U.S. manufacturing employment growth. However, a 1% increase in manufacturing import growth from Canada leads to an increase of 0.39% [significant at 1%] in U.S. manufacturing employment growth. Similar to the results in Table 10, the inconsistent findings here prohibit a strong conclusion from being made.

Lastly, the interaction terms $sea_i \, x \, NAFTA_t$ and $hpc_i \, x \, NAFTA_t$ are insignificant here. The coefficients on the two interaction terms are negative, the same sign as the results from equation (1a). These findings indicate that counties with an HPC or seaport do not experience any extraordinary benefits regarding U.S. manufacturing employment growth following the implementation of NAFTA, contradicting earlier predictions.

Rising education rates are not significantly associated with U.S. manufacturing employment growth. The resulting coefficient on $ed_{it}$, is positive, conflicting with the negative coefficient in equation (1a). This finding suggests that U.S. manufacturing employment growth modestly increases as county education rates increase.

Table 11 displays the goodness of fit for column (1b). The adjusted $R^2$ is demonstrates a modest explanatory power of 0.0945, compared to 0.1147 for equation (1a). Lastly, the Durbin-Watson statistic of 1.65 is also lower than the resulting statistic of 1.78 for equation (1a), thus indicating the presence of positive autocorrelation among the error terms. Overall, equation (1a) provides a better goodness of fit for the employment equation, thus demonstrating the importance of county fixed effects for this specification.

*Wage Effects*

Column (2b) of Table 11 presents the estimation of wage effects. Increased trade liberalization positively influenced U.S. manufacturing wage growth. The 1984 establishment of GATT increased U.S. manufacturing wage growth by 3.17%

[significant at 10%]. Furthermore, CUSFTA is correlated with a 4.78% increase [significant at 10%] in U.S. manufacturing wage growth, while NAFTA is associated with a 12.64% rise [significant at 5%] in wages to manufacturing workers. The relatively larger impact of NAFTA relative to the GATT and CUSFTA is consistent with the employment effects discussed for equation (1b). These findings support HO predictions that increased trade liberalization will increases wages in skill-intensive sectors such as manufacturing.

Three of the four trade-distance coefficients are significant. The resulting coefficient for $miles_i^C \, x \, CUSFTA_t$ implies that for each additional 100 miles that a U.S. county is located from the Canadian border, U.S. manufacturing wage growth increases by 0.16% [significant at 5%]. On the other hand, NAFTA provides a positive border effect for firms located near both the international border with Canada and Mexico. The resulting coefficient for $miles_i^M \, x \, NAFTA_t$ indicates that for every 100 miles that a U.S. county is located away from the Mexican border, U.S. manufacturing wage growth declines by 0.26% [significant at 1%]. Likewise, the coefficient for $miles_i^C \, x \, NAFTA_t$ shows that for every 100 miles from the Canadian border, U.S. manufacturing wage growth falls by 0.31% [significant at 1%]. $miles_i^M \, x \, GATT_t$ is positive but insignificant here. Consistent with employment effects, NAFTA interaction coefficients are negative and significant, indicating the presence of locational effects for counties located near an international border following NAFTA. It is unclear, however, if the effects are actually beginning in 1994 due to limitations of the dummy variable approach.

Increased trade between Canada and the U.S. positively impacts U.S. manufacturing wage growth. The results are consistent with the earlier findings reported in column (2a) of Table 10. A 1% increase in U.S. manufacturing import growth from Canada leads to a 0.324% [significant at 1%] increase in U.S. manufacturing wage growth. Although insignificant, the resulting coefficient on $\Delta canex_t$ is also positive. However, the coefficients for U.S. manufacturing export and import growth with Mexico are insignificant here, while the coefficients for $\Delta mexex_t$ and $\Delta mexim_t$ are positive and negative, respectively. The positive coefficient for $\Delta canim_t$ may suggest the presence of a regional production network between the U.S. and Canada. These results indicate that the U.S. manufacturing sector has had relatively higher wage growth following increased trade liberalization with Canada. Overall, these findings support HO predictions of higher manufacturing wages following free trade.

Consistent with previous results from Table 10, construction of high priority NAFTA corridors negatively affects U.S. manufacturing wage growth. Consistent with equation (1b), the coefficient for $hpc_i x\ NAFTA_t$ implies that U.S. countries through which an HPC passes experienced a 0.74% decline [significant at 1%] in manufacturing wage growth. Also, the presence of a seaport following NAFTA is negative and insignificant here. These results indicate that counties with an HPC or seaport did not experience an increase in wage growth after 1994, contradicting earlier predictions.

Table 11 displays the goodness of fit for column (2b). The adjusted $R^2$ is slightly improved in this restricted specification with an explanatory power of 0.0393 compared to the adjusted $R^2$ equal to 0.0283 for equation (1b). The resulting Durbin-Watson statistic of 2.04, also improved from the previous results shown in Table 10, but still exhibiting negative serial correlation among the error terms. Although an improvement in the goodness of fit, this estimation performs poorly as found in previous studies.

*Establishment Growth*

Table 11 displays the estimated effects of increased trade liberalization on the number of U.S. manufacturing establishments in column (3b). The results are similar to those shown in column (3a) of Table 10. Establishment growth is not significantly correlated with trade agreements between the three countries observed. The coefficients for $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ are positive, with magnitudes ranging from 1.2% to 6.2%. The failure to find a significant relationship between increased trade liberalization and U.S. manufacturing sector expansion contradicts earlier predictions.

Distance is significantly correlated with growth in the number of U.S. manufacturing establishments. The coefficient for $miles_i^M x\ GATT_t$ implies that for each additional 100 miles that a county seat is located from the international border with Mexico following GATT, U.S. manufacturing establishment growth increases by 0.102% [significant at 1%]. The coefficient for $miles_i^C x\ CUSFTA_t$ implies that for every 100 miles that a U.S. county is located from the Canadian border, U.S. manufacturing establishment growth increases by 0.11% [significant at 10%] also. However, $miles_i^M x\ NAFTA_t$ shows that for the same additional 100 miles from the

Mexican border, U.S. manufacturing establishment growth falls by 0.145% [significant at 1%]. Lastly, the coefficient for $miles_i^C$ x $NAFTA_t$ indicates that after NAFTA's finalization, the change in the number of U.S. manufacturing establishments decreased by 0.254% [significant at 5%] for every additional 100 miles that a county seat is located from the Canadian border. As found in previous estimates, the negative coefficients for the NAFTA interaction terms may indicate the presence of proximity effects near Canada and Mexico following NAFTA.

Increased trade leads to rising growth in the number of U.S. manufacturing establishments. A 1% increase in the value of manufacturing import growth from Mexico leads to higher growth in the number of manufacturing establishments of 0.213% [significant at 1%]. Likewise, a 1% increase in U.S. manufacturing export growth to Canada leads to a 0.098% increase [significant at 1%] in the number of U.S. manufacturing establishments. Although insignificant, the resulting coefficients on $\Delta mexex_t$ and $\Delta canim_t$ are negative and positive respectively. The results are similar to the previous estimation provided in column (3a) of Table 10, supporting earlier predictions of manufacturing sector expansion following increased trade liberalization, possibly through the strengthening of regional production networks.

Consistent with the result presented for column (3a) in Table 10, construction of an HPC following NAFTA negatively influenced U.S. manufacturing establishment growth. The resulting coefficient for $hpc_i$ x $NAFTA_t$ indicates that U.S. countries with an HPC experienced a 0.163% [significant at 1%] reduction in manufacturing establishment growth. The presence of a seaport following NAFTA is negative and insignificant here. These results contradict earlier predictions of U.S.

manufacturing establishment growth in counties located near a major transportation route.

Educational attainment rates positively influenced U.S. manufacturing establishment growth. The resulting coefficient for $ed_{it}$ implies that as education levels increase by 1%, U.S. manufacturing establishment growth rises by 0.038% [significant at 5%]. This finding suggests that as education levels increase, new manufacturing establishments emerge, possibly due to entrepreneurial efforts.

Table 11 displays the goodness of fit for column (3b). The adjusted $R^2$ is slightly improved with an explanatory power of 0.109 compared to 0.097 in equation (3a). Also, the Durbin-Watson statistic of 2.25 shows an improvement from the previous estimation, but still indicates the presence of negative serial correlation among the residuals. Overall, equation (3b) provides a better goodness of fit for the estimated establishment growth effects compared to equation (3a).

#### 5.2.1.3 U.S. Manufacturing Sector: Includes Average Tariff Rates

Due to limitations with the dummy variable approach, it is unclear whether the estimated trade liberalization effects accurately demonstrate the impact on the U.S. manufacturing sector. For this reason, I now replace the trade dummies $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ with the annual change in average tariff rates $\Delta avgtar_t^C$ and $\Delta avgtar_t^M$ as discussed in Chapter 4. There are no county fixed effects included here. Otherwise, the three equations reported previously are once again employed in this section.

The findings here are similar to those presented previously, but a few differences are observed in the results. First, there is no evidence of proximity effects near the border regions. Second, the presence of a seaport following NAFTA positively influences U.S. manufacturing employment growth. Third, there is no significant relationship between increased trade liberalization and changes in U.S. manufacturing wage growth. Lastly, there are inconsistent results regarding the impact of trade liberalization on U.S. manufacturing establishment growth. I present a detailed discussion of the results below.

*Employment Effects*

I present the estimated employment effects in column (1c) of Table 12. Increased trade liberalization is positively associated with U.S. manufacturing employment growth during the sample period. The resulting coefficient for $\Delta avgtar_t^C$ implies that a 1% point reduction in average tariff rates on Canadian imports is correlated with a 2.3% increase [significant at 1%] in U.S. manufacturing employment growth. Likewise, a 1% reduction in average U.S. tariff rates on Mexican manufacturing imports is related to a 3.16% increase [significant at 1%] in U.S. manufacturing employment growth. The results are consistent with those presented for equations (1a) and (1b) in which the coefficients for $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ were positive and significant. These findings support HO predictions.

There is no evidence of positive proximity effects near the U.S. border with Canada or Mexico. The coefficient on $miles_i^M x\ GATT_t$ indicates that for each 100 miles that a county seat is located from the Mexican border, U.S. manufacturing employment growth increases by 0.069% [significant at 10%] following GATT. Likewise, the resulting coefficient on $miles_i^M$ x $NAFTA_t$ implies that for the same 100 miles from the U.S.-Mexico border, U.S. manufacturing employment increases by 0.237% [significant at 1%] following NAFTA. Lastly, for the same 100 miles from the Canadian border following NAFTA, U.S. manufacturing employment growth increases by 0.165% [significant at 5%]. Although insignificant, the resulting coefficient for $miles_i^C$ x $CUSFTA_t$ is positive. The results are similar to those in equation (1a) where three of the four trade-distance coefficients were positive while the coefficient on $miles_i^M$ x $GATT_t$ was negative. These findings fail to support earlier predictions of relatively large proximity effects near the U.S. border regions.

The effect of increased trade on U.S. manufacturing employment growth is similar to the results presented for equations (1a) and (1b). The resulting coefficient signs are the same for each of the trade variables, with the positive and significant coefficient for $\Delta canim_t$. This finding once again suggests the formation of regional production networks between the U.S. and Canada.

The presence of a seaport positively influenced U.S. manufacturing employment growth. The resulting coefficient for $sea_i$ x $NAFTA_t$ suggests that for each county in which a seaport is located, U.S. manufacturing employment growth increased by 0.91% [significant at 10%] following NAFTA. This finding conflicts with previous results in (1a) and (1b) where the resulting coefficient was negative for each. The positive coefficient suggests that U.S. counties benefit from having a seaport. Although insignificant, the coefficient for $hpc_i$ x $NAFTA_t$ is positive and insignificant compared to the negative results from equations (1a) and (1b).

The goodness of fit for equation (1c) is displayed in Table 12. The adjusted $R^2$ is 0.1262, higher than the 0.1147 from equation (1a). Lastly, the Durbin Watson statistic of 1.78 equals the statistic from (1a), still indicating the presence of positive autocorrelation among the error terms. Overall, equation (1c) has a better goodness of fit relative to previous estimates.

*Wage Effects*

I present the estimated wage effects in column (2c) of Table 12. Increased trade liberalization did not significantly impact U.S. manufacturing wage growth. The resulting coefficients for $\Delta avgtar_t^C$ and $\Delta avgtar_t^M$ were both negative and insignificant. The positive coefficient signs for $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ are consistent with the results for equation (2b). The failure to find a significant relationship between tariff reductions and U.S. manufacturing wage growth contradicts HO predictions.

All of the distance interaction terms are positive, which indicates no proximity effects for counties located relatively close to the international border with Canada or Mexico. The resulting coefficient for $miles_i^C \times CUSFTA_t$ implies that for each 100 miles that a U.S. county is located from the U.S.-Canada border following CUSFTA, U.S. manufacturing wage growth increases by 0.15% [significant at 5%]. The three remaining trade-distance interaction terms are also positive but insignificant. These results differ from previous findings where NAFTA-trade coefficients were negative and significant in equation (2b).

Increased trade positively affected U.S. manufacturing wage growth. The estimated coefficients on $\Delta canex_t$ and $\Delta canim_t$ indicate that a 1% increase in export growth to Canada leads to a 0.044% [significant at 1%] increase in U.S. manufacturing wage growth, while a 1% increase in Canadian import growth results in a 0.211% [significant at 1%] increase in U.S. manufacturing wage growth. The resulting coefficient signs are similar to those estimated for equation (2b), in which all four trade coefficients are positive and $\Delta canim_t$ is significant. These findings support HO predictions of higher manufacturing wages following increased trade and may suggest the presence of regional production networks between North American countries.

The relationship between counties with an HPC and U.S. manufacturing wage growth is negative and insignificant here. This finding is consistent with the results of equations (2a) and (2b) in which the estimated coefficient for $hpc_i x\ NAFTA_t$ was negative and insignificant, indicating that the presence of an HPC does not lead to higher wage growth in U.S. counties following NAFTA.

*Establishment Effects*

Table 12 presents the estimated establishment effects in column (3c). Tariff reductions had contrasting effects on U.S. manufacturing establishment growth. The estimated coefficients on $\Delta avgtar_t^C$ and $\Delta avgtar_t^C$ are negative and positive respectively. The insignificant coefficients for specifications (3c) and (3b) imply that there is no effect of trade liberalization on establishment growth. This finding fails to support earlier predictions of manufacturing sector expansion following trade liberalization.

I find no significant proximity effects for counties located relatively close to an international border. The coefficients for the NAFTA interaction terms are both negative, similar to previous results in equations (3a) and (3b). The failure to find evidence of significant proximity effects contradicts earlier predictions.

Increased trade had mixed effects on U.S. manufacturing establishment growth. The resulting coefficient for $\Delta mexex_t$ indicates that a 1% increase in U.S. manufacturing exports to Mexico is correlated with a 0.057% reduction [significant at 5%] in U.S. establishment growth. On the other hand, a 1% increase in Mexican import growth increases the rise in the number of U.S. establishments by 0.244% [significant at 5%]. Lastly, a 1% increase in U.S. export growth to Canada results in a 0.109% rise [significant at 1%] in U.S. manufacturing establishment growth. Three of the four coefficient signs on the trade variables in equation (3c) have the same signs as those estimated for equation (3b), with only the negative coefficient for $\Delta canim_t$ differing from earlier findings. The positive coefficients for three of the four trade variables imply that the U.S. manufacturing sector has expanded following increased trade growth, possibly due to strengthened regional production networks between the three countries. The negative coefficient for $\Delta mexex_t$ is counterintuitive, possibly implying that only large suppliers are able to compete in global markets, leading to employment growth in large competitive establishments while the smaller establishments exit the market.

The presence of an HPC did not significantly impact U.S. manufacturing establishment growth. The resulting coefficient sign for $hpc_i$ x $NAFTA_t$ is positive, compared to a negative and significant coefficient in equation (3b). This finding suggests that U.S. counties do not benefit from proximity to major transportation routes, contradicting earlier predictions.

### 5.2.2 Mexican Border States

Now, I estimate the effects of increased trade liberalization on manufacturing employment, wage, and establishment growth in counties of states located along the U.S. border with Mexico. The three equations include 177 counties from California, Arizona, New Mexico, and Texas for 1980 to 2000. Specifications (4)-(6) differ from the previous estimations because the interaction terms $miles_i^C$ x $CUSFTA_t$ and $miles_i^C$ x $NAFTA_t$ are omitted in order to isolate the distance effects to the U.S.-Mexico border region. Table 13 provides the results to these specifications in columns (4), (5), and (6).

I employ an F-test of group significance, comparing the restrictive results of equations (4)-(6) in which there is an overall constant, and equation (4)-(6) with county specific effects to allow for unspecified differences among the 177 counties. The results of this test for equation (4) reject the null hypothesis at the 99% confidence level, indicating that fixed effects are significant in equation (4). The test failed to reject the null hypothesis, however, for equations (5) and (6).[20] In this case, equation (4) includes county fixed effects while equations (5) and (6) have one overall constant. Also, the resulting error terms for each specification were tested for the presence of heteroskedasticity using White's residual test. In each case, heteroskedasticity was found at the 99.5% confidence level.[21] For this reason, White standard errors are included in each of the specifications to address this finding.

*Employment Effects*

Column (4) of Table 13 displays the estimation of employment effects. Increased trade liberalization positively influenced U.S. manufacturing employment growth in states adjacent to the international border with Mexico. The implementation of GATT is correlated with a 4.82% [significant at 1%] increase in U.S. manufacturing employment growth. Manufacturing employment growth increased by 8.38% [significant at 1%] after CUSFTA, and 12% [significant at 1%] following NAFTA. Coefficient signs are the same as in equation (1a) while the impact of CUSFTA and NAFTA are larger here, implying that trade liberalization had a relatively larger impact on the Mexican border region compared to the U.S.

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[20] The resulting F statistic was 1.239 with a critical value of 1.16 for equation (4). The F statistics were 0.638 and 0.435 for equations (5) and (6) respectively, with the same critical value of 1.16.

[21] The resulting test statistic was 182.66 with a chi-squared critical value of 53.67 for equation (4), while the test statistics were 55.47 and 197.89 for equations (5) and (6) respectively.

overall. These results support HO predictions of increased U.S. manufacturing employment growth following trade liberalization efforts.

Proximity to the international border with Mexico does not impact U.S. manufacturing growth in counties located within the Mexican border states. The resulting coefficient signs for $miles_i^M x\ GATT_t$ and $miles_i^M x\ NAFTA_t$ are positive although neither is significant. Similar to the findings of Yoskowitz et al. (2002), these results may imply that cities such as Houston, Phoenix, and Albuquerque are still close enough to the border that they receive lower transportation costs and have available labor markets and infrastructure, making these cities lower cost than true "border" areas. The failure to find positive border effects for U.S. firms located in the border region with Mexico contradicts earlier predictions.

Increased trade positively is positively associated with manufacturing employment growth in the U.S.-Mexico border region. A 1% increase in U.S. manufacturing exports to Mexico is related to a 0.073% increase [significant at 1%] in U.S. manufacturing employment growth, while a 1% increase in Canadian manufacturing imports is correlated with a 0.291% rise [significant at 1%] in manufacturing employment growth in the border region with Mexico. The insignificant coefficients for growth in U.S. manufacturing imports from Mexico and exports to Canada are negative and positive respectively. Perhaps the negative coefficient on $\Delta mexim_t$ implies the strengthening of regional production networks between the U.S. and Mexico. The coefficients have the same signs as those presented for equation (1a), but only $\Delta mexex_t$ has a larger estimated impact here. Three of the four findings support HO predictions that increased trade results in an expansion of the U.S. manufacturing sector. The results contradict earlier predictions of relatively larger trade effects between the U.S. and Mexico compared with the U.S. and Canada.

The presence of a major seaport following NAFTA positively influenced U.S. manufacturing employment growth in counties of states bordering Mexico. The resulting coefficient for $sea_i \, x \, NAFTA_t$ implies that counties with a seaport is experienced a 2% increase [significant at 1%] in manufacturing employment growth in the border region. This finding differs from the negative and significant coefficient in equation (1a). The significance of seaports following NAFTA supports earlier predictions of benefits to firms located near major transportation routes, while the insignificant coefficient for $hpc_i \, x \, NAFTA_t$ does not.

Table 13 displays the goodness of fit for column (4). The adjusted $R^2$ equals 0.1216, higher than $R^2$ equal to 0.1147 in equation (1a). This specification performs better than previous employment estimates.

*Wage Effects*

Column (5) of Table 13 presents the estimation of wage effects. Trade liberalization via trade agreements is not significantly related to U.S. manufacturing wage growth in the Mexican border region. The resulting coefficients signs on $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ are positive, similar to the results from equation (2b). These results are also consistent with the estimated employment effects from equation (4). The failure to find a positive and significant correlation between the implementation of trade agreements and U.S. manufacturing wage growth contradicts HO predictions of higher manufacturing wages.

Distance to the international border with Mexico did not significantly affect U.S. manufacturing wage growth after the implementation of trade agreements between the U.S. and Mexico. The resulting coefficient on $miles_i^M x\ GATT_t$ is positive while it is negative for $miles_i^M x\ NAFTA_t$, which are the same signs as in equation (2b). Perhaps these findings suggest that weak proximity effects are present near the Mexico border following NAFTA. The inconsistent results, however, prevent a strong conclusion from being made regarding the effects of distance on U.S. manufacturing wage growth.

Increased trade between the U.S. and Mexico significantly influenced U.S. manufacturing wage growth in the border region in one of the four coefficients. A 1% increase in U.S. manufacturing imports from Mexico is associated with a 0.131% increase [significant at 5%] U.S. manufacturing wage growth. Although insignificant, resulting coefficients are positive for the remaining trade variables, just as they were in equation (2b). These findings support earlier predictions of higher wage growth in the U.S.-Mexico border region following increased trade.

The presence of an NAFTA HPC negatively impacted U.S. manufacturing wage growth in the Mexican border region. The coefficient for $HPC_i\ x\ NAFTA_t$ implies that counties with an HPC experienced a 1.23% reduction [significant at 10%] in manufacturing wage growth. This finding is consistent with previous estimations, contradicting earlier predictions of wage growth in counties located near major transportation routes.

Table 13 displays the goodness of fit for equation (5). The adjusted $R^2$ provides a modest explanatory power of 0.0421, larger than previous estimates. This specification provides the best goodness of fit for estimating wage effects observed thus far.

*Establishment Effects*

Column (6) of Table 13 displays the estimated effect on the number of manufacturing establishments. Increased trade liberalization does not significantly influence U.S. manufacturing establishment growth in the Mexican border region. The resulting coefficient for $GATT_t$ is negative while positive for $CUSFTA_t$ and $NAFTA_t$. The negative coefficient for $GATT_t$ differs from the positive and significant coefficient in equation (3b), and is inconsistent with the positive and significant relationship between trade liberalization and employment growth in equation (4). This finding suggests that existing manufacturers expand their operations, instead of new establishments opening in the border states.

Distance to the Mexican border following NAFTA is significantly correlated with U.S. manufacturing establishment growth. The resulting coefficient for $miles_i^M x\ NAFTA_t$ implies that for each additional 100 miles a U.S. county is located from the Mexican border, U.S. manufacturing establishment growth falls by 0.77% [significant at 10%]. On the other hand, the resulting coefficient for $miles_i^M x\ GATT_t$ is positive and insignificant. The negative coefficient for $miles_i^M x\ NAFTA_t$ is similar to the previous establishment growth estimates. This finding possibly implies that the implementation of NAFTA created proximity effects for firms located in the U.S.-Mexico border region.

Increased trade is significantly related to U.S. manufacturing establishment growth in the Mexican border region. A 1% increase in U.S. manufacturing imports from Mexico is associated with a 0.219% rise [significant at 1%] in the number of establishments. Furthermore, a 1% increase in U.S. manufacturing exports to Canada is correlated with a 0.112% increase [significant at 1%] in U.S. establishment growth. Estimated coefficients for $\Delta mexex_t$ and $\Delta canim_t$ are negative and insignificant. The positive coefficient for $\Delta mexim_t$ differs from the negative coefficient in equation (4), suggesting the presence of a regional production network in the between the U.S. and Mexico.

The presence of an HPC following NAFTA is negatively related to U.S. manufacturing establishment growth in the border region. The resulting coefficient on $HPC_i \, x \, NAFTA_t$ implies that counties with an HPC experienced a 1.55% decline [significant at 1%] in manufacturing establishment growth. This finding is similar to the estimated employment effects in which the coefficient on $HPC_i \, x \, NAFTA_t$ was negative and insignificant. I fail to find a positive and significant relationship between U.S. manufacturing establishment growth and the presence of a seaport, or HPC, contradicting earlier predictions of manufacturing sector expansion in counties located near major transportation routes.

Table 13 displays the goodness of fit for column (6). The adjusted $R^2$ provides an explanatory power of 0.1122, slightly below the $R^2$ equal to 0.1216 from equation (4). This specification performs modestly compared to the employment estimation in equation (4).

### 5.2.3 Canadian Border States

Next, I estimate the effects of increased trade liberalization on manufacturing in counties of states located along the U.S. border with Canada. The three equations employed include observations for 251 counties from 1980 to 2000 for the following states: Washington, Idaho, Montana, North Dakota, Minnesota, Michigan, New York, Vermont, New Hampshire and Maine. Specifications (7), (8) and (9) differ from the previous estimations by including the interaction terms $miles_i^C \, x \, CUSFTA_t$ and $miles_i^C \, x \, NAFTA_t$ and omitting $miles_i^M \, x \, GATT_t$ and $miles_i^M \, x \, NAFTA_t$ to isolate the distance effects to the U.S.-Canada border region. Table 14 provides the results to these specifications in columns (7), (8), and (9) respectively.

Equations (7)-(9) were run with an overall constant and then re-estimated with a fixed effect. I determined the proper specification using an F-test of group significance on the county fixed effects. The results of this test for equation (7) reject the null hypothesis at the 99% confidence level, indicating that fixed effects are significant in equation (7). The test failed to reject the null hypothesis, however, for equations (8) and (9).[22] In this case, equation (7) includes county fixed effects while equations (8) and (9) are restricted by an overall constant. I also use White's test for heteroskedasticity on the residuals from each estimation. In each case,

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[22] The resulting F statistic was 1.19 with a critical value of 1.16 for equation (7). Equations (8) and (9) had test statistics of 0.999 and 0.513 with the same critical value.

heteroskedasticity was found at the 99% confidence level.[23] Therefore, White standard errors are included in each of the specifications to address this concern.

*Employment Effects*

Column (7) of Table 14 provides the estimation results of employment effects. Increased trade liberalization positively impacted U.S. manufacturing employment growth in the Canadian border region. The implementation of the GATT increased U.S. manufacturing employment growth by 6.01% [significant at 1%]. Manufacturing employment growth also increased by 6.35% [significant at 1%] after CUSFTA, and 10.66% [significant at 1%] following NAFTA. The coefficients for $CUSFTA_t$ and $NAFTA_t$ are smaller than the estimated employment effects in Table 13, suggesting that perhaps the similar factor endowments between the U.S. and Canada may yield smaller trade effects than U.S. trade with Mexico. These results support HO predictions of increased U.S. job creation following trade liberalization efforts.

Proximity to the Canadian border is not significantly related to U.S. manufacturing employment growth. The resulting coefficient for $miles_i^C$ x $CUSFTA_t$ is positive while $miles_i^C$ x $NAFTA_t$ is negative. The failure to establish a significant relationship between proximity to the U.S.-Canadian border and increased U.S. manufacturing employment growth indicates that proximity effects are not present near the U.S.-Canadian border.

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[23] The resulting chi-squared test statistics were 58.59, 58.83, and 412.44 with a critical value of 53.67 for equations (7), (8), and (9) respectively.

Increased trade with Canada positively influenced U.S. manufacturing employment growth. A 1% increase in U.S. manufacturing import growth from Canada is associated with a 0.439% predicted increase [significant at 1%] in U.S. manufacturing employment growth. On the other hand, a 1% increase in manufacturing import growth from Mexico results in a 0.101% [significant at 5%] decline in U.S. manufacturing employment growth for the region. The insignificant coefficients on $\Delta canex_t$ and $\Delta mexex_t$ are positive and negative, respectively. These findings support earlier predictions of increased trade with Canada benefiting employment growth in the U.S.-Canada border region, but also demonstrate that rising trade with Mexico may hinder this growth.

Neither the presence of a major seaport or a NAFTA HPC is significantly associated with manufacturing employment growth in the U.S.-Canada border region. The resulting coefficient for $sea_i \times NAFTA_t$, however, is positive while it is negative for $hpc_i \times NAFTA_t$. The coefficient signs are the same as those presented for equation (4) and contradict predictions that proximity to transportation routes will serve to attract manufacturers.

Table 14 displays the goodness of fit for column (7). The adjusted $R^2$ provides a relatively high explanatory power of 0.153, surpassing the resulting 0.1216 from equation (4). Overall, this specification performs relatively well in explaining the impact of trade on U.S. manufacturing employment growth in the Canadian border region.

*Wage Effects*

Table 14 displays the estimation of wage effects in column (8). Trade agreements are positively related to U.S. manufacturing wage growth in the Canadian border region. Following GATT, U.S. manufacturing wage growth increased by 4.22% [significant at 10%]. Likewise, manufacturing wage growth rose by 9.05% [significant at 5%] after NAFTA. Surprisingly, the resulting coefficient for $CUSFTA_t$ is positive but insignificant. The coefficient signs are the same as those reported for equation (5). These findings support HO predictions of higher U.S. manufacturing wages following trade liberalization.

Distance to the international border with Canada is not significantly correlated with U.S. manufacturing wage growth following the implementation of trade agreements. The resulting coefficient signs on $miles_i^C \, x \, CUSFTA_t$ and $miles_i^C \, x \, NAFTA_t$ are consistent with estimated employment effects as well as those shown for equation (2b). This finding may suggest that weak border proximity effects near the Canadian border are present following NAFTA.

Increased trade between the U.S. and Canada positively affected U.S. manufacturing wage growth the border region. A 1% increase in U.S. manufacturing imports from Canada is associated with a 0.437% rise [significant at 1%] in U.S. manufacturing wage growth. Although insignificant, the resulting coefficient for U.S. manufacturing imports from Mexico is also positive. On the other hand, the coefficients for $\Delta mexex_t$ and $\Delta canex_t$ are negative and insignificant. The significant correlation between increased import growth from Canada and rising U.S. manufacturing wages is counterintuitive, thus contradicting HO predictions.

Table 14 displays the goodness of fit for column (8). The adjusted $R^2$ provides an explanatory power of 0.041, slightly higher than the 0.0393 from equation (2b). This specification provides a relatively low goodness of fit.

*Establishment Growth*

Table 14 presents the estimation of establishment effects in column (9). Growth in the number of U.S. manufacturing establishments is not significantly related to increased trade liberalization. The resulting coefficients for $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ are positive, consistent with the results from equation (7). The coefficient signs support predictions of U.S. manufacturing sector expansion following increased trade, but the failure to find a significant relationship was unexpected.

Increased trade increases establishment growth in the Canadian border region. A 1% increase in U.S. manufacturing import growth from Mexico is related to a 0.226% increase [significant at 1%] in establishment growth. Furthermore, a 1% increase in U.S. export growth to Canada is correlated with a 0.094% increase [significant at 1%] in U.S. manufacturing establishment growth. Increased U.S. export growth in manufactures to Mexico, as well as import growth from Canada are insignificant here. The resulting coefficient on $\Delta mexex_t$ is negative while it is positive for $\Delta canex_t$. The positive coefficients for $\Delta mexim_t$ and $\Delta canim_t$ may indicate the emergence of a regional production network between the U.S. and Canada. The significant findings support HO predictions of U.S. manufacturing sector expansion following trade liberalization efforts.

The presence of a major seaport following NAFTA is negatively related to growth in the number of U.S. manufacturing establishments. U.S. counties in the Canadian border region with a seaport experienced a 1.49% decline [significant at 1%] in U.S. manufacturing establishment growth. Recall the estimated coefficient was positive and insignificant in equation (7). This finding implies that counties in the U.S.-Canada border region do not benefit from having a seaport, thus contradicting earlier predictions.

Educational attainment rates are positively associated with manufacturing establishment growth in the border region with Canada. As education levels increase by 1%, U.S. manufacturing establishment growth rises by 0.082% [significant at 1%]. This finding may imply that with rising education rates, human capital levels rise and thus new establishments possibly emerge due to entrepreneurial efforts.

Table 14 displays the goodness of fit for equation (9). The adjusted $R^2$ provides an explanatory power of 0.1138, lower than the resulting 0.153 in equation (7). This specification performs poorly, compared to equation (7), in estimating the impact of trade on U.S. manufacturing sector growth.

### 5.2.4 Sunbelt vs. Rustbelt States

In addition to observing the effects of increased trade on the overall U.S. manufacturing sector, it is also important to examine the persistence of the historical rustbelt region as a center of manufacturing activity. I will also investigate the emerging popularity of the sunbelt region and its increasing attractiveness for manufacturers. Specifically, this section compares the estimated effects of increased trade liberalization on the manufacturing sectors of U.S. counties in states located in the sunbelt and the manufacturing belt regions. By observing the sunbelt and rustbelt separately, I can compare the estimated trade effects to examine differences in regional impacts. I employ the same three reduced form equations used previously. A detailed discussion is provided below.

### 5.2.4.1 U.S. Counties in Sunbelt States

The estimations (10)-(12) include trade-distance interaction terms $miles_i^M$ x $GATT_t$ and $miles_i^M$ x $NAFTA_t$ for the following sunbelt states: Alabama, Arizona, California, Florida, Georgia, Louisiana, Mississippi, New Mexico and Texas.[24] There are 417 counties in this sub-sample and the period observed remains from 1980-2000. Four of the nine sunbelt states are located along the international border with Mexico, this I predict similar results to those found observing the Mexican border region.

An F-test of group significance was employed, comparing the results of equation (10)-(12) in which there is an overall constant, and equation (10)-(12) with county specific effects. The results of this test for equation (10) reject the null hypothesis at the 99% confidence level, while failing to reject the null hypothesis for equations (11) and (12).[25] In this case, equation (10) includes county fixed effects while equations (11) and (12) are restricted by an overall constant. Also, the resulting error terms for each specification were tested for the presence of heteroskedasticity

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[24] The sunbelt states are defined *Columbia Electronic Encyclopedia, 6th ed.* (2005).
[25] The resulting F statistic for equation (10) was 1.162 with a critical value level of 1.16. The F statistics for equations (11) and (12) were 0.82 and 0.63, respectively, with the same critical value of 1.16.

using White's test. In each case, heteroskedasticity was found at the 99.5% confidence level, thus White standard errors are included in each of the specifications to address this concern.[26]

*Employment Effects*

Column (10) of Table 15 presents the estimation of employment effects. Increased trade liberalization is significantly correlated with employment growth in the sunbelt states, and is consistent with employment estimates for the entire U.S. and border states. Following the 1985 implementation of the GATT, manufacturing employment growth increased by 5.41% [significant at 1%]. Likewise, manufacturing employment growth increased by 8.13% [significant at 1%] following CUSFTA and 11.51% [significant at 1%] following NAFTA. The resulting coefficients are similar to those reported in Table 13, supporting earlier predictions of U.S. manufacturing sector expansion following trade liberalization.

Proximity to the Mexican border following the implementation of trade agreements is not significantly related to manufacturing employment growth in the sunbelt region. The coefficient on $miles_i^M \times GATT_t$ is positive while it is negative for $miles_i^M \times NAFTA_t$. The NAFTA-distance coefficient differs from the positive result presented for equation (4), possibly suggesting that weak proximity effects are present near the Mexican border.

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[26] The chi-squared test statistics for equations (10)-(12) are 611.16, 57.23, and 385.47 respectively, with a critical value of 51.81.

Increased trade is significantly associated with manufacturing employment growth in the sunbelt region. A 1% increase in U.S. manufacturing import growth from Canada is correlated with a 0.335% increase [significant at 1%] in employment growth. U.S. manufacturing export growth to Canada, however, is positive but insignificant here. Also insignificant, the resulting coefficients for $\Delta mexex_t$ and $\Delta mexim_t$ are positive and negative respectively. The resulting coefficients signs are the same as those presented in Table 13. Once again, the negative coefficient for $\Delta canim_t$ may suggest the presence of regional production networks between the U.S. and Canada.

The presence of a seaport following NAFTA is positively related to a 1.72% increase [significant at 1%] in sunbelt manufacturing employment growth. On the other hand, sunbelt counties with an HPC do not benefit. The resulting coefficient on $hpc_i \, x \; NAFTA_t$ is negative and insignificant. The findings are similar to those reported for equation (4), suggesting that sunbelt counties benefit more from proximity to a major seaport rather than major highway corridors, thus shipping may be the preferred method for transporting goods between the U.S., Mexico and Canada relative to trucking.

Table 15 presents the goodness of fit for column (10). The adjusted $R^2$ provides an explanatory power of 0.093, compared to 0.1216 from equation (4). Overall, this specification provides a relatively lower goodness of fit compared to employment effects for U.S. counties in Mexican border states.

*Wage Effects*

Column (11) of Table 15 provides the estimation of wage effects. Increased trade liberalization is positively correlated with manufacturing wage growth in the sunbelt region. Although insignificant, the resulting coefficient for $GATT_t$ is positive. The 1989 implementation of CUSFTA increased manufacturing wage growth by 5.72% [significant at 10%], while manufacturing wage growth also rose by 8.82% [significant at 10%] after NAFTA. These results are consistent with the estimated employment effects for the sunbelt region. Although the coefficient signs are the same, the trade variables were positive and insignificant in equation (5). These findings support HO predictions of higher manufacturing wages following increased trade.

Distance between a U.S. county seat and the U.S. border with Mexico is also significant. The resulting coefficient for $miles_i^M$ x $GATT_t$ implies that for each additional 100 miles that a county seat is located away from the international border with Mexico following the GATT, U.S. manufacturing wage growth is increased by 0.28% [significant at 5%]. On the other hand, the resulting coefficient for $miles_i^M$ x $NAFTA_t$ indicates that for the same additional 100 miles from the Mexican border, manufacturing wage growth declines 0.15% [significant at 5%] in the sunbelt region. The negative coefficient for the NAFTA term is consistent with equation (10), implying the presence of locational effects near the Mexican border after 1994.

Increasing trade is positively related to manufacturing wage growth in the sunbelt. A 1% increase in U.S. manufacturing export growth to Mexico is associated with a 0.058% rise [significant at 5%] in sunbelt manufacturing wage growth.

Likewise, a 1% rise in U.S. export growth to Canada increased sunbelt wage growth of 0.048% [significant at 5%]. Although insignificant, the resulting coefficients for $\Delta mexim_t$ and $\Delta canim_t$ are positive. The coefficients on the trade growth variables are similar to those presented for counties in U.S.-Mexico border states. These findings support predictions of increased wages to sunbelt manufacturing workers following increased trade liberalization.

The presence of either a seaport of HPC following NAFTA is negatively related to sunbelt manufacturing wage growth. Sunbelt counties through which a high priority NAFTA corridor passes experienced a 0.75% decline [significant at 1%] in manufacturing wage growth, while the coefficient for $sea_i \, x \, NAFTA_t$ is negative and insignificant. These findings are consistent to those presented in Table 13, once again contradicting predictions of increased wage growth near major transportation routes in the U.S. sunbelt region.

Column (11) of Table 15 provides the goodness of fit for this estimation. The adjusted $R^2$ provides a modest explanatory power of 0.0396, slightly lower than the 0.0421 adjusted $R^2$ reported in Table 13. The specification performs relatively poorly compared to previous estimates.

*Establishment Effects*

Table 15 displays the estimation of establishment effects in column (12). Increased trade liberalization is not significantly related to manufacturing establishment growth in the sunbelt. Although insignificant, the resulting coefficients for $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ are positive. These results differ from those presented in Table 13 in which the estimated coefficient for $GATT_t$ was negative while it was positive for $CUSFTA_t$, and $NAFTA_t$. These findings may suggest that although manufacturing employment has increased in the sunbelt, establishments are getting larger as they become more globally competitive, yet the number of establishments is not significantly changed.

Distance to the Mexican border significantly influenced manufacturing establishment growth in the sunbelt region. For each additional 100 miles that a sunbelt county is located from the Mexican border following GATT, growth in the number of manufacturing establishments increases by 0.218% [significant at 1%]. On the other hand, for the same additional 100 miles from Mexico, sunbelt manufacturing establishment growth falls by 0.131% [significant at 1%] following NAFTA. The estimated coefficient signs are consistent with those presented in Table 13, indicating NAFTA may have led to proximity effects for sunbelt counties located near the U.S.-Mexico border.

Increased trade growth is significantly related to sunbelt manufacturing establishment growth. A 1% increase in U.S. import growth from Mexico is associated with a 0.249% rise [significant at 1%] in establishment growth, while a 1% increase in U.S. manufacturing export growth to Canada is related to a 0.115% increase [significant at 1%] in sunbelt establishment growth. The results are similar to those in which I observe the four states bordering Mexico. Although insignificant, the resulting coefficient on $\Delta mexex_t$ is negative while it is positive for $\Delta canim_t$. While the negative coefficient on $\Delta mexex_t$ is counterintuitive, the positive coefficients for import growth may suggest the presence of regional production networks between the three countries.

Neither the presence of a major seaport or an HPC significantly affects the number of sunbelt manufacturing establishments. This contrasts with results for Mexican border states. Observe that the resulting coefficients for $sea_i \, x \, NAFTA_t$ and $hpc_i \, x \, NAFTA_t$ are positive and insignificant, while the resulting coefficient for $hpc_i \, x \, NAFTA_t$ was negative and significant in the Mexican border states. These findings suggest that there is a modestly positive correlation between proximity to major transportation routes and manufacturing establishment growth in the sunbelt. The failure to find a significant relationship, however, contradicts earlier predictions.

Education attainment rates positively impacted growth in the number of U.S. manufacturing establishments. A 1% rise in education rates is correlated with a 0.043% increase [significant at 1%] in sunbelt manufacturing establishment growth. This coefficient sign is consistent with the result reported for the Mexican border states.

Table 15 presents the goodness of fit for this estimation in column (12). The specification performs relatively well, providing an adjusted $R^2$ of 0.1314 compared to an $R^2$ equal to 0.1122 as presented in Table 13. Overall, equation (12) provides a better goodness of fit than equation (6).

#### 5.2.4.2 U.S. Counties in Rustbelt States

Now, I estimate employment, wage and establishment growth effects for the rustbelt region in equations (13)-(15) of Table 16 using the same 3 specifications employed previously. These estimations, however, include only the trade-distance interaction terms $miles_i^C \; x \; CUSFTA_t$ and $miles_i^C \; x \; NAFTA_t$, omitting the trade-distance interaction terms relevant to Mexico. Observations from 1980-2000 include 326 counties located in the following rustbelt states: Illinois, Indiana, Michigan, Ohio, and Pennsylvania.[27] Michigan is the only rustbelt state that is also included in the previous estimations for U.S. counties in states located along the Canadian border. The rustbelt region is located relatively close to the border with Canada, primarily separated by the Great Lakes. For this reason, I expect to observe similar results to those found for the Canadian border region.

I employ an F-test of group significance for each estimation, comparing the results using an overall constant with county specific effects. Consistent with previous tests of group significance, the results of this test on the employment estimation reject the null hypothesis at the 99% confidence level, but failed to reject the null hypothesis, however, for results from the wage and establishment growth estimations.[28] The common finding for the significance of county fixed effects for employment estimates may be due to large population and/or labor force differences between the 1,584 counties, while average manufacturing wages and establishments are more similar. In this case, the employment growth estimation includes county fixed effects while the estimations for wage and establishment growth are restricted by an overall constant term. Also, the resulting error terms for each specification

[27] The rustbelt states are defined *Columbia Electronic Encyclopedia, 6th ed.* (2005).
[28] The resulting F statistic for equation (13) was 1.21 with a critical value of 1.16. Test statistics were 0.89 and 0.71 for equations (14) and (15), respectively, with the same 1% critical value.

were tested for the presence of heteroskedasticity using White's test. In each case, heteroskedasticity was found at the 99% confidence level, thus White standard errors are included in each of the specifications to address this concern.[29]

The results in this section differ in several ways from those found for counties located in U.S.-Canada border states. For example, there is a larger estimated impact of trade liberalization on manufacturing wage growth in the rustbelt compared to the Canadian border region. Additionally, proximity to Canada following NAFTA benefits establishment growth in the rustbelt while not in the U.S.-Canada border states. Lastly, increased education rates do not significantly influence manufacturing establishment growth in the rustbelt while it does in the Canadian border region.

*Employment Effects*

Table 16 displays the estimation of employment effects in column (13). Trade liberalization efforts are positively associated with U.S. manufacturing employment growth within the rustbelt region. The implementation of the GATT is correlated with a 6.62% increase [significant at 1%] in rustbelt manufacturing employment growth. Rustbelt employment growth also increased by 6.78% [significant at 5%] following CUSFTA and 9.67% [significant at 5%] after NAFTA. These findings are similar to those reported for the Canadian border states, supporting HO predictions that increasing international trade leads to an expansion of the skill-intensive U.S. manufacturing sector.

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[29] The estimated chi-squared test statistics for equations (13)-(15) were 93.5, 55.53, and 290.14 respectively, with a critical value of 51.81.

Proximity to the international border with Canada is not significantly related to rustbelt manufacturing employment growth. Results presented in Table 14 also fail to show a significant relationship, but the resulting coefficients on $miles_i^C \; x \; CUSFTA_t$ and $miles_i^C \; x \; NAFTA_t$ are both positive here. The failure to find a significant correlation between trade liberalization and proximity to the border with Canada is consistent with earlier predictions of no border effects for this region due to the similar factor content of trade shared between the U.S. and Canada.

Increased trade growth between the U.S., Canada, and Mexico is significantly correlated with manufacturing employment growth in the U.S. rustbelt region. A 1% increase in U.S. manufactures import growth from Mexico is associated with a 0.167% decline [significant at 1%] in rustbelt manufacturing employment growth, while a 1% increase in U.S. manufactures import growth from Canada is related to increased manufacturing employment growth of 0.547% [significant at 1%]. Although insignificant, the resulting coefficients for $\Delta mexex_t$ and $\Delta canex_t$ are negative and positive, respectively. These coefficients have the same signs and significance as those reported for equation (7), but the magnitudes are larger for equation (13). Perhaps these results indicate the presence of regional production networks between the U.S. and Canada.

Neither the presence of a major U.S. seaport or HPC following NAFTA is significantly correlated with rustbelt manufacturing employment growth. The resulting coefficient for $sea_i \; x \; NAFTA_t$ is positive while it is negative for $hpc_i \; x \; NAFTA_t$. These findings are consistent with previous estimations provided in Canadian border states. Perhaps these results indicate that firms located near a shipping port weakly benefit from proximity to a major transportation route while those near high priority NAFTA corridors do not.

Column (13) displays the goodness of fit for the estimation of employment effects in Table 16. The specification performs relatively well, providing an adjusted $R^2$ of 0.20 compared to 0.153 for the Canadian border states. The specification may perform better for the rustbelt because the large amount of economic activity in the densely populated region may capture more gains from trade compared to the more spacious states along the Canadian border. Overall, equation (13) demonstrates a better goodness of fit than found for the Canadian border states.

*Wage Effects*

Column (14) of Table 16 presents the estimated wage effects. Trade liberalization increases manufacturing wage growth in the U.S. rustbelt. Manufacturing wage growth increased by 8.76% [significant at 1%] following the establishment of GATT, also increasing by 9.47% [significant at 1%] and 14.74% [significant at 1%] following CUSFTA and NAFTA, respectively. The positive coefficients are similar to the results presented in Table 14, but the magnitudes are larger here. These results support HO predictions that U.S. manufacturing wages should increase as trade increases.

Proximity to the international border with Canada is not significantly related to rustbelt manufacturing wage growth following trade liberalization. The results are consistent with those reported for the Canadian border states in which the coefficients for $miles_i^C \, x \, CUSFTA_t$ and $miles_i^C \, x \, NAFTA_t$ are positive and negative, respectively.

Once again, the NAFTA term coefficient is negative, indicating a weak presence of proximity effects near the border after 1994.

Increased trade growth is significantly related to U.S. manufacturing wage growth in the rustbelt. A 1% increase in manufacturing imports from Mexico is associated with a decrease in manufacturing wage growth of 0.168% [significant at 1%], while a 1% increase in manufacturing imports from Canada increased wage growth by 0.669% [significant at 1%]. The resulting coefficients on $\Delta mexex_t$ and $\Delta canex_t$ are positive and insignificant. The positive coefficient on $\Delta canim_t$ may suggest the presence of a regional production network between the U.S. and Canada. These findings are similar to those presented in Table 14.

Counties in the U.S. rustbelt region are negatively impacted by the presence of a major seaport following NAFTA. The coefficient implies that counties with a seaport experienced a 2.68% decline [significant at 5%] in manufacturing wage growth, compared with a negative and insignificant coefficient for $hpc_i \, x \, NAFTA_t$. The coefficient signs are the same as the estimations for the U.S. states bordering Canada. The failure to establish a significant relationship between rustbelt region wage growth and proximity to major transportation routes contradicts earlier predictions.

Table 16 presents the goodness of fit for the estimation of wage effects in column (14). The specification performs modestly with an adjusted $R^2$ of 0.061, improving from 0.041 in Table 14. Overall, equation (14) provides the best goodness of fit for estimating the effects of increased trade liberalization on U.S. manufacturing wage growth.

*Establishment Effects*

Column (15) of Table 16 presents estimated establishment growth effects. Increased trade liberalization positively impacts rustbelt region manufacturing establishment growth. The implementation of GATT is correlated with a 2.98% increase [significant at 1%] in rustbelt establishment growth, and a 3.67% rise [significant at 10%] after CUSFTA. Although insignificant, the resulting coefficient on NAFTA is also positive. The coefficient signs are consistent with those presented for U.S. counties in the Canadian border states. These findings support predictions of manufacturing sector expansion following increased trade liberalization.

Proximity to the Canadian border following NAFTA significantly increased rustbelt establishment growth. For each additional 100 miles that a rustbelt county is located from the international border with Canada after 1994, establishment growth declines by 0.13% [significant at 10%]. On the other hand, for the resulting coefficient for $miles_i^C xCUSFTA_t$ is positive and insignificant. The results imply that NAFTA creates proximity effects near the Canadian border.

Increased trade growth significantly increases the number of rustbelt manufacturing establishments. A 1% rise in manufacturing import growth from Mexico is related to a 0.143% increase [significant at 1%] in rustbelt establishment growth. Additionally, a 1% increase in U.S. export growth to Canada is correlated with an increase in rustbelt establishment growth of 0.094% [significant at 1%]. Although insignificant, the resulting coefficients for $\Delta mexex_t$ and $\Delta canim_t$ are negative and positive respectively. These results are similar to those presented for

Canadian border states. Perhaps the negative correlation between U.S. manufacturing export growth to Mexico and rustbelt establishment growth indicates major exporters to Mexico chose to locate outside of the rustbelt region, perhaps closer to the international border with Mexico as predicted. The positive coefficient for $\Delta mexim_t$ may suggest the presence of regional production networks between the U.S. and Mexico.

Neither the presence of a major seaport or HPC significantly increases rustbelt establishment growth after 1994. The resulting coefficients on $sea_i x\ NAFTA_t$ and $hpc_i x\ NAFTA_t$ are both negative, while they were negative and positive, respectively, in Table 14. This finding indicates that counties receive no benefit due to proximity to major transportation routes in the rustbelt region, contradicting earlier predictions of U.S. manufacturing sector expansion in counties located near a major transportation route.

Column (15) of Table 16 provides the goodness of fit for the estimation of establishment growth effects. The specification performs modestly, with the adjusted $R^2$ providing an explanatory power of 0.0793, lower than the $R^2$ of 0.1138 for equation (9). This specification performs poorly relative to the establishment growth estimates provided in Table 14.

### 5.3 SPECIFIC MANUFACTURING INDUSTRIES

I now examine the effects of trade liberalization on specific industries within the U.S. manufacturing sector. The industries chosen vary in skill-intensities pre-liberalization tariff levels. The HO model predicts relatively skill-intensive industries will expand following trade liberalization while less skill-intensive industries contract. Industry level estimations will examine the impact of skill-intensities and tariff levels on trade effects. The six industries included in this analysis are: (1) Printing and publishing, (2) Chemicals and allied products, (3) Food and kindred spirits, (4) Primary metals, (5) Transportation Equipment, and (6) Leather and leather products.

### 5.3.1 Industry Estimations: Dummy Variable Approach

I use the same reduced form equations employed previously to examine the trade liberalization effects on employment, wage, and establishment growth in each industry. These specifications are numbered (16), (17), and (18), respectively. I include the trade dummy variables $GATT_t$, $CUSFTA_t$, and $NAFTA_t$ to measure the immediate trade effects. As previously discussed, the level of skill-intensity determines the direction of trade effects in each industry, while I predict the magnitude of the trade impact to be positively correlated with the level of initial tariffs. The observations employed are only a subset of the overall data set, including only counties with industry activity between 1980 and 2000. The number of counties observed for each industry is provided in Table 17.

*Employment Effects*

Table 17 presents the estimated employment effects for each industry. Increased trade liberalization is not significantly correlated with employment growth in any U.S. industry observed. Furthermore, both the printing and leather industries had negative coefficients for the three trade agreement variables. The relatively low skill-intensive primary metal industry had the largest positive coefficients of the six industries, indicating this industry benefited the most from trade liberalization. These findings are inconsistent with the estimated employment effects for the U.S. manufacturing sector in Tables 10 and 11. This result fails to demonstrate a positive trade impact on the relatively skill-intensive industries compared to less skill-intensive industries, contradicting HO predictions. The primary metal industry had relatively low initial tariff rates, contradicting earlier predictions of high-tariff industries benefiting from increased trade liberalization.

Proximity to an international border significantly influenced four of the six industries observed. U.S. leather employment growth rose by 0.792% [significant at 5%] for each additional 100 miles that a U.S. county was located from the Canadian border following CUSFTA. For each additional 100 miles that a U.S. county is located from the Mexican border following NAFTA, U.S. food industry employment growth increased by 0.201% [significant at 10%] while primary metal employment growth falls by 0.593% [significant at 5%]. Also, for each additional 100 miles that a U.S. county is located from the Canadian border following NAFTA, primary metal industry employment growth decreases by 0.58% [significant at 10%] while transportation equipment industry employment growth declines by 0.679% [significant at 5%]. In regards to previous results, the chemical, primary metals, and transportation equipment industries each had negative coefficients for the NAFTA interaction terms, suggesting the presence of locational effects near an international border following NAFTA.

Increased trade values are positively associated with employment growth in three of the six industries. A 1% increase in imports of Canadian primary metals manufactures is related to a 0.198% increase [significant at 10%] in employment growth, while a 1% increase in Canadian leather imports led to a 0.171% increase [significant at 5%] in employment growth. Likewise, a 1% increase in transportation equipment imports from Mexico resulted in a 0.02% increase [significant at 5%] in employment growth. The resulting positive coefficients on $\Delta canim_t$ and $\Delta mexim_t$ are counterintuitive, perhaps indicating the presence of regional production networks. On the other hand, the three industries significantly and positively influenced by increased trade growth are less-skill intensive, contradicting HO predictions. The primary metal and transportation equipment industries have relatively low tariffs, failing to support earlier predictions.

Coefficients for $sea_i \times NAFTA_t$ are significantly associated with employment growth in two of the six industries observed.[30] The presence of a seaport following NAFTA is related to a 2.88% fall [significant at 5%] in chemical employment growth, while leather employment growth rose by 11.26 % [significant at 5%]. Of the remaining four industries, only printing and food had positive coefficients for having a seaport. Although two of the three relatively skill-intensive industries had positive coefficients, the failure to find a positive and significant relationship between the presence of a seaport and skilled employment growth fails to support earlier predictions.

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[30] I calculated the percentage of counties observed with a seaport for each industry. The results are shown in parentheses: Printing (3%), Chemicals (7.6%), Food (4%), Primary Metals (9.1%), Transportation Equipment (8.7%), and Leather (21.6%).

The presence of an HPC following NAFTA is significantly correlated with employment growth in the primary metal industry.[31] Counties with an HPC experienced a 1.73% decline [significant at 10%] in primary metal employment growth after 1994. The failure to establish a positive and significant relationship between the presence of an HPC and employment growth in relatively skill-intensive industries contradicts earlier predictions, implying that these industries do not benefit from trade-related job creation in counties with an HPC.

Table 17 provides the goodness of fit for the estimated industry employment effects. The primary metal industry had the highest adjusted $R^2$ of 0.0351, while the food industry had the lowest with an adjusted $R^2$ equal to 0.0029. These specifications perform poorly compared to previous estimates for the U.S. manufacturing sector.

*Wage Effects*

Table 18 presents the estimated industry wage effects. Trade liberalization is significantly related to decreased wage growth in two of the six industries. Following the GATT, printing industry wage growth fell by 4.25% [significant at 5%] while transportation equipment wage growth decreased by 12.37% [significant at 10%]. Likewise, the implementation of CUSFTA led to a 7.75% decline [significant at 5%] in printing industry wage growth and a 28.19% decrease [significant at 1%] in

[31] The percentage of counties from the data set with an HPC is presented below for each industry: Printing (32%), Chemicals (36%), Food (33%), Primary metals (38.6%), Transportation equipment (39%), and Leather (31.4%).

transportation equipment wage growth. Lastly, NAFTA led to a 10.4% reduction [significant at 5%] in printing wage growth while transportation equipment wage growth decreased by 24.91% [significant at 5%]. The negative coefficients are inconsistent with the positive employment effects reported in Tables 10 and 11. The large wage decline in the less skill-intensive transportation equipment industry supports HO predictions of large wage losses for low-skilled industries, but the failure to establishment a positive relationship between trade liberalization and skill-intensive wage growth does not. The printing and transportation equipment industries have relatively low initial tariff rates, supporting earlier predictions.

Proximity to an international border is significantly correlated with wage growth in three of the six industries. For each additional 100 miles that a U.S. county is located from the Mexican border, printing industry wage growth increases by 0.133% [significant at 5%] following GATT. Likewise, each additional 100 miles that a county is from the Canadian border, leather industry wage growth increases by 0.859% [significant at 5%] following CUSFTA. Primary metal industry wage growth, however, fell by 0.598% [significant at 5%] for every 100 miles between a U.S. county and the Mexican border following NAFTA. The chemicals, primary metals, and transportation equipment industries had negative coefficients for both NAFTA interaction terms, supporting previous findings of modest proximity effects for industries located near an international border following NAFTA.

Increased trade significantly affects wage growth in five of the six industries observed. A 1% increase in chemical exports to Canada is associated with a 0.082% [significant at 5%] increase in wage growth, while a 1% increase in food and transportation equipment exports to Canada led to a 0.037% increase [significant at 5%] and 0.236% rise [significant at 5%] in industry wage growth, respectively. On the other hand, a 1% increase in Canadian imports of primary metals and leather manufactures is related with increased wage growth of 0.198% [significant at 5%] and 0.226% [significant at 1%], respectively. U.S. food industry wage growth declined by 0.025% [significant at 5%] following a 1% increase in industry exports to Mexico, while a 1% increase in U.S. transportation equipment manufactures to Mexico is associated with a 0.041% increase [significant at 1%] in wage growth. Lastly, a 1% increase in transportation equipment imports from Mexico led to a 0.029% increase [significant at 1%] in industry wage growth. Of the three industries benefiting from increased U.S. exports, the food and chemical industries are considered to have relatively high tariffs, supporting earlier predictions. These findings, as well as the positive coefficients on $\Delta canim_t$ and $\Delta mexim_t$, may suggest the creation of regional production networks as found previously.

The presence of a seaport is only positively related to wage growth in the U.S. leather industry following NAFTA. Leather industry wage growth increased by 11.89% [significant at 1%] in counties with a seaport after 1994. Although the remaining five industries had insignificant coefficients, the printing industry is the only one to have a positive coefficient. The failure to find a positive and significant relationship between the presence of a seaport and industry wage growth in skill-intensive industries contradicts earlier predictions. Likewise, the leather industry has high initial tariff rates, contradicting earlier predictions of larger wage decreases in high tariff and less skill-intensive industries.

After 1994, counties with an HPC did not experience significant wage growth relative to counties without an HPC. The printing, food, and transportation equipment industries had positive coefficients. This insignificant result fails to support previous predictions of increased wage growth for relatively skill-intensive industries.

Higher education rates are significantly related to wage growth in one of the six industries. A 1% increased in education is correlated with a 0.064% decline [significant at 1%] in food industry wage growth. Of the five remaining insignificant coefficients, the relatively skill-intensive printing and chemical industries had positive coefficients.

I provide the goodness of fit for the estimated wage effects in Table 18. The highest adjusted $R^2$ is 0.0303 for the primary metal industry and 0.0218 for the printing industry, while the lowest $R^2$ is 0.0052 for the chemical industry. These specifications perform poorly compared to previous wage estimates.

*Establishment Effects*

Table 19 reports the estimated effect of trade liberalization on the number of industry establishments. Increased trade liberalization is negatively associated with growth in the number of establishments per industry. The implementation of GATT and CUSFTA are led to decreases of 10.2% [significant at 5%] and 13.41% [significant at 5%] in transportation equipment establishment growth, respectively. Although the remaining five industries had insignificant coefficients for the three trade dummies, printing, chemicals, food, and transportation equipment have negative coefficients in each case. The results are consistent with the estimated employment effects in Table 17, contradicting HO predictions of increased trade liberalization leading to an expansion in skill-intensive industries. Additionally, the large decrease in transportation equipment establishment growth contradicts earlier predictions of relatively small effects in low-tariff industries.

Proximity to an international border is significantly correlated with industry establishment growth in three of the six industries observed. For each additional 100 miles that a U.S. county is located from the Mexican border following GATT, transportation equipment establishment growth increased by 0.215% [significant at 1%], while leather establishment growth declined by 0.257% [significant at 5%]. Leather establishment growth increased by 0.289% [significant at 5%] for every 100 miles that a U.S. county is located from the Canadian border following CUSFTA. Lastly, each additional 100 miles between a U.S. county and the Mexican border following NAFTA decreased establishment growth by 0.342% [significant at 10%] and 0.648% [significant at 5%] in the primary metals and leather industries, respectively. The chemicals, primary metals, transportation equipment and leather industries have a negative coefficient for both NAFTA interaction terms, suggesting locational effects near an international border following NAFTA. The failure to demonstrate the presence of significant proximity effects for the three skill-intensive industries, however, contradicts earlier predictions. Additionally, the primary metal and transportation equipment industries have low tariffs, contradicting the prediction of larger effects in high-tariff industries.

Increased trade growth is significantly correlated with establishment growth in three of the six industries. A 1% increase in U.S. chemical exports to Canada is associated with a 0.137% rise [significant at 1%] in establishment growth. On the other hand, a 1% increase in U.S. printing exports to Mexico is related to a 0.047% decline [significant at 1%] in establishment growth. Lastly, a 1% increase in Mexican transportation equipment imports is associated with a 0.01% increase [significant at 5%] in establishment growth. While the negative coefficients for $\Delta mexex_t$ is counterintuitive, the positive coefficients on $\Delta mexim_t$ may suggest the presence of a regional production network between transportation equipment manufacturers in the U.S. and Canada. The large and significant trade impact on the highly protected chemical industry supports earlier predictions of larger establishment growth in relatively high-tariff industries.

The presence of a seaport is positively related to establishment growth in only one of the six industries. Counties with a seaport experienced a 2.31% increase [significant at 5%] in food industry establishment growth following NAFTA. Chemicals and leather are the only industries of the remaining five to have positive coefficients. Two of the three skill-intensive industries demonstrate positive affects from a seaport, supporting earlier predictions. The chemical and food industries have relatively high initial tariff rates, contradicting earlier predictions.

Construction of an HPC following NAFTA is not significantly associated with industry establishment growth. Only the printing and food industries had positive coefficients here. The failure to find a positive and significant relationship between counties with an HPC and industry establishment growth contradicts predictions discussed previously.

Increased education is positively correlated with establishment growth in two of the six industries observed. A 1% increase in education rates is correlated with increases of 0.055% [significant at 5%] and 0.07% [significant at 1%] in the printing and food industries, respectively. Of the remaining four industries, only the less skill-intensive primary metal industry had a negative coefficient for $ed_{it}$. These findings support earlier predictions.

Table 19 presents the goodness of fit for the estimated establishment effects. The printing and food industries have the highest adjusted $R^2$ values of 0.0406 and 0.0216, respectively. The industry estimations perform poorly compared to previous specifications.

**5.3.2 Industry Estimations: Includes Average Industry Tariff Rates**

I estimate trade liberalization effects on industry employment, wage and establishment growth using the same three reduced form equations employed in previous sections of this chapter. These three estimations are numbered (19), (20), and (21), respectively. As discussed in chapter 4, the change in the tariff rate charged on imports from Canada and Mexico are included in the estimations here to account for the level of protection found in each industry. As with the dummy variable approach, skill-intensity determines the direction of the related trade effects, while in this case I predict the magnitude of the trade impact to be negatively correlated with initial tariffs. This is because the coefficients on $\Delta cantar_{kt}$ and $\Delta mextar_{kt}$ predict the effect of a 1% point change in tariffs. In industries with relatively higher tariffs, a 1% point change in tariffs represents a relatively smaller percentage rate of change in tariffs. In order to avoid problems with endogeneity, the trade dummy variables $GATT_t$, $CUSFTA_t$, and $NAFTA_t$, are omitted here and the effects of trade liberalization are based on the resulting coefficients of the tariff variables.

*Employment Effects*

Table 20 provides the estimation results of employment effects for each industry observed. Tariff reductions on U.S. manufacturing imports from Canada and Mexico significantly influenced three of the six industries observed here. For example, a 1% point reduction in U.S. tariff rates for food and transportation equipment manufacturing imports from Canada led to a 0.803% [significant at 5%] and 5.82% increase [significant at 1%] in industry employment growth, respectively, while a 1% point reduction in U.S. tariff rates on Mexican leather manufactures increased employment growth by 2.06% [significant at 1%]. These significant coefficients are consistent with estimated employment effects reported in Table 10 for the U.S. manufacturing sector. Although insignificant, printing and leather industries have positive coefficients on $\Delta cantar_{kt}$, while printing, chemicals, and food manufacturing industries have positive coefficients on $\Delta mextar_{kt}$. Of the three industries positively influenced by tariff concessions, only the food industry is skill-intensive while the transportation equipment and leather industries are less skill-intensive. These findings contradict HO predictions that increased trade liberalization will harm relatively low skill-intensive industries. The relatively large estimated impact for the low-tariff transportation equipment industry supports earlier predictions of larger magnitude trade effects in relatively low-tariff industries.

Proximity to an international border is significantly correlated with U.S. employment growth in four of the six industries observed. For each additional 100 miles that a U.S. county is located from the Mexican border following GATT, transportation equipment manufacturing employment growth increases by 0.332% [significant at 5%]. For the same additional 100 miles from the border with Canada following CUSFTA, printing industry employment growth falls by 0.196% [significant at 5%] while transportation equipment employment growth decreases by 0.607% [significant at 10%]. On the other hand, the resulting coefficient on $miles_i^C$ x $CUSFTA_t$ implies that for the same additional 100 miles from Canada, leather employment growth increased by 0.68% [significant at 1%]. Following the implementation with NAFTA, transportation equipment industry employment growth rose by 0.35% [significant at 10%] for every 100 miles that a U.S. county is located from the U.S. border with Mexico. Lastly, for the same additional 100 miles from the Canadian border, food industry employment growth fell by 0.219% [significant at 5%] following NAFTA, while it increased by 0.765% [significant at 5%] in the leather industry. Proximity effects are predicted to be significant for skill-intensive industries located relatively close to the border with Mexico. Only the trade-distance coefficients for the skill-intensive chemical industry are consistent with this prediction. I find no consistent pattern of relatively large distance effects in low-tariff industries, contradicting earlier predictions. Similar to the results presented using the dummy variable approach, these mixed findings on the distance-trade interaction terms unfortunately do not allow for any specific conclusions regarding the significance of proximity to an international border.

Increased trade growth is positively related to employment growth in only two of the six industries observed. The resulting coefficients on $\Delta canex_t$ were insignificant in each case, with only the printing and food manufacturing industries receiving a positive coefficient. A 1 % increase in U.S. primary metal manufactures import growth from Canada, however, led to a 0.211% rise [significant at 5%] in industry employment growth. Although the remaining five industries also had a positive coefficient on $\Delta canim_t$, they were not statistically significant. Also, a 1% increase in U.S. transportation equipment manufactures export growth to Mexico increased employment growth by 0.053% [significant at 5%]. Of the remaining five industries, printing, primary metals and leather manufacturing also have positive coefficients on $\Delta mexex_t$, but they were all insignificant. Lastly, increased import growth from Mexico does not significantly influence U.S. manufacturing employment growth. Of the six industries observed, only the food and transportation equipment manufacturing industries have a positive coefficient on $\Delta mexim_t$. Contradicting HO predictions, the three skill-intensive industries do not experience significantly job creation from increased trade while the three less skill-intensive industries do. The low-tariff primary metals and transportation equipment industries experienced relatively large trade effects, supporting earlier predictions of increased trade leading to larger employment changes in relatively low-tariff industries.

The presence of a major seaport within a U.S. county significantly affected two of the six industries. The estimated coefficients are consistent with those presented in Table 17. The less skill-intensive leather industry experienced job creation from the presence of a seaport while the skill-intensive chemical industry did not, contradicting earlier predictions. Once again, the inconsistent coefficient signs prevent a strong conclusion from being made regarding potential benefits to firms located near a major seaport following NAFTA.

NAFTA high priority corridors significantly increased employment growth in the less skill-intensive transportation equipment industry. Counties with an HPC experienced an average increase in transportation equipment employment growth of 2.66% [significant at 1%] after 1994. Similar to the results in table 12, this finding portrays a positive relationship between an HPC and employment growth, suggesting that industries benefit from proximity to major transportation routes. I find no pattern of relatively larger effects in low-tariff industries compared to high-tariff industries.

Table 20 presents the goodness of fit for the estimated establishment effects. The primary metal and leather manufacturing industries had the largest adjusted $R^2$ of 0.035% and 0.022% respectively, while the food manufacturing industry had the lowest $R^2$ equal to 0.003%. In terms of explanatory power, these estimations perform poorly relative to the results for the entire U.S. manufacturing sector provided in Table 12.

*Wage Effects*

Table 21 provides the estimation results of wage effects for each of the six industries observed. Tariff concessions on Canadian manufacturing imports are only significantly associated with wage growth in the transportation equipment industry.

A 1% point reduction in U.S. tariff rates for transportation equipment manufacturing imports from Canada is correlated with a 3.43% [significant at 5%] increase in transportation equipment industry wage growth. Although insignificant, three of the remaining five industries have a negative coefficient on $\Delta cantar_{kt}$. None of the industries are significantly influenced by tariff concessions on Mexican imports. The resulting coefficients show no consistent pattern of wage declines in relatively less skill-intensive industries, thus contradicting HO predictions. The low-tariff transportation equipment industry experiences the largest wage effect from U.S. tariff concessions on Canadian imports, supporting earlier predictions of higher wage growth in relatively low tariff industries.

The distance of a U.S. county to Mexico is not significantly related to industry wage growth following the establishment of GATT. Likewise, distance to the Mexican border following NAFTA is also insignificant for each industry. On the other hand, proximity to the Canadian border after CUSFTA is significantly associated with wage growth in three of the six industries. For each additional 100 miles that a U.S. county is located from the Canadian border after 1989, U.S. printing industry wage growth fell by 0.196% [significant at 5%], while transportation equipment and leather industries experienced declining wage growth of 0.594% [significant at 10%] and 0.737% [significant at 5%], respectively. As previously discussed, the printing industry is relatively skill-intensive while the transportation equipment and leather industries are less skill-intensive. Both printing and transportation equipment industries, however, had relatively little trade protection. Lastly, proximity to the international border with Canada did not significantly influence any of the industries observed here following NAFTA. Four of the six coefficients on $miles_i^C\ x\ NAFTA_t$ are positive, including the relatively skill-intensive print and chemical industries as well as the relatively low skill-intensive primary metal and leather industries. These mixed findings fail to demonstrate a significant relationship between proximity to an international border and wage growth in relatively skill-intensive as previously predicted, consistent with previous wage estimates presented in Table 12. Likewise, I find no discernible pattern of relatively larger proximity effects in low-tariff industries compared to high-tariff industries.

Increased trade growth is significantly correlated with industry wage growth in four of the six industries. A 1% increase in U.S. food manufactures export growth to Canada led to a 0.045% rise [significant at 5%] in industry wage growth. A 1% increase in primary metal and leather import growth from Canada resulted in a 0.212% increase [significant at 5%] in primary metal wage growth and a 0.204% rise [significant at 1%] in leather wage growth. Increased U.S. export growth to Mexico does not significantly influence industry wage growth. Finally, a 1% increase in U.S. food manufacturing import growth from Mexico decreased wage growth by 0.088% [significant at 5%], while a 1% increase in transportation equipment manufacturing imports from Mexico increased wage growth by 0.012% [significant at 1%]. As discussed previously, the positive relationship between increased imports and wage growth may suggest the presence of regional production networks between North American countries. Similar to previous estimation results, these findings contradict HO predictions of relatively large wage declines in low skill-intensive industries following trade liberalization. Low-tariff industries show no pattern of experiencing larger trade effects relative to high-tariff industries.

The presence of a seaport within a U.S. county is significantly related to wage growth in the leather industry. For counties with a seaport following NAFTA, leather industry wage growth increased by 12.06% [significant at 1%]. Of the remaining five industries, only the printing industry has a positive coefficient on $sea_i x\ NAFTA_t$. The coefficients are consistent with the previous industry wage estimates using the dummy variable approach. Although the resulting coefficient for the leather industry is as expected, these findings overall contradict earlier predictions that counties with major seaport will benefit due to the proximity to a major transportation route. The relatively larger impact on the high-tariff leather industries contradicts earlier predictions of more sizeable trade effects in low-tariff industries.

U.S. food manufacturing industry wage growth is negatively correlated with rising education rates. A 1% increase in county education rates is associated with a 0.067% decline [significant at 1%] in U.S. food manufacturing industry wage growth. The estimated coefficients are consistent with previous estimates using the dummy variable approach. The inconsistent findings here demonstrate no significant pattern of wage growth in skill-intensive versus less skill-intensive industries.

Table 21 provides the goodness of fit for the specifications. The printing and primary metal industries have the largest adjusted $R^2$ of 0.0203 and 0.0291, respectively, while the chemical and leather industries have the lowest $R^2$ equal to 0.0056 and 0.0054, respectively. In terms of explanatory power, these estimations perform poorly relative to the adjusted $R^2$ of 0.0375 provided in Table 12 in which the overall manufacturing sector is observed. Similar to the goodness of fit for estimated industry wage effects using the dummy variable approach, this specification performs poorly in explaining the impact of trade liberalization on industry wage growth.

*Establishment Growth*

Table 22 provides the estimation results of establishment effects for each industry. U.S. tariff concessions on Canadian manufacturing imports are positively related to an increase in the number of establishments in two of the six industries observed. For example, for food manufacturing, a 1% point reduction in U.S. tariff rates on Canadian imports increased establishment growth by 7.28% [significant at 5%], while in chemicals a 1% point reduction in tariffs on Canadian imports increased establishment growth by 2.98% [significant at 1%]. The remaining four industries were not significantly affected by U.S. tariff concessions on Canadian imports, although the primary metal and transportation equipment industries have negative coefficients on $\Delta cantar_{kt}$. In regards to U.S. tariff concessions on manufacturing imports from Mexico, two of the six industries observed were significantly affected. Surprisingly, a 1% point reduction in tariff rates on Mexican printing manufactures led to a 9.85% decline [significant at 5%] in establishment growth. A 1% point reduction in tariff rates on Mexican leather imports resulted in a 1.68% increase [significant at 1%] in establishment growth. These findings contradict earlier predictions that increased trade liberalization will lead to contractions in low skill-intensive industries such as leather manufacturing and expansions in relatively skill-intensive industries such as printing. The relatively large trade effect in the low-tariff printing industry supports earlier predictions of larger growth in relatively low-tariff industries.

Nearness to an international border is significantly associated with establishment growth in three of the six industries. For each additional 100 miles that a U.S. county is located from the international border with Mexico following GATT, food manufacturing establishment growth decreased by 0.38% [significant at 5%], while establishment growth also fell by 0.213% [significant at 5%] in the leather industry. Three of the four remaining coefficients on $miles_i^M x\ GATT_t$ are positive, while only the primary metal industry has a negative coefficient. The coefficients for $miles_i^C x\ CUSFTA_t$ are insignificant, with positive coefficients for the food and leather manufacturing industries. Likewise, the coefficients on $miles_i^M x\ NAFTA_t$ are insignificant, with only the primary metals and leather manufacturing industries receiving a positive coefficient. Lastly, for each additional 100 miles that a U.S. county is located from the U.S. border with Canada after 1994, chemical industry establishment growth increases by 0.187% [significant at 5%], while leather industry establishment growth also increases by 0.384% [significant at 1%]. Although insignificant, the coefficients for $miles_i^C x\ NAFTA_t$ are positive for the printing and primary metal industries. Overall, the inconsistent findings here fail to demonstrate a consistent pattern of proximity effects for relatively skill-intensive industries.

Increased trade is significantly related to establishment growth in two of the six industries observed. The resulting coefficients on U.S. export growth to Canada were insignificant in each case, with the food and transportation equipment manufacturing industries receiving a negative coefficient sign. A 1 % increase in Canadian printing import increased establishment growth by 0.198% [significant at 5%], while for chemicals a 1% increase in Canadian imports decreased establishment growth by 0.176% [significant at 5%]. Although insignificant, three of the four remaining industries have a negative coefficient on $\Delta canim_t$, while only the primary metal industry has a positive coefficient. Increased trade growth between the U.S. and Mexico did not significantly influence U.S. manufacturing industry establishment growth. In each case, the resulting coefficient on $\Delta mexex_t$ is negative and insignificant. Likewise, increased industry import growth from Mexico, or $\Delta mexim_t$, was insignificant as well, with the chemicals, primary metals, and leather industries receiving a negative coefficient. I find no consistent pattern of increased establishment growth in skill-intensive industries compared to less skill-intensive industries. Additionally, I find no evidence of larger trade effects in low-tariff industries relative to high-tariff industries.

The presence of a seaport within a U.S. county is positively related to an increase in the number of food and leather industry establishments. For counties with a seaport, food industry establishment growth increased by 2.4% [significant at 5%], while leather industry establishment growth rose by 3.14% [significant at 10%] following NAFTA. Although insignificant, the remaining four industries had negative coefficients here, just as the coefficient for $sea_i$ x $NAFTA_t$ was negative and insignificant in equation (3c). The relatively large establishment gains for the high-tariff food and leather industries contradict earlier predictions. These inconsistent results call into question the importance of sea shipping in my sample.

Increased education rates are significantly related to establishment growth in the skill-intensive food manufacturing industry. A 1% rise in county education rates is correlated with a 0.077% increase [significant at 1%] in food industry establishment growth. The resulting coefficients are consistent with the previous industry establishment estimates using the dummy variable approach, suggesting that increased education is associated with an emergence of new manufacturing establishments, possibly due to a rise in entrepreneurial efforts.

Table 22 presents the goodness of fit for the specifications. The printing and food industries had the largest adjusted $R^2$ of 0.05 and 0.0466, respectively, while the transportation equipment manufacturing industry had the lowest $R^2$ equal to 0.007. Similar to previous establishment estimates using the dummy variable approach, these estimations perform poorly in explaining the relationship between industry establishment growth and trade liberalization.

# CHAPTER 6

# CONCLUSION: SUMMARY OF FINDINGS

## 6.1 ESTIMATED TRADE EFFECTS ON U.S. AND REGIONAL ECONOMIES

The U.S. manufacturing sector benefits from increased trade liberalization with Canada and Mexico. The implementation of both trade agreements and tariff concessions is positively and consistently associated with U.S. manufacturing employment, wage, and establishment growth. I also observe a positive relationship for counties located in the sunbelt and rustbelt states, as well as counties in states adjacent to the border with Canada or Mexico. Counties in Canadian and Mexican border states have experienced a relatively large increase in employment growth compared to the entire U.S. manufacturing sector. CUSFTA and NAFTA coefficients consistently exceed those for GATT, implying that more recent trade agreements have built upon the effects of GATT. This result is based on both the magnitude of the significant coefficients and their standard deviations. The estimations for employment and establishment growth perform relatively better than the wage estimates employed. This finding is similar to the results of several studies reviewed in chapter 2 such as Gaston and Trefler (1997) and Sachs and Shatz (1994).

There is a weak pattern of positive proximity effects for counties located near an international border following NAFTA. I observe locational effects for employment growth in the U.S., as well as the Canadian border and sunbelt regions. Proximity effects are also related to wage and establishment growth for the U.S., as well as the Mexican border, sunbelt and rustbelt states. This finding is consistent with Hanson (1995), and supports earlier predictions of counties benefiting due to proximity to an international border following increased trade liberalization.

U.S. manufacturing employment growth also benefits from increased trade volumes. Likewise, there is a positive and significant association between increased trade and manufacturing wage growth in the U.S., as well as the regional economies, with the exception of Canadian border states. The Mexican border and sunbelt states have relatively higher trade effects on wage growth than the U.S. overall. There were two surprising findings here, a negative relationship between increased exports to Mexico and establishment growth, and a positive relationship between rising Canadian imports and manufacturing employment and establishment growth. First, the negative association between increased exports to Mexico and manufacturing establishment growth may suggest that as trade rises, only the large, efficient manufacturers remain in the market as smaller firms exit. Second, the positive relationship between increased Canadian imports and U.S. employment and establishment growth possibly implies the presence of regional production networks between the U.S. and Canada.

Lastly, the presence of a major seaport following NAFTA is positively correlated with overall U.S. manufacturing employment growth, as well as growth in all sub-country regions observed. On the other hand, the presence of a seaport is negatively associated with wage growth in all sub-samples, while seaports are negatively related to the establishment growth in the U.S. as well as the Canadian border and rustbelt states. This may indicate that firms located in these areas do not benefit from having a major seaport. The negative relationship between seaports and manufacturing wage and establishment growth, however, is inconsistent with estimated employment effects, contradicting earlier predictions.

Construction of a NAFTA high priority corridor is negatively correlated with overall U.S. manufacturing employment growth in all samples. U.S. manufacturing wage growth is also negatively associated with the presence of an HPC. There is no discernible pattern observed regarding the relationship between the presence of a HPC and U.S. manufacturing establishment growth. In each case, the inconsistent findings contradict earlier predictions, thus indicating that U.S. manufacturers do not benefit by locating near these HPCs following NAFTA. For this reason, the construction of these HPCs does not appear to have been a very profitable investment for the United States. Perhaps an extension of the sample period beyond 2000 were more accurately portray the effects of these transportation routes.

## 6.2 ESTIMATED TRADE EFFECTS ON SPECIFIC INDUSTRIES

The industry specific results are much weaker than the findings for the sample. The correlation between increased trade liberalization and manufacturing industry expansion is mixed. There is no significantly relationship between trade agreements and employment growth in the six industries observed using the dummy variable approach, while weak trade effects are found for industries using the average tariff rates. Likewise, I find inconsistent results for the impact of trade liberalization on industry wage growth. These results indicate that industry wage growth is correlated with neither skill-intensity nor initial tariff rates. The implementation of trade agreements is negatively correlated with establishment growth in the skill-intensive printing, chemicals, and food industries, as well as the low tariff transportation equipment industry. These findings, although contrary to earlier predictions, may suggest that as foreign competition increases, less efficient manufacturers exit the market, allowing competitive firms to expand.

Using the dummy variable approach, three industries show evidence of proximity effects to an international border. The chemical, primary metals, and transportation equipment industries experienced increased employment, wage, and establishment growth in counties located near the Mexican or Canadian border. The chemical industry is relatively skill-intensive, supporting earlier predictions of proximity effects impacting skill-intensive industries. I do not observe larger trade effects for high-tariff industries. There is also no evidence of industry proximity effects in estimates using average industry tariff rates.

There is no consistent pattern of relatively skill-intensive or low tariff industries benefiting from the presence of a seaport or HPC. Negative coefficients for the skill-intensive chemical industry and the low tariff primary metals and transportation equipment industries may suggest that these industries have not located near seaports. Once again, the failure to establish a positive relationship between HPCs and industry expansion may imply that investment in the construction and maintenance of HPCs has not benefited the U.S. manufacturing sector. These findings contradict earlier predictions of skill-intensive industries expanding in counties located near a major transportation route.

## 6.3 CONCLUDING REMARKS

I find strong support for the HO predictions of increased trade liberalization resulting in U.S. manufacturing employment, wage and establishment growth. Furthermore, the relatively larger employment and establishment growth in the U.S.-Mexico and sunbelt region supports earlier predictions as well. I also find evidence of positive proximity effects for U.S. counties located near an international border following NAFTA. Other explanatory variables, however, such as increased trade growth and the presence of major transportation routes are not significant here. The effects of increased trade liberalization on U.S. manufacturing wage growth, however, supports HO predictions. The poor performance of estimated wage effects are similar to the findings of Sachs and Shatz (1994) and Gaston and Trefler (1997), who find a relatively strong relationship between increased trade liberalization and manufacturing employment but insignificant wage effects as trade liberalization efforts rise.

Overall, I find strong evidence of U.S. manufacturing sector expansion following trade liberalization, both nationally and in regional economies. Predictions of major economic downturns by Ross Perot and other opponents of free trade are not supported. Future trade agreements, such as the FTAA, will provide additional natural experiments for observing potential gains from future trade liberalization. Further research is needed to investigate the effects of trade liberalization over the same time period in Canada and Mexico. Employment, wage, and establishment effects should be relatively larger in Mexico than Canada. This research should also examine the presence of location effects for Mexican and Canadian manufacturers located near the U.S. border and their persistence over time.

**Table 1: U.S. Employment (shown in 1000s)**

| Year | Total | Manufacturing | Services |
|---|---|---|---|
| 1980 | 90,526 | 18,732 | 66,263 |
| 1981 | 91,285 | 18,634 | 67,167 |
| 1982 | 89,673 | 17,364 | 67,122 |
| 1983 | 90,274 | 17,049 | 68,163 |
| 1984 | 94,524 | 17,921 | 71,089 |
| 1985 | 97,507 | 17,819 | 73,923 |
| 1986 | 99,472 | 17,552 | 76,155 |
| 1987 | 102,086 | 17,609 | 78,617 |
| 1988 | 105,342 | 17,905 | 81,434 |
| 1989 | 108,010 | 17,984 | 83,967 |
| 1990 | 109,489 | 17,695 | 85,764 |
| 1991 | 108,384 | 17,068 | 85,793 |
| 1992 | 108,723 | 16,801 | 86,629 |
| 1993 | 110,847 | 16,776 | 88,626 |
| 1994 | 114,282 | 17,024 | 91,505 |
| 1995 | 117,306 | 17,244 | 94,145 |
| 1996 | 119,699 | 17,236 | 96,287 |
| 1997 | 122,767 | 17,418 | 98,883 |
| 1998 | 125,924 | 17,560 | 101,571 |
| 1999 | 128,992 | 17,323 | 104,525 |
| 2000 | 131,791 | 17,266 | 107,139 |

| | | | |
|---|---|---|---|
| change in # of jobs | 41265 | -1467 | 40875 |
| % change 1980-2000 | 0.455833794 | -0.078295646 | 0.616858724 |
| % change 1994-2000 | 0.153210693 | 0.01420054 | 0.170848432 |

data located at BLS website, (CES) Historical B Tables
total=total nonfarm employment

**Table 2: U.S. Manufacturing Output per Hour (1992=100); Seasonally Adjusted**

| Year | Qtr1 | Qtr2 | Qtr3 | Qtr4 | Annual |
|---|---|---|---|---|---|
| 1987 | 86.2 | 87.7 | 88.5 | 89.4 | 88 |
| 1988 | 89.2 | 89.6 | 89.8 | 90.4 | 89.8 |
| 1989 | 90.5 | 90.2 | 89.7 | 90.6 | 90.3 |
| 1990 | 91.7 | 92.4 | 93.8 | 93.7 | 92.9 |
| 1991 | 93.6 | 95 | 96.6 | 97.2 | 95.6 |
| 1992 | 98.1 | 99.5 | 100.9 | 101.4 | 100 |
| 1993 | 102.3 | 102.4 | 102.4 | 103.6 | 102.7 |
| 1994 | 104.7 | 105.8 | 106.3 | 107.2 | 106 |
| 1995 | 108.7 | 109.7 | 110.5 | 111.7 | 110.1 |
| 1996 | 112.6 | 113.3 | 114.5 | 115.2 | 113.9 |
| 1997 | 116 | 116.8 | 119 | 120 | 117.9 |
| 1998 | 121.7 | 122.7 | 124.3 | 125.2 | 123.5 |
| 1999 | 126.7 | 127.5 | 128 | 130.8 | 128.2 |
| 2000 | 132.3 | 134 | 134.6 | 135.3 | 134.2 |
| 2001 | 134.8 | 136.2 | 137.5 | 140.5 | 137.2 |
| 2002 | 143.8 | 146 | 148.1 | 148.4 | 146.5 |
| 2003 | 149.9 | 150.8 | 154.4 | 156.2 | 152.8 |

located at www.bls.gov
Seasonally Adjusted
Sector : Manufacturing, Durable Goods
Measure : Output Per Hour
Duration : index, 1992 = 100

**Table 3: U.S. Manufacturing and Service Employment Shares for 1987-2000**

| year | Manufacturing Share | Mfg Emp Share | Service Emp Share |
|---|---|---|---|
| 1987 | 16.159% | 17.249% | 77.011% |
| 1988 | 16.614% | 16.997% | 77.305% |
| 1989 | 15.922% | 16.650% | 77.740% |
| 1990 | 15.498% | 16.161% | 78.331% |
| 1991 | 15.017% | 15.747% | 79.157% |
| 1992 | 14.789% | 15.453% | 79.678% |
| 1993 | 14.907% | 15.135% | 79.953% |
| 1994 | 15.391% | 14.896% | 80.069% |
| 1995 | 15.995% | 14.700% | 80.256% |
| 1996 | 15.800% | 14.400% | 80.441% |
| 1997 | 15.938% | 14.188% | 80.545% |
| 1998 | 15.929% | 13.945% | 80.661% |
| 1999 | 15.986% | 13.430% | 81.032% |
| 2000 | 16.150% | 13.101% | 81.294% |

data on employment and GDP located at BLS website and census, author's calculations
Manufacturing Share=Mfg GDP/Total GDP
Manufacturing Emp Share = Mfg Employment/Total Employment
Service Emp Share = Service Employment/Total Employment

## Table 4: Literature Review Summary

**Table 4A:** *Studies examining the effects of trade liberalization on employment*

| Studies | Finding | Sample | Countries included |
|---|---|---|---|
| Sachs and Shatz (1994) | yes | 1978-1990 | U.S. and 12 Developing countries |
| Wood (1995) | yes | 1970-1990 | Developed and Developing countries |
| Trefler (2004) | yes | 1980-1996 | Canada and the U.S. |
| Krugman and Lawrence (1994) | yes | 1970-1990 | U.S. and Developing countries |
| Tamor (1987) | no | 1980 | 15 OECD countries |
| Gaston and Trefler (1997) | yes | 1980-1993 | Canada and the U.S. |
| Beaulieu (2000) | yes | 1983-1996 | Canada and the U.S. |
| Hinojosa-Ojeda et al (2000) | yes | 1990-1997 | U.S., Canada, and Mexico |

**Table 4B:** *Studies examining the effects of trade liberalization on income inequalities.*

| Studies | Finding | Sample | Countries included |
|---|---|---|---|
| Sachs and Shatz (1994) | yes | 1978-1990 | U.S. and 12 Developing countries |
| Trefler (1993) | yes | 1983 | 33 countries |
| Davis et al (1997) | yes | 1989-1993 | 10 Japanese regions |
| Beyer, Rojas, and Vergara (1999) | no | 1960-1996 | Chile |
| Davis and Weinstein (2001) | no | 1985-1995 | 10 OECD countries |
| Feenstra and Hanson (2000) | no | 1982-1994 | United States |
| Revenga (1997) | no | 1984-1990 | Mexico |

**Table 4C:** *Studies investigating the presence of location/agglomeration effects*

| Studies | Finding | Sample | Countries Included |
|---|---|---|---|
| Bernat (1998) | yes | 1996 | U.S. Component Economic Areas |
| McCallum (1995) | yes | 1988 | 30 U.S. states and 10 Canadian provinces |
| Holmes (1996) | yes | 1880s to 1980s | United States |
| Hanson (1995) | yes | 1974-1989 | U.S. and Mexico border MSAs |
| Hanson (1998) | yes | 1980-1995 | border region between U.S. and Mexico |
| Yoskowitz et al. (2002) | no | 1990-1997 | U.S. counties in south Texas |
| Hanson (1994) | yes | 1970-1988 | border cities between the U.S. and Mexico |
| Krugman (1991) | yes | mid-1800s to 1980s | U.S. manufacturing belt region |
| Robertson (2000) | yes | 1987:1-1997:4 | 3 U.S. MAs and 6 Mexican MAs |

**Table 5: Intensity of Low-Skilled Production (1958-1996)**

| Manufacturing Industry | Skill Decile | memp | prod memp | prod share |
|---|---|---|---|---|
| Printing and publishing (27) | 1 | 47548.30 | 27212.10 | 0.5723 |
| Chemicals and allied products (28) | 2 | 32442.50 | 19710.60 | 0.6076 |
| Food and kindred spirits (20) | 3 | 60799.70 | 42346.10 | 0.6965 |
| Primary Metal Industries (33) | 4 | 38286.00 | 30511.90 | 0.7969 |
| Transportation Equipment Mfg (37) | 5 | 28120.80 | 22972.30 | 0.8169 |
| Leather and leather products (31) | 6 | 9011.90 | 7888.50 | 0.8753 |

ILSP= (prod emp / total emp) for each industry
based on Sachs & Shatz, 1994
data located at NBER productivity data set

***Table 6A: U.S. Tariff Rates on Canadian Imports***

| year | print (27) | trans eq (37) | pmetal (33) | food (20) | leather (31) | chem (28) |
|---|---|---|---|---|---|---|
| 1980 | 2.447% | 2.767% | 5.319% | 7.247% | 9.322% | 9.727% |
| 1981 | 2.604% | 3.219% | 5.323% | 7.510% | 9.552% | 10.448% |
| 1982 | 2.648% | 3.980% | 5.289% | 7.289% | 10.179% | 10.584% |
| 1983 | 2.127% | 3.498% | 5.305% | 6.179% | 10.072% | 9.901% |
| 1984 | 2.111% | 2.167% | 5.021% | 6.032% | 9.526% | 8.832% |
| 1985 | 1.792% | 2.766% | 4.878% | 5.792% | 9.897% | 8.829% |
| 1986 | 1.707% | 2.445% | 4.468% | 5.884% | 9.706% | 8.290% |
| 1987 | 1.707% | 2.070% | 3.994% | 5.619% | 9.334% | 6.860% |
| 1988 | 1.917% | 2.204% | 3.991% | 5.775% | 8.970% | 5.990% |
| 1989 | 1.301% | 1.447% | 1.611% | 3.659% | 8.853% | 3.111% |
| 1990 | 1.066% | 1.264% | 1.468% | 3.316% | 8.746% | 2.195% |
| 1991 | 0.796% | 1.005% | 1.245% | 3.103% | 7.944% | 1.721% |
| 1992 | 0.440% | 0.809% | 0.912% | 3.242% | 6.537% | 1.318% |
| 1993 | 0.149% | 0.574% | 0.626% | 2.516% | 5.446% | 0.695% |
| 1994 | 0.096% | 0.594% | 0.597% | 2.402% | 4.747% | 0.576% |
| 1995 | 0.040% | 0.401% | 0.444% | 1.883% | 3.938% | 0.335% |
| 1996 | 0.017% | 0.287% | 0.337% | 1.120% | 2.733% | 0.240% |
| 1997 | 0.021% | 0.199% | 0.182% | 0.874% | 2.038% | 0.167% |
| 1998 | 0.012% | 0.199% | 0.041% | 2.062% | 0.558% | 0.137% |
| 1999 | 0.008% | 0.036% | 0.052% | 1.151% | 0.354% | 0.123% |
| 2000 | 0.010% | 0.036% | 0.046% | 0.952% | 0.510% | 0.108% |

***Table 6B: U.S. Tariff rates on Mexican Imports***

| year | print (27) | trans eq (37) | pmetal (33) | chem (28) | food (20) | leather (31) |
|---|---|---|---|---|---|---|
| 1980 | 1.378% | 3.046% | 3.061% | 5.215% | 7.018% | 9.445% |
| 1981 | 1.410% | 3.236% | 3.714% | 7.435% | 7.203% | 9.590% |
| 1982 | 1.477% | 3.909% | 3.570% | 8.143% | 6.195% | 9.732% |
| 1983 | 1.196% | 2.772% | 3.542% | 8.999% | 6.422% | 10.484% |
| 1984 | 0.967% | 3.462% | 3.756% | 7.453% | 6.342% | 8.857% |
| 1985 | 0.885% | 3.417% | 3.258% | 6.845% | 7.566% | 9.230% |
| 1986 | 0.943% | 3.481% | 3.068% | 5.934% | 6.914% | 9.752% |
| 1987 | 0.806% | 2.845% | 2.887% | 5.103% | 6.214% | 9.007% |
| 1988 | 0.825% | 2.694% | 2.022% | 4.027% | 5.788% | 8.657% |
| 1989 | 1.024% | 1.090% | 1.150% | 1.817% | 2.603% | 11.923% |
| 1990 | 0.955% | 1.378% | 1.323% | 1.821% | 2.864% | 11.989% |
| 1991 | 0.876% | 1.816% | 1.063% | 1.958% | 2.844% | 11.883% |
| 1992 | 1.032% | 1.534% | 0.884% | 1.873% | 2.258% | 7.599% |
| 1993 | 0.523% | 1.124% | 1.031% | 1.807% | 2.361% | 5.361% |
| 1994 | 0.421% | 0.946% | 0.700% | 1.325% | 1.260% | 5.191% |
| 1995 | 0.360% | 0.703% | 0.555% | 1.096% | 0.861% | 4.727% |
| 1996 | 0.149% | 0.570% | 0.455% | 0.888% | 1.637% | 3.105% |
| 1997 | 0.026% | 0.436% | 0.400% | 0.817% | 1.398% | 2.862% |
| 1998 | 0.040% | 0.323% | 0.339% | 0.625% | 0.732% | 2.709% |
| 1999 | 0.053% | 0.557% | 0.266% | 0.411% | 1.189% | 2.727% |
| 2000 | 0.067% | 0.442% | 0.213% | 0.361% | 1.152% | 2.604% |

***Table 6C: Average U.S. Manufacturing Tariff Rates on Imports***

| year | $AVGTAR^{C}_{t}$ | $AVGTAR^{M}_{t}$ |
|---|---|---|
| 1980 | 6.138% | 4.860% |
| 1981 | 6.443% | 5.431% |
| 1982 | 6.661% | 5.504% |
| 1983 | 6.180% | 5.569% |
| 1984 | 5.615% | 5.139% |
| 1985 | 5.659% | 5.200% |
| 1986 | 5.417% | 5.015% |
| 1987 | 4.931% | 4.477% |
| 1988 | 4.808% | 4.002% |
| 1989 | 3.330% | 3.268% |
| 1990 | 3.009% | 3.389% |
| 1991 | 2.636% | 3.407% |
| 1992 | 2.210% | 2.530% |
| 1993 | 1.668% | 2.034% |
| 1994 | 1.502% | 1.640% |
| 1995 | 1.173% | 1.384% |
| 1996 | 0.789% | 1.134% |
| 1997 | 0.580% | 0.990% |
| 1998 | 0.502% | 0.794% |
| 1999 | 0.287% | 0.867% |
| 2000 | 0.277% | 0.807% |

**Table 7: Summary Statistics**

**Table 7A: U.S. Counties with Population levels exceeding 20,000**

| Variables: | mean | median | max | min | variance | std. Dev |
|---|---|---|---|---|---|---|
| $\Delta memp_{it}$ | 0.0048 | 0.0043 | 1.043 | -1.2303 | 0.0071 | 0.084 |
| $\Delta mwgs_{it}$ | 0.0407 | 0.0431 | 3.5315 | -6.8721 | 0.0223 | 0.1493 |
| $\Delta mests_{it}$ | 0.0099 | 0.0082 | 1.0033 | -1.4214 | 0.0082 | 0.0906 |
| $\Delta pop_{it}$ | 0.0093 | 0.0075 | 0.1311 | -0.635 | 0.0003 | 0.0164 |
| $unemp_{st}$ | 0.0638 | 0.06 | 0.18 | 0.022 | 0.0005 | 0.0227 |
| $miles_i^M \ x\ GATT_t$ | 243.46 | 0 | 2583 | 0 | 286428.34 | 535.19 |
| $miles_i^C \ x\ CUSFTA_t$ | 152.89 | 0 | 1776 | 0 | 105748.54 | 325.19 |
| $miles_i^M \ x\ NAFTA_t$ | 426.06 | 0 | 2583 | 0 | 423449.53 | 650.73 |
| $miles_i^C \ x\ NAFTA_t$ | 214.05 | 0 | 1776 | 0 | 134960.72 | 367.37 |
| $\Delta mexex_t$ | 0.0998 | 0.1573 | 0.3469 | -0.409 | 0.0333 | 0.1824 |
| $\Delta mexim_t$ | 0.119 | 0.1243 | 0.2269 | -0.1005 | 0.0053 | 0.0726 |
| $\Delta canex_t$ | 0.081 | 0.0956 | 0.3434 | -0.222 | 0.0158 | 0.1255 |
| $\Delta canim_t$ | 0.0859 | 0.0801 | 0.2431 | -0.011 | 0.0038 | 0.0618 |
| $ed_{it}$ | 0.7147 | 0.729 | 0.97 | 0.271 | 0.0112 | 0.1059 |

**Table 7B: Counties in states located along U.S.- Mexico border**

| Variables | mean | median | max | min | variance | std. Dev |
|---|---|---|---|---|---|---|
| $\Delta memp_{it}$ | 0.0086 | 0.0108 | 0.9851 | -1.0557 | 0.0103 | 0.1013 |
| $\Delta mwgs_{it}$ | 0.0433 | 0.0455 | 1.7553 | -1.5208 | 0.0287 | 0.1694 |
| $\Delta mests_{it}$ | 0.0158 | 0.0144 | 0.5108 | -0.925 | 0.0102 | 0.1011 |
| $\Delta pop_{it}$ | 0.0181 | 0.0166 | 0.1202 | -0.635 | 0.0005 | 0.0224 |
| $unemp_{st}$ | 0.0671 | 0.067 | 0.101 | 0.04 | 0.0002 | 0.0142 |
| $miles_i^M \ x\ GATT_t$ | 60.4 | 0 | 302 | 0 | 15360.63 | 123.938 |
| $miles_i^M \ x\ NAFTA_t$ | 105.7 | 0 | 302 | 0 | 21838.93 | 147.78 |
| $ed_{it}$ | 0.7007 | 0.7062 | 0.919 | 0.271 | 0.0102 | 0.1012 |

**Table 7C: Counties in States Located Along U.S.-Canada Border**

| Variables | mean | median | max | min | variance | std. Dev |
|---|---|---|---|---|---|---|
| $\Delta memp_{it}$ | 0.0007 | -0.0004 | 0.5386 | -1.0687 | 0.0051 | 0.0717 |
| $\Delta mwgs_{it}$ | 0.0355 | 0.0385 | 2.3638 | -2.289 | 0.0211 | 0.1454 |
| $\Delta mests_{it}$ | 0.0102 | 0.0114 | 0.7453 | -0.9163 | 0.0076 | 0.0869 |
| $\Delta pop_{it}$ | 0.0081 | 0.0064 | 0.1 | -0.0764 | 0.0002 | 0.0133 |
| $unemp_{st}$ | 0.0586 | 0.056 | 0.121 | 0.024 | 0.0003 | 0.0178 |
| $miles_i^C \ x \ CUSFTA_t$ | 53.889 | 0 | 694 | 0 | 12676.73 | 112.591 |
| $miles_i^C \ x \ NAFTA_t$ | 75.445 | 0 | 694 | 0 | 16120.75 | 126.968 |
| $ed_{it}$ | 0.7786 | 0.7835 | 0.94 | 0.5157 | 0.0049 | 0.0697 |

**Table 7D: Counties in Sunbelt States**

| Variables | mean | median | max | min | variance | std. Dev |
|---|---|---|---|---|---|---|
| $\Delta memp_{it}$ | 0.0066 | 0.0081 | 0.9851 | -1.0557 | 0.0086 | 0.0926 |
| $\Delta mwgs_{it}$ | 0.0433 | 0.0455 | 3.5315 | -1.5208 | 0.025 | 0.1581 |
| $\Delta mests_{it}$ | 0.0104 | 0.009 | 0.5108 | -1.4214 | 0.0109 | 0.1046 |
| $\Delta pop_{it}$ | 0.0154 | 0.013 | 0.1215 | -0.635 | 0.0004 | 0.0205 |
| $unemp_{st}$ | 0.0693 | 0.066 | 0.144 | 0.036 | 0.0004 | 0.0203 |
| $miles_i^M \ x \ GATT_t$ | 144.5577 | 0 | 1556 | 0 | 113406.09 | 336.7582 |
| $miles_i^M \ x \ NAFTA_t$ | 252.976 | 0 | 1556 | 0 | 171027.82 | 413.5551 |
| $ed_{it}$ | 0.6732 | 0.778 | 0.924 | 0.271 | 0.0113 | 0.1061 |

**Table 7E: Counties in Rustbelt States**

| Variables | mean | median | max | min | variance | std. Dev |
|---|---|---|---|---|---|---|
| $\Delta memp_{it}$ | 0.0039 | 0.0029 | 0.8720 | -0.9151 | 0.0061 | 0.0784 |
| $\Delta mwgs_{it}$ | 0.0372 | 0.0405 | 2.3316 | -6.8721 | 0.0215 | 0.1467 |
| $\Delta mests_{it}$ | 0.0094 | 0.0077 | 0.4595 | -0.6931 | 0.0044 | 0.0661 |
| $\Delta pop_{it}$ | 0.0038 | 0.0032 | 0.0877 | -0.1938 | 0.0001 | 0.0109 |
| $unemp_{st}$ | 0.0690 | 0.064 | 0.155 | 0.03 | 0.0007 | 0.0259 |
| $miles_i^C \ x \ CUSFTA_t$ | 66.8453 | 0 | 639 | 0 | 17380.2 | 131.834 |
| $miles_i^C \ x \ NAFTA_t$ | 93.5835 | 0 | 639 | 0 | 21829.68 | 147.7487 |
| $ed_{it}$ | 0.7447 | 0.7509 | 0.929 | 0.4312 | 0.0051 | 0.0713 |

## Table 8: Regional Comparisons of Manufacturing Shares for 1980, 1990, and 2000



**Manufacturing Employment (as % of U.S.)**

| year | non-border states | U.S.-Mexico border states | U.S.-Canada border states | Sunbelt states | Rustbelt states |
|---|---|---|---|---|---|
| 1980 | 66.68% | 15.86% | 17.46% | 24.39% | 27.22% |
| 1990 | 65.72% | 17.48% | 16.81% | 27.22% | 24.59% |
| 2000 | 66.57% | 17.96% | 15.47% | 27.97% | 24.88% |

**Manufacturing Wages (% of U.S.)**

| year | non-border states | U.S.-Mexico border states | U.S.-Canada border states | Sunbelt states | Rustbelt states |
|---|---|---|---|---|---|
| 1980 | 64.62% | 16.00% | 19.38% | 22.99% | 30.69% |
| 1990 | 62.68% | 18.54% | 18.78% | 26.59% | 26.39% |
| 2000 | 63.42% | 19.63% | 16.95% | 28.05% | 26.77% |

**Manufacturing Establisments (% of U.S.)**

| year | non-border states | U.S.-Mexico border states | U.S.-Canada border states | Sunbelt states | Rustbelt states |
|---|---|---|---|---|---|
| 1980 | 60.88% | 19.26% | 19.86% | 28.73% | 22.15% |
| 1990 | 60.93% | 20.72% | 18.34% | 31.11% | 21.09% |
| 2000 | 60.71% | 21.72% | 17.57% | 31.78% | 21.61% |

**Table 9: Regional Comparisons of Industry Shares for 1980, 1990, and 2000**

**Industry Employment (as % of U.S.)**

**U.S.-Mexico border states**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 17.46% | 15.47% | 15.10% | 8.98% | 9.85% | 21.36% |
| 1990 | 18.12% | 16.30% | 16.24% | 13.80% | 9.73% | 24.11% |
| 2000 | 16.83% | 14.42% | 17.35% | 18.92% | 9.60% | 14.16% |

**U.S. Sunbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 28.76% | 22.27% | 25.31% | 13.09% | 15.98% | 29.49% |
| 1990 | 30.06% | 24.29% | 26.09% | 18.62% | 16.77% | 32.68% |
| 2000 | 29.02% | 24.20% | 28.30% | 25.60% | 16.43% | 22.89% |

**U.S.-Canada Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 14.66% | 21.45% | 11.49% | 25.86% | 13.96% | 24.99% |
| 1990 | 13.83% | 20.00% | 12.04% | 23.56% | 13.49% | 22.63% |
| 2000 | 13.29% | 16.09% | 12.81% | 23.47% | 13.33% | 22.96% |

**U.S. Rustbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 21.57% | 22.23% | 22.15% | 12.78% | 50.36% | 34.32% |
| 1990 | 19.49% | 22.26% | 23.02% | 15.46% | 45.55% | 28.60% |
| 2000 | 18.29% | 23.07% | 21.71% | 16.71% | 45.63% | 37.57% |

**Non-Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 67.88% | 63.08% | 73.41% | 65.16% | 76.18% | 53.65% |
| 1990 | 68.05% | 63.71% | 71.72% | 62.64% | 76.78% | 53.26% |
| 2000 | 69.87% | 69.50% | 69.85% | 57.61% | 77.07% | 62.88% |

**Industry Wages (% of U.S.)**

**U.S.-Mexico border states**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 18.21% | 15.25% | 16.11% | 10.10% | 9.09% | 23.74% |
| 1990 | 18.75% | 16.29% | 17.42% | 12.73% | 8.62% | 26.16% |
| 2000 | 17.57% | 13.82% | 17.41% | 15.43% | 8.66% | 15.06% |

**U.S. Sunbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 27.17% | 21.06% | 26.63% | 13.55% | 14.60% | 31.30% |
| 1990 | 28.89% | 23.27% | 27.03% | 16.39% | 14.92% | 33.30% |
| 2000 | 27.93% | 23.95% | 24.16% | 20.24% | 14.79% | 22.26% |

**U.S.-Canada Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 15.14% | 23.74% | 11.08% | 28.49% | 14.04% | 27.68% |
| 1990 | 14.41% | 22.57% | 11.47% | 25.27% | 13.67% | 24.20% |
| 2000 | 13.96% | 15.91% | 12.32% | 23.93% | 13.71% | 26.10% |

**U.S. Rustbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 23.89% | 25.78% | 22.53% | 21.71% | 53.82% | 35.66% |
| 1990 | 21.55% | 22.26% | 23.86% | 20.17% | 49.11% | 30.25% |
| 2000 | 20.61% | 22.65% | 22.11% | 16.79% | 48.83% | 40.66% |

**Non-Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 66.66% | 61.02% | 72.80% | 61.41% | 76.88% | 48.58% |
| 1990 | 66.83% | 61.14% | 71.11% | 62.00% | 77.71% | 49.64% |
| 2000 | 68.48% | 70.27% | 70.27% | 60.64% | 77.63% | 58.84% |

**Industry Establishments (% of U.S.)**

**U.S.-Mexico border states**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 17.68% | 18.87% | 20.06% | 16.10% | 16.58% | 26.10% |
| 1990 | 19.97% | 21.18% | 20.84% | 19.79% | 16.32% | 20.90% |
| 2000 | 21.02% | 20.38% | 21.73% | 25.63% | 16.94% | 21.14% |

**U.S. Sunbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 27.90% | 27.60% | 30.46% | 21.09% | 22.79% | 39.32% |
| 1990 | 29.71% | 31.23% | 32.45% | 25.67% | 23.52% | 35.31% |
| 2000 | 29.80% | 31.11% | 33.74% | 33.65% | 24.65% | 33.02% |

**U.S.-Canada Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 17.21% | 21.14% | 14.63% | 30.41% | 18.13% | 17.24% |
| 1990 | 17.59% | 18.61% | 13.57% | 26.80% | 16.83% | 17.37% |
| 2000 | 19.74% | 16.89% | 13.03% | 23.22% | 16.17% | 18.52% |

**U.S. Rustbelt**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 19.33% | 20.26% | 22.53% | 12.07% | 36.32% | 21.65% |
| 1990 | 18.15% | 18.55% | 21.53% | 12.69% | 35.41% | 21.20% |
| 2000 | 18.38% | 20.20% | 20.64% | 12.23% | 33.51% | 25.30% |

**Non-Border States**

| *year* | *Food (20)* | *Print (27)* | *Chemicals (28)* | *Leather (31)* | *Primary Metals (33)* | *Trans. Equipment (37)* |
|---|---|---|---|---|---|---|
| 1980 | 65.11% | 60.00% | 65.31% | 53.48% | 65.29% | 56.66% |
| 1990 | 62.44% | 60.20% | 65.60% | 53.41% | 66.85% | 61.73% |
| 2000 | 59.24% | 62.73% | 65.23% | 51.15% | 66.89% | 60.34% |

**Table 10: Estimation Results from U.S. Trade with Mexico and Canada Includes County Fixed Effects**

| Variables | (1a) $\Delta\, memp_{it}$ | (2a) $\Delta\, mwgs_{it}$ | (3a) $\Delta\, mests_{it}$ |
|---|---|---|---|
| $C$ | 0.05935 | 0.03141 | -0.0261 |
| | (1.533) | (0.27) | (-0.48) |
| $time_t$ | -0.0051 | -0.00828 | -0.00462 |
| | (-2.482) | (-2.895) | (-1.642) |
| $\Delta\, pop_{it}$ | 0.46198*** | 0.59285*** | 0.39871*** |
| | (3.3) | (3.613) | (3.321) |
| $unemp_{st}$ | -0.33869*** | -0.30733 | 0.44159 |
| | (-2.655) | (-1.332) | (1.528) |
| $GATT_t$ | 0.06736*** | 0.02742 | -0.01005 |
| | (3.844) | (1.331) | (-0.367) |
| $CUSFTA_t$ | 0.06481*** | 0.04577* | 0.06172 |
| | (2.691) | (1.809) | (1.484) |
| $NAFTA_t$ | 0.09127*** | 0.10051** | 0.06471 |
| | (2.818) | (2.496) | (1.099) |
| $miles_i^M xGATT_t$ | -7.79E-06 | 4.70E-06 | 3.03E-05*** |
| | (-0.7601) | (0.429) | (3.967) |
| $miles_i^C xCUSFTA_t$ | 1.53E-05 | 1.93E-05 | -8.68E-06 |
| | (1.25) | (1.236) | (-0.985) |
| $miles_i^M xNAFTA_t$ | 4.75E-06 | -1.35E-05 | -5.17E-06 |
| | (0.598) | (-1.02) | (-0.641) |
| $miles_i^C xNAFTA_t$ | 2.46E-07 | -1.41E-05 | -3.46E-05** |
| | (0.018) | (-0.812) | (-2.116) |
| $\Delta\, mexex_t$ | 0.00224 | 0.01908 | -0.05979 |
| | (0.139) | (0.87) | (-1.6003) |
| $\Delta\, mexim_t$ | -0.09213 | 0.02776 | 0.21495*** |
| | (-1.848) | (0.555) | (2.768) |
| $\Delta\, canex_t$ | 0.04393 | 0.03643 | 0.09901*** |
| | (1.66) | (1.771) | (5.97) |
| $\Delta\, canim_t$ | 0.38987*** | 0.32459*** | 0.02442 |
| | (5.528) | (3.825) | (0.171) |
| $sea_i \times NAFTA_t$ | -0.00975* | 0.01485 | 0.00567 |
| | (-1.892) | (0.55) | (0.751) |
| $hpc_i \times NAFTA_t$ | -0.00099 | -0.00764*** | -0.00367** |
| | (-0.4197) | (-2.696) | (-2.319) |
| $ed_{it}$ | -0.10367** | 0.03851 | -0.01299 |
| | (-2.078) | (0.234) | (-0.117) |
| SSE | 188.04 | 651.31 | 222.82 |
| Adjusted $R^2$ | 0.1147 | 0.0283 | 0.097 |
| Durbin-Watson Statistic | 1.78 | 2.12 | 2.32 |
| Akaike info criterion | -2.188 | -0.946 | -2.018 |

There are 1,584 counties and 31,680 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 11: Estimation Results from U.S. Trade with Mexico and Canada**
**No County Fixed Effects**

| Variables | (1b) $\Delta memp_{it}$ | (2b) $\Delta mwgs_{it}$ | (3b) $\Delta mests_{it}$ |
|---|---|---|---|
| $C$ | -0.02388** | 0.05412*** | -0.0347 |
| | (-2.061) | (3.955) | (-1.071) |
| $time_t$ | -0.00575 | -0.00782 | -0.00525 |
| | (-2.772) | (-3.765) | (-1.554) |
| $\Delta pop_{it}$ | 0.63206*** | 0.85304*** | 0.71014*** |
| | (6.914) | (10.878) | (7.277) |
| $unemp_{st}$ | -0.18596** | -0.25477** | 0.15601 |
| | (-2.336) | (-2.015) | (1.425) |
| $GATT_t$ | 0.07279*** | 0.03171* | 0.01154 |
| | (4.591) | (1.897) | (0.419) |
| $CUSFTA_t$ | 0.06588*** | 0.04779* | 0.04417 |
| | (2.94) | (1.939) | (1.219) |
| $NAFTA_t$ | 0.14269*** | 0.12638*** | 0.06194 |
| | (5.324) | (3.595) | (1.201) |
| $miles^M xGATT_{it}$ | -1.18E-05** | 2.29E-06 | 1.02E-05*** |
| | (-1.992) | (0.397) | (3.406) |
| $miles^C xCUSFTA_{it}$ | 1.18E-05*** | 1.63E-05** | 1.10E-05* |
| | (2.615) | (2.249) | (1.668) |
| $miles^M xNAFTA_{it}$ | -2.09E-05*** | -2.55E-05*** | -1.45E-05*** |
| | (-6.039) | (-2.782) | (-2.804) |
| $miles^C xNAFTA_{it}$ | -3.16E-05*** | -3.11E-05*** | -2.54E-05** |
| | (-5.777) | (-3.301) | (-2.467) |
| $\Delta mexex_t$ | 0.00718 | 0.0209 | -0.06767 |
| | (0.453) | (1.047) | (-1.754) |
| $\Delta mexim_t$ | -0.09156 | 0.02771 | 0.21305*** |
| | (-1.863) | (0.57) | (2.825) |
| $\Delta canex_t$ | 0.04223 | 0.03566 | 0.09822*** |
| | (1.597) | (1.939) | (5.738) |
| $\Delta canim_t$ | 0.38741*** | 0.32445*** | 0.025103 |
| | (5.521) | (3.87) | (0.177) |
| $sea_i$ x $NAFTA_t$ | -0.00505 | -0.02414 | -0.00535 |
| | (-1.103) | (-1.113) | (-0.566) |
| $hpc_i$ x $NAFTA_t$ | -0.00082 | -0.00742*** | -0.00163** |
| | (-0.5297) | (-3.14) | (-2.055) |
| $ed_{it}$ | 0.00611 | -0.00882 | 0.03786** |
| | (0.525) | (-0.509) | (2.234) |
| SSE | 202.44 | 677.803 | 231.41 |
| Adjusted $R^2$ | 0.0945 | 0.0393 | 0.109 |
| Durbin-Watson Statistic | 1.65 | 2.04 | 2.25 |
| Akaike info criterion | -2.214 | -1.006 | -2.08 |

There are 1,584 counties and 31,680 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 12: Estimation Results from U.S. Trade with Mexico and Canada Includes Average Tariff Rates**

| Variables | (1c) $\Delta\, memp_{it}$ | (2c) $\Delta\, mwgs_{it}$ | (3c) $\Delta\, mests_{it}$ |
|---|---|---|---|
| $C$ | 0.10896 | 0.05923 | -0.04001 |
| | (2.896) | (3.082) | (-1.046) |
| $time_t$ | -0.00243 | -0.00454 | -0.00265 |
| | (-2.962) | (-4.677) | (-2.240) |
| $\Delta\, pop_{it}$ | 0.48094*** | 0.85429*** | 0.74182*** |
| | (3.101) | (9.881) | (7.07) |
| $unemp_{st}$ | -0.41842*** | -0.28783** | 0.17552 |
| | (-4.017) | (-2.391) | (1.471) |
| $\Delta\, avgtar^{c}{}_t$ | -2.30291*** | -0.97819 | -2.85065 |
| | (-3.376) | (-0.918) | (-1.296) |
| $\Delta\, avgtar^{M}{}_t$ | -3.15456*** | -0.82138 | 0.83131 |
| | (-3.539) | (-0.497) | (0.274) |
| $miles_i{}^{M} xGATT_t$ | 6.89E-06* | 3.90E-06 | 5.55E-06 |
| | (1.76) | (0.497) | (0.455) |
| $miles_i{}^{C} xCUSFTA_t$ | 1.10E-05 | 1.5E-05** | 1.46E-05 |
| | (1.488) | (2.491) | (1.500) |
| $miles_i{}^{M} xNAFTA_t$ | 2.37E-05*** | 6.20E-06 | -5.92E-06 |
| | (4.824) | (0.734) | (-0.616) |
| $miles_i{}^{C} xNAFTA_t$ | 1.65E-05** | 8.32E-06 | -1.51E-05 |
| | (1.981) | (0.854) | (-0.971) |
| $\Delta\, mexex_t$ | 0.02512 | 0.0332 | -0.05646** |
| | (1.776) | (1.762) | (-2.301) |
| $\Delta\, mexim_t$ | -0.10454*** | 0.05411 | 0.24388** |
| | (-3.647) | (0.721) | (2.357) |
| $\Delta\, canex_t$ | 0.08143*** | 0.04358*** | 0.10912*** |
| | (6.699) | (2.687) | (5.081) |
| $\Delta\, canim_t$ | 0.16826*** | 0.21096*** | -0.07354 |
| | (4.655) | (3.274) | (-0.756) |
| $sea_i \text{ x } NAFTA_t$ | 0.00905* | -0.02461 | -0.00562 |
| | (1.718) | (-1.122) | (-0.606) |
| $hpc_i \text{ x } NAFTA_t$ | 0.00151 | -0.00088 | 0.00011 |
| | (0.56) | (-0.348) | (0.065) |
| $ed_{it}$ | -0.13697*** | -0.00531 | 0.04086** |
| | (-2.775) | (-0.320) | (2.305) |
| SSE | 185.61 | 679.09 | 230.69 |
| Adjusted $R^2$ | 0.1262 | 0.0375 | 0.1118 |
| Durbin-Watson Statistic | 1.78 | 2.04 | 2.24 |
| Akaike info criterion | -2.201 | -1.004 | -2.083 |

There are 1,584 counties and 31,680 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 13: Estimation Results for U.S. Counties in Mexican Border States**

| Variables | (4) $\Delta\, memp_{it}$ | (5) $\Delta\, mwgs_{it}$ | (6) $\Delta\, mests_{it}$ |
|---|---|---|---|
| $C$ | -0.02359 | 0.05794 | -0.00836 |
| | (-0.243) | (1.438) | (-0.239) |
| $time_t$ | -0.00884 | -0.00897 | -0.00545 |
| | (-3.434) | (-2.532) | (-1.64) |
| $\Delta\, pop_{it}$ | 0.85301*** | 0.86738*** | 0.63643*** |
| | (2.92) | (5.633) | (5.652) |
| $unemp_{st}$ | -0.20048 | -0.66344 | 0.13897 |
| | (-0.622) | (-1.412) | (0.383) |
| $GATT_t$ | 0.04817*** | 0.0051 | -0.010001 |
| | (2.842) | (0.178) | (-0.318) |
| $CUSFTA_t$ | 0.08378*** | 0.04932 | 0.03074 |
| | (3.119) | (1.297) | (0.905) |
| $NAFTA_t$ | 0.11996*** | 0.07533 | 0.04566 |
| | (2.667) | (1.276) | (0.779) |
| $miles^M xGATT_{it}$ | 2.43E-05 | 4.44E-06 | 3.82E-06 |
| | (0.932) | (0.148) | (0.128) |
| $miles^M xNAFTA_{it}$ | 2.29E-05 | -2.57E-05 | -7.66E-05* |
| | (0.905) | (-0.829) | (-1.768) |
| $\Delta\, mexex_t$ | 0.0732*** | 0.06764 | -0.03725 |
| | (2.774) | (1.398) | (-0.996) |
| $\Delta\, mexim_t$ | -0.04642 | 0.13112** | 0.21909*** |
| | (-1.014) | (2.112) | (3.341) |
| $\Delta\, canex_t$ | 0.03322 | 0.05896 | 0.1123*** |
| | (1.392) | (1.600) | (4.952) |
| $\Delta\, canim_t$ | 0.29077*** | 0.11629 | -0.09335 |
| | (3.52) | (0.944) | (-0.745) |
| $sea_i$ x $NAFTA_t$ | 0.01999*** | -0.01065 | 0.00149 |
| | (2.984) | (-0.415) | (0.101) |
| $hpc_i$ x $NAFTA_t$ | -0.00464 | -0.01227* | -0.01548*** |
| | (-0.597) | (-1.921) | (-3.204) |
| $ed_{it}$ | 0.02427 | 0.05243 | 0.03886 |
| | (0.178) | (1.481) | (1.43) |
| SSE | 30.16 | 96.83 | 31.97 |
| Adjusted $R^2$ | 0.1216 | 0.0421 | 0.1122 |
| Durbin-Watson Statistic | 1.75 | 2.02 | 2.25 |
| Akaike Info Criterion | -1.819 | -0.752 | -1.86 |

There are 177 counties and 3,540 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 14: Estimation Results for U.S. Counties in Canadian Border States**

| Variables | (7) $\Delta\, memp_{it}$ | (8) $\Delta\, mwgs_{it}$ | (9) $\Delta\, mests_{it}$ |
|---|---|---|---|
| $C$ | -0.0535 | 0.00466 | -0.06608 |
| | (-0.934) | (0.151) | (-2.783) |
| $time_t$ | -0.00523 | -0.00846 | -0.00543 |
| | (-2.441) | (-3.119) | (-1.563) |
| $\Delta pop_{it}$ | 0.33114*** | 0.73135*** | 0.50226*** |
| | (3.074) | (3.859) | (3.492) |
| $unemp_{st}$ | -0.0403 | -0.00146 | 0.13978 |
| | (-0.22) | (-0.007) | (1.231) |
| $GATT_t$ | 0.06006*** | 0.04221* | 0.02508 |
| | (4.982) | (1.86) | (0.858) |
| $CUSFTA_t$ | 0.06347*** | 0.04698 | 0.04301 |
| | (3.464) | (1.486) | (1.104) |
| $NAFTA_t$ | 0.10659*** | 0.0905** | 0.01584 |
| | (4.898) | (2.289) | (0.403) |
| $miles^C xCUSFTA_{it}$ | 3.92E-05 | 6.03E-05 | 6.21E-06 |
| | (1.614) | (1.518) | (0.293) |
| $miles^C xNAFTA_{it}$ | -9.87E-06 | -1.12E-07 | 6.02E-05 |
| | (-0.372) | (-0.003) | (1.21) |
| $\Delta\, mexex_t$ | -0.00884 | -0.00065 | -0.07695 |
| | (-0.45) | (-0.025) | (-1.95) |
| $\Delta\, mexim_t$ | -0.10081** | 0.02877 | 0.22634*** |
| | (-2.317) | (0.554) | (2.823) |
| $\Delta\, canex_t$ | 0.02497 | -0.00364 | 0.09402*** |
| | (1.078) | (-0.184) | (4.209) |
| $\Delta\, canim_t$ | 0.43892*** | 0.43746*** | 0.05025 |
| | (6.649) | (3.776) | (0.326) |
| $sea_i$ x $NAFTA_t$ | 0.00396 | -0.03533 | -0.01488*** |
| | (0.363) | (-1.109) | (-3.678) |
| $hpc_i$ x $NAFTA_t$ | -0.00298 | -0.00471 | 0.00213 |
| | (-0.663) | (-0.869) | (0.473) |
| $ed_{it}$ | 0.02448 | 0.02808 | 0.082*** |
| | (0.285) | (1.077) | (4.432) |
| SSE | 21.81 | 95.97 | 30.87 |
| Adjusted $R^2$ | 0.153 | 0.0413 | 0.1138 |
| Durbin-Watson Statistic | 1.81 | 2.23 | 2.24 |
| Akaike Info Criterion | -2.495 | -1.113 | -2.247 |

There are 251 counties and 5,020 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 15: Estimation Results for U.S. Counties in Sunbelt States**

| Variables | (10) $\Delta\,memp_{it}$ | (11) $\Delta\,mwgs_{it}$ | (12) $\Delta\,mests_{it}$ |
|---|---|---|---|
| $C$ | 0.02519 | 0.05189 | -0.05 |
| | (0.641) | (2.627) | (-1.296) |
| $time_t$ | -0.0072 | -0.00909 | -0.00628 |
| | (-3.303) | (-3.184) | (-1.437) |
| $\Delta\,pop_{it}$ | 0.64779** | 0.75142*** | 0.79581*** |
| | (2.562) | (6.721) | (5.384) |
| $unemp_{st}$ | -0.1706 | -0.13037 | 0.3048 |
| | (-0.954) | (-0.763) | (1.34) |
| $GATT_t$ | 0.05413*** | 0.00037 | 0.00339 |
| | (3.025) | (0.018) | (0.094) |
| $CUSFTA_t$ | 0.08134*** | 0.05671* | 0.05604 |
| | (3.194) | (1.872) | (1.173) |
| $NAFTA_t$ | 0.11507*** | 0.0882* | 0.03726 |
| | (3.093) | (1.842) | (0.626) |
| $miles^M xGATT_{it}$ | 4.14E-06 | 2.83E-05** | 2.18E-05*** |
| | (0.2904) | (2.564) | (3.126) |
| $miles^M xNAFTA_{it}$ | -4.51E-06 | -1.51E-05** | -1.31E-05*** |
| | (-0.322) | (-2.021) | (-3.209) |
| $\Delta\,mexex_t$ | 0.03764 | 0.05803** | -0.06542 |
| | (1.955) | (2.164) | (-1.421) |
| $\Delta\,mexim_t$ | -0.0906 | 0.06489 | 0.24904*** |
| | (-1.882) | (1.292) | (2.639) |
| $\Delta\,canex_t$ | 0.03131 | 0.04795** | 0.11466*** |
| | (1.279) | (2.448) | (5.005) |
| $\Delta\,canim_t$ | 0.33498*** | 0.18068 | 0.03794 |
| | (4.433) | (1.926) | (0.215) |
| $sea_i\ x\ NAFTA_t$ | 0.01722*** | -0.01664 | 0.00162 |
| | (2.885) | (-0.796) | (0.091) |
| $hpc_i\ x\ NAFTA_t$ | -0.00194 | -0.00752*** | 0.0004 |
| | (-0.311) | (-2.97) | (0.062) |
| $ed_{it}$ | -0.05387 | 0.0104 | 0.04352*** |
| | (-0.815) | (0.456) | (2.656) |
| SSE | 61.53 | 199.72 | 79.03 |
| Adjusted $R^2$ | 0.0933 | 0.0396 | 0.1314 |
| Durbin-Watson Statistic | 1.73 | 2.1 | 2.24 |
| Akaike Info Criterion | -1.968 | -0.8901 | -1.817 |

There are 417 counties and 8,340 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 16: Estimation Results for U.S. Counties in Rustbelt States**

| Variables | (13) $\Delta\, memp_{it}$ | (14) $\Delta\, mwgs_{it}$ | (15) $\Delta\, mests_{it}$ |
|---|---|---|---|
| $C$ | -0.07602 | -0.04389 | -0.05366 |
| | (-1.019) | (-1.019) | (-1.865) |
| $time_t$ | -0.00748 | -0.00723 | -0.00291 |
| | (-2.848) | (-4.293) | (-1.551) |
| $\Delta\, pop_{it}$ | 0.48269*** | 1.27743*** | 0.53229*** |
| | (3.495) | (6.922) | (4.07) |
| $unemp_{st}$ | -0.50272** | 0.44691 | 0.44377** |
| | (-1.982) | (1.585) | (2.15) |
| $GATT_t$ | 0.06621*** | 0.08762*** | 0.0298** |
| | (3.824) | (5.93) | (2.042) |
| $CUSFTA_t$ | 0.06784** | 0.09469*** | 0.0367* |
| | (2.232) | (4.592) | (1.757) |
| $NAFTA_t$ | 0.09667** | 0.14736*** | 0.03939 |
| | (2.531) | (5.52) | (1.474) |
| $miles^C xCUSFTA_{it}$ | 5.09E-05 | 3.85E-05 | 1.85E-05 |
| | (1.606) | (1.438) | (0.855) |
| $miles^C xNAFTA_{it}$ | 4.93E-05 | -1.25E-05 | -1.30E-05* |
| | (-1.473) | (-0.635) | (-1.858) |
| $\Delta\, mexex_t$ | -0.01117 | 0.01307 | -0.03435 |
| | (-0.682) | (0.812) | (-1.389) |
| $\Delta\, mexim_t$ | -0.16698*** | -0.16821*** | 0.14291*** |
| | (-2.763) | (-4.205) | (2.672) |
| $\Delta\, canex_t$ | 0.03746 | 0.03061 | 0.07142*** |
| | (1.44) | (1.695) | (4.459) |
| $\Delta\, canim_t$ | 0.5472*** | 0.66901*** | -0.01769 |
| | (6.628) | (13.399) | (-0.215) |
| $sea_i\ x\ NAFTA_t$ | 0.01177 | -0.02684** | -0.00616 |
| | (1.409) | (-2.108) | (-1.008) |
| $hpc_i\ x\ NAFTA_t$ | -0.00306 | -0.00458 | -0.00096 |
| | (-0.775) | (-0.906) | (-0.439) |
| $ed_{it}$ | 0.12142 | -0.01825 | 0.01921 |
| | (1.169) | (-0.468) | (1.057) |
| SSE | 30.38 | 131.428 | 26.173 |
| Adjusted $R^2$ | 0.1999 | 0.0606 | 0.0793 |
| Durbin-Watson Statistic | 1.81 | 1.78 | 2.32 |
| Akaike Information Criterion | -2.426 | -1.061 | -2.675 |

There are 326 counties and 6,520 observations included.

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 17: U.S. Industry Employment Growth Using the Dummy Variable Approach**

| Variables | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | 0.00693 | 0.01837 | 0.04087 | 0.01732 | 0.02567 | -0.10776 |
| | (0.251) | (0.347) | (1.776) | (0.309) | (0.271) | (-1.227) |
| $time_t$ | 0.00065 | -0.00096 | 0.00018 | -0.00756 | 0.01501 | -0.00319 |
| | (0.206) | (-0.282) | (0.134) | (-1.077) | (1.452) | (-0.424) |
| $\Delta pop_{it}$ | 0.90601*** | 0.87526*** | 0.71297*** | 0.76217 | 0.95688*** | 0.19195 |
| | (7.259) | (4.052) | (4.886) | (1.692) | (2.769) | (0.149) |
| $unemp_{st}$ | -0.16099 | -0.53645** | -0.28481** | -0.41288 | -0.38086 | -0.21409 |
| | (-1.781) | (-2.299) | (-2.280) | (-1.263) | (-0.697) | (-0.300) |
| $GATT_t$ | -0.00172 | 0.00165 | 0.01242 | 0.07183 | -0.0341 | 0.05879 |
| | (-0.077) | (0.061) | (0.894) | (1.294) | (-0.429) | (1.108) |
| $CUSFTA_t$ | -0.03561 | 0.01197 | -0.00131 | 0.06113 | -0.19464 | -0.01495 |
| | (-1.091) | (0.330) | (-0.094) | (0.740) | (-1.59) | (-0.190) |
| $NAFTA_t$ | -0.03867 | 0.04213 | -0.04366 | 0.22039 | -0.13194 | 0.10032 |
| | (-0.803) | (0.608) | (-1.495) | (1.593) | (-0.901) | (0.612) |
| $miles^M xGATT_{it}$ | 2.06E-06 | 1.79E-07 | -4.08E-06 | -3.00E-05 | -1.42E-05 | -5.83E-05 |
| | (0.418) | (0.021) | (-0.502) | (-1.544) | (-0.547) | (-1.577) |
| $miles^C xCUSFTA_{it}$ | -8.47E-06 | 7.20E-06 | -4.60E-07 | -1.32E-06 | 1.69E-06 | 7.92E-05** |
| | (-1.377) | (0.964) | (-0.045) | (-0.093) | (0.056) | (2.316) |
| $miles^M xNAFTA_{it}$ | 1.16E-06 | -1.33E-05 | 2.01E-05* | -5.93E-05** | -1.35E-05 | -5.20E-05 |
| | (0.208) | (-0.744) | (1.911) | (-2.516) | (-0.528) | (-1.593) |
| $miles^C xNAFTA_{it}$ | 7.65E-06 | -1.18E-05 | -4.41E-07 | -5.80E-05* | -6.79E-05** | 1.40E-05 |
| | (0.876) | (-0.745) | (-0.030) | (-1.771) | (-2.301) | (0.333) |
| $\Delta mexex_t$ | 0.00635 | -0.01503 | -0.01154 | 0.07320 | 0.04227 | 0.04267 |
| | (0.292) | (-0.337) | (-1.442) | (1.379) | (1.802) | (0.583) |
| $\Delta mexim_t$ | -0.0211 | -0.02303 | 0.00337 | -0.03551 | 0.01952** | -0.00222 |
| | (-1.939) | (-0.700) | (0.171) | (-0.909) | (1.996) | (-0.029) |
| $\Delta canex_t$ | -0.00654 | -0.04464 | -0.00052 | -0.0304 | 0.13281 | -0.08964 |
| | (-0.145) | (-1.007) | (-0.034) | (-0.307) | (0.994) | (-1.503) |
| $\Delta canim_t$ | 0.0032 | 0.02118 | 0.01643 | 0.19772** | -0.1281 | 0.17127** |
| | (0.059) | (0.308) | (0.268) | (1.996) | (-0.514) | (2.206) |
| $sea_i \, x \, NAFTA_t$ | 0.00393 | -0.02880** | 0.00027 | -0.00791 | -0.03042 | 0.11259** |
| | (0.369) | (-2.468) | (0.016) | (-0.320) | (-1.609) | (2.477) |
| $hpc_i \, x \, NAFTA_t$ | 0.00025 | -0.00711 | 0.01134 | -0.01729* | 0.00473 | -0.08961 |
| | (0.112) | (-1.379) | (1.546) | (-1.946) | (0.425) | (-1.589) |
| $ed_{it}$ | 0.04388 | 0.03159 | -0.04387 | -0.01408 | -0.04017 | 0.10485 |
| | (1.167) | (0.755) | (-1.728) | (-0.235) | (-0.533) | (0.993) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 442.93 | 296.59 | 539.96 | 206.67 | 400.39 | 76.43 |
| Adjusted $R^2$ | 0.0139 | 0.0063 | 0.0029 | 0.0351 | 0.0171 | 0.0187 |
| Durbin-Watson Stat | 2.36 | 2.24 | 2.28 | 2.28 | 2.22 | 2.25 |
| Akaike Info criterion | -0.799 | -0.216 | -0.298 | -0.165 | 0.511 | 0.282 |

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 18: U.S. Industry Wage Growth using the Dummy Variable Approach**

| Variables: | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | 0.03921 | 0.08327 | 0.11602 | 0.03219 | 0.09097 | -0.16957 |
| | (0.919) | (1.368) | (5.553) | (0.579) | (0.980) | (-2.073) |
| $time_t$ | 0.00159 | -0.00364 | -0.00316 | -0.00187 | 0.01887 | 0.00213 |
| | (0.414) | (-0.955) | (-1.230) | (-0.324) | (2.166) | (0.438) |
| $\Delta pop_{it}$ | 1.16933*** | 0.97040*** | 0.82326*** | 0.87279** | 0.92634** | 0.52086 |
| | (10.82) | (5.069) | (4.200) | (2.011) | (1.983) | (0.323) |
| $unemp_{st}$ | -0.18075 | -0.50162 | -0.41614*** | -0.03818 | -0.46909 | -0.24073 |
| | (-1.815) | (-1.736) | (-3.084) | (-0.119) | (-0.910) | (-0.257) |
| $GATT_t$ | -0.04251** | -0.03329 | 0.00249 | 0.02073 | -0.12368* | 0.07684 |
| | (-2.129) | (-1.154) | (0.081) | (0.461) | (-1.722) | (1.310) |
| $CUSFTA_t$ | -0.07754** | -0.01285 | -0.00085 | -0.01463 | -0.28191*** | 0.00674 |
| | (-2.011) | (-0.335) | (-0.035) | (-0.233) | (-2.778) | (0.122) |
| $NAFTA_t$ | -0.10404** | 0.00754 | -0.00106 | 0.11373 | -0.24913** | 0.02795 |
| | (-2.235) | (0.093) | (-0.038) | (0.937) | (-2.049) | (0.246) |
| $miles^M xGATT_{it}$ | 1.33E-05** | 2.62E-06 | 7.17E-06 | -2.03E-05 | 9.64E-07 | -4.36E-05 |
| | (2.031) | (0.361) | (0.705) | (-1.632) | (0.038) | (-1.423) |
| $miles^C xCUSFTA_{it}$ | -4.88E-06 | -3.76E-06 | -6.45E-06 | -3.72E-06 | 2.30E-07 | 8.59E-05** |
| | (-0.909) | (-0.682) | (-0.624) | (-0.228) | (0.008) | (1.969) |
| $miles^M xNAFTA_{it}$ | 1.20E-05 | -2.77E-06 | 3.69E-06 | -5.98E-05** | -1.09E-05 | -3.10E-05 |
| | (1.208) | (-0.106) | (0.330) | (-2.310) | (-0.350) | (-0.647) |
| $miles^C xNAFTA_{it}$ | 2.42E-05 | -2.88E-06 | -1.19E-05 | -4.74E-05 | -6.45E-05 | 2.49E-05 |
| | (1.516) | (-0.144) | (-1.398) | (-1.064) | (-1.454) | (0.633) |
| $\Delta mexex_t$ | 0.00125 | 0.01926 | -0.02543** | 0.06770 | 0.04147*** | -0.01687 |
| | (0.124) | (0.400) | (-2.176) | (1.659) | (2.893) | (-0.267) |
| $\Delta mexim_t$ | -0.00853 | -0.02475 | -0.08598 | -0.01851 | 0.02892*** | 0.03161 |
| | (-0.639) | (-0.587) | (-1.571) | (-0.641) | (3.325) | (0.613) |
| $\Delta canex_t$ | -0.0346 | 0.08154** | 0.03701** | 0.11006 | 0.23622** | -0.02694 |
| | (-0.732) | (2.176) | (2.152) | (1.944) | (2.140) | (-0.517) |
| $\Delta canim_t$ | -0.04574 | -0.04809 | 0.18300 | 0.19829** | -0.25115 | 0.22625*** |
| | (-0.748) | (-0.678) | (1.312) | (2.260) | (-1.178) | (3.933) |
| $sea_i$ x $NAFTA_t$ | 0.03302 | -0.01795 | -0.00687 | -0.01325 | -0.03340 | 0.11885*** |
| | (1.229) | (-1.433) | (-0.949) | (-0.574) | (-0.986) | (5.207) |
| $hpc_i$ x $NAFTA_t$ | 0.00471 | -0.00612 | 0.01154 | -0.01117 | 0.00939 | -0.07280 |
| | (1.029) | (-0.949) | (1.075) | (-1.080) | (0.376) | (-1.288) |
| $ed_{it}$ | 0.09141 | 0.05696 | -0.06371*** | -0.02492 | -0.01357 | 0.14046 |
| | (1.58) | (1.191) | (-2.657) | (-0.379) | (-0.179) | (1.452) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 556.07 | 373.20 | 515.69 | 310.49 | 486.02 | 156.71 |
| Adjusted $R^2$ | 0.0218 | 0.0052 | 0.0115 | 0.0303 | 0.0168 | 0.0055 |
| Durbin-Watson Stat | 2.12 | 2.22 | 2.16 | 1.74 | 2.14 | 1.67 |
| Akaike Info criterion | -0.554 | 0.014 | -0.344 | 0.242 | 0.704 | 1.000 |

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 19: U.S. Industry Establishment Growth using the Dummy Variable Approach**

| Variables | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | -0.01016 | 0.00818 | -0.03473 | 0.04433 | 0.05202 | -0.05427 |
| | (-0.373) | (0.282) | (-1.348) | (1.511) | (0.886) | (-0.986) |
| $time_t$ | -0.00114 | -0.00023 | 0.00434 | -0.00030 | 0.00680 | 0.00203 |
| | (-0.224) | (-0.093) | (0.703) | (-0.045) | (1.462) | (0.471) |
| $\Delta pop_{it}$ | 0.95454*** | 0.75520*** | 0.57894*** | 0.67784** | 0.66128*** | 0.23153 |
| | (9.482) | (6.507) | (4.819) | (2.547) | (2.855) | (0.470) |
| $unemp_{st}$ | 0.10781 | 0.08416 | 0.24197 | -0.23376 | 0.06844 | 0.03494 |
| | (1.029) | (0.522) | (1.558) | (-0.913) | (0.291) | (0.055) |
| $GATT_t$ | -0.00927 | -0.02716 | -0.08189 | 0.00442 | -0.10196** | -0.00232 |
| | (-0.365) | (-1.334) | (-1.555) | (0.120) | (-2.545) | (-0.071) |
| $CUSFTA_t$ | -0.00796 | -0.03735 | -0.05241 | -0.00247 | -0.13407** | -0.04181 |
| | (-0.152) | (-1.242) | (-0.922) | (-0.037) | (-2.571) | (-1.001) |
| $NAFTA_t$ | -0.0334 | -0.00901 | -0.11687 | 0.04704 | -0.08290 | 0.04981 |
| | (-0.455) | (-0.194) | (-1.124) | (0.436) | (-0.689) | (0.467) |
| $miles^M xGATT_{it}$ | 4.19E-06 | 2.52E-06 | 2.15E-06 | -5.38E-06 | 2.15E-05*** | -2.57E-05** |
| | (0.886) | (0.301) | (0.220) | (-0.544) | (3.00) | (-2.285) |
| $miles^C xCUSFTA_{it}$ | 1.22E-06 | 2.86E-06 | 8.57E-06 | 8.86E-06 | 1.19E-05 | 2.89E-05** |
| | (0.167) | (0.397) | (1.309) | (0.940) | (0.857) | (2.342) |
| $miles^M xNAFTA_{it}$ | 5.83E-06 | -5.94E-06 | 3.15E-05 | -3.42E-05* | -2.36E-05 | -6.48E-05** |
| | (1.026) | (-0.588) | (1.333) | (-1.666) | (-0.750) | (-2.375) |
| $miles^C xNAFTA_{it}$ | 1.90E-06 | -2.67E-06 | 1.82E-05 | -2.50E-05 | -5.85E-05 | -1.99E-05 |
| | (0.183) | (-0.231) | (1.277) | (-1.509) | (-0.897) | (-0.608) |
| $\Delta mexex_t$ | -0.04709*** | -0.01776 | -0.00209 | -0.03725 | -0.00201 | -0.05956 |
| | (-3.019) | (-0.418) | (-0.095) | (-1.163) | (-0.109) | (-0.938) |
| $\Delta mexim_t$ | 0.00206 | -0.04796 | 0.15485 | -0.02642 | 0.00972** | 0.00184 |
| | (0.091) | (-1.476) | (1.359) | (-1.055) | (2.086) | (0.038) |
| $\Delta canex_t$ | 0.0446 | 0.13725*** | -0.03505 | 0.02807 | 0.05276 | 0.05350 |
| | (0.502) | (2.727) | (-0.884) | (1.026) | (0.532) | (1.028) |
| $\Delta canim_t$ | 0.03495 | -0.12741 | -0.39840 | 0.00586 | -0.28918 | -0.01011 |
| | (0.298) | (-1.662) | (-1.545) | (0.070) | (-1.850) | (-0.288) |
| $sea_i \, x \, NAFTA_t$ | -0.00366 | -0.00096 | 0.02312** | -0.00186 | -0.00685 | 0.02249 |
| | (-0.408) | (-0.147) | (1.991) | (-0.230) | (-0.834) | (1.363) |
| $hpc_i \, x \, NAFTA_t$ | 0.00302 | -0.00423 | 0.00582 | -0.00121 | -0.00049 | -0.03471 |
| | (1.185) | (-0.684) | (1.100) | (-0.098) | (-0.121) | (-0.935) |
| $ed_{it}$ | 0.05484** | 0.02842 | 0.07018*** | -0.04133 | 0.00993 | 0.05485 |
| | (1.992) | (0.875) | (2.856) | (-1.320) | (0.211) | (0.679) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 303.26 | 128.85 | 285.83 | 100.27 | 140.28 | 34.08 |
| Adjusted R2 | 0.0406 | 0.0190 | 0.0216 | 0.0112 | 0.0123 | 0.0165 |
| Durbin-Watson Stat | 2.40 | 2.37 | 2.34 | 2.39 | 2.38 | 2.54 |
| Akaike Info criterion | -1.178 | -1.049 | -0.934 | -0.889 | -0.538 | -0.526 |

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 20: U.S. Industry Employment Growth Using Average Tariff Rates**

| Variables | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | 0.00728 | 0.01226 | 0.04019 | 0.00247 | -0.01459 | -0.09911 |
| | (0.245) | (0.24) | (1.757) | (0.037) | (-0.19) | (-1.135) |
| $time_t$ | -0.00171 | 0.00027 | -0.00029 | -0.00268 | 0.00212 | -0.00420 |
| | (-1.091) | (0.174) | (-0.348) | (-0.97) | (0.557) | (1.236) |
| $\Delta pop_{it}$ | 0.91768 | 0.87415*** | 0.75448*** | 0.92483** | 1.37252*** | 0.34342 |
| | (7.662) | (4.05) | (5.162) | (2.217) | (4.335) | (0.309) |
| $unemp_{st}$ | -0.15306 | -0.53989** | -0.22962 | -0.31377 | 0.15327 | -0.32738 |
| | (-1.727) | (-2.186) | (-1.829) | (-1.154) | (0.308) | (-0.441) |
| $\Delta cantar_{kt}$ | 0.183 | -0.82133 | -0.80261** | -2.49257 | -5.81796*** | 3.85044 |
| | (0.075) | (-0.562) | (-2.473) | (-0.945) | (-3.302) | (1.904) |
| $\Delta mextar_{kt}$ | 1.83053 | 0.3735 | 0.09851 | -4.03198 | -2.265 | -2.06331*** |
| | (0.703) | (0.336) | (0.422) | (-1.133) | (-1.247) | (-3.236) |
| $miles^M xGATT_{it}$ | 9.71E-06 | -1.44E-06 | 5.89E-06 | -1.43E-05 | 3.32E-05** | -3.04E-05 |
| | (1.397) | (-0.275) | (1.168) | (-0.825) | (2.214) | (-1.606) |
| $miles^C xCUSFTA_{it}$ | -1.96E-05** | 7.14E-06 | -1.4E-06 | -1.83E-05 | -6.07E-05* | 6.78E-05*** |
| | (-2.393) | (0.70) | (-0.154) | (-0.987) | (-1.826) | (2.997) |
| $miles^M xNAFTA_{it}$ | 1.51E-06 | -6.08E-07 | 3.9E-06 | 6.72E-06 | 3.52E-05* | -2.84E-06 |
| | (0.244) | (-0.055) | (0.750) | (0.399) | (1.73) | (-0.142) |
| $miles^C xNAFTA_{it}$ | 7.51E-06 | 3.77E-06 | -2.19E-05** | 1.50E-05 | -2.28E-05 | 7.65E-05** |
| | (0.721) | (0.347) | (-2.503) | (0.67) | (-1.063) | (2.194) |
| $\Delta mexex_t$ | 0.01009 | -0.01255 | -0.00769 | 0.06187 | 0.05314** | 0.07281 |
| | (0.428) | (-0.248) | (-0.968) | (1.264) | (2.428) | (0.962) |
| $\Delta mexim_t$ | -0.02356 | -0.02222 | 0.00736 | -0.07506 | 0.00808 | -0.03022 |
| | (-1.664) | (-1.023) | (0.409) | (-1.378) | (1.852) | (-0.414) |
| $\Delta canex_t$ | 0.01191 | -0.06897 | 0.00464 | -0.01515 | -0.01317 | -0.06611 |
| | (0.264) | (-0.887) | (0.307) | (-0.154) | (-0.113) | (-1.433) |
| $\Delta canim_t$ | 0.05201 | 0.01762 | 0.00027 | 0.21118** | 0.12679 | 0.08802 |
| | (0.855) | (0.223) | (0.005) | (2.568) | (0.768) | (1.442) |
| $sea_i \; x \; NAFTA_t$ | 0.00392 | -0.02822** | 0.00056 | -0.00882 | -0.02966 | 0.12209*** |
| | (0.367) | (-2.464) | (0.034) | (-0.358) | (-1.574) | (2.592) |
| $hpc_i \; x \; NAFTA_t$ | 0.00041 | -0.00202 | 0.00636 | 0.01009 | 0.02657*** | -0.06527 |
| | (0.161) | (-0.418) | (0.940) | (1.036) | (2.606) | (-1.492) |
| $ed_{it}$ | 0.03767 | 0.03383 | -0.04870 | -0.0104 | -0.0762 | 0.12404 |
| | (1.015) | (0.825) | (-1.929) | (-0.158) | (-1.032) | (1.235) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 443.509 | 296.605 | 539.881 | 206.858 | 400.181 | 76.274 |
| Adjusted $R^2$ | 0.01276 | 0.00642 | 0.00313 | 0.0345 | 0.0178 | 0.0217 |
| Durbin-Watson Stat | 2.36 | 2.24 | 2.29 | 2.27 | 2.21 | 2.24 |
| Akaike Info criterion | -0.7981 | -0.2158 | -0.2983 | -0.1648 | -0.5096 | -0.278 |

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**Table 21: U.S. Industry Wage Growth using Average Tariff Rates**

| Variables | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | 0.03427 | 0.06743 | 0.10921 | 0.03219 | 0.04301 | -0.16506 |
| | (0.782) | (1.212) | (4.910) | (0.533) | (0.489) | (-1.934) |
| $time_t$ | -0.00408 | -0.00308 | -0.00317 | -0.00181 | 0.00015 | 0.00220 |
| | (-2.759) | (-1.477) | (-2.353) | (-0.897) | (0.039) | (0.500) |
| $\Delta pop_{it}$ | 1.16958*** | 0.93971*** | 0.86058*** | 0.95078** | 1.23031*** | 0.77489 |
| | (11.428) | (4.682) | (4.569) | (2.290) | (2.927) | (0.522) |
| $unemp_{st}$ | -0.20431** | -0.55482 | -0.37706*** | -0.04075 | -0.09549 | -0.19612 |
| | (-1.993) | (-1.872) | (-2.599) | (-0.137) | (-0.182) | (-0.220) |
| $\Delta cantar_{kt}$ | 0.51894 | -1.88146 | -1.35539 | -0.40464 | -3.4299** | 0.11938 |
| | (0.236) | (-1.201) | (-1.079) | (-0.176) | (-2.046) | (0.060) |
| $\Delta mextar_{kt}$ | 5.51836 | 1.93029 | 0.33111 | -1.22926 | -1.34474 | -0.55062 |
| | (1.689) | (1.470) | (0.672) | (-0.489) | (-0.730) | (-0.842) |
| $miles^M xGATT_{it}$ | 6.35E-06 | -4.51E-05 | 1.2E-05 | -9.40E-06 | 2.24E-05 | -8.82E-06 |
| | (1.188) | (-0.635) | (1.260) | (-0.574) | (1.470) | (-0.708) |
| $miles^C xCUSFTA_{it}$ | -1.96E-05** | -3.57E-06 | -1.18E-05 | -2.63E-05 | -5.94E-05* | 7.37E-05** |
| | (-2.241) | (-0.366) | (-1.302) | (-1.443) | (-1.742) | (2.379) |
| $miles^M xNAFTA_{it}$ | 7.76E-06 | 6.63E-06 | 4.92E-06 | -6.08E-06 | 3.06E-05 | -2.48E-05 |
| | (0.900) | (0.471) | (0.538) | (-0.471) | (1.360) | (-1.006) |
| $miles^C xNAFTA_{it}$ | 1.89E-05 | 9.34E-06 | -1.12E-05 | 1.28E-05 | -2.51E-05 | 2.97E-05 |
| | (1.345) | (0.540) | (-0.952) | (0.521) | (-0.907) | (0.709) |
| $\Delta mexex_t$ | 0.00955 | 0.02721 | -0.02215 | 0.05988 | 0.03332 | 0.00151 |
| | (0.555) | (0.556) | (-1.716) | (1.324) | (1.387) | (0.027) |
| $\Delta mexim_t$ | -0.01835 | 0.00180 | -0.08795** | -0.02845 | 0.01242*** | 0.02297 |
| | (-1.104) | (0.055) | (-2.251) | (-0.566) | (2.593) | (0.473) |
| $\Delta canex_t$ | 0.02302 | -0.02385 | 0.04493** | 0.10578 | 0.09284 | -0.01671 |
| | (0.47) | (-0.25) | (2.237) | (1.808) | (0.697) | (-0.294) |
| $\Delta canim_t$ | 0.08809 | -0.03946 | 0.19345 | 0.21211** | 0.14803 | 0.20360*** |
| | (1.375) | (-0.496) | (1.555) | (2.300) | (1.001) | (3.238) |
| $sea_i \times NAFTA_t$ | 0.03327 | -0.01732 | -0.00701 | -0.01367 | -0.03261 | 0.12056*** |
| | (1.236) | (-1.453) | (-0.991) | (-0.597) | (-0.978) | (5.306) |
| $hpc_i \times NAFTA_t$ | 0.00358 | -0.00241 | 0.01194 | 0.01116 | 0.02838 | -0.07015 |
| | (0.771) | (-0.235) | (1.312) | (1.143) | (1.637) | (-1.644) |
| $ed_{it}$ | 0.08397 | 0.0595 | -0.06674*** | -0.02749 | -0.04744 | 0.14202 |
| | (1.488) | (1.271) | (-2.602) | (-0.398) | (-0.573) | (1.467) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 566.94 | 373.1 | 514.92 | 310.96 | 488.46 | 156.89 |
| Adjusted $R^2$ | 0.0203 | 0.0056 | 0.0131 | 0.0291 | 0.0121 | 0.0054 |
| Durbin-Watson Stat | 2.12 | 2.22 | 2.16 | 1.74 | 2.13 | 1.67 |
| Akaike Info criterion | -0.5526 | 0.0136 | -0.3457 | 0.2428 | 0.7089 | 0.9992 |

*** denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.**

**Table 22: Industry Establishment Growth Using Average Tariff Rates**

| Variables | Print (27) | Chemical (28) | Food (20) | PriMetal (33) | Tran Eqp (37) | Leather (31) |
|---|---|---|---|---|---|---|
| $C$ | -0.03582 | -0.00154 | -0.01441 | 0.04411 | 0.01754 | -0.03205 |
| | (-1.352) | (-0.048) | (-0.492) | (1.201) | (0.294) | (-0.670) |
| $time_t$ | -0.00271 | -0.00175 | -0.00065 | -0.00059 | -0.00134 | -0.00177 |
| | (-1.664) | (-2.039) | (-0.329) | (-0.254) | (-0.418) | (-0.798) |
| $\Delta pop_{it}$ | 0.97689*** | 0.79409*** | 0.4462*** | 0.71749*** | 0.71805*** | 0.22562 |
| | (10.258) | (6.877) | (4.184) | (2.655) | (2.898) | (0.537) |
| $unemp_{st}$ | 0.09195 | 0.11067 | 0.12874 | -0.21703 | 0.17129 | -0.21702 |
| | (0.881) | (0.737) | (0.632) | (-0.866) | (0.633) | (-0.424) |
| $\Delta cantar_{kt}$ | -7.27579** | -2.98293*** | 4.57869 | -1.11072 | -0.04671 | 2.40472 |
| | (-2.489) | (-2.723) | (1.941) | (-0.669) | (-0.028) | (1.782) |
| $\Delta mextar_{kt}$ | 9.85212** | 1.3018 | -1.40145 | -2.30848 | -1.33881 | -1.68430*** |
| | (2.225) | (1.742) | (-1.568) | (-0.899) | (-0.763) | (-4.954) |
| $miles^M xGATT_{it}$ | 1.78E-06 | 9.47E-07 | -3.80E-05** | -7.19E-06 | 3.98E-06 | -2.13E-05** |
| | (0.214) | (0.203) | (-2.210) | (-0.560) | (0.305) | (-2.126) |
| $miles^C xCUSFTA_{it}$ | -1.09E-05 | -1.19E-05 | 2.04E-05 | -2.41E-06 | -1.17E-05 | 1.90E-05 |
| | (-1.129) | (-1.227) | (1.484) | (-0.172) | (-0.550) | (1.423) |
| $miles^M xNAFTA_{it}$ | 6.31E-06 | 1.25E-05 | 1.02E-05 | -9.78E-06 | 9.06E-06 | -2.07E-05 |
| | (0.554) | (1.549) | (0.774) | (-0.962) | (0.673) | (-1.451) |
| $miles^C xNAFTA_{it}$ | 1.96E-06 | 1.87E-05** | -5.93E-06 | 2.12E-06 | -2.35E-05 | 3.84E-05*** |
| | (0.133) | (2.187) | (-0.376) | (0.137) | (-0.641) | (2.683) |
| $\Delta mexex_t$ | -0.01492 | -0.01503 | -0.01174 | -0.05091 | -0.00604 | -0.05145 |
| | (-1.020) | (-0.366) | (-0.479) | (-1.356) | (-0.277) | (-0.964) |
| $\Delta mexim_t$ | 0.01362 | -0.00686 | 0.12162 | -0.05026 | 0.00219 | -0.01037 |
| | (0.700) | (-0.375) | (1.813) | (-1.089) | (0.720) | (-0.222) |
| $\Delta canex_t$ | 0.16477 | 0.01721 | -0.05518 | 0.02708 | -0.00365 | 0.07076 |
| | (1.863) | (0.287) | (-1.467) | (0.625) | (-0.032) | (1.614) |
| $\Delta canim_t$ | 0.19831** | -0.17609** | -0.35474 | 0.02915 | -0.05771 | -0.07429 |
| | (1.987) | (-2.521) | (-1.547) | (0.321) | (-0.532) | (-1.728) |
| $sea_i$ x $NAFTA_t$ | -0.00345 | -0.00023 | 0.02399** | -0.00216 | -0.00597 | 0.03140* |
| | (-0.382) | (-0.034) | (1.999) | (-0.266) | (-0.759) | (1.907) |
| $hpc_i$ x $NAFTA_t$ | 0.00319 | 0.00325 | -0.00079 | 0.00896 | 0.01555 | -0.01228 |
| | (0.906) | (0.613) | (-0.170) | (1.195) | (1.107) | (-0.349) |
| $ed_{it}$ | 0.04846 | 0.02218 | 0.07703*** | -0.04363 | 0.00085 | 0.06744 |
| | (1.858) | (0.690) | (2.893) | (-1.279) | (0.017) | (0.838) |
| # of Cross-sections | 843 | 316 | 623 | 210 | 207 | 51 |
| SSE | 300.31 | 128.53 | 278.54 | 100.12 | 141.14 | 33.93 |
| Adjusted $R^2$ | 0.05 | 0.0216 | 0.0466 | 0.0129 | 0.0065 | 0.0219 |
| Durbin-Watson Stat | 2.38 | 2.37 | 2.31 | 2.39 | 2.37 | 2.53 |
| Akaike Info criterion | -1.188 | -1.0521 | -0.9601 | -0.8905 | -0.5326 | -0.5321 |

* denotes significance at 90% confidence level and **(***) denotes significance at a 95% (99%) confidence level. White standard errors are included to control for heteroscedasticity.

**U.S. Manufacturing Trade with Canada, Mexico, and the World (1989-2000)**

**Figure 1A: U.S. Imports**

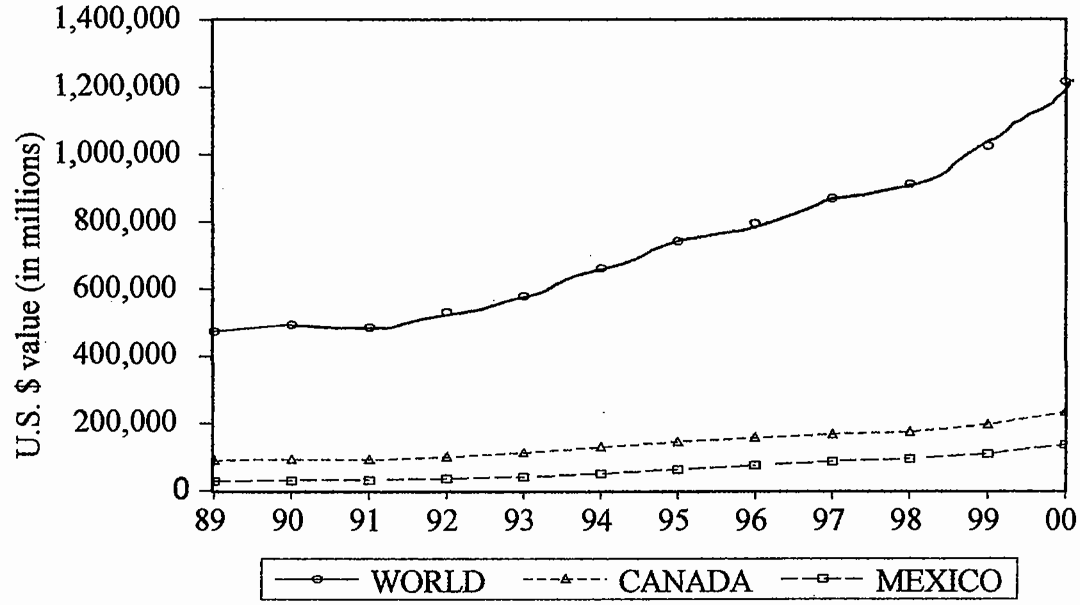
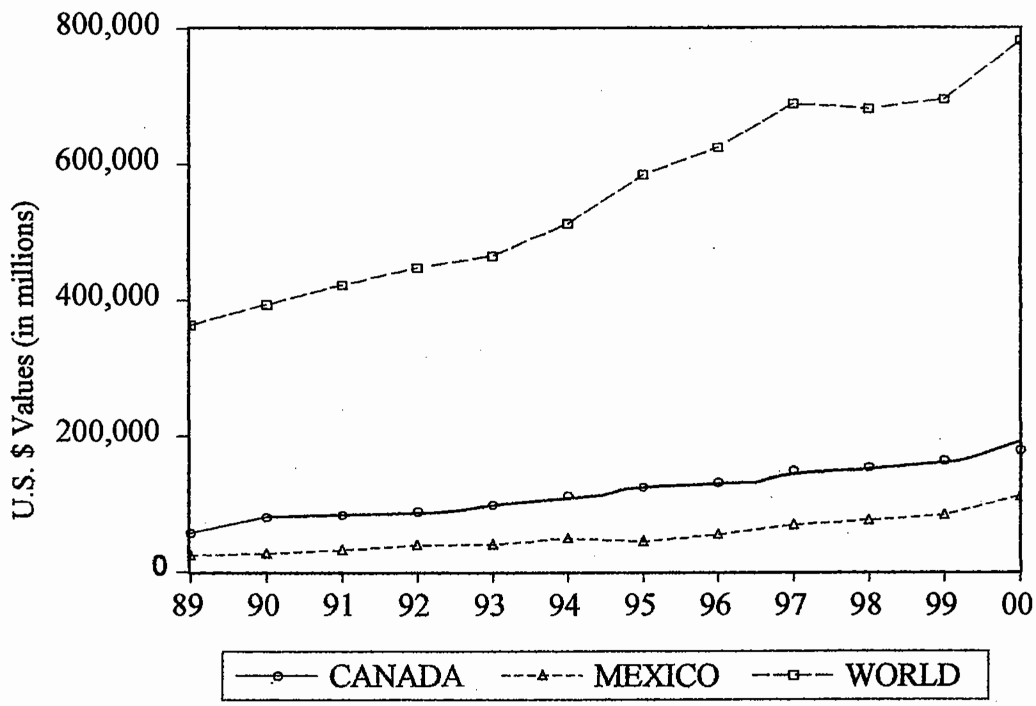



**Figure 1B: U.S. Exports**



**Employment and Wages in the Sunbelt and Rustbelt Regions; shown as a percentage of U.S. levels (1980-2000)**

**Figure 2A Regional Manufacturing Employment Shares**

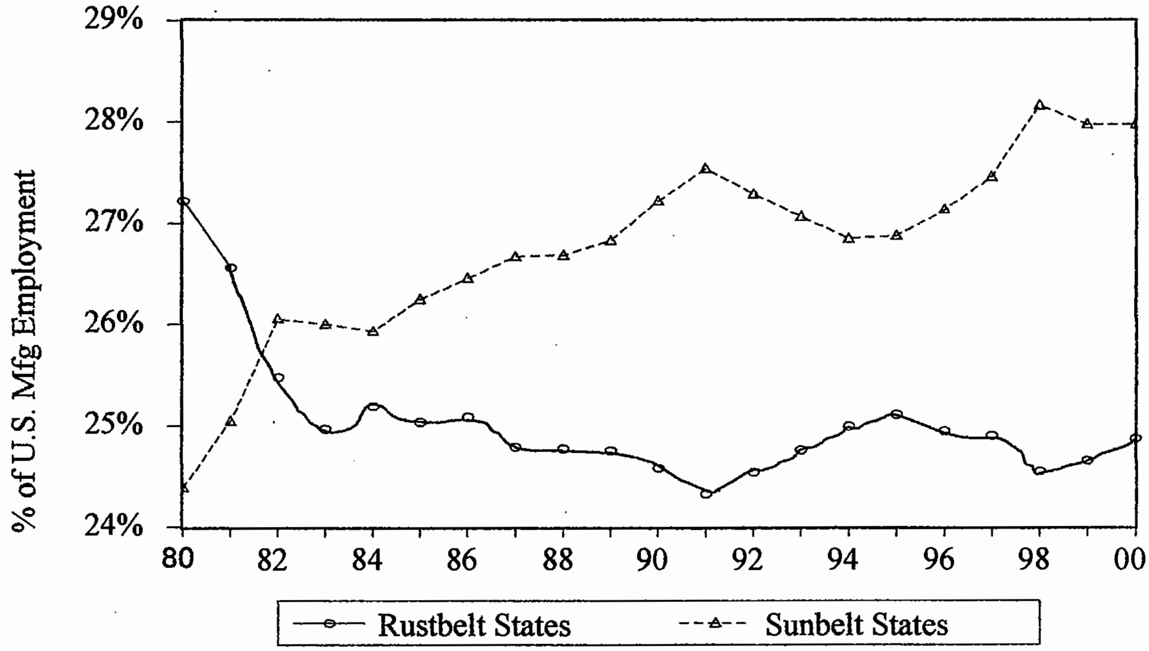



**Figure 2B Regional Manufacturing Wage Shares**

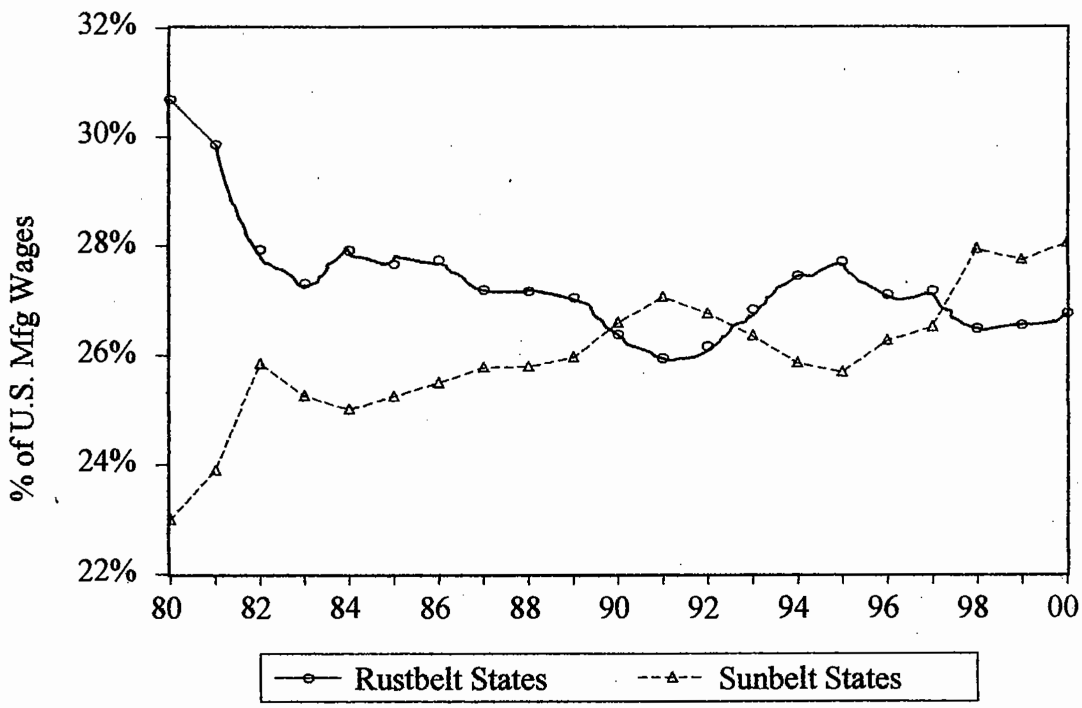


Figure 3A: U.S. Tariffs on Canadian Imports (1980-2000)

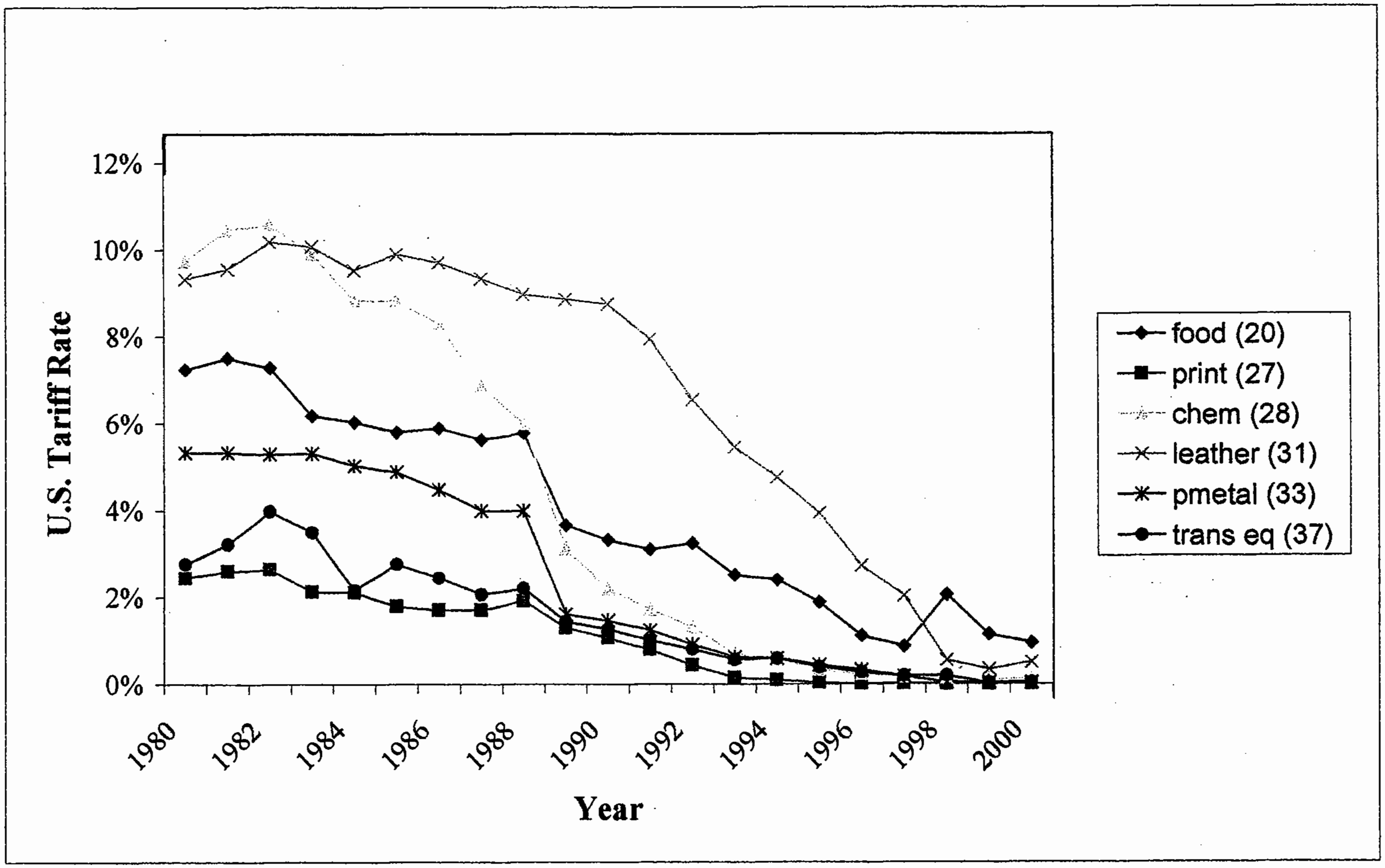
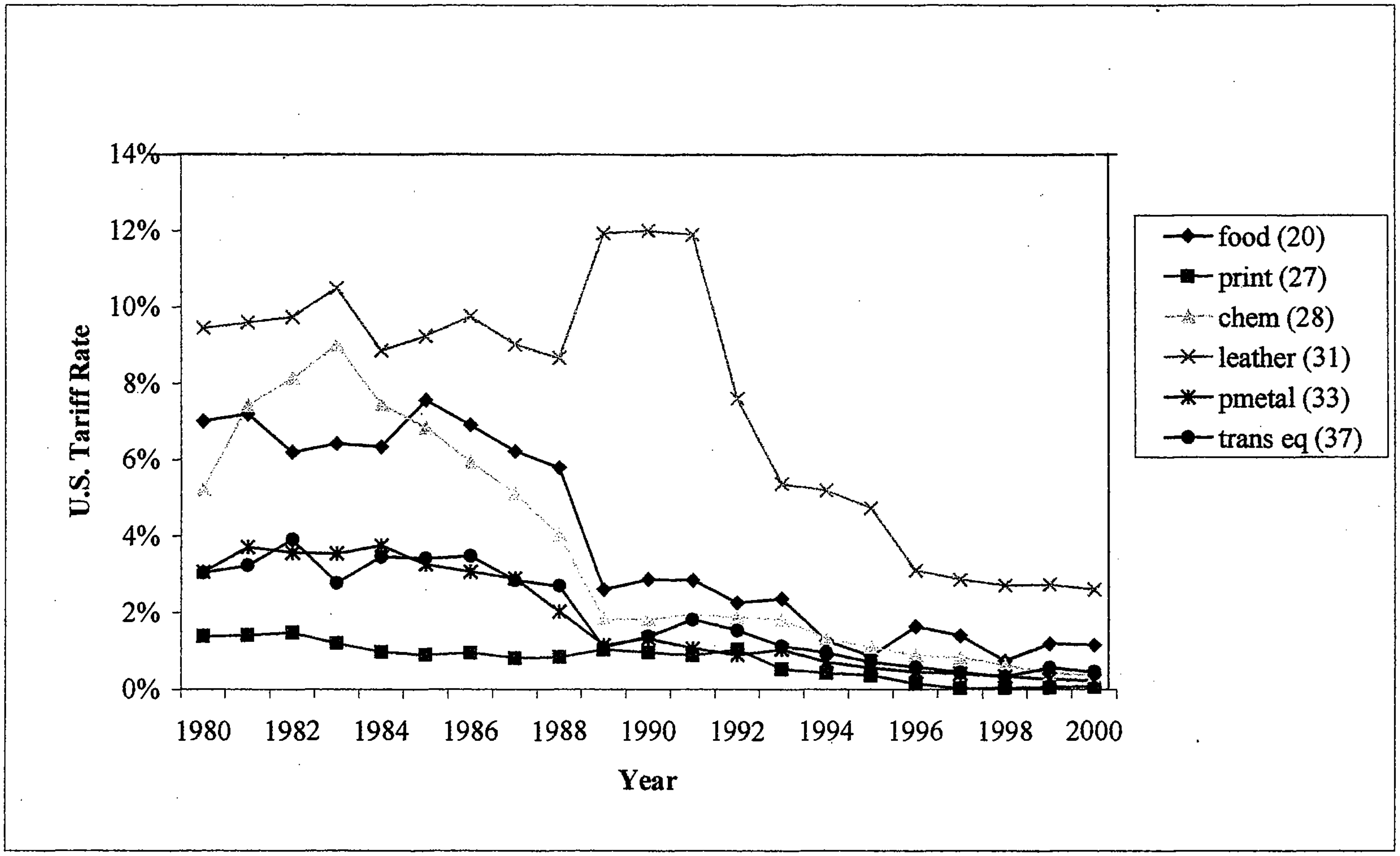


**Figure 3B: U.S. Tariffs on Mexican Imports (1980-2000)**



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